

wg gM6 ..—U\$ó *S-ú..V v3 vµM.

(gMñ -ú..v).àM\$UM6...

n oXg -3 oU..v)..n oøo vX3 oU..gU9 ..OU\$ vU3 oU-g .à-µ9S*

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...

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GUg ú*S*..v)..àµ*-gSUGi o..n oøo vX3 oU..wg—ó U*..GMv**...

<vµU- S*...

n vMv g .n S*ó -g-SvU...

...

t v' g3 o9...! -SSM...

àµXó øSv n\$g v3 ´ ...! g 3 o6...

...

...

V v3 vµMí -í %..

à-g-o3 oU..v)...V SgUg S-ú.....

...

I hereby declare that this dissertation is my own original work and that all sources and references used have been appropriately acknowledged. No part of this work has been submitted for any other degree or qualification at this or any other institution.

Olomouc, 2025

GMUv” o9Q3 oU*...

(S*-gU9..)v o3 v*-Nr.g3 .9ooXú.Qg-o)μ ...v.3 ú.*μXó øSv Ns g v3 ´ ...” g 3 o6Z(v .*v3 ovUo...
” ’ v...oMURQio**o*...! S *o)..g*..g...9gSú...! vi i úNr...Mμ 9...Uv-...! gøo..g*6o9...)v ..g..i o—ó ..Qi9oZ.
s g v3 ´ ...! g*..g’... g o...-g oU-...)v .6Uv” SUQ.o’ gM ú...” ’ oU-.-v...*-oX.SU.gU9...” ’ oU-.-v...*-oX.i gM
výó SUQ.;μ*-oUvμQ .) oo9v3 ...v...o-..3 o..Qv” NgU9...;μ*-oUvμQ ..*’ μMí o...v..oU*í o.r..99U-...
Q-.M3 Xo-o ú...v*-..SU-..! o...” S9ó Uo**..v)..9og*Z" o..g v” o9..3 o...v..Mg oUQ...! S .3 v o...S o*...
-’ gU.r..X vi gi ú.*’ vμ 9...! gøoNyU ú...!)v .3 o...v...og UN-..S o..gU9..gQgUN-..! g-... ” ’ g-..3 g—ó *.S*...
Uv-...” ’ g-..úvμ.6Uv” Nñ μ-...” ’ g-..úvμ....

9v...” ’ oU..úvμ.9vU-.6Uv” Z...-! S*.9S*ó -g-SvU.S*.g*.3 μM..g.X v9μM.v)...! S*.3 oU- v’ SX.g*.S..S*...
v)..3 ú.v” U.oýv -NgU9-..! o...o**vU*.r øo...og Uo9..) v3 ...! S i v-’ ..gM9o3 SMgU9...! μ3 gU ” S ...
*gú...” S’ .3 o...” o .i oúvU9-..! o*o.XgQ*Z...

r.g *v..v” o.*SUM o...! gU6*...v..wo-’ g..7’ ú vøgN” ’ v...! g*..i ooU.g..MfU*-gU-..gM9o3 SMM3 XgUSvU...
SUM...-! o..øó ú..i oQUSUQ.v)...! S..;vμ UoúZ.wo-’ g...! g*..g ” gú*..3 o-..3 ú..*M—ó o9...9og*...” S’ ...
Mμ S*Sú...gU9...oU-! μ*S*3 NgU9...výó o9...3 gUú...í S SgU-...vUo*..v)...! ó ...v” U...SU.. o-í UZ..” ó ...
μU” gøó SUQ9o9Mg-SvU-..v..S X vøSUQ-..! o.3 og*μ o3 oU-..v)..M3 Xv*So..SU9Mg-v’ *N. ó .vXoUUb*...
-v..o’ MgUQNgU9...! ó ..oUMμ gQ3 oU-..! gøo.*SUS MgU-ú.*’ gXo9-..! S*...” v 6Z.“ S’ vμ-...! ó N-! S*...
-! o*S*...” vμ 9...! gøo.i ooU.i v-’ ..MUMX-μg ú-..! SUö .gU9..)g ...o**..)μU-.-v...” SoZ...

-v.3 ú.Xg oU-*NgU9-.-v.3 ú.*S*ó *.Gúg.gU9.r6 g3 -’ gU6..úvμ..)v .i o SøSUQSU.3 o.oøoU...” ’ oU...
r...” g*U-..*μ o.r..i o Søo9..SU.3 ú*o)Zs vμ øo.*v3 o’ v” .3 gSU-gSb9..SU-ó o*-..SU...” ’ g-..r.9vN9o*XS o...
3 ú..) offμoU-ú..MUøv μ-o9..g—o3 X*...-v..o’ XgSU.SZs vμ ...vøo..gU9..*-og9ú..*μXXv -...! gøo.i ooU...
3 ú.QvμU9SUQ.)v MZ...

(SÚg úN-.-v..GUSgN3 ú... gUMo..gU9...9o *..3 v*...Xg-SbU-..MRμ-’ v -’ gU6..úvμ..)v .i oSUQ.3 ú...
Moó og9ó ..9μ SUQ-..! o...Sb*-..øSMv S*.gU9..3 ú..*g)o...! g i v ..9μ SUQ-..! o.*-v 3 Sb*...*-i gM*Z.
š vμ øo...Søo9-...” vμQ ..øó ú..MgX-ó .v)...! S*...! o*S*.g*.S.S...” ó o..úvμ .v” U.xgU9..SU.*v3 o...” gú*N.
S..SZs vμ .;vúNúvμ .6SU9Ub**NgU9..úvμ .i o S).SU.3 o.3 g9o.g ...! o.9Sýó oUMZ...

-v.g .v)..úvμ -’ gU6..úvμZ...

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Gi vμ-...! S...! o*S.....

—! S...9S*ó -g-SvU..MUs*..v)..g..i S9SUQ.M3 3 oU-é ú..MgX-ó ..gU9...*oøoU..S9S9μg '... o*og M...
XgXó *N' ' SM...vQ-! ó .)ý 3 .g.M' o*Sø.o.gU9..v S9Ug .Mv- S μ-SvU...v...! o... o 9..v)..*μ*-gSgi SSú...
*μ9S*Z.—! o...vøó g MSUQ..gS ...v)...! o...9S*ó -g-SvU...S...-v...9oøo vX...gU9...gXXú...SUvøg-Sø...
3 og*í o3 oU-.) g3 o" v 6*...! g-oU' gUM...vμ .μU9ó *gU9SUQ.v)..Qvi g ..*μ*-gSgi SSú..Xg-ó U*N..
)vMμ*SUQ..SU...Xg- SMμ g ...vU...! v" ...*vMμ-S*...MgU...g9øgUM...í vg9...! μ3 gU..." o R oSUQ..SU...gU..
oUøSvU3 oU-g ú..o MμU..gU9..*vMg ú..*μXXv -o9.3 gUÜ Z...

—! o...! o*S..S.v QUSio9.g vμU9...! oo.SU-ó' o g-o9...o*og M...! o3 o*mSYM3 Xv*S-o.3 og*í o3 oU...
v)..! o R oSUQ.NSYLoUøSvU3 oU-g .o MμUM..v)..! o R oSUQNgU9..SSYMS g-o.MgUQ..Xó Mx-SvUZ..
—! o*o...! o3 o*.g o.Uv...vUú.gUg ú-Sg ú.9S*-SUM.i μ-g *v.3 o-! v9v vQSM ú..MUÜMo9...! vμQ ...
g...M3 3 vU..o3 X' g*S..vU... vi μ*-..Mv**BvμU- ú..S9SMg-v *..gU9...M3 Xv*S-o..S9o' ..9o*SQZ.OgM...
' o*og M.g -SMb.MU- S μ-o*..v.g-...og*-vUo.v)...! o*o...! o3 g-SMXS g *N' ' So...! o.i S9SUQMgX-ó ...
SU-oQ g-o*...! oS ... U9SUQ..SU-v.g..M3 X o' oU*Sø.o.gUg ú-Sg .Ug' g-SøZ...

—! o... ' *...! o3 o..vMμ*o*..vU... o USUQ..! v" ...*vMμ-g ...! o R oSUQ..S...3 og*í o9...i oúvU9...SUM3 o...
3 o-! SMN9 g" SUQ..) v3 ..gU9...o' -oU9SUQ..! o..àvMg ..w vQo**..rU9o' ..xàwrY..) g3 o" v 6Z.—! oo...
XgXó *.g99 o**...! S.g ogng...vQSp9Sg '...oMU- μMSvU.v)...! o..àwr..) v3 ..Wu- í-í-Ng..*μ9ú...
vU..Subffμg Sú...! vμQ ..LvURMvUv3 SM9S oU*SvU*NgU9..g.3 o-! v9v vQSM ..XgXó ..o' X v SUQ..! o...
oøv øSUQ..S Xv -gUM...v)..*vMg ..gU9...Qvó UgUM...S9SMg-v *Z.—! o...*oMU9...! o3 o..MU-ó *..vU..
g**o**SUQMμU- S* .gi SSú...v..: gU* g-o..oUøSvU3 oU-g .SUXμ-*..SU-v..*vMg ..vμ-M3 o*Nμ*SUQ.." v...
Uo" ú..9oøo vXo9..S9SMg-v * -! o.sμ*...-gU*SSvU..àM o.xs-àY.gU9...! o..<g i vU..O MμUM..v)...
àvMg ... w vQo**... x<OàwYZ.—! o*o...! v... XgXó *..g9øgUM...! o... MUMX-μg ... gU9... o3 XS SMg ...
μU9ó *gU9SUQ.v)..*μ*-gSgi SSú...Xó)v 3 gUM...gU9...- gU*SSvU..9úUg3 SMZ.(Sg úN..! o...! S9...
-! o3 o..Søo*-SQ-o*...! v" ..MS g-o..MgUQ..S..Xó MSø9.i ú...! o.Xμi SM' v 9" S9oZ.—! v.XgXó *.SU..
-! S*..- gU9...výó ..g..Uvøo ...< S g-o..wó Mx-SvU..rU9o' ..x<wrY.gU9..gUg úüo...! o..*vMμBvMvUv3 SM..
X o9SMv *..v)..MS g-o..." v' ú..gU9...gMSvUN.o3 X' g*SiSUQ..! o...S Xv -gUM...v)..g S9SUQ..Xμi SM..
oUgQ3 oU..." S' ..MS g-o..Xv SMZ...

-vQ-! ó N..! o...! oo... o*og M...! o3 o*..MU- S μ-o...v..g.3 v o..M3 X o' oU*Sø..μU9ó *gU9SUQ.v)...
μ-gSgi SSú vUo...! g-..SU-oQ g-o*..." ' g-..." o..*- Sø..)v ..xí vg9...! μ3 gU..." o R oSUQN! v" ...! o...
gMSøo..S..x" S' ..3 g' S g ..oUøSvU3 oU-g .o MμUM.YNgU9..." ' ú..S..μ -S g-o ú..*μMø9*..v ..)gS*...
xXμi SMXó Mx-SvU..gU9...*μXXv -..)v ..MgUQ.YZ.—! o..Uo' -..i S9SUQ.MgX-ó ..úU-! o*Sio*...! o*o...
MU- S μ-SvU*NmS S o*...! o..MUMX-μg ..SU-ó S6gQ*..gMv**...! o3 o*NgU9..Xv*SvU*...! o..." v 6...
" S' SU.í vg9ó ..gMg9o3 SMgU9..Xv SM..9oi g-o*..vU..*μ*-gSgi SSú..3 og*í o3 oU-NoUøSvU3 oU-g ...
;μ*-SMNgU9..Xμi SMoUgQ3 oU-Z.

...

7 oú" v 9*màμ*-gSgi SSúNàvMg ..w vQo**NOUøSvU3 oU-g ..O MμUM.N:“ o i oSUQN<v3 Xv*S-o...
rU9SM*N< S g-o...< gUQ..wó Mx-SvU*...

<vU-oU-mi S9SUQMgX-ó ...

W.	rU- v9µMSvU	ZW.
í ...	Vðó øS” .v)...’ o.n S*ó -g-SvU.á o*og M...’ o3 o*.gU9..Vµ-M3 o*	í ...
ß...	<vUMX-*Nt o-’ v9*NgU9..rU*SQ -*... .àµ*-gSugi o.n øøo vX3 oU-.GUg ú*o*	Z1...
ßZW.	<v3 Xv*S-o...“ o i oSUQt og*í o3 oU-m’ S-’ Sg .gU9..O3 XS Sg ..<vU-o’ -	Z1...
ßZ ...	wv Sµ.r3 XSg-SvU*.v).t µ -9S oU*SvUg ..“ o H oSUQt og*í o*	ZW.
ßB...	t o-’ v9v vQsg ..<’ vSm*.gU9..rUvøg-SvU*.gU9..rUvøg-SvU*.SU.<v3 Xv*S-o...	
.....	“ o H oSUQt og*í o3 oU-	ZW...
ßZ ...	OUpSvU3 oU-g .O MΣUMi.v)...“ o i oSUQn<vUMX-µg ..(vµU9g-SvU*	ZW...
ßZ%.	t o-’ v9v vQs*..)v’ .t og*í SUQ.OUpSvU3 oU-g .O MΣUMi.v)...“ o H oSUQ	Z %.
ßZ ...	<vUMX-µg ..(vµU9g-SvU*.v)...< S g-o...<’ gUQp..wó MX-SvU	Z 1...
ßZ ...	’-oU9*.gU9..wg-ó U*.SU.< S g-o...<’ gUQp..wó MX-SvU*	Z- ...
ßZ...	<v3 Xv*S-o.t og*í o3 oU*.v)...< S g-o...<’ gUQp..wó MX-SvU	Zí ...
. ...	àúU-’ o*SiSUQ.“ o i oSUQnàµ*-gSugi SS-ún’ ..wó MX-SvU*.3 og*í o3 oU*	ß%.
. ZV.	7 óú.<vU- S µ-SvU*.v)...’ o.n S*ó -g-SvU.á o*og M	ZB ...
. Z ...	(µ-í o.á o*og M.n SoMSvU*	Z1...
%.	<vUMµ*SvU	ßu...
á o)ó oUM		ZZ - ...

...

<vU-oU-m-o*og M.ég -SMb*...

àvMg ..w vQo**rU9o’ ..Wu-H-í-nt og*í SUQàvMg-g ...“ o i oSUQ.Vðó .ßWš og *	Z ° ...
àn +WnrUffµg Ss*.i óúvU9..SUM3 oZG...” v’ 9” 9o...vUQsµ9Sug ..Xó *XoMSøo...	
—’ vµQ ...’ o...oU*.v)...’ o.àvMg ..w vQo**rU9o’	ZZ Z1. ...
—’ o.Oøv øSUQ..r3 Xv -gUM .v).àvMg .gU9...+vðó UgUM.t og*í o*.Vðó ...-S o	ZW...
sµ*...’-gU*SSvU.àM ont og*í SUQ.-’ o.á o g-So.àµ*-gSugi SS-ú.v).àvMg ..w vQo**	W. ...
GMSøSUQsµ*...’-gU*SSvU...’ vµQ ...<vUðó QUM.SU.-’ o...<g i vU.O MΣUMi.v).àvMg ..w vQo**..W1...	
t µ -9S oU*SvUg ..< v**R<vµU- ú.t og*í o3 oU-.v)...< S g-o...<’ gUQp..wó MX-SvU	Wi ...
n S*S Sg Ss*.SU.-’ o.*vMvRMUv3 SMX o9SMv *.v)..MS g-o..MgUQp...” v’ ú.gU9...	
gMSvU.gMv**.ß- ..MµU- S*	ZZ W...

Analysis of Sustainable Development Patterns Across Countries

Abstract

This chapter synthesizes key methodological and empirical contributions of the thesis, focusing on the environmental efficiency of social progress, composite wellbeing measurement, and climate change perception. It highlights the interconnections between these dimensions, emphasizing the importance of an integrated approach to sustainability assessment. The research advances composite indicator methodologies by exploring time-varying weighting, non-compensatory aggregation, and environmental efficiency metrics. It also develops a novel multidimensional framework for analyzing climate change perception across countries, linking public attitudes to policy effectiveness. This chapter reaffirms the thesis' contribution to sustainability science by refining measurement tools and providing empirical insights into sustainability trajectories. Future research should explore methodological advancements in composite indices, particularly in integrating uncertainty, distributional considerations, and adaptive weighting mechanisms. This work underscores the necessity of robust, multidimensional approaches to sustainability measurement, ensuring that policy interventions effectively balance social progress, environmental constraints, and public engagement.

1 Introduction

Sustainable development is a multidimensional challenge that requires an integrated understanding of social progress and environmental constraints. At its core, it necessitates an analytical balance between two fundamental imperatives: fulfilling an array of social and economic goals to meet human needs while simultaneously safeguarding environmental integrity to ensure that these achievements remain viable for future generations. Without a holistic approach, efforts to improve wellbeing may lead to unsustainable patterns of resource consumption, undermining long-term sustainability and intergenerational equity. Consequently, sustainability research must incorporate frameworks that assess how societies can achieve social progress while maintaining livable conditions.

This binding chapter brings together the various research components of the thesis, demonstrating their interconnectedness and collective contribution to sustainability discourse. It synthesizes key findings from the thesis, focusing on environmental efficiency of social progress, composite wellbeing measurement, and climate change perception. Through a structured review, this chapter enhances clarity, positions the research within broader academic and policy discussions, and highlights its significance in addressing global sustainability challenges. By integrating these perspectives, it provides a comprehensive framework that links different strands of sustainability research, offering insights that extend beyond isolated disciplinary approaches.

The overarching goal of the thesis, which consists of this binding chapter and seven research papers, is to develop robust methods for assessing sustainability while maintaining a balance between environmental and social dimensions of sustainable development. To achieve this, novel composite indicators are introduced, enabling cross-country comparisons over time. The research is structured

around three core themes: (i) addressing methodological and conceptual challenges in wellbeing measurement, (ii) measuring environmental efficiency of social progress using composite indicators, and (iii) examining public perceptions of climate change. Although distinct, these themes share a common focus on sustainability assessment and policy relevance. This chapter explores their interconnections, reinforcing the argument that sustainability must be evaluated holistically to capture its multifaceted nature.

2 Overview of the Dissertation Research Themes and Outcomes

The first theme addresses the complexities involved in constructing and refining composite indicators for wellbeing measurement. Conventional economic indicators often fail to account for the multidimensional nature of wellbeing, necessitating a broader approach that integrates social and environmental dimensions. This thesis contributes to this area by enhancing composite measurement frameworks, particularly through the use of the Social Progress Index (SPI), which provides a more comprehensive perspective on societal development beyond income-based metrics. In addition, it explores advanced methodological approaches such as time-varying weighting schemes and non-compensatory aggregation techniques. These refinements help ensure that composite indicators remain adaptable to changing development priorities, improving their relevance and reliability for policymakers seeking to craft informed sustainability strategies.

The second core theme examines the relationship between social progress and environmental impacts, emphasizing the challenge of balancing development with ecological integrity. Achieving environmental efficiency in social progress requires evaluating how effectively countries utilize natural resources to enhance societal well-being while minimizing environmental impacts. This is particularly significant in discussions of just transition, where equitable and lasting progress must align with sustainable environmental practices. The Just Transition Score (JTS) and the Carbon Efficiency of Social Progress (CESP) developed in this thesis offer a systematic way to assess sustainability performance by measuring the extent to which nations achieve social advancement with minimal environmental impacts. By identifying disparities across countries, these metrics provide critical insights into policy interventions that can facilitate more sustainable development pathways.

The third core theme delves into the role of public perceptions in shaping climate change responses and sustainability efforts. While scientific research and economic policies provide the backbone of climate action, their success ultimately depends on public awareness and engagement. People's views on climate risks, mitigation policies, and environmental responsibility influence both individual behavior and collective action. Without public support, even the most well-designed policies can face resistance, limiting their effectiveness and long-term impact. This thesis takes therefore a multidimensional approach to examining climate change perception, analyzing how awareness and action vary across different socio-economic and cultural settings. By identifying key factors that shape public understanding and responses, the research sheds light on the social complexities influencing climate change perception. Integrating perception data with environmental and social indicators allows for a more comprehensive view of how societies interpret and engage with climate challenges. This perspective helps policymakers design communication strategies and policy interventions that resonate with public concerns, ultimately encouraging greater societal involvement in sustainability efforts.

Under the broader dissertation topic, these three research themes have been tackled in seven papers which have been (at least) submitted to respected academic journals. These more specific research

pieces, that together with this binding chapter form an integral part of the dissertation thesis, are listed in Table 1.

Research Theme	Title	Authors	Status of the Paper
Composite Wellbeing Measurement	Social Progress Index 1990–2020: Measuring Societal Wellbeing Over 31 Years	Petra Krylova, Jaromír Harmáček & Mohamed Htitich	Accepted and undergoing editorial production as of March 27 th , 2025, in <i>International Journal of Social Research Methodology</i> (IF 3.0, Q1)
	Inequalities Beyond Income. A Worldwide Longitudinal Perspective Through the Lens of the Social Progress Index	Petra Krylova, Jesús Peiró-Palomino, Mohamed Htitich & Jaromír Harmáček	Accepted book chapter in <i>The Elgar Companion to Data and Indicators for the Sustainable Development Goals</i> as of March 13 th , 2025
	The Evolving “Importance” of Social and Governance Measures Over Time	Mohamed Htitich, Jaromír Harmáček & Petra Krylova	Under review in <i>Global Policy</i> as of March 28 th , 2025 (IF 2.3, Q1)
Environmental Efficiency of Wellbeing	Just Transition Score: Measuring the relative sustainability of social progress	Mohamed Htitich, Petra Krylova & Jaromír Harmáček	Published in <i>Environmental and Sustainability Indicators</i> as of July 23rd, 2024 (IF 5.4, Q1)
	Achieving Just Transition Through Convergence in the Carbon Efficiency of Social Progress	Mohamed Htitich, Jaromír Harmáček & Petra Krylova	Under review in <i>Geography and Sustainability</i> as of March 28 th , 2025 (IF 8.0, Q1)
Climate Change Perception	Multidimensional Cross-Country Measurement of Climate Change Perceptions	Mohamed Htitich, Jaromír Harmáček, John Lisney & Petra Krylova	Published in <i>Measurement: Interdisciplinary Research and Perspectives</i> as of May 21st, 2024 (IF 1.0, Q3)
	Dissimilarities in the Socio-economic Predictors of Climate Change Worry and Action Across 30 Countries	Mohamed Htitich & Jaromír Harmáček	Under review in <i>Journal of Computational Social Science</i> as of March 28 th , 2025 (IF 8.0, Q2)

Table 1: Overview of research papers included in the thesis

Beyond methodological contributions, these papers, and therefore also the thesis, advance empirical knowledge on sustainability performance across nations. By analyzing trends in wellbeing, environmental efficiency, and climate change perception, the research provides valuable insights into sustainability trajectories. The findings illuminate disparities in performance, highlight key drivers of convergence and divergence, and offer perspectives on policy interventions. This first chapter distills these insights, demonstrating their significance for theoretical discourse and practical application.

Moreover, the importance of an interdisciplinary approach to sustainability research is underscored as well. The thesis employs diverse procedures, from environmental efficiency metrics to Bayesian latent variable models for composite index construction, alongside comparative analyses of climate change perception. This methodological breadth enhances the thesis’ contributions, enabling a

nuanced exploration of sustainability challenges. The following text weaves these approaches into a coherent framework, illustrating their collective role in refining sustainability assessment.

Ultimately, this binding chapter serves to unify the thesis’s key insights, ensuring their clear and coherent presentation. By linking different research strands into a structured discussion, it reinforces the overarching argument and strengthens the thesis’ contribution to sustainability measurement and policy discourse. The synthesis provided here aims to facilitate further research and inform evidence-based policy decisions in the pursuit of a just transition and sustainable development.

2.1 Composite Measurement of Wellbeing

Economic growth alone does not guarantee improvements in societal wellbeing, particularly when inequalities in social conditions persist. As a result, composite indicators have gained prominence as more comprehensive tools for assessing development. These indices incorporate multiple dimensions of human progress, capturing economic, social, and environmental aspects to provide a more holistic picture of wellbeing. This thesis builds upon established frameworks, particularly the Social Progress Index (SPI), to refine wellbeing measurement methodologies. The SPI represents a major step forward in composite measurement by assessing non-economic aspects of development, such as access to education, healthcare, and environmental quality. However, constructing composite indices presents methodological challenges, particularly in selecting relevant indicators, determining appropriate weighting schemes, and applying aggregation techniques that accurately reflect multidimensional wellbeing.

One of the key contributions of the dissertation research is the exploration of innovative approaches to weighting and aggregation. Conventional composite indices often apply static weighting methods, but this thesis introduces time-varying weighting techniques that adjust to evolving development priorities. Additionally, non-compensatory aggregation methods are examined to prevent dominant indicators from overshadowing others, ensuring that all dimensions of wellbeing are adequately represented. The empirical findings reveal that while significant progress has been made in global wellbeing, substantial inequalities remain.

The first paper, *Social Progress Index 1990-2020: 31 Years of Societal Wellbeing* (see Table 1), provides a longitudinal analysis of societal wellbeing using the Social Progress Index (SPI) across 172+ countries from 1990 to 2020. The study highlights global trends in social progress, showing that while social outcomes have improved in most countries, the rate of progress has slowed in recent years. Some countries, particularly those that started from lower levels of development, have made significant gains, while others have stagnated or even reversed their earlier progress. The research underscores the importance of measuring social outcomes independently from economic indicators, as GDP-based assessments often overlook crucial aspects of human development. A key methodological contribution of the paper is the adaptation of the SPI framework over three decades, requiring adjustments in indicator selection and weighting methods to ensure comparability over time. This approach provides valuable insights into regional disparities, sustainability challenges, and policy effectiveness in improving social wellbeing.

The second paper, *Inequalities Beyond Income: A Worldwide Longitudinal Perspective Through the Lens of the Social Progress Index* (see Table 1), expands on the SPI methodology by exploring non-economic inequalities in societal wellbeing. It argues that cross-country disparities in education, healthcare, and social rights persist even among high-income nations, challenging the notion that economic growth alone leads to lower inequality. Using a panel dataset on social outcomes for 172

countries over 1990-2020, the analysis finds that while some dimensions of social progress, such as access to basic education and healthcare, have improved globally, others, such as inclusiveness and personal freedoms, have stagnated or declined. Globally, while disparities in key areas of well-being—such as nutrition, access to electricity, and sanitation—have narrowed significantly, striking differences persist in dimensions related to personal freedoms and equal opportunities. The study provides empirical evidence that composite wellbeing indicators must incorporate distributional aspects of social outcomes to reflect the true extent of inequalities beyond income-based measures.

The third paper, *The Evolving Importance of Social and Governance Measures Over Time* (see Table 1), examines how the weighting of social and governance indicators should react to the evolving global conditions. It introduces time-varying weighting methodologies that allow for dynamic adjustments in the relative importance of different indicators based on global trends and policy shifts. The findings show that governance-related measures, particularly those linked to institutional trust and democratic stability, have gained prominence in assessing social progress, reflecting their increasing influence on long-term development outcomes. The study highlights the methodological challenges of weighting schemes in composite indices, demonstrating how different approaches—such as entropy-based methods and Bayesian techniques—can impact the interpretation of social progress trends.

Together, these three studies provide a comprehensive empirical foundation for understanding the methodological and conceptual challenges in composite wellbeing measurement. They reinforce the argument that social progress cannot be adequately captured by static, income-based measures but instead requires adaptive, multidimensional indicators that reflect evolving societal priorities. These insights contribute to the Composite Measurement of Wellbeing section of the binding chapter by demonstrating the need for robust measurement frameworks that ensure comparability over time while remaining flexible enough to account for shifting development challenges.

2.2 Environmental Efficiency of Social Progress

Achieving sustainability requires an assessment of how well countries balance social progress with environmental constraints. Environmental efficiency, in this context, refers to the ability of a country to improve societal wellbeing while minimizing environmental impacts. Frameworks such as the Just Transition Score and the Carbon efficiency of Social Progress (introduced in detail later) play a critical role in assessing how well countries manage the dual challenge of advancing social progress while minimizing environmental harm. These frameworks serve as essential tools for policymakers, enabling them to move beyond GDP-based assessments and adopt a more nuanced evaluation of sustainability. By integrating social and environmental indicators, these measures allow for a comparative analysis of national performance over time, shedding light on disparities in sustainability efforts and identifying effective policy approaches.

The application of such frameworks, designed and constructed as part of this thesis, extends beyond basic assessment; they provide insights into how different governance structures, economic models, and development strategies influence environmental efficiency. By analyzing patterns of resource use and social advancement, these tools help identify best practices for sustainable progress. Additionally, they highlight the trade-offs that nations must navigate when pursuing development while ensuring environmental sustainability.

Environmental efficiency is increasingly relevant given the mounting global pressures on natural resources and ecosystems. Rapid industrialization and economic expansion have undeniably im-

proved living standards, but they have also intensified environmental degradation. Countries that achieve higher environmental efficiency manage to decouple social progress from ecological harm, demonstrating the feasibility of sustainable development models. This thesis explores country-level variations in environmental efficiency, identifying best practices and governance structures that facilitate the integration of environmental and social objectives.

The first paper addressing this issue is titled *Just Transition Score: Measuring the Relative Sustainability of Social Progress* (see Table 1), introduces the Just Transition Score (JTS) as a novel metric for evaluating the environmental efficiency of social progress across countries. The JTS is designed to assess how well nations achieve improvements in societal wellbeing while minimizing environmental damage, using a ratio-based approach that accounts for both carbon footprint and material footprint per unit of social progress. Covering 161 countries from 2011 to 2019, the study finds significant disparities in sustainability performance. While countries like Portugal, Spain, and Costa Rica exhibit high environmental efficiency and achieve social progress with relatively low environmental costs, others, particularly oil-rich and high-emission nations, score poorly due to excessive environmental degradation relative to their social advancements. The findings underscore the trade-offs in balancing development and ecological sustainability, highlighting the need for context-specific policy measures to ensure that environmental efficiency is improved without compromising social progress.

The second paper, *Achieving Just Transition Through Convergence in the Carbon Efficiency of Social Progress* (see Table 1), extends the discussion by examining whether countries are converging in their ability to balance social progress with carbon efficiency. Using a panel dataset of 160 countries from 1990 to 2020, the study introduces the Carbon Efficiency of Social Progress (CESP), a measure that captures how effectively nations achieve social progress with minimal per capita carbon emissions. Employing time-varying factor models, the study reveals a mixed pattern of convergence: low-emitting countries show signs of catching up in carbon efficiency, while middle-emitting nations diverge, suggesting barriers to transitioning toward more sustainable development. This divergence indicates that despite the growing focus on sustainability, many countries still face structural challenges in decoupling social progress from environmental harm. The study highlights the importance of differentiated sustainability strategies that take into account the specific development pathways and emission profiles of different country groups.

Together, these studies contribute to the Environmental Efficiency of Social Progress framework by offering a quantitative assessment of sustainability performance and tracking the evolving patterns of convergence across countries. They reinforce the argument that achieving a just transition requires not only improving environmental efficiency but also ensuring that the transition is equitable across different economic and social contexts. By integrating these insights, the binding chapter situates the discussion of environmental efficiency within a broader sustainability framework, emphasizing the need for robust composite indicators to guide policy and assess progress toward sustainable development goals.

2.3 Climate Change Perception

Public perception of climate change is a crucial yet often underestimated factor in shaping sustainability efforts and policy effectiveness. While scientific research and economic incentives play major roles in climate action, public engagement and awareness determine the extent to which policies are accepted and implemented. Societal attitudes toward climate risks, environmental responsibilities, and mitigation policies influence not only government strategies but also individual behaviors that drive collective change.

This thesis examines climate change perception through a cross-country comparative analysis, highlighting variations in awareness, concern, and willingness to act across different socio-economic and cultural contexts. The findings suggest that although climate awareness is growing globally, significant differences persist in how climate risks are perceived and prioritized. Education levels, media influence, political ideologies, and institutional trust play substantial roles in shaping public attitudes toward environmental policies. These variations directly impact the effectiveness of climate governance, as policies that fail to align with public concerns may face resistance, weakening their implementation and impact.

A key contribution of this research is the integration of perception metrics with environmental and social indicators to provide a multidimensional understanding of climate engagement. By analyzing the intersection of public attitudes and policy effectiveness, this study offers insights into how governments can design more targeted and culturally attuned communication strategies. The findings emphasize the importance of developing inclusive climate policies that address socio-economic disparities in climate awareness and action. Strengthening public engagement in sustainability efforts requires tailored interventions that bridge knowledge gaps and build trust in climate governance, ensuring that climate policies resonate across diverse populations.

The first paper, *Multidimensional Cross-Country Measurement of Climate Change Perceptions* (see Table 1), introduces the Climate Perceptions Index (CPI) as a composite measure of public perceptions of climate change across 107 countries. The CPI is structured around three key dimensions: awareness, risk perception, and commitment to action, providing a holistic framework for assessing how climate change is understood and prioritized globally. Using survey data from over 100,000 Facebook users, the study finds significant cross-country disparities in climate change perceptions, with no clear correlation between economic development and high perception levels. While European countries tend to have high awareness scores but low risk perception and commitment to action, Latin American nations show stronger risk perception and action-oriented engagement despite moderate awareness levels. A key finding is that higher awareness does not necessarily translate into higher risk perception or commitment to action, suggesting that climate communication strategies must go beyond knowledge dissemination to address factors that influence behavioral engagement with climate issues.

The second paper, *Dissimilarities in the Socio-Economic Predictors of Climate Change Worry and Action Across 30 Countries* (see Table 1), expands on this analysis by investigating the socio-economic drivers of climate change concern and action using data from a cross-national Facebook survey. Employing latent variable modeling and machine learning techniques, the study identifies substantial variation in how climate concern and willingness to act are shaped across different national contexts. In countries that are highly vulnerable to climate change, climate worry and action are driven by a broader range of socio-economic factors, including education, exposure to extreme weather, and political beliefs. In contrast, low-vulnerability countries exhibit more uniform

socio-economic influences, indicating that climate change concern in these nations is shaped by more consistent, structural determinants rather than immediate environmental risks. The findings highlight the importance of tailoring climate communication and policy strategies to reflect the distinct socio-economic and cultural drivers of climate change engagement in different regions.

Together, these studies contribute to the Climate Change Perception framework by offering empirical evidence that climate awareness, risk perception, and commitment to action do not follow a straightforward, linear relationship. They reinforce the need to integrate climate perception metrics into broader sustainability assessments, as variations in public engagement can significantly impact the success of environmental policies. These insights support the binding chapter’s discussion on climate change perception by demonstrating that policy effectiveness depends not just on scientific evidence but also on how societies interpret and react to climate risks. By incorporating social and psychological dimensions into climate action strategies, sustainability frameworks can be better aligned with public attitudes, fostering stronger and more sustained environmental engagement.

Overall, this binding chapter brings together the various research components of the thesis, demonstrating their interconnectedness and collective contribution to sustainability discourse. It synthesizes key findings from the thesis, focusing on environmental efficiency of social progress, composite wellbeing measurement, and climate change perception. Through a structured review, this commentary enhances clarity, positions the research within broader academic and policy discussions, and highlights its significance in addressing just transition challenges. By integrating these perspectives, the commentary provides a comprehensive framework that links different strands of sustainability research, offering insights that extend beyond isolated disciplinary approaches.

2.4 Significance of the Thesis

This thesis makes several significant contributions to the study of sustainability and wellbeing measurement by integrating environmental, social, and governance dimensions into a unified analytical framework. Through the development of novel composite indicators and empirical analyses, the research advances understanding of how countries navigate trade-offs between social progress and environmental efficiency, offering methodological and conceptual innovations that enhance policy relevance.

One of the major contributions of this work is the introduction of the Just Transition Score (JTS) and the Carbon Efficiency of Social Progress (CESP), which provide refined metrics for assessing sustainability performance beyond GDP-based indicators. These indices capture the efficiency with which nations achieve social progress while minimizing environmental impacts, addressing a critical gap in sustainability assessment. By incorporating environmental efficiency measures into development evaluations, this thesis offers a more balanced and policy-relevant framework for understanding sustainable growth trajectories.

In the field of well-being measurement, a major advancement has been the long-term assessment of social progress over the past three decades (1990–2020). This extended timeframe not only reveals the trajectory of social improvements across multiple dimensions but also enables a detailed analysis of convergence patterns among countries during this period. Furthermore, through the exploration of time-varying weighting techniques and non-compensatory aggregation methods, the research enhances the robustness and adaptability of composite indices. These methodological advancements ensure that wellbeing measurement frameworks remain reflective of evolving societal priorities, making them more applicable to long-term sustainability assessments.

Additionally, this thesis advances knowledge in climate change perception research by developing a multidimensional framework that links public attitudes to environmental policies and governance effectiveness. The empirical findings highlight the crucial role of socio-economic and cultural factors in shaping climate perception, demonstrating that awareness alone does not guarantee climate action. By integrating perception metrics with sustainability indicators, this research provides actionable insights into how public engagement can be strengthened to support more effective climate policies.

Collectively, these contributions reinforce the thesis’ broader significance in advancing sustainability and wellbeing measurement, and policy development. By bridging conceptual gaps between environmental efficiency, wellbeing assessment, and climate perception, the research provides an integrated framework for understanding sustainable development in a multidimensional context. The findings have direct implications for policymakers, offering evidence-based insights into how different countries can improve sustainability performance while ensuring equity and long-term environmental resilience.

3 Concepts, Methods, and Insights in Cross-Country Sustainable Development Analyses

The following section offers a comprehensive conceptual and methodological grounding for cross country sustainable development analyses, which is reflected through the three core themes explored across this dissertation: composite well-being measurement, environmental efficiency of well-being, and climate change perception.

The historical and policy context surrounding the “Beyond GDP” movement and the evolution of alternative indices (such as the HDI, SPI, and OECD frameworks) directly inform the first set of articles, where new measures of social progress are developed, refined, and extended over time. These papers contribute empirically to the global debate on how to measure human development more holistically, and align with the policy applications discussed here—particularly those concerning inequality, inclusion, and environmental sustainability as central to national planning. Methodologically, the section discusses the implications of common design choices and highlights potential innovations in the construction of composite well-being measures. Regarding environmental efficiency, it reviews diverse empirical strategies, placing particular emphasis on the theoretical underpinnings of the ratio-based approach employed in the development of the JTS and CESP.

Finally, the third theme—climate change perception—is situated within this broader framework through the development of a novel Climate Perception Index (CPI), which applies composite index theory to public attitudes, risk perception, and behavioral commitment. The conceptual and technical foundations presented in this section therefore serve as both context and analytical justification for the empirical contributions made across the dissertation’s core articles.

3.1 Composite Wellbeing Measurement: Historical and Empirical Context

For much of the 20th century, Gross Domestic Product (GDP) was the dominant yardstick of development. Over time, however, scholars and policymakers recognized that GDP – a measure of economic output – is an incomplete proxy for societal well-being. This led to a shift toward composite indices that encompass health, education, and other quality-of-life factors beyond income. Key milestones in this evolution include following:

1990 – Human Development Index (HDI)

The United Nations Development Programme introduced the HDI to “emphasize that people and their capabilities should be the ultimate criteria for assessing the development of a country, not economic growth alone” (UNDP 1990). Devised by Mahbub ul Haq with Amartya Sen’s input, the HDI combined indicators of longevity, education, and income into a single score, shifting focus toward human well-being rather than just national income. Its creators explicitly wanted to “shift the focus of development economics from national income accounting to people-centered policies”, reflecting the belief that GDP fails to adequately measure improvements in people’s lives (Haq 1995).

2009 – Stiglitz-Sen-Fitoussi Commission

A major turning point was the report of the Commission on the Measurement of Economic Performance and Social Progress, led by Joseph Stiglitz, Amartya Sen, and Jean-Paul Fitoussi (Stiglitz et al. 2009). This high-profile commission, convened by France, concluded that GDP is an insufficient metric of progress and recommended a broader dashboard of indicators covering quality of life and sustainability. It called for measures of health, education, environmental sustainability, and subjective well-being to complement GDP. The commission’s report (often referenced as “Mismeasuring Our Lives”) became a cornerstone of the “beyond GDP” movement and spurred governments and international organizations (like the OECD and EU) to invest in well-being metrics.

2011 – OECD Better Life Index

In response to the beyond-GDP agenda, the OECD launched the Better Life Index in 2011 as part of its Better Life Initiative (Kerényi 2011). This interactive index allows comparison of countries across 11 dimensions of well-being – including housing, jobs, community, life satisfaction, and environment – rather than a single income metric. It was unveiled on the OECD’s 50th anniversary with the slogan “Better Policies for Better Lives,” signaling a shift in policy emphasis. The Better Life Index and accompanying How’s Life? reports provided a framework for countries to monitor progress in a people-centered, multi-dimensional way (OECD 2011).

2014 – Social Progress Index (SPI)

Around the same time, non-governmental efforts also emerged. The Social Progress Index, developed by the Social Progress Imperative (with academics like professors Michael Porter and Scott Stern), offered a holistic measure of societal well-being independent of GDP. First released in 2014, the SPI compiles 50+ indicators across Basic Human Needs, Foundations of Wellbeing, and Opportunity to score countries’ social and environmental performance (Porter 2015). Notably, the SPI excludes GDP and other economic metrics altogether, focusing only on outcomes such in education, health, personal safety, rights, and environmental quality. Its creators were explicitly influenced by Sen’s capabilities approach and the Stiglitz Commission’s call to “measure what matters” for citizens’ lives (Porter 2015).

Several other alternative metrics have also been developed, including the Gross National Happiness (GNH) index in Bhutan (Ura et al. 2012), the Happy Planet Index (HPI) (Abdallah et al. 2009) and the Sustainable Development Index (Hickel 2020). Additional indices include the Multidimensional Poverty Index (Alkire and Foster 2011), the Inclusive Wealth Index (Managi and Kumar 2018), and the Genuine Progress Indicator (Kubiszewski et al. 2013). More recent efforts also include the

Doughnut Economics framework (Raworth 2017). However, among these, the Human Development Index (HDI) (UNDP 1990), the Social Progress Index (SPI) (Stern et al. 2022), and the OECD’s well-being framework (OECD 2011) stand out in global use. Over the past few decades, this evolution from GDP to broader indices represents an expanding consensus that development means more than just economic growth—it encompasses human well-being and sustainable progress.

Research comparing GDP with multidimensional well-being measures reveals that economic growth does not always translate into social progress, and vice versa. Generally, countries with higher GDP per capita tend to score better on indices like HDI or SPI – there is a positive correlation – but significant discrepancies are common (Porter 2015; Stern et al. 2022). These discrepancies underscore why relying on GDP alone can mislead assessments of true progress. There are cases where a nation’s economy expands strongly yet broader well-being stagnates. For example, the United States has the highest GDP per capita among G20 countries, but its Social Progress Index outcomes rank below many peers, indicating shortfalls in areas like health and safety despite its wealth. Similarly, fast-growing emerging economies such as China and India have not yet achieved the level of social development that their GDP growth could enable – improvements in education, healthcare, and environmental quality have lagged behind economic gains (Social Progress Imperative, Stern et al. 2022).

Oil-rich countries in the Middle East present another pattern: high per-capita income but moderate performance on human development indicators (due to gaps in education, gender equality, etc.). These examples highlight that GDP is far from destiny for social outcomes; growth can be “unequal or non-inclusive,” benefiting only a segment of society while broader indicators barely improve. Empirical analyses have linked such imbalances to social instability – for instance, Russia and Egypt saw robust GDP growth in certain years but lagging social progress, a divergence accompanied by political unrest (Porter 2015). In short, more money does not automatically mean better lives for all citizens.

Conversely, some countries achieve strong well-being outcomes despite relatively modest incomes. Costa Rica is a frequently cited example – with barely one-third of Italy’s GDP per capita, Costa Rica nonetheless outranks Italy on social indicators like health and education, achieving a higher Social Progress Index score (Stern et al. 2022). This indicates Costa Rica has been highly efficient at converting limited economic resources into longer lives, literacy, and environmental conservation. Other cases include countries like New Zealand and Senegal, which outperform on translating income into social progress compared to peers at similar or higher income levels. Even within the developed world, some lower-GDP nations excel in well-being (for instance, the Nordic countries) while some richer ones underperform on dimensions such as work-life balance or income inequality. Such outliers demonstrate that policy choices and social investments – not just wealth – drive well-being. As the Social Progress Index data shows, “wealth alone is not a determinant of social progress” and substantial gains in health, education, or equity can be made at various income levels.

3.2 Policy Implications of Multidimensional Well-Being Measures

The rise of well-being indices has significant implications for governance and policy, as they provide a more nuanced toolkit to guide public decision-making. By highlighting specific areas of progress or shortfall, these metrics inform governments where to target interventions in order to raise overall quality of life. In practice, multidimensional well-being measures have started to shape national strategies, budgeting, and sustainability plans in several ways:

Informing Integrated Social Policies

Multidimensional well-being indices encourage cross-sectoral policy responses. Since these measures span areas like health, education, housing, safety, and income, they push governments to design comprehensive strategies – for example, a low ranking in “education and skills” (as seen in the OECD Better Life Index for some countries) might lead to simultaneous investments in school infrastructure, teacher training, and affordable access, while also addressing related factors like child nutrition or digital access. The HDI’s use has similarly led countries to ask “why are our education outcomes lagging despite income gains?” and then adjust policies (UNDP 1990). In this way, well-being metrics serve as a diagnostic tool: they pinpoint whether under-performance in overall development is due to, say, poor healthcare, high inequality, or lack of basic services. Governments can then tailor social policies to those specific deficits. For example, after observing multidimensional poverty indices, some countries launched targeted programs for the worst-off regions (focusing on multiple deprivations at once). In sum, these indices have elevated issues like literacy, life expectancy, and social inclusion on policy agendas, ensuring that progress in these fields is pursued alongside economic growth.

Addressing Inequality and Inclusion

Unlike GDP, which is an aggregate, many well-being frameworks explicitly track distributional aspects (such as inequality, gender gaps, or regional disparities). This has policy implications for promoting inclusive growth. For instance, the OECD’s well-being framework and the SPI both include measures of inequality (e.g., income inequality or unequal access to education). When countries benchmark themselves, they may find that high average income coexists with large inequality – prompting initiatives to spread opportunities more evenly. The Stiglitz-Sen-Fitoussi Commission had recommended incorporating the distribution of income and wealth into performance metrics (Stiglitz et al. 2009), a principle that is now reflected in various national indicator sets. As a result, governments are increasingly setting targets to reduce inequality and social gaps. A concrete case is New Zealand’s wellbeing budget: one of its priorities was explicitly to reduce inequalities faced by indigenous Māori and Pacific people (Mintrom 2019).

Similarly, the Sustainable Development Goals (SDGs) adopted by all UN member states in 2015 include a goal on reducing inequality (SDG 10) alongside goals for poverty, health, education, etc. (United Nations 2015). By measuring and reporting on these dimensions, policymakers have justification to implement redistributive policies, anti-poverty programs, or anti-discrimination efforts as integral to development – rather than treating inequality as an afterthought. In essence, multidimensional well-being measures have helped institutionalize the idea that “no one should be left behind” in development progress, guiding policies toward marginalized groups and poorer areas.

Promoting Environmental Well-being and Sustainability

A critical policy implication of going beyond GDP is the integration of environmental outcomes into the definition of progress. Traditional GDP growth often ignores natural resource depletion or pollution, whereas new well-being indices incorporate environmental indicators (e.g., air quality, access to clean water). Environmental wellbeing, and possibly also sustainability, has thus become a core consideration. The OECD’s Better Life Index, for example, has an environment dimension, and the SPI includes a component of environmental quality (among other indicators more or less related to environmental outcomes). This encourages governments to pursue “green growth” – balancing economic and environmental objectives. As a consequence, many countries now track their carbon

footprint or pollution levels alongside GDP, and some have adopted adjustments like “Green GDP” or separate sustainability indices.

The policy effect is that issues like climate change and resource management are on equal footing with economic issues in national plans. Internationally, the emphasis on sustainability in well-being metrics influenced agreements like the Paris Climate Accord and the SDGs (which devote multiple goals to environmental sustainability such as SDG 13 Climate Action, and SDG 15 Life on Land, [United Nations 2015](#)). National development strategies increasingly contain explicit environmental targets (e.g., renewable energy share, forest cover) as a result of this paradigm shift. In practice, one can see this in initiatives such as Bhutan’s Gross National Happiness, which weighs environmental conservation heavily in policy, or in New Zealand’s priority of transitioning to a low-emission economy as a well-being goal ([Mintrom 2019](#)).

By measuring well-being “beyond GDP,” which includes the state of the environment, policymakers are incentivized to enact sustainable practices – for instance, investing in public transit to improve both environmental quality and citizens’ well-being, or regulating industries to protect air and water quality as part of social progress. Over time, this integration aims to ensure that today’s well-being gains do not come at the cost of future generations’ welfare, addressing the long-term aspect of true development.

Multidimensional well-being measures have moved from academic concepts to practical policy tools. They reshape how governments define success: rather than focusing narrowly on increasing national income, leaders are using these indices to pursue balanced progress in social, economic, and environmental spheres. Agencies now routinely publish well-being dashboards, and countries compare performance in health, education, inequalities, or sustainability – spurring a healthy competition to improve human outcomes. The OECD notes that its well-being framework is “informing people-centric and integrated policy making across [...] many dimensions that matter for people and the planet” ([OECD 2024](#)). Likewise, the UN and development banks use these indicators to guide their aid and investments (for example, allocating resources according to the rates of multidimensional poverty). The policy implication is clear: what gets measured gets managed. By measuring well-being more holistically, policymakers are better equipped to manage and improve it. The end result is a more comprehensive approach to development – one that aims for economic prosperity that is translated into healthier, better-educated, more equitable and sustainable societies.

However, in this context, it is crucial to stress the following issue. While it is possible to include environmental wellbeing or outcome indicators into composite indices of wellbeing, integrating global environmental impact indicators directly into such indices would significantly distort their meanings and rankings. For instance, the SPI is designed to rank countries on social outcomes independent of economic indicators – it uses 50+ social and environmental outcome metrics to create a score purely reflecting societal well-being ([Stern et al. 2022](#)). If one were to add, for example, CO₂ emissions per capita as a negative indicator within the SPI framework, a country with high social progress but high emissions (e.g., a wealthy country) would see its overall score pulled down, and a country with modest social progress but low emissions might rise in rank. On the surface this may seem desirable from a sustainability standpoint, but methodologically it mixes two different phenomena: the first country’s score would now conflate how well its people are doing and how much carbon the economy emits. The composite no longer strictly measures “social progress”; it becomes an amalgam of progress and impact. This can lead to inconsistencies and confusion.

For instance, year-to-year changes in the index could occur due to environmental data swings (e.g., a recession lowers emissions and suddenly boosts the well-being score) even if there was no real improvement in social conditions. Likewise, countries could game the ranking by outsourcing carbon-intensive production abroad (reducing domestic footprint without improving domestic well-being), thus scoring better on a “Social-Carbon” index despite no true social gain. These issues illustrate how additive integration of environmental impacts into a well-being index violates the conceptual framework and purpose of indices like SPI, which aim to strictly measure social outcomes (Usubiaga-Liaño and Ekins 2024). The European Commission’s Joint Research Centre, which provides guidance on composite indicators, emphasizes that the selection of components must align with a clear conceptual framework – adding incongruent indicators can reduce the validity of the index (Nardo et al. 2008).

Attempts to promote sustainability by embedding global environmental impact indicators within a well-being composite such as the SPI is theoretically and methodologically problematic. It blurs the meaning of the index, violates the design principles of composites, and could mislead rankings. The preferred approach – grounded in both theory and practice – is to measure well-being and sustainability separately yet in parallel, and use approaches like efficiency ratios or complementary indices to illustrate the interaction between the two. This way, we maintain a clear view of social progress on its own terms, while also holding countries accountable for the global environmental impacts associated with that progress. Such a framework provides a clearer representation of sustainable development: it shows whether a country is advancing human well-being “within safe environmental limits” (Rockström et al. 2009; Raworth 2012) and highlights the adjustments needed to move toward truly sustainable social progress. These issues are addressed in more details in section 3.3.

3.3 Methodological Choices and Innovations in Composite Well-Being Measurement

Composite well-being indices aggregate diverse dimensions (health, education, income, environment, etc.) into a single summary measure. This simplification aids communication, but it must balance inclusivity (capturing broad societal aspects and stakeholder values), comprehensiveness (covering all relevant dimensions of well-being), and interpretability (producing results that are understandable and policy-relevant). In this section, the theoretical and practical implications of the common methodological choices in the composite measurement of wellbeing are briefly discussed, and methodological innovations that might address these challenges are then presented. Namely, time-varying weighting schemes, Bayesian latent variable analysis, and non- or semi-compensatory aggregation techniques.

3.3.1 Implications of Common Methodological Choices in Composite Measurement of Wellbeing

Composite indices of well-being distill complex, multidimensional phenomena into a single summary metric, making it easier to compare and communicate overall quality of life across populations. However, the usefulness and credibility of a well-being index heavily depend on how it is constructed. Key methodological steps – indicator selection, normalization, and aggregation (with weighting) – involve subjective choices that can profoundly influence the index’s accuracy in representing “true” well-being, its interpretability, and its relevance for policy. As experts note, “composite indicators may send misleading, non-robust policy messages if they are poorly constructed or misinterpreted,” because each design decision (what indicators to include, how to scale them, how to weight and

combine them) “will affect the message brought by the composite index” (Nardo et al. 2005). In the context of well-being measurement, carefully considering these steps – both in theory and practice – is crucial to ensure the index is a valid and useful guide for decision-makers.

A major challenge in composite measurement is determining how to assign weights to different indicators or dimensions, as these choices reflect implicit value judgments about the relative importance of each aspect of well-being. A commonly used approach is equal weighting, where all indicators or dimensions receive the same weight, as seen in the Human Development Index (HDI) and the Social Progress Index (SPI). This method has the advantage of simplicity and transparency, avoiding the perception of arbitrary prioritization. However, equal weighting assumes all dimensions contribute equally to well-being, an assumption that may not hold in practice. If one domain is represented by multiple indicators, it might receive disproportionate influence in the final index. Additionally, equal weighting does not account for differences in variability or redundancy among indicators—highly correlated variables may effectively be counted twice. Despite these limitations, equal weighting remains widely used because it circumvents contentious debates about how well-being components should be prioritized.

Other methods attempt to refine weighting through expert judgment or statistical analysis. Expert-driven weighting relies on structured elicitation methods such as Delphi surveys or analytic hierarchy processes, where specialists assign weights based on perceived importance. This approach enhances policy relevance, ensuring that the index reflects societal priorities, such as emphasizing health in contexts where it is deemed fundamental to well-being. However, expert weighting introduces subjectivity and potential bias, as different groups may disagree on the relative importance of indicators. Alternatively, statistical methods such as principal component analysis (PCA) or factor analysis assign weights based on patterns in the data, reducing redundancy by capturing the most explanatory variation. While this method enhances objectivity, it may produce unintuitive or normatively problematic weight distributions, such as down-weighting critical well-being dimensions if they show little statistical variation. These trade-offs illustrate the tension between conceptual soundness, empirical validity, and practical interpretability in weighting choices.

Beyond weighting, aggregation choices also shape the final index values. A common approach is linear aggregation, where scores are summed using assigned weights. This method is intuitive and easy to communicate but allows for full compensability, meaning high scores in some dimensions can offset deficits in others. In contrast, nonlinear aggregation methods, such as geometric means or minimum function approaches, impose constraints on compensation, ensuring that extreme deficits in one dimension have a stronger negative impact on the overall index score. The geometric mean, adopted in the revised HDI methodology since 2010, penalizes imbalance across dimensions, reinforcing the notion that well-being requires a minimum level of achievement across all domains. More restrictive approaches, like Bhutan’s Gross National Happiness index, require individuals to meet specific thresholds in multiple domains before being considered “happy,” reflecting a policy stance that well-being is inherently multidimensional and non-compensatory. The choice of aggregation thus fundamentally shapes the interpretation of an index, influencing its role as a tool for policy and public communication.

3.3.2 Time-Varying Weighting Schemes

Composite indices traditionally use fixed weights for components, often chosen by expert judgment or statistical methods. Fixed weights ensure comparability over time, but they may become misaligned with evolving societal priorities. Time-varying weighting schemes allow the relative importance of

dimensions to change over time, enhancing the index’ adaptability. This reflects the reality that what society values (and thus what well-being means) can shift – for example, rising environmental consciousness or mental health awareness would warrant higher weights on those dimensions in recent years than in past decades. In essence, if the goal is tracking a consistent bundle of outcomes, constant weights suffice, but if the goal is identifying best practices or emergent priorities at each time, “weights should necessarily change over time” (OECD 2008).

By analogy, economists use a fixed-weight Laspeyres price index to study inflation over time, but a Paasche index updates weights to current consumption patterns (Tarantola 2008). Likewise, a well-being index with time-sensitive weights can remain inclusive of new concerns and comprehensive in scope as societal values change. For instance, an index might gradually increase the weight of environmental quality as climate change impacts intensify. This adaptability makes the index more interpretable in a specific context – stakeholders can see that the index gives more emphasis to dimensions that are pressing. However, changing weights do complicate direct comparisons of index scores over long periods (Mazziotta and Pareto 2015). A careful balance is needed, such as transparently reporting both a fixed-weight trend (for long-term progress) and a dynamic-weight index (for current well-being), to maintain interpretability. Overall, time-varying weighting schemes enhance the policy relevance and inclusivity of composite well-being measures by aligning them with contemporary priorities and stakeholder preferences, while still retaining comparability through appropriate methodological choices (OECD 2008; Tarantola 2008).

3.3.3 Bayesian Latent Variable Analysis

Another innovative approach is to view composite well-being as a latent variable – an unobserved construct inferred from many observed indicators. Bayesian latent variable analysis uses statistical modeling to estimate this latent well-being factor, treating the composite not as a simple weighted sum but as a probabilistic model output. This approach offers several advantages in terms of uncertainty incorporation and measurement robustness.

First, the Bayesian framework naturally produces credible intervals (or confidence ranges) for each country or unit’s well-being score, explicitly acknowledging uncertainty in the measurement (Høyland et al. 2012). For example, if data for some dimensions are sparse or noisy, the model will reflect that in wider intervals for the composite score, cautioning users against over-interpreting small differences. This improves interpretability by not giving a false sense of precision in rankings. Høyland et al. (2012) demonstrate that applying a Bayesian latent model to well-being pillars can quantify the uncertainty underlying country index rankings – often the differences between countries are not statistically significant once uncertainty is accounted for, a fact obscured by traditional methods that yield single point estimates.

Second, Bayesian latent analysis can handle missing data and measurement errors more robustly. Instead of dropping indicators or imputing ad-hoc, the model estimates the latent well-being score even for cases with partial data, using the relationships among all available indicators. In a long-term well-being dataset with patchy historical data, Rijpma (2016) constructs a composite using a latent variable model that deals well with missing data and measurement error issues, providing reasonable estimates even for countries or periods with sparse information. The uncertainty from these estimates is transparently carried into the composite’s confidence intervals. This means the index remains inclusive and comprehensive – no country or important indicator is dropped due to missing values – yet the interpretability is guarded by clearly indicating higher uncertainty where appropriate.

Third, the Bayesian latent approach improves robustness by statistically learning the weights (loadings) from the data structure rather than fixing them a priori. Essentially, indicators that co-move strongly and consistently get higher implicit weight in explaining the latent well-being factor, while those that diverge contribute less ([Jackson 2009](#); [Rijpma 2016](#)). This data-driven weighting can be more stable and objectively grounded, reducing subjective bias. It also often yields an effective weighting scheme that varies by context (e.g., an era or region) within the model, without the analyst having to manually adjust weights. The result is a composite index that is comprehensive (uses all relevant indicators), yet parsimonious in capturing common information, and explicitly accounts for uncertainty in both data and modeling. By embracing uncertainty and complexity through Bayesian latent variable analysis, we get a more nuanced and robust picture of well-being – one that policymakers can still interpret (through scores and their credible ranges) but with greater caution and insight into the reliability of the measurements ([Jackson 2009](#); [Høyland et al. 2012](#)).

3.3.4 Non- and Semi-Compensatory Aggregation Techniques

A critical issue in composite indices is the compensability of dimensions – can excellence in one aspect of well-being offset a deficit in another? Traditional linear (additive) indices assume full compensability, meaning a high score in one dimension could balance out a low score in another. This can undermine interpretability and inclusivity: a country might rank high overall despite catastrophic failure in one essential dimension (for example, very high income but very poor health outcomes). Non-compensatory aggregation rules address this by ensuring that poor performance in critical dimensions is not masked by strengths elsewhere. In other words, they impose the notion that some trade-offs are not acceptable ([Munda and Nardo 2009](#)).

One simple semi-compensatory approach is the geometric mean (used in the revised Human Development Index) which is less compensatory than the arithmetic mean – low values in one indicator only partially substitute high values in others. The switch by UNDP to a geometric mean for HDI in 2010 was explicitly to penalize unbalanced development – a country must show progress in all key dimensions (health, education, income) to achieve a high HDI, since a low score in one will drag down the geometric average ([United Nations Development Programme \(UNDP\) 2010](#)). This is a semi-compensatory strategy: it still allows some trade-off but with diminishing returns to extreme imbalance, thus improving interpretability ([Klugman et al. 2011](#)). Users of the index can no longer ignore a glaring deficit; an overall score will drop sharply if any component is very low, aligning with the intuitive notion that comprehensive well-being requires balanced achievements.

Fully non-compensatory techniques go further, disallowing any compensation between certain dimensions. One method is the outranking approach from Multi-Criteria Decision Analysis (MCDA), where alternatives (countries) are compared pairwise on each dimension and an overall ranking emerges without collapsing everything into a single trade-off metric ([Zhang and Zhou 2018](#)). Zhang and Zhou (2018) apply an outranking-based composite indicator for low-carbon development, arguing that full substitutability of environmental indicators with economic ones is not desirable. In their non-compensatory index, a city that performs terribly on carbon emissions cannot outrank another city that is only mediocre on emissions simply by virtue of better performance in another area – critical sustainability thresholds are respected ([Zhang and Zhou 2018](#)).

Another family of methods uses a “penalty for bottleneck”: for example, the Mean–Min function takes an average but subtracts a penalty proportional to the distance of the worst-performing dimension from the others ([Casadio Tarabusi and Guarini 2013](#); [Mazziotta and Pareto 2015](#)). This

creates an intermediate case between full compensation and none – some compensation is allowed, but a larger imbalance incurs a bigger penalty, so no dimension can be completely overshadowed without consequence (Casadio Tarabusi and Guarini 2013). Such approaches uphold inclusivity by treating each dimension as indispensable to some degree and enhance interpretability: a high composite score genuinely signals all-around good performance, while an “imbalanced” profile is clearly visible through a lower composite score or separate penalty term (Mazziotta and Pareto 2015).

From a comprehensiveness standpoint, non- and semi-compensatory aggregations acknowledge that well-being is multi-faceted and that certain minimum achievements in each facet are necessary. They align with the concept of “weak vs. strong sustainability” in environmental/ecological economics: under strong sustainability, natural capital (environment) cannot be perfectly substituted by human capital, analogous to how in a non-compensatory index a dimension like environmental quality has a non-negotiable role (Neumayer 2012). By embedding this principle, composite measures become more policy-actionable – a low score in a crucial sub-index pinpoints an area needing urgent improvement, instead of being drowned out by other highs. In practice, adopting non-compensatory aggregation can make an index more credible and salient to diverse stakeholders.

3.3.5 Applications in the Thesis

The three articles in this thesis reflect a deliberate engagement with both established and innovative methodologies in composite well-being measurement, allowing for a broad and nuanced exploration of global development patterns. The first two papers – the historical analysis of the Social Progress Index (SPI) and the book chapter on SDG 10 – apply traditional composite index construction techniques, including fixed weights and linear aggregation, aligned with the SPI framework. These contributions prioritize interpretability and policy relevance. By extending the SPI back to 1990, the historical paper enables long-term trend analysis, highlighting structural shifts in well-being and revealing how countries have converged or diverged in different dimensions over time. Meanwhile, the SDG 10 chapter emphasizes the institutional and political salience of multidimensional indicators in addressing social inequalities, showing how composite indices like the SPI can inform inclusive policy design.

Both of these articles embody the strengths of equal weighting and additive aggregation: they offer transparency, comparability, and ease of communication, which are essential for influencing public discourse and policy. While this approach does not penalize imbalances across dimensions, it aligns with the SPI’s core principle of measuring well-being outcomes in a people-centered and GDP-independent manner. In terms of the broader methodological debate, these articles are especially relevant to discussions in section 3.2.1 of this chapter regarding the trade-offs between simplicity and nuance. They demonstrate how well-constructed traditional indices can still provide powerful insights, particularly when the research objective is historical mapping or agenda-setting for inclusive development.

In contrast, the third paper in the thesis introduces several methodological innovations aligned with the approaches discussed in sections 3.2.2 through 3.2.4. It employs a time-varying weighting scheme derived from entropy-based methods to analyze the evolving importance of different well-being dimensions across time and regions. This dynamic weighting captures how disparities and convergence patterns shift over decades, offering a more responsive view of social progress than fixed-weight indices. By using entropy to quantify variation and assign weights accordingly, the paper embraces both conceptual inclusivity and empirical sensitivity – dimensions that fluctuate

more across countries and years receive higher weights, reflecting their increasing salience in a globalized and unequal world. This approach addresses critiques of static indices by allowing the measurement framework to adapt as new social challenges (e.g., governance or digital access) rise in importance.

3.4 Environmental Efficiency of Wellbeing: Conceptual Foundations

A key concept linking well-being and sustainability is environmental efficiency, sometimes termed ecological efficiency. In sustainability science, environmental efficiency refers to the ability to achieve human well-being with minimal environmental impact. Formally, it can be defined as the ratio of useful output (human well-being) to environmental input (ecological footprint or resource use) (Tamburino and Bravo 2024). This notion is analogous to efficiency in physics – maximizing desirable outcomes (e.g., health, happiness, or social progress) per unit of energy, material, or emissions expended. Dietz et al. (2009) introduced the related idea of the “environmental intensity of well-being”, essentially the inverse of efficiency, measuring environmental impact per unit of human well-being. Their research argued that sustainability should be rethought as improving well-being relative to ecological costs, rather than pursuing well-being at any cost. In practical terms, a society that achieves high life expectancy and life satisfaction with low carbon emissions, low resource consumption, and low pollution exemplifies high environmental efficiency (Knight and Rosa 2011).

Environmental (or ecological) efficiency has become a central indicator for sustainable development since it captures the essence of decoupling economic or social progress from environmental degradation. In empirical studies, researchers have quantified metrics like “CO₂ emissions per unit of human development” or “material footprint per capita of life expectancy” to compare how efficiently different countries convert natural resource use into well-being (Knight and Rosa 2011; O’Neill et al. 2018). For example, Hickel (2020) proposes a Sustainable Development Index that divides a country’s human development (as measured by a modified HDI) by its ecological overshoot, thereby measuring the ecological efficiency of human development. Such metrics reveal large disparities: some high-income nations attain high well-being but at very high environmental cost (low efficiency), whereas some countries achieve moderate well-being with relatively low impact (higher efficiency, Hickel 2020).

Overall, the goal in sustainability is to improve environmental efficiency so that quality of life can be maintained or raised while absolute impacts on climate, ecosystems, and resources decline. This concept underpins the idea of green growth and circular economy strategies – improving technology and practices so that each unit of well-being “output” requires ever fewer inputs of energy and materials (Schandl et al. 2016). However, researchers also caution that efficiency alone may not be sufficient; phenomena like the Jevons paradox show that efficiency gains can be offset by increased consumption if not coupled with wise policy (Alcott 2005). Thus, environmental efficiency is a crucial but not standalone component of sustainability – it must be complemented by absolute limits (as highlighted by planetary boundaries) and equitable transition strategies to truly achieve sustainable well-being.

3.4.1 The Just Transition: Equity in Sustainability Transitions

As societies strive to improve environmental efficiency and shift toward sustainable systems, the concept of a Just Transition has emerged to ensure these changes are equitable and inclusive. A “Just Transition” refers to a fair and inclusive process of moving toward a low-carbon, sustainable

economy that protects livelihoods and enhances social justice (McCauley and Heffron 2018). In other words, it emphasizes that the burdens and benefits of sustainability transitions (such as phasing out coal, expanding renewable energy, improving resource efficiency) should be shared fairly, without leaving workers, communities, or less-developed regions behind. The term originally gained prominence in the labor and environmental justice movements and has since been integrated into global climate policy discourses – notably, the United Nations Framework Convention on Climate Change (UNFCCC) (2016) acknowledges “the imperatives of a just transition of the workforce and the creation of decent work” in its preamble.

McCauley and Heffron (2018) define a just transition as a “fair and equitable process of moving toward a post-carbon society”, stressing that this framework brings together climate, energy, and environmental justice. It calls for addressing distributional justice (who bears costs and who gains from the transition), procedural justice (inclusive decision-making processes), and recognition justice (acknowledging and respecting the rights of all stakeholders, including vulnerable groups) in sustainability policies (McCauley and Heffron 2018; Jenkins et al. 2020).

The significance of Just Transition in equitable sustainability transitions cannot be overstated. Without deliberate attention to justice, policies like carbon pricing, coal plant closures, or land conservation can impose disproportionate hardships on certain communities (e.g., fossil fuel industry workers, low-income households, indigenous peoples). A just transition approach aims to mitigate such outcomes through measures like re-skilling programs for workers, social safety nets, community engagement, and investment in alternative livelihoods (ILO 2015). For example, the International Labour Organization’s (ILO) guidelines on Just Transition outline strategies to secure workers’ rights and incomes during green transitions, ensuring that climate action also enhances social well-being (ILO 2015).

Likewise, the European Union has established a Just Transition Fund to support coal-dependent regions in shifting to sustainable industries, exemplifying how the concept shapes real policy (European Commission 2020). By putting social well-being and equity at the center, Just Transition frameworks strengthen the political and ethical legitimacy of sustainability initiatives. They recognize that true well-being is not only about aggregate outcomes but also about who benefits – reinforcing that environmental sustainability and social justice must progress hand in hand. In the context of well-being measurement, the inclusion of “just transition” considerations means tracking indicators of quality of life alongside carbon reductions and efficiency gains (Newell and Mulvaney 2013). Ultimately, the idea of Just Transition seeks to harmonize the goals of environmental efficiency and improved well-being with the principles of fairness and “leaving no one behind”, as advocated in the UN Sustainable Development Goals (United Nations 2015).

3.4.2 Conceptual Relevance of Weak vs. Strong Sustainability Paradigms

Underpinning the discussions of well-being and sustainability is a fundamental theoretical debate: weak vs. strong sustainability. These paradigms offer differing answers to the question of how far human-made capital (infrastructure, technology, knowledge) can substitute for natural capital (ecosystems, resources, biodiversity) in supporting human well-being. Weak sustainability posits that various forms of capital are largely substitutable, meaning that as long as the total aggregate stock of capital (natural + produced + human capital) is maintained or grows, sustainable development can be achieved (Solow 1993; Neumayer 2012). In this view, natural resources and ecosystem services can be depleted or degraded so long as we compensate by increasing wealth or technological capabilities that confer equal or greater benefits to future generations.

A classic articulation of weak sustainability is that it “does not matter whether the current generation uses up non-renewable resources or dumps CO₂ in the atmosphere as long as enough machineries, roads and ports are built in compensation” (Neumayer 1999). This perspective underlies economic models like the Hartwick rule (Hartwick 1977), which suggests that investing the rents from resource depletion into produced capital can preserve the total wealth for the future. Proponents of weak sustainability tend to have confidence in human innovation and market mechanisms to solve environmental problems (through, for example, cleaner technologies or resource substitution), and often endorse monetary compensation for environmental damage as an acceptable trade-off (Ekins et al. 2003).

In contrast, strong sustainability argues that natural capital is fundamentally non-substitutable in many cases, because ecosystems provide critical life-support functions that built capital cannot replicate once lost (Daly 1995; Ekins et al. 2003). Strong sustainability holds that there are critical natural capital stocks and planetary life-support systems – e.g., a stable climate, fertile soil, biodiversity, ozone layer – that must be maintained in kind, not merely in value, to ensure long-term human well-being. Proponents point out qualitative differences: the destruction of a forest or species is often irreversible, whereas man-made capital can usually be rebuilt or replaced (Ekins et al. 2003). Moreover, the uncertainty and complexity of ecological systems mean we often cannot predict which losses might prove catastrophic (Dietz and Neumayer 2007).

Therefore, strong sustainability calls for strict limits and a precautionary principle regarding natural capital use: certain environmental thresholds should not be crossed, and some natural losses cannot be justified by gains in man-made wealth (Goodland 1995). In practical terms, a strong sustainability approach might insist on conserving critical ecosystems, reducing material throughput, and respecting planetary boundaries even if there is an opportunity cost in terms of conventional economic growth. This paradigm aligns with the idea that sustainable well-being requires living within the means of nature, not merely compensating for environmental degradation with income or technology.

The weak vs. strong sustainability debate has important empirical and policy implications. For instance, the World Bank’s Genuine Savings indicator (also known as Adjusted Net Saving) is rooted in weak sustainability – it subtracts natural resource depletion and pollution damage from national savings rates, but treats different forms of capital as interchangeable in monetary terms (Hamilton and Hartwick 2014). If a country’s genuine savings remain positive, it is deemed “sustainable” in the weak sense, even if it is drawing down certain natural assets. In contrast, advocates of strong sustainability would criticize such an approach for potentially masking irreversible ecological loss; they argue for physical indicators of natural capital preservation (e.g., forest cover, fossil fuel reserves left unburned) and for maintaining critical natural capital intact (Ekins et al. 2003).

The tension between these paradigms is also reflected in international policy debates: should “green growth” be pursued (an essentially weak sustainability notion that economic growth can continue as it becomes more efficient and cleaner), or “post-growth” or “degrowth” pathways need to be envisioned, that respect absolute ecological limits (strong sustainability)? (Jackson 2009; Hickel and Kallis 2020) Increasingly, scientific evidence of climate change, biodiversity loss, and resource constraints lends weight to strong sustainability arguments that some natural systems’ integrity is a non-negotiable foundation for long-term well-being. This is where the concept of planetary boundaries becomes a crucial framework, reinforcing the view that certain environmental thresholds define a safe operating space for humanity.

3.4.3 Key Contributions of Planetary Boundaries and the Safe Operating Space

The planetary boundaries framework, introduced by Rockström et al. (2009) and refined by Steffen et al. (2015), identifies a set of nine biophysical thresholds that delineate a “safe operating space” for human development on Earth. These boundaries – including climate change, biodiversity loss, biogeochemical flows (nitrogen and phosphorus cycles), land-system change, freshwater use, stratospheric ozone depletion, ocean acidification, atmospheric aerosol loading, and novel entities (chemical pollution) – represent limits which, if persistently exceeded, could trigger destabilizing environmental changes at the global scale.

Contextualizing well-being and sustainability within the planetary boundaries framework means recognizing that human progress is embedded in Earth’s systems and must operate within ecological limits. Rockström et al. (2009) argued that crossing these boundaries risks abrupt or irreversible environmental shifts (e.g., ice sheet collapse, ecosystem regime shifts) that would severely undermine human well-being. Indeed, several boundaries (notably climate, biosphere integrity, and biogeochemical flows) are already in a zone of uncertainty or beyond safe limits due to the scale of human activity (Steffen et al. 2015). This scientific framework has profound implications for how we measure and pursue well-being: it implies that true sustainable well-being requires achieving social goals without overshooting critical planetary capacities.

Planetary boundaries align closely with the strong sustainability paradigm by underscoring non-negotiable ecological constraints. They emphasize that certain environmental processes cannot simply be substituted or offset by economic gains – for example, no amount of manufactured capital can compensate for a runaway climate change or mass extinction event. In this sense, respecting planetary boundaries is a precondition for long-term human well-being; it sets the outer envelope within which humanity can thrive. The concept of a “safe and just operating space” has emerged by combining planetary boundaries with social foundations for well-being (Raworth 2017; O’Neill et al. 2018). Raworth (2012) proposed the idea of a doughnut-shaped space: the outer ring are the planetary boundaries (ecological ceiling) and the inner ring are minimum social requirements (a social foundation of basic well-being such as access to food, education, healthcare, etc.). Sustainable development, in this view, means meeting all people’s essential needs and improving quality of life without overshooting the Earth’s ecological limits – essentially, finding a safe and just space for humanity.

Unfortunately, empirical analyses show a substantial challenge: countries that achieve high human development tend to exceed planetary boundaries, while countries that stay within per-capita fair shares of planetary limits often still have unfulfilled human needs. For example, O’Neill et al. (2018) found that no country meets all basic needs (like life expectancy, sanitation, income sufficiency) for its citizens within its fair share of planetary boundaries; high-income nations overshoot especially on carbon emissions and nutrient cycles, highlighting a gap in sustainable well-being. This underscores the necessity of dramatically improving environmental efficiency (the amount of well-being per unit of environmental use) and rethinking development models if we are to achieve well-being for all within the planet’s carrying capacity. In policy terms, the planetary boundaries framework has started to inform global sustainability agendas – from the scientific underpinnings of the Paris Climate Agreement’s goal to limit warming (climate boundary) to discussions of a global deal for nature to protect biosphere integrity. It serves as a scientific guardrail for human progress, reminding policymakers that any long-term strategy for improving lives must remain compatible with Earth system stability.

3.4.4 Policy and Theoretical Implications

The integration of well-being beyond income, environmental efficiency, just transition principles, and the insights of sustainability paradigms within planetary boundaries is reshaping global sustainability policies and governance. Well-being indices and broader progress measures have begun to influence policy decisions at national and international levels. Following the Stiglitz-Sen-Fitoussi report (Stiglitz et al. 2009), organizations like the OECD and UN launched the Beyond GDP initiatives, leading to regular well-being reporting and new indices that guide policy. Several countries (e.g., New Zealand, Scotland, Bhutan, Costa Rica) have formally incorporated well-being metrics into governance: Bhutan’s Gross National Happiness index pioneered this approach by guiding development policy with surveys of psychological well-being, cultural integrity, and ecological resilience (Ura et al. 2012). New Zealand’s government now publishes a Wellbeing Budget that allocates spending based on well-being priorities such as mental health, child welfare, and environmental quality, rather than solely on economic growth projections (Mintrom 2019). These examples illustrate a broader trend of governments and international bodies recognizing that measuring success “beyond income” leads to different priorities – for instance, more emphasis on poverty reduction, public health, and environmental protection – and helps track progress on the UN Sustainable Development Goals (many of which explicitly pertain to non-income dimensions of well-being). In theoretical terms, this shift operationalizes Sen’s ideas and capability-based definitions of development into concrete metrics that can complement or even replace GDP in decision-making (Stiglitz et al. 2018).

Environmental efficiency metrics likewise play an increasing role in sustainability governance. At the global level, the UN Sustainable Development Goals include targets for decoupling economic growth from environmental degradation (e.g., SDG 8.4 and 12.2 call for improving resource-use efficiency and reporting material footprint per capita). Many countries track indicators such as energy intensity (energy per GDP) and carbon intensity (CO₂ per GDP) as part of their climate strategies, aiming to increase efficiency as a means to achieve green growth. The Paris Agreement encourages nations to peak emissions and then reduce them, implicitly relying on improvements in carbon efficiency of well-being to allow continued development while cutting emissions. On a policy level, frameworks like the Inclusive Wealth Index (which accounts for natural capital, human capital, and produced capital) reflect attempts to incorporate efficiency and sustainability into national accounting – if a country’s inclusive wealth per capita is stagnant or falling, it indicates that well-being gains may be unsustainable (Managi and Kumar 2018).

Furthermore, corporate and urban governance use environmental efficiency metrics through tools like eco-efficiency analysis, life-cycle assessment, and sustainability reporting (e.g., measuring water or energy use per unit of service delivered). Such metrics help translate the abstract concept of sustainability into quantifiable performance indicators, informing policies like building efficiency standards, waste reduction goals (improving material efficiency), and technology benchmarks (e.g., fuel efficiency requirements for vehicles). The theoretical implication is a move toward quantified sustainability, where maximizing well-being output per environmental input becomes a normative goal (Bergh 2011). However, governance must also guard against simply optimizing efficiency in the short term while ignoring absolute scale – hence parallel efforts to set caps or boundaries (for example, carbon budgets consistent with the 1.5°C climate boundary).

Crucially, the principle of Just Transition has been increasingly woven into international climate and sustainability policies, reflecting a recognition that the shift to sustainability must be socially fair to be politically sustainable. For instance, at COP26 in 2021, numerous countries and development

banks pledged funding for just transition partnerships to help coal-dependent developing countries move to renewables while supporting affected workers and communities. The European Green Deal (Fetting 2020) includes a robust Just Transition Mechanism with financial instruments to alleviate socio-economic impacts in regions facing green transition challenges.

This policy embedding of just transition illustrates how the concept’s core tenets – equity, inclusion, stakeholder engagement – are becoming standard considerations in climate action plans and energy policies worldwide (Jenkins et al. 2020). Theoretically, it brings social justice theory into sustainability governance, ensuring that measures of well-being in sustainability include process fairness and not just end-states. It also expands the governance discourse from focusing purely on efficiency or technology to incorporating values of distributive justice (who gains/loses) and procedural justice (who has a voice in shaping transitions). In practice, this could mean that when governments evaluate policies (say, closing a coal plant for emissions reduction), they also measure and address the impacts on employment, community well-being, and inter-generational equity, rather than evaluating success solely on emissions metrics.

The debate between weak and strong sustainability further influences policy orientations: many mainstream economic policies and international financial institutions still operate on a weak sustainability model, promoting solutions like carbon pricing or investment in eco-innovation to solve environmental problems without questioning growth paradigms (OECD 2011). Yet, there is a growing counter-movement in policy circles influenced by strong sustainability and planetary boundaries. This is evident in calls for establishing ecological limits in policy – for example, some countries are exploring legal rights for nature or constitutional environmental thresholds (as seen in countries like Ecuador with rights of nature, or proposals for “Earth system boundaries” treaties). The Stockholm+50 conference (Baste and Watson 2022) and the formation of the Earth Commission are signs that planetary boundaries thinking is penetrating global governance, aiming to set science-based targets for Earth system integrity that policymakers should heed (Rockström et al. 2021). Theoretical work on “doughnut economics” (Raworth 2017) has even influenced city planning (e.g., Amsterdam adopting a City Doughnut model) and discussions of a post-growth economy focused on human thriving within ecological ceilings.

These concepts collectively shape an emerging sustainability governance paradigm in which well-being is the ultimate goal, environmental efficiency is a key means, equity and justice are guiding principles, and planetary boundaries define the necessary conditions. Well-being indices and sustainability indicators are used to inform budgeting, policy priorities, and performance evaluation. Environmental efficiency metrics guide innovation and measure progress toward decoupling, while just transition policies ensure the human impacts of these shifts are managed with care. Meanwhile, the tension of weak vs strong sustainability plays out in debates between those advocating technological optimism and market solutions versus those urging precaution, conservation, and perhaps new economic models. The planetary boundaries framework provides a scientific backdrop that anchors these discussions, constantly reminding decision-makers that sustainability is not only a socio-economic aspiration, but also a biophysical necessity. As global challenges like climate change and biodiversity loss accelerate, integrating these insights is increasingly seen not just as an academic exercise but as foundational to designing policies for a resilient and thriving future.

3.5 Methodologies for Measuring Environmental Efficiency of Well-Being

Measuring environmental efficiency of well-being involves evaluating how effectively societies convert environmental inputs (or impacts) into human well-being outcomes. Two broad approaches are commonly used: ratio-based metrics and non-parametric frontier methods. Each approach offers distinct insights and has different implications for policy and sustainability assessments. Below, we expand on these methodologies, including their theoretical underpinnings, formulae, key examples, and how methodological choices can influence policy interpretation in the context of sustainability and Just Transition principles.

3.5.1 Ratio-Based Metrics of Environmental Efficiency of Well-Being

Ratio-based metrics provide a straightforward quantification of well-being achieved per unit of environmental impact (or vice versa). Fundamentally, a ratio-based indicator can be expressed as:

$$Efficiency = \frac{W_i}{E_i}$$

Where W_i is a measure of well-being for entity i (e.g., a country or region), and E_i is an environmental pressure or resource use for the same entity. A high value of this ratio indicates that a high level of well-being is achieved with relatively low environmental cost, signifying greater sustainability. Conversely, the inverse ratio $\frac{W_i}{E_i}$ sometimes termed the environmental intensity of well-being – a lower value of this intensity implies more environmentally efficient well-being (Dietz et al. 2009). In practice, researchers choose specific indicators for well-being and environment, yielding various metrics:

Environmental Efficiency of Well-Being (EWEB)

This concept was introduced as a holistic sustainability metric relating human welfare to environmental impact (Dietz et al. 2009). For example, well-being can be represented by life expectancy or a composite index, and environmental impact by per capita carbon emissions or ecological footprint. An early cross-national analysis measured EWEB as the ratio of life expectancy to per capita ecological footprint, finding wide international disparities (Knight and Rosa 2011). Countries like Costa Rica and Cuba emerged as examples of high EWEB, achieving long life expectancies with modest resource use, whereas some high-income nations had lower efficiency due to disproportionately large footprints. These findings highlight that sustainability can be reframed as maximizing well-being per unit of environmental burden, not just minimizing emissions in absolute terms.

Carbon and Ecological Intensity of Well-Being

Many studies focus on the inverse ratio – environmental impact per well-being – often termed intensity. For instance, the carbon intensity of human well-being (CIWB) is defined as annual CO₂ emissions per capita divided by a well-being indicator (often life expectancy) (Jorgenson 2014). Similarly, ecological intensity of well-being (EIWB) uses ecological footprint in the numerator. These intensity measures are conceptually the reciprocals of efficiency: lower intensity corresponds to higher efficiency. Jorgenson (2014) demonstrated that as countries develop economically, their CIWB does not automatically improve without targeted policies – some high-income nations still emit large CO₂ for marginal gains in life expectancy. Recent research has explored how CIWB and EIWB evolve with development and environmental policy, including tests of Environmental

Kuznets Curve dynamics for these metrics (Barak et al. 2024). Such studies show, for example, that expanding forest cover or investing in cleaner technologies can bend the trajectory of CIWB downward, enabling nations to sustain health and longevity while curbing emissions (Barak et al. 2024).

Composite Indices

In addition to simple ratios, composite indicators have been devised to encapsulate sustainable well-being. The Happy Planet Index (HPI), for example, combines subjective well-being (survey-based life satisfaction), life expectancy, inequality adjustments, and ecological footprint into a single index that essentially reflects “well-being per planetary resource unit” (Abdallah et al. 2009). While not a pure ratio, it is grounded in the ratio concept of maximizing well-being and equity for each unit of environment used. Such indices have gained visibility in policy discussions to illustrate which countries achieve more happiness per carbon or health per hectare. They underscore conceptual implications: high well-being need not come with high emissions – a decoupling central to Just Transition goals.

Ratio-based measures are intuitive and easily communicated. A higher ratio signals that a society delivers more well-being for each unit of environmental impact. This directly aligns with sustainability ideals of decoupling human progress from resource consumption and emissions. However, the choice of numerator and denominator matters. Well-being can be measured in diverse ways (life expectancy, a multidimensional index, subjective happiness, etc.), and environmental impact can range from carbon emissions to ecological footprint or material consumption. Different choices can lead to different rankings and policy messages. For example, using life expectancy may favor countries with strong public health systems, whereas using a happiness index might highlight other leaders. Policymakers should thus be aware of what each ratio captures. Nonetheless, the overall message of ratio metrics is clear and policy-relevant: improve the denominator (reduce environmental impact) and/or improve the numerator (increase well-being) to achieve better sustainability performance. This provides a simple yardstick for progress toward goals like the SDGs and Paris climate targets: ideally, countries should strive to increase well-being while shrinking their per-capita footprint, thereby moving to a higher EWEB (Dietz et al. 2009; Knight and Rosa 2011).

3.5.2 Other Non-Parametric Frontier Approaches

DEA is a linear programming technique originally developed to evaluate the efficiency of production units (Charnes et al. 1978). In the context of environmental efficiency of well-being, a country can be conceptualized as a “Decision Making Unit” that uses environmental inputs to “produce” well-being outputs. For example, inputs could include per capita CO₂ emissions, energy or material use, and outputs could include indicators of human development such as life expectancy, education level, or an aggregate well-being index. DEA computes an efficiency score for each unit by finding the optimal weighted output-input ratio for that unit, subject to the constraint that no other unit exceeds an efficiency of 1 under the same weights (Charnes et al. 1978). In effect, each country’s performance is compared to a convex combination of peer countries – the frontier represents the highest attainable well-being for a given environmental input level, based on observed data.

DEA has been widely applied in environmental and sustainability assessments (Zhou et al. 2008). It generalizes the ratio approach: if there is one output and one input, DEA efficiency is just the simple ratio (normalized to the best performer). With multiple factors, DEA considers the best possible weighted ratio, which means it does not require analysts to pre-decide the relative importance of,

say, health vs education, or CO₂ vs material footprint – the data determine the most favorable weights for each unit. This is advantageous in a policy context because it avoids subjective weighting and can handle trade-offs explicitly. For example, a country with moderate CO₂ emissions and high life expectancy and education may achieve an efficiency score of 1 by emphasizing the weights on those well-being outputs, identifying it as a best-practice case for sustainable human development (Chansarn 2014). In Chansarn’s cross-country DEA analysis of 115 nations, countries like Sweden and Portugal were found to be 100% efficient in converting resources (energy use, CO₂ emissions, etc.) into human development (life expectancy, schooling, income), setting benchmarks for others (Chansarn 2014). Such results indicate that those countries achieve a balance of high social outcomes with relatively low environmental inputs, embodying the ideals of a just and sustainable pathway.

A technical challenge in DEA for environmental applications is that pollution or resource use are “bad” outputs or inputs. DEA models have been adapted so that undesirable outputs (e.g. emissions) are treated appropriately – for instance, by modeling pollutants as inputs to be minimized, or by using directional distance functions and slacks-based measures that allow reduction of bad outputs in efficiency improvement projections (Färe et al. 1989; Zhou et al. 2008). These extensions ensure that a unit that simply produces a lot of well-being and a lot of pollution is not erroneously deemed efficient. Instead, efficiency requires comparatively low pollution for the level of well-being. Modern DEA studies often use such approaches to derive an eco-efficiency score or sustainable well-being efficiency score. For example, an analysis of EU countries over 2005–2012 used an enhanced DEA model incorporating undesirable outputs to rank nations’ environmental efficiency (Hermoso-Orzáez et al. 2020). Likewise, slack-based DEA models have assessed how countries could reduce specific resource uses or emissions while maintaining human development, pinpointing concrete improvements for policy (Chansarn 2014).

3.5.3 Findings and Policy Relevance of the Environmental Efficiency of Wellbeing Measures

Each methodology for measuring the environmental efficiency of well-being carries unique implications for policy interpretation and the pursuit of sustainability and a Just Transition. Maintaining technical rigor while ensuring policy applicability is crucial.

Ratio-based indicators are simple and transparent, which aids communication with the public and policymakers. A metric like “CO₂ per life-year” or “well-being per hectare” can succinctly illustrate the challenge of sustainable development. For example, the narrative that “Country A emits 10 tons of CO₂ per year for its average citizen to live to 75, whereas Country B only emits 5 tons for the same life expectancy” is compelling and easy to grasp. This clarity supports policy dialogues around efficiency and equity – it becomes evident who is using more than their fair share of environmental capacity for similar outcomes. However, simplicity can mask trade-offs. A high ratio might be achieved by excelling in one well-being dimension while neglecting others (e.g., long life expectancy but perhaps poor subjective life satisfaction). In contrast, DEA can incorporate multiple facets (health, education, income, etc.), aligning with the multi-dimensional nature of wellbeing. This complexity provides a richer diagnostic for policy – highlighting which aspect of well-being is achieved efficiently and which aspect may be lagging. Yet, the complexity means results must be carefully communicated to non-experts, and transparency can be a challenge (since the weights in DEA are not fixed and can be hard to explain). The choice may thus depend on the context: if a policy goal is narrowly defined (e.g., maximize health with minimal carbon), a simple ratio suffices; if it is broad (improve overall quality of life sustainably), a DEA approach is more informative.

While the JTS and the CESP developed in this thesis are ratio-based approaches, they address key limitations of simpler ratio metrics by integrating multiple dimensions of well-being and environmental impact. As discussed earlier, ratio-based measures offer intuitive and transparent comparisons, making them particularly effective for tracking efficiency trends and communicating sustainability challenges. However, traditional ratio indicators often focus on a single aspect of well-being, such as life expectancy or life satisfaction, without capturing broader social progress. By contrast, the JTS and CESP account for multiple well-being dimensions, ensuring a more comprehensive assessment of how efficiently countries translate environmental resources into social outcomes. The findings align with previous studies demonstrating that while high-income nations achieve superior well-being, their environmental efficiency remains low (Knight and Rosa 2011; Fanning et al. 2022). Likewise, the identification of relatively efficient middle-income countries mirrors research on sustainable development trajectories (Hickel 2020), reinforcing the argument that well-being can be decoupled from excessive resource consumption under the right policy conditions.

The empirical results of both the JTS and CESP reveal striking disparities in the environmental efficiency of social progress across world regions. High-income countries generally achieve top scores in absolute well-being, but their relative performance falls sharply once environmental costs are factored in. This is particularly evident among OECD members, many of which remain heavily reliant on carbon-intensive consumption patterns and exceed per capita ecological thresholds despite high social outcomes. In contrast, several middle-income countries—such as Costa Rica, Albania, and Sri Lanka—emerge as comparatively efficient performers. These countries achieve moderate to high well-being scores while maintaining significantly lower CO₂ emissions and material footprints, thus positioning themselves closer to the normative vision of sustainable development. These findings substantiate earlier claims that high social performance need not be contingent upon high environmental impact, and that policy choices—rather than income alone—play a crucial role in shaping sustainability outcomes.

Building on the empirical disparities highlighted above, the CESP also reveals distinct convergence dynamics that are crucial for understanding the potential for a global just transition. Specifically, the convergence analysis shows that while countries as a whole are moving toward greater environmental efficiency in achieving social progress, this trend is highly uneven across emission groups. Low-emitting countries, which represent nearly half of the global population, exhibit strong sigma convergence, with rapidly improving CESP scores and diminishing performance disparities. Their convergence signals the potential for relatively low-carbon development pathways that still ensure substantial social outcomes. High-emitting countries also show early-stage convergence, albeit at a much slower pace, reflecting marginal efficiency gains but persistent overconsumption patterns. In stark contrast, middle-emitting countries—often emerging economies—are diverging, with significant internal stratification. This divergence is driven by a subset of countries (notably China, Russia, and Turkey) that have failed to improve their carbon efficiency over time, placing a third of the world’s population on an increasingly unsustainable path. These findings underscore the need to tailor just transition strategies to distinct convergence profiles, as global averages mask the urgent structural challenges in the middle-emitting group.

3.6 Conceptual Foundations of Climate Change Perception

Climate change perception refers to the ways in which people understand, interpret, and feel about climate change – including their awareness of the issue, beliefs about its causes, level of concern or risk perception, and willingness to support climate actions. Measuring these perceptions

is crucial because public opinion can powerfully influence political will and individual behavior related to climate change (Lee et al. 2015). Within the broader context of sustainable development, understanding climate change perceptions helps ensure that climate policies and initiatives align with public values and knowledge, thereby enhancing their effectiveness. This section provides a structured review of climate change perception measurement and patterns, covering conceptual foundations, methodological approaches, cross-national patterns, and linkages to policy and governance. By examining both how perceptions are measured and what those measurements reveal, we can better integrate public sentiment into climate action strategies for global sustainability.

In research, “climate change perception” is a multidimensional concept encompassing awareness (whether people have heard of climate change), cognitive beliefs (e.g., accepting that it is happening and human-caused), affective responses (level of worry or concern), risk perceptions (perceived seriousness or threat to oneself, others, or the world), and behavioral intentions related to climate action (Lee et al. 2015). For instance, Leiserowitz (2005) found that Americans generally perceived climate change as a moderate risk that would mostly affect distant places and future generations – a phenomenon often described as psychological distance. This highlights that perception is not just binary (believe or disbelieve) but involves gradations of concern and perceived relevance.

Theoretical frameworks from environmental psychology and risk research shed light on what drives these perceptions. For example, psychometric risk theory suggests people intuitively evaluate hazards based on characteristics like dread and familiarity – climate change tends to be a slow-moving, abstract risk, which can dampen personal sense of urgency (Weber 2010). Similarly, psychological distance theory posits that people see climate change as distant in time (affecting future generations), space (happening in faraway countries or the global level), and social relevance, which leads to underestimating its personal impact (Leiserowitz 2005; Weber 2010). On the other hand, direct experiences with extreme weather (such as heatwaves or floods) can reduce this distance, making the risk more salient and immediate, as shown by studies linking personal experience to increased concern (Spence et al. 2011).

Decades of research in behavioral and environmental psychology, climate communication, and political science have identified numerous factors shaping climate change perceptions. At the individual level, cognitive factors like knowledge and understanding of climate science play a role – those with higher climate literacy are often more aware of the issue, though knowledge alone does not guarantee concern (Linden 2015). Affective and experiential factors are critical: feelings of worry, personal experience with climate impacts, and overall trust in science influence how serious people judge the threat (Weber 2010; Van der Linden 2017). Cultural and social factors, including values and norms, also guide perceptions. The value-belief-norm (VBN) theory (Stern 2000) suggests that people with strong altruistic or biospheric values are more likely to believe in the seriousness of environmental problems and feel a personal moral obligation to act, whereas those with strong egoistic values may be less concerned.

Similarly, social norms (what people perceive others in their community believe and do) can reinforce climate attitudes – if climate concern is common in one’s peer group, individuals are more likely to also view it as important (Linden 2015). In many Western countries, climate change has also become a politicized issue; political ideology and partisan identity strongly influence perception. In the United States, for example, conservatives tend to be far more skeptical about the reality and risks of climate change than liberals, a divide that has grown over the past two decades (McCright and Dunlap 2011). This polarization is reinforced by media echo chambers and elite cues

– people often take signals from political leaders or media outlets aligned with their ideology, shaping whether they downplay or emphasize climate threats (McCright and Dunlap 2011). Cross-cultural research indicates that the importance of these drivers can vary by context. In some countries, basic awareness of climate change correlates most with education and access to information, whereas in others personal observation of environmental changes is more influential (Lee et al. 2015). Overall, a comprehensive model of climate change risk perception (Linden 2015) groups determinants into three categories: cognitive (knowledge, understanding, and beliefs about causes/effects), experiential (personal experience and emotional reactions), and socio-cultural (values, norms, and trusted information sources). These factors interact to shape whether an individual perceives climate change as an immediate, serious threat or a distant, negligible concern.

From a conceptual standpoint, measuring climate change perception is not only about assessing public opinion – it is about understanding the readiness of society to engage in climate action and the potential barriers to such engagement. Perceptions influence behavior; for instance, if people perceive low personal risk from climate change, they may be less likely to support mitigation policies or adopt pro-environmental behaviors (Weber 2010). Moreover, misperceptions or lack of awareness can impede sustainable development initiatives. The United Nations Framework Convention on Climate Change (UNFCCC) explicitly recognizes in its Article 6 the importance of public education, awareness, and participation regarding climate change, underlining that addressing climate change is as much a social challenge as a technical one. Therefore, understanding how the public perceives climate change – conceptually and empirically – is a cornerstone for designing effective communication, education, and policy strategies in the pursuit of sustainability.

3.7 Trends and Patterns in Climate Change Perceptions

Measuring climate change perceptions across different countries has revealed notable patterns and divergences. These patterns are shaped by socioeconomic development, cultural context, exposure to climate impacts, and political discourse, among other factors. Understanding these trends is important for tailoring communication and policy strategies to different audiences and for fostering international cooperation under frameworks like the Paris Agreement and the Sustainable Development Goals.

One striking global pattern is the gap between awareness and concern. Lee et al. (2015) found that in wealthier, industrialized countries (North America, Europe, Japan, etc.), public awareness of climate change is very high – often above 90% of adults have heard of climate change. By contrast, in many developing countries, especially in parts of Africa and South Asia, awareness is much lower; large portions of the population have limited familiarity with the concept of “climate change” as a planetary issue. This is often linked to education levels and access to media – education emerged as the strongest predictor of climate awareness worldwide, with more educated individuals far more likely to have heard of climate change (Lee et al. 2015).

However, when looking at concern or risk perception among those who are aware, the pattern often flips. People in developing countries who know about climate change tend to perceive it as a very serious threat, often more so than people in developed countries. For example, surveys have shown that respondents in countries like Bangladesh, Kenya, or the Philippines (which are highly vulnerable to climate impacts) frequently rate their personal risk from climate change as high, whereas a significant minority in the US or Europe might downplay personal risk even though they acknowledge climate change in the abstract (Carle 2015). This likely reflects the lived experiences – developing regions are already experiencing severe impacts (floods, droughts, crop failures) and

have fewer resources to cope, making climate change less abstract. In contrast, individuals in richer nations may feel insulated or think the worst effects will happen elsewhere or in the future, contributing to a more complacent attitude.

Globally, concern about climate change has generally risen over the past decade, though with fluctuations. In many countries, public concern dipped slightly around 2010–2012 (possibly due to the global financial crisis shifting priorities, and events like the “Climategate” controversy that temporarily undermined trust in climate science for some) and then rebounded strongly in the late 2010s as climate impacts became more evident and climate movements (e.g., school strikes, Extinction Rebellion) gained momentum. For instance, Eurobarometer surveys in Europe show an upward trend in the proportion of citizens rating climate change as one of the most serious problems facing the world from the early 2010s to 2019 ([Commission 2019](#)). In the United States, Yale’s tracking surveys (Climate Change in the American Mind series) indicate that the percentage of Americans “very worried” about global warming increased between 2015 and 2020, and the segment of “Dismissive” (strong deniers) shrank somewhat during that period ([Leiserowitz et al. 2021](#)).

However, perceptions can be volatile – extreme weather events like catastrophic hurricanes or wildfires often trigger short-term spikes in concern and discussion, while other crises (such as the COVID-19 pandemic in the early 2020s) can temporarily eclipse climate change in the public’s mind. A Center ([2022](#)) survey of 19 advanced economies found that a median of 75% of the public viewed climate change as a “major threat” to their country – making it one of the top-rated global threats – suggesting that in many countries concern is at historically high levels. Notably, in that 2022 survey, Europeans were especially likely to rank climate change as the top global threat, even above issues like pandemics or cyber-attacks ([Center 2022](#)).

Building on these political and ideological divides, the thesis provides a comprehensive cross-country analysis of the socio-economic factors influencing climate change worry and action (article title: Dissimilarities in the socio-economic predictors of climate change worry and action across 30 countries). By constructing latent variables that encapsulate these dimensions, we uncover significant disparities in how different demographic and socio-economic attributes shape climate perceptions. Gender emerges as the most prominent factor in several countries, with women generally exhibiting higher levels of concern and willingness to engage in climate action. This finding aligns with prior research suggesting that women tend to have stronger pro-environmental attitudes and a heightened perception of climate risks due to socialization processes that emphasize care and responsibility ([McCright and Dunlap 2011](#)). Meanwhile, education plays a crucial role in shaping concern in multiple high-vulnerability countries, reinforcing the notion that increased knowledge and exposure to climate science lead to greater awareness of risks and support for action ([Lee et al. 2015](#)).

Moreover, our results highlight notable differences in the determinants of climate change perception between countries with high and low vulnerability to climate risks. In high-vulnerability nations, a wider range of socio-economic predictors influence climate change worry and action, suggesting that these countries experience a more complex interplay of economic, demographic, and cultural factors. In contrast, low-vulnerability countries display more uniform socio-economic influences, with gender and education emerging as the dominant factors. This implies that in highly vulnerable contexts, policies aiming to enhance public engagement with climate action must account for a broader set of socio-economic and institutional dynamics, while in lower-vulnerability nations, interventions targeting gender and education disparities may be more effective.

Crucially, these findings align with previous studies on climate perception, confirming the significant role of demographic attributes in shaping attitudes toward climate change (Leiserowitz 2005; Linden 2015). While political ideology remains a key determinant in polarized societies, our study reinforces the broader influence of socio-economic factors across diverse national contexts. These insights emphasize the need for tailored climate communication strategies that consider both structural socio-economic differences and country-specific vulnerability levels to maximize public engagement in climate action.

3.8 Composite Measurements of Climate Change Perception

Measuring climate change perception across countries requires carefully combining multiple indicators into composite indices. Researchers aim to capture how people know about, feel about, and respond to climate change. These efforts involve making methodological choices about which survey questions or data points to include, how to gather comparable data worldwide, and how to construct an index that is meaningful for policymakers. This analysis examines two key aspects of such index construction: (1) Indicator Selection & Conceptual Framework, (2) Data Sources & Sampling.

3.8.1 Indicator Selection & Conceptual Framework: The Climate Perception Index

Composite indices of climate change perception typically encompass multiple dimensions of how the public understands and reacts to the issue. A common conceptual framework is to include indicators for awareness, risk perception, and action or behavioral commitment. In a research which is part of this dissertation thesis, Htitch et al. (2024a) developed a Climate Perceptions Index (CPI) covering these three dimensions across 107 countries. This multidimensional approach is theoretically grounded in prior perception research that distinguishes cognitive, affective, and behavioral components of environmental attitude (Linden 2015). For example, the knowledge–attitude–practice model in environmental psychology suggests that knowing about an issue (cognitive) influences concern (affective), which in turn can shape action (behavioral). By selecting indicators representing each stage, composite indices aim to reflect an individual’s progression from understanding climate change to feeling at risk and finally to willingness to act.

Generally, awareness indicators often measure basic knowledge and recognition of climate change. These can include survey questions on self-assessed understanding of climate change, belief in the reality of global warming, awareness of its causes, and exposure to information (e.g., how often one hears about climate change). The rationale for including such indicators is that public awareness is a prerequisite for informed concern – people must first know about climate change before they can form opinions on its risks. However, research also shows that awareness alone is not sufficient and can be misleading if taken in isolation. Single-item knowledge self-assessments (e.g., “I know a lot about climate change”) often yield inconsistent findings (Leiserowitz 2006) and may not correlate strongly with concern. Some individuals claim high knowledge yet downplay risks, while others with similar knowledge are very worried. Thus, an index should go beyond awareness to capture how that knowledge translates (or fails to translate) into perception of threat.

Risk perception indicators gauge the level of concern and perceived threat from climate change. These items probe how serious people think climate change is for themselves, their community, or future generations. For instance, a composite index might include questions on personal worry about climate change or belief that climate change poses a serious threat to one’s country or the world (Lee et al. 2015). In the CPI example, the risk perception dimension included perceived personal harm and concern for future generations (Htitch et al. 2024a). The theoretical justification comes

from extensive literature on risk perception: perceiving climate change as a high risk is often linked to affective responses like worry or dread ([Leiserowitz 2006](#)) and is a known predictor of support for climate policies. Established frameworks such as the value-belief-norm theory posit that threat perceptions (belief that climate change is dangerous) are a key motivator for personal norms to act ([Stern 2000](#)). Including risk perception indicators aligns the index with these frameworks, ensuring it captures the affective dimension of public opinion that drives concern-driven behaviors. It is also consistent with cross-national findings that concern varies widely by context – for example, awareness of climate change is relatively high worldwide, but the level of worry or perceived seriousness shows more variation ([Lee et al. 2015](#)). An index that separately measures risk perception can thus highlight where awareness exists but public urgency is lacking.

Action or commitment indicators reflect the behavioral or conative aspect – what people are willing to do or support in response to climate change. This dimension can include personal behaviors (e.g., willingness to adopt sustainable practices), policy preferences (support for government action or climate policies), and the personal importance placed on climate change as an issue. For example, the CPI’s “Commitment to Action” dimension incorporated how important climate change is to the respondent, and their support for government involvement and national responsibility in addressing it. Theoretical justification for including action-based indicators lies in the observation that concern does not automatically translate into action due to various barriers. Psychological research emphasizes the role of efficacy and contextual factors: even highly concerned individuals may not act if they feel powerless or lack opportunities ([Grothmann et al. 2013](#)). By explicitly measuring willingness or self-reported action, the CPI index captures this critical gap. It recognizes action as a distinct component of perception, consistent with frameworks highlighting that perceived efficacy and social norms mediate the step from concern to behavior ([Jugert et al. 2016](#)). In other words, a person can know about climate change and even fear its impacts, yet remain inactive – a composite index should reveal such disparities.

Indeed, in our CPI research, we note that some countries score high on awareness but much lower on willingness to act, or vice versa, underscoring the importance of treating these dimensions separately ([Htitch et al. 2024a](#)). This multidimensional design echoes established perception models and allows researchers to test relationships between the dimensions. For instance, one can examine whether greater awareness strengthens the link between risk perception and action – a hypothesis consistent with the idea that knowledge can empower concern to spur behavior ([Maartensson and Loi 2022](#)).

In practice, selecting specific indicators for each dimension involves both theory and empirical testing. For example, in the CPI construction, 16 candidate questions were available from a global survey managed by Facebook. Being granted the access to the survey data, the authors chose 12 of those questions (four per dimension) based on conceptual relevance and tested that each set of four formed a unidimensional scale ([Htitch et al. 2024a](#)). They reported that inter-item correlations and a principal component analysis supported the three-factor structure, with each dimension showing good internal consistency (e.g., acceptable Cronbach’s alpha) across countries.

This approach ensures that each indicator included contributes meaningfully to measuring its latent concept and that combining them is psychometrically sound. The result is a composite index underpinned by an explicit conceptual framework (awareness–risk–action) that is well-aligned with established theories in climate perception research. Other studies have followed similar logic – for example, [Lee et al. \(2015\)](#) distinguished awareness (heard of climate change) from risk perception (consider it serious) in their global analysis, and recent surveys often include separate items on

knowledge, concern, and willingness to act (Leiserowitz et al. 2022). In sum, careful indicator selection grounded in theory yields a multidimensional index that captures the complexity of climate change perception, rather than relying on any single question or proxy.

3.8.2 Data Sources & Sampling

Measuring climate change perception globally poses significant data collection challenges. Traditional survey-based approaches and newer digital data sources each have strengths and limitations. A crucial methodological consideration is how to obtain comparable, representative samples in different countries so that the index scores truly reflect population perceptions (and not artifacts of sampling bias).

Most academic studies on climate perception rely on surveys with nationally representative samples. Examples include the Gallup World Poll, Pew Global Attitudes surveys, the World Values Survey, and regional barometers (Eurobarometer, Afrobarometer, etc.), which have incorporated climate change questions. These surveys typically use stratified sampling of the adult population (via face-to-face interviews, telephone, or online panels) to approximate the demographic makeup of each country. The advantage of such surveys is greater representativeness: they attempt to include people of all backgrounds, including those without internet access, ensuring urban-rural, age, and gender representation. For instance, Lee et al. (2015) used Gallup poll data covering 119 countries to analyze global awareness and concern, benefitting from Gallup’s rigorous sampling (random-digit dialing or area probability sampling in each country).

However, traditional surveys are resource-intensive – high costs often limit the number of countries or frequency of polling. Questions may also vary from survey to survey, complicating the task of assembling a consistent cross-national index. Despite best efforts, even reputable surveys can have nonresponse bias (certain groups not participating) or coverage gaps (e.g., excluding remote areas or people without phones). Researchers must often apply statistical adjustments such as post-stratification weights (aligning the sample to known population margins like age, gender, education levels) to improve representativeness.

In recent years, global tech platforms have emerged as an alternative way to sample public opinion rapidly across many countries. One prominent example is the Facebook-based climate change perception survey done by Meta’s Data for Good program in partnership with researchers (Leiserowitz et al. 2022). This approach uses Facebook’s enormous user base to distribute questionnaires to users in dozens of countries. The 2022 “International Public Opinion on Climate Change” survey reached respondents in over 100 countries via Facebook, providing a trove of data on climate knowledge, beliefs, and policy preferences (Leiserowitz et al. 2022). The benefit is scale and consistency: the same questions were asked worldwide at roughly the same time, yielding a harmonized dataset for index construction. Moreover, it accessed opinions in many developing countries where dedicated climate polling is rare, thus filling important data gaps. The trade-off, however, is that a social media sample is not fully representative of the general population. Facebook users tend to be younger and more urban, and in some regions Facebook penetration is low or skewed toward certain demographics.

To mitigate this, the Meta survey used stratified sampling and weighting techniques (Leiserowitz et al. 2022). Despite weighting adjustments, some biases may remain in social-media-based data. Internet penetration varies greatly – in low-income countries, the survey samples may still exclude large segments of society (those without internet or not on Facebook). Additionally, response bias

is possible: Facebook users had to opt in to take the climate survey, so those who chose to respond might be systematically different (perhaps more interested in climate issues) than those who ignored it.

Researchers who work with such data usually acknowledge these limitations. For example, the Facebook dataset was used also for the construction of the CPI, and Htitich et al. (2024a) note that these data can introduce homophily and “echo chamber” effects – people’s information environments online may reinforce existing beliefs. This means a respondent’s self-reported knowledge or concern on Facebook could be influenced by algorithm-curated content or peer groups, which is a dynamic less present in random household surveys. Moreover, in some authoritarian contexts, social media samples might underrepresent those fearful of expressing opinions. Each of these factors can introduce cross-country differences that are not due to true opinion differences but due to sampling artifacts.

In the CPI example, Htitich et al. (2024a) addressed this comparability issue by selecting questions that performed well across diverse countries and by statistically validating that each set of indicators formed a consistent dimension worldwide. To calculate the Index, survey responses were aggregated at the country level and normalized using a min-max scaling approach, ensuring cross-country comparability. The aggregation follows a straightforward arithmetic mean, reflecting a fully compensatory framework where a high score in one dimension can offset a lower score in another. Alternative aggregation techniques, such as geometric mean and principal component analysis, were tested but yielded similar results. Internal consistency of the dimensions was validated through correlation analysis, Cronbach’s alpha, and principal component factor analysis, confirming that the selected survey items appropriately capture the three core dimensions. Additionally, the study examines the interrelationships among these dimensions, exploring how awareness moderates the link between risk perception and commitment to action.

Another key methodological contribution of the CPI paper (Htitich et al. 2024a) is the use of hierarchical model trees to assess how different levels of awareness influence the relationship between risk perception and commitment to action. The results suggest that this relationship is strongest at lower awareness levels and weakens as awareness increases, potentially due to normalization effects or ideological biases. These findings align with previous research on climate change perception (Linden 2015; Shi et al. 2016), which highlights the complexity of translating knowledge into action. The CPI thus provides an empirically grounded measure of climate change perceptions that can inform policy and communication strategies aimed at fostering greater public engagement with climate action.

4 Synthesizing Wellbeing, Sustainability, & Perceptions measurements

Sustainability emerges as a holistic concept when viewing environmental and social dimensions in tandem. This thesis’ three core themes – the composite well-being measurement, environmental efficiency of wellbeing, and climate change perception – are deeply interconnected facets of that holistic view. Composite well-being measurement provides multidimensional metrics needed to evaluate societal development beyond GDP alone [Stiglitz et al. (2009); Fleurbaey (2009)]. Such indices capture health, education, (in)equality, and other facets of wellbeing, ensuring that progress is evaluated in people-centered terms rather than just economic output. The environmental efficiency of well-being examines how effectively societies convert natural resources into societal outcomes,

embodying the ideal of “doing more with less” (Dietz et al. 2009). This reflects the sustainable development imperative to achieve high quality of life within ecological limits (Hickel 2020). These two perspectives then extends to the domain of public perception, where public attitudes toward climate change are considered as a vital component of sustainability, and captured to comprehensively measure the cognitive and behavioral dimensions of sustainability.

Crucially, the first two themes are complementary: robust wellbeing indices supply the “output” side of the efficiency equation, while environmental metrics supply the “input” side, allowing us to assess how sustainably well-being is achieved (Knight and Rosa 2011). The third theme, climate change perception, adds a critical behavioral and policy context. Public perception of climate change influences societal response and willingness to support sustainable policies (Weber 2010; Lee et al. 2015). If people do not perceive climate threats or value sustainability, advances in efficiency or measurement may not translate into action. By synthesizing these themes, the thesis underscores that true sustainability requires both efficient resource use and high social wellbeing, underpinned by an informed and engaged public. In other words, achieving human development within planetary boundaries (O’Neill et al. 2018) hinges not only on technical or economic factors but also on social awareness and values.

Together, the three research themes contribute to a more comprehensive understanding of sustainability – one that integrates what we strive for (broad human wellbeing), how we achieve it (with maximal environmental efficiency, i.e., least possible environmental impacts), and why it ultimately succeeds or fails (public perception and support for change). This integrated perspective aligns with the broad vision of sustainable development set out by the Brundtland Commission’s call to meet present needs without compromising future generations (WCED 1987), highlighting that environmental health and human prosperity must advance hand-in-hand.

4.1 Key Contributions of The Dissertation Research

This research makes several novel contributions to the fields of sustainability science, wellbeing measurement, and climate change perception. First, it introduces innovative metrics for evaluating the environmental efficiency of social progress. Notably, the thesis developed the Just Transition Score (JTS) and the Carbon Efficiency of Social Progress (CESP), which together quantify how well countries translate resources and emissions into improved social outcomes. These indicators fill a critical gap by extending traditional development indices to include ecological efficiency, offering a new way to compare countries’ sustainable development performance (Dietz et al. 2009; Hickel 2020).

By capturing the ratio of human well-being (e.g., Social Progress Index scores) to environmental impact (e.g., CO₂ emissions per capita), the JTS and CESP highlight cases of “smart” development – where social gains are high but environmental costs are low – and expose where progress remains coupled with unsustainable resource use (Htitch et al. 2024b). This contribution advances the state of knowledge methodologically (through novel index design) and substantively (by revealing global variability in efficiency), equipping policymakers with more balanced metrics beyond GDP-based rankings. It directly informs sustainability debates by showing that some countries achieve high wellbeing at much lower ecological cost than others, thereby charting pathways for efficient, low-carbon social progress (Knight and Rosa 2011). For instance, our findings indicate that while low-emitting countries exhibit strong convergence towards higher carbon efficiency of social progress, middle-emitting countries remain fragmented, with some advancing and others stagnating or even regressing. This divergence suggests structural challenges in decoupling social progress from

environmental impacts at intermediate levels of development. At the same time, high-emitting countries show signs of slow convergence, likely driven by technological advancements and policy shifts towards decarbonization.

Second, the thesis refines composite wellbeing measurement techniques. Building on the “beyond GDP” movement ([Stiglitz et al. 2009](#)), the measurement of social progress was expanded to cover three decades (1990–2020), providing an unprecedented perspective on the long-term evolution of global social conditions and enabling a detailed analysis of disparities across key dimensions of quality of life. Related dissertation research paper also improved the composite indices methodology by exploring dynamic weighting and aggregation methods. In particular, it pioneered the use of time-varying weights to reflect changing societal priorities and explored non-compensatory aggregation alternatives to ensure that poor performance in one dimension (say, health or education) is not completely masked by excellence in another. These methodological innovations represent a step-change in composite index construction. They contribute to the literature by increasing index robustness and sensitivity to context, addressing common critiques of composite indicators (e.g., arbitrary weighting).

Third, the thesis breaks new ground in understanding climate change perception through a multidimensional, comparative lens. It develops and applies a composite Climate Perception Index (CPI) framework (or similar multidimensional analysis) to gauge public awareness, risk perception, and willingness to act on climate change across countries ([Htitch et al. 2024a](#)). This is a notable contribution to climate social science, as previous studies often examined single aspects of perception or were limited in scope ([Leiserowitz 2006](#); [Lee et al. 2015](#)). By combining survey data on climate knowledge, concern, and behavioral engagement, the research provides one of the first cross-country indices capturing how populations perceive and respond to climate change.

This multidimensional analysis is further enriched by insights from research on socio-economic predictors of climate change worry and action across 30 countries. By employing advanced statistical techniques, such as latent variable modeling and random forest analysis, this study reveals significant disparities in how different socio-economic factors shape public climate concerns and actions across diverse national contexts. Notably, countries that are highly vulnerable to climate change exhibit a broader range of influential predictors, highlighting the diverse socio-economic drivers behind climate perception and engagement. On the other hand, nations with low vulnerability to climate change display more uniform patterns. These findings reinforce the necessity of context-specific climate communication strategies and further validate the need for a composite index approach to effectively capture the multidimensionality of climate change perception.

Such insights enrich academic knowledge by revealing how socio-economic development, education, and cultural context shape climate perceptions worldwide ([Lee et al. 2015](#)). For example, the results also showed that better education often correlates with greater climate awareness, but also uncovered exceptions where even well-informed publics may not support climate action due to economic or political factors. Methodologically, this work demonstrates how to construct a valid composite index from perception data – including careful indicator selection, weighting, and validation – contributing a new tool for climate perception research. Substantively, it highlights a key insight: awareness and concern do not automatically translate into action, pointing to “gaps” where policy can intervene ([Weber 2010](#); [Jugert et al. 2016](#)).

By linking the CPI with sustainability indicators (like emissions or adaptation policies), the thesis offers policy-relevant evidence that stronger public engagement often aligns with more ambitious climate action, and that enhancing public perception of climate risks can be a lever for sustainability. This has direct implications for climate communication and education policy, underlining the need for improving public understanding as part of the sustainability transition. Overall, by integrating climate perception into the sustainability assessment framework, the thesis broadens the scope of sustainability science to explicitly include societal readiness and support, an often overlooked but crucial component of achieving environmental goals.

Collectively, these contributions advance the state of knowledge and have high policy relevance. The research bridges traditionally separate domains – environmental efficiency analysis, composite social indicator development, and environmental psychology – demonstrating the value of interdisciplinary approaches in sustainability studies. It provides policymakers and scholars with improved metrics and insights to navigate the trade-offs and synergies between human well-being and environmental integrity.

For instance, the new efficiency metrics can help identify best practices for sustainable development (showing how some nations attain progress with low emissions), while the improved well-being indices and perception insights ensure that less inequality and more public support are central in crafting climate policies. In advancing methodological frontiers (e.g., composite index design, integration of perception data) and producing actionable findings (e.g., which policy levers might decouple wellbeing from carbon emissions), the thesis contributes to a more evidence-based, comprehensive toolkit for pursuing the Sustainable Development Goals ([United Nations 2015](#)). It reinforces the idea that measuring and achieving sustainability is not one-dimensional, but requires concurrent progress on multiple fronts – a message that this research operationalizes with concrete tools and data.

4.2 Future Research Directions

Building on these findings, future research can further enhance sustainability assessment through several methodological and empirical avenues. One important direction is refining composite indices for wellbeing and sustainability. Future studies could experiment with more advanced weighting techniques, such as participatory weights derived from public surveys or machine learning algorithms that adjust weights based on predictive accuracy. These could complement the time-varying approach pioneered in this thesis, making indices even more responsive to emerging global priorities. Additionally, incorporating distributional aspects into composite measures is a frontier worth exploring – for example, adjusting national wellbeing scores to penalize high inequality, so that “sustainable development” implies broad-based progress ([Stiglitz et al. 2018](#)).

There is also scope to extend environmental efficiency metrics: researchers might develop analogous indices for other environmental pressures (water use, biodiversity loss) linked to social outcomes, or apply the JTS/CESP framework at sub-national scales (cities or regions) to inform local sustainability policies. Advancements in data availability will be a key enabler in this context. Future composite indices could integrate new data sources such as high-resolution satellite data (to measure environmental degradation in real time), and big data on human wellbeing (e.g., mobility data as a proxy for access to services, sentiment analysis of social media for real-time wellbeing or climate concern signals). Merging traditional indicators with big-data streams can improve the timeliness and richness of sustainability metrics, though careful validation will be needed to maintain reliability.

Another promising avenue is the longitudinal and causal analysis of the environment–wellbeing relationship. While this thesis took important steps in measuring and comparing, future work could employ panel data and quasi-experimental methods to identify how improvements in efficiency or wellbeing indices translate into long-term sustainability outcomes. For instance, do countries that improve their JTS (i.e., becoming more resource-efficient in social progress) subsequently show slower environmental degradation? Answering such questions would deepen our causal understanding and inform policy on the most effective levers for change.

Similarly, in the realm of climate change perception, future research can expand the multidimensional approach by integrating psychological and cultural variables more explicitly. There are opportunities to incorporate insights from behavioral science – for example, including measures of climate-related emotions (hope, fear) or cognitive biases in perception studies ([Linden 2015](#)). This could yield a more granular Climate Perception Index that captures not just factual awareness but also the motivational factors that drive action. Repeating the perception index over time (longitudinal surveys) would be valuable to track how public opinion shifts with events or policies, enabling researchers to evaluate the impact of climate communication strategies or education campaigns.

Interdisciplinary approaches will be crucial in all these future endeavors. Combining expertise from environmental science, economics, sociology, and psychology can lead to innovative methods – such as using systems modeling to link an economic wellbeing model with a climate model, or applying machine learning to fuse diverse datasets (e.g., linking remote-sensing environmental data with household survey well-being data). This could help address complex questions like how climate change impacts feed back into human wellbeing and perception, forming a sustainability loop.

Finally, translating improved metrics into policy application remains an ongoing priority. Future research should work closely with policymakers to integrate composite sustainability indices into decision-making frameworks. For instance, using the JTS or similar indicators to evaluate the sustainability of policy proposals (“sustainability impact assessments”), or adopting climate perception measures to tailor public engagement programs. Developing user-friendly dashboards or tools based on these indices can bridge the gap between academic research and practical governance, ensuring that the next generation of sustainability metrics directly inform strategic planning and international reporting (e.g., for the SDGs or national development plans).

In short, the path forward lies in refining measurement techniques, embracing new data and cross-disciplinary methods, and enhancing the real-world relevance of sustainability assessments. By doing so, future research can continue to advance the comprehensive, multi-dimensional understanding of sustainability that this thesis has begun – moving us closer to a world where high wellbeing, low environmental impact, and an engaged citizenry coalesce to define progress.

5 Conclusion

This chapter has brought together the key empirical and methodological insights developed across the thesis, with a focus on composite well-being measurement, environmental efficiency of social progress, and climate change perception. Together, these dimensions provide a multidimensional and policy-relevant framework for assessing sustainable development. The research demonstrates that while substantial improvements in social outcomes have been achieved globally, the challenge of aligning these gains with environmental sustainability and equitable climate engagement remains significant. By integrating methodological innovation with empirical analysis, the thesis advances

the field of sustainability measurement and offers new tools to evaluate how societies can transition toward more just and resilient development pathways.

The development of the JTS and CESP illustrates the need for refined sustainability metrics that go beyond GDP or conventional well-being indicators. These indices assess how efficiently countries convert environmental inputs into social outcomes, highlighting best-performing nations and identifying structural inefficiencies in high-income countries. Importantly, the CESP’s convergence analysis reveals uneven trajectories: while some lower-emitting nations are catching up, many middle-income countries remain trapped in inefficient patterns, underscoring the role of institutional, economic, and technological constraints. These findings emphasize the necessity of differentiated policy strategies that accommodate varying development stages and environmental burdens, while promoting convergence in sustainable outcomes.

In parallel, the thesis contributes to ongoing efforts to measure well-being in a conceptually sound and empirically rigorous way. Through time-varying weights and Bayesian latent variable modeling, the research demonstrates how composite indices can better reflect dynamic societal priorities and complex trade-offs between well-being components. When combined with analyses of public climate change perception, these approaches reveal that technical policy solutions must be coupled with social engagement and inclusive communication. The convergence of measurement innovation and empirical insight reaffirms the central argument of the thesis: that sustainable development must be approached holistically, accounting for environmental constraints, social equity, and public participation. This integrated perspective is critical for informing the next generation of sustainability metrics and guiding effective policy responses in a rapidly changing world.

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(v v” SUQ.-! o...Sv- v9µMSvU..v)...-! o...” µ3 gU...n oøo vX3 oU...rU9o' N.3 gUú...v-! ó ...o))v -*...
 SUM Xv g-SUQg..” Só '...gUQ.v)...vMg .Xó)v 3 gUM.3 o- SM'...! gøo.*X µUQµXNv)-oU.ó X' g*SiSUQ..
 -! oS ... i oúvU9...+n w ...Ug-µí o...xà-SQSü..o...g ZNí - WYZ.-! o*o...SUMµ9o...3 o- SM'...µM...g*...-! o...
 V QUSig-SvU..))v ...OMUv3 SM.<vvXó g-SvU..gU9...n oøo vX3 oU-*...I o-ó .../ So...rU9o' ..xVO<n N.
 í-í- YN.-! o...àvMg ..w vQo**...rU9o' ...xàvMg ..w vQo**...r3 Xó g-Son.í-í í gYN.-! o.../oQ-µ3 ...
 w v*Xó Sú...rU9o' ..x/oQ-µ3 ..rU*-Sµ-oNí-í ßYNgU9...3 v o... oMU-úNo))v -*...v...3 og*µí o...-! o...
 àµ*gUgi o.n oøo vX3 oU...+vg *.xà +*YNµM.g*...-! o.àn +*rU9o' .xàgM*.o-g ZNí -í í YZ.

...

G3 vUQ.-! o*o..o))v -*N.-! o...àvMg ..w vQo**...rU9o' *gU9*..vµ-...))v ...-” v...3 µ-µg ú... oS))v MUQ..
 ' og*vU...xWYg*.gUgXXS9..Xv SM...vv čxí Y.” S' .g..µUffio.*o-v)..9o*QUX SUMX o*Z.-! o.àvMg ...
 w vQo**...rU9o' NXµi S' o9..gUµg ú...i ú...-! o...àvMg ..w vQo**...r3 Xó g-SonNg**o**o...MµU- S* ...
 Xó)v 3 gUM.i ú...o úSUQ.vU.Xµi SMí.gøgSgi o.9g-g.*ví M*Z.-! o.rU9o' .ó3 Xvú*µUffio.9o*QU...

X SUMX o*.x9SMi**o9...g-ó .SU.9o-gSYN3 v*-Uv-gi ú...-! g-.S.vUú...g6o*.SU-v.gMμU-.*vMg .gU9...
oUo SvU3 oU-g .vμ-M3 o.SU9Mg-ý *N' ' SM.3 g6o.S...-! o.)S *-gøgSgi o.3 o- SMv).Xí o ú.*vMg ...
gU9..oUo SvU3 oU-g .g*XoM* .xGUUvUS..` .àM\$USNí -í í YZ...

...

àSUM.S*.)S *-Xμi Mg-SvU.SU.í -WN.-! o.rU9o' *.gXX vgM.gU9.3 o-! v9v vQí...! gø.o.i ooU.gXXS9...
i ú...Xv SM.3 g6ó *.vU..øg Sμ*...øo *.v)..g93 SUS- g-SvU.SU.9S)ó oU...Xg *-x.v)...! o..." v 9Z.-! o...
Oí vXogU.<v3 3 S**SvU.g9vX-o9...! o.àvMg .w vQo**rU9o' .)v ...! o.2 —àí "...oQSVU*.v)...! o.O—...
xGUUvUSo..g ZNí -Wč.GUUvUS..` .I v *SNí -í -Nn o.n v3 SUS*.o..g ZNí -í . YZr-! g*.i ooU.gXXS9...
)v ...! o.*-g-o*.v)..Gμ*- g Sg..x<oU- o.)v .àvMg .r3 XgMNUZ9ZN.-! o.X vøSUM*.v)..àvμ-! ..G) Mg...
xr0 i μ*Subo**Ní -WYN.-! gSgU9..xàg*SU.àMvv .v).t gUgQ3 oU-NUZ9ZNgU9.<v*g.á Mg.xrU*-Sμ-v...
<v*g- g' SMU*o..9o...-í S3 vNí -WYZà3 g ó ..g93 SUS- g-Søo..μUS*NoZ9Z.-! o... oQSVU.v)..7 v*SMN.
à vøg6Sg.xGμ-! v vU9vU*.I v vμQ .v).I g 6SUQgU9..n gQv g3 .x/I I n Ní -í í Y..! gøo...
g *v..μ*o9...! o.rU9o' Z.-! o.rU9o' ..S..g *v..SUMog*SUQú..μ*o9..SU.gMg9o3 SM. o*og MN*μM..g*.i ú...
w SMo—...xí -í í YN.V—gøSgUS..o...g Z.xí -í WN.<! g o*...` ...n G o\*\*Sv...xí -í -YN.V àμ SgU...` ...
7' gSv Uμ-! g*Subo.xí -WYNàú vø -6g...` .àM v**g o6.xí -WYNgU9..t g gú.xí -WYZ...

...

rU...! o.í -í í ..o9SSvU..xàvMg .w vQo**r3 Xó g-SøoNí -í í gYN.-! o.rU9o' ..SUMp9o9... -.*vMg .gU9...
oUo SvU3 oU-g .vμ-M3 o.SU9Mg-ý *.Møó SUQ.Wu..MμU- S*N*XgUUSUQ.W..úog *.xí -WYR-í í YZ..
“ ' So...-! S*.S..g...μ))SSU-ú...vUQ.Xó S9...-v.v))ó ..S*SQ *-vU.MμU- S*flMí oU...Xó)v 3 gUM...
gU9..vU.Qvi g .- oU9*NS.9vo*.Uv-.g v” .)v .gU.SU9oX' .μU9ó *gU9SUQv)...vUQ Ró 3 .*vMg-g ...
” o i oSUQZ.-! ó o)v oN.-! S*.XgXó .X o*oU*...! o.3 o-! v9v vQí..gU9..6oú..)SU9SUQ*.v)..g..Uvøo .gU9...
μUX oM9oU-o9..àvMg .w vQo**rU9o' .MμU- μMo9..)v .g.βWúog ...vUQXó S9.v)..Wu- R-í -NgU9...
SU.9vSUQ.*vNS..gS *-v.v.3 g6o...! o.)v v” SUQ.-! oo.MμU- S μ-SvU*m

...

(S*-úN.-! o...XgXó ...MμU- S μ-o*...-v...-! o...3 o-! v9v vQó*...μ*o9...)v ...MμU- μMSUQ..M3 Xv*Sø...
SU9Mg-ý *.x*oo...-! o.*μi *offμoU-.*oMSvU..)v .3 v o.9o-gS*.gi vμ-..M3 Xv*Sø..SU9Mg-ý *YZ.“ ' So...
-! o.rU9o' ..Qvó g ú..)v v” *..*-gU9g 9..3 o-! v9v vQvMg .gXX vgMo*..x*μ3 3 g Sio9..)v .o' g3 Xo...
SU.2 g 9v..o..g ZNí --1YNS*.Qvi g .Møó gQ.v).3 v o...! gU.W-..MμU- S*.vøó .βWúog *..” S' ..% ...
SU9Mg-ý *.. offμSø9...-gSv o9..gU9...o**..M3 3 vU..*v μ-SvU*N.” ' SM...Mμ 9...! gøo..g..Xv-oU-Sg ú...
í vg9ó .gXXMgi SS-úZà oMμU úN.-! o.XgXó .X vø9o*.g.MμU- S μ-SvU..v.9o)SSUQgU9..*v S9SúSUQ..
*vMg .X vQo**..g*.g'..o*og M..gU9..Xv SM..)S9Z.-! o.gXXMg-SvU.v)...! o.àvMg .w vQo**rU9o' ...
X SUMX o*.gU9.3 o-! v9v vQí..vøó .βWúog *...oX o*oU*.gU.μUX oM9oU-o9..o))v -v)...vUQ-μ9Sg ...
3 og*μi o3 oU..v)..*vMg .X vQo**vU.g..Qvi g .Mg oZ.-! S9 úN.-! o.XgXó .X vø9o*.S*SQ *-gU9..g...
Qog-ó .μU9ó *gU9SUQv)..*vMg .X vQo**vøó ...S o..)v ...! o..." v 9.g*g..." ' v o.gU9..)v .SU9S9μg ...
MμU- S*Z...

...

“ ' So...-! o...àvMg ...w vQo**rU9o' ...Wu- R-í -...)v v” *...gU...o*-gi S' o9...3 o-! v9v vQí...gU9...
gXX vgMo*.v).gU.o' S-SUQSU9o' NS.*' vμ 9.i o.Uv-o9...! g-.S.S.o**oU-Sg ú.g.Ub” .3 o- SMZ.“ ' So...
v-! ó ..g-o3 X*...-v... oXSMg-o...-! o.àvMg .w vQo**rU9o' ..3 o-! v9v vQí..gU9...X v9μM..*μM..g...

⁹ NUTS stands for Nomenclature of territorial units for statistics, which is a system for dividing up the territory of the European Union.

vUŠµ9Ug .g**o**3 oU-.g o.gMŮv” o9Q9.xwoS Rwg v3 SŮv..o-.g ZŇi - í ßYN-! o*o.o))v -*.9S)ó ...
SŮ..*oóó g .g*XoM*Z2 v-gi ún-! oú..MŮóó .)o” ó ..MµU- Š*.xWŮuYNvóó .g.*' v -ó .Xó Šv9..v)..Š o...
xWŮu%R- WYNgU9..µ*o..)o” ó ..S9Sg- v *x %Z...

...

—! o.XgXó .i oQŮ..” S' .g.MŮMX-µg .o*-gi Š' 3 oU-.v)..*vMg .X vQ o**g*.9o)Šb9.i ú-! o.àvMg ...
w vQ o**rU9o' Zr-.MŮ-SŮio*..v.9ŠMŮ**..SŮ9o-gS-! o.9g-g.gU9.3 o-! v9v vQŠg .MvŠM*..)v -! o...
MŮ*- µMSŮU..v)..! o.àvMg ..w vQ o**rU9o' ..WŮu- R- í - Zr-.MŮMµ9o*..” S' .g..9ŠMŮ**SŮU..v)..S*...
3 gSŮ.)S9SŮQ*.gU9..SŮ*ŠQ -*Z...

...

í n o)SŮSŮQ*vMg .X vQ o**...

rU. v 9ó ...v..o*-gi Š' .g..3 og*µí o3 oU..gXX vgMNS-..Š..UoM**g' ú...v..9o)Šb...” ' g-..MŮ*-Sµ-o*...
*vMg .X vQ o**..SŮ-! o..)S *-XgMZ:“ ' So.*MŮU-ŠSMŮU*oµ*vU..! o.9o)SŮSŮU..v)..*vMg .X vQ o**...
' g*.i ooU.9S)ŠMŮ -..v..)SŮ9.x“ o ũo .o-.g ZŇi - - ßYN-! o.Xv ŠMŮ.9Sg vQŮo..! g*.Xó ' gX*.gMŠoó9.3 v o...
*µi *-gU-Šo.o.vµ-MŮ3 o*Z:“ ' So-! o.à-SQS-ŮŇà oU.gU9..(S-vµ**S..oXv -..xà-SQS-ŮŇà-.g ZŇi - - uY9vo*...
Uv-..9o)Šb...*vMg .X vQ o**..Xó ..*oNS-..X vø9o*..g..µ*o)µ ..) g3 o” v 6..)v ..)µ -! ó ..o gi v g-SŮU.i ú...
µ3 3 g' ŠiSŮQ-! oo.óóú.MŮMX-µg .gXX vgMŮo..µ*o9...v.9o)Šb.gU9.3 og*µí o-! o.ſſµg S-ú.v)..Som
xWŮ.*µi ;oMSŮo..” o R oSŮQŇi Y-! o.Uv-SŮU.v)..MŮXgi SSŠ*NgU9.xſY-! o.Uv-SŮU.v)..)gS.g vMŮ-SŮU.Z.
(µí -! ó 3 v oNS-..X vXv*o*..oŠQ -..9S oU*SŮU*..v.i o..MŮ*9ó o9..*S µ -gUovµ* ú..” ' oU.g**o**SŮQ..
” o R oSŮQŇiSYt g-ó Šg ...ŠSŮQ*-gU9g 9*.xŠMŮ3 oNMŮµµ3 X-SŮU.gU9..” og -! Y.xŠSY..” og -! č.xŠSY..
O9µMŮ-SŮU-ŠxŠY.wó *vUg ..gMŠSŠ*..SŮMµ9SŮQ..” v 6č.xŠY.wv SŠMŮ..øvŠM.gU9..QŮó UgUMč.xŠSY..
àvMg ...MŮUoMŠvU*..gU9.. o g-SŮU* SX*-xŠSY.OŮŠvU3 oU-..xX o*oU-..gU9..)µ-µí o..MŮ9SŠvU*Y..
xøŠSY.rU*oMŮi S-úNv)..gU.oMŮUv3 ŠMg*..” o .g*.g.X' ú*ŠMŮ .Ug-µí oZ...

...

I g*o9..vU..! o*o..MŮMX-µg ..Q vµU9SŮQ-N-! o.àvMg ..w vQ o**..r3 Xó g-ŠoNg-..àR g*o9..Qvi g ...
-! ŠŮRgU6N*o-gi Š' o9...! o.àvMg ..w vQ o**..rU9o' N.” ' SM...9o)Šb...*vMg ..X vQ o**..g*... -! o...
MŮXgMŮú.v)..g..*vMŮ-ú...v..3 oo-! o.i g*SM' µ3 gU..Uoo9*..v)..S*..MŠSioU*No*-gi Š' ...! o.i µS9SŮQ..
i vMŮ*..! g-.g v” .MŠSioU*.gU9.MŮ3 3 µUSŠ*..v..oU' gUM.gU9..µ*-gSŮ-! o.ſſµg S-ú.v)..! oS ...Šo*N..
gU9..Mog-o-! o..MŮ9SŠvU*..)v ..g ..S9S9µg *..v...ogM-! oS ..)µ ..Xv-oU-Šg Z ...xwv -ó ..o-.g ZŇi.
í - WYZ-! Š*.9o)SŮSŮU.g µ9o*..v..! oo.í vg9..9S oU*SŮU*..v)..*vMg .X vQ o**m-! o.X vøŠSŮU.v)...
XovXo *I g*SM' µ3 gU.2 oo9*č.o*-gi Š' SŮQ-! o.(vµU9g-SŮU.v)..“ o i oSŮQ.)v .S9S9µg *.gU9...
MŮ3 3 µUSŠ*..v..µ*-gSŮ-! o.ſſµg S-ú.v)..! oS ...Šo*čgU9..VXXv -µUS-ú.)v .g .S9S9µg *..v...ogM..
-! oS ..)µ ..Xv-oU-Šg ZOgM..9S oU*SŮU.MŮU*..*..v)..)vµ .MŮ3 XvUoU*N” ' SM..g o..)µ -! ó ..9o)Šb9...
i ú..g..*o-..v)..S9Sg- v *..o*XvU9SŮQ-..v..MŮMX-µg ..ſſio*-SŮU*..! o..MŮ3 XvUoU*..*oo6...v..gU*” ó ...
x*oo.GUŮb' .n .SŮ-! o.vUSŮb.*µXX o3 oU-g' ú..)SoYZ:“ ' So.9o)gµ -ú..µ*o9..” S' .MµU- Š*... ” ' SM..
g' o.*-S -! o.3 v*-..MŮ3 3 vU..µUS-..v)..3 og*µí o3 oU-..xg*..SŮ-! Š*.XgXó Y.. -! o..g)v o3 oU-SŮb9...
9o)SŮSŮU..v)..*vMg .X vQ o**..! g*.i ooU.gXXŠ9-..v.øg' Šµ*...oóo *.v)..g93 SŮŠ- g-SŮU.xg*.g' og9ú...
* v” UYZ.

...

—! o.MŮ3 Xv*SSŮU.v)..! o.àvMg ..w vQ o**rU9o' .i µS9*.vU..! o.3 gUí.X' Sv*vX Š*.gU9-! vµQ -*...
-! g-! gø.o.i ooU..9oóo vXo9...gi vµ-! ” ' g-..MŮ*-Sµ-o*..! µ3 gU..” o R oSŮQZ.G3 vUQ-! o*oN-! o...

2 g-í g ..á SŁ -*...! óv ú...! g*.i ooU..)vμU9g-SvUg ...)v ..9o)SUSQ.gU9..MUMX-μg SiSUQ.-! o..àvMg ...
w vQo**..rU9o' ...) g3 o" v 6...xV àμ SgUN.í - WYZ.-! o..I g*SM." μ3 gU..2 oo9*...9S oU*SvU...S...
QvμU9o9..SU.S*.3 v g ..gU9..Xv SSmg ..X' Sv*vX' úN." ' SM...vμ- SOb*...! g-...)v ...! o..*XS Sμg ..." o R
i oSUQ.gU9..)μ)S 3 oU..v)! μ3 gU.Xv-oU-Sg NM -gSU..SŁ -*.*' vμ 9.i ó...o*XoMo9..g*.gi *v μ-o..)v ...
oθó ú...! μ3 gU.i oSUQo' Mx...v...! o.o' -oU...! g-...! oú.3 gú.SU) SUQ.vU...! ó...SŁ -*.v)..v-! ó *Z.-! o...
3 v*...i g*SM. SŁ -*...g o...! v*o... o g-o9...-v...*í øSg N." ' SM...S XSb*...-v... Sbo...SU...oMí SúN." S' ...
g9offμg-o.*' o-ó Nμ))SMU-..." g-ó .gU9..)vv9NgU9.i g*SM3 o9Smg .Mg o...v..i o.gi o...v...*í øSbo...v...
3 g-í S-ú.xö gU.n μ))o Ní - WYZrU...! o..(vμU9g-SvU..v)..“ o i oSUQ9S oU*SvUNV àμ SgU.xí - WY..
g *v... o)ó *...v...! o..2 g-í g ..á SŁ -*...! óv ú...!v ..i g*SM6Uv" o9QNgMM**..-v..SU)v 3 g-SvU.gU9...
oUoSvU3 oU-g .ffμg S-úZ" og -! .gU9.." o Uo**..S*NSU! S..øS" NgUMv o9..SU.g.μ-SSg SgU.øg μo...
;μ9Q3 oU..gi vμ-..." o RoSUZI í Q *..xí-í í Y.gU9..svUo..xí-í W..o' -oU9...! o..gXXSmg-SvU..v)..! o...
2 g-í g .. SŁ -*...! óv ú...-v..oUoSvU3 oU-g ..MUM UxZ...(Sg úN-! o..VXXv -μU-ú..9S oU*SvU..S...
gUMv o9..SU...! o...! vμQ -*.v)..sv' U./vMöN?" ' v.g. Qio9...! g-...! ó...SŁ -*...v...S ó-ú..g o.S- S*SM.
-v..! μ3 gUi oSUQ.N-! μ*)v 3 SŁ-! o.i g*SM.)v .SU9S9μg .) oo9v3 *.gU9.vXXv -μUSb*.SU.*vM-ú...
xö gU.n μ))o Ní - WYZ...

...

β àvMg ..w vQo**..rU9o' ..Wu- R- í - m9g-g.gU9.3 o-! v9v vQí...

—! S*..oMSvU.g99 o**o*...! o..9g-g.gU9.3 o-! v9v vQí..μ*o9..SU.MU- μMSUQ.-! o..àvMg ..w vQo**...
rU9o' ..Wu- R- í - N-! μ*.Mθó SUQβWíog *.v)..*vMg .X vQo**Zr-.X vø9o*.gUgMμU-..v)..! o.6oú...
Mg oUQ*..)v ..SU9Mg- v ..*o oMSvU.gU9..9SMí**o*.SU9o-gS..ogM..*-oX.v)..! o..Mg Mí g-SvUZ...

...

—! o..àvMg ..w vQo**..rU9o' ..S*.g..M3 Xv*Sö..SU9Mg- v Z.-! o..rU9o' ..S*.i μS-..i g*o9..vU...! o..àvMg ...
w vQo**..rU9o' ..*gU9g 9..) g3 o" v 6..gU9.3 o-! v9v vQí..xàvMg ..w vQo**..r3 Xö g-SöNí-í í YN.
gU9.)v v" *...! o.. gU9i vv6..vU.<vU- μMSUQ.<v3 Xv*Sö..rU9Mg- v *N." ' SM...gú*...! o..vμU9g-SvU...
)v ..MU- μMSUQ.M3 Xv*Sö..3 og*í o*.x2 g 9v..o-..g ZNí - -1YZ.“ ' So..ví .SU-oU-SvU..S*..-v..)v v" ...
-! o..*gU9g 9.3 o-! v9v vQí..." ' oUθó .Xv*S öN9oθo vXSUQgU.SU9o' .." S' .g.*SU9SMU-ú..vUQ ...
-S o..Mθó gQ...offμSo*.3 v9SMg-SvU..gU9..g9gX-g-SvU..*-o3 3 SŁ.) v3 ...! o..3 gUí..MUMX-μg ...
Mg oUQ*..9SMí**o9..i o v" Z.“ ' So...! o..i g*SM) g3 o" v 6..v)..! o..rU9o' ..S*.6oX-..SU-gM..SU..3 *...
v)..S*..Mf o.*- μMí oNSZNM3 XvUoU*.gU9.9S oU*SvU*NSU9Mg- v *..." ó o..*o Mo9.gU9.3 o-! v9*...
g9gX-o9...-v... o) oM...! o...vUQ-μ9Sg ..Ug-í o..v)..! o..oUSö..βWíog ..Xö S9ZrU...! S*..*oU*oN-! o...
X o*oU-o9..rU9o' ..*' vμ 9.i ó...oQg 9o9..g*.g..Lb" .3 o- SMv)..*vMg .X vQo**Z.

...

n g-g...

“ S' .3 v o...! gU.í - -..MμU- S*..g vμU9...! o..." v 9N" S' ..9S-SUM..MU-o' -*.gU9..Mí -í o*NgUí...
M3 Xg g-Sö.g**o**3 oU..o))v -..." S ..*oU-Sg ú..oUMμU-ó .9g-g.Mg oUQ*Zt v ovθó N-! o..Wu- R
í - í - Xö S9..." SOb*o9.3 gUí..*SU9SMU-! S- v Sg ..oθoU*..g*.9Só *o.g*...! o..Qvi g ..' XgU*SvU...
v)..9o3 vMgMí.g)-ó ...! o..g ..v)..! o...SvU.Mí -gSU N" g *.gU9...! ó...Sö..v)..! o..9Sg .." v 9Z.-! S*...
SU ó oU-ú..S XSb*..MUMX-μg ..3 og*í o3 oU...Mg oUQ*N." ' SM...MgU..i o...μ3 3 g Sio9..μU9ó ...
-! oo.í vg9ó .g*XoM*nl' ' g-..S.3 og*í o9.gU9...! v" č." ' g-..S..Uv-..3 og*í o9čgU9..." ' v.3 og*í o*Z.

....

rU...ó 3 *.v)... ' g-... ' o.rUo' ..3 og*í o*.gU... ' v" NS-...)v v" *-... ' o.6oú..9o*~~SU.X SUMX~~o*.v)... ' o...
àvM~~g~~ ..w vQo**rUo' m~~W~~r-..MU*9ó *.o' M~~u~~*So ú.*vM~~g~~ .gU...oU~~o~~SvU~~o~~ oU-g ..SUS~~g~~-v *N" ' SM...
g v" *)v ..g..3 v o... SQ~~g~~ v~~u~~*..gU...ú*o3 g-SMgU~~g~~ ú*(S..v)... ' o... o g-SvU* SX.i o-" ooU..oMUv3 SM.
9o~~o~~ vX3 oU...x3 og*í o9N.)v ..o' g3 XoNi ú...+n w...Xó ..M~~g~~XSgY.gU...*vM~~g~~ ..9o~~o~~ vX3 oU-Zw S' ...
o))v *-...v..3 v~~o~~o..i oúvU...+n w...! g~~o~~o..M3 3 SUQo9...*vM~~g~~ ..gU...oMUv3 SMSUS~~g~~-v *N3 g6SUQ.S...
9S)SM~~i~~ -...v..9SoU-gUQo... ' o..." v..9S~~g~~ oU*SvU*.v)..9o~~o~~ vX3 oU-Z- ' S*.*' v" *-... ' g-... ' o.rUo' ..S*.g...
- μo... oX o*oU-g-S~~o~~o..v)... ' o... I oúvU...+n w ...gQoUg..." ' SM... ' g*... Qg9μg ú...i oM3 o... ' o...
M U~~o~~ *vU~~o~~..v)..9o~~o~~ vX3 oU...3 o' SM...xà-SQSü..o...g ZNí - WYZxí Y... ' o.rUo' ..3 og*í o*... ' o...
v~~u~~-M3 o*... ' g-..3 g-ó ...v...XovXoNgU...Uv-... ' o.SUX~~u~~-*Z.(v ..o' g3 XoN- ' o.rUo' ..MU*9ó *...
3 o' SM... ' g-...g**o**...XovXofk... ' og - ' ...*g-μ*...gU...o9μM~~g~~-SvUg ...g-gS~~g~~ oU-N.gU...o' M~~u~~9o*...
SUS~~g~~-v *.μM...g*.ffigU-S~~o~~*.v)...Mvv *.gU... ' v*XSg *Zx~~g~~Y.G*... ' o.M~~o~~ó gQ..v)... ' o.rUo' ..S*...
Qvi g Ng ..SUS~~g~~-v *.Uo9...-v..i o... o o~~g~~U...-v...g ..xv ..Uo~~g~~ ú...g Y.μUS*.v)...vi *ó o~~g~~-SvUN~~SZ~~ZN.
M~~u~~U- S*Z(v ... ' S*...og*vUN*v3 o.*XoN)SMS*μo*.*μM..g*.3 g g S~~g~~.9og- ' *M~~g~~Uv-i o.SUM~~u~~9o9.g*...
- ' oú..9v..Uv-..g))oM..g ..M~~u~~U- S*Z." v" o~~o~~ó NSUS~~g~~-v *.g o..*o oMo9..M~~g~~ o)μ ú...v..oU*í o... ' o...
9S)ó oU..MUo- *-..g o..M~~g~~X-í o9NoZ~~Q~~N3 og*í SUQ.X o3 g-í o..9og- ' *) v3 ..UvUM3 3 μUS~~g~~i o...
9Sog*o*Z.x Y... ' o.rUo' ..S*...3 ogU...-v...X v~~o~~9o...o~~o~~9oUM...-v...S) v 3 ...9oM~~S~~vU...3 g6SUQ..gU...
g9o~~g~~UMSUQ*vM~~g~~ .X vQo**NgU... ' S*.S*.g *v...o) oMo9..SU... ' o..*o oMSvU.v).SUS~~g~~-v *Z...

...

- ' o.rUo' ..vUú..MU*9ó *...o Sgi o..gU...Mo9S o..SUS~~g~~-v *-... ' g-..g o..g*..M3 Xo-o..g*..Xv**S o...
gU...v))ó .gU.vi ;oMS~~o~~.gM~~u~~U-..v)... ' o.Xó S9ZrU9S~~g~~-v *.g o..*o oMo9..vUú.S)... ' oú.g o.3 og*í o9...
" o N" S' ..MU*S-oU...3 o- ' v9v vQ~~i~~Ni ú... ' o..*g3 o..v QgUSig-SvU.gU...gMv**..g ..xv ..o**oU-S~~g~~ ú...
g Y.M~~u~~U- S*..SU... ' o..*g3 XoZ... ' o*o..X SUMX o*..oU*í o..MU*S-oUM...SU.3 og*í o3 oU...gMv**...
M~~u~~U- S*ZOgM.SUS~~g~~-v ..S*.o~~g~~g μg-o9...v..oU*í o... ' g-..S.3 oo-*... ' o*o.ffig S-ú.MSó S~~g~~.gU... ' g-...
S..M~~g~~X-í o*..." ' g-..S..X~~u~~ Xv *-...v..M~~g~~X-í oZrU...-v-g N% ..SUS~~g~~-v *) v3 ..W..9g-g..*v~~u~~ M*..." ó o...
μ*o9...v..MU* μM... ' o.àvM~~g~~ ..w vQo**rUo' ..Wu- R-í - NgU.g..))í - ' ó ..W..μ~~u~~XXv -S~~o~~o.SUS~~g~~-v *...
" ó o..μ*o9...-v..M~~g~~ M~~u~~ g-o..Uo" ..SUS~~g~~-v *.gU...S X~~u~~-o.3 S*SUQ.o~~g~~ μo*..x9SM~~u~~**o9..i o v" YZ... ' o...
rUo' ..) g3 o" v 6..S*.M~~g~~X-í o9..SU.(SQ~~i~~ o..YZn o-gSo9..S) v 3 g-SvU..v) .g ..SUS~~g~~-v *.xSUM~~u~~9SUQ..
- ' o.μ~~u~~XXv -S~~o~~o.vUo*YS*.SUM~~u~~9o9..SU.GUo' .G.gU...GUo' .I N.o*XoMS~~o~~ úNSU... ' o.μ~~u~~XXo3 oU-g ú...
)SoZ.

...

n o*XS o..v~~u~~ ..i o*-..o))v *-N3 gUú..MSS~~g~~ ..*vM~~g~~-g ..MUM U*..g o..Uv-..9SoM ú..3 og*í o9..i ú... ' o...
rUo' NgU...*v3 o.g o.vU ú..3 og*í o9..." v~~u~~Q .S Xó)oM.X v' S*Zt oU-g !.og - ' N- ' o...SQ -*.gU...
) oo9v3 *.v).. / +I -0 rz ..M3 3 μUS~~o~~*Ng*..." o ..g*... ' o...SQ -*.v)..3 SQgU*..gU...v- ' ó .3 S~~u~~v S~~o~~*...
g o.;μ*-g..o" ..o' g3 Xo*.v)..μM..S*μo*... ' g-..g o..S~~u~~μ))SM~~u~~-ú.g99 o**o9Z- ' S*.S*.X~~g~~ -ú.9μo..v...
- ' o..gM~~u~~.v).Qvi g NM3 X~~g~~ g-S~~o~~o.3 o' SMN" ' SM.3 oo-... ' o.gi v~~o~~o.MSó S~~g~~..v) ..SUS~~g~~-v ..*o oMSvUZ...

...

á o' v*XoMS~~o~~.3 og*í o3 oU-g *v.3 ogU-... ' g-..." o! g9...v..)gM.9S)SM~~i~~ -...g9ov))*..SU... ' o.SUS~~g~~-v ...
*o oMSvU..X vM**Z." o..gM~~u~~v" o9Qo... ' g-... ' o.rUo' ..S*..gUM v o9..SU... ' o..X o*oU-N.9o)SUSQ..
' S*-v S~~g~~ ...3 og*í o3 oU-... ' o' v*XoMS~~o~~ úZ... ' S*..S*..i o*-...9o3 vU*-g-o9...SU... ' o...GM~~u~~*...-v...
rU) v 3 g-SvU.gU...<v3 3 μUS~~g~~-SvU..M3 XvUoU..." ' ó o... ' o..MUMX-μg ..gXX vgM... o) oM*... ' o...

Mí' oU..Xó S9..v)..SU-ó Uo..gMm*.gU9..3 vi So..9oøSm*.i µ-..MU*9ó *... ' o..Xg*...-' vµQ ..gMm*...
-v...gU9 Súb*Z.

...

(SQWavMg ..w vQo**rU9o' ..Wu- R-í - NSU9Mg-ý *) g3 o'' v 6...

Basic Human Needs	Foundations of Wellbeing	Opportunity
Nutrition and Basic Medical Care Deaths from infectious diseases Child mortality Child stunting Maternal mortality Nutritional deficiencies Diet low in fruits and vegetables Water and Sanitation Improved sanitation Improved water source No access to a handwashing facility Deaths from unsafe water, sanitation and hygiene Shelter Deaths from household air pollution Access to electricity Prevalence of cooking with coal/biomass Personal Safety Interpersonal violence Deaths from road injuries Political killings and torture Intimate partner violence against women Political violence	Access to Basic Knowledge Population with no education Equal access to quality education Gender parity in basic education Mean years of schooling Access to information and Communications Internet users Mobile and landline telephone subscriptions Alternative sources of information Health and Wellness Life expectancy at 60 Premature deaths from non-communicable diseases Equal access to quality healthcare Universal health coverage Environmental Quality Deaths from outdoor air pollution Deaths from lead exposure Particulate matter (2.5) pollution Species protection	Personal Rights Access to justice Freedom of religion Political rights Property rights for women Freedom of assembly Freedom of discussion Personal Freedom and Choice Satisfied demand for contraception Public sector corruption Early marriage Vulnerable employment Freedom of domestic movement Inclusiveness Equal protection of social groups Equal access to power Power distributed by sexual orientation Access to public services distributed by social group Access to Advanced Education Respect for academic freedom Population with advanced education Years of tertiary schooling Gender parity in advanced education

...

àvµí Mngµ-' v *Z2 v-oní' o.X vø9o..µi .9o)SSSVU*.v).SU9Mg-ý *.xGUUó' ..GYgU9..µi .Mg-SvU*...
v)..9g-g..*vµí M*.xGUUó' ..<Y.SU..-' o..vUSú..µiXXo3 oU-é ú..)SoZ...

...

—' o..ffµo*-SvU.v)... ' ' v..3 og*µi o* ..MgU..*SUSSMgU-ú..g))oM...-' o... SQý ..gU9..vi ;oMSóS-ú..v)..9g-gZ..
“ ' So..” o..! gøo..*’ SþoU..v..MU*9ó ...-' o..S XS\$..i \$*..v).gUú..SU9Mg-ý ..*vµí MNgU9..MU*- µM.g...
M3 i SÚg-SvU.v).SU9Mg-ý *..-' g-..” vµ 9..o S SÚg-o..-' o..S) µoUM.v)..µiM..i \$*..v..X vø9o.g...vi µ*-...
gU9...M3 X o' oU\$þo...g**o**3 oU-...v)..ogM...MUMX-N..-' S*..v)-oU...X vøo9...9S)SMi -...9µo...v...-' o...
µUgøgSgi SS-ú..v)..9g-gZàv3 o..M3 XvUoU-*..! gøo..i ooU.g))oMo9..3 v o...! gU.v-' ó *Z..-' S..S*..-' o...
Mg*o..SU..-' o..VXXý -µUS-ú..9S oU*SvU.gU9..o*XoMg ú..SU..-' o..wó *vUg ..á SQ -*.gU9..rUMµi*SþoUo**...
M3 XvUoU-*N” ' SM..X o9v3 SÚgU-ú..o ú..vU..-' o..ð é S-S*..v)..n o3 vMgMµi.9g-g*o-Z.“ ' So..-' o*o...
i \$*o*..! gøo..i ooU..! SQ SQ -o9'...oMU-ú..x/S- o.. t oUQN-í . YN” o.é o..MU)9oU-...-' g-...-' oú..! gøo...
vUú..g...3 SS g ..o))oM..vU..-' o...MUMX-µg ...øg SþS-ú..v)..-' o...3 og*µi o3 oU-...gU9...é o...*S ...g...
3 ogUSUQµi .g**o**3 oU-..v)..*vMg ..X vQo**No*XoMg ú..” ' oU.gQQoQg-o9..” S' ..v-' ó .3 o- SMZ...

...

rU..-' o... SQ -..v)..-' o*o..Mg oUQ*N” o..é Qio...-' g-..MU*- µMSUQ.g...M3 Xv*So..SU9Mg-ý ...S*..gU..
gXX vX \$-o.gXX vgMNg*.S..oUgi o*.M3 X o' N3 µ -S9S oU*SvUg ..S*µo*..v..i o..µi3 3 é Sio9..SU-v...
g..*SUQo.3 o- SM' g-..S..og*Sþ ..v..SU-ó X o-..gU9..M3 Xé o.gMv**..MµU- S*..” ' So.g *v..! é Uo**SUQ..
-' o..Xv” ó ..v)..øé Sµi*.3 o- v9v vQSMg ..gXX vgMo*..-' g-...S S-...-' o..S) µoUM.v)..9Só *o..Mµi -µi g ...
gU9..! S-ý SÚg ..MU-o' -*Z.

...

“ o.gMŮv” o9Qo-’ g-...’ o*o.Mg oUQ*...! g9.g.9SoM.SU) μoUM.vU-’ o.SU9SŮ-’v ..*o oMSvUNgU9...
 -’ μ*..vU.9o)SU9Q-’ o.MUMX-..v)...*vMg ...X vQo**Ng*...” o ..g*..vU-’ o.3 og*í o3 oU-..Mg oUQ*...
 x9SŮM**o9.i o v” YgU9N-’ ó o)ý oNgUú.SU-ó X o-g-SvU.v)...’ ó...o*μ -*.*’ vμ 9’...o) oM-’ SŮZ...

....
 ...
 t o-’ v9v vQí...

—’ ó o..g o..*oó g ..MŮ o..*oX*...)v ..Mg MŮ g-SUQ-’ o..àvMg ..w vQo**..rU9o’ ..Wu- í-í-...’ g-..g o...
 9SŮM**o9..SU9o-gSZ-’ o*o.*oX*.g o.X oM9o9.í ú...’ o.gMμg .9g-g.MŮ oMSvU.)v ..ogM..SU9SŮμg ...
 SU9SŮ-’ Z-’ o.9g-g.MŮ oMSvU.X vM**..v v” *..’ o.gi vooB3 oU-SvU9..ffμg S-ú.MSó Sg.i μ-..g *v...
 ‘ offμSo*..MŮ -gSU.X vM9μ o*..v)..9g-g.3 gUgQ3 oU-..xozZNMμU-’ ú..M9SUQúoó .g SŮB3 oU-YgU9...
 MogUSUQ.9μo-..v-’ o.og S-ú.v)..*vμ M*Z-—USo-’ o.gUμg ..àvMg ..w vQo**..rU9o’ N” ‘ ó o-’ o...
 g**o**3 oU-..S*..gQQ9..í ú..vUo..x’ ...’ v..úoó *N-’ o..Wu- í-í-..rU9o’ ..S*.X oNso ú..g SŮb9NμUo**...
 -’ ó o...” ó o.S*μo*...” S-’ ..9g-g.gogSgi SS-ú..x9SŮM**o9...g-ó YZ-’ o.9g-g.MŮ oMSvU-..vv6..XgM.SU...
 í-í WgU9.í-í í Zàv3 o.v)...’ o.9g-g.X vø9ó *..! gøo.*SUM.Xμi S-’ o9..Uo” ..9g-g..xozZNMó g S-S*..v)...
 n o3 vMgMŮN” ‘ So.v-’ ó ..*vμ M*...ó- gMo9.X oøSvμ*ú..Xμi S-’ o9..SU)ý 3 g-SvU.xVμ ...’ v 9.rU...
 n g-gY^wZ...

...
 VUM...-’ o..μ) ..9g-g*o-..S*..o*-gi S-’ o9N-’ o..MŮ o..Mg MŮ g-SvU.3 o-’ v9v vQí..S*..g*..v v” *mW...
 Mg MŮ g-SUQ.SU9SŮ-’ *.9ó Sbo9..) v3 .3 v o-’ gU.vUo..x SŮg ..SU9SŮ-’ Ní Y.g99 o**SUQ.3 S*SUQ..
 øg μo*NBY-’ og-SUQvμ- S *gU9..! SŮ ú..*6o” o9..SU9SŮ-’ *.. Yø*-gi S-’ SUQi o*-RgU9...” v *-Rg*o...
 *MŮg S*v.N. %Λ.. Sbo -SUQ.. SU9SŮ-’ *N” Y.. Mg MŮ g-SUQ.. M3 XvUoU-... *MŮ o*N. ° Y.. gQQ oQg-SUQ..
 M3 XvUoU-*.gU9.9S oU*SvU*..v.vøó g ..àvMg ..w vQo**..rU9o’ ..MŮ o*NlY-..o*-SUQ.)v ..*-g-S-SŮg ...
 øg 9S-ú.gU9..uYMU9μMSUQ.. vi μ*-Uo**..MoM*Z.

...
 W rU9SŮ-’ ..Mg MŮ g-SvU..
 —’ ó o..g o..*S ..SU9SŮ-’ *..’ g-..g o..*XoMSŮ ú..Mog-o9...v) ..’ o..rU9o’ ...-v..gMSboo-’ o..i o*-...
 MUMX-μg ..gU9..*g-S-SŮg ..)SZG)-ó ...’ o..Mg MŮ g-SvU-’ o..SU9SŮ-’ *.g o..SUMμ9o9..SU-’ o..)Sg ...
 S-..v)..SU9SŮ-’ *.g*.*’ v” U.SU..(SŮí o..VZ.

...
 xWn S-... v” ..SU.) μS*.gU9..øoQ-gi o*..” g*.MU-’ μMo9..μ*SUQ.g.*S X o..gøó gQo.i g*o9..vU...
 -” v..SU9SŮμg ..SU9SŮ-’ *.3 og*í SUQ.9S-...v” ..SU.xSY.) μS*.gU9..xSYøoQ-gi o*ZI v-’ ...
 SU9SŮ-’ *..M3 o..v) v3 ...’ o..*g3 o..*vμ M...x+ vi g ..I μ 9oU..v)...n Sog*o...<v gi v g-Sbo...
 2 o-” v 6Ní-í-gYgU9.g o.3 og*í o9..vU-’ o.*g3 o.*Mg oZ.

...
 xí Yt vi So..gU9...gU9 Sb...-o oX’ vUo...μi *MSX-SvU*.gQQ oQg-o*..i v-’ ...gU9 Sb..gU9..3 vi So...
 *μi *MSX-SvU*..xXó ..W- ..XvXμ g-SvUč...” v 9..I gU6Ní-í í Y-..v’...o) oM-’ o-..oMŮv vQŮg ...
 oøv μ-SvU...” S-’ SU-’ o.3 og*í o3 oU-..Xó Sv9Z-’ S*.3 o-’ v9..v)..SUMμ*SvU...” g*..X o)ó’ o9N..
 SU*-og9..v)..MU*9ó SUQ-’ o...” v..SU9SŮ-’ *.Xó g-o úNv ..vUú...o úSUQvU.3 vi So.X’ vUo...
 *μi *MSX-SvU*N-..v..gMμU-..v) ...’ ó...og S-ú-’ g-...gU9 Sb*...” ó o-’ o..X oøgSSUQ.Xμi SŮí...

¹⁰ The Varieties of Democracy have since published a new edition of its dataset. Our World in Data no longer publishes the Access to electricity indicator with its 1990-2016 timeseries.

gM**S o.3 v9o.v)...o oX' vUo.M3 3 μSM-S'U.SU.-' o.SUSg .9oM9o.v)...' o.3 og*í o3 oU...
Xó S'9Z.-' o...)Sg ..S9SM-ý ..S*.-' o..." oSQ -o9..gðó gQ.v)... gU9 SUb..gU9..3 vi So..X' vUo...
*μi *MSX-S'U*..Xó ..W- ..XvXμ g-S'UN." ' ó o...-' o..." oSQ -*.g o..gXXS9..MμU-ó Rg g o ú...
vðó ...)SoRoó ..Xó S'9*...-v... o) oM...-' o...xμUgøgSgi SS-ú.v)...-' o...ó øSM..SU.-' o...)v v" SUQ..
3 gUó m..

- Wu- RWu. mW- y ..." oSQ -.)ý ...gU9 SUb*N- y ..." oSQ -.)ý .3 vi So..X' vUo...
- Wu%Wuuml- y ..." oSQ -.)ý ...gU9 SUb*N- y ..." oSQ -.)ý .3 vi So..X' vUo...
- í --- R - - . m - y ..." oSQ -.)ý ...gU9 SUb*N- y ..." oSQ -.)ý .3 vi So..X' vUo...
- í - - %R - - um - y ..." oSQ -.)ý ...gU9 SUb*N- y ..." oSQ -.)ý .3 vi So..X' vUo...
- í - WR - Wmí - y ..." oSQ -.)ý ...gU9 SUb*Nl- y ..." oSQ -.)ý .3 vi So..X' vUo...
- í - WR - í - m - y ..." oSQ -.)ý ...gU9 SUb*NW- y ..." oSQ -.)ý .3 vi So..X' vUo....

...

xBNY.+oU9ó ..Xg S-ú..SU.i g*SMo9μMg-S'UNgU9...+oU9ó ..Xg S-ú..SU.-ó -g ú.o9μMg-S'Ug o...
Mg Mμ g-o9...-v... o) oM...-' o..offμg S-ú..i o-" ooU..i vú*..gU9..CS *.SU..g..3 ý o..QU9ó Rbμ- g ...
)g*! S'UZ.-' o.S9SM-ý *.g o.. gU*)ý 3 o9...v.ó' X o**...-' o.gi *v μ-o.9S*-gUM.) v3 .WV' ' ó o...
W. oX o*oU*..gU..offμg ..Uμ3 i ó ..v)...CS *.gU9..i vú*..oU v o9Z." ' So..SU..3 v*...MμU- S*N..
3 ý o..i vú*..g o..oU v o9..SU.o9μMg-S'U.-' gU.CS *N.-' ó o.g o..MμU- S*NgU9...-' S*- oU9.S*...
3 ý o..øø9oU-..vðó ...S o..gU9..SU..oMU-úoó *NSU..." ' SM...-' o..vXXv*S o..S*- μoZ.-' ó o)ý oN..
-' o.gi *v μ-o.9S*-gUM.) v3 ..WS*..μo9...-v..gMUv" o9Q...-' o..gM.v)...Xg S-ú..ý .i v- ' .i vú*...
gU9..CS *.gMv**..MμU- S*Z..

...

x%NY.w vXv -S'U.v)..XvXμ g-S'U.." S' ..Lv..o9μMg-S'UgU9...w vXv -S'U.v)..XvXμ g-S'U.." S' ...
g9øgUM9.o9μMg-S'U..." ó o..ogM.Mg Mμ g-o9..g*..XvXμ g-S'UR' oSQ -o9..gðó gQ.v)...' o.*g3 o...
S9SM-ý ..)ý .3 g o*..gU9...)o3 g o*ZG ..S9SM-ý ..M3 o..) v3 ...-' o.*g3 o.*vμi M..x+ vi g ...
I μ 9oU..v)...n S*og*o...<v gi ý g-S'o..2 o-" ý 6Ní -í -i Y.gU9...g o..3 og*í o9..vU...-' o.*g3 o...
*Mg oZ..

...

í Y t S*SUQøg μo*....

—' o.3 o- ' v9v vQí..*- S'o*...-v..oU*í o...-' g-..g ..S9SM-ý *.SUMp9o9..SU.-' o..àvMg ..w vQo**..rU9o' ...
Wiu- í -í - .g o.3 S*SUQg*..)o" ..vi *ó øg-S'U*..g*..Xv**S o...-v..gøv9...;ovXg 9SiSUQ.-' o..MUMX-μg ...
ffμg S-ú..v)...-' o.rU9o' Z." v" øó N" ' oU.3 og*í SUQ.% ..S9SM-ý *.vðó ..ßWúoó *)ý .3 ý o...-' gU..
W- ..MμU- S*NS..S*..SubøSgi o...-' g-..*v3 o..S9SM-ý *..." S ...! gðo.3 S*SUQ.vi *ó øg-S'U*..oS' ó ..)ý ...
*v3 o..MμU- S*N)ý ..*v3 o..Xó S'9*..v)...S oNý ..g..3 S ..v)...i v- ' Zt S*SUQøg μo*..MgU*..o3 ..) v3 ...
-' o...gM.v)...Mðó gQ..i ú...-' o..9g-g*..*vμi MNg*..." o ..g*..SUM3 X o-o... oXv -SUQ.i ú..g..MμU- ú...-v...
SU-ó Ug-S'Ug ..ý QgUSig-S'U*Z...

...

—' o...- og-3 oU...v)...3 S*SUQøg μo*..9oXoU9*...vU...-' o..vðó g ..3 o- ' v9v vQí..v)...gUí..M3 Xv*So...
S9SM-ý Z.-' o..S Xμ-g-S'U..3 o- ' v9*...gUQ..) v3 ..*S X o...μU- og-3 oU- NSZ9S* oQg 9SUQ.-' o...
3 S*SUQøg μo*N..v... SQ ú..M3 X o' .gU9...oMUMg ..*g-S*SM .o*S g-o*Z.-' o.3 ý o..M3 X o' ...-' o...
S Xμ-g-S'U..X vM9μi o..S*N.-' o...o**..μU9ó *gU9gi o..S*...-' o.rU9o' ..)ý ..g..." 9ó ..gμ9SUMN" ' So...
*S X o..*v μ-S'U*..3 SQ -..X vø9o..g.3 S*og9SUQo*-S g-oZ...

...

....

—' o.rUo' .gXXS*.g.M3 i Sg-SvU.v).gXX vgMo*.i g*o9.vU.g.Mg o)µ .MUs9ó g-SvU.v).ogM.Mg*oZ.
+oUó g ún-' ó o.ég o..” v..MUG Sv*..” ' oU.9g-g.XvSU*..ég o.3 S*SUQZrU..’ o.)S*..Mg*oNg.MµU- ú...
gM*.v3 oNlv-.g NSU9Sg-’v .9g-g..” S' SU..’ o.o’ g3 Svb9...S o..Xó Sv9ZrU..’ o..*MU9..Mg*oNg...
MµU- ú..9vo*.Uv-..’ gðo..gUú..xS6ZNS..3 S*SUQ.g Y.9g-g..XvSU*..v)..gU..SU9Sg-’v ZOgM..MUG Sv...
‘ offµSo*.g..9S)ó oU..gXX vgMZrU..’ o.)S*..Mg*oN.” ' oU.g.MµU- ú..S..3 S*SUQ*.v3 o.9g-g..XvSU*...
v)..gU..SU9Sg-’v N9oXoU9SUQ.vU..” ' oU..SU..’ o..βVñog ...vUQ.Xó Sv9...’ o..øg µo..S..3 S*SUQN..” v...
3 o-’ v9*..ég o..gXXS9mSY.G...)µ-µi o..v’ ..’ S-’v Sg ..øg µo..S..Mg’ S9..i gM...v’ ..)v’ ” g 9..x)v’ ..’ o...
3 g’ S µ3 .v)..%MU*oMµ-Sbo.úog *Y.9.g..9g-g..XvSU..S..3 S*SUQg-..’ o.i oQUSUQN’v .g-..’ o.oU9...
v)..’ o..S oRó S*^WCSY..+gX*.i o-” ooU.úog *ég o.S Xµ-o9.i ú.gXXúSUQ.Sbóg .SU-ó Xv g-SvU.x)v’ ...
-’ o.3 g’ S µ3 .v)..W..MU*oMµ-Sbo.úog *YZ..’ S..oU*µi o*..*3 vv-’ ..úog RvRñog ..o-S g-o*.i g*o9...
vU.Mµ’ oU..gU9..’ S-’v Sg .9g-gNgU9.i ú.g**µ3 SUQ.Sbóg .MgUQZr).9g-g.ég o.3 S*SUQ.)v’ ..vUQ ...
Xó Sv9*N. oQo**SvU..X o9SMSvU*..ég o..µ*o9...-v...Mg Mµ g-o...’ o..3 S*SUQ..øg µo*Z.r)..’ oQo**SvU..
S Xµ-g-SvU*.9v..Uv-.g SU..” S' .gøgSgi o.9g-g..XvSU*..N)v’ ..’ o.o’ -’ gXv g-SvU.gU9..SU-ó Xv g-SvUN..
-’ o.3 o-’ v9v vQí.gXXS*..’ ó..oQo**SvU..’ oU9...’ g-.S..gUMv’ o9..SU..’ o.vi *ó øo9.øg µo*Z.

...

—' o..*MU9..MUG Sv.µ*o*...oQo**SvU.X o9SMSvU*..v..S Xµ-o.3 S*SUQøg µo*..)v’ .SU9Sg-’v *..’ g-...
gM.g .vi *ó øg-SvU*..)v’ .g.MµU- úZ..’ ó..oQo**SvU.3 o-’ v9’...o S*.vU.g .SU9Sg-’v *..” S' SU..’ o...
‘ o*XoMSbo.M3 XvUoU-..v..o*-S g-o..’ o.3 S*SUQøg µo*Z..’ o.SU9Sg-’v ..” S' .3 S*SUQ9g-g..XvSU*...
S*.X o9SMo9..µ*SUQ.g .v-’ ó ..SU9Sg-’v *) v3 ..’ o.. o*XoMSbo..M3 XvUoU-..g*.X o9SMv’ *Z..’ S*...
gXX vgM..S..QÜ g ú..gXXS9..vUú..)v’ .MµU- S*..’ g-..’ gðo.3 S*SUQøg µo*..)v’ ..Uv.3 v’ o..’ gU..
vUo...SU9Sg-’v ...Xó ...M3 XvUoU-Z..” v” oðó N..’ ó o..ég o..-” v...Uv-gi o..o’ Mx-SvU*č..GMó*...-v...
o oM S^Sú..gU9...-ó -S^S ú..*Mvv ...Sbo.o’ XoMgUM..SU9Sg-’v *Z..’ o*o.o’ Mx-SvU*..ég o.g v” o9..SU..
v’ 9ó ...v..SUMµ9o.3 v’ o..MµU- S*..SU..’ o..)Sg ..’ gU6SUQZ-..v..S Xµ-o..’ o.3 S*SUQøg µo*..’ o...
3 o-’ v9v vQí.)S*-µ*o*..µXXv’ -Sbo.SU9Sg-’v *.x S*-o9..SU.GUÜ’ .I .SU..’ o.vUSbo..µXXo3 oU-úg ú...
)SoYN.” ' SM..M’ o g-o..’ SQ ú..” S' ..’ o..SU9Sg-’v ..SU.ffiµo*-SvU.gU9..MgU..’ ó o)v’ o.gXX v’ S g-o...
-’ o..3 S*SUQ..9g-g..” S' ...i o-ó ...X oMSvU..’ gU..v-’ ó ..SU9Sg-’v *Z.VUú..g)-ó ...’ S*... X oR
S Xµ-g-SvUg ...*oX..S*..’ o.ó o*-..v)..’ o..3 S*SUQøg µo*..Mg Mµ g-o9...’ vµQ ...’ o..*gU9g 9...
M3 XvUoU-R g*o9’...oQo**SvUZ...

...

rU.g99SSvUN..’ ó o.ég o.g..)o” ..Mg*o*..’ g-..’ offµSo.g..3 v’ o.µUMUøoU-SvUg .gXX vgMZ..’ o.rUo’ ...
SUMµ9o*..g..)µ .rUo’ ..*M oN. gU6*.gU9’..o g-Sbo.Xó)v’ 3 gUM..)v’ ..’ o..” o*-..I gU6.gU9...+gügZ..
àv3 o.SU9Sg-’v *.vµi M*.X vø9o.9g-g..)v’ ..’ o..” o*-..I gU6.gU9...+gügN.” ' So.v-’ ó *.X vø9o.9g-g...
oXg g-o ú..)v’ ..’ o..” o-..I gU6.gU9..)v’ ..+gügZrU..’ o*o.Mg*o*NSU9Sg-’v ..øg µo*..ég o.Mg Mµ g-o9...
g*.g..XvXµ g-SvUR’ oSQ -o9..gðó gQ...v.vi -gSU.vUo..9g-g..XvSU..)v’ ..’ o..” ' v o.oU-S-ún.” ' SM..S*...
-’ oU.µ*o9..SU..’ o..vøó g .rUo’ .Mg Mµ g-SvUZàS Sg ún-v..’ gðo.g..)µ .rUo’ ..*M o..)v’ ..àó i SgN..
‘ g” ..øg µo*..v)..rU-ó Uo-..µ*ó *.xvøó ...Wiu-R--βY.gU9..i v-’ ..t vi So..gU9../gU9 Svbo-o oX vUo...
*µi *MSX-SvU*..xg *v...vøó ...Wiu-R--βY..ég o..S Xµ-o9...g*...gðó gQ*..v)..MµU- S*..v)..)v’ 3 ó ...
š µQ* gøSg.xS6ZNa vøoUSgN< vg-SgN2 v-’ ó U.t gM9vUSgNI v*USg.gU9...” ó üoQvøSgYZ.

¹¹ The IHME Covariates dataset is available from 1980 to 2019, in this case the entire time series is shifted by one year (i.e., 1989-2019 is used for 1990-2020).

...

BY.Vμ-Š ː og-3 oU.gU9.g-g-ː gU*) 3 g-SvU..

“ ' oU.MUː μMSUQg.M3 Xv*So.SU9Sg-ː v NSU.gU.Sog .Mg*oN-ː o.μU9ó úSUQSUSg-ː v *..! gðo.g...
Uog ː.Uv 3 g ː9Sː S μ-SvUZ-ː! Sː.Sː.M3 3 vUú.3 og*ıı o9..i ú-ː! o..*6o” Uo**..gU9..6ı -v*Sː-o*Z..
" v” oðó N9g-g.ğ o.v)-oU.Uv-ː.Uv 3 g ú.9Sː S μ-o9NgU9.SUMı9o.o’ ː o3 o.øg μo*NS6Zvμ-Š *Z..
I v-ː! ..Mg*o..ː offıS o..ː og-3 oU-ː.SU.ːv 9ó ː.Uv-ː-v..9Sː-ː v -ː-ː! o..)Sg ː.3 og*ıı o3 oU-Z-ː! ó o..Sː.g...
Xo-ː ː g...v)...oMUSffıo*..-v...9og ...” S’ ː..vμ-Š *..gU9..S Xó)oM..9Sː S μ-SvU*Z.“ Sːv Sig-SvU..
3 o-ː v9*..ğ o.M3 3 vUú..μ*o9...v..MgX.gU.vμ-ː úSUQ.øg μo.i úː..oXgMUQ.S...” S’ ː.g...v” ó ː.øg μoZ..
-ː! o.gXXSg-SvU.gXX vgMo*..gUQ.) v3 ː.S Xú.μ*SUQ-ː! o..Uo’ -ː! SQ o*é v” o*-øg μo.xàgSgUg...
o-ː.g ZNı-WYː-v..3 ː v o.g9øgUM9 ː..μM ː.g*..vUoB9o9...” Sːv Sig-SvU.x<’ g3 i ó *..o-ː.g ZNı---Yː..
rU9Sg-ː v *..” S’ ː! SQ ː*6o” Uo**..ğ o.v)-oU-ː og-o9...” S’ ː..vQ S’ 3 SM- gU*) 3 g-SvUZ" v” oðó N..
vQ S’ 3 SM- gU*) 3 g-SvU.Uo9*..-v..i o.gXXS9...” S’ ː.o’ ː o3 o.Mμ-SvU.g*..S..MgU.9Sː-ː v -ː-ː! o...
9g-g.SUg.” gú-ː! g-ː! oú...ğ o.v)-oU.Uv-ː..o oøgU-ː) ː! o.ːv SQg NUvUR gU*) 3 o9.9g-g .x(oUQ..
o-ː.g ZNı-WYː.V-ː ó ː..M3 3 vU..3 o-ː v9*..SUMı9o...ffıg oRvv-N.I v’ R<v’ N.gU9... oMv vMg ...
ː gU*) 3 g-SvUZ.

...

“ o.*-Š o..v.3 g6o.g*..o)” .g9;μ*3 oU*.g*.Xv*S o.SU.ːv 9ó ː.Uv-ː-v..9Sː-ː v -ː-ː! o.SU) 3 g-SvU-ː! o...
SU9Sg-ː v ː.X vø9o*Z-ː! ó o.ğ o..-ː! oo..vMg*SvU*..-ː g-ː..offıS o..SU9Sg-ː v ː gU*) 3 g-SvUZrU-ː! o...
)S*..Mg*oN9g-g..ğ o-ː gU*) 3 o9-ː-v..3 oo-ː-ː! o.i vμU9ğ Sː*..o-ː.i ú-ː! o..SU9Sg-ː v ː9o)SSvUZrU..
-ː! o..*oMU9..Mg*oNo’ ː o3 o.øg μo*..-ː! g-ː.3 gú.9Sː-ː v -ː o*μ -ː..S...o)-..μU- og-o9..ğ o.g99 o*o9Z..
-ː! S9 úNSU9Sg-ː v *..” S’ ː.o’ ː o3 o..*6o” Uo**..ğ o-ː gU*) 3 o9Z-ː! o.3 gSU-ː” v-ː..oMUSffıo*..v)...
9g-g-ː gU*) 3 g-SvU.ğ o-ː-v.oS’ ó ː.MgX.gU.SU9Sg-ː v ː.x” Sːv Sig-SvUN*o-SUQg.Mog ː.μXXó ː.ː v ...
v” ó ː.i vμU9ğ ú.Mı-Rv)).øg μoNv ː..v.μ*o..-ː! o..ffıg oː..vv-ː.v).gU.SU9Sg-ː v Zː“ o.Mv*o..-ː! o..ffıg o...
ː vv-ː.3 o-ː v9..Sː-og9..v)...vQ S’ 3 SM- gU*) 3 g-SvU.i oMμ*o..S..i o-ó ː.X o*ó øo*..-ː! o.ːv SQg ...
Xó) 3 gUM...oøo *.gU9.MgU.i o.μ*o9...” S’ ː.üó v.øg μo*N” ’ SM.Sː.Uv-ː-ː! o.Mg*o..) ː-ː! o..g-ó Z...

...

“ o..μ*o..-ː” v...g-SːSg ː-o*..-ː-v..-ː! o X..9oU-Sú..SU9Sg-ː v *..-ː! g-ː..*’ vμ 9...i o..MU*9ó o9...) ː ...
ː gU*) 3 g-SvUZ-ː! o..o*..v).*6o” ː9o-ó 3 Sv*..-ː! o.9oQoo.v).g*ı3 3 o-ː ú.v).øgM.SU9Sg-ː v Z-ː! o...
" gU9ı vv6..x2 g 9v...o-ː.g ZNı--Yː..oM3 3 oU9*..ː og-SUQ.SU9Sg-ː v *..” S’ ː-ː! o..Mo))SSU-ː.v)...
*6o” Uo**..? í ZG)-ó ː.g..Mg o)μ ː.g**o*3 oU-ː.v).g ː.SU9Sg-ː v *N-ː! o..àvMg ː.w vQo**..rU9o’ ː.Wıu-R
ı-ı-ː.3 o-ː v9v vQı...gXXSː...g...-ː! o*’ v 9...v)...Wː..*6o” ...) ː..SU9Sg-ː v ː-ː! gU*) 3 g-SvUN.” ’ ó o...
SU9Sg-ː v *..” S’ ː-ː! o..Mo))SSU-ː.v).*6o” Uo**..? í ː.ğ o-ː gU*) 3 o9..μ*SUQ-ː! o..ffıg oː..vv-N” ’ So...
SU9Sg-ː v *..” S’ ː.*6o” Uo**..i o-ː” ooU.WːgU9.ı ː.ğ o.MgXXo9.g-ː-ː! o..uu-ː! éWː.Xó MU-So.øg μoZ-ː! o...
ffıg oː..vv-ː-ː! gU*) 3 g-SvU.g v” *..-ː-ː! o-gU-ː! oː o g-Sːo..Xv*SSvSUQ.v)...MμU-Š *..” ’ So...
Mog-SUQg.3 ː v o..*oUːS o.9Sː S μ-SvUZVUú...” v.SU9Sg-ː v *..ğ o-ː gU*) 3 o9..μ*SUQ-ː! o..ffıg o...
ː vv-ː-ː! gU*) 3 g-SvUm og-ː! *) v3 ...og9..o’ Xv*ıı o.gU9.rU-ó Xó *vUg ː.øSv oUMZ...

...

-ː! o..*oMU9...o*N” ’ SM..MU*9ó *..-ː! o.9S))ó oUM.i o-ː” ooU-ː! o..SU9Sg-ː v ː.3 SS g..gU9-ː! o..W-ː..
Xó MU-SoNgU9-ː! o..SU9Sg-ː v ː.3 g’ S g.gU9-ː! o..uu-ː! Xó MU-SoN. o X*..v.9oU-Sú.g.*SUQo.ː v ː.g...
’ gU9)μ ː.v).o’ ː o3 o.øg μo*.SUgU.v-ː! ó ” Sːoːo g-Sːo ú..o*..*6o” o9.9Sː S μ-SvUZr)-ː! o.9S))ó oUM...
Sː.Qog-ó ː-ː! gU.ı ː.gU9ğ 9.9oøSg-SvU.g.MgX.Sː.gXXS9.g-ː-ː! o..uu-ː! éWː.Xó MU-So.øg μoZ...

...

I g*o9..vU..-! o..gi vøo...o*~*N-! o..)v v” SUQ.SU9SMġ-ŧ *..ġ o..MġXXo9..g-...-! o..uu-! ..Xó MU-So..øg mo... xvUb..SU9SMġ-ŧ ..MġXXo9..g-...-! o..W-..Xó MU-So..øg moYm

- <’ S9.3 ŧ -g S-ú...
- n og-! *.ŧ) v3 ..SU)oMSvµ*..9S*og*o*...
- n og-! *.ŧ) v3 ..µU*g)o..” g-ó N*gUSg-SvUNgU9..! úQbUb...
- n og-! *.ŧ) v3 ..! vµ*o’ v 9..gS..Xv µ-SvU...
- n og-! *.ŧ) v3 ‘...vg9.SU;µ S*
- /So.o’ XoMgUMġ.g-... -..MġXXo9..g-...-! o..W-..Xó MU-SoY..
- w o3 g-µ o.9og-! *.ŧ) v3 ..UvURM3 3 µUSMġi o..9S*og*o*...
- n og-! *.ŧ) v3 ..vµ-9vŧ ..gS..Xv µ-SvU...
- Oġ ú.3 ġ’ SgQ...

...

rU.g99SSvUN*oó g ..SU9SMġ-ŧ *..ġ o..MġXXo9..i g*o9..vU..-! ov o-SMġ ..i vµU9ġ S*ZG..) vŧ ..S*..o-..g-... -Zβ..)ŧ ..QUBó ..Xġ S-ú..SU.o9µMġ-SvUSU9SMġ-ŧ *..v..g v” ..ŧ)ŧ ..3 og*µi o3 oU-..ó’ ŧ ..i g*o9..vU..-! o... ‘ oM3 3 oU9g-SvU*...v)...-2 Oà<V...x-2 Oà<V...rU*-Sµ-o...)ŧ ...à-g-S*SMN.í -WYZ..-! o... w’ vUb... *µi *MSX-SvU*.SU9SMġ-ŧ ..S*..MġXXo9..g-..W-..*µi *MSX-SvU*...v...o) oM...-! o..i vµU9ġ ú..o-..i ú.S*..µUS... v)..3 og*µi o3 oU-..xUµ3 i ó ..v)...*µi *MSX-SvU*..Xó ..W-..XovXoYZ.ŧ oġ *..v)...-ó -Sġ ú..*Mvv SUQ.S*... MġXXo9..g-..)So..úoġ *..v..gøv9...-! o..SU) µoUM..v)..g..)o” ..Uoġ Rµ-S S*.gU9..v..i o..SU...Sb...” S’ ..-! o... o*-gi S’ o9...I v vQġg...ú*-o3 ..v)...-ó -Sġ ú...o9µMġ-SvU..xβz í YZ../g*-úN..-! o...w vXŧ -SvU..v)...-! o... XvXµ g-SvU...” S’ ..g9øgUM9..o9µMġ-SvU.S*..MġXXo9..g-... Z%v...o) oM..SU-ó Ug-SvUg ...-ġ Q-*.gU9... Mġ’ oU..gMSoó3 oU*..xOµi v*-g-Ní -í βYZ.

...

. YI o*-RgU9...” ŧ *-Rġ*o.*MUġ Sv*....

O*-gi S’ SUQ..-! o..i vµU9ġ S*..)ŧ ..ogM..SU9SMġ-ŧ NSZN..-! o..i o*-RgU9...” ŧ *-Rġ*o.*MUġ Sv*NS*..g... MµMġg ..*~oX..SU..-! o..3 o-! v9v vQġi..*SUM..S..9SoM ú..g))oM*...-! o...øo ..v)...SUg ..*M* o*~x- RW- YZ.. -! ó o)ŧ oN’ ‘ So...-! o..i o*-RgU9...” ŧ *-Rġ*o..øg mo*..ġ o.9o)Sb9..)ŧ ..ogM..SU9SMġ-ŧ N’ o.*’ So...v...)v v” ...-! o..*g3 o.3 o-! v9..)ŧ ..*S Sġ .3 o- SMZ(ŧ ..SU9SMġ-ŧ *..” S’ ..X oB9o)Sb9..i vµU9ġ S*..xg ... SU9SMġ-ŧ *.ŧ) v3 ..ö ġ S-S*..v)..n o3 vMgMNµµ3 3 ġ ú..o’ Xv*µi o.øg mo*..o-MZ..-! o..µXXó .gU9...v” ó ... Mġ*o*...ġ o...o*-gi S’ o9...i g*o9...vU..-! o...X o9o)Sb9...Mġ oZ.2 g-µi g ...i vµU9ġ S*...ġ o...µ*o9...)ŧ ... SU9SMġ-ŧ *..-! g-...! gøo..g...Ug-µi g ..i o*-Rġ*o.*MUġ SvN*µM..g*..3 g-ó Ug ..3 ŧ -g S-ú..xiö vY.gU9... 3 vi So.X’ vUb..*µi *MSX-SvU*.xW-..Xó ..W-..XvXµ g-SvUYZ(ŧ ..SU9SMġ-ŧ *..-! g-9v..Uv-..! gøo.g..Móġ ... ” ŧ *-Mġ*o.ŧ ..” ‘ ó o..-! o..X vi gi SS-ú..v)...ogMSUQ..-! o..” ŧ *-Rġ*o.*MUġ Sv.S*..o’ -! o3 o ú..µUSo ú... xoZQNMIS9.3 ŧ -g S-úN..)ŧ ..” ‘ SM..-! o..-! ov o-SMġ ...” ŧ *-Mġ*o...” vµ 9..i o..-! g-..øó ú..MS9..9S*... i o)ŧ o..-! o..gQ..v)...SoYN..-! o..i vµU9ġ ú..S*..i g*o9..vU..-! o..” ŧ *-’.. oM 9o9..Xó)ŧ 3 gUM..SU..-! o... 3 og*µi o3 oU-..Xó Sv9..xSbZNMu- R-í -YZ<gX*.Mµ-Sµ-o..-! o..i vµU9ġ S*..)ŧ ..MġXXo9..SU9SMġ-ŧ *Z.. I o*-RgU9...” ŧ *-Rġ*o..SU9SMġ-ŧ .øg mo*..ġ o..SUMµ9o9.g*...” v.g99SSvUg ..vi *ó øg-SvU*...” S’ SU..-! o... MµU- ú..9g-g*o-Zàoo..GXXoUS ..G..xSU..-! o..vUSb..*µXXo3 oU-ġ ú..)SoY..)ŧ ...-! o...XoMSSMøg mo*... µ*o9..)ŧ ..ogM..SU9SMġ-ŧ *.i o*-RgU9...” ŧ *-Rġ*o.*MUġ SvZ...

...

%rU9SMġ-ŧ ..Sbó *SvU...

...

—' o...Sðó *SvU..v)...SðSMg-ú *...Sk' offiSo9...-v...g SQu..g ...SðSMg-ú *...SU...-' o...*g3 o...9SoMSvUZ.
àXoMSMg úNg .SðSMg-ú *)'v' ' SM.g.' SQu ó .øg µo.9oUv-o*...v" ó .*vMg .X vQ o**..xozN9og-' ...
' g-o*Y.é o.-' gU*)'v 3 o9..i ú..g...S X o.3 µ -SXSMg-SvU.i ú..RWZ.-' Sk..Sðó -*...-' o..9SoMSvU..v)...-' o...
SðSMg-ú *...-v...M' o*XvU9..." S' ' SQu ó ..øg µo*...oU-gSSUQ.i o—ó ..Xó)'v 3 gUMZ.-' ó o..é o..í %..
Sðó -o9..SðSMg-ú *..SU...-' o..Wiu- R-í - .àvMg ..w vQ o**..rU9o' N.-' o*o.é o..Uv-o9..SU.GXXoU9S ..G...
SU...-' o..vUSb..*µXXo3 oU-é ú..)SoZ...

...

° Y.<v3 XvUoU..*M o*...

—' o..Mg Mh g-SvU..v)...M3 XvUoU..*M o*..Sk.i g*o9..vU...-' o..gQQ oQg-SvU..v)...SðSMg-ú *..." S' SU.ogM...
M3 XvUoU..gMv**..g ..vi *ó øg-SvU..xSbZNMµU- S*..gU9..úog *Y.µ*SUQ.-' o..X SUMXg M3 XvUoU...
)gMv' ..xw<(Y..gUg ú*Sk..x(ðó v...` ...I o)S' oNí - WYZ.-' o...w<(N.µ*SUQ..à-g-gf*..BgMv' N.XMR..
M3 3 gU9NS*..g...9g-g'.. o9µMSvU..-oMUSffµo...)'v ..gUg úüSUQ.g...Q vµX..v)...SðSMg-ú *...-' vµQ -...-v...
3 og*µi o.g.*SUQo..MUMX-Zr-..9oU-SS*..M3 Xv*S o.o.ó3 oU*..i) v3 ...-' o..SðSMg-ú *..gU9..M3 i Sð*...
-' o3 ..SU-v..g..M3 3 vU..MµU'- µM..xGMFMNí - í ßY'..('v 3 gUü..v)...-' o..." o øo..M3 XvUoU-*Nw<(...
QðU g-o*..S Sg' .." oSQ -*..)'v ...-' o..SðSMg-ú *Z.-' Sk..S.9µo...v..oU*µi SUQg..)gS...oøo ..v)...M' o g-SvU..
i o-" ooU..SðSMg-ú *..." S' SU.g..M3 XvUoU..X S' ...-v...-' o..rU9o' ..Mg Mh g-SvUZ'..." v" oøó N)'v ...-' v*o...
Mg*o*..." ' ó o..SðSMg-ú *..é o...o*..M' o g-o9..." S' SU...-' oS ..M3 XvUoU-N*µM ..g*..wó *vUg ..àg)o-ú...
gU9..GMM*...-v..rU)'v 3 g-SvU..` ..<v3 3 µUSMg-SvU*Nw<(..X vø9o*..g..Qv9...*g-Sk-SMg ..gXX vgM...
)'v ..9o-ó 3 SðUQ.-' o*o..SðSMg-ú *...MµU- S µ-SvU..-v...-' o..M3 XvUoU..*M o*..." ' So... o3 gSSUQ..
vi ;oMSðo..xS 9YZ.('v ...-' Sk'.. og*vUN.w<(..Sk..X o)ó' o9..vøó ..offiµg ..." oSQ -SUQ..-v...oU*µi o...-' g-...
SðSMg-ú *...é o...3 ogUSUQµ ú...MµU- S µ-SUQ..-v...g...M3 XvUoU..*M oN.." ' So...gMMµU-SUQ..)'v ...
S Sg Sð..i o-" ooU...-' o3 Z'..." oSQ -*.9ó Sðo9..i ú..w<(.é o..Uv-o9..SU.GXXoU9S ..G..SU...-' o..vUSb...
*µXXo3 oU-é ú...)SoZ.<v3 XvUoU..*M o*...é o...Mg o9...-v...- RW- ...øg µo*...µ*SUQ.-' o...3 SðB g' ...
gU9g 9Sig-SvU..3 o-' v9N.." ' ó o...-' o..i o..Rg*o...*MUG Sv*..MµU-Sµ-o...-' o..3 g' S gN.." ' So...-' o...
3 SðB µ3 ..øg µo..Sk'.. oX o*oU-o9..i ú...-' o..." 'v *..Rg*o...*MUG Sv*Z.w' S' ...-v...gXX úSUQ.-' o..w<(...
3 o-' v9NSðSMg-ú *..é o...gU9g 9Sio9..SU-v..üRµM o*N.." ' SM'...o*µ -..SU..øg µo*..." S' ..g..3 ogU..v)...
gU9..*gU9g 9.9oðSg-SvU..v)...VZ.

...

° Y.(Sg ..gQQ oQg-SvU..

OgM..9S oU*SVU..*M o..Sk..Mg Mh g-o9..g*...-' o..é S' 3 o-SMgðó gQ..v)...-' o..vµi ..M3 XvUoU-*...-' g-...
3 g6o..µX.-' o.9S oU*SVUZ.-' o..rU9o' ..Sk...-' oU..Mg Mh g-o9..g*...-' o..é S' 3 o-SMgðó gQ..v)...-' o...-' oo...
9S oU*SVU*Z.." o..Mvv*o..é S' 3 o-SMgðó gQ..vøó ..QðU g Sio9..3 ogU*..gU9..Qv3 o- SMgðó gQ...
oøoU...-' vµQ ..S..g v" *)'v ..)µi ..M3 XoU*gi SS-ú..gMv**..M3 XvUoU-*Z.." o..9v...*v..i g*o9..vU...-' o...
øg 9g-SvU..v)... vi µ*-Uo**..gU9..MµU*9ó SUQ.-' o..g9øgU-gQ*..v)...é S' 3 o-SMgðó gQZ<vµU- S*...

¹² The Stata command -factor, pcf- performs a factor analysis using principal component analysis (PCA) for factor extraction. This provides basically identical results as running PCA for example in SPSS, but the two methods should be regarded as different (see for example Mardia et al., 2024; Mulaik, 2009; Jolliffe, 2002).

¹³ As per recommendations (Nardo et al., 2008), the correlation coefficients should range between 0.30 and 0.92. From the 92 correlation coefficients in the framework (all of which are significant at the 1% level), 10 are lower than 0.30 (the lowest value is 0.13, while the highest value is 0.92).

¹⁴ It should be noted that PCF and other data-driven weighting methods have also received notable criticism in recent years, see for example Greco et al. (2019).

—' g-9v..Uv-..! gøo.*Mf o*.SU.g ..)vþí .M3 XvUoU-*.v).g.QSboU.9S oU*SVU.9v..Uv-..! gøo.g.9S oU*SVU..
 Mf oZr).g..MþU- ú.9vo.Uv-..! gøo.g.9S oU*SVU.*Mf oNS.9vo*.Uv-..! gøo.g.UrU9o' .*Mf o.oS' ó Z.

...

1Yà-g-S-SMf .øg 9Sú...

—' o.*-g-S-SMf .øg 9Sú.v)...' o.rU9o' .S...o*-o9.3 µ -SXo...S o*.9þí SUQ..! o.Mf Mþ g-SvUZ“ o.*- Sbo...
 -v..SUMþ9o.vUú..*µM.SU9SMf-ý *...! g-.g9offµg-o ú.MfX-þí o...! o.MUMX..v)..ogM..M3 XvUoU..gU9...
 -' g-..g o..MUMX-µg ú..g*...” o ..g*..*-g-S-SMf ú...SÜ6o9...-v..vUo..gUv-! ó Z...! o.*-g-S-SMf ..)S...v)...
 SU9SMf-ý *...X oRbo oMo9...!ý ...g...M3 XvUoU-...S*...g**o**o9...SU...! o...o' Xv g-ý ú...X' g*o...i ú...
 M' o g-SvU.gU9..)gMv .gUg ú*SZrU9SMf-ý *...! g-..g o.*-g-S-SMf ú..SUM3 Xg-S o...” S' ...! ó...o*-v)...
 -' o..M3 XvUoU-..g o..o' Mþ9o9..) v3 ..)þí -! ó ..MU*9ó g-SvUNgU9NS)..Xv**S oNg ó...oXgM9...” S' ...
 g -ó Ug-Sbo*Zà-g-S-SMf ..)S..S'...oXog-o9 ú..MU)S3 o9...! vµQ vµ-...! o.Mf Mþ g-SvU.X vM**Z...

...

G*..Xó ..sá <..Q19o SÜo*.x2 g 9v..o-.g ZNí -- 1YN9og úN..! ó o.*' vµ 9..i o..vUú..vUo..9o-ó 3 SSUQ..
)gMv .Xó .M3 XvUoU-..xSQÜøg µo.? WZ..! S..MSó SvU! g*.i ooU.3 o-..)ý .g .M3 XvUoU-*.v)...! o...
 rU9o' Z..(þí -! ó 3 ý oN..! o.*-gU9g 9..àvMg ..w vQo**..rU9o' .3 o-! v9v vQí..SÜv øo*.øøg µg-SUQ..
 -! o...!S...i o-” ooU...! o...SU9S9µg ...SU9SMf-ý *...i ú...Mf Mþ g-SUQ..< vUi gM *..G X' g...!ý ...ogM...
 M3 XvUoU-Z..! o.g X' g.*-g-S-SMf.3 og*þí o9..vU.g..RWMf o.gU9.X vø9o*.g.3 og*þí o.v)..SU-ó Ug ...
 MU*S-oUM..v)..SU9SMf-ý *...” S' SU.g.M3 XvUoU-NSZ..! o.o' -oU-..v...” ' SM.g .So3 *.3 og*þí o...! o...
 g3 o..MUMX-..ý ..MU- µMZG*.gU.gXXS9'.. µ o.v)...! µ3 i N..! o.g X' g..øg µo.*' vµ 9..i o.gi vøo...
 -Z ..)ý ..gUú...vQMf ..QvµXSUQ.v)...øg Sgi o*..xàvMg ..w vQo**..r3 Xó g-SboNí -ííi YZ..! o.g X' g...
 øg µo*.Mf Mþ g-o9...!ý ...! o..rU9o' ..M3 XvUoU-*.g o..g ..gi vøo...! o...! o* v 9N! v” øó ..Übó ...! o...
 S S..SU...! o.Mf*o.v)..GM**..-v..rU)ý 3 g-SvU..` ..<v3 3 µUMf-SvU..gU9..OUbSvÜB oU-g .0 µg S-úZ..
 /g*-úN..! o.Qv9Uo**..v)..)S..v)..SU9SMf-ý *...” S' SU.ogM..M3 XvUoU-..S..øøg µg-o9.µ*SUQ..! o.7 gSó R
 t ouó RV 6SU.x7 t VY3 og*þí o.v)..*g3 XSUQg9offµgMfZ..! o.3 og*þí ó...o) oM*...! o.X vXv -SvU.v)...
 øg SgUM.g3 vUQøg Sgi o*...! g-.3 SQ -i o...! o.M3 3 vU.øg SgUMZ..! o.7 t V..øg µo*...gUQ..) v3 ...
 -...v..WV!” ' So...! o.3 ogU.7 t V...* vµ 9..i o.gi vøo... ZàxàvMg ..w vQo**..r3 Xó g-SboNí -ííi YZrU..
 -! o..àvMg ..w vQo**..rU9o' ..Wiu- R-í -Ng .3 ogU.7 t V..øg µo*.g o..Qog-ó ...! gU...! S*...! o* v 9Z..
 -! o.*-g-S-SMf .øg 9Sú...o*µ -*.g o.*µ3 3 g Sio9.SU.GUUb' ..O.SU..! o..vUSÜb.*µXXo3 oU-g ú..)SoZ.

...

uYá vi µ*-Üo**..MoMf...

-v..g**o**..! ó... vi µ*-Üo**..v)...! o..Mf Mþ g-SvU.X vM9þí oNXg -SMþ g ú...! g-..v)...! o..gQQ oQg-SvU..
 gU9...” oSQ -SUQ.3 o-! v9*N..! o.rU9o' .S...oMf Mþ g-o9...! oo...S o*.µ*SUQ9S)ó oU..gQQ oQg-SvU.gU9...
 ” oSQ -SUQgXX vgMo*Z..! o.*-gU9g 9.3 o-! v9v vQí..µ*o*.X SUMXg .M3 XvUoU-..)gMv .QÜb g-o9...
 ” oSQ -*...!ý ..gQQ oQg-SvU..vU...! o...M3 XvUoU-...øøo ...” ' So...S..gXXSb*..µU” oSQ -o9...g S' 3 o-SM.
 gøó gQUQSU...! o..)Sü .gQQ oQg-SvU.*-oX.x) v3 .M3 XvUoU-*.v..9S oU*SVU.gU9..) v3 .9S oU*SVU*..
 -v...! o.rU9o' YZ..! o.g -ó Ug-Sbo.vX-SvU*..-v...! S..i g*o SÜb...! g-...” ó o...o*-o9.g om

- xSY.µU” oSQ -o9.g S' 3 o-SMgøó gQUQSU.g ..*-gQ*....
- xSY.µU” oSQ -o9..Qv3 ó SMgøó gQUQSU.g ..*-gQ*^W....
- xSSY.w<(RQÜb g-o9...” oSQ -*.gU9.gQQ oQg-SvU.SU.g ..*-gQ*....

¹⁵ The calculational sequence was adapted as well: the standardization of indicators (to 0-100 scores) was done prior to aggregation to eliminate negative values.

...

<v3 Xg SUQ.-' o.-' oo.g -ó Ug-Só.o.gXX vgMo*..." S' ...' o.gXXS9..3 o- v9v vQí.xS6ZNi g*o SúbYN.
" o.vi *ó øo.-' g-.-' o'.. gU6..M' o g-SvU..xXó3 gUY.Mo))SbU*..i o-" ooU.-' o.i g*o Súb.gU9..g ...
-' oo.g -ó Ug-Só.o.vX-SvU*..g o.óó ú!.. SQ ZàXoM)SMg ún.-' o..v" o*-Mo))SbU..v).. Zi ..Sk.vi *ó øo9...
i o-" ooU.-' o..i g*o Súb...gU9...-' o...*oMU9...g -ó Ug-Só.o.-' g-...Sk...i g*o9...vU...Qv3 o- SM.góó gQZ.
" v" øóó N." ' So...-' o... ' SQ ...Mo))SbU*...*pQQ*...g...QÜb g ... vi μ*-Uo**..v)...-' o...Mg Mh g-SvU...
3 o- v9v vQí...xgU9...S So9...*oU*SbSú...v..MgUQ*..SU.-' o..gQQoQg-SvU.gXX vgMYN.-' ou!..3 gú...
g *v...3 g*6...*v3 o...*SUSSMgU...9S)ó oUM*..SU.. gU6SUQ*..v)...SU9S9μg ...MμU- S*..i o-" ooU.-' o...
i g*o Súb...gU9...-' o.-' oo.g -ó Ug-Só.o.vX-SvU*ZrU9oo9N.-' o..9o*MSX-Só.o.*-g-S-M..v)...-' o'.. gU6...
9S)ó oUM*..9o3 vU*- g-o.-' SNo*XoMg ú..." ' oU.-' o..i g*o Súb... gU6SUQ.S*..M3 Xg o9..." S' ...-' g-...
i g*o9...vU...Qv3 o- SMgQQoQg-SvUN)" ' SM..o**oU-Sg ú..MU)S3 *..-' o..)SU9SUQ! SQ SQ -o9..gi vøoZ..
-' S*..S*..Uv-...μUó' XoMo9N.g*..-' o...Qv3 o- SM.góó gQ...gQQoQg-SvU..XoUg Sio*..-' o...μUøoU...
Xó)v 3 gUM..v)..MμU- S*..gMv**..M3 XvUoU*-Z.-' o..M3 Xo-o'..o*μ -*.v)...-' o'..vi μ*-Uo**..MoM6*...
g o.gøgSgi o..SU.GUUb' o*..(.gU9..(Z ..SU.-' o..vUSb..*μXXo3 oU-g ú..)SoZ.

...

. n S*Mμ**SvU.v)'...o*μ -*...

-' o'.. o*μ -*.v)...-' o...àvMg ...w vQo**..rU9o' ...Wiu- R-í - N.Móó SUQ..W- z ...MμU- S*N.v))ó ...g...
3 μ -Sμ9o.v)..vXXv -μUSb*..)v .gUg ú*o*.vU.g.Xo- v g.v)..vXSMZ.-' S*.XgXó N. v" øóó N)vMμ*o*...
vUú.vU.-' o..v v" SUQg*XoM*m..

- -'oU9*.SU*..vMg ..X vQo**..Qvi g úci g*o9..vU.gQQoQg-o.gUg ú*S.gU9.SU9S9μg .MμU- ú...
gUg ú*S.Z.
- wó)v 3 gUM..v)..*vMg ..X vQo**..gMv**..MμU- S*..ci g*o9...vU..MμU- S* ..gi *v μ-o..gU9...
' o g-Só.o.Xó)v 3 gUMNgU9.9S*-gUM...v.i o*-RMg*oRMUg Sv.3 o- v9Z.

...

-v..o' g3 Súb.-' oU9*.SU*..vMg ..X vQo**..Qvi g ú..." o..gXX v' S g-o.-' o..àvMg ...w vQo**..rU9o' ...
*M o..)v ...-' o..." v 9..SU.-' o..v v" SUQ.3 gUÜb m-v..Mg Mh g-o.-' o..*M o*NSU9SMg-v *..g o..)S*-...
gQQoQg-o9..SU-v..XvXμ g-SvUR' oSQ -o9'...g" .øg μo*Nμ*SUQ.9g-g..v)..g '..gU6o9..xW- z YMμU- S*Z..
" oSQ -*..QÜb g-o9..i ú..w<(...xi g*o9...vU.-' o..v SQUg ...MμU- ú...*g3 XoY.g o..gXXS9...X Sv ...v...
Mg Mh g-SUQ.9S oU*SvU*..gU9...-' o..rU9o' ...*M oZr-...S*..S Xv -gU...-v..Uv-o.-' g-.-' S*..3 o- v9..S*...
9S)ó oU-..) v3 ..Mg Mh g-SUQ.XvXμ g-SvUR' oSQ -o9..*M o*.xS6ZNgXXúSUQ." oSQ -*..vU..M3 XvUoU-...
*M o*YNgU9..SU.o**oUM.-' og*-.-' o..." v 9.g*.g..MμU- úZ...

...

I g*o9..vU.-' S*.gXX vgMIN.-' o.." v 9..*M o..S X vøo9..i ú..WZ β..XvSU*..i o-" ooU..Wiu- ..gU9..í - í - Z..
-' o.." v 9..Xó)v 3 gUM..." g*..-' o..i o*-..SU.-' o..I g*SM" μ3 gU..2 oo9*..9S oU*SvUN)ý ..." ' SM..S*...
*M o..SUMog*o9...*μi *-gU-Sg ú..) v3 .. βZ β...SU..Wiu- ...-v..° Zβ...SU..í - í - Z.r-*..Xó)v 3 gUM...SU..
(vμU9g-SvU..v)..“ o i oSUQSUMog*o9..øøoU.3 v o.x) v3 ... Z W- v...βZ. Y9 SboU.g Q ú.i ú..QgS*...
SU.-' o..GM6*..v.rU)ý 3 g-SvU.gU9...<v3 3 μUSMg-SvU*..M3 XvUoU-Z.-' o..VXXv -μUSú..9S oU*SvUN..
' v" øóó N9vo*..Uv-..MU)ý 3 ...-v...-' S*..Qv" -' ..Xg-óó U.R." ' So.-' ó o.." g*.g..MU*S-oU-..SUMog*o...
) v3 ..Wiu- .x 1ZuY..v.í - Wk%Z. YS..." g*..v v" o9..i ú.g.Xó Sv9..v)..*-gQÜg-SvU.xgU9..øøoU.* SQ -...

...

9oMUbY.µU-S.í-í-...x%ZuβYZG...S Sg :- oU9..v)..µUoøoU.9oøo vX3 oU-.S..g *v..vi *ó øo9..gMv**...
g .M3 XvUbU-*.x*oo.GUUb' ..+.SU.-' o.vUSUb.*µXXo3 oU-g ú.)SoYZ...

...

—' ó...o*µ -*.9o3 vU*- g-o.-' g-...' ' So.-' o.*vMg .X vQo**..v)..- ' o..' ' 9..S X vøø9..vøó ...S oN.-' o...
Xg- ' *.gU9 :- g;omV S*.v).S*.9S oU*SvU*.gU9.M3 XvUbU-*. ' ' ó o.Uv-.-' o.*g3 oZàv3 o.9S oU*SvU*...
gU9..M3 XvUbU-*. o-gSUb9...- ' oS ...Qv9...Xó)v 3 gUMN." ' So..v- ' ó *..*-g o9..gU9...9oMSUb9Ni µ-...
*v3 o.g *v.gMSøø9'...o3 g 6gi o..QgS*...oøó *SUQ.-' oS .X oøSvµ* ú...gQQUQXv*SSvUZ.-' ó...o*µ -*...
g *v.SU9SM-o.-' g-.-' o..' ' 9 *..vMg .X vQo**..Xó)v 3 gUM.3 gú.i o.µUoøoUú.9S- S µ-o9..vøó ...
-S oZ.-v.i o-ó ..µUó *gU9.-' S.Xg-ó UN" o..)µ -' ó ..o' g3 SUb.QgS*.i ú.9oMg9o*.gU9...Rúog ...
Xó S9*.x- ' ó...o*µ -*.g o.gøgSgi o.SU.GUUb' .." .SU.-' o.vUSUb.*µXXo3 oU-g ú.)SoYZ...

...

+gS*.SU.-' o..' ' 9 *..vMg .X vQo**..Xog6o9.i o-'' ooUí --- R-W.xz %Z .X*Yi µ-.* v" o9.9v" U...
SU.-' o.)v v" SUQ9oMg9o.xz βZ% X*YZG...S Sg :- g;omV ú.S*.vi *ó øo9.SU.i v- ' ..' o.I g*SM" µ3 gU...
2 oo9*.gU9.-' o.(vµU9g-SvU*.v)." o i oSUQ9S oU*SvU*ZrUMU- g*-N- ' o.VXXV -µUS-ú.9S oU*SvU...
' oM 9o9...- ' o.. SQ o*-..QgS*.SU.-' o.Wiu- *Ni µ-..d' Xó SUM9.g.9oMSUb.SU.-' o.3 v*-...oMU-.9oMg9o...
xR ZVX*YZ.-' S*.µUoøoU.X vQo**..vøó ...S o.S..g *v..gU.SU' ó oU-.)og-µi o.v).3 v*-..M3 XvUbU-Z...

...

—' o*ó... o*µ -*..µQQ*-..gU..vøó g ..* v" 9v" U..SU.*vMg .X vQo**..SU.-' o.3 v*-... oMU-.9oMg9oZ...
<v3 Xg SUQ.-' o..g*-..)So..úog *..v.-' o.X oM9SUQ.-' oo.Xó S9*...oøog *.g.*µi *gU-Sg ..* v" 9v" U...
)v ...- ' o.rU9o' Ng ..9S oU*SvU*.gU9..o øøoU.M3 XvUbU-Z.-' S*- oU9..S..g *v..gXXg oU-...' ' oU...
o' g3 SUSUQ.-' o... øøo ...v)...X vQo**..v)..SU9S9µg ...MµU- S*..vøó ...S oZr-..MgU..i o..* v" U..)v ...
o' g3 XoN.-' g-.-' o.3 v*-... oMU-..Xó S9'.. oM 9o9...- ' o.. SQ o*-..Uµ3 i ó ..v)..MµU- S*..oS- ' ó ..SU...
9oMSUb.ý .SU.*-gQg-SvU.SU.-ó 3 *.v)..- ' o.vøó g .rU9o' Z...

...

<vµU- ú...oøó '...o*µ -*...

àvMg .X vQo**..Xó)v 3 gUM.óg S*.. ' 9o ú.gMv**..MµU- S*Z:" ' So.MµU- S* ..M *o.g o.3 v o...
S Sg .SU.í-í- -..- ' gU.-' oú.." ó o.SU.Wiu- Nóg Sgi SS-ú'...o3 gS..! SQ Z.-' o.i SQo*-..QgS*.SU.-ó 3 *...
v)...Ug' v" SUQ.-' o..*X og9..SU.MµU- ú..Xó)v 3 gUM..." ó o..gMSøø9..SU.I g*SM" µ3 gU..2 oo9*Z...
(vµU9g-SvU*.v)." o i oSUQ..oM 9o9...- ' o..g Q*-..vøó g .SUMog*o.." ' ó og*.VXXV -µUS-ú..gQQ9...
i v- ' ..vU.-' o..vøó g ..S X vøø3 oU-NG*.." o ..SU.-ó 3 *.v)..- ' i' SUQUQ.MµU- S*..Mv*ó ...vQ- ' ó Z...
<v3 XvUbU-...øøo .gUg ú*S..X vø9o*..)µ -' ó ..SUSQ -x*oo.GUUb' ..r.gU9..GUUb' ..s ..SU.-' o.vUSUb...
*µXXo3 oU-g ú.)SoYZ.

...

n o*XS-o..µi i µ oU-.9oøo vX3 oU-*.gU9.µUoøoU.gMSøø3 oU-*.gMv**..MµU- S*N*øøoU.v)..- ' o..vX...
W..Xó)v 3 ó *.SU.Wiu- -..o-gSUb9...- ' oS ...vX.Xv*SSvU.g *v..SU.í-í-ZV)..- ' o.-' oo..MµU- S*..- ' g-...
' gøo... v*-.-' oS ...X o3 S *' SXN.-' o...-USo9..à-g-o*..9oMSUb9...- ' o.3 v*-N.)g SUQ.-v..βW*-XgM...
xl o Qµ3 .W- NGµ*- g Sg.W- YZVU.-' o.v- ' ó !' gU9NrM gU9.S X vøø9.i ú.WXgM*..v.3 g6o.S...
-v.-' o..vX... ..SU.í-í- -xGµ*- Sg..S X vøø9..i ú...° ..gU9..2 o- ' ó gU9*..i ú..β.XgM*.. o*XoMSø úYZ...
àS Sg úN)Sø.v)..- ' o.i v-v3 .Xó)v 3 ó *.SU.Wiu- .S ..)SU9.-' o3 *o øo*.g3 vUQ.-' o.i v-v3 ..oU...
βWúog *..g-ó ZG3 vUQ.-' o*o.i v-v3 .MµU- S*..- ' g-..S X vøø9NGUQy g.gMSøø9...- ' o.Qog-o*-...

;µ3 X.xW.XgM*Y..g6SUQ.-' o..W¹⁹.XgM.SU.í-í-Zàoo.GUOb' .7 .SU.-' o.vUSUb.*µXXo3 oU-é ú...
)So..)v' ...' o..vX.gU9.i v-v3 .W.Xó)v 3 ó *.SU.Wiu-.gU9.í-í-Z.

...

“ ' So..g 3 v*..g .MµU- S*.S X vøø9..SQ)SgU-ú..SU..ó 3 *.v)..-' o.rU9o' ..M' o.xW1..xµ-..W- ...
MµU- S*.S X vøø9..i ú..W.gU9.3 v' o.XvSU*Y^N.-' o.QgSU*..” ó o.µUøøUú.9S⁻ S µ-o9Z.-' o..vX..
%S X vøó *..SU..ó 3 *.v)..*M' o..MgUQ..” ó o..I ' µ-gU..xz í uZ βX*Y^t. g 9\$ø*..xz í °Z 1X*Y..
t úgU3 g' ..xz í Zⁱ X*Y^O.-' S vXSg..xz í Z[%]X*Y^t.<g3 i v9Sg..xz í Z uX*Y^ZG-..-' o..v- ' ó ..oU9..v)...
-' o...XoM µ3 N.MµU- S*..-' g-..9\$...Uv-..9v...v...” o ...g' o..ö oUüµo g...R Z í X*Y^t..-g;SS-gU..
xz -ZβX*Y² Sg gQig..xz . ZβX*Y^I o g' µ..xz . Z^oX*Y^t.gU9..-6 gSb..xz %Z[%]X*Y^Zr-.*' vµ 9.i o..
Uv-o9N. v” øó N.-' g-..” ' So.vUú.vUo.MµU- ú.9oMSb9.vøó ...' o.βW¹⁹og' .Xó S9NB v' o.MµU- S*..
o' Xó SUM9.9oMSb*.SU.-' o.3 v*...oMU-úog' *.g*.9Sµ¹⁹*ø9.gi vøøZ...

...

(µí -' ó 3 v' oN.-' o.µUøøU.9S⁻ S µ-SvU.v).gi *v µ-o.QgSU*..” g*...o) oMo9 .SU.-' ó...o g-Sø.ó 9ó .v)...
MµU- S*NSZNSU..gU*Z<vµU- S*..-' g-.S X vøø9..-' o.3 v*..SU.-' S⁻..oQ⁹ 9..” ó o.-' o.t g 9\$ø*..
xS X vøø9.i ú.βu...gU*Y^N ' µ-gU.xβ1Y^Nvµ- ' .G') Sg.xβ. YNG i gUg.xββYNgU9..<gi v.ö ó 9o.xⁱ YZ..
G-..-' o..v- ' ó .oU9N.-' o.MµU- S*..-' g-..9oMSb9..-' o.3 v*..” ó o.ö oUüµo g.x9oMSb.i ú.%ú...gU*Y^N..
-g;SS-gU.x %N2 Sg gQig..x - YN- µí 63 oUS-gU.xβ° YNgU9.2 v' -' .7 v' og.xβ° YZ...

...

<vµU- S*..” S' ..SSSg ú...v” ó ..M' o*..gMSbøø9..! SQ ó ..QgSU*..SU.*vMg' ..X vQo**..vøó ...-' o.βW..
úog' *...-' S*.S.SU9Sg-o9.i ú.g..! SQ ..UoQ-Sø.o.M' o g-SvU.x .P.RZβYi o-” ooU.MµU- S* .SSSg ...
øøo .v)..*vMg' ..X vQo**..xSU.Wiu- Y.gU9..-' o.MgUQ..SU.XvSU*..vøó ...-' o.Wiu- R-í- .Xó S9Z.-' S..
S.N.-v..*v3 o..o' -oU-N.-' o..MU*offµoUM..v)..-' o..i vµU9o9..Ug-µí o..v)..-' o.rU9o' N3 ogUSUQ.-' g-..
MµU- S*.Mv*ó ..v..-' o.i o*-Rg*o.*MÜg S*..! gøø.*v” ó ..Qv” -' '...g-o*..-' gU.MµU- S*..)µí -' ó ...
g” gú..) v3 ...' o3 Z.-' ó o)v' oNS.S.µ(o)µ ..v...vv6.g-..-' o.Xó)v 3 gUM.v).MµU- S*.g *v..) v3 ...' o..
Xó *XoMSø.v).9S-gUM...o9µMSvU..v..-' o.i o*-Rg*o.*MÜg SvZrU.-' S⁻..oQ⁹ 9N.-' o.3 v*..*µM¹⁹*)µ ...
MµU- ú.vøó .Wiu- R-í- .” g*.àvµ- ' .7 v' ogN? ' SM'...o9µM9.S*.9S-gUM.i ú... Ziy N)v v” o9.i ú..
rM gU9..x . Ziy YN^r o gU9..x í Ziy Y.gU9..à” Süó gU9..x í Ziy YZ.-' o.i v-v3 .%Xó)v 3 ó *.g' o..
ö oUüµo g...RZ y YN.-g;SS-gU..xW¹⁹ y YN.<oU- g ...G') SgU..á oXui SM.xuZ y YN.2 v' -' ...7 v' og..
xWZ y YNgU9..2 Sg gQig..xW¹⁹ y YZ.-' o..M' o g-SvU.i o-” ooU.MµU- S* .SSSg ...øøo .v)..*vMg' ...
X vQo**..gU9..-' o.Xó MU-gQ.v).9S-gUM...o9µM9.S*.Xv*SSø.gU9.*- vUQ⁹ .x.Z. YN^r v” SUQ.-' g-..
MµU- S*..” S' !. SQ ó .SSSg ...øøo *.v)..*vMg' ..X vQo**..g' o.i o-ó ..SUMv*SUQ.-' o.QX.v..-' o.9og ...
Xó)v 3 gUMZ." v” øó NS..MgU..i o..g' Qio9..-' g-..)vM¹⁹*SUQ.vU.-' o.. o9µMSvU.v)..-' o..9S-gUM..
9SMS Sg-o*..gQgSU*..MµU- S*..” S' ..SSSg ú...-' o..v” o*..*M' o*..SUM..-' ou!.. gøø..-' o..vUQ*...
9S-gUM..v..Møó .xOg*-ó úNí -- uYZ...

...

% <vUMµ*SvU..

n o*XSø.MUMX-µg .gU9.3 og*µí o3 oU-.Mg oUQ*N' o.MU⁻ µMo9.g.Ub” .àvMg' ..w vQo**..rU9o' ...
*XgUSUQβW¹⁹og' *.gU9.Møó SUQ.Wí .MµU- S*..oUSo ú.gU9..)µí -' ó .í. .MµU- S*.Xg -Sg úZ.-' o..

¹⁶ Two countries are not considered as their data only became available later - Timor-Leste and South Sudan.

àvMg ..w vQ o**..rUo' ..Wu- R- í - .." g*.i μS-..μ*SUQ.vUú..Xpi SMi..gøgSgi o..9g-g..gU9..Mo9S o...
 *vμi M*NgU9..S'..oX o*oU-*.gU.μUX oM9oU-o9..o))v' -..SU.3 og*í SUQ-.' o..ffig S-ú..v)...So..Qvi g úN.
 vøó .gU.o' -oU*So..S o..Xó S'9Z." v" øó N-.' ó o.ég o..MU*9ó g-SvU*..-' g-.*' vμ 9..i o..g6oU.SU-v...
 gMMμU-.." ' oU.SU-ó X o-SUQ-.' ó...o*μ -Z...

...

—' o.rUo' ..S*.i μS-..SU-.' o..X o*oU-..3 SU9Ro-..gU9..vUú..3 og*í o*.." ' g-.." g*.)og*S o..v..3 og*í o...
 9μo..v..9g-g...S Sg-SvU*N." ' SM..oU-gS*..-' g-..3 gUú..S*μo*..g o..Uv-..MX-í o9..9SoM ú..i ú..-' o...
 rUo' NSUMμ9SUQ-.' o..3 v*-.. oMU-..úóg *.gU9...-' o..S XgM..v)...-' o..<vø9RM..XgU9o3 SZ-.' o*o...
 Mg oUQ*.. offiSo9..*v3 o..μUM3 3 vU..*v μ-SvU*..SU-ó 3 *.v)..3 S*SUQ.øg μo*..S Xi-g-SvU*..gU9...
 9g-g-.' gU*)v 3 g-SvU*Ni μ-.*-g-S*SMg .øg 9g-SvU.MU)S3 *..-' o.rUo' ..S*.g'..vi μ*-..3 ó- SZ...

...

“ ' So..-' o.. o*μ -*..SU9SMg-o..-' ó o.." g*..gU..vøó g ..SUMog*o..SU..*vMg ..X vQ o**..Xó)v 3 gUM...
 Qvi g ú..) v3 ..Wu- R- í - ^WNg..Mv*ó .gUg ú*S'..oøog *..-' g-..-' S*.X vQ o**.. g*.i ooU.øó ú..μUøoU..
 SU-ó 3 *.v)..xSYo o3 oU-*.v)..*vMg ..X vQ o**..N*SYX vQ o**..vøó ..S oNgU9..g *v..xSY9S' S μ-SvU..
 v)..X vQ o**..gMv**..MμU- S*ZVUú..g..)ó" ..M3 XvUoU-*.S X vøo9..MU*S-oU-ú..vøó ..S oN" S' ...
 ' o9μM9..9S)ó oUM*..g3 vUQ.MμU- S*Zàv3 o.v-' ó .g og*..gUg-o9..x .øøoU.9oMSU9..vøó ..-' o...
 βWúóg .Xó S'9Zn í SUQ-.' o..g*-..9oM9oNgU9..oXoMg ú..SUM.í- WΛ-.' o.rUo' ..S*.v" *gU.vøó g ...
 v" 9v" U.SU.g 3 v-..g .o o3 oU-*.v)..*vMg ..X vQ o**Z...

...

n 9)ó oUM*..i o-" ooU..MμU- S*..Xó *S-..SU-ó 3 *.v)..*vMg ..X vQ o**.. øøo *N.g*.." o ...g*..SU..
 - g;oMv S*Z.“ ' So..3 gUú..*μMδ*)μ ..MμU- S*.. o3 gSU..*μMδ*)μ NgU9..3 gUú..μU*μMδ*)μ ...
 MμU- S*..- μQQo..v.gMSoøo.*SUSSMU-..X vQ o**N-.' ó o.ég o.3 gUú..o' g3 Xo*.v)..MμU- S*..-' g-..
 S X vøo9..vøó ..S oNi μ-..g *v..v)..-' v*o..-' g-..9oMSU9Z...

...

“ ' So..-' S*.XgXó .gU9..S*.gM43 XgUúSUQ.vURSU.gUú' o*.X vø9o.gU.vøó øS" ..v)..-' o..)SU9SUQN..
 " o..gMUV" o9Qo..-' g-..g..3 v' o.9o-gSo9..gUg ú*S*.v)..-' o.rUo' '...o*μ -*.." vμ 9..i o.i v-' ..Xv**S o...
 gU9...! SQ ú..øg μgi oZ." v" øó N*μM..gU.o))v' -.." vμ 9'.. offiSo o.oS' ó ..g*..SUSSMU-..*') 9-..) v3 ...
 -' o..3 o- v9v vQSMg ..)vMμ*Nv ..gU..o' -oU*So..o' XgU*SvU..v)..-' o..XgXó Z-.' ó o)v' oN" o..XgU-..v...
 μU9ó -g6o.g.3 v' o.9o-gSo9..o' Xv g-SvU..v)..-' ó...o*μ -*.SU.)μ-í ó...o*og MNgU9.." o.g *v..oUMí gQ...
 v-' ó '...o*og Mí o *.SU-ó o*-o9..SU.3 og*í SUQ*vMg ..X vQ o**..gU9..*vMg-g .." o i oSUQ-..v..μ-SSio..-' o...
 X o*oU-o9..)SU9SUQ..)v' ..-' oS ..v" U.gUg ú-SMg .gU9'..o*og M..Xi Xv*o*Z..

...

á o)ó oUM*..

...

GMMNGZ.<Zxí - í βYZ.G...+oU- o..rU- v9μMSvU-..v..à-g-gZá øøSo9... -' ..O9SSvUZà-g-g..w o**Z..
 ràI 2 mα° 1RWα° WB ° BZ.

...

GUUvUNwZΛ. .I v *SNwZxí - í - YZ-—" O.á O+rV2 G/.n rt O2 àrV2 ..V(.à V<rG/.wá V+á Oàà...
 r2 ..O-á VwOmá o*oU-SUQ-.' o..Ló" ..O-..àvMg ..w vQ o**..rUo' Zn SoMv g-oR+oUø g ..)v' ...

^W In line with the findings of Peiró-Palomino et al. (2023).

á oQſUg ... gU9... ´ i gU... wv SMZ.
'-X*réoMj vXgZpé oQſUg ó Xv SMé*vpí M*é" v 6éí-í-´ ó *XS oUZ9)...
 ...
 GUUvUSNwZ\` .àMſUSNt Zxí-íí YZ.-' o...-Uí g gUM..woUg Sg-SvU.t o-' v9..)v .t o' SM.v).àvMſg ...
 w vQo**Z.. àvMſg ... rU9Sſg-´ *... á o*og MN. WíxßYN. Wuß WWWZ.
'-X*ré9vSſ QſWZV-°é*WV-°Rí VRí1° R...
 ...
 GUUvUSNwZ\` S6\*´ gN/ Z\` ... o 3 gUN.-Zxí- WYZ.-" O.O-..á O+rV2 G/..àwrnG..t OGà-á O..
 V(.à V<rG/..wá V+á Oàà.r2 ...- " O.O-..á O+rV2 àNt O-" Vn V/V+r<G/..wGwOá Z.
 n SoMv g-oRt-oUó g ...)v ... á oQſUg ... gU9... ´ i gU... wv SMZ.
'-X*réoMj vXgZpé oQſUg ó Xv SMé*vpí M*é" v 6é3 o-' v9v vQſg ó Uv-oó oíó *XS í- WZ9)...
 ...
 I pí Q *N/ Zxí-íí YZw Sg-o'...SQ -*.v)..Ug-pí oZ.-' gU*Ug-SvUg ..OUøSvUB oU-g ./g" NWWßYN' ßR
 . °. Z! -X*ré9vSſ QſWZVWé*í- . ° Wí %í --- . - W.
 ...
 <oU- o...)v ...àvMſg ...r3 XgMZ.xUZYZ.-' o...Gµ*´ g SgU..àvMſg ...w vQo**...rU9o' ...xGàwrYZ.-' o...
 Gµ*´ g SgU.. àvMſg ... w vQo**... rU9o' ... xGàwrYZ. GøgSgi o...) v3 ...
'-X*réé" " " Z4S69µZpé3 X SùRvMſg B3 XgMégu*´ g SgURvMſg B vQo**BU9o' é...
 ...
 n o.n v3 SUS\$N/ Z\`<gi öüg..t g -SüüNI ZN7 vøgMMNt Zo-.g Zxí-íí . YN.-' o..O-´...oQſUg ..àvMſg ...
 w vQo**..rU9o' .í Zí-í . ..o9SSvU.NOj vXogU..<v3 3 S*SvUNn SoMv g-oRt-oUó g ..)v ...
 á oQſUg ...gU9...´ i gU...wv SMN.wpi Sſ-SvU*...V))SM...v)...- ' o...Oj vXogU..-USvUN.í-í . N.
 ' -X*ré9g-gZj vXgZpé9vSſWZ °° é°I %% ...
 ...
 Og*-ó ún:" Zxí--uYZ." v" ...- ' o..t S oUUSi3 .n øøo vX3 oU...+vg *.g o...-U)gS ...-v..G) SſZ." v 9...
 n øøo vX3 oUNß°xWſſ ßZ! -X*ré9vSſ QſWZVWé;Z v 99øøZ--1ZíZ-u...
 ...
 Oj v*-g-Z.. xí-íßYZ.. O9µMſ-SvUg ... g-gSß oU... *-g-S*-SMZ.
'-X*réoMj vXgZpéoj v*-g-é*g-S-SMR
o' XgSb9éSU9o' Z' XfiS-oP O9µMſ-SvUg ó g-gSß oU-ó *-g-S*-SM...
 ...
 (øó vN/ ZwZ\` .I o)S' oNwZxí- WYZw SUXg ...<v3 XvUoU..(gMv ..GUg ú*SZrU..(øó vN/ Z.
 wZ\` .I o)S' oNwZn g-g..àMſUM..)v .I µ*Uo**..gU9..n oMſSvU.t g6SUZGM9o3 SMw o**Z.
 ràI 2 ..u° 1R RWRHWWWRZn VrmWZVWéI u° 1R RWRHWWWRZ - - WR ...
 ...
 (oUQN.<Z\` " gUQN." Z\`/ µN.2 Z\`<' oUN.-Z\` " oN." Z\`/ µN.š Z\`´ ...-µN.´ Z..t Z..xí- WYZ./ vQR
 ´ gUk)v 3 g-SvU...gU9...S*...S XSMſ-SvU*...)v ...9g-g...gUg ú*SZ. à' gUQ gS.. G MSøo*... v)...
 w*úMſg-´ iNſ xí YNW% WuZ! -X*ré9vSſ QſWZü ué;Z*UZV-íR lí uZ- WZíZ-u...
 ...

(opí i goúNt ZN.` ..I gUMo-Nn Zxí - WYZ.I oúvU9...+n wmt og*í SUQ.“ o)g o..gU9...G**o**SUQ..
àμ*-gSgi SSúZV')v 9...-U\$ó *Sú.ń o**Z.

...

+ vi g .I í 9oU.v)..n Sog*o..<v gi v g-S\$o.2 o-” v 6Zxí - í - gYZ.+ vi g .I í 9oU.v)..n Sog*o.à-μ9ú...
í - Wx+I n .í - WYI9g-g*o-IZ." og -' M\$ o..GM\$**gU9.0 μg Sú.rU9o' ..Wiu- R- WIZàog— oN.
—USo9.à-g-o*.v)..G3 ó SgnrU*-Sμ-o..)v .." og -' .t o- SM.gU9..Oøg μg-SvU.xr" t OY..

...

+ vi g .I í 9oU.v)..n Sog*o..<v gi v g-S\$o.2 o-” v 6Zxí - í - i YZ.+ vi g .I í 9oU.v)..n Sog*o.à-μ9ú...
í - Wx+I n .í - WY<vøg' S-g-o*..Wl- R- W..I9g-g*o-IZrU*-Sμ-o..)v .." og -' .t o- SM.gU9...
Oøg μg-SvU.xr" t OYZ! [-X*íé9vS\\$ Q\\$WZ- ué<\(<\\$ R G\\$W.](#)

...

+ oMNaZr*' Sig6gNGZN-g*SμNt ZN. ...-v' S\$N+Zxí - WYZVU...! o.t o- v9v vQ\$..(g3 o” v 6...
v)...<v3 Xv*S...rU9SM*mG...á oø\$” ...v)...-! o...r**μo*...v)...“ oSQ -SUQ.GQQ oQ-SvUN.gU9...
á vi μ*-Uo**Z. àvM\$... rU9M-v' *... á o*og MN. WIKWN. " Wu. Z.
['-X*íé9vS\\$ Q\\$WZV- °é*WW- %R.WRWÍ Rl...](#)

...

<' g3 i ó *Ná ZN7 v6SMwZNa3 S' NwZN' ...< μ99g*Nt Zxí --- YZ.“ S\$-v' Sig-SvU..)v ..r9oU-SúSUQ..
gU9...'-og-SUQ.Vμ-S \$ *.SU.I μ*S\$o**..àí øóú*Zw vMø9SUQ*.v)...-! o.àøMU9.rU-ó Ug-SvUg ...
<vU)ó oUM.vU.O*-gi S' 3 oU.àí øóú*N. W °í Z.

...

<' g o*Nö ZN.` ...n G o**SvN.(Z.GZxí - í - YZ.GU..oUøo vX3 oU-R g*o9...gXX vgM...-v...3 og*í SUQ..
' oQ\$Ug ... *vM\$... X vQ o**Z. àvM\$ROMUv3 SM. w gU\$UQ.. àM\$UM*N. °-N. W- °WZ..
['-X*íé9vS\\$ Q\\$WZVWé;ZøX*Z- WIZ %Z-](#)

...

rU*-Sμ-v...<v*-g' SMU*o.9o...-í S3 vZxí - WYZrU9SM.9o..v vQ o*v.àvM\$...<oU- v..9o.n o*g' v v...
-μ' *-M\$Z. ['-X*íé” ” ” ZMZyMéo*9vM3 oU-v*R](#)
[SU*-SμM\\$Ug o*éo*-g9y <βy Gn *-M\\$éM\\$ g*Rí y <βy Gn *-M\\$éSxéW- %BX*R](#)
[í - Wé\)SoZ -3 ...](#)

...

...

r0 i μ*S\$o**Z. xí - WYZ. —' o... àvM\$... w vQ o**... rU9o' ... á oXv - àvμ-' ... G) M\$Z..
['-X*íéSfi μ*S\\$o**Zb-éví R' vμQ -é*vM\\$ R vQ o**RU9o' RoXv -é.....](#)

...

sv S)oNzZ-Zxí - í YZw SM\$g' ..<v3 XvUvU.GUg ú*S\$Z U9.O9SSvUZàX SUQ N2 o” .š v 6ZràI 2 m
u° 1R B1° Rí% . í RZ! [-X*íé9vS\\$ Q\\$WZV- °éi u1lβ%..](#)

...

svUo*NOZxí - í WZwv*-! μ3 gU.SU-ó Ug-SvUg ...g” ..gU9...! o...SQ -*.v)..Ug-μ oZs vμ Ug ..v)...! μ3 gU..
á SQ -*.gU9...! o..OUøS vU3 oU-NWx- YN. RWVZ! [-X*íé9vS\\$ Q\\$WZ Bβ°é;](#)” oZ - í WZ - Z. ...

...

7 müÜ- *Nà ZxWiß. YZ2 g-SvUg .rUM3 oNWí uRWí ZrU.2 g-SvUg .rUM3 oNWí uRWí .xXXZWWYZ.
2 I Oá Z. '-X*ré" " " Zi ó Z Qi vv6*BgU9MgX-ó *éUg-SvUg BUM3 oRWí uR
Wiß éUg-SvUg BUM3 oRWí uRWí ...

...

/I I n Z. xí-í í YZ. àvMg ...X vQo**...S9o' ...j.../vU9vU...I v vµQ ...v)...I g' 6SUQ..gU9...n gQU' g3 Z.
'-X*ré" " " Zi i 9ZyøZi6éMµU\$BgU9B3 vMgMé*-g-S-SBgU9B-gé*vMg R
X vQo**B9o' ...

...

/oQ-µ3 ... rU*-Sµ-oZ. xí-í βYZ. -' o... í-í β... /oQ-µ3 ... w v*Xó Sú... rU9o'Z.
'-X*ré" " " ZX v*Xó SúM3 é9v" Uvg9ó)SoéøS" ó SUSbé. ° 1u...

...

/S-o..GZ- ZN` .t oUQNGZxí-í. YZt og*í SUQ.n o3 vMg-SMI gM* 9SUQZwàmwv SSMg .àMUM...
` ..wv SSM.º xí YNWu WVZ! -X*ré9vSv QWZVWéàW. u-ü %B- - β' ...

...

t g gúNVZOZxí - WYZn v.I óuvU9...+n w.SU9Mg- v *SUSg-o9.i ú.Xv" ó)µ .*-g6o' v 9ó *! gøø.g...
' gUk) v 3 g-Sø... Xv-oU-Sg ffi. OM vQMF ... OMUv3 MAN. WYN. W- W° Z.
'-X*ré9vSv QWZVWé;ZM oMUZ - WIZ. Zi β...

...

t g 9SgN7 Zö ZN7 oU-NsZ.-Z. ...-gú v N<Z<Zi-í. Zt µ -Sg' Sg-o.GUg ú*SZi U9..O9SSvUZ. SoúZ.
ràI 2 mº 1RWWWRβ1-í BZ! -X*ré9vSv QWZVuβé; **géffUgoWß....

...

t µ gSNàZ.GZi - - uZ(vµU9g-SvUk..v)..(gM' ..GUg ú*SZi U9..O9SSvU.xoI vv6YZ<' gX3 gU.gU9...
" g é<á <N2 o" .š v 6ZràI 2 mº 1- . í uWí - u. Z! -X*ré9vSv QWZY- Wi WáW.

...

2 g 9vNt ZNàgSgUgNt ZNàg -o SNGZN.-g gU-v gNàZn" v))3 gUUNGZN.+SøgUUSUNOZxí - - 1YZ.
" gU9i vv6...vU...<vU*- µMSUQ.<v3 Xv*So...rU9Mg- v *mt o-' v9v vQi...gU9...-ó ...+µ9oZ.
w'g S... x(gUMYm VO<n ... Xui S' SUZ. sá <. ° - - 1Z.
'-X*réXui Mg-SvUz MZMj vXgZué oXv*Sv ué' gU9 oésá <. ° - - 1...

...

V àµ SgUN. wZ. xí - WYZ. <vUMX-µg ...)vµU9g-SvUk... v)... -' o... àvMg ... w vQo**... rU9o'Z.
'-X*ré" " " ZvMg X vQo**Z Q*-g-SMlí g°)u-° i - %W)W9- . - Mā-gM). u°9éi - WR
*vMg BK vQo**B9o' B o-' v9v vQiZX9)...

...

V àµ SgUN.wZN` ...7' gSv Uµ-' g*SuboNàZ.xí - WYZ.š V-...OGá 2 ...g*..š V-.../ rö O...g*..š V-...
ö G/ -Om <vUµ3 X-SvU " v 6... 9Sg oMSM.gU9... S*... S XSMg-SvUk...)v ... *µ*-gSgi SS-úZ.
àµ*gSgi SSú... GMMµU-SUQ. t gUgQ3 oU... gU9... wv SM... svj Ug N. WYN. í u . %Z.
'-X*ré9vSv QWZW1éàGt wsRWR- WRβ í...

...

VO<n Z. xí-í - YZ. " v" f... /Soffi. í-í - Z. O' oM-Sø... µ3 3 g' ūZ. VO<n Z.
'-X*ré9vSv QWZW1°éog° Wß WU...

V—gø\$UN.(ZN./ o..á vúN.GZN.` ...V *µ SgUN.wZxí - í WZ.<vU* µMSUQ.2 vUB vUo—g ú..àvM\$...
rU9SMf—v *mGU..GUg ú*S...v)...- ' o...O))oM*...v)...rU—ó X o—So...<v3 3 µUSS*Z..OMf vQSMf ...
OMfUv3 SMNWZNW ü í Z! —X*[né9vSv QëWZWé;ZM oMUZ-í VV ü í](#)...

...

woS Rwg v3 SÜvNs ZWvMgüvR-g9ovNGZs ZN. .á S*vNö Zxí - í ßZàvM\$.X vQo**g vµU9... ' o..” v 9m
—oU9*... gU9... MÜó QUMZ. V’)v 9... OMfUv3 SM wgXó *N. °%í YN. í 1WB” Z.
[' —X*\[né9vSv QëWZWüßévoXéQXgMíí\]\(#\)](#)...

...

wv —ó Nt Z.ONà—ó UNàZN.` ...+ ooUNt Zxí - WZàvM\$..w vQo**..rU9o’ ..í - W..R.O’ oM—So...
àµ3 3 g úZàvM\$..w vQo**..r3 Xó g—SoN“ g*’ SUQ-vUNh <Z...

...

w SMo—N./ Zxí - í í YZ.2 g—SvUg ...9oøo vX3 oU...9o Só *mGU9... ' v” p..GU9... ' v” ffl. OMfUv3 SM
t v9o SUQNW°NW% WZ! —X*[né9vSv QëWZWé;ZMUB v9Z-í VV% W](#)...

...

á vi ouU*NrZN` .I ú*6vøNt Z(Zxí - í WZ.— ' o..<gXgi SS—ú..GXX vgMZrU.OZ2 ZÜg -g.xO9ZN.— ' o...
à—gU)v 9...OUMMvXo9\$...v)...w’ Sv*vX’ ú..x“ SU—ó ..í - í WZ.t o—gX’ ú*SM..á o*og M.../ gi N.
à—gU)v 9... —Üó *S—úZ.
[' —X*\[néXg—vZ—gU\\)v 9Z9pég MSo*é\]\(#\)” SÜ-í WöU— S*éMvXgi SS—úRXX vgMé](#)...

...

àgM*Ns ZN’ v N<ZN/ g)v —µUbN+ZN(µ ó N+ZN. “ vo 3 N(Zxí - í í YZàµ*—gSgi o.n øøo vX3 oU...
á oX’ —... í - í í ... xW... o9ZZ. <g3 í 9Q... —Üó *S—ú... w o**Z.
[' —X*\[né9vSv QëWZWéu° 1W-uí W- %1\]\(#\)](#)...

...

àgSgUgNt ZNG i ó —Nö ZNG øg öüNt ZNI oMó N.“ ZN.<gXó Ug...+ZNo...g Zxí - WYZ.W— ' ..sá <...
GUUµg ...—gSSUQ.vU.<v3 Xv*So..rU9SMf—v *.gU9..àM oi vg 9*ZsvSU..á o*og M...<oU— om
<v3 Xo—oUM...<oU— o.vU.<v3 Xv*So..rU9SMf—v *.gU9..àM oi vg 9*Z.

...

àg*SÜàMvv ..v).t gUgQ3 oU—ZxU9ZZ.— ' o.àvM\$..w vQo**..rU9o’ ..)v ... ' o..w vøSUM*..v)...— ' gSgU9...
j.àg*SÜàMvv ..v).t gUgQ3 oUZ! —X*[né*g*SÜZ9pé*vM\\$ K vQo**R' gSgU9](#)...

...

àvM\$..w vQo**..r3 Xó g—SoZxí - í í gZàvM\$..w vQo**..rU9o’ ..í - í í ZàvM\$..w vQo**..r3 Xó g—SoZ.
“ g*’ SUQ-vUNh <Z...

...

àvM\$..w vQo**..r3 Xó g—SoZxí - í í YZàvM\$..w vQo**..rU9o’ ..í - í í ..Rt o— ' v9v vQí..àµ3 3 g úZ.
àvM\$..w vQo**..r3 Xó g—SoZ.“ g*’ SUQ-vUNh <Z...

...

à—QS—üNs ZOZN(Svµ**Ns RvZ.` .n µ gU9Nt Zxí - WYNI ouvU9...+n wnt og*í SUQ.“ ' g—...<vµU—*...
)v ... OMfUv3 SM. gU9... àvM\$... wó)v 3 gUMZ. VO<n ... wµi S’ SUQ. wé SZ.
[' —X*\[né9vSv QëWZW1°éu° 1uf’ .ß-°í uí RÜZ\]\(#\)](#).

...

à-SQS-üNs Z.OZNàoUNGZ.7 ZN.`(S-vµ**SNs ZWZxí - - uYZá oXv -..i ú...-' o...<v3 3 S*SvU..vU..-' o...
t og*µí o3 oU... v)... OMUv3 SM. gU9... àvMg ... w vQ o**Z.
'-X*réoMµí vXgZµéojí v*-g-é9vµ3 oU*é1Wwí W1Ww° í èà-SQS-üRaoUR S-vµ**R
<v3 3 S*SvURoXv -Z9)...

...
à-SQS-üNs Z.OZNàoUNGZ.7 ZN.` ..(S-vµ**SNs ZWZxí - WYZt S3 og*µí SUQ.Vµí ../\$o*m“ ' ú...+n w...
n vo*U-..G99...-XZ.-' o.2 o” ..w o**Z.

...
àú vø -6gNt ZN.` ..àM v**g o6Nt Zxí - WYZt og*µí SUQ.9oøo vX3 oU...” S' ..Soffµg Súm" v” ...
x*' vµ 9Y..gQQ oQ-o...SU9Sg-ý *.v)...9oøo vX3 oU...gMµU...)ý ...Soffµg Súffl.OM vQMg ...
OMUv3 SMNW. NW Bí - Z.' -X*ré9vSv QWZWwé;ZM oMUZ - WIZ . Z Bí ...

...
-2 n wZxí - í ßYZ." µ3 gU..n oøo vX3 oU...rU9o' Z.rU... " µ3 gU..n oøo vX3 oU...á oXv -Z.-USo9...
2 g-SvU*Z.' -X*ré' 9 ZµUXv Q9g-gRµU-ó é' µ3 gUR9oøo vX3 oU-µU9o' ...

...
-2 Oà<V...rU*Sµ-o...)ý ...à-g-S*SMZ.xí - WYZ. +/VI G/... On -<... G-rV2 ... n r+Oà-... í - WN
<v3 Xg SUQO9µMg-SvU-à-g-S*SM..GMv**..-' o...” v 9Z-2 Oà<V..rU*Sµ-o...)ý ..à-g-S*SMZ.
'-X*réµSµUo*MZ Q*So*é9o)gµ -é)So*é9vµ3 oU*éQvi g R9µMg-SvUR9Q*-R- WR
M3 Xg SUQR9µMg-SvUR-g-S*SMRµv**R' oR' v 9RUX9)...

...
ö gU..n µ))o NàZxí - WwZ.2 g-µí g '...SQ -*...-v...” o)g oZOpí vXogU..svµí Ug ...v)...w' Sv*vX' úNí W. YN.
“ . WR . Z.' -X*ré9vSv QWZWwWé;ZW 1Rß°1Z - WwZ -.” Z ...

...
“ o üo N<ZNRUQo' g -Ná ZN` ..7 SQ3 gUUN" ZN Zxí - - ßYZ.-' o...-' oó ú..v)... µ3 gU..9oøo vX3 oU-m
G...Mv**Rµí -µí g ..gUg ú*SZ.Opí vXogU..svµí Ug ...v)...wv SSGf ...á o*og MN. íxßYNß. Wß° uZ.
'-X*ré9vSv QWZWwW°%R° %Z--1 ...

...
“ v 9... I gU6Z. xí - í í YZ. “ v 9... n oøo vX3 oU... rU9Sg-ý *. j... n g-gI gU6Z.
'-X*ré9g-gi gU6Z v 9i gU6Z Q*vµí Mé” v 9R9oøo vX3 oU-µU9Sg-ý * ...

...

àvMg ..w vQo**rU9o' ..Wu- R- í- m og*í SUQàvMg ..“ o i oSUQ.Vøó .fWš og *...
àµXXo3 oU- g ú.3 g-ó Sg ...

...

/S-..v).gUUb' o*...

GUUb' ..GmrU9Mg- v ...S- Ni o* RgU9...“ v * Rg*o.*MUg S*NgU9..SU9Mg- v * ...“ oSQ -*....

GUUb' .I màµXXv -So..SU9Mg- v *...

GUUb' ..<mn g-g.àv í M*...

GUUb' .n m.àvMg ..w vQo**rU9o' ..RMUMX-µg ..) g3 o” v 6...

GUUb' ..Omà-g-S-SMg ..øg Sg-SvU...o*µ -*...

GUUb' ..(màXog 3 gU...gU6..M' o g-SvU*.v)...' o.*gU9g 9.3 o-' v9v vQí...“ S' ...' oo.g -ó Ug-So.vX-SvU*Z.

GUUb' ...(Z m n o*MSX-So...*g-S-SM...v)...9S)ó oUM*...SU... gU6SU*...i g*o9...vU...-' o...*gU9g 9...gQQ oQ-SvU...3 o-' v9v vQí...gQSU*...-' oo...
g -ó Ug-So.vX-SvU*...

GUUb' ..+mrU9o' N9S oU*SvUNgU9..M3 XvUbU-...“ v 9..*M o*..Wu- R- í- ...

GUUb' ..! m<' gUQp..SU.*vMg ..X vQo**vøó ...S o...

GUUb' .rmrU9o' .gU9..9S oU*SvURoøo ..*M o*.9S'- S µ-SvU.SU.Wu- .gU9.í- í- ...

GUUb' .sm<v3 XvUbU-Roøo ..*M o*.9S'- S µ-SvU.SU.Wu- .gU9.í- í- ...

GUUb' .7 m-vXgU9.i v-v3 ..Xó)v 3 SUQMµU- S*.SU.Wu- .gU9.í- í- ...

...

...

GUU' ..GmU9SM-ý ...S*-Ni o*-RgU9..." ý *Rg*o..*MUg Sv*NgU9.SU9SM-ý *..." oSQ -*...

n S oU*SvU...	<v3 XvUoU...	rU9SM-ý ..Lg3 o...	-US..v).. 3 og*í o3 oU...	n o)SUSvU...	àví M...	I o*-.. Ng*o.. *MUg Sv...	“ ý *.. Ng*o.. *MUg Sv...	rUøó -o9.. xš P úo*N.. 2 P UvY...	“ oSQ -...
I g*SM' µ3 gU.2 oo9*...	2 µ'-SSvU.gU9.I g*SM' o9SM' ..<g o...	n og-' *.j) v3 .. SU)oMSµ*.. 9Sog*o*...	x9og-' *éW- N-- Y...	n og-' '...g-o..Mµ*o9.i ú.. " rö éGrn àN-µi ó Mµ v*S*N.. 9Sg' ' vogNSU-o*S Ug ..SU)oMSvU*N.. ' o*XS g-v' ú..SU)oMSvU*Nv-S*S*.. 3 o9SgN3 oUSQS*NoUMX' g S*S*N.. 9SX' -' ó SgN?' ' vvXSUQ.MµQ N.. -o-gUµ*N3 og*o*Nøg SM gN.. ' ó Xo*..üv*-ó N3 g g SgN<' gQg*.. 9Sog*oN.oS' 3 gUSg*S*N.. - úXgUv*v3 Sg*S*N.. *MS*-v*v3 Sg*S*NMµ*-SM M*S*N.. Mµ*-SMoMSUvMMµ*S*N.. ú3 X' g-SM)Sg Sg*S*N.. vUMvM Ng*S*N- gMv3 gN.. 9oUQioNúo v" ..)oøó N.gi S*S*N.. SU-o*S Ug ..Lb3 g-v9o.SU)oMSvU*N..)vv9R ý Uo.-' o3 g-v9Sg*o*N.. oX v*úNoi v gNüSg..øSµ*N.. QµSlog..." ý 3 ..9Sog*oN*o' µg ú.. - gU*3 S-o9..9Sog*o*.xo' Mµ9SUQ.. " rö YN'. oXg-S S*NgU9..v-' ó ... SU)oMSvµ*.9Sog*o*.Xó ..W- N- - ... XovXoZ..	rU*-Sµ-o..)ý .." og -' .. t o- SM.gU9... Oøg µg-SvUN+ vi g ... I í 9oU.v)..n Sog*oN.. o9SSvU.í - Wí....	- Z - ...	Wu%Z 1...	š o*...	WZy ...
		<' S9..3 ý -g Sú.....	x9og-' *éWN-- ...Sšo.. i S-' *Y....	w vi gi SS-ú.v)..9úSUQi o-" ooU.. i S-' ..gU9..o' gM ú..%úog *..v)... gQbNo' X o**o9..Xó ..WN- - ...Sšo.. i S-' *Z...	-2 ..rU-ó IgQUMi.. + vµX.)ý ..<' S9 ... t ý -g Sú.. O*S Sg-SvU..	- Z - ...	í í -Zi- ...	š o*...	WZy ...
		<' S9..*µU-SUQ...	xy ..v)..XvXZ....	w oøg oUM.v)..*µU-SUQ.SU.. MS9 oU.µU9ó ..%úog *..v)..gQZ.	rU*-Sµ-o..)ý .." og -' .. t o- SM.gU9... Oøg µg-SvUN+*...	- Z - ...	ßZ - ...	š o*...	WZy ...
		t g-ó Ug .. 3 ý -g Sú.....	x9og-' *éW- N-- .. Sšo.i S-' *Y....	t g-ó Ug ..9og-' *.Xó ..W- N-- .. Sšo.i S-' *SU.." v3 oU.gQ9..Wp% ... úog *Z...	rU*-Sµ-o..)ý .." og -' .. t o- SM.gU9... Oøg µg-SvUN+*...	- Z - ...	u° WZ%...	š o*...	WZy ...

n S oU SvU...	<v3 XvUoU...	rU9Sg-ý .Ug3 o...	-US.v).. 3 og*í o3 oU...	n o)SUSVU...	àvpi M...	I o*-.. Ng*o... *MUg Sv...	“ ý *-.. Ng*o... *MUg Sv...	rUøó -o9.. xš P úo*N.. 2 P UvY..	“ oSQ -...
		2 µ- S SvUg .. 9o)SbUlb*....	xy .v)..XvXY....	GQI*-gUg 9Sio9..X oøg oUM.v).. Uµ- S SvUg .9o)SbUlb*Z.	rU*-Sµ-o..)ý .." og -' .. t o- S M.gU9... Oøg µg-SvUN+ vi g ... I jí 9oU.v)..n Sog*oN.. o9SSvUí - Wi....	- Z - ...	- Zí ...	š o*...	WZ y ...
		n S-...v” .SU.) µS*.. gU9.øoQ-gi o*....	x- P v” ‘...S6č. W- P ' SQ ‘...S6Y....	á S6F” oSQ -o9NgQI *gUg 9Sio9Ngøó gQ... X oøg oUM.v)..Uµ- S SvU.v” .SU..) µS*.gU9.øoQ-gi o*.g*... 3 og*í o9.i ú...’ o.µ13 3 g ú... o’ Xv*í o.øg µoZ.	gµ-’ ý *fl.M M g-SvU*.. i g*o9 .vU.µXXv -Søo... SU9Sg-ý *...	- Z - ...	W- Z - ...	š o*...	WZ y ...
“ g-ó -gU9.àgUS-g-SvU..		r3 X vøø9... *gUSg-SvU....	xX vXv -SvU.v).. XvXY....	w vXv -SvU.v)..XvXµ g-SvU.” S’ ... gM*...v..S X vøø9...vSo-...úXo*... g*.9o)Sb9.i ú...’ o.svSU-... t vUS-ý SUQ.w vQg3 .xst wYZ.	rU*-Sµ-o..)ý .." og -' ... t o- S M.gU9... Oøg µg-SvUN+ vi g ... I jí 9oU.v)..n Sog*oN.. Møg Sg-o*N.o9SSvU.. í - Wi...	VZ - ...	- Z B...	2 v...	í %Zy ...
		r3 X vøø9...” g-ó .. *vpi M....	xX vXv -SvU.v).. XvXY....	w vXv -SvU.v)..XvXµ g-SvU.” S’ .. gM*...v..S X vøø9...” g-ó ... *vpi M*.g*.9o)Sb9.i ú...’ o.svSU-... t vUS-ý SUQ.w vQg3 .xst wYZ.	rU*-Sµ-o..)ý .." og -' .. t o- S M.gU9... Oøg µg-SvUN+ vi g ... I jí 9oU.v)..n Sog*oN.. Møg Sg-o*N.o9SSvU.. í - Wi...	VZ - ...	- Z B...	2 v...	í . Zy ...
		2 v.gM*...v..g.. ' gU9” g*’ SUQ..)gSSú....	x- P v” ‘...S6č. W- P ' SQ ‘...S6Y....	á S6F” oSQ -o9..X oøg oUM.v).. XvXµ g-SvU*.” S’ vµ-.gM*...v..g.. ' gU9” g*’ SUQ.)gSSúNg*.. 3 og*í o9.i ú...’ o.µ13 3 g ú...	rU*-Sµ-o..)ý .." og -' .. t o- S M.gU9... Oøg µg-SvUN+ +*...	- Z - ...	W- Z - ..	š o*...	í %Zy ...

n S oU*U...	<v3 XvUoU...	rU9Sg-ý .Ug3 o...	-U-..v).. 3 og*í o3 oU...	n o)SUSU...	àvpi M...	I o*.. Ng*o.. *MUg S...	“ ý *.. Ng*o.. *MUg S...	rUøó -o9.. xš P úo*N. 2 P UvY..	“ oSQ -...
				o' Xv*í o.øg μo.xàOö Y.)ý .. μU*g)o... úQöUo.xy YZ...					
		n og-¹ *..) v3 .. μU*g)o..." g-ó N. *gUSg-SvU.gU9... ' úQöUo...	x9og-¹ *éW- N-- Y...	n og-¹ '...g-o.g- S μ-gi o...v.. μU*g)o..." g-ó N*gUSg-SvU.gU9... ' úQöUo.Xö ..W- N-- ..XovXoZ.	rU*-Sμ-o.)ý ..." og-¹ .. t o- SgU9... Oøg μg-SvUN+ vi g ... I jí 9oU.v).n Sog*oN. o9SSvUí - Wi...	- Z - ...	ß- uZí ...	š o*...	í %ZY ...
	à' o-ó ...	n og-¹ *..) v3 .. ' vμ*o' v 9.gS ... Xv μ-SvU....	x9og-¹ *éW- N-- Y...	n og-¹ '...g-o.Mμ*o9.i ú.. ' vμ*o' v 9.gS ..Xv μ-SvU.) v3 ... *v 9.)μio *.Xö ..W- N-- ..XovXoZ. " vμ*o' v 9.gS ..Xv μ-SvU.. SUMμ9o*.o' Xv*í o...v... Xg -Sv g-o.3 g-ó ...o**..-' gUí Z%.. 3 SMvU*.SU9Sg3 o-ó .xwt í ZY.. 9μo...v...-' o.μ*o.v).*v 9.)μio *..)ý ... Mv6SUQSUMμ9SUQMg N. Mg Mg N" vv9NgQ Sv -jí g ... ' ..o*SμoNgU9.gUS g .9μUQZ.	rU*-Sμ-o.)ý ..." og-¹ .. t o- SgU9... Oøg μg-SvUN+ vi g ... I jí 9oU.v).n Sog*oN. o9SSvUí - Wi...	- Z - ...	ßWiZ1...	š o*...	ßZ y ...
		GM**..v.. o oM S\$ú....	xy ..v)..XvXZ....	-¹ o.Xö MU-gQ.v)..-¹ o.. XvXμ g-SvU.." S' .gM**..v.. o oM S\$úZ.	“ ý 9.I gUö..." ý 9.. n oøo vX3 oU-.. rU9Sg-ý *NgU9... *μXXý -So.S9Sg-ý ...) v3 ..Vjí ..." ý 9.rU.. n g-g...	W- Z - ...	- ZB...	2 v...	ßZY ...
		w oøg oUM.v).. Mv6SUQ." S' ... Mg éi Sv3 g**....	xX vXý -SvU.v).. XvXZ....	" vμ*o' v 9..X oøg oUM.v).. Mv6SUQ." S' ..Mg .v .i Sv3 g**...	rU*-Sμ-o.)ý ..." og-¹ .. t o- SgU9... Oøg μg-SvUN+ vi g ... I jí 9oU.v).n Sog*oN. Møg Sg-o*N.o9SSvU.. í - Wi..	- Z - ...	VZ - ..	š o*...	ßZY ...

n S oU*U...	<v3 XvUoU...	rU9Sg-ý .Ug3 o...	-U-..v).. 3 og*í o3 oU...	n o)SSS/U...	àvpi M...	I o*.. Ng*o.. *MUg S...	“ ý *.. Ng*o.. *MUg S...	rUøó -o9.. xš P úo*N.. 2 P UvY..	“ oSQ -...
					...				
	wó *vUg .àg)o-ú...	rU-ó Xó *vUg .. øSv oUM.....	x9og-! *éW- N- - Y...	n og-! *.Xó .W- N- - .XovXo.) v3 .. SU-ó Xó *vUg .øSv oUMZ.. rU-ó Xó *vUg .øSv oUM.S.. 9o)Sú9.g*.9og-! .ý .9Sgi SSú...) v3 .SU-oU-SvUg .µ*o.v).X' ú*Sg ...)ý M.ý .Xv” ó N-’ og-oU9.ý ... gMµg N) v3 .gUv-! ó .Xó *vU.ý ... QvµX.Uv-.SUMµ9SUQ3 SSg' ú.ý ... Xv Sd.)ý M*Z.	rU*-Sµ-o.)ý ...! og-! .. t o- Sg.gU9... Oøg µg-S'UN+ vi g ... I í 9oU.v).n Sog*oN.. o9SSvUí - Wi...	- Z - ...	WBZ V...	š o*...	WZ y ...
		n og-! *..) v3 .. ’ vg9.SU;í S*....	x9og-! *éW- N- - Y...	GQl*-gU9g' 9So9.9og-! '...g-o.. 9µo...v...vg9.SU;í S*Z.	rU*-Sµ-o.)ý ...! og-! .. t o- Sg.gU9... Oøg µg-S'UN+*...	- Z - ...	%B...	š o*...	í VZ y ...
		wv SSg' .6S SUQ*.. gU9...-ý -í o....	x- P v” ..) oo9v3 č. WP' SQ .) oo9v3 Y..	w' ú*Sg' .øSv oUM.SU9o' ...S.. i g*o9.v.U.SU9Sg-ý *...! g-...o) oM.. øSv oUM.M3 3 S-o9.i ú... Qøó U3 oU-.gQpU-*.gU9...! g-... g' o..Uv-.9SoM-ú...o)ó' SUQ-v... o oMSvU*Z.	ö g' S-S*.v).. n o3 vMgM.xõ R n o3 YNn g-g*o-... ö ó *SvU.W...	VZ - ...	- Z - ...	2 v...	í BZ y ...
		rU-S g-o.Xg' -Uö .. øSv oUM.gQgS*... ” v3 oU..	xy ..v)...” v3 oU.gQ9.. Wz Y...	GQl*-gU9g' 9So9.X oøg oUM.v).. oøó Bg' -Uö o9...” v3 oU.gQ9.Wz.. úog' *.gU9.v 9ó ..” ' v... o' Xó SUM9.X' ú*Sg' .ý .*o' µg ... øSv oUM.i ú.g.M' oU-ý ..)ý 3 ó ... SU-S g-o.Xg' -Uö .SU..! o...g*-..W... 3 vU-! *.xy YZ.	rU*-Sµ-o.)ý ...! og-! .. t o- Sg.gU9... Oøg µg-S'UN+*N.. í - Wi.µX9g-o...	- Z - ...	%B° ..	š o*...	í -Z y ...
		wv SSg' .øSv oUM...	x- P Uv.øSv oUMé.. . P øSv oUM.v)-oUY...	wv SSg' .øSv oUM.g*..! o.µ*o.v).. X' ú*Sg' ..)ý M...v.gMSøo... Xv SSg' .vi ;oMSøo*.i ú..UvUR *g-o.gMv *Z..! o...o*- SMSvU..v... Xv SSg' .vi ;oMSøo*.o' Mµ9o*... X v)Sf S oU.MS oRo g-o9... øSv oUMZI ú..UvUR-g-o.gMv *... g' o.SU9Sgµg *.ý .oU-SS*..! g-..	ö g' S-S*.v).. n o3 vMgM.xõ R n o3 YNn g-g*o-... ö ó *SvU.W...	- Z - ...	. Z - ..	š o*...	.í í Z y ...

n S oU*SVU...	<v3 XvUoU...	rU9Sg-ý .Ug3 o...	-UŠ..v).. 3 og*í o3 oU...	n o)SSSVU...	àvpi M...	I o*.. Ng*o.. *MUg S...	“ ý *.. Ng*o.. *MUg S...	rUøó -o9.. xš P úo*N.. 2 P UvY..	“ oSQ -...
				g o..Uv-..)v 3 g ú.Xg -..v)..-’ o.. *-g-oZ-’ μ*NXv SSg ú.ý S U-o9... 3 SSg*.gU9..úvμ-’ .Q vμX*.. MμU-.g*.UvU- g-o.gMv *..øøoU.. -’ vμQ ..-’ oú.3 SQ -.Xv-oU-Sg ú... i o..S)úv 3 g ú.g))SSg-o9..’ S’ ... -’ o...μ SUQXg -ú.ý ...’ o.*-g-oZ.. wv SSg .øSv oUM.gQgS*.. Xó *vU*.o’ Mμ9o*.X*úMv vQg ... gU9..ú3 i v SμSv oUM.xoZg.. 9o*- μMSvU.v)..vi ;oM*YZ... 					
(vμU9g-SvU*.x)..“ o i oSQ.	GMb**..v.I g*SM7 Uv” o9Q..	wvXμ g-SvU..’ S’ .. Uv.o9μMg-SvU..	xX vXv -SvU.v).. XvXZY....	w vXv -SvU.v)..XvXμ g-SvU.xgQf *-gU9g 9Sio9Y..’ S’ ..-..úog *.v)... o9μMg-SvU...	gμ-’ ý *fl.Mg Mμ g-SvU*.. i g*o9..vU.*μXXv -Šo.. SU9Sg-ý *...	- Z - ...	- Zμ ...	š o*...	í °Zy ...
		Offpig .gMμ**..-v.. ffpig S-ú.o9μMg-SvU..	x- P μUoffpig č.. . P offpig Y...	<vμU- ú.o’ Xó -*flgQQ oQg-o9.. oøg μg-SvU.v)..-’ o..ffμo*-SvUNfi-v... ” ’ g-..o’ -oU-Š..! SQ ..ffpig S-ú... i g*Sμo9μMg-SvU.Qig gU-oø9..-v... g N*μ))SSU-..-v.oUgi o...’ o3 ..-v... o’ ó M*o...’ oS.i g*SM.SQ -*.g*.. g9μ -..MŠioU*ffi..	ö g S-S*..v).. n o3 vMgMμ.xö R n o3 YNn g-g*o-... ö ó *SvU.W...	. Z - ...	- Z - ...	2 v...	í í Z y ...
		+oU9ó ..Xg S-ú.SU.. i g*Sμo9μMg-SvU.....	x9S*gUM.) v3 .. Xg S-úY...	-’ o.gi *v μ-o.9oøg-SvU.) v3 .. Xg S-ú..xP WLSU.o9μMg-SvU.. g-gS3 oU-..v)..” v3 oU.gU9.3 oU.. ” S’ ..xv3 o.i μ-...o**..-’ gU.W... úog *.v)..o9μMg-SvUZ..	gμ-’ ý *fl.Mg Mμ g-SvU*.. i g*o9..vU.*μXXv -Šo.. SU9Sg-ý *...	- Z β..	- Z 1...	š o*...	í βZy ...
		t ogU.úog *.v).. *Mvv SUQ....	xúog *Y...	Gøó gQ..Uμ3 i ó .v)..M3 X o-o9.. úog *.v)..*Mvv SUQ.v)..g.. MμU- úfk.XvXμ g-SvU.gQ9.í %.. úog *.gU9..v 9ó Z..	-2 n wN" μ3 gU.. n øo vX3 oU-.rU9o’ ... í -í W.	WZ - ...	- Z u..	2 v...	í Ziy ...

n S oU*SVU...	<v3 XvUoU...	rU9Sg-ý .Ug3 o...	-U-..v).. 3 og*qi o3 oU...	n o)SUSVU...	àvpi M...	I o*.. Mg*o.. *MUg Sv...	“ ý *.. Mg*o.. *MUg Sv...	rUøó -o9.. xš P úo*N. 2 P UvY..	“ oSQ -...
GMM*...v.rUý 3 g-SvU.gU9..<v3 3 μUSg-SvUk...		rU-ó Uo-μ*ó *....	xy .v)..XvXZY....	—' o.o*-S3 g-o9..Uj3 i ó .v).. rU-ó Uo-μ*ó *.vμ-..v)..-' o.-v-g ... XvXp g-SvUNp*SUQ.-' o.rU-ó Uo-...) v3 .gUú.9oøSó.xSUMp9SUQ.. 3 vi So.X vUo*YSU.-' o...g*-..W... 3 vU-' *Z...	“ ý 9.I gU6...“ ý 9.. n oøo vX3 oU-... rU9Sg-ý *...	W- Z- ...	- Z- ...	2 v...	fuZy ...
		t vi So.gU9.. gU9 Sbo.. -o oX vUo.. *pi *MSX-SvUk....	x*qi *MSX-SvU*éW-.. XovXoY....	àpi *MSX-SvU*.-v.3 vi So*.gU9.. gU9 Sbo*Z.	gm-' ý *fl.Mg Mh g-SvU*.. i g*o9..vU.*μXXv -Sbo.. SU9Sg-ý *...	W- Z- ...	- Z- ...	2 v...	. -ZÝ ...
		G -ó Ug-Sbo.. *vpi M*.v).. SUý 3 g-SvU...	x- P v” č.MP' SQ Y...	<vpU- ú.o' Xó -*flgQQ oQg-o9.. oøg μg-SvU.v)..-' o.flp o*-SvU*-v... ” ' g-.o' -oU-.S*.-' o.3 o9Sg.xgY.. μUR Sg*o9.SU.-' oS.Møó gQo.v ... gM.v)..Møó gQo.v)..-' o... vXXv*SvUNxi Yg v” o9.-v.i o.. MS-Sg .v)..-' o..oQ3 oNgU9.xMY.. ' oX o+oU-g-Sbo.v).g..” Sbo.é' gú... v)..Xv S Sg .Xó *XoMSbo*fi.	ö é S-S*.v).. n o3 vMgM.xó R n o3 YNn g-g*o-... ö ó *SvU.W...	VZ- ...	- Z- ...	2 v...	í -Zy ...
" og -' .gU9...“ o Uo*...		/So.o' XoMgUMi.. g-... -	xúog *Y...	—' o.gøó gQo.Uj3 i ó .v)..úog *.. -' g-.g.Xó *vU.v)..- ..v... . úog *... v).gQo.Mp 9.o' XoM.-v...SboNS)... ' o.v .s' o..” ó o.-v.Xg*.-' vμQ ... So.o' Xv*o9.-v.-' o.*o' RgU9... gQoR.XoMSM9og-' '...g-o*.. X oøgSSUQg-.-' o.-S o.v)..! S.v ... ' ó ... - .úog *Ný .g.*XoMSMúog N. SU.g..Q3oU.MpU- úN-ó' S-ý úNý ... QpvQgX Sg ogZ.	rU*-Sμ-o.)ý ..." og -' .. t o- Sg.gU9... Oøg μg-SvUN+ vi g ... I jí 9oU.v).n Sog*oN. o9SSvUí - Wi...	í uZV...	uZ	2 v...	í Z y ...
		w o3 g-μi o.. 9og-' *..) v3 ..UvUR M3 3 μUSgi o... 9Sog*o*....	x9og-' *éW- N- - Y...	t ý -g S-ú...g-o.9μo.-v.. Mg 9Søg*Mh é .9Sog*o*N. MgUM *N9Si o-o*NgU9..M vUSM. ' o*XS g-ý ú.9Sog*o*.g3 vUQ.. XvXp g-SvU*.gQ9.β- ° - .úog *Z.	rU*-Sμ-o.)ý ..." og -' .. t o- Sg.gU9... Oøg μg-SvUNn +*...	- Z- ...	WV° Z ..	š o*...	í BZý ...

n S oU*U...	<v3 XvUoU...	rU9Sg-ý .Ug3 o...	-U-..v).. 3 og*í o3 oU...	n o)USSU...	àvî M...	I o*.. Mg*o.. *MUg S...	“ ý *.. Mg*o.. *MUg S...	rUøó -o9.. xš P úo*N. 2 P UvY..	“ oSQ -...
		Offiug .gMó**..v.. ffig Sú.. ' og -' Mg o....	x- P µUoffiug č. . P offiug Y....	<vµU- ú.o' Xó -*flgQQ oQg-o9.. oøg µg-S'U.v)..-¹ o..ffio*-S'UNfi-v... ” ' g-..o' -oU-..S..! SQ .ffig Sú.. i g*SM. og -' Mg o..Qíg gU-oø9...v... g N*µ))SSU-..v.oUgi o..¹ o3 ..v... o' ó M*o..¹ oS .i g*SMXv S SMg ... ' SQ -*.g*.g9µ -..M\$ioU*ffi....	ö g S-S*.v).. n o3 vMgMl.xö R n o3 YNn g-g*o-... ö ó *S'U.W...	. Z - ...	- Z - ...	2 v...	í í Ziy ...
		-Ušó *g ..¹ og -' .. Møó gQ...	xy ..v)..XvXYZ....	-¹ o.µUšó *g ..¹ og -' .Møó gQ.. x-" <Y3 og*í o*..¹ o..Møó gQ.. v)..u..- gM .SU-ó øoU-S'U*.gU9... ' S6R-gU9g 9Sio9.9og-¹ '...g-o*...) v3 .Bí .Mgµ*o*.g3 oUgi o..v... Xó *vUg ..¹ og -' Mg oNSUMµ9SUQ.. øgMl.bK øøoU-gi o.9Sog*o*... xoZQ9SX -¹ ó SgN:-o-gUµ*N. 3 og* o*YN..o*XS g-ý ú.S) oMS'U*N. MgUM .xí og*-NM øSg N. µ-ó SubN:o*-Sµi g YN. og -... 9Sog*o*N9Sgi o-o*N6SUóú... 9Sog*oYNgU9...¹ o..g9øó *o... o))oM*.v)..3 o9Sg ..- og-3 oU-Z.	rU*-Sµ-o..)ý ..¹ og -' .. t o- Sg.gU9... Oøg µg-S'UN+ vi g ... I jí 9oU.v)..n Sog*oN. Møg Sg-o*N.o9SS'U.. í - Wi...	W- Z - ...	1Z u...	2 v...	í ° Zy ...
OÚšvU3 oU-g .o µg Sú...		n og-¹ *..) v3 .. vµ-9vV .gS ... Xv µ-S'U...	x9og-¹ *éW- N- - Y...	GQl*-gU9g 9Sio9.9og-¹ '...g-o.. Xó ..W- N- - .XovXo.g-¹ S µ-gi o... -v..g3 i SöU-.Xg -Sµi g-o.3 g-ó ... Xv µ-S'UNSUMµ9SUQo3 S*S'U*...) v3 .SUµ*- Sg .gMSöS-úN. ' vµ*o' v 9*MNg *gU9..- µM*Z...	rU*-Sµ-o..)ý ..¹ og -' .. t o- Sg.gU9... Oøg µg-S'UN+ vi g ... I jí 9oU.v)..n Sog*oN. o9SS'U.i - Wi...	- Z - ...	W%Z 1...	š o*...	í . Ziy ...
		n og-¹ *..) v3 ...og9.. o' Xv*í o....	x9og-¹ *éW- N- - Y...	GQl*-gU9g 9Sio9.9og-¹ '...g-o.. Xó ..W- N- - .XovXo.g-¹ S µ-gi o... -v...og9.o' Xv*í oZ/ og9... o' Xv*í o.S..9o)Sub9.g*.gMl-o... o' Xv*í oN3 og*í o9.i ú... 3 SMvQg3 *.v)...og9..Xó .9oMSS- o... v)..i vv9NgU9..M vUSMo' Xv*í oN.	rU*-Sµ-o..)ý ..¹ og -' .. t o- Sg.gU9... Oøg µg-S'UN+ vi g ... I jí 9oU.v)..n Sog*oN. o9SS'U.i - Wi...	- Z - ...	WVW%...	š o*...	í Z y ...

n S oU*SVU...	<v3 XvUoU...	rU9Sg-ý .Ug3 o...	-UŠ..v).. 3 og*ří o3 oU...	n o)SSSVU...	àvří M...	I o*.. Ng*o.. *MUğ S...	“ ý *.. Ng*o.. *MUğ S...	rUøó -o9.. řš P úo*N.. 2 P UvY..	“ oSQ -...
				3 og*ří o9..i ú.3 SMvQg3 *.v).. og9..Xó .Qg3 ..v)..i vUóZ..					
		wğ -Sř g-o.. 3 g-ó .xí ŽY.. Xv ř-SvU....	x3 ogU.gUUřg .. o' Xv*ří oN. Qř3 BŸ..	wvXř g-S'UP" oSQ -o9..3 ogU.. oøo *.v)...' o.Xğ -Sř g-o.3 g-ó ... *3 g ó ...' gUi Ž%3 SMvU*.SU.. gó v9úUg3 SM9Sğ3 o-ó ... xwt í ŽYZ..	rU*-Sř-o..)ý ..." og -' .. t o- Sř.gU9... Oøg řg-S'UNàn +*...	- Z - ...	Wí Ž° ...	š o*...	í ° Žy ...
		àXoMŠ*.. X v-oMSvU....	x- P v" č.W- P' SQ Y...	—' o.àXoMŠ*.w v-oMSvUrU9o' .. 3 og*ří o*.. v" ..." o .g..MřU- úřk.. -ó' o*- Sğ .X v-oMo9..ğ og*.. vøó gX.." S' ...' o...gUQ*.v).S*.. øó -oí' g-oNSUøó -oí' g-oNgU9... XgU-.*XoMŠ*Z..-' o.rU9o' .S*.. Mğ Mř g-o9..ř*SUQ..o3 v-o..*oU*SUQ.. 9g-gNQvi g .i S:9Šó *Sú.. SU)ý 3 g-SřNgU9..SU-oQg-Sšo.. 3 v9o *.v..3 gX.*řSgi o.. gi Sg-..)ý .vøó .B- N- - ...ó' o*- Sğ ... *XoMŠ*.g-... SQ '...o*v ř-S'U*Z..	OùSvU3 oU-g .. wó ř 3 gUM.rU9o' ...	W- Z - ...	- Z - ...	2 v...	.í -Žy ...
VXXš -řUŠ-ú...	wó *vUğ .đ SQ -*...	GMđ**..v...;ř*Šđ.....	x- P UvUfo' Š-oU-č.. VP vi *ó øo9Y..	<vřU- ú.đ' Xó -řfgQQoQg-o9.. oøg řg-S'U.v)...' o.řřřo* S'UNřn v... MŠřioU*.oU;vú..*oMř o.gU9... o))oMSšo.gMđ**..v...;ř*Šđřřř.....	ö g Š-S*.v).. n o3 vMgMř.xó R n o3 Yřn g-g*o-... ö ó *S'U..W...	VŽ - ...	- Z - ...	2 v...	WZ y ...
		(' oo9v3 ..v).. ' o SğvU....	x- P Uv..) oo9v3 č.. . P)ř ..) oo9v3 Y...	<vřU- ú.đ' Xó -řfgQQoQg-o9.. oøg řg-S'U.v)...' o.řřřo* S'UNřř*.. -' ó o..) oo9v3 ..v)...o SğvUřř.....	ö g Š-S*.v).. n o3 vMgMř.xó R n o3 Yřn g-g*o-... ö ó *S'U..W...	. Z - ...	- Z - ...	2 v...	WZř y ...
		wv SŠğ '...SQ -*....	xVP)ř '...SQ -*č.. ° P Uv'...SQ -*Y..	GU.oøg řg-S'U.v)...' oo.. *řř Mğ-oQý Š*.v)..Xv SŠğ '...SQ -*m.. o oMv g .X vM*NXv SŠğ ... X ř g S3 .gU9..Xğ -SřNg-S'UN.. gU9..)řUMŠvUSUQ.v)..Qøó U3 oU-.. vU.g.*Mğ o..) v3 ..xUv..Xv SŠğ ...	(' oo9v3 ..." řř*o...	VŽ - ...	° Z - ...	š o*...	WZř y ...

n S oU*SVU...	<v3 XvUoU...	rU9Sg-ý .Ug3 o...	-US.v).. 3 og*í o3 oU...	n o)SUSVU...	àvpi M...	I o*.. Ng*o.. *MUg Sv...	“ ý *.. Ng*o.. *MUg Sv...	rUøó -o9.. xš P úo*N.. 2 P UvY..	“ oSQ -...
				SQ -*Y..v... - .x)µ .Xv SSg .. SQ -*Y...					
		w vXó -ú...SQ -*..)ý ... v3 oU....	x- P Uv...SQ -*č. %P)µ ...SQ -*Y...	<vµU- ú.o' Xó -*fgQQ oQg-o9.. oøg µg-SvU.v)... o.ffiio*-SvUNfi v... ” v3 oU.oU;vú... o'...SQ -...v... X Sg-o.X vXó -úffi...	ö g S-S*.v).. n o3 vMgM.xõ R n o3 YNn g-g*o-... ö ó *SvU.W...	%Z - ...	- Z - ...	2 v...	WZy ...
		(oo9v3 .v).. g**o3 i ú....	x- P Uv..) oo9v3 č. . P)µ ..) oo9v3 Y...	<vµU- ú.o' Xó -*fgQQ oQg-o9.. oøg µg-SvU.v)... o.ffiio*-SvUNfi v... ” ' g-.o' -oU-.9v.*-g-o... gµ-' ý SS*...o*XoM.gU9..X v-oM.. -' o'...SQ -.v)..XogM)µ ... g**o3 i úffi...	ö g S-S*.v).. n o3 vMgM.xõ R n o3 YNn g-g*o-... ö ó *SvU.W...	. Z - ...	- Z - ...	2 v...	WZy ...
		(oo9v3 .v).. 9S*µi**SVU...	x- P v” č.MP' SQ Y...	<vµU- ú.o' Xó -*fgQQ oQg-o9.. oøg µg-SvU.v)... o.ffiio*-SvUN. fiG o..SioU*.gi o..v.vXoUú... 9S*µi**Xv SSg ..S*µio*.SU.. X Sg-o.. v3 o*.gU9..SU.Xµi SM. *XgM*ffi...	ö g S-S*.v).. n o3 vMgM.xõ R n o3 YNn g-g*o-... ö ó *SvU.W...	VZ - ...	- Z - ...	2 v...	WZy ...
wó *vUg -(oo9v3 .gU9 ..< vSM...		àg-S)S9..9o3 gU9..)ý .MvU- gMX-SvU...	xy ..*g-S)S9.. 9o3 gU9Y..	- o.Xó MU-gQ.v)...v-g .. 9o3 gU9..)ý ..)g3 Sú.XgUUSUQ.. g3 vUQ3 g' S9..ý .SURµUSvU.. ” v3 oU.gQ9..Wv-v... u... g-.S.. *g-S)S9...” S' .3 v9ó U.3 o- v9*Z.	-USo9..2 g-SvU*.. wvXµ g-SvU.n SSSvU..	W- Z - ...	VZ - ...	2 v...	í - Zy ...
		wµi SM*oM' .. M' µX-SvU...	x- P v” .M' µX-SvUč. WP' SQ ... M' µX-SvUY..	- o.Xó MS9o9...oøo .v)..Xµi SM *oM' .M' µX-SvU.i g*o9.vU.. o' Xó -.vXSvSvUN3 og*í o9.vU.g.. *Mg o.) v3 ..x' SQ ú..M' µX-Y..v... W- .xóó ú..MgUY...	ö g S-S*.v).. n o3 vMgM.xõ R n o3 YNn g-g*o-... ö ó *SvU.W...	- Z - ...	VZ - ...	š o*...	í VZy ...
		Og ú.3 g' SgQ....	xy .v)..3 g' S9.. ” v3 oU.gQ9..WR WY..	- o.Xó MU-gQ.v)... v3 oU.gQ9.. WvM.úog *..” ' v.g o.3 g' S9..ý ... SURµUSvUZ.	-USo9..2 g-SvU*.. wvXµ g-SvU.n SSSvU..	- Z - ...	%Z u...	š o*...	í VZy ...
		ö µ Uõ gi o... o3 Xvú3 oU-....	xy .v)...v-g ... o3 Xvú3 oU-Y...	<vU- S µ-SUQ)g3 Sú...” ý 6ó *.. gU9.v” URNMµU-...” ý 6ó *g*g...	“ ý 9.I gU6...” ý 9... n oøo vX3 oU-... rU9Sg-ý *...	- Z - ...	u%Z °	š o*...	í í Zy ...

n S oU SvU...	<v3 XvUoU...	rU9Sg-ý .Ug3 o...	-UŠ.v).. 3 og*í o3 oU...	n o)SUSvU...	àvpi M...	I o*.. Ng*o.. *MUg S...	“ ý *.. Ng*o.. *MUg S...	rUøó -o9.. šš P úo*N. 2 P UvY..	“ oSg -...
				Xó MU-gQ.v)..v-g .. o3 Xvú3 oU-Z.					
		(‘ oo9v3 .v).. 9v3 o*-SM. 3 vøo3 oU...	x- P v” č.MP' SQ Y...	<vpiU- ú.o' Xó -*fgQQ oQg-o9.. oøg µg-SvU.v)..-' o.ffiio*-SvUNfi v... MŠSioU*.oU;vú.) oo9v3 .v)... 3 vøo3 oU-.gU9'..o*S9oUMffi...	ö g S-S*.v).. n o3 vMgMl.xõ R n o3 YNn g-g*o-... ö ó *SvU.W...	VZ - ...	- Z - ...	2 v...	WZY ...
	rUMi*SboU*..	Offpig .X v-oMSvU.. v)..*vNĚ ..Q vpiX*..	x- P v” č.MP' SQ Y...	<vpiU- ú.o' Xó -*fgQQ oQg-o9.. oøg µg-SvU.v)..-' o.ffiio*-SvUN. fi' v” .offpig .S*..-' o.X v-oMSvU.v)... ' SQ -*.gU9..) oo9v3 *.gMv*.. *vNĚ ..Q vpiX*.i ú..-' o.*-g-offfi...	ö g S-S*.v).. n o3 vMgMl.xõ R n o3 YNn g-g*o-... ö ó *SvU.W...	VZ - ...	- Z - ...	2 v...	í %ay ...
		Offpig .gM*..v.. Xv” ó ...	x- P v” č.MP' SQ Y...	<vpiU- ú.o' Xó -*fgQQ oQg-o9.. oøg µg-SvU.v)..-' o.ffiio*-SvUN. fi' v” .offpig .S.gM*..v.. Xv” ó ffi...	ö g S-S*.v).. n o3 vMgMl.xõ R n o3 YNn g-g*o-... ö ó *SvU.W...	VZ - ...	- Z - ...	2 v...	í Z y ...
		wv” ó .. 9S'- S µ-o9.i ú.. *o' µg ... ý ŠU-g-SvU..	x- P o' ' o3 o ú.. µUoffpig č.βP offpig Y...	<vpiU- ú.o' Xó -*fgQQ oQg-o9.. oøg µg-SvU.v)..-' o.ffiio*-SvUNfi-v... " ' g-.o' -oU-.S.Xv SŠĚ .Xv” ó ... 9S'- S µ-o9.gMŠ 9SUQ..v.*o' µg ... ý ŠU-g-SvUffi...	ö g S-S*.v).. n o3 vMgMl.xõ R n o3 YNn g-g*o-... ö ó *SvU.W...	βZ - ...	- Z - ...	2 v...	í . Z y ...
		GM*..v.Xpi SM *ó øSM*.. 9S'- S µ-o9.i ú.. *vNĚ ..Q vpiX...	x- P o' ' o3 o ú.. µUoffpig č. P offpig Y...	<vpiU- ú.o' Xó -*fgQQ oQg-o9.. oøg µg-SvU.v)..-' o.ffiio*-SvUN. fiG o.i g*SMXpi SM*ó øSM*N*µMl.. g*.x' 9ó .gU9..*oMl S-úNX Š g' ú.. o9µMg-SvUNMogU..” g-ó NgU9 ... ' og -' Mġ oN9S'- S µ-o9.offpig ú.. gMv*..*vNĚ ..Q vpiXffi...	ö g S-S*.v).. n o3 vMgMl.xõ R n o3 YNn g-g*o-... ö ó *SvU.W...	. Z - ...	- Z - ...	2 v...	í βZ y ...
	GM*..v.G9øgUM9. O9µMg-SvU..	á o*XoM.)ý ... gM9o3 SM.) oo9v3	x- P v” č.MP' SQ Y...	<vpiU- ú.o' Xó -*fl.gQQ oQg-o9 ... oøg µg-SvU.v)..-' o.ffiio*-SvUNfi-v... " ' g-.o' -oU-.S.gM9o3 SM.) oo9v3 '...o*XoMo9 ffi...	ö g S-S*.v)... n o3 vMgMl.xõ R n o3 YNn g-g*o-... ö ó *SvU.W...	VZ - ...	- Z - ...	2 v...	WZY ...
		wvXpi g-SvU.” S' ... g9øgUM9... o9µMg-SvU....	xX vXý -SvU.v)... XvXZY....	w vXý -SvU.v)..XvXpi g-SvU.xgQpR *gU9g 9Sio9 Y.” S' .g-...og*..W... úog *.v).o9µMg-SvUZ.	gµ-' ' *fl.Mġ Ml g-SvU*.. i g*o9.vU.*µXXý -Šo... SU9Sg-ý *...	- Z %	- Z W	2 v...	í l Z y ...

n S oU SvU...	<v3 XvUoU...	rU9Sg-ú .Ug3 o...	-U-..v).. 3 og*í o3 oU...	n o)SUSvU...	àvpi M...	I o*-.. Ng*o... *MUg Sv...	“ ú *-.. Ng*o... *MUg Sv...	rUøó -o9.. xš P úo*N.. 2 P UvY..	“ oSQ -...
		š og *v)..ó -Šg ú.. *Mvv SUQ...	xioğ *l...	2 μ3 i ó .v)..úog *g..Xó *vU.v).. -ó -Šg ú..*Mvv .oU- gUM.gQ... MgU.o' XoM..v..*XoU9.." S' SU.. -ó -Šg ú..o9μMg-SvUZ...	-2 ..O9μMg-SvUg N àM\$U-SMNgU9... <μ -pí g ... V QgUSig-SvU.. rU*-Sμ-o..)v ... à-g-S*-SvM...	%Z - ...	- Z V...	2 v...	í °Zy ...
		+oU9ó ..Xg Sú.SU.. g9øgUM9... o9μMg-SvU..	x9S-gUM.) v3 .. Xg SúY...	-' o.gi *v μ-o.9oøŠg-SvU.) v3 .. Xg Sú.xP W\$SU.g9øgUM9... o9μMg-SvU.g-gS3 oU-.v).. ” v3 oU.gU9.3 oU.." S' .g-...og*-... W.úog *v)..o9μMg-SvUZ..	gμ-' v *flMg Mh g-SvU*.. i g*o9 .vU.*μXXv -Šo... SU9Sg-ú *-...	- Z β...	- Z1..	š o*...	í Zby ...

...

...

GUUb' .I màµXXý -Šo.SUŠŤ-ý *...

n Š oU*ŠU...	<v3 XvUbU...	rUŠŤ-ý ..Ug3 o...	-UŠ.v).3 og*í o3 oU...	àví M...
I g*ŠŤ' µ3 gU. 2 oo9*...	à' o -ó ...	GŤŤ**..v.o oM ŠŤú....	xy .v)..XvXY....	Ví' ..“ ‘ 9.SU.n g-gŤWiu- Hí - W..*ó Š*....
I g*ŠŤ' µ3 gU. 2 oo9*...	2 µ- ŠŠ/U.gUŤ.I g*ŠŤ t o9ŠŤ ..<g o...	n Š-...v” ..SU.) µŠ*...	x- P v” ‘...Š6č.W- P' ŠQ .. ‘ Š6Y....	rU*-Šµ-o.)ý .." og -' .t o- ŠŤ.gUŤ.Oøg µg-ŠvUN+ vi g .. I í 9oU.v).n Šog*oNø9ŠŠ/U.í - Wi...
I g*ŠŤ' µ3 gU. 2 oo9*...	2 µ- ŠŠ/U.gUŤ.I g*ŠŤ t o9ŠŤ ..<g o...	n Š-...v” ..SU.øoQ-gi o*...	x- P v” ‘...Š6č.W- P' ŠQ .. ‘ Š6Y....	rU*-Šµ-o.)ý .." og -' .t o- ŠŤ.gUŤ.Oøg µg-ŠvUN+ vi g .. I í 9oU.v).n Šog*oNø9ŠŠ/U.í - Wi...
(vµUŤg-ŠvU*.v).. “ o i oŠUQ..	GŤŤ**..v.. SU)ý 3 g-ŠvU.gUŤ.. M3 3 µUŠŤ-ŠvU*...	t vi Šo..o oX' vUb.. *µi *MSXŠvU*...	×µi *MSXŠvUéW- .. XovX oY....	“ ‘ 9.I gU6...“ ‘ 9.n øø o vX3 oU-.rUŠŤ-ý *...
(vµUŤg-ŠvU*.v).. “ o i oŠUQ..	GŤŤ**..v.. SU)ý 3 g-ŠvU.gUŤ.. M3 3 µUŠŤ-ŠvU*...	/gUŠ Šb...o oX' vUb.. *µi *MSXŠvU*...	×µi *MSXŠvUéW- .. XovX oY....	“ ‘ 9.I gU6...“ ‘ 9.n øø o vX3 oU-.rUŠŤ-ý *...
(vµUŤg-ŠvU*.v).. “ o i oŠUQ..	GŤŤ**..v..I g*ŠŤ 7 Uv” o9Q...	“ v3 oU.” Š' .i g*ŠŤ o9µŤ-ŠvU..	xX vXý -ŠvU.v)..” v3 oUY....	rU*-Šµ-o.)ý .." og -' .t o- ŠŤ.gUŤ.Oøg µg-ŠvUN+ vi g .. I í 9oU.v).n Šog*oNŤøg Šg-o*Nø9ŠŠ/U.í - Wi...
(vµUŤg-ŠvU*.v).. “ o i oŠUQ..	GŤŤ**..v..I g*ŠŤ 7 Uv” o9Q...	t oU.” Š' .i g*ŠŤ o9µŤ-ŠvU..	xX vXý -ŠvU.v).3 oUY....	rU*-Šµ-o.)ý .." og -' .t o- ŠŤ.gUŤ.Oøg µg-ŠvUN+ vi g .. I í 9oU.v).n Šog*oNŤøg Šg-o*Nø9ŠŠ/U.í - Wi...
VXXý -µUŠú...	GŤŤ**..v..G9øgUŤ9.. O9µŤ-ŠvU..	“ v3 oU.” Š' .. g9øgUŤ9..o9µŤ-ŠvU..	xX vXý -ŠvU.v)..” v3 oUY....	rU*-Šµ-o.)ý .." og -' .t o- ŠŤ.gUŤ.Oøg µg-ŠvUN+ vi g .. I í 9oU.v).n Šog*oNŤøg Šg-o*Nø9ŠŠ/U.í - Wi...
VXXý -µUŠú...	GŤŤ**..v..G9øgUŤ9.. O9µŤ-ŠvU..	t oU.” Š' .g9øgUŤ9.. o9µŤ-ŠvU..	xX vXý -ŠvU.v).3 oUY....	rU*-Šµ-o.)ý .." og -' .t o- ŠŤ.gUŤ.Oøg µg-ŠvUN+ vi g .. I í 9oU.v).n Šog*oNŤøg Šg-o*Nø9ŠŠ/U.í - Wi...

...

...

...

...

GUU' ..<mm g-g.àvjí M*...

...

OU~~ø~~SvUB oU-g ..wó)' 3 gUM.rUo'

“ v)Nt Zs ZNO3 ó *vUNs Z:“ ZNO*úNn Z<ZNo.à' ó i SUsUNGZ\ ...“ oU9 SUQNUZGZxí -íí YZí -íí ..OU~~ø~~SvUB oU-g ..wó)' 3 gUM.rUo' ..I2 o” ...
" gøoUN<-nš g o..<oU-ó ..)v' ..OU~~ø~~SvUB oU-g ./g” ..` ..wv SMZZ! -X*~~ré~~éoxSZig oZø9mé...

...

(‘ oo9v3 ...! vµ*o...

(‘ oo9v3 ...! vµ*oZxí -íí YZ(á OOn Vt ..r2 ...-“ O...“ Vá /n .í -íí ZGøgSgi o..) v3 ml -X*~~ré~~é) oo9v3 ' vµ*oZ Q*So*é9o)gµ -é)So*éí -íí R
-íé((r“ ó í -íí ó wn (ó I vv6 o-ó n SQS-g ó (SÜg ó “ oi ZX9)...

...

rU*-Sµ-o..)v' ...! og -' .t o- SM.gU9..Oøg µg-SvUN+ vi g .I jí 9oU.v).n Sog*oNo9SSvU.í - Wl...

+ vi g .I jí 9oU.v).n Sog*o..<v gi v g-Søo.2 o-” v 6Zxí -í -g YZ+ vi g .I jí 9oU.v).n Sog*o.à-µ9ú.í - Wl.x+I n .í - WYI9g-g*o-lZrU*-Sµ-o..)v' ...
" og -' .t o- SM.gU9..Oøg µg-SvU.xr" t OY..

...

rU*-Sµ-o..)v' ...! og -' .t o- SM.gU9..Oøg µg-SvUN+ vi g .I jí 9oU.v).n Sog*oNMøg Sg-o*No9SSvU.í - Wl...

+ vi g .I jí 9oU.v).n Sog*o..<v gi v g-Søo.2 o-” v 6Zxí -í -i YZ+ vi g .I jí 9oU.v).n Sog*o.à-µ9ú.í - Wl.x+I n .í - WYI<vøg Sg-o*..Wl-R- Wl..
I9g-g*o-lZrU*-Sµ-o..)v' ...! og -' .t o- SM.gU9..Oøg µg-SvU.xr" t OYZ! -X*~~ré~~é9vSZ Q*WZ - ué<(<š R G%W.

...

rU*-Sµ-o..)v' ...! og -' .t o- SM.gU9..Oøg µg-SvUN+ +*9g-g*o-...

rU*-Sµ-o..)v' ...! og -' .t o- SM.gU9..Oøg µg-SvU.xr" t OYZxí - WYZ..“ og -' Ro g-o9.àn +*ZGøgSgi o..) v3 ...! -X*~~ré~~éøSi' µi Z og -' 9g-gZ Q*9Q..

...

-2 n wN! µ3 gU.n øøo vX3 oU-.rUo' ...

-2 n wZxí -íí Yzn vMµ3 oU-g-SvU.gU9.9v” Uvg9*ZrU...“ µ3 gU.n øøo vX3 oU-.á oXí -*Z- -USo9.2 g-SvU*Z! -X*~~ré~~é' 9 4U9XZ Q*9g-gR
MU-ó é9vMµ3 oU-g-SvUgU9Bv” Uvg9*...

...

-2 ..O9µMg-SvUg NàM~~ø~~U-SSMgU9..<µ -jí g ..V QgUSig-SvU.rU*-Sµ-o..)v' .à-g-S-SM..

-2 Oà<V.rU*-Sµ-o..)v' .à-g-S-SM.x-rà YZxí -íí YZ.-2 Oà<V.rU*-Sµ-o..)v' .à-g-S-SM.x-rà Z! -X*~~ré~~é9g-g4IS4U~~ø~~*MZ Q*...

...

—2 .rU-ó RQUM...f vµX.)v ..<' S9.t v -g S-ú.O*-S g-SvU....
 <t O.rU)v <' S9.t v -g S-ú.O*-S g-o*Zxí -íí YZGøgSgi o.) v3 ...! —X*íéMS93 v -g S-úZ Q...

...

—US-o9.2 g-SvU*.wvXµ g-SvU.n SSSvU..
 —US-o9.2 g-SvU*.wvXµ g-SvU.n SSSvUZxí -íí YZ." v3 o.wgQ.j.n g-g..wv -g ZwvXµ g-SvU.n SSSvU.n g-g..wv -g Z.
 ' —X*íéXvXµ g-SvUµUZ Q9g-gXv -g é...

...

ö g S-S*.v).n o3 vMgM.xö R o3 YNn g-g*-ö ó *SvU.W...
 <vXXo9Qnt SMgo Nsv' U..+ó' SUQN<g ..." oU S6.7 Uµ-*oUNà-g))gUrZ/SU9i ó QNs gU...-óv o N2 güRSg..G Sig9gNn gø9..G -3 gUNt SMgo ...
 I ó U g 9NGQUo*..<v Uo Nt Zà-oøoU.(S' N/ Sg..+g*-g 9SN" gg6vU..+;ó " NG9g3 ..+ úUUNàgU9 g..f g' UNG oU.." SMoUN+g' ú...
 " SU9 oN2 Sg.r MoU6vN7 g- SU.7 SÜo i gMNs v* µg..7 µ*o N7 ú o./ Zt g fµg 9-N7 o ú.t M gUUNö g ó Sig.t oM6vøgNs µ g;...
 t o9üs v *6úNwg3 o g.wg' -vUNn gUSb .wo3 *-oSUNsv*)SUb.wó Ub*Nv*6g .á ú9.mUNsv' gUUb*.øvU.á .v3 ó NI' SS-o.àoS Ná gMo ...
 àSQ gUNàøoU9R S.à6ggUSQNso)) ou.à-g-vUNG6*o .àµUR* .v3 NOS-gU...-üo QøNŠ RSUQ.“ gUQN.-v o.“ SQNà-oøoU.“ SvU.gU9...
 n gUSb .ÜS g-Zxí -íí YZö R o3 .n g-g*-í -íí .I9g-g*-lZö g S-S*.v).n o3 vMgM.xö R o3 Y.w v;oMZ.
 ' —X*íé9vSZ QWZß ü éö n Ot n àíí...

...

“ v 9.I gU6.“ v 9.n øøo vX3 oU..rU9SM-v *...
 “ v 9.I gU6Zxí -íí YZ.“ v 9.n øøo vX3 oU..rU9SM-v *.j.n g-gI gU6Z! —X*íé9g-gi gU6Z v 9i gU6Z Q*vµ Mé” v 9Røøo vX3 oU-R
 SU9SM-v *_...

...

Vµ ...“ v 9.SU.n g-g...
 Vµ ...“ v 9.SU.n g-gZxí -íí Wµ µ.í WZO oM S S-ú.gMM**ZVµ ...“ v 9.SU.n g-gZn g-g.é o.Uv...vUQ .gøgSgi oZá ó- Søø9..) v3 m
 ' —X*íévµ ” v 9SU9g-gZ QgX' ó é* g oRv)R' oRvXµ g-SUR S' RgM**RvR oM S S-ú...

...

...

...

GUU' .n m àvMg ..w vQ o**rU9o' .RMUMX-µg .) g3 o" ´ 6...



...

àvµí Mm àvMg ..w vQ o**r3 Xó g-Só.o.xí-ííi YZ.

...

...

...

...

...

GUUó' .Omà-g-S*SMf .øg Sg-SvU...o*µ -*...

<v3 XvUoU-...	(gMv̇ ..W oSQUøg µo... xẆ..	(gMv̇ ..W X vXv̇ -SvU... xí Y..	(gMv̇ .í .. oSQUøg µo... xßY..	G X g... ... x Y..	7 t V... ... x°Y..
2 µ´ SSvU..` .I g*SMt o9SMf ..<´g o...	.Zí ...	- Z ° ...	- Z ° ...	- Zi. ...	- Zu...
“ g-ó ...` .àgUS-g-SvU...	ßZ - ...	- Z %...	- Z ...	- Zi. ...	- Z ...
à' o -ó ...	í Zi- ...	- Ziß...	- ZW...	- Zi ...	- Z ° ...
wó *vUg .àg)o-ú...	í Zi í ...	- Z 1...	- Zi í ...	- Zi í ...	-`Z 1...
GMM**..v.I g*SM7 Uv” o9Q...	ßZ V...	- Z %...	-`Z ° ...	- Zu...	- Z V...
GMM**..v.rU)´ 3 g-SvU..` .. <v3 3 µUSMf-SvU*...	Wm%...	-`Z %...	- Z 1...	- Z - ...	- Z% ...
" og -' ...` “ o Uo**...	ßZ	- Z ...	-`Z	- Zu...	- Z V...
OÜßSvUß oU-g .0 µg S-ú...	í ZW...	- Zß...	- Zi- ...	- Z - ...	-`Z ° ...
wó *vUg .á SQ -*...	.Zí ...	- Z ° ...	- Z% ...	- Zi. ...	- Zi- ...
wó *vUg ..(´ oo9v3 ...` ..<' vSM...	ßZ - ...	-`Z - ...	- Zi 1...	- Ziß...	- Zi- ...
rUMµ*SoUo**...	í Zi ...	- Z	- Z ...	- Zi 1...	- Z u...
GMM**..v..G9øgUM9..O9µMf-SvU...	í Z %...	-`Z u...	- Z	- Zi. ...	- Z 1...

àvpi Mmgpi-1 v * ..Mg Mh g-SvU*Z2 v-om-1 ó o..*! vpi 9..i o..vU ú..vUo..9o-ó 3 SUSQ.)gMv ...Xó ..M3 XvUoU...xoSQUog po...? WZ.-1 S*.S*.*' v" U..SU.. M pi3 U*.xWVXi YNgU9.xfYZ.-1 o..< vUi gM *.G X' g.xM pi3 U.. YX vø9o*.g.3 og*pi o..v).SU-ó Ug .MUs*-oUMi.v).SU9Mg-v *.. S' SU.g.M3 XvUoU-N. gU9..g*..gU.gXXS9'.. pi o..v)..-1 pi3 i NS..*! vpi 9..i o..gi vøo.. Z Z.-1 o..7 gSó R ouó RV 6SU.x7 t VY.3 og*pi o..oøg mg-o*..-1 o..Qv9Uo*..v)..)S..v)... SU9Mg-v *.. S' SU.ogM..M3 XvUoU..i ú..o) oMSUQ.-1 o..X vXv -SvU.v)..øg SgUM..g3 vUQ.øg Sgi o*..-1 g-.3 SQ -.i o..-1 o..M3 3 vU..øg SgUMZ.-1 o.. 3 ogU.7 t V.*' vpi 9..i o..gi vøo.. ZxM pi3 U.x%Z.

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GUUb' ..(màXog 3 gU..gU6..M' o g-SvU*.v)..-1 o.gXXS9.3 o-1 v9v vQí.. S' ..-1' oo.g-ó Ug-Só.vX-SvU*Z.

VX-SvU..	àwr....	I " 2	(v“	Vww....
piU' ó g S' 3 ...	- Ziu...	- Ziu...	- Ziu...	- Ziu...
piU' ó Qv3 ...	- Zi ...	- Ziu...	- Zií ...	- Zi° ...
XM..	- Ziu...	- Ziu...	- Ziu...	- Ziu...

àvpi Mmgpi-1 v * ..Mg Mh g-SvU*Z2 v-om-1 o.g-ó Ug-Só.vX-SvU*.v)..-1 o.i g*o SÜb.xSZN.-1 o.gXXS9..Mg Mh g-SvU.3 o-1 v9v vQí.Yg o..-1 o..v v" SUQn.. xSY.piU' oSQ -o9..g S' 3 o-SMgøó gQUQ.SU.g ..*gQp*..xpiU' ó g S' 3 Y..xSY.piU' oSQ -o9..Qv3 o- SMgøó gQUQ.SU.g ..*gQp*..xpiU' ó Qv3 Y..xSY.. w<(RQÜb g-o9.. S' oSQ -*.gU9.gQQ oQg-SvU.SU.g ..*gQp*..xX/MZ.....

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GUUb' ..(Zmm o*MSX-Só.*g-S-M.v).9S)ó oUM*.SU..gU6SU*.i g*o9.vU..-1 o.gXXS9..gQQ oQg-SvU.3 o-1 v9v vQí.gQgSU*..-1' oo.g-ó Ug-Só.. vX-SvU*..

á gU6*.9S)ó oUM*..	2 vZv)..vi *Z..	*-ZøøZ	3 SU..	W*.. ffpig -So.	3 o9SgU.	ß 9.. ffpig -So.	3 g' ...
àwr.*gU9g 9.ø*ZXM..	% u° .xW- RFI'...gÜb*.úog ú..v) .g .bWúog *Y..	í Z	RW...	RW.	- ...	W.	W...
àwr.*gU9g 9.ø*Z. piU' ó g S' 3 ...	% u° .xW- RFI'...gÜb*.úog ú..v) .g .bWúog *Y..	VZí ...	Ru...	RW.	- ...	W.	W...
àwr.*gU9g 9.ø*Z. piU' ó Qv3 ...	% u° .xW- RFI'...gÜb*.úog ú..v) .g .bWúog *Y..	WM	R	R ...	W.	" ...	ßW.
I " 2 ..*gU9g 9.ø*ZXM..	% u° .xW- RFI'...gÜb*.úog ú..v) .g .bWúog *Y..	í Z° ...	RW...	R ...	- ...	í ...	W%..

I " 2 ..*-gU9g 9..ø*Z.. μU" ó g' S' 3 ...	% u° .xW- HÍ'...gU6*.úog' ú..)v' .g' ..Búúog' *Y..	Vúí ...	HV...	HV.	- ...	W.	u...
I " 2 ..*-gU9g 9..ø*Z.. μU" ó Qv3 ...	% u° .xW- HÍ'...gU6*.úog' ú..)v' .g' ..Búúog' *Y..	" Z- ...	Hd...	R...	W.	β...	í - ...
(V“ ..*-gU9g 9..ø*ZXM..	% u° .xW- HÍ'...gU6*.úog' ú..)v' .g' ..Búúog' *Y..	βZ 1...	HV...	R...	- ...	í ...	W...
(V“ ..*-gU9g 9..ø*Z.. μU" ó g' S' 3 ...	% u° .xW- HÍ'...gU6*.úog' ú..)v' .g' ..Búúog' *Y..	. Z W.	R- ...	R...	- ...	í ...	W...
(V“ ..*-gU9g 9..ø*Z.. μU" ó Qv3 ...	% u° .xW- HÍ'...gU6*.úog' ú..)v' .g' ..Búúog' *Y..	WZ W.	HV- ...	R...	W.	° ...	" u...
Vww.*-gU9g 9..ø*ZXM..	% u° .xW- HÍ'...gU6*.úog' ú..)v' .g' ..Búúog' *Y..	VZ	HV...	HV.	- ...	W.	WV.
Vww.*-gU9g 9..ø*Z.. μU" ó g' S' 3 ...	% u° .xW- HÍ'...gU6*.úog' ú..)v' .g' ..Búúog' *Y..	í Z ...	HV...	HV.	- ...	W.	W...
Vww.*-gU9g 9..ø*Z.. μU" ó Qv3 ...	% u° .xW- HÍ'...gU6*.úog' ú..)v' .g' ..Búúog' *Y..	WZu...	Hí ...	B...	W.	%..	β- ...

àvpi Mngμ- ' v' * ..Mg Ml g-SvU*Z2 v-on- ' o.g -ó Ug-Spo..vX-SvU*..v... ' o.i g*o Sbo..xSbZN- ' o.gXXS9 ..*-gU9g 9..Mg Ml g-SvU.3 o- ' v9v vQhYg' o... ' o...
 g3 o.g.*XoM\$S9.gi vøo.xSU.GUW' .(YZ- ' ó...o*μ -*.*' v" ... ' g-... ' ó o.g' o.*v3 o.*SUSM(U..9S)ó oUM*.SU- ' ó...gU6SUQ*.v).SUSS9μg .MμU- S*N.
 o*XoMg' ú.i o- ' ooU- ' o.i g*o Sbo...gU6SUQgU... ' g-.i g*o9.vU- ' o.Qv3 o- SMgQQoQ-SvU.xμU" ó Qv3 YZ- ' S.*.øø9oU-) v3 ... ' o.øg μo*.v)... ' o...
 *-gU9g 9.9oøSg-SvU*Ng*.. ' o .g*..) v3 ... ' o.3 SUS g.gU9.3 g' S g.. ' SM'...oM 9.xMb'g' úY- ' o.. SQ o*..øg μo*Zàv3 o.MμU- S*.9 vX.*SUSM(U- ú...
 SU- ' ó...gU6SUQ.. ' oU- ' o.Qv3 o- SMgQQoQ-SvU.S*μo9Z- ' o.3 gSU...og*vU.)v' ... ' S.*S- ' o.μUoøoU.Xó)v' 3 gUM.v).MμU- S*.SU- ' o.VXXv' -μUSú...
 9S oU*SvU.xM3 Xg' o9...v... ' o.v- ' ó ... ' v..9S oU*SvU*YNgU9..S..S..o*XoMg' ú... ' o.Mg*o..v' ..MμU- S*..) v3 ..Og*-ó U..Opí vXo..xá μ**SgNI o g' μ*YN.
 <oU- g .G*Sg.x-üi o6SgUN7 güg6' *-gYNN- ' o..+μ).xàgμ9S.G gi SgN0 g-g' YNg*.. ' o .g*..)v' ..*v3 o.v- ' ó *.x<μi gN2 v' - ' .7 v' ogYZ.

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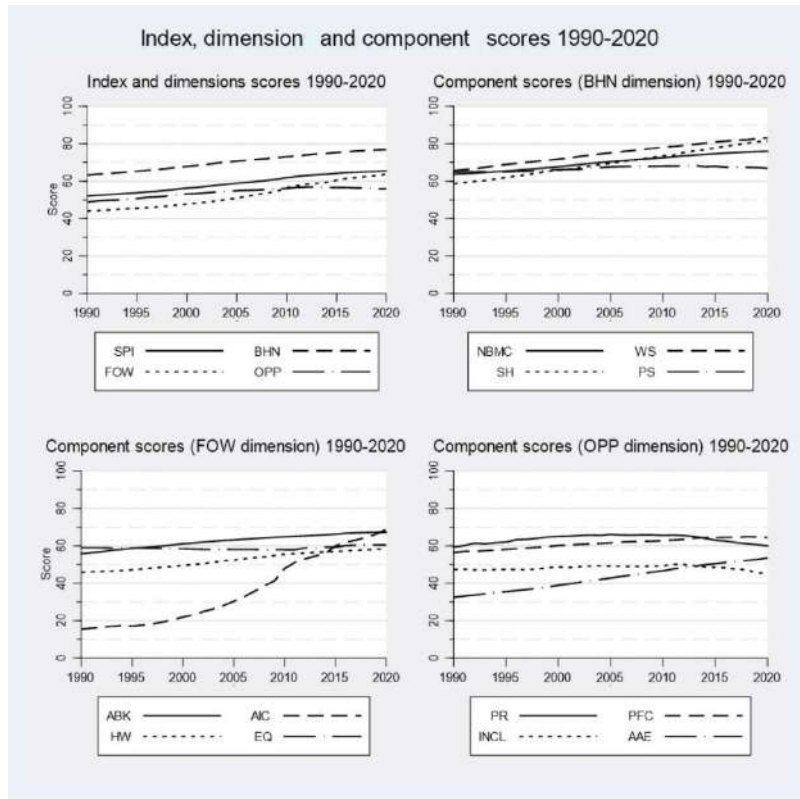
GUU' ..+rU9o' N9S oU*SvNgU9..M3 XvUoU-...' 9..*M o*.Wu- H- í - ...

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Explanations:

BHN – Basic Human Needs;

FOW – Foundations of Wellbeing;

OPP – Opportunity;

NBMC – Nutrition and Basic Medical Care;

WS – Water and Sanitation;

SH – Shelter;

PS – Personal Safety;

ABK – Access to Basic Knowledge;

AIC – Access to Information and Communication;

HW – Health and Wellness;

EQ – Environmental Quality;

PR – Personal Rights;

PFC – Personal Freedom and Choice;

INCL – Inclusiveness;

AAE – Access to Advanced Education.

GUU' .! m<' gUQ..SU.*vMg ..X vQ o**..vøó ...S o...

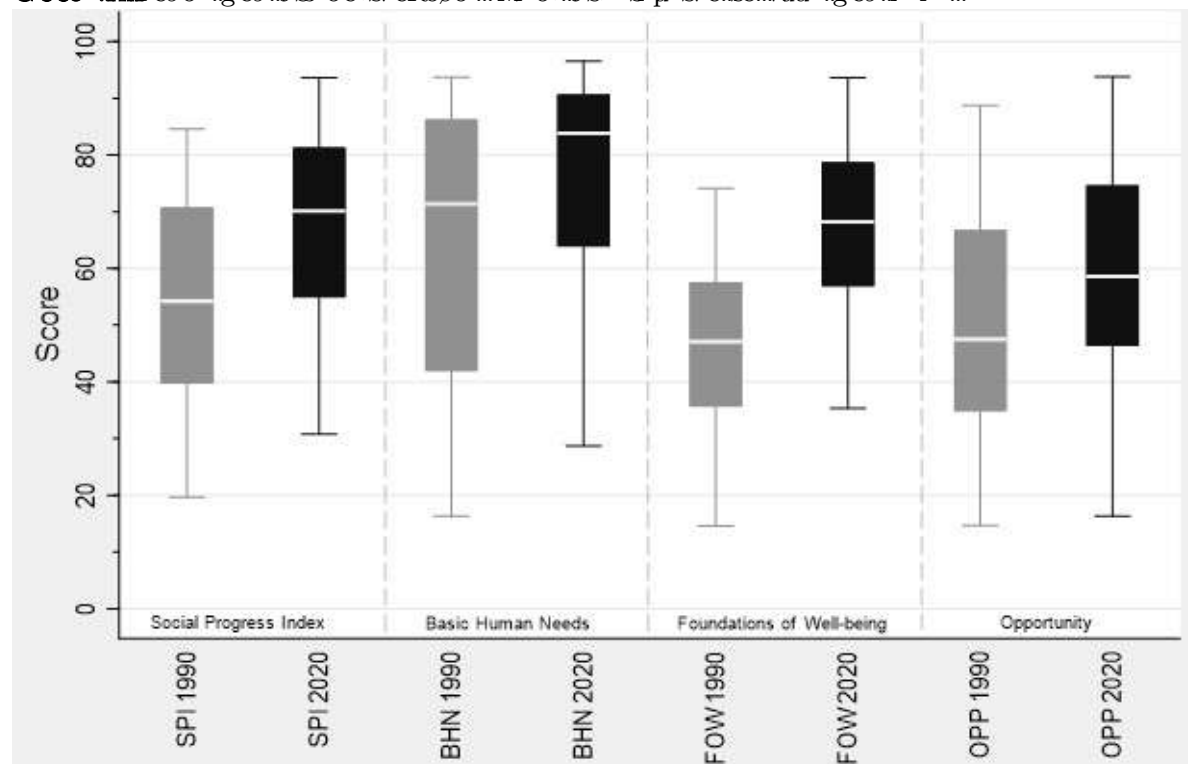
rU9o' ... o o3 oU*...	OU-So... Xó S9... Wiu- R- í - ...	n oMg9o*...			(S9oRiog' ..Xó S9*...					
àwr...	WZ B...	. Z B...	%Z	ßZ% ...	WZ W.	í Z í ...	í Zú...	ßZ %.	í Z	WZí ...
I " 2 ... (V“ ... Vww...	WZ - ... WZ B... ° Z	. Z 1... ßZ u... . ZW.	%Zú... 1Z í Z 1...	ßZ B... ° ZV... R ZV%.	í Z 1... WZ ... WZ 1...	í Z - ... í Z B... í Z B...	í Z %... ßZ ° ... WZ	í Z %Z% ... WVW ...	í Z V... . Z ... - Z ...	WZ% ... ßZ R'Z W.
2 I t <...	WZ B...	. Z %...	. Zu- ...	ßZ 1...	WZ u...	í Z ...	í Z' ...	í Z	í Z %...	WZ B...
“ à...	WZ. ...	Z u...	Z. ...	. ZuV...	ßZV...	í Zu ...	ßZB...	ßZ V...	í Z - ...	í Z V...
à" ...	í í Z í ...	° Z u...	° Z u...	° Z	ßZ ...	ßZúB...	ßZ% ...	. ZV...	. ZV...	ßZ u...
wà...	í Z W.	WZ ...	WZ ...	RZVW.	- Z B...	WZ B...	WZ 1...	- Z 1...	RZ ° ...	RZ
GI 7 ...	WZ u...	%Z- ...	ßZ B...	í Z ...	í Z u...	í Z W.	WZú1...	WZ %.	WZ ° ...	- Zu...
Gr<...	%ZBí ...	" Z u...	í ZW.	í - Z í ...	WZ í ...	. Z ° ...	1Z - ...	WZVW.	WZ ...	1Z' ...
" “ ...	WZ	ßZ %.	" Z W.	í Zú1...	WZ ...	í Z u...	í Z B...	ßZV...	WZ	WZV ...
O0 ...	WZ u...	RZú1...	RZ' ...	í Z% ...	RZV...	RZ' ...	RZBí ...	RZV...	WZ ° ...	WZ ° ...
wá ...	- Z B...	%Z 1...	- Z% ...	RZ% ...	í Z% ...	ßZV...	WZ u...	RZ% ...	R'Z %.	RZúí ...
w(<...	1Z V...	ßZ	í Zú1...	WZú1...	WZ' ...	í Z 1...	WZ í ...	WZV...	WZ% ...	- Z ...
r2 </ ...	RZ %...	WZ%...	- Zú1...	BZú1...	- Z 1...	WZ ° ...	- Z% ...	- Z u...	í - Z í ...	í Z ° ...
GGO...	í WVW...	Z - ...	° Z u...	Zu...	ßZV...	ßZ ° ...	ßZú	ßZ %...	ßZ - ...	ßZV...

àvµì Mmguµ-í v * ..Mg Mµ g-SvU*NUv-om-í o..øg µo*.SU9Mg-o..-í o..9S)ó oUM..i o-” ooU..-í o..)Sµg ..gU9...-í o..SU9Sg ..úoó ..v)..ogM’..o*XoM9o..Xó S9N.
 Xv*S9o..QgSU..oU-gS.gU.SUMog*o..SU.*M ON” ’ ó og*.g...v**..oU-gS*...-í o..vXXv*S oZ...

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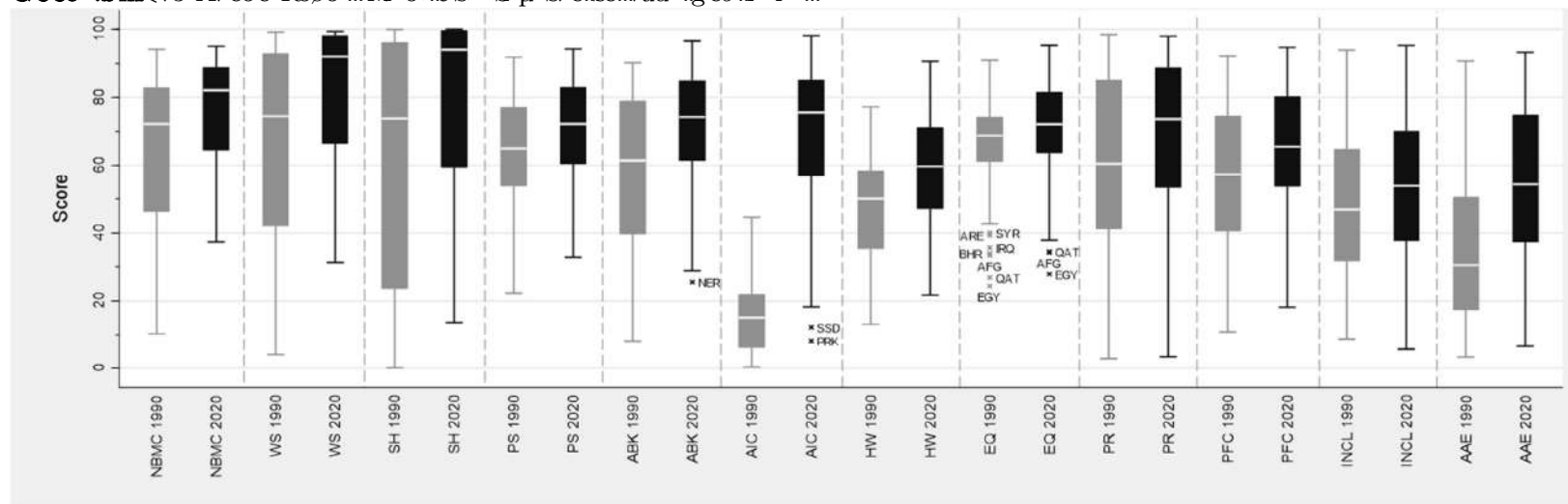
...
 GUUB' .rmrU9o' .gU9.9S oU*SvURo9o .*M o*.9S' S μ-SvU.SU.Wiu- .gU9.í-í- ...



...
 àvµí Mmgµ- ' ý * ..Mg Mµ g-SvU*ZO' XgUg-SvU*µàwr... ..àvMg ..w vQ o**rU9o' č.I " 2I g*SM' µ3 gU.2 oo9*č....
 (V“(vµU9g-SvU*.v)...“ o i oSUQ.Vww... ..VXX' -µUS-úZ.

...

...
 GUUB' .sm<v3 XvUbU-Ro0o ..M o*.9S< S μ-SvU.SU.Wiu- .gU9.í-í- ...



àvpi Mngp-! v * ..M M g-SvU*ZO' XgUg-SvU*n2 I t <... ..2 μ- SSvU.gU9.I g*SMt o9SMf ..<g oč.“ à... ..“ g-ó .gU9.àgUSg-SvUč.à"à' o-ó č.wà...
 ..wó *vUg ..àg)o-úč.GI 7GMM**..-v..I g*SM7 Uv” o9Qč.Gr<... ..GMM**..-v.rU)ý 3 g-SvU.gU9...<v3 3 μUSM-SvUč.. ““ og -' ..gU9...“ o Ub**č..
 O0OU0SvU3 oU-g ..0 μg S-úč.wáwó *vUg ..á SQ -*č.w(<... ..wó *vUg ..(oo9v3 ..gU9...<' vSMč.r2 </rUM1μSoUb**č..GGO... ..GMM**..-v...
 G90gUM9..09μM-SvUZ.

...
 ...

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GUUb' ..7 m-vX.gU9.i v-v3 .Xó)v 3 SUQMµU- S*.SU.Wu- .gU9.í-í- ...

—vX.W.Xó)v 3 ó *.SU. Wu- ...	—vX.W.Xó)v 3 ó *.SU. í-í- ...	I v-v3 ..W.Xó)v 3 ó *. SU.Wu- ...	I v-v3 ..W.Xó)v 3 ó *. SU.í-í- ...
V.. <gUg9g... 1. Z% . í.. à" o9oU... 1. B. .	V.. à" S-üó gU9... ußZ . í.. 2 v " gú... ußZV.	WV.. <Gá ... í ° B- . Wí.. n á <... í ° Z . +µSogI	Wß.. 2 SQ BZuí . W.. .. +µSog... . BZW.
ß.. 2 v " gú... 1ßZ . .. n oU3 g 6... 1ßZ %.	ß.. n oU3 g 6... ußZ% . .. rM gU9... uí Zú.	Wß.. I S*gm... í %Z - . W.. .. <' g9... í . ZV. Offµg-Z	W% G)Q gUS*-gU.. . í Z 1. W .. I µ µU9... ßuZ ß.
% à" S-üó gU9... 1ßZ (SUgU9... 1í Z u. ° .. +ó 3 gUí... 1VZuí . —USo9..	% +ó 3 gUí... uí'Z ° . .. (SUgU9... uí'Z V. ° .. à" o9oU... uí Z í .	W% +µSog... í . ZV . W .. GUQ g... í BZ% . W° .. O S- og... í VZß.	W° .. š o3 oU... ßuZß- . W1.. O S- og... ß° Z %. Wu.. <' g9... ß° ZV.
1.. à-g-o*... 1VZ% u.. I o Qµ3 ... 1VZß.	1.. 2 o-' ó gU9*.. uí ZV% u.. <gUg9g... uí ZV.	W1.. G)Q gUS*-gU... í - Z . . Wu.. àv3 g Sg... WíZ ° .	W- .. <Gá ... ß. ZVß. WV.. àv3 g Sg... ßßZßß. àvµ-' ..
W.. Gµ*'- g Sg... 1VZ W	W.. Gµ*'- Sg... uVZí .	W- .. O-' SXSg... WíZ W	Wí .. àµ9gU... ß- Z í .

àvµí Mngµ-' v * .Mg Mµ g-SvU*...

...

àn + WmrUoffiug S-S*.i ouvU9..SUM3 oZG.." v 9" So...
vUQs-µ9Sug .Xó *XoMSóo..-' vµQ ..-' o...oU*.v)...-' o...
àvMg ..w vQo**.rU9o' ...

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wo- g..7' ú vøgNs o* *.woS Rwg v3 SvNt v' g3 o9..." -SSM... .s g v3 ' ...' g 3 o6...

.....

WtU- v9µMSvU..

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rUoffiug Sú...! g*...o*µi)gM9...v...-' o..)v o) vU...v)..Xv SSMg .gU9..Xv SMi.gQoU9g*.SU...oMU-úio g *Ni µ-...
S...! g*.i ooU.Xg -..v)..Xv SMi.gU9..Xv SSMg .9oi g-o*.g*..." o .g*...o*og M..oyv -*..)v .MU-µi S*Zr-.S*...
g..M3 Xo' ..gU9..3 µ -9S oU*SvUg ..MUMX...-' g-..S*..9S Ml -...v..9o Uo..gU9...v..3 og*µi o..g*..S...
SU-ó *oM*.g '...og 3 *.v)...SoZ-..U9ó *gU9SU..." ' g-..Soffiug Sú..S*.gU9..." ' g-..S..3 ogU*...v..XovXo...
oøv øo9...vøó ...-S o..gU9...*v..99...-' o..3 og*µi o3 oU-..gXX vgMo*Z.7 v' ..xí -í -NXZ.f uY.9o Uo*...
Soffiug Sú...g*...g... X' oUv3 oUvU...v)...µUoffiug ...gU9év ...µU;µ*...9S* S µ-SvU...v)... o*vµi M*...gU9...
vXXv -µUSs*.g3 vUQ3 o3 i ó *.v)..g.QsoU.*vMS-ú.L' ' SMl.oUM3 Xg**o*.9S*-SUM.úio-..vøó gXXSUQ..
oMUv3 SM*vMg NgU9.*Xg-Sg .9S oU*SvU*Z.

...

-' o..t S oUUsµ3 ..n øo vX3 oU-...+vg *.xt n + YNg9vX-o9..SU.í --- NSUMµ9o9...*v3 o..g*XoM*.v)...
Soffiug SúNo*XoMg ú..SU.t n + ..β..w v3 v-o..+oU9ó ..Offiug Sú..gU9..O3 Xv"ó ..." v3 oUNt n + ..W.
O g9SMg-o.O' -' o3 o..wvøó -ú..gU9..." µUQ NgU9..t n + ..1...+ vi g ..w g -Uó *' SX..)v ..n øo vX3 oUZ..
" v" øó NS..." g*..Uv-..µU-S...-' o..àµ*-gSgi o..n øo vX3 oU-...+vg *.xàn + Y.." ó o.g9vX-o9..SU.í - W%..
-' g-...o9µMSUQ.Soffiug Sú..." g*... Ug ú..gQo9..g*.gU.o' XSMS-Qvi g .Xv SMi-..g Q-Z.....

...

rU...-' o..MU-o' -..v)...-' o..àµ*-gSgi o..n øo vX3 oU-...+vg *NSoffiug Sú..S*.g99 o**o9..i ú..àn + ..W...
" ' SM.gS *..v...o9µM.SUM3 o..Soffiug Sú..." S' SUGU9.g3 vUQMµU- S*Zàn + ..W..)µi -' ó .SUMµ9o*...
-oU.*XoMS M-g Q-..." S' ..M' o*XvU9SUQ.SU9Mg-ú *..v..i o.gMSøø9..i ú.í -β- Z-..-' o*o..g o..í vg9...
gU9'.. o g-o...v..3 gUú..*vMS-g ..g*XoM*NSUMµ9SUQ.oMUv3 SM9øø vX3 oU-Noffiug ..vXXv -µUSs*N..
SU*-Sµ-SvUg ..)gS Uo**gU9..Xv SSMg .SUMµSvUNi µ-.g *v..3 SQg-SvUNQvi g ... UgUNg .3 g 6o*.gU9...
-' o..Xv*SvU.v)..9øø vXSUQ.MµU- S*Z:" ' So...-' S*.S..Uv-..g..M3 Xo' oU*So..*o..v)...-g Q-*N*v3 o...
' o)ó ...v..XovXoNv-' ó *..v...MµU- S*N*v3 o..g o..Uv-..ffiugU-S o9..gU9..gS ...v...oUMµi gQ ..gU9...
)gMSg-o xSZ+vg ..WZ .gU9..WZ N..o*XoMSóo úYNS..S.S Xv -gU-...v..gMUv" o9Q...-' g-..µUSo...
-' o..t n + *NSU..." ' SM..Soffiug Sú..." g*..SU-ó *Mo9..gMv**..g..Uµ3 i ó ..v)..Qvg *N-..-' o..àn + *..Xµ-...
Soffiug Sú..o' XSMS-ú..vU-..-' o..Qvi g .gQo9gN" ' SM..S.gU.S Xv -gU-..3 o**gQ..SU.gU9..v)..S*o)Z..

.....

r-..*' vµ 9..i o..Uv-o9...-' v" øó N-..-' g-..Soffiug Sú..S*.g *v..SU-ó *Mo9..SU.3 v*..v-..-' ó ..Qvg *NoS' ó ...
9SOM úmàn + ..%x+oU9ó ..offiug SúYNàn + ... x0 µg Sú..o9µMg-SvYNàn + ..β..x+vv9...-' og -' ..gU9...
"o i oSUQNàn + ..Wx2 v..Xvøó -úYNàn + ..í ..xÜó v..." µUQ YNàn + ...° ..xGýv 9gi o..gU9...MbgU..

oUō QīYÑàn +...1...xn oMŮ...” v̇ 6...gU9...oMŮv3 SMQv” -’ YÑàn +...WV.xàμ*-gSgi o...MSs*...gU9...
M3 3 μUS-S*YÑàn +...u.xrU9μ*’ úNSUvøg-SvUgU9...S) g*’ μMí oYÑàn +...W.xwogMNμ*-SM.gU9...
’ vUQ.S-Sμ-SvU*Y.ý ..S9S oM ú..SU.àn +...Wb.x< S g-o.gMSvYÑàn +...W.x/So.i o v” ...” g-ó YN.
àn +...Wx/So.vU.gU9YgU9..àn +...W.xwg -Uō *’ Sx*.)v̇ ...-’ o..Qg *Z.....

...

rU..*μ3 3 ġ S*SUQX vQo**.)v̇ ..+vg ..WN-’ o...-USo9.2 g-SvU*.n øo vX3 oU..ẇ vQg3 3 o.x-2 n wY..
’ SQ SQ -*.9Sýó oU..g*XoM*.v)..SM#3 o.Subffig S-ú.x-2 n wN̄ -í . YZš o-NSubffig S-ú.S*.gi vμ-3 μM...
3 v̇ o...’ gU.SUM#3 o.gU9..oMŮv3 SM)gMv̇ *NgU9...’ o..àn +*..*’ vμ 9...og9...’ o...” gú..)v̇ .í’ vg9oUSUQ..
-’ o..9SMμ**SVZ.....

...

O*XoMġ ú..*SUM...’ o.3 v*’...oMŮ..oMŮv3 SMMSo*N-’ o.oyý -...v.3 vøo.i oúvU9...#n w.ø3 X’ g*Sø9...
-’ o..Ubo9...-v..í’ vg9oU..vμí ..g**o**3 oU...v)..” o i oSUQ.gU9...MμU- ú..Xó)v̇ 3 gUM...i oúvU9...*v o ú...
oMŮv3 SM) g3 SUQx...ø.à-SQS-üNàoU..̇ .(Svμ**SN̄ - Wč.(opí i goú...̇ .I gUMo-N̄ -í í YZrU...oMŮ...
úoġ *.g.3 μ -Sμ9o..v)..M3 Xv*Sø..S9SMġ-v̇ *..! gøo.i ooU.X vXv*ø9.i ú...o*oġ M..g*...” o ..g*..Xv SM̄...
Sμ-Sμ-SvU*.x)v̇ .ø’ g3 Xo..VO<n N̄ -í -č...-’ o../oQ-μ3 .rU*-Sμ-oN̄ - Wič.àgM*.ø-g ZN̄ -í -YZ...

...

rU...-’ S*..MgX-ó ...” o...X vXv*o...gU..g -ó Ug-Søo...) g3 o” v̇ 6...)v̇ ...3 og*μí SUQ.gU9...μU9ó *gU9SUQ..
UvUoMŮv3 SMSubffig Ss*NSZ)vMμ*SUQ.vU..vμB-g ...” o i oSUQZGUMv̇ o9.SU...’ o.àvMġ .ẇ vQo**...
rU9o’ .xàwrY...x” ġ 3 gM6...̇ .7’ ú vøgN̄ -í BY...” ’ SM.3 og*μí o*..*vμB-g ...” o R oSUQ.S9oXoU9oU...
v)...oMŮv3 SM.S9SMġ-v̇ *N-’ o...MgX-ó ...výó *..g...Ub” ...Xó *XoMSøo...)v̇ ...μU9ó *gU9SUQ..Qvi g ...
Subffig S-úN. gU9... gUg ú*o*... Subffig S-ú...’ o g-o9...-v... XovXo *...i g*SM. Ubo9*N. ” o i oSUQ.. gU9...
vXXv̇ -μUSs*Z.I ú...μ*SUQ...øġ Svμ*...*g-S-SMġ ...3 o-’ v9*N-’ o...MgX-ó ...)vMμ*o*...vU...MμU- S* ...
Xó)v̇ 3 gUM...vøó ...-’ o..βVWioğ̇ ..Xó Sv9NgUġ ú*o*...’ oU9*..SU.Xó)v̇ 3 gUM..9S- S μ-SvU*.gU9...SU..
MμU- S*..Xó)v̇ 3 gUMNgU9..! SQ SQ -*.ġ og*v)..S X vøø3 oU..gU9..9oMSUoZI ú..9vSUQ*vN̄” o... ..
-’ o...QgX.SU.9o USsvU..gU9...3 og*μí o3 oU...v)..Subffig S-úNo*XoMġ ú...” S-’ .. oQġ 9*...-v..àn +...W...
-ġ Q-*..WZ ..gU9..WZ...” ’ SM..MUM U..*vMġ NoMŮv3 SMgU9...Xv SSMġ ..SUMμ*SVNgU9...oU*μí SUQ..
offiġ .vXXv̇ -μUS-ú.gU9’...o9μMSUQSubffig Ss*.v)..vμ-M3 oN̄.o*XoMSøo úZ.....

...

“ o..*ġ -..vμí .gUġ ú*S*...” S-’ .g.í’ Sb)..vøó øSb” ..v)..-’ o.9øøo vX3 oU...v)..Subffig S-ú.gXX vgMo*.gU9...
3 og*μí o*.vøó ...S oNgU9..! SQ SQ -! v” ...-’ o*o.3 og*μí o*..! gøo.Uġ v” ú..vMμ*ø9.vU...’ o.oMŮv3 SM.
g*XoM*.v)..Subffig S-ú.gU9..! v” ...-’ o...gM̄..v)..9g-g...S S*.g..9o-gSo9..μU9ó *gU9SUQ.v)..Subffig S-úZ..
“ o...-’ oU.Sv̇ v9μM.gU9..í’ Sb̄ ú..9o*MS o...’ o.àvMġ .ẇ vQo**..rU9o’ ...-S o.àó S*NS*.X SUMXo*...
gU9.3 o-’ v9v vQíZ.“ o..)μí -’ ó .μ*o...-’ o.SU9o’ ...v.g**o**..Subffig S-ú.Qvi ġ úN)v̇ .*o oMo9’...oQsvU*...
gU9.gMv**..MμU- S*Z.“ o.MUMμ9o...” S-’ .9SMμ**SvU.v)..-’ o.3 gSU.. U9SUQ.gU9..S*SQ -*Z.....

.....

í .t S*B og*μí SUQSubffig S-ú

.....

Vμí .μU9ó *gU9SUQgU9.3 og*μí o3 oU...v)..Subffig S-ú.øøv øø9..vøó ...S oZ.“ o.MŮ. gM̄.-’ o.øó ú...
’ *-g-o3 X*...v..g99 o**..Subffig S-ú.SU...’ o..OUSQ -oU3 oU..Xó Sv9Z.-U-S...’ oUNSubffig S-ú...” g*...

MU*9ó o9...-! o..µUgøv9gi o..MU9SSvU.v)..! µ3 gU.o' S*-oUM .xàû o-ó Ní - í WXYZ. YZVUo.v)..-! o...
3 v*-X v3 SÚU-3 og*µí o3 oU*.v)..Súffig SÚNX vXv*o9.g' og9ú.SU.WWNS*.S .g.6óú.SU9Mg-ý ...
-v9gúZ.-! o..+SUSMo MBU-3 og*µí o*...! o.o' -oU...v..." ' SM...! o.9S'- S µ-SvU.v)..SUM3 o.9oøSg-o*...
) v3 ..Xó)oM.offig SÚZrU.Wi%NàS vU.7 müUo-*.).µí -! ó ..! úXv-! o*Sio9...! g-..Súffig SÚ.3 S' v*...
-! o.*-gQ*.v)..9oøo vX3 oU.v)..g..MµU- ú.SU.g..." gú.-! g-..S-..SUSg' ú..SUMog*o*NgU9..9oMog*o*.SU...
g... g-ó ...*-gQ...v)..SU9µ*- Sg Sig-SvUN." ' SM...Mg3 o...-v...i o...6Uv" U...g*...-! o...7 müUo-*.Mµ øoZ.G...
)vµU9g-SvUg ..MU- S µ-SvU...v...-! o.3 og*µí o3 oU...v)..Súffig SÚ..." g*.X vø9o9..i ú..àS ..GU- vUú...
G-6SúvUN" ' v.vøó ..! S*.Mg óó ..X vXv*o9..g..Uµ3 í ó .v)..gXX vgMo*.gU9..3 o-! v9*..)ý .g**o**SUQ..
gU9..3 og*µí SUQ.Súffig SÚNSUMµ9SUQ.-! o..G-6SúvU.rU9o' NG-6SúvU.rU9o' SÚ.t og*µí oN.-! o...
-vXRk-ý' oMo9...+SUS.gU9..3 gUú.v-! ó *.x' S*..." v 6*.Mg3 o...-v...i o..M oMSø ú...o)ó' o9...-v..g*...-! o...
G-6SúvU.Súffig SÚ.3 og*µí o3 oU...vV 6SVZrUí - WBN.-! v3 g*.wSø-ú.Xµi S* o9...<gXSg' ..SU.-! o...
-! oU-úR S*-...<oU-µí úM' ' SM.X vø9o*.gU.µUX oM9oU-o9..vøó øS" ..v)..-! o..! S*-v Sg' ..-! oU9*.v)...
SUM3 o..gU9..." og -! ..Súffig SÚNg*..." o ..g*.MUMX-µg ..gU9..3 o-! v9v vQMS' MU*9ó g-SvU*..)ý ...
g**o**SUQ..Súffig SÚZ.I oúvU9...gMg9o3 SM.MU- S µ-SvU*N.wSø-ú...g *v...g- gMo9...Xµi SM.gU9...
Xv SMµB g6ó * ..g-oU-SvU...v...-! o..Mµµo*..gU9...MU*offioUM*...v)..Súffig SÚZ." o..g' Qio*...-! g-...
Súffig SÚ.S*..v.g.Q og-.o' -oU.g.Xv SSMg' MvSMNgU9.X vXv*o*..øó g .Xv SM'...oM3 3 oU9g-SvU*...
SUMµ9SUQ.g.Qvi g .." og -! ..g' .SU.ý 9ó ..v...S S*-! ó...Sø.v)..Súffig SÚZ.

...

t og*µí SUQ.Súffig SÚN*S Sg' ú...-v...3 og*µí SUQ.MµU- ú..Xó)v 3 gUMN' g*..i ooU..)ý ..9oMg9o*...
3 gSUú..9o Uo9..SU.oMvUv3 SM-ó 3 *Z.-! o...! *-..*SUS MgU-..g-o3 X-..)ý ..g..3 v o..M3 X o' oU*SøN..
3 µ -9S oU*SvUg ..g**o**3 oU...v)..!" o i oSUQ.." g*..XSvUó o9..i ú...-2 n w..SU.Wiu- ..i g*o9..vU...-! o...
MUMX-..v)..MgXgi SS-S*Z.-! o..." µ3 gU.n øo vX3 oU...rU9o' ..x" n rY..! g*..i ooU...-! o..X o9v3 SUGU...
g -ó Ug-Søo...3 o- SM.v)..MµU- S* ..Xó)v 3 gUMZ.-! o..." n r...x-2 n wN.í - í ßY..3 og*µí o*...-! oo...
9S oU*SvU*..i ú..gQQ oQ-SUQ.)vµi .SU9Mg-ý *... ..vUQgU9..! og -! ú...Sø.o.xSø.o' XoMgUMi.g-i S-! YN..
6Uv" o9Q..x3 ogU.úog *.v)..*Mvv SUQNo' XoMo9..úog *.v)..*Mvv SUQNgU9..9oMU-..*-gU9g 9..v)..
SøSUQ..xQ v*...Ug-SvUg ..SUM3 o...Xó ..MgXSg...SU..Xµi Mg*SUQ.Xv" ó ...Xg SÚYZ.-v...gMµU-..)ý ...
Súffig SÚN.gU9...gUMv o9...SU..G-6SúvU*..." v 6N.(v*-ó N./ vXöRk g øg...gU9...àüo6o ú...xí -- %N..
X vXv*o9..gU.Súffig SÚRg;µ*-o9..." µ3 gU.n øo vX3 oU...rU9o' ..xr" n rYZ.-! o..g9;µ*-o9..SU9o' ...
3 og*µí o*..! µ3 gU.9oøo vX3 oU..." ' So.gMµU-SUQ.)ý ..Súffig SÚZ.-! o..g9;µ*-3 oU-SN' v" øó N..
*-S ..gUMv o9..SU.-! o.." n r..9o*SUN" ' SM..MU*S*..v)..vUú.g..! gU9)µ ..v)..SU9Mg-ý *NSUMµ9SUQ.g...
3 og*µí o.v)..oMvUv3 SMXó)v 3 gUMZ...

...

n o*XSø...-! o..X o9v3 SUGU-ú..oMvUv3 SM)vMµ*.xU.3 og*µí SUQ.gU9..ffigU-SúSUQ.Súffig SÚN.-! ó o...
' g*..i ooU..Uv...*! v -gQ...v)..-! óv o-Sg' ..gU9...MUMX-µg ..oyý -*Z.I vµi 9Sµ...xWi° uY..MSb9...-! o...
MUMX-..v)..Mµ-µí g' .MgXSg' ..gU9..o' X v o9..! v" ..S*..* gXo9..*vMg' ..Súffig SÚ-č..< oU* g" ..xWiUy..
X vXv*o9...-! o..MUMX-..v)..SU-ó *oMSvUg SÚ..." ' SM...oU-gS*...-! g-..Súffig SÚ..S*..SU µoUM9..i ú...
Uµ3 ó vµ*..)gMv *SUMµ9SUQ..gMNQoU9ó NgU9..*vMµRMvUv3 SM-g-µ*č.GMó .xWiu- Yø*-gi S* o9...
-! o..MUMX-..v)..9vSUQ.QU9ó NXgøSUQ.-! o..." gú..)ý ..)µí -! ó ..o*og M..vU.QoU9ó .gU9..Súffig SÚZ..
á oQg 9 o**..v)..-! o*o...oyý -*N' v" øó N.-! ó o...! g*U-...i ooU..g..MU*oU*µ*..vU...-! o..) g3 o" v 6N..
ffigU-S Mg-SvU..gU9...3 og*µí o3 oU...v)..UvUoMvUv3 SM.Súffig SÚ-S*Z..àøó g ...M3 Xv*Sø...SU9SM*...

SUM₁₉o...Subffug Sú...g*~~XoM~~*...xàú vøg-6g...` ...àM v**g o6Ní - WYN.i μ...UvUb...v)...-' o3 ...)vM₁*o*...
o' XSN₅ ú.vU.-' o.3 μ -SgM-o9..Ug-μ₁ o.v).UvUbM_{Uv3} SMSubffug SúZ...

...

rU...o*XvU*o...v...-' o.*' v -M3 SUQ*.v).oM_{Uv3} SM3 og*μ₁ o3 oU-Ng.øg S-ú.v).M3 Xv*S-o.SU9SM₁-v *...
' gøo.i ooU.9oøo vXo9.xoZ₂N₁ o-ó ./ So.rU9o' NàvM₃ .xv vQo**rU9o' YZ.-' o.*vM₃ .*μ*-gS_{Ugi} SSú...
' o*og M..*- og3 ...! SQ SQ -o9...-' g-.*vM₃-g ..." o R oSUQ...SZNg.*vM₃ ..9S oU*SvU... ..3 μ*-i o.gU...
SU-oQg ...Xg₁ -...v)...*μ*-gS_{Ugi} SSú...g**o**3 oU-N.SUM₁₉SUQ...SU-ó R.gU9...S_U- gQ_Uø g-SvUg ...offμ₁Sú...
MU*9ó g-SvU*x" μ*Q_g)øo Ní - í WZ...

...

n g-g.Møó gQ'...oX o*oU*..vUb.v)...-' o.3 v*-X o**SUQM_g oUQ*..)v₁ .3 og*μ₁ SUQSubffug SúNi v-' ...
SU.oM_{Uv3} SMgU9..UvURM_{Uv3} SM-ó 3 *ZG øg o9v...o-.g Zxí - í Y.! SQ SQ -...-' g-..oM_{Uv3} SM9g-g...
μ*o9...v.o*-S g-o.oM_{Uv3} SMSubffug Sú.g₁ o.)g₁ .) v3 .Xó)oM.9μo...v...-' o...o g-S_o ú.Xv₁ .Møó gQ...
v)...' vμ*o' v 9...*μ₁ øóú*N.SUMog*SUQ.3 og*μ₁ o3 oU...QX*...SU.3 gUú...MμU- S*N.gU9...MUMX-μg ...
9Sýó oUM*..gMv**..9g-g...*o*...μ₁M..g*..g93 SUS₁- g-S_o..9g-g..gU9...*μ₁ øóú*ZrU...-' o.í - í í ...+ vi g ...
rUoffug Sú.á oX₁ -...<' gU*o ..o-.g Zxí - í í NXZ.WY.MUM₁₉o...-' g-... " o...S_o..SU.g..9g-gR_{gi} μU9gU...
" v₁ 9..gU9...úo... " o...gM₁.i g*(MSU)v₁ 3 g-SvU.gi vμ-..Subffug SúZ. GMM**SUQ.*μ₁M..9g-g..S*.MSSM₁ ...
)v₁ ..9o3 vMgMZ.I óuvU9...SUM3 o..gU9..." og -' NS...S*.g *v...MSSM₁ ...-v...S X vøo...v₁ ..M₁ oMS_o...
MgXgi SSú...-v.3 og*μ₁ o.gU9.3 vUS₁ v₁ -' ó .9S oU*SvU*.v)...*vM₁oM_{Uv3} SM9S₁Xg₁ SS*N.SUM₁₉SUQ..
Q_U9ó .gU9..oU₁SvU₃ oU-g .Subffug S₁S*Z.

...

2 øó -' o o**N.-' o..gøgSgi SSú..v)..9g-g..vU.oM_{Uv3} SMxSUM3 oY.Subffug Sú..S*..S ..3 μM₁.i o-ó ...
M3 Xg₁ o9...v...-' o..UvURM₁3 o.9S oU*SvU*Z.-' o.." v₁ 9.I gU₆..wvøó -ú.gU9.rUoffug Sú.w g-)v₁ 3 ...
Xμ₁ S₁ o*..-' o.+SSrU9o' .xgU9.*v3 o.v- ' ó .3 og*μ₁ o*Y.)v₁ .SUM3 o.Subffug Sú..)v₁ .3 gUú..MμU- S*...
i μ-..." S₁ .Uv-gi o.QX*.gMv**..úog₁ *gU9..MμU- S*N9o3 vU₁- g-SUQ.-' o..gM₁.v).M3 Xg₁ gi o.9g-gZ₁.
(v₁ .o' g3 XoN)v₁ .í - í í N.-' o.3 v*...oMU...vi *ó øo9..úog₁ N9g-g.g₁ o.gøgSgi o..)v₁ ..*øøoU.MμU- S*...
vUúNSU.í - í WS...S*.í í .MμU- S*Z₁OøoU.SU.í - W..." ' oU.9g-g.g₁ o.gøgSgi o..)v₁ ..11..MμU- S*..-' o...
+SSrU9o' .3 S*o*.vμ-..3 v₁ o.-' gU! g₁).v)...-' o..." v₁ 9 *.Ug-SvU*.xMμU- ú.MμU..i g*o9.vU.." v₁ 9...
I gU6Ní - í βYZ.-' o.." v₁ 9.rUoffug Sú..n g-gi g*o.X vø9o*.9g-g..)v₁ .3 v*-MμU- S*Ni μ-..vU ú..)v₁ ...
SUM3 oN" og -' NgU9..M₁ i vU.Subffug SúZ<v3 Xg₁ gi o.9g-g.gMv**..MμU- S*.gU9..vøó ...S₁ o.g₁ o...
o**oU-S₁ ú...UvUR' S*oU...)v₁ ...Subffug Sú...SU...*vM₃ ...SU9SM₁-v *...μ₁M...g*...-' og -' N.U₁- SSvUN.v₁ ...
o9μ₁g-SvUNUv...-v.3 oU-SvU.S*μo*..μ₁M..g*.gM₁**...v...SQ -*.v₁ .) oo9v3 *Z.

...

GU.g -ó Ug-S_o..." gú.v).gXX v' S g-SUQSubffug Sú..S*.v₁ó o9.i ú..o' Xó -.g**o**3 oU*N*μ₁M..g*.SU..
-' o...ó g₁ S-S*..v)...n o3 vMgM₁...X v;oM...x<vXXo9Q...o-Z.g Ní - í í YN." ' SM...SUM₁₉o...SU9SM₁-v *...
3 og*μ₁ SUQ.Offug .gM₁**...v.ffug Sú...! og -' Noffug .gM₁**...v.ffug Sú..o9μ₁g-SvUNOffug Sú.i o) v₁ o...
-' o...g..." gU9.3 gUú..v- ' ó *Zr-..Ubo9*..v.i o.o3 X' g*S₁o9N₁.v" øó N.-' g-...-' o*o.MμU- úRoøo .9g-g...
9v..Uv-...o oM.9S₁- S μ-SvU*.SU.-' o.XvXμ₁ g-SvU.xg₁.Uv₁ 3 g₁ ú.o*-S g-o9.vU.-' o.i g*S.v)... vμ*o' v 9...
*μ₁ øóú*Yi μ-..g₁ ó...g- ' ó .i g*o9..vU.o' Xó -.vXSUSvU*.Xó -gSSUQ.-v.9Sýó oU-...úXo*.v).Subffug S₁S*Z.

...

—' o..àn +*..’’ ó o..Uv—..9o*~~SU~~o9...v..i o..g..MUMX-µg ú..M3 X o' oU*~~So~~..) g3 o’’ v 6Z.—' o..9o Uo9...
 —g Q—*..g o...—' o... v’’ o*—..M3 3 vU..9oUv3 Sg—v ...v)...MµU— S* ...Xv SSMg ...’’ S .. g—' ó ...—' gU..gU..
 g3 i SSµ*...o...v)...SU9Mg—v *...—' g—...Q...i oúvU9...—' o...*g—µ*...ffµv...v)...Sbfftµg Sú...3 og*µi o3 oU-Z..
 t v ovó N.—' oú...9v...Uv—..í v g9oU...—' o...µU9ó *gU9SUQ..gU9...9o USSvU..v)...Sbfftµg Sú...i oúvU9...
 SUMµ9SUQ.—' o...vMg ..gU9...Xv SSMg ..MUMX*...xUv—..3 o— SMY.g vUQ*9o...—' o..oMµv3 SMZ.—' S*...! g*...
 ‘ o*µi -o9...SU..g...’) g3 o’’ v 6...v)...3 o— SM...—' g—... S S*...Sbfftµg Sú...3 og*µi o3 oU—...v...oMµv3 SM..
 Xó)v 3 gUMN.’ ’ SM..S*..µ*o9...v..SgXX vX Sg—o ú..gXX v’ S g—o.*vMg—g ..Sbfftµg S S*Z..

...

—' o..àvMg ..w vQo**rU9o’ ...S o..ào S*.g99 o**o*.3 gUú.v)...’ o*o.Mg oUQ*~~ms~~.9vo*.Uv—..SUMµ9o..
 gUú..oMµv3 SMSU9Mg—v *.SU.S*..) g3 o’’ v 6NgU9..X vø9o*.g...vUQ.vøó øS’’ ..v)...— oU9*..Møó SUQ..
 ßWúog *.xWu- R- í - Y.)v ...—' o.øg*—..3 g;v Sú.v).MµU—S*.xW- YZ.—' ó o)v oN’ o.µ*o...—' S*.M3 Xv*S...
 SU9o’ ..gU9...S*...o o3 oU*...x9S oU*S’U*..gU9...M3 XvUoU*Y...v...o’ X v o...—' o..oøv µ—S’U..v)...Qvi g ...
 Sbfftµg Sú.gMv**..MµU— S*.gU9..vøó ...S o..SU.UvURMµv3 SM9S oU*S’U*..v)...9oøo vX3 oU-Z...

.....

ß..àvMg ..w vQorU9o’ ...S o..ào S* ...**

.....

—' o..àwr..v ýó *.g..µUSffµo..Xó *XoMS~~so~~..vU...—' o..Xó)v 3 gUM...v)...MµU— S*ZI ú..vUú..Mµ*9ó SUQ..
 *vMg ..gU9..oUøSvU3 oU-g ..vµ—M3 o..SU9Mg—v *NS..S*...—' o...’ *.gøgSgi o.3 o— SMv).Xí o ú..*vMg ...
 gU9..oUøSvU3 oU-g ..g*XoM* ..xGUUvUS..’ ..àMUSNí - í í NXZ.Wu. YZr—..9o Uo*..*vMg ..X vQo**..g*...
 —' o..MgXgMú.v).g.*vMg—ú...v..3 oo...—' o.i g*SM. µ3 gU.Uo9*.v).S*.MSioU*No*gi S’ ...—' o.i µS9SUQ..
 i vM*...—' g—g v’’ ..MSioU*..gU9..M3 3 µUS S*...v..oU’ gUM.gU9..*µ*gSU...—' o.ffµg Sú.v)...—' oS ...So*N..
 gU9..Mog-o...—' o..MU9SS’U*..v) ..g ..SU9S9µg *...v...ogM...—' oS ..)µ ..Xv—oU—Sg ..xàvMg ..w vQo**...
 r3 Xó g—SoNí - í . NXZ%YZ.—' S*..9o USSvU..S*... vv—o9..SU...—' oo..vøó g MSUQ.9S oU*S’U*..v)...*vMg ...
 X vQo**m—' o..)µ 3 oU—v).XovXo *I g*SM’ µ3 gU2 oo9*N.—' o.o*gi S’ 3 oU—v)...(vµU9g—S’U*..v)...
 “ o i oSUQ.)v ..SU9S9µg *.gU9..M3 3 µUS S*...v..*µ*gSU...—' oS ..ffµg Sú.v)...SoNgU9...—' o.X vøS’U..
 v)... VXXv —µUSú...v) ..g ...SU9S9µg *...v...gMSøo...—' oS ...3 g’ S µ3 ...Xv—oU—Sg Z.“ S’ SU..ogM...
 9S oU*S’U...—' ó o.g o..vµi .M3 XvUoU*NgM..9o Uo9.i ú.g.*o—v).SU9Mg—v *9o*~~SU~~o9...v.g99 o**...
 —' o..MUMX-µg ..ffµo*—S’U*..SU’ ó oU—SU...—' v*o..M3 XvUoU*...x*oo..(SQí o.í ZW)v .9o-gS*YZ.

...

—' o...àwr...*ó øo*...g*...g...M3 Xv*S...SU9Mg—v N.MU9oU*SUQ..3 µ —9S oU*S’Ug ...*vMg—g ...gU9...
 oUøSvU3 oU-g ...3 g—ó *...SU—v...g...*SUQo...3 o— SM.)v ...og*S ...SU—ó X o—g—S’U..gU9...Mv**RµU— ú...
 M3 Xg S’vUZ.—' o..*o oMSvU.v).SU9Mg—v *.g9’ ó o*...v..óú..9o*~~SU~~X SUMX o*..v)...—' o.rU9o’ m’ *—úN..
 S..o’ Mµ*S~~so~~ ú..SUM Xv g—o*..*vMg ..gU9..oUøSvU3 oU-g ..SU9Mg—v *NgMSSg—SUQg.3 v o.*ú*—o3 g—SM..
 gUg ú*S.v)...—' ó...o g—S’U*’ SXi o—’ ooU..oMµv3 SM9oøo vX3 oU—xoZQN+ n w.Xó .MgXSgYgU9..*vMg ...
 9oøo vX3 oU-Zà oMµU9 úN.—' o.rU9o’ ..øg µg—o*..vµ—M3 o*...—' g—9SoM ú..S XgM.XovXó...g—' ó ...—' gU..
)vMµ*SUQ..vU...SUXµ—*č...v) ...S*—gUMNS...g**o**o*...3 o— SM... So...’ og —’ ...*g—µ*...gU9...o9µMg—S’Ug ...
 g—gS3 oU—...’’ ’ So..o’ Mµ9SUQ.SU9Mg—v *..*µM..g*...—' o..Lµ3 i ó ..v)...*Mvv *..v’ ! v*XSg *Z.—' S9 úN..
 *o oMo9.SU9Mg—v *.g o.µU9ó *g ú...o øgU—NgXXSMgi o...v..g .v’ ..Uó g ..MµU— S*NoU*µi SUQ..
 í v g9..M3 Xg gi SSúZ.<vU*offµoU—úN*XoMS MS*µo*...So..3 g g Sg..9og—' *N.’ ’ SM..9v...Uv—..gýoM..

g ..MµU- S*Ng o..o' Mµ9o9Z./ g*- úN.-' o..rU9o' ..S..SU-oU9o9...v...)µí US' ..oø9oUM...)v' ..9oMSvUR
 3 g6SUQgU9.g9øgUMSUQ*vNq .X vQ o**Ng.Xµ Xv*o.g *v...o oMo9.SU.-' o.*o oMSvU.v).SU9Sg- v' *Z.
 ...

—gi o..WàvNq ..w' vQ o**rU9o' ...S o.àó S*.Wu- R- í- N) g3 o'' v' 6...

I g*SM' µ3 gU.2 oo9*.....	(vµU9g-SvU*v)...“ o i oSUQ....	VXX' -µU-ú.....
<u>2 µ- SSUgU9.I g*SM' o9Sg <é o.....</u>	<u>GM**..v.I g*SM7 Uv" o9Q.....</u>	<u>wó *vUg .á SQ -*.....</u>
n og-¹ *..) v3 .SU)oMSµ*.9Sog*o*.....	wvXµ g-SvU.." S' .Uv.o9µMg-SvU....	GM**..v..;µ*-SM.....
<' S9.3 v' -g Sú.....	Offµg .gM**..v.ffµg Sú.o9µMg-SvU....	(oo9v3 .v)....o SVU.....
<' S9.*µU-SUQ.....	+oU9ó .Xg Sú.SU.i g*SMo9µMg-SvU.....	wv SSMg' .SQ -*.....
t g-ó Ug .3 v' -g Sú.....	t ogU.úog *v).*Mv v SUQ.....	w' vXó -ú...SQ -*..)v' .." v3 oU..
2 µ- SSUg .9o MSUM*.....	.....	( oo9v3 .v).g**o3 i ú.....
n S-...v" .SU.) µS*.gU9.o9Q-gi o*.....	<u>GM**..v.SU)v' 3 g-SvUgU9...</u>	(oo9v3 .v).9SMµ**SvU....
.....	<u><v3 3 µUSg-SvU*.....</u>	.....
...	rUó Uo-µ*ó *.....	.....
<u>“ g-ó .gU9.àgUSg-SvU.....</u>	t vi So.gU9...gU9 Sv...o oX' vUo.*µi *MSX-SvU*.....	<u>wó *vUg .(oo9v3 .gU9...</u>
r3 X vø9...gUSg-SvU.....	G -ó Ug-Sv...o.*vµi M*.v).SU)v' 3 g-SvU....	<u><' vSM.....</u>
r3 X vø9..." g-ó ..*vµi M.....	.....	àg-S* o9.9o3 gU9..v' ...
2 v.gM**..v.g..! gU9" g*! SUQ)gMSú.....	<u>' og-¹ .gU9.“ o Uo**.....</u>	MU- gMX-SvU.....
n og-¹ *..) v3 .µUg)o.." g-ó NsgUSg-SvU.gU9... /9o.o' XoMgUMi.g-... -		wµi SMoMv' .M' µX-SvU....
' úQbUo.....		Og' ú.3 g' SgQ.....
.....	w' o3 g-µi o.9og-¹ *..) v3 .LvURM3 3 µUSgi o... 9Sog*o*.....	(oo9v3 .v).9v3 o*-SM. 3 vø3 oU-....
<u>à' o-ó</u>	Offµg .gM**..v.ffµg Sú..! og-¹ M' o.....	.....
n og-¹ *..) v3 ..! vµ*o' v 9.gS .Xv µ-SvU.....	-USó *g ..! og-¹ .Mó gQ.....	<u>rUMµ*SoUo**.....</u>
GM**..v..o oM SSú.....	.....	Offµg .X v-oMSvU.v).*vNq ...
w' oøg oUM.v).Mv6SUQ." S' .Mg éi Sv3 g**.....	<u>OUsvU8 oU-g .0 µg Sú.....</u>	QvµX*....
.....	n og-¹ *..) v3 .vµ-9v' .gS..Xv µ-SvU....	Offµg .gM**..v..Xv" ó
<u>wó *vUg .àg)o-ú.....</u>	n og-¹ *..) v3 ...og9.o' Xv*µi o.....	wv" ó .9S'- S µ-o9.i ú.*o' µg v' SvU-g-SvU....
rUó Xó *vUg .øSv oUM.....	wg' -SMi g-o.3 g-ó .xí ZvXv µ-SvU.....	GM**..v..Xµi SMó øSM*...
n og-¹ *..) v3 ..vg9.Súµi S*.....	àXoMS*.X v-oMSvU.....	9S'- S µ-o9.i ú.*vNq .Q vµX
wv SSMg .6S SUQ.gU9...v' -µi o.....	.....	.....
rU-S g-o.Xg -Uó .øSv oUM.gQgU*..." v3 oU.....		<u>GM**..v.G9øgUM9...</u>
wv SSMg .øSv oUM.....		<u>O9µMg-SvU....</u>
.....		á o*XoM..v' .gM9o3 SM.) oo9v3
.....		wvXµ g-SvU.." S' .g9øgUM9...
.....		o9µMg-SvU.....
.....		š og' *.v)...ó -Sg' ú..*Mv v SUQ..
.....		+oU9ó .Xg Sú.SU.g9øgUM9...
.....		o9µMg-SvU....
.....		
àvµi Mm' g' 3 gM6.gU9..7' ú vøg...		
xí-íBY..		
...		

—' o.àvM\$..w vQo**rUo' ...S o.ào S*.xWiu- R- í - Y.*XgU*.fWúog *.gU9..oUM3 Xg**o**vM\$...
X vQo**9g-g..) v3 ..vóó ..W- ..MµU- S*Ni ú..M3 i SUQ.% ..SU9M- v *) v3 ..LSb.9g-g..*vµ M*Z^v..
—' o.rUo' ..o' MµSó ú..µ-SSo*... o Sgi oNMo9S oNgU9..M3 X o' oU*So..9g-g...- g-..X vø9o..gU..
vi ;oMSó.gMµU..v)... o.Xó S'9ZrU9M- v *.g o.SUM19o9..vUú..S)... oú.g o..” o B og*µi o9N' S' ...
MU*SoU..3 o- v9v vQNi ú..- o.*g3 o.v QUSg-SvNgU9..gMv**..g ..v ..o**oU-Sg ú..g ..MµU- S*..
SU...- o...*g3 XoZ..—' o*o...X SUMXo*...oU*µi o...3 og*µi o3 oU...MU*SoUM...gMv**... Ug-SvU*...gU9...
3 o-Sµi vµ*..g**o**3 oU..v)...SU9M- v ..ffµg Sú...v..gMµi g-o ú... o oM...- o..SU-oU9o9..X' oUv3 oUgZ..
—' o.rUo' NS*...9S oU*SvU*..gU9..M3 XvUoU*..g o...Mg o9...) v3 oX o*oU-SUQ..- o...” v *-...
Xó)v 3 gUM...v..W- oX o*oU-SUQ..- o.i o*-Xó)v 3 gUMZG..µUS o9..Mg o.x- RW- Y.g v” *)v ...
i o—ó ..M3 Xg gi SSú..v)..9Só *o.S*µio..gMv**..MµU- S*..gU9..gMv**..- o.i µS9SUQi vM*.v)...- o..
SUo' Z.

“ o..µ*o...- o.àvM\$..w vQo**rUo' ' NS*...9S oU*SvU*..gU9..M3 XvUoU*..x*oo...-gi o.í ZW...v...
gXX v' S g-o..Sbffµg Sú..gMv**..MµU- S*..gU9...” v 9'...oQvU*..SU..-’ oo...” gú*Z.“ ' So...- o.rUo' ..S*..
Uv...MU*- µMo9...v..3 og*µi o..Sbffµg Sú..9SoM úN' o...vv6..g-...- o..Mv**RMµU- ú..- oU9*N..oQvUg ...
- oU9*..gU9...o3 Xv g ..- oU9*..vóó ...- o..fWúog ..Xó Sv9..SU.gU.g—o3 X...v..g**o**..Sbffµg Sú..i ú..
o' g3 SUQ..- o...oøo *.v)..Q v” -' ..gU9..MUó QUM..gMv**..MµU- S*Ni µ-..g *v..Mv**BoMSvUg ú..
gU9..v) ..MUMX*..SUM19o9..SU..- o..SUo' NSZNM3 XvUoU*Z.

...
—v.9v...- S...” o..µ*o...- o.*M o*...v..M3 Xg o.MµU- úRoøo .gU9'...oQvUg ..Xó)v 3 gUM*..SU.9Só oU...
gXXoM*.v)...vM\$..X vQo**..xM3 XvUoU*..N9S oU*SvU*NrUo' Y.vóó ...S oZt v o.*XoM\$ Mg úN' o..
g o..SU-ó o*-o9..SU...” ' o- ó ...- o..9Só oUM*..SU.*vM\$..vµ-M3 o*..gMv**..MµU- S*..SUMog*o9..v ...
9oMog*o9..vóó ...- o..fWúog ..Xó Sv9..xSZN.oøo *.v)..Q v” -' YZ.“ ' So...- o.)v 3 ó ...” vµ 9..*µQQ*...
-' ó o...” g*..gU..SUMog*o..SU.Sbffµg Sú..i oMµ*o..v)..9Só QoU..9oøo vX3 oU*..gMv**..MµU- S*N..- o..
g—ó ..Mµ 9..i o..g*..SQ..v)... o9µM9..Sbffµg SSo*..gU9..Xv**S o..MUó QUM..SU..MµU- S*fl.*vM\$...
Xó)v 3 gUMZàoMU úN' o..3 gú..g *v..µ*o...- o.*M o*...v..M3 Xg o.*vM\$..vµ-M3 o*..vóó ...-S o..
gMv**..- o..M3 XvUoU*..v)...- o.rUo' NSZN' ' o- ó ...- o...oµi -*..gMv**..- o.rUo' ..M3 XvUoU*..
g o.3 v o.*S Sg ..SU..- o..X o*oU..x v” ó ..Sbffµg SúY..- gU...- oú...” ó o..SU..- o..Xg*Z.

...
—' S9 úN' o.g *v..µ*o...- o.rUo' ...v..gXX v' S g-o..Sbffµg Sú...” S' SUMµU S*.i g*o9..vUMµU- ú..
Xó)v 3 gUM..SU...” v..M3 XvUoU*..v)...- o.rUo' N' ' SM..gXX v' S g-o..Sbffµg Sú..3 v o..9SoM ú..
- gU... v- ó *m -' o... rUMµ*SoUo**... gU9... wó *vUg ... á SQ -*.. M3 XvUoU*... g o... -' o... Mv*o*-...
gXX v' S g-SvU*..v)..offµg Sú..v)..vXXv -µUSúZ..- oú.g o..M3 Xv*o9..v)..SU9M- v *.9SoM ú...o g-o9...
-v..offµg ..9S- S µ-SvU..v)..Xv” ó ..i ú..*o' µg ..v S vU-g-SvUN*vM\$..Mg**N*vM\$..Q vµXNQU9ó ..gU9...
*vMv*oMUv3 SMXv*SvU..xrUMµ*SoUo**YgU9..SU9M- v *...o g-o9...v..offµg ..gMó**..v..µ*-SMN.SQ -*...
gU9..) oo9v3 *.xwó *vUg ..á SQ -*YZ.

¹ A further 13 indicators were used for supportive calculations.

² In this chapter we propose using the Social Progress Index to better understand the non-economic inequalities around the world. However, the Social Progress Index lends itself to measuring progress on the Sustainable Development Goals overall (Social Progress Imperative, 2017).

.....

. ...+ vi g .gU9'...oQvUg .Subffug Sú ...

.....

—v..o' g3 Sub... oU9*.SU.vMg .X vQ o**..Qvi g ú...” o.gXX v' S g-o... o.rU9o' .*M o..)v ...' o...” v 9...
gU9.*o oMo9'...oQvU*.x—gi o.í Z YZ.“ o.9v.*v.i ú.Mg M g—SUQg.XvXp g—SvUR' oSQ —o9.*M o.µ*SUQ..
‘ g” .9g—g.v).g ‘...gU6o9..MµU— S*...” ' SM...— og—*...” o...” v 9é oQvU*.g*.g.MµU— ú^BZ.....

.....

—gi o.í m+ vi g .gU9'...oQvUg ... oU9*.SU.vMg .X vQ o**..Wu- R- í - ...

.....	Wu-	Wu%...	í - - -	í - - %...	í - W	í - W%...	í - í -
“ v 9....	% Z	%BZ%...	% Z °	%Z	“ VñW...	“ .ZV%...	“ %Z °
àµi Rg' g gU.G) Sg.....	B.Z °	BIZ %...	. - Z %...	. BZ	“ ZB....	. uZ í	% ZB
àvµ- ' .G*Sg.....	. - ZW...	. í Z 1....	. . Z%	. ° Z%	%V 1....	%Z	%Z.
2 v - ' .G3 ó Sg.....	1W.	1í Z °	1. Z	1 Z	11Z 1....	1uZ í	11Z 1
t 99 o.Og*... .2 v - '							
G) Sg.....	. 1Z....	% Z W...	%Z%	% Z W...	%Z%	“ Vñ°	. Z.
/g—SU.G3 ó Sg...`							
<g S i ogU....	“ - Z	“ í Z%	“ %ZV...	“ 1Z B....	° VZ W...	° BZ B....	° í ZñV
Opí vXogU.—USvU.xO—R ° YN) v v” o9..Mv*o ú.i ú..2 v - ' ..G3 ó SgZ—' o.3 v*...S X vøo9'... oQvU*...	° ° Z í	° uZ W...	1í Zñ....	1%Z 1....	11Z....	1uZ.	1uZ%
Og*..G*Sg...` .wgM M....	. uZ	%V 1....	%Z °	%ZB....	“ í Z í	“ %Z	° Z%
<oU— g ..G*Sg...` ..<gµM*µ*.....	% Z %...	%ZñW...	% Z í	% Zñ....	“ VñV...	“ BZB....	“ Zñu

àvµi MµGµ- ' v *....

.....

“ ' So...- ' o...vøó g ...- oU9...* v” *...- ' g—g ‘... oQvU*...S X vøo9...- ' oS...*vMg .X vQ o**..9µ SUQ.- ' o...
vi *ó øo9..Xó S'9N.- ' o.9úUg3 SM...” ó o.9S'ó oU-Z.- ' o.i o*...Xó)v 3 SUQ.. oQvU.SU.í - í - ...” g*...- ' o...
Opí vXogU.—USvU.xO—R ° YN) v v” o9..Mv*o ú.i ú..2 v - ' ..G3 ó SgZ—' o.3 v*...S X vøo9'... oQvU*...
SUM..Wu- .g o.Og..G*Sg..gU9..wgM Mxz WZWXvSU*YN” ' SM... g*... v” U...- ' o.3 v*...MvU*—oU...
S X vøo3 oU—NgU9...àµi Rg' g gU.G) Sg...xz WZ YZ.—' o... og*...S X vøo9'... oQvU*...g o.2 v - ' ...
G3 ó Sg...xz Z . Y.gU9...<oU— g ..G*Sg..gU9...- ' o...<gµM*µ*...xz uZWYN.” ' ó o...X vQ o**..9oMSUo9...
—' vµQ ...v.í - W%gU9...- ' oU... oMøó o9Z/g—SU.G3 ó Sg..gU9...<g S i ogU.xz WZ ° YX vQ o**... g*...
*g o9...*SUM..í - WZ2 v - ' ..G3 ó Sgff...X vQ o**... g*..9oMSUo9...*SUM..í - W...” ' SM... o*µ —o9..SU...- ' o...
‘ oQvU*..9oMSUo...v...*oMvU.i o*...Xó)v 3 SUQg) —ó ...- ' o.O—Zl oúvU9...- ' o.S X vøo3 oU—SUgi *v µ—o...
—ó 3 *NS..S...ø9oU...- ' g—... oQvU*...! gøo.3 gUgQ9...v..Ug' v” ...- ' o.QXi o—' ooU...- ' o.i o*...gU9...- ' o...
” v *...Xó)v 3 SUQvøó ...S oN” ' SM...µQQ*...- ' g—Subffug Sú.SU.vMg .X vQ o**..i o—' ooU...oQvU*...
gU9..MµU— S*...S..9oMog*SUZr—S...ø9oU...- ' g—o*XoMg ú...- ' o...” v *...Xó)v 3 SUQ.. oQvU*...! gøo...
3 gUgQ9...v.3 gSU—gSU.g.*gi o.SUMog*o.vøó ...S oN” ' ó og*...- ' o.i o—ó .Xó)v 3 SUQ.. oQvU*.xO—N.
2 v - ' ..G3 ó SgN/g—SU.G3 ó Sg..gU9...- ' o...<g S i ogUY! gøo...ogMo9.g.Xg—ogµ..SU...oMU—úó g *Z.

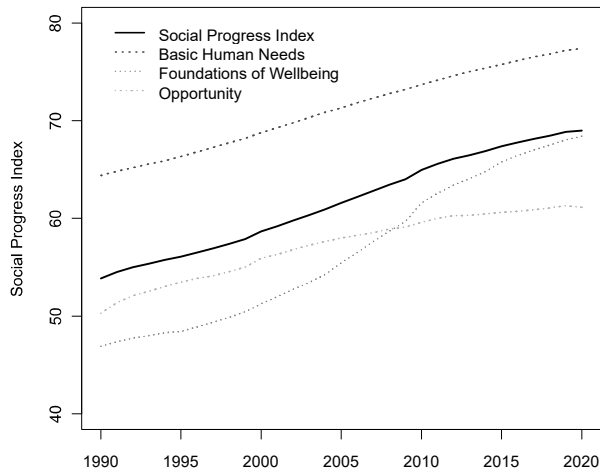
³ To calculate the scores, indicators are first aggregated into population-weighted raw values, using data of all ranked countries. Weights (established through statistical methods) are applied prior to calculating dimensions and the overall Index score. It is important to note that this method is different from calculating population-weighted scores (i.e., applying weights on component scores), and in essence treats the world as a country.

...

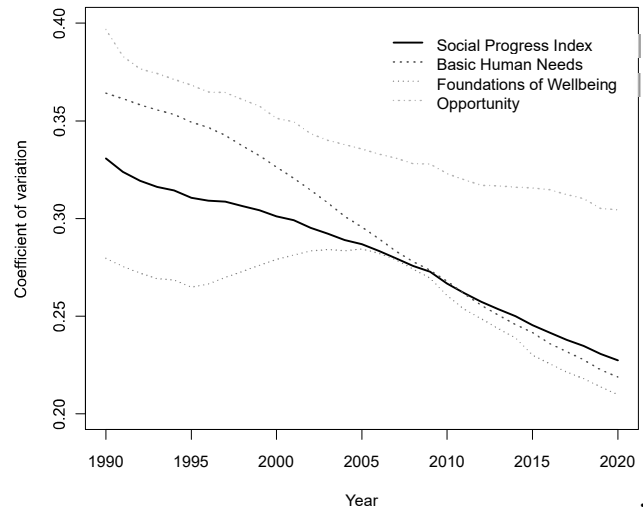
(μ - $\acute{o}$.. $\acute{i}$ og69v" U.) $\acute{v}$... $\acute{o}$.. $\acute{v}$ 9..g*..g.." ' v o..SU. (SQ $\acute{i}$ o..WX $\acute{g}$ -..g..xSZ $\acute{r}$ oU9*..SU..àwr.gU9..S*..
9S oU*SvU*Y.. o ϕ og *.. $\acute{r}$ g-.. $\acute{r}$ o.." $\acute{v}$ 9... g*..i oM3 o..3 $\acute{v}$ o..off μ g ..SU..X v ϕ 9SUQ.i g*SMUbo9*..gU9...
o*-gi S' SUQ.. $\acute{r}$ o..i μ S9SUQ.i vM*..v)..." o i oSUQNi μ -..S*..X vQ o**..vU..vXX $\acute{v}$ - μ US-ú...! g*..*-g o9Z..
- $\acute{r}$ o..àwr.." $\acute{v}$ 9..*M o..S X v ϕ o9.i ú..WZ β ..XvSU*..i o-" ooU..Wiu- .gU9.. $\acute{i}$ - $\acute{i}$ - Z.. $\acute{r}$ o..i o*-Xó) $\acute{v}$ 3 SUQ..
9S oU*SvU.." g*.. $\acute{r}$ o..I g*SM" μ 3 gU.2 oo9*.." ' SM..SUMog*o9*.. μ i *-gU-S $\acute{g}$ ú..) v3 ... β Z β ..SU..Wiu- ...v...
° Z β ..SU.. $\acute{i}$ - $\acute{i}$ - Z(v μ U9g-SvU*..v)..." o i oSUQSUMog*o9..o ϕ oU.3 $\acute{v}$ o..x) v3 ... Z W-v... β Z . YN9 \$oU..
 $\acute{g}$ Q ϕ ú...i ú...Q ϕ SU*..SU.. $\acute{r}$ o... GMM*..-v...rU) $\acute{v}$ 3 g-SvU..gU9...<v3 3 μ USM-SvU*..M3 XvUoU-Z.. $\acute{r}$ o...
VXX $\acute{v}$ - μ US-ú..9S oU*SvU.. v" o ϕ o N9vo*..Uv-..MU) $\acute{v}$ 3 ...v...! S*..Qv" - $\acute{r}$.X $\acute{g}$ -ó U... " ' So.. $\acute{r}$ ó o.." g*..
g...MU*S-oU-..SUMog*o..) v3 ..Wiu- ..x 1ZuY-..v.. $\acute{i}$ - Wx%Z . Y.S..." g*..)v v" o9..i ú..g..Xó Sv9..v)...
-gQ ϕ -SvU.xgU9..o ϕ oU. SQ -9oMSU ϕ Y μ U-S.. $\acute{i}$ - $\acute{i}$ - ..x%Z β YZ..

...

(SQ $\acute{i}$ o..WigY.. $\acute{r}$ oU9*..SU..àvM $\acute{g}$.. $\acute{w}$ vQ o**..rU9o' .gU9..S*..9S oU*SvU*..Ni Y.<vo M ϕ U-..v).. ϕ $\acute{g}$ S $\acute{g}$ -SvU..
SU..àvM $\acute{g}$.. $\acute{w}$ vQ o**..rU9o' .gU9..S*..9S oU*SvU*..Wiu- R- $\acute{i}$ - ...



...



...

àv μ MmG μ - $\acute{r}$ $\acute{v}$ *...

...

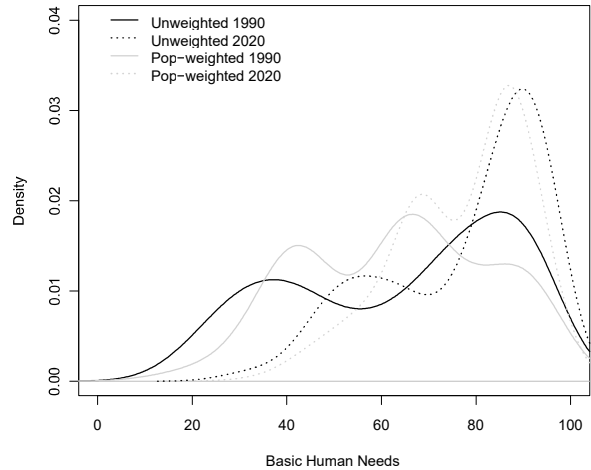
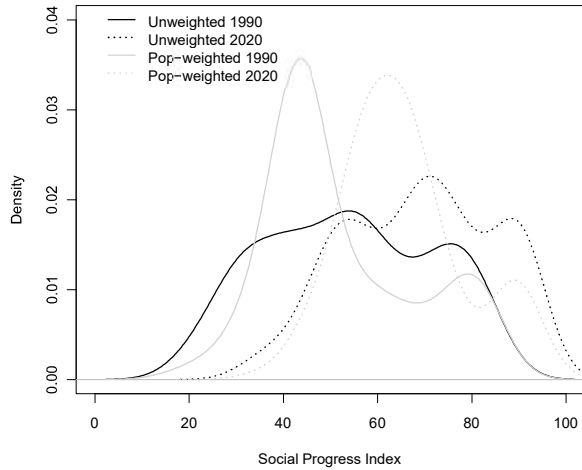
(SQ $\acute{i}$ o..WX $\acute{g}$ -..i ..xSZZMo M ϕ U-..v).. ϕ $\acute{g}$ S $\acute{g}$ -SvU..SU..àwr.gU9..S*..9S oU*SvU*..Wiu- R- $\acute{i}$ - Y.) μ - $\acute{r}$ ó ...
9o3 vU $\acute{r}$ g-o*..! v" ... $\acute{r}$ o*o.. $\acute{r}$ oU9*.. $\acute{r}$ gU* g-o9...SU-v.. $\acute{r}$ o.. $\acute{o}$ o9 μ MSvU..v)..Subff μ g S-úN3 og* μ o9..i ú...
Mo M ϕ U-..v).. ϕ $\acute{g}$ S $\acute{g}$ -SvUNSZNgXX v' S g-SUQ! v" ..S $\acute{g}$ S $\acute{g}$.. $\acute{v}$.9S*-gU-.) v3 ..ogM..v- $\acute{r}$ ó ..M μ U- S ϕ * ...
Xó) $\acute{v}$ 3 gUM*.. $\acute{g}$ o..vU.. $\acute{r}$ o..SU9o' .gU9..S*..9S oU*SvU*Z:" ' So.. $\acute{r}$ ó o..I g*SM" μ 3 gU.2 oo9*..9S oU*SvU..
' g*..Uv-..gMS ϕ o9... $\acute{r}$ o..! SQ o*-..gi *v μ -o..Q ϕ SU*NS..gMS ϕ o9... $\acute{r}$ o..! SQ o*-..9oQ oo..v)..M ϕ U ϕ o QUM..
i o-" ooU..M μ U- S ϕ *..Xó) $\acute{v}$ 3 gUM*N3 ogUSUQ.. $\acute{r}$ g-..M μ U- S ϕ *.. $\acute{g}$ o..3 $\acute{v}$ o..S $\acute{g}$ S $\acute{g}$..SU.. $\acute{i}$ - $\acute{i}$ -.. $\acute{r}$ gU.. $\acute{r}$ oú...
" ó o..SU..Wiu- Z.. $\acute{r}$ o..(v μ U9g-SvU*..v)..." o i oSUQ9S oU*SvU.g *v..gMS ϕ o9..M ϕ U ϕ o QUM..v ϕ o g N..
' v" o ϕ o ..." o..M ϕ U.vi * ϕ o.. $\acute{r}$ g-..g-..*v3 o..XvSU-9 μ SUQ.. $\acute{r}$ o.. β W ϕ og ..Xó Sv9..Subff μ g S-ú..i o-" ooU..
M μ U- S ϕ *..SUMog*o9..gU9.. $\acute{r}$ oU..9oMSU ϕ 9..gQ ϕ SNGU9..SU.. $\acute{i}$ - $\acute{i}$ -..S.. $\acute{r}$ g9.. $\acute{r}$ o..v" o*-..Mo M ϕ U-..v)...
 ϕ $\acute{g}$ S $\acute{g}$ -SvUZ.. $\acute{r}$ o...VXX $\acute{v}$ - μ US-ú..9S oU*SvU! g*..g *v...oM 9o9..S X v ϕ o3 oU*..SU.. $\acute{r}$ o.. $\acute{o}$ o9 μ MSvU..v)...

Stoffig Súní μ...! ó o.S.g.Uv-SMgi o.* v” 9v” U.g...! o.μU9.v)...! o.vi *ó øø9.Xó S9.gU9.S*...øøo *...
 g o.3 μM...! S9 ó ...! gU.)ý ...! o.X øøS7μ*...” v.9S9 oU*S7U*Z.

...

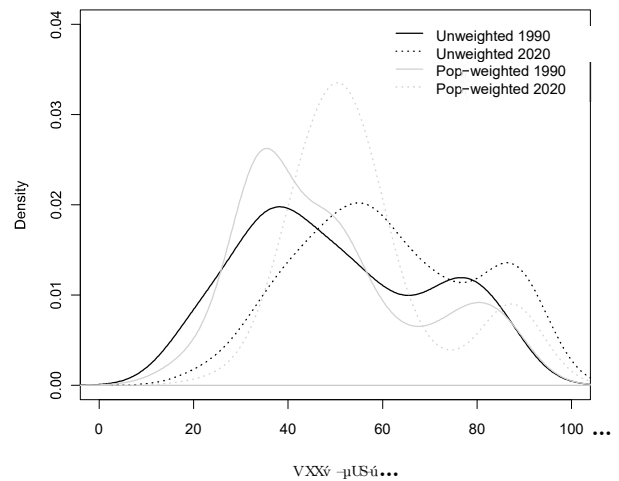
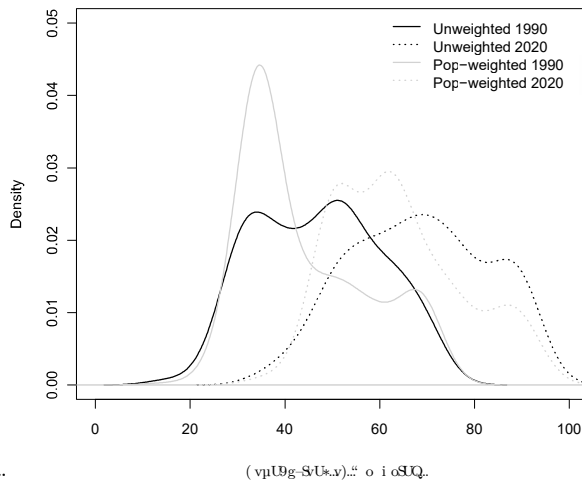
(S9í o.í mwwXμ g-S7UR’ oS9 -o9.gU9..μU’ oS9 -o9.9S* S μ-S7U.v)...! o.rU9o’ .gU9.9S9 oU*S7U...
 M o...

....



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....

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à vμ MmGμ-! ý *....

...

-! o*o... U9SU9.g o...)μ -! ó ..μXXý -o9..i ú..o’ g3 SU9Q..! o.9oU*Sú..Xv-*..v)...! o.rU9o’ .gU9...! o...
 -!’ oo.9S9 oU*S7U*ZG.9oU*Sú.Xv-* v” *.. v” ...! o.9g-g.g. o.9S* S μ-o9.gMv**g’...gU9.v).Xv**S o...
 øg μo*ZrU.vμ .Xv-*N” o.* v” ...! o.*M o*.v)...! o.rU9o’ .xgU9.S*..9S9 oU*S7U*Y.vU...! o..! ý SivU-g ...
 g’ S...x-! o.. gU9...v)...Xv**S o.*M o*..S...) v3 ...-v...W- YZ.-! o.9oU*Sú..xv ...MUMU- g-S7UY.v)...
 MμU- S* ..M o*..S.3 og*μ i o9..vU...! o.óó -SM .g’ SZ.-! o.9oU*Sú..Xv-*..øSμg So...” v.3 o’ SM.SU...

—' v..XvSU*.SU...S omXvXµ g-SvUR' oSQ -o9.xQ oúYgU9.µU' oSQ -o9.xi gMY.*M o*.SU.Wiu- .xv S...
 SubYgU9.í -í - .x9g*' o9...SubYZ('ó' g3 X oNSU... o... ' *-Xv-v.) (SQí o.í Z N... o.*v S9.i gM...Sub...
 S9Sg-o*... ' g-... ' o.àwr...*M o*...v)...MµU- S*...SU.Wiu- ...' ó o..3 v*-ú...MUMU- g-o9..i o-'' ooU... ' o...
 øg µo*.v)... - ...v... - Z.....

...

“ o...MU* µM... ' o*o...Xv-...-v...o' X'v o... ' o...9S' S µ-SvU...v)...MµU- S*fl.Xó)'v 3 gUM...gU9...S*...
 oøv µ-SvU.vó ...S oZwvXµ g-SvUR' oSQ -o9.3 o- ' v9.*' S o*...v.gXX v' S g-o... ' o.gøø gQ...oøo .v)...
 *vMg ...X vQ o**..v)...gU.S9S9µg Zr-...S*...Q og-ú...SU µoUM9..i ú... ' o...Xó)'v 3 gUM...v)... ' o...3 v*-...
 XvXµ vµ*.MµU- S*...g*... ' o*o... ' gøo... ' o... SQ o*...'' oSQ -*Z-U' oSQ -o9..Xó)'v 3 gUMNvU... ' o.v- ' ó ...
 ' gU9N.9vo*...Uv-...gMMµU-...) 'v ...MµU- S*...XvXµ g-SvU*...gU9... ' o oM*...MµU- ú...Xó)'v 3 gUMZ...
 <v3 Xg SQ... ' o*o...'' v.3 og*µí o*.g *v.X vøS o*...SU*SQ -*SU-v.Subffµg S-ú.i o-'' ooU.MµU- S*Z... ' o...
 I g*SM " µ3 gU..2 oo9*...Xv-...µQQ*... ' g-... ' ó o... ' g*...i ooU...g...*SUS MµU-...* S-...-v...i o-ó ...
 Xó)'v 3 gUM...)'v .3 v*-MµU- S*...gU9.3 v*-XovX o*ZI v- ' ...'' oSQ -o9.gU9.µU' oSQ -o9.í -í - .øg µo*...
 ' oM 9... ' o... SQ o*...9oU*S-ú.SU... ' o... - RW- ...*M ó...gUQNo**oU-Sg ú...o*µ -SUQS.g.UoQg-S o*.6o" N...
 " ' ' ó og*...Wiu- ..øg µo*...g o.3 µM...3 'v o...offµg ú..9S' S µ-o9..SU... ' o.í - RW- ...*M ó...gUQZ...“ o.g *v...
 oo.g.Uv-SMgi o.' S-...v" g 9*.i o-ó ...*M o*...SU... ' o.(vµU9g-SvU*.v)...“ o i oSQ9S oU*SvU...“ ' ó o...
 - ' o.Xó)'v 3 gUM...)'v .i v- ' ... ' o...'' oSQ -o9.gU9.µU' oSQ -o9.3 og*µí o.S X vøo9.3 v*-ú...v...*M o*...
 gi vøo... - Z... ' o...VXX' -µUS-ú.9S oU*SvU...oM 9o9... ' o...3 g o*-Xó)'v 3 gUM...SUMog*o*...g*...“ o ...
 g*.vUú...S So9.MgUQ*...SU... ' o.9S' S µ-SvUN' S' .3 v*...'' oSQ -o9.gU9.µU' oSQ -o9.Xó)'v 3 gUM...
 i oSUQS... ' o... - R- ...*M ó...gUQZ.

....

—' o*o... U9SU*...µQQ*... ' g-MµU- S*... ' gøo.MUó Q9.vó ...S o.xµU' oSQ -o9YNSZNSoffµg SS*...
 i o-'' ooU.MµU- S*...9oMSb9Ni µ-.g-.9S'ó oU-...Xoo9*.gU9.9S'ó oU-...oøo *.gMv**..MµU- S*...gU9...
 g*XoM*.x9S oU*SvU*YZ<vµU- S*...g o.Mv*ó ... ' gU.oó .i o) 'v o...v..oU*µí SUQXovX o*.i g*SMlbo9*...
 g o.X vøS o9... .3 v*-MµU- S*... U9... ' o3 *o øo*...SU... ' o... - RW- ...*M ó...gUQ...SU.í -í - Z" v" oøo N...
 oMí SUQ.í vg9ó ..." o i oSUQ.gU9...vXX' -µUS S...oo3 *...v..i o.3 'v o...Mg oUQU... " ' ' So... ' ó o...
 ' gøo.i ooU.S X vøo3 oU*.gU9.MµU- S*fl.Xó)'v 3 gUM... ' g*.3 vøo9'...SQ -'' g 9*.vU... ' o... Rg' S N... ' o...
 g9øgUM3 oU*...g o...o**...*SUS MµU-...M3 Xg o9...'' S' ... ' o...I g*SM" µ3 gU..2 oo9*.9S oU*SvUZ... ' S*...
 M' o*XvU9*...'' S' .v- ' ó ...µ9S*...µ*SUQg...S Sg .9g-g*o-xwoS Rvg v3 Sv..o-.g ZNí -í βYZr-.g *v...
 µQQ... ' g-...Subffµg SS*...i o-'' ooU...XovX o...xXvXµ g-SvU..." oSQ -o9Y.9oMSb9Ni µ-...S Sg úN...
 X vQ o**... ' g*.i ooU.µUoøoU.SU...ó 3 *.v)...S o.gU9.9S oU*SvU*.v)...*vMg .X vQ o**Z.

...

n S9SUQ9ooXó .SU-v... ' o.Mv**RoMSvUg '...og SS*N' o.ó' g3 Sub... ' o.S9S9µg .M3 XvUoU*..." ' SM...
 3 g6o.µX... ' o... ' oo.9S oU*SvUZ...“ o.g*o*... ' o.6oú...µi3 3 g ú...*-g-S*SM.x-gi o.í Z YgU9... ' oS ...
 9úUg3 SM...)'v ... ' o.SUSg .xWiu- YgU9... Ug .úoó .xí -í - Yv...3 og*µí o3 oU-č.*XoMS Mg ún..." o.g*o*...
 - ' o.9S'ó oUM...SU.3 SUS g..xgYN3 g' S g.xi YNgó gQ.xMN*-gU9g 9..9oøSg-SvU.x9YNM o MSU-v)...
 øg Sg-SvU.x<vø YxoYgU9... ' o.*X og9.x)Y) 'v ... ' o.W...M3 XvUoU*Z.....

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r-..S..oø9oU-...! g-..Uoğ ú.g ..M3 XvUoU-*.S X vøø9..) v3 ..-! oS..SUSg .3 SUS g .Xó)v 3 gUM..SU...
Wiu- ..xM µ3 U.gYZ-...! o..vUú..o' MX-SvU.S-...! o..rUMµ*SoUo**..M3 XvUoU-...! ' SM'...oM 9o9.g...v" ó ...
3 SUS µ3 ..M o..Sú-í-...! gU..SU..Wiu- Z2 oğ ú.g ..M3 XvUoU-*.g *v...v" ó o9...! oS..Mo MøU-..v)...
øğ Sg-SvU.xM µ3 U.oY..! ' SM..*SUg *.MUpó QUMZ.. v" oøó Ng..9o-gSo9..g**o**3 oU-...oøog *-...! g-...
-! o..XSMµi o..S..3 S o9..gU9-...! o..! v 9..S..Uv-..gMSøSUQ-...! o..Mv*µi o..v)...! o..QX*..SU.g ..ğ og*Z..

...

-gi o..bm<v3 XvUoU-...oøo ..µi3 3 g ú.*-g-S-SM...

	a) min	b) max	c) average	d) standard deviation	e) coefficient of variation	f) spread (max-min)
Nutrition and Basic Medical Care	27.03	0.18	11.03	-3.30	-0.10	-26.85
Water and Sanitation	27.34	0.06	14.94	-6.51	-0.15	-27.28
Shelter	13.55	-2.48	18.02	-9.01	-0.24	-16.03
Personal Safety	10.31	13.15	7.00	1.07	-0.03	2.84
Access to Basic Knowledge	17.37	6.38	14.17	-8.12	-0.20	-10.99
Access to Information and Communications	7.91	50.07	54.76	9.74	-0.41	42.16
Health and Wellness	8.55	13.42	11.86	2.43	-0.03	4.87
Environmental Quality	3.67	7.60	4.45	2.44	0.02	3.93
Personal Rights	0.51	-0.45	7.27	-0.91	-0.07	-0.96
Personal Freedom and Choice	7.21	2.52	9.43	-0.51	-0.08	-4.69
Inclusiveness	-3.17	1.43	5.38	1.27	-0.03	4.60
Access to Advanced Education	3.27	2.53	20.41	2.60	-0.16	-0.74

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à vµi MmGµ-! v *...

...

<v3 XvUoU-*.SU-...! o..I g*SM" µ3 gU..2 oo9*..9S oU*SvU... oM 9o9...! o..! SQ o*-..QSU*..SU.3 SUS g ...
*M o*N)v v" o9.i ú-...! o..GMD**..v..I g*SM7 Uv" o9QZ-...! S..SU9SM-o*-...! g-..MµU- S*..! S' ..SUSg ú...
v" ...oøo *.v).Xó)v 3 gUM... gøø.3 gUgQ9-...v..*SU S M U- ú..S X vøø-...! o..X vøSvU.v).i g*SMUoo9*...
gU9...i g*SMo9µMg-SvU...! v-...! oS...MSioU*Z..(µi -! ó ..SU*SQ -..SU-v...! o..*X og9..gU9...Mø MøU-..v)...
øğ Sg-SvU..µiQQ*-...! g-..MµU- S*..ğ o..Ug' v" SUQ-...! o..QXi o-" ooU-...! o..! v *-..gU9-...! o..i o*-..gU9...
-! oS...Xó)v 3 gUM...S..MUpó QSUQ-...! S' ...! o..o' MX-SvU.v)...! o..wó *vUg ..àg)o-ú..M3 XvUoU-..g ...
v-! ó ..g*XoM*..v)...I g*SM" µ3 gU..2 oo9*..gU9-...! o..M3 XvUoU-..v)...GMD**..v..I g*SM7 Uv" o9Q...
SUMog*o9-...! oS..gøó gQn9oMog*o9-..gU9g 9..9oøSg-SvUNøğ Sg-SvU.gU9...v" ó o9...! oS..*X og9Z..

.....

rU-...! o..v-! ó ...! v..9S oU*SvU*NSZ(vµU9g-SvU*..v)...“ o i oSUQgU9...VXXv -µUú-...! o..XSMµi o..S...
Uv-..g*..*- gSQ -)v " g 9Z.“ ' So..g ..M3 XvUoU-*.SU-...! o..(vµU9g-SvU*..v)...“ o i oSUQ9S oU*SvU...
SUMog*o9-...! oS..3 SUS µ3 ..gU9..3 g' S µ3 ..M o*NÜv-..g ..Ug' v" o9...! o..QX..SU.Xó)v 3 gUMZ..

—' o..GMD**..v.rU) 3 g-SvU.gU9.<v3 3 μUSg-SvU..M3 XvUoU'..oM 9o9'..o3 g 6gi o..QSU*.vøó ...
 —' o.Xó Sv9.i oMμ*o..v)..-! o.SU-ó Uo-.gU9..3 vi So.X' vUo*..oM Uv vQí.i oSUQ.gøgSgi o.g .g vμU9...
 —' o.." v 9N' v" oøó N'! S*..! g*..g *v'.. o*μ -o9..SU.3 g 6o9 ú.9Sýó oU'.. o*μ -*) v ..MSioU*.SU.." o ...
 Xó)v 3 SUQMμU- S*NgU9..-! v*o.SU..o**..Xó)v 3 SUQMμU- S*.g*..-! o.*X og9.i o-" ooU.i o*-gU9...
 " v *-..Xó)v 3 gUM..SUMog*o9NgU9..3 SUS μ3 ..Xó)v 3 gUM..SUMog*o9..vU ú.* SQ -ú..M3 Xg o9...
 -v...-! o..SUMog*o..SU.3 g' S μ3 ..Xó)v 3 gUMZ..-! S*..SQg *..-! g-..9o*XS o..gU.vøó g ..9oMog*o..SU..
 øg Sg-SvU..-! ó o.g o..MμU- S*.g-..-! o.i v-v3 ..v)..-! o.*XoM μ3 ..-! g-..g o..)g SUQ.i o' SU9ZrU..-! o...
 VXXv -μUSú.9S oUkSVUN..-! o..rUMμ*SoUo**..M3 XvUoU-..S*..-! o..vU ú..vUo..-! g-... oM 9o9..." v *o...
 3 SUS g ..Xó)v 3 gUM..SU.í -í -..M3 Xg o9...v..Wiu-.gU9..-! o..wó *vUg .á SQ -*.M3 XvUoU-.*g o9Z..
 àSUS MgU-..QSU*.SU..ó 3 *.v)..gøó gQ*..M o..SUMog*o.gU9..g..v" ó ..Mo MSU-..v)..øg Sg-SvU.." ó o...
 gMSøøo9..SU..-! o..GMD**..v..G9øgUM9..O9μMg-SvUZ..

...

-v..g**o**..! v" ..MμU- S*..g o..Mv*SUQ..-! o..Subffig Sú..QX.." o..g *v...o' Xv o..-! o..X vQo**..v)...
 MμU- S*.i o-" ooU..Wiu-.gU9..í -í -..XX o*oU-o9..SU..-gi o.. YZ:" o..MUk9ó .*øó g ..Xó *XoMSø*..v)...
 S X vøó3 oU-m

...

- 1) gi *v μ-o..QSU*NSZNI-! o.*M o..MgUQ..i o-" ooU..Wiu-.gU9..í -í -č.....
- 2) ' o g-So o..QSU*N.SZNI.S X vøó3 oU*..SU..MμU- S* ..' o g-So o..Xv*SSvU*..øS*..g...øS*..v-! ó ...
 MμU- S*č.....
- 3) ' o9μMSvU..v)..9S*-gUM..-v..i vμU9g úNSZNI' v" ..3 μM..9S*-gUM..! gøo..MμU- S*..Móó o9...
 SUM..Wiu-.xMg Mμ g-o9..g..-! o..MgUQ..SU.*M o.i o-" ooU..Wiu-.gU9..í -í -..vøó ..-! o..9S*-gUM...
 -v..i vμU9g ú.xSZNW- Y.) v3 ..-! o..Wiu-.*M oYZ.....
- 4) gUUpg So9'..g-o..v)..Qv" -! NSZNI-! o..gøó gQ*..g-o..v)..Qv" -! ..Xó ..úó g ..vøó ..-! o..βWúó g ...
 Xó Sv9..xMg Mμ g-o9..g*..-! o..Ug-í g ...vQ.v)..àwr.*M o..SU..-! o.. Ug ..úó g ..3 Sμ*..-! o..Ug-í g ...
 vQ.v)..àwr.*M o..SU..-! o..SUSg ..úó g ..9S9o9.i ú.β- YZ.....

.....

-gi o.. m<vμU- úRoøo ..Xó)v 3 gUMm-vX.gU9..i v-v3 ..Xó)v 3 ó *..

gUUpg Sio9'..g-o..v).....

...	*M o..MgUQ.....	.....	' gU6.MgUQ.....	.....	9S*-gUM..-v..i vμU9g ú.....	.....	Qv" -!
					á oXpi SMv)...		
I ' μ-gU....	í uZβ.....	t g 9Sø*.....	Bu....	7 v og....	" . Zi1 ...	O-! SvXSg....	- Zí u...
-S v R/o*o.....	í uZW..	I ' μ-gU....	B1....	rM gU9....	" . Z %..	GUQy g....	- Zí %..
t g 9Sø*o.....	í °Z1....	àvμ-! .G') Sg.....	B. ...	f o gU9....	" í Zi1 ...	G)Q gUS-gU....	- Zí
						Offpg-v Sg ...	
t úgU3 g'	í Zi ...	G i gUSg....	Bβ... ..	à" Süó gU9....	" í Zí ...	+μSlog....	- Zí β...
O-! SvXSg....	í Z %..	-S v R/o*o.....	Bí ...	2 v " gú....	" - ZV...	<g3 i v9Sg....	- Zí í ...
<g3 i v9Sg....	í Zu....	<gi v.óó 9o....	R' ...	n oU3 g 6....	%Zi. ...	-S v R/o*o.....	- Zí í ...
+gi vU....	í %Z %..	t úgU3 g'	R %..	Gμ*- Sg....	%Z1 ...	+μSlogH S*gmμ...	- Zí W.
GUQy g....	í %Z ° ...	+gi vU....	R %..	+ó 3 gUú....	%Z - ...	àS' g./ ovUo....	- Zí W.

àvμ ⁻¹ ..G) Sḡ.....	í %Z W..	<g3 i v9Sg.....	Rβ...	2 o ⁻¹ ó gU9*.....	%1 Z í ...	t úgU3 g'	- Z í - ...
G i gUḡ.....	í %Z - ...	I v*Uḡ.gU9...	R í ...	àXgSU.....	%1 Z u... ..	2 oXg'	- Z W..
.....							
ö oUöüpo g.....	... R Z í ..	ö oUöüpo g.....	%1... ..	ö oUöüpo g.....	R Z° ..	ö oUöüpo g.....	R Z - W.
-g;SS*-gU.....	- Zβ..	-g;SS*-gU.....	. %..	-g;SS*-gU.....	WZ° ..	-g;SS*-gU.....	- Z - - ...
...	...	...	...	<oU ⁻ g' ...	...	...	...
2 Sḡ gQig.....	. Zβ..	2 Sḡ gQig.....	. - ...	á oXui SM..	uZu... ..	I o g' μ*.....	- Z - í ...
...	...	n o3 vMg-SM...	...	n o3 vMg-SM...	...	...	...
I o g' μ*.....	. Z1° ..	á oXui SMv)...	...	á oXui SMv)...	...	...	...
-6 gUö.....	... %Z° ..	7' ó g.....	β° ...	7' ó g.....	WZ β..	-USo9.à-g-o*...	- Z - í ...
...	...	-í 63 oU*-gU...	β° ...	2 Sḡ gQig.....	WZ - ...	-6 gUö.....	- Z - í ...
n o3 vMg-SM... ..	...	...	...	...	...	...	...
á oXui SMv)...	...	...	...	...	...	...	...
7' ó g.....	%Z u..	w' SSXSUo*.....	ββ... ..	I' í μU9S...	WZ° ...	2 Sḡ gQig.....	- Z - β..
-í 63 oU*-gU... ..	%Z° ..	ÜS i gi' " o.....	βW..	-í 63 oU*-gU...	WZ - ...	<gUg9g.....	- Z - β..
...	...	wgXüg.2 o' " ...	...	...	...	...	...
-USo9.à-g-o*...	" Z1..	+μSög.....	í 1... ..	ÜS i gi' " o.....	WZ	à' " o9oU.....	- Z - β..
<oU ⁻ g'	...	...	...	...	...	...	...
G) SḡU.....	...	...	...	...	...	...	...
á oXui SM..	" Zβ..	7' ú Qü*-gU.....	í° ...	<' g9.....	WZ W..	-í 63 oU*-gU...	- Z - β..
ÜS i gi' " o.....	" Z1..	-üi o6S*-gU.....	í %..	š o3 oU.....	WZ 1... ..	" μUḡ' ú.....	- Z - β..
...	...	...	...	...	...	...	- Z -

.....
àvμ MmGμ⁻¹ ' *.....

.....
OgM.v)...! o*o.3 o⁻¹ v9*.gXXS*.g.9S'ó oU.Xó *XoMSo.gU9'...o*μ *-S.U.óg úSUQSUSQ -*ZrU..ó 3 *...
v)...gi *v μ-o... QgSU*N.S...S*...3 v*-ú...9oøo vXSUQ..MμU⁻ S*...-' g-...' gøo..' oM' 9o9...-' o... g' Q*-...
S X vøo3 oU*-Z..-' o.*g3 o.S*- μo..)' '...o g-Sø..S X vøo3 oU*-N' ' 'ó o.3 gUí..MμU⁻ S*..gi *v μ-o...
QgSU*.g *v...- gU* g-o9..SU-v..g..i o-ó '...o g-Sø..Xv*SSvUZ..-' S*..S..Uv...μUo' XoMo9...SUM.3 gUí..v)...
-' o*o.MμU⁻ S*...! g9...v" 'ó .SSSḡ .*M' o*.gU9...-' ó o)ó o...-' o.*XgM...v..S X vøoZ.

...
-' o.MμU⁻ ú.M3 Xv*SSvUMgUQ*.oUSo ú..'' ' oU..'' o.g**o**...-' o.9S*-gUM...v...-' o.i vμU9g' ú..'' ' 'ó o...
-' o...vX.W..Xv*SSvU*.g' o...g6oU.i ú..9oøo vXo9..MμU⁻ S*Z..-' S*3 SQ -.i o.MμU-ó SU-μSSøo..'' S' ...
-' o...X oøSμ*... U9SUQ..-' g-...MμU⁻ S*...'' S' ...SSSḡ' ú.. v" 'ó ... oøo *...v)...*vMḡ ...X vQo**...-' g9...
*μi *offμoU-ú..! SQ' ó .Qv" ' ' .SU..-' o.rU9o' .*M' o.xgU9.øSM.óó *gYZ." v" oøó N' ' ' So...-' o..g-ó .S.N.
-v.*v3 o.o' -oU-N..-' o.MU*offμoUM.v)...! o.i vμU9o9.Ug-í o.v)...! o.rU9o' N3 ogUSUQ..-' g-MμU⁻ S*...
Mv*ó ..v...-' o.i o*-Rḡ*o.*MUG Sv.x*M' o.v)..W- Y! gøo.*v" 'ó .Qv" ' ' '...g-o*...-' gU.MμU⁻ S*..)í -' 'ó ...
g" gú..) v3 ...-' o3 N..-' o..9S*-gUM...-v...i vμU9g' ú..*' v" *...-' o..vXXv*SomMμU⁻ S*...Mv*ó ...-v...-' o...
i vμU9g' ú.g' o.i o-ó .g-..Mv*SUQ..-' o.QXxSZZ9S*-gUM...-v..i vμU9g' úYZ.

...
 —' o.i v—v3 .Xv*SSvUk.ğ o.3 v*—ú...g6oUi ú.g.*S Sğ .*(o.v).MµU- S*N3 gUú.v)... ' SM.Mµ 9.i o...
 MU*9ó o9...gSo9NgU9..µU9ó vMg-SZö oUöµo g.Sk... ' o.vUú.MµU- ú..." ' ó o.vMg .X vQo**NSU..
 gi *v µ-o...ó 3 *N9oMSU9...SUM..Wiu- Z." v" oó N-' o..gUUµg So9... g-o..v)...Q v" —' N." ' SM..g *v...
 gMMµU*..)v ...' o..SSSg ...oóo ..v)...MµU- ú..Xó)v 3 gUMN*' v" *... ' g—S..S..Uv—..UbM**g Sú.;µ*...
)gSo9...*g-o*... ' g—... U9... ' o3 *o oó*.g—... ' o.i v—v3 ..v)... ' o...ogQio...gi oNi µ-.g *v..MµU- S*..µM...
 g*... µUQğ úN<gUg9gNgU9.à" o9oUZ.

...
%“ S' SU.MµU- ú..SÜffµg Sú ...

....
 r—S*.Xv**S o...v..MU*9ó ...' o..rUMµ*SoUö**gU9...wó *vUg .á SQ —*.M3 XvUöU*..g*... ' o..Mv*o*...
 gXX v' S g—SvU.v)... S' SU.MµU- ú..SÜffµg SúZ.“ ' So..*v o ú.i g*o9..vU.o' Xó —.g**o**3 oU*..xSZN..
 3 v*...SU9Sğ—v *..ğ o..) v3 ...' o..öğ S-S*...v)...n o3 vMgM...9g-g*o-YN.SU... ' o..gi *oUM...v)...9g-g...
 Mgx-í SUQSÜffµg Sú.SU.g.3 v o.9SoM.3 gUö No' Xó —.g**o**3 oU..S*... ' o..Mv*o*...o*—S g—SvU.v)...
 ' og SúZ.

...
 rUMµ*SoUö**S*... ' o..vUú..M3 XvUöU... ' ó o... ' o..." v 9..9oMSU9NSZNXó)v 3 gUM.SU.í-í-..." g*...
 " v *o... ' gU... ' o..." v 9..*M o..SU..Wiu- Z.—' S*.Xv**S ú..µUQö**... ' g—... ' o..." v 9 *.XvXµ g—SvU..." g*...
 vUgöó gQ..o**..offµg .SU.í-í- .M3 Xg o9...v..Wiu- Z.—' S*.9vo*.Uv—..UbM**g Sú.3 ogU... ' g—..oóó úvUb...
)vµU9... ' o3 *o oó*..v.i o...o**..offµg .SU.í-í- ... ' gU.SU..Wiu- Zt gUú.MµU- S*...oM 9o9.gU.SUMog*o...
 SU... ' oS ..Xó)v 3 gUM..vU.rUMµ*SoUö**NoUgSSUQ... ' g—... ' oS .M\$SioU*.i oM3 o.3 v o..offµg .vóó ...
 —S oZ... " v" oóó No' g3 SSUQ... ' o..Uµ3 i ó ..v)...MµU- S*... ' g—..9oMSU9..gU9...*gQg—o9..gU9... ' v*o...
 —' g—..*SUS MµU-ú..S X vóo9...x—gi o..%N rUMµ*SoUö**gU9...wó *vUg .á SQ —*.9v..Uv—..)ğ o..." o ...
 M3 Xg o9...v..v—' ó ..M3 XvUöU*Z.Vóó ...' o..BWröğ ..Xó Sv9..%WgU9...°- ..MµU- S*...*gQg—o9..x ...
 9oMSU9..vU.rUMµ*SoUö**gU9...wó *vUg .á SQ —*.o*XoMSö úNSZN... ' oS ..*M o..S X vóo9..i ú...o*...
 —' gU.WXvSU..x .9oMSU9Z... ' o..vUú.v—' ó ..M3 XvUöU... ' g—...oM 9o9.g..! SQ .Uµ3 i ó ..v)..9oMSUö *...
 " g*... ' o...OÜbSvÜB oU-g ...0 µg SúZ.—' o...*g3 o...Xg—ó U..MµU..i o..vi *ó o9o9...v) ...' o..Uµ3 i ó ..v)...
 MµU- S*... ' g—..S X vóo9...*SUS MµU-úNSZNi ú..3 v o... ' gU..%XvSU*N." ' ó o...wó *vUg .á SQ —*...
 ' oM 9*... ' o..v" o*—..Uµ3 i ó ..v)..µM..S X vóó *N)v v" o9..i ú..wó *vUg .àg)o—ú.gU9..OÜbSvÜB oU-g ...
 0 µg SúNgU9..rUMµ*SoUö**Z.

....
 —gi o..%m<vµU..v)..MµU- S*..SU.9oMSUö.gU9..." S' ..S X vóo3 oU...

M3 XvUöU....	n oMSUö... *gQg—SvU.....àSUS MµU..S X vóo3 oU... ..	
GMD*...v.rU)v 3 g—SvU.gU9...<v3 3 µUSMg—SvU*....	-	WW..
à' o—ó	Bí	Wí ...
wó *vUg .á SQ —*....	°-	1W.
2 µ— SSvU.gU9..I g*Smt o9Sğ—<ğ o....	. .....	WW..
GMD*...v..G9ögUM9..O9µMg—SvU....	%....	W. ...
rUMµ*SoUö**....	%W..	uí ...
“ g—ó .gU9.àgUSg—SvU....	W....	W° ...

wó *vUg .(oo9v3 .gU9.<' vSM....	í -	WV...
GMM*...v..I g*SM7 Uv" o9Qp....	W%...	W81...
" og -' .gU9.“ o Uo*....	WV...	W8V...
wó *vUg .àg)o-ú....	ßW...	1° ...
OÜSvÜ3 oU-g .0 µg Sú....	%/o....	1° ...

.....

àvî MmGµ-í ´ *....

.....

O' g3 SUsUQ..-' o..M3 XvUoU* ..oðv µ-SvU.vøó ...' o.ßVWóó .Xó Sv9N" o.MfU.vi *ó øo...-' g-.S-.S*...-' o...
g*...W%úóó *..." ' oU...-' o..M3 XvUoU* ..Xó)ý 3 gUM.i oQgU...v..9oMSÜbZwó *vUg .á SQ -*..." ó o.vU...
gU.µX" g 9...- g;oMv ú..µU-S.í - - %Ni µ-...µi *offµoU...9oMSÜb..SÜ...-' o...g*...W%úóó *..Uóó ú..ó g*o9...
g ..X oðSvµ* ú..QgSü9..S X vøó3 oU-Z.rUMµ*SoÜb*..." g*...vU.g'.. g-í ó ... g-...- g;oMv ú..vøó ...-' o...
oU-S o..Xó Sv9..." S' ..vUo... o g-Sø ú...- vUQ ..3 v3 oU...x V% ° ..X-*NWu%R - - - Y.gU9...Uv-SMgi o...
9oMSÜb..SÜ...-' o...g*...9oMf9o.xßZ .X-*YZ.

...

.. .n S*Mµ**SvU.v).6oú... U9SUQ*...

.....

rUoffµg Sú...S*...g...3 µ -SgM-o9...MUMX-..." ' SM'.. offµS o*...3 µ -Sß oU*SvUg ...gU9...Mv**RoMv g ...
9o USsvU.gU9.3 og*µí o3 oU-Z:" ' So...-' ó...-' o-v SMvU.Süffµg Sú.S*.*' S-SUQ..v'..o oM.3 v o...-' gU...
SUM3 o.gU9..." og -' ..Süffµg SúN..-' o.Qvi g ..9oi g-o.S*.*S ..) g3 o9..g vµU9..oMvUv3 SMSüffµg SúZ.

...

t og*µí o3 oU*..v)..Süffµg Sú..g o..)g ..) v3 ..Sog Zn g-g..vU.SUM3 o.gU9..." og -' ..Süffµg Sú..g o...
S oQí g N.Uv-...M3 Xg gi oNgU9...v-í ó " So...S Xó)oMNi µ-...9g-g...vU..*vMS-g ..Süffµg Sú..g o...
o**oU-Sg ú...UvUR' S-oU-Z.-' o...àn +*...' oX o*oU...gU...S Xv -gU...3 So*-vUo...SÜ...o*-gi S' SUQ..
Süffµg Sú.g*.g..Qvi g ..Xv SM.vi ;oMSöZ.-' ó..g *v.X vø9o...-' o..vµU9g-SvU..)ý .í vg9oUSUQ..-' o...
9S*Mµ**SvU.gi vµ-..Süffµg Sú..gU9'..o oMSUQ.S*..M3 Xo' N3 µ -Sß oU*SvUg .gU9..SÜ-ó *oMSvUg ...
Ug-í oZ.

...

-' o.àvMg ..w vQo**rU9o' '...oðog *...-' g-...-' o..." v 9..." g*..3 v o.offµg .SÜí -í - ...-' gU.S..." g*.SU.Wiu- ...
SÜ...ó 3 *.v)..Süffµg Sú.i o-" ooU.MµU- S*Z.-' o..." v 9 *.XvXµ g-SvU.S*..vU.gøó gQ.i o-ó ..vý..SÜ..
g .g*XoM*.v)..*vMg .X vQo**Nb' MX-..)ý .rUMµ*SoÜb**gU9..wó *vUg .á SQ -Z.-' o.QXi o-" ooU..
MµU- S*.gU9..XvXµ g-SvU*..." g*..SUS MgU-ú...o9µM9..SÜ.X vø9SUQ.)ý ..XovXo *.i g*SMÜo9*Ng*...
" o ..g*..SÜ..*µXXv -SUQ..-' oS..í vg9ó ..." o i oSUQN! v" øóó N" ' So..XovXo *.vXXv -µUS S*..g *v...
S X vø9N*SUS MgU..QgX'..o3 gSÜ.i o-" ooU...-' o.i o*-gU9...-' o..." v *-Xó)ý 3 SUQMµU- S*Z.

...

-' o... U9SUQ*.g *v..*µQp*-N! v" øóó N..-' g-...-' o..." v 9..S*...o**offµg ...v9gú...-' gU.S..." g*.SU.Wiu- ..SÜ..
-ó 3 *.v)..Süffµg Sú..." S' SÜ.MµU- S*NoøoU..-' vµQ ..vU.gøó gQ..XovXo.g o.i o-ó ..vý..SÜ.í -í - ...
-' gU...-' ó..-' ó o.SÜ.Wiu- Z.-' S*.oUgS*..-' g-...-' o.i oÜ -*.v)..*vMg .X vQo**..-' ó o.Uv-..9S- S µ-o9...
øøoUú..gMv*.g ..3 o3 i ó *.v)..-' o..*vMS-úZ.-' S*... U9SUQ.S*..Qog-ú..SÜ µoUM9..i ú...-' o..." oSQ -v)..

—' o...3 v*...XvXµ vµ*..MµU- S*..gU9...*' vµ 9..i o...MU*9ó o9..." S' ..Mµ-S'UZ.." v" oó N-' o..9g-g...
 µQ...*' g-..rUMµ*SoUb**gU9..wó *vUg ..á SQ -*.g o...gQSUQi o' SU9..v-' ó .g*XoM*.v)..*vMg-g ...
 " o i oSUZ.

...

—' o... U9SUQ*.g *v..Ubo9...v.i o..MU*9ó o9.gQSU*...-' o...S Sg-S'U*.Xv*o9.i ú...-' o.3 o-' v9v vQí.v)...
 —' o.rU9o' .g*..." o .g*...-' o.gUg ú*o*Z:" ' So.MU*9ó o9...-' o.3 v*..M3 X o' oU*So.3 o' SM).*vMg-g ...
 " o i oSUQ.SU9oXoU9oU-..v)..oMUv3 SMU9Mg-ý *N-' o.rU9o' ..9vo*..Uv-..SUMµ9o.3 gUú.S*µio*...-' g-...
 g' o... o oøgU-..)ý ...-' o..3 og*µí o3 oU-..v)... o i oSUQ.gU9..Soffµg Súč..oS' ó ..9µo...v...-' o...gM...v)...
 M3 Xg gi o..9g-g..." S' ..Qvi g ..Móó gQN*µM..g*..3 oU-g ...' og -' N-' o'.. SQ -*.gU9..) oo9v3 *.v)...
 3 SŮ SŠ*.g*..." o .g*./ +I -θ rz .M3 3 µUSS*NV .S o oøgUM..vU.g..Qvi g ..Mg oN*XoS MS*µio*...
 µM..g..3 g g' Sg..9og-' *..MgUv-..i o..SUMµ9o9..g*...-' oú..9v...Uv-..gýoM..g ..MµU- S*Zr-..S*..g *v...
 S Xý -gU-..v..Uv-o...-' g-...-' o.rU9o' ..S*..gUM'v o9..SU...-' o..X o*oU-N9o USUQ.*vMg ..X vQ o**..gU9...
 ' µ3 gU..." o i oSUQ..o' v*XoMSšo úZ(Sg úN?' ' So...-' o..SU9o' '...o S*.vU.g.3 µ -Sµ9o.v)..SU9Mg-ý *...
) v3 ..Mo9S o..9g-g...*vµ M*N*v3 o..M3 XvUoU-*NgU9..o*XoMg ú...-' o...VXXŮ -µUSú..9S oU*S'U...
 ' o S*.vU...-' o.ó g' S-S*.v)..n o3 vMgM..9g-g*o..." ' SM...! g*...oMU- ú..i ooUMSŠšo9...)'v ..S' ó oU...
 i Sg*o...x/S- o...` ..t oUQNI- íßZn o*XS o...-' o*o...S Sg-S'U*N-' o.rU9o' ..S*..g'.. vi µ*..3 o' SM)ý ...
 g**o**SUQ...-' o..ffµg Sú..v)... Šo..g vµU9...-' o..." ý 9NSU9oXoU9oU- ú..v)..oMUv3 SMU9Mg-ý *..gU9...
)vMµ*o9..vU.vµ-M3 o*Z.

...

rU...-' S.MgX-ó N' o.*- Šo9...v.X o*oU-..g.9S'ó oU-Xó *XoMSšo.vU.Soffµg SúZ:" o.µ*o9...-' o.àvMg ...
 w vQ o**..rU9o' ..-S o.àó S*.v..X vø9o..SU*SQ -*.vU...-' v*o..g*XoM*.v)..Soffµg Sú...-' g-..g o...o)-...
 vµ-..v)..v Mg .3 og*µí o3 oU-..óýý -*Z:" o.g *v..9o3 vU*'- g-o9...-' g-..Soffµg Sú.S*..g.í vg9..MUMX-...
 " ' SM..oUM3 Xg**o*.g .g*XoM*.v)..! µ3 gU..." o i oSUQgU9..oUßSvUß oU-g ..µ*..gSgi SSúNUv-..µ*...
 oMUv3 SMX v*Xó Sú..." ' SM..S*...-' o.3 v*..M3 3 vU...oU*..)ý ..9o USUQ.gU9..3 og*µí SUQ.Soffµg SúZ.
 —' o..àn +*N' v" oó N9v..Uv-..Q...)'g ..oUvµQ ..SU...-' S'.. oQg 9NgU9..." ' So...-' o...o' -..v)...-' o..Qg *...
 SU9Mg-o*...-' g-..Soffµg Sú...Qo*..i oúvU9..oMUv3 SM3 ogU*N-' o...SU9Mg-ý *)gS...v...MgX-µí o..g...
 í vg9ó ..Xó *XoMSšoZ.

...

G*.à-SQS-üNàoU.gU9..(S-vµ**Sxí - -uNXZuYUv-oN.“ ' g-..." o.3 og*µí o.gýoM*..." ' g-..." o.9včgU9..S)...
 vµí .3 og*µí o3 oU*..g' o... g" o9N9oMSS'U*.3 gú.i o..9S*-v -o9 ZrU...-' S*.MU-o' -N-' o.3 og*µí o3 oU-...
 v)...-' o..àn +*..S*..MU*'- gSb9..i ú..v Mg ú..gQ oo9..SU9Mg-ý *..." ' SM...! gøo.g..øó ú..Ug' v" ..)vMµ*...
 gU9..µU9ó *gU9SUQ.v)..Soffµg Sú...xSZNøMUv3 SMXó *XoMSšoYNgU9..µUo*...-' S*..gXX vgM...S*...
 ' oøŠo9N-' o.3 og*µí o3 oU-..." S ..Uv-...o oM...-' o'..og ...Šo9..o' Xó SUM..gU9..." o i oSUQ.v)..XovXo...
 gU9.XgUß-Z.....

....

...

...

...

...

GMUv” o9Q3 oU*...

.....

sZwoS Rvg v3 Sv.gMUv” o9Q*...’ o... UgUMg .*µXXv -v)...’ o.GQUMg.O*-g-g .9o.rUbo*-SQMS UN.
t SS*-ó Sv.9o...<SUNG...o.rUvøgMS U.t <r2 éGOréWZB- Bué...% WV-- WVßß..Iwrn .í-í- WVW%..
+I R- -l.gU9...’ o...+oUß g Sg-..ög oUMg Ug..Iwá Vt O—OV...<rwá Vt éí-ííé%lZ...

...

á o)ó oUM*...

.....

G øg o9vN(ZNn o.á v*gNt ZN(v o*NrZnt v QgUNt Zxí-íí YZ...’ o.rUoffug Sú..xv ...’ o...+ v” -’ Y..
” o.t og*µí omn g-g..+gX*.gU9...’ o.n S- S µ-SvU.v).rUM3 o*N’ v 9.rUoffug Sú../ gi ...’ v 6SUQ..
wgXó .í-ííé-°Z.

.....

GMó NsZxWiu- YZ." S g MS*N;vi *Ni v9S*mG...’ ov ú.v)..QU9ó o9..v QgUSig-SvU*Z.+oU9ó .gU9...
àvMS-ú... xí YmWu %lZ....

...

GUUvUSNwZN. .àMSvUSnt Zxí-íí YZ...’ o...-U g gUM..woUg Sg-SvU.t o-’ v9..v .t o-’ SM.v)..àvMSg ...
w vQo**ZàvMSg .rU9Sg-v *á o*og MINWí xßYNWuß WWWZ! —X*[né9vSv QvWZV-°é*WV-%í VR](#)
[-í1° R...](#)

...

I vpi 9SpN.wZ.xW° uYZ.n S-SUMSvUmG..àvMSg ...< Sffio...v)...’ o..sµ9Q3 oU...v)...-g*-oZ." g øg 9...
-USó *Sú.w o*Z...

...

<’ gUM N/ ZNwSo-ún- ZNagoüNOZNUµM gUN+Zo-.g Zxí-íí YZ.“ v 9.rUoffug Sú.á oXv -í-íí N.
“ v 9.rUoffug Sú../ gi Z...

...

<vXXo9Qnt ZN+ó’ SUQNsZN7 Uµ-*oUN.<Z." ZN/ SUi ó QNàZrZo-.g Zxí-íí YZö Rn o3 ..n g-g*o...
í-íí... I9g-g*o-lZ. ög S-S*... v)... n o3 vMgMl... xö Rn o3 Y.. w v;oMZ..
[! —X*\[né9vSv QvWZß ü éö n Ot n àíí...\]\(#\)](#)

.....

< oU*’ g” N7 ZxW1uYZn o3 g QUG SiSUQ...’ o.rU-ó *MSvU.v)..á gM.gU9..àó mG..I gM..(o3 SS*...
< Sffio...v)...GU-9S*MS SUG-SvU...n vM SöN.(o3 SS*...—’ ov ú...gU9...GUSgMS*...wv SSMZ..
-USó *Sú.v)...<’ SgQy../oQg ..(v µ3 nō v ZW1uNG -SMb.lZ...

...

(opí i goúN... t ZN... ` I gUMo-N... n Z... xí- WYZ... I oúvU9..... +n wZ.V’)v 9...
... -USó *Sú..... w o*Z! —X*[né9vSv QvWZVußégMX v\)m*véu°1- Wiu° ° WiuZ - VZ-- W.](#)

...

(v*-ó NsZOZN/ vXou <g øgN/ Z(ZN. .àüo6o úNt Zxí-- %Zt og*µí SUQ...’ o.n S- S µ-SvU.v)...” µ3 gU..
n oøo vX3 oU-m 3 o-’ v9v vQí... gU9... gU.. gXXSMg-SvU...-v... t o’ SMZ. svµ Ug ... v)... ” µ3 gU..
n oøo vX3 oU... xW%í %Z! —X*[né9vSv QvWZV1-éW .u11-%---ß.ííí-...](#)

...

" g 3 gM6Ns ZN. ` ..7 ú vøgNwZxí - í ßYZàvMg ..w vQ o**..rUo' ..-S o..ào S*mt og*í SUQ.àvMg ...
Vµ-M3 o*..Wüu- R- í - ZàvMg ..w vQ o**..r3 Xó g-SoZ:“ g*! SUQvUNn <Z.

...

" µ*(Q)øo N. á Z. xí - í WZ. O' X v SUQ.. *vMg ... *µ*-gSgi SS-ú... ' gU9X SU- Xg -...í m *µ*-gSgi o...
9oøo vX3 oU... gU9... *µ*-gSgi SS-úZ.. àµ*-gSgi SS-úN. WxWYN. Wv%WZ.
' -X*íé9vSv QvWZßu- é*µWvWvWv%W.

...

7 v' NàZš Zxí - í - YZrUoffµg S-úZrU.rU-ó Ug-S'Ug ..OUMiMvXo9Sg.v)." µ3 gU.+ovQgX' ú.xXXZí u
í °°YZO *oøS Z.' -X*íé9vSv QvWZvWvWéi u° 1R R 1RWí í u° 1vZvWí Rí...

...

/oQ-µ3 rU*-Sµ-oZ... xí - í ßYZ... -' o.... í - í ß.... /oQ-µ3 w v*Xó Sú.... rUo' Z.
' -X*íé” ” ” Z v*Xó SúZv3 é9v” Uvg9ó oéøS” ó SU Sbé. ° 1u...

...

/S- oNGZ.-ZN. ` ..t oUQNGZ.xí - í ßYZàµi ;oMSø..gU9...Vi ;oMSø..t og*í o3 oU...v)..n o3 vMg-SM.
I gM* 9SUQZVà(..w oX SU*Z.' -X*íé9vSv QvWZvWvWév*)ZréUBí ü6...

...

V QvUSig-S'U.)v ..OMUv3 SM<vvXó g-S'U.gU9..n øøo vX3 oU..xVO<n YZxí - í - YZ...
.....O' oMí-So..µ3 3 g úZVO<n Z.' -X*íé9vSv QvWZvW1°éog°Wß WvU...

...

woS Rvg v3 SvNs ZNwSµiivR-g9ovNGZs ZN. .á Sv*Nö Zxí - í ßYZàvMg ..X vQ o**..g vµU9....
.....' o.” v 9m'-oU9*.... gU9.... MUpó QUMZ..V')v 9.... OMUv3 SMwgXó *N..
°%í YNí.1Wß- Z.' -X*íé9vSv QvWZvWvWévoXéQXgMí í ...

...

àgM*Ns ZN7 v N<ZN/ g)v -µUoN+ZN(µ ó N+ZN. ..“ vo 3 N(Zxí - í í YZàµ*-gSgi o.n øøo vX3 oU...
á oXv -... í - í í ... xW-... o9ZZ. <g3 í 9Q... -Uó *Sú... w o**Z.
' -X*íé9vSv QvWZvWvWéu° 1W- uí W- %1...

...

àvMg ..w vQ o**..r3 Xó g-SoZxí - WYZ.-' o..<vU- S µ-S'U.v)..-' o.àvMg ..w vQ o**..rUo' ..v.-' o...
í - ß- ..GQvU9gZGøgSgi o.) v3 m
' -X*íé” ” ” ZvMg X vQ o**Z Qv*-g-SM°ßßß9gßWß)- 1- u1- ußg- . ° u9I u°% -)éí - í . y í - àv
vUv)RvXvRvR- ß- RvQvU9gZ9)...

...

àvMg ..w vQ o**..r3 Xó g-SoZxí - í . YZO' oMí-So..àµ3 3 g ú.í - í . .àvMg ..w vQ o**..rUo' Z...
.....GøgSgi o.) v3 m..
' -X*íé” ” ” ZvMg X vQ o**Z Qv*-g-SM°ßßß9gßWß)- 1- u1- ußg- . ° u9I u°% -)éí - í . y í - àv
Mg...y í - w vQ o**y í - rUo' y í - O' oMí-Sooy í - àµ3 3 g úy í - x YX9)...

...

à-SQSüNs.Z.OZN.àoUN.GZN. ` ...(Svµ**SN.sZ.wZ.xí - - uYZ.á oXv -...i ú...-' o...M3 3 S*SvU..vU...-' o...
3 og*í o3 oU..v)..oMUv3 SMXó)v 3 gUM.gU9..*vMg ..X vQ o**Z.

...

à-SQStüNsZ.OZNàOUNGZ.7 ZN.` ..(Svµ**SNsZ.wZ.xí - WYZt S*3 og*µ SUQ.Vµ .. / \$o*m“ ' ú...+n w...
n vo*U-..G99...-XZ.-' o.2 o” ..w o**Z.

...

àú vø -6gNt ZN.` ..àM v**g o6Nt Z.xí - WYZt og*µ SUQ.9oøo vX3 oU-...” S' ...Subffug Súm" v” ...
x*’ vµ 9Y..gQQ oQ-o...SU9Mf-ý *...v)...9oøo vX3 oU-...gMµU-...)ý ...Subffug Súffi. OM vQ9M ...
OMUv3 SMNW. NW bí - Z! -X*íé9vSv QWZWVé;ZM oMUZ - WIZ . Z bí ...

...

àû o-ó NàZ.xí - í WZ.-' o..! S*-ý ú...v)...Subffug Súm-' o..9ooXRgMSUQ.9ov vQ9M ..gU9...S*-Sµ-SvUg ...
SU µoUM*Z. r(à... n og-vU.. á oøS” ... v)... rUffug SS*Z. GøgSgi o...) v3 m
' -X*íéS)*Z Qµ6éSubffug Súé-' oR S*-ý úR)Subffug Sú...

...

-USo9...2 g-SvU*.n oøo vX3 oU-..w vQg3 3 o..x-2 n wYZ.xí - í fYZ." µ3 gU.n oøo vX3 oU-..rU9o' ZrU..
" µ3 gU... n oøo vX3 oU-... á oXv -*Z. -USo9... 2 g-SvU*Z. GøgSgi o...) v3 m
' -X*íé' 9 ZµU9XZ Q9g-gMU-ó é' µ3 gU9oøo vX3 oU-BSU9o' ...

...

-USo9...2 g-SvU*.n oøo vX3 oU-..w vQg3 3 o..x-2 n wYZ.xí - í . YZ.+vg ..W..á o9µM9..Subffug SS*Z..
GøgSgi o...) v3 m ' -X*íé” ” ” ZµU9XZ Q*µ*-gSgi o9oøo vX3 oU-Ryg *é o9µM9R
Subffug SS*.....

—' o..Oøv øSUQ.. r3 Xý -gUM .v).àvMg .gU9...
 +vøó UgUM.t og*í o*...Vøó ...S o...

...

t v' g3 o9..." -SSM...^{Wí}Ns g v3 '..." g 3 o6^{.BN.N%}... ..wo' g..7' ú vøg^{N.N.1}...

...

...

Gi *' gM..

<vµU- S*.oS' ó .MUó Q..v .9Só Q..SU..-' oS ..*vMg .gU9..Qøó UgUM.Xó)v 3 gUMZ.
 —' S*.9úUg3 SM9SoM.ú..SU µoUM*..-' o..gi SS.ú.v)..*vMg .gU9..Qøó UgUM..SU9Mg-ý *...
 -v..9Só oU-Sg-o..i o-" ooU..MµU- S*N" S' ..9Só QUM..SUMog*SUQ..-' oS ..SU)ý 3 g-SvU..
 MU-oU...gU9...MUó QUM...9S SS* SUQ..SZ. -'gMSUQ..-' o...oøv µ-SvU..v)...-' o*o...
 SU9Mg-ý *fL.SU)ý 3 g-SvU..MU-oU..vøó ..gU..o' -oU9o9...Xó Sv9...X vø9o*...SUSQ -*..SU-v...
 ' S-..SU..-' oS'...o g-Só..S Xý -gUM..gU9N3 v*...S Xý -gU-úNg v" *..v..µUMøó ...-' o...
 øg Svµ*.X' g*o*..-' g-...-' o.Qvi g ..Xv SM...gU9*MgXo.µU9ó Qyo*Z- *SUQg..." 9ó..gUQo.v)...
 SU9Mg-ý *.gMv**..W- ..MµU- S*N" o.o' g3 Sb...-' o.oøv µ-SvU.v)..SU)ý 3 g-SvU..MU-oU...
) v3 ..Wu- ...v.í -í -..v).øg Svµ*..*vMg .gU9..Qøó UgUM..MU- µM*Z..-' ó...o*µ -*...oøog ...
 g..Uv-gi o..*' S-...) v3 ..*vMg ...v..Qøó UgUM..9S oU*SvU*ZrUSg úN9Sxg SSb*..." ó o...
 3 v o.X vUvµUM9.SU.I g*SM. µ3 gU.2 oø9*.gU9.(vµU9g-SvU*.v)..." o i oSUQZ. v" øó N.
 MµU- S*..! gøo.*SUM..MUó Q9.SU..-' o*o.g og*ZrU.MU- g*-NMµU- S*..Xó)v 3 gUM...
 SU.Qøó UgUM.9S oU*SvU*NµM.g*.à-g-o..<gXgM\$ú.gU9.n o3 vMg-SMGMµU-gi SS.ún.
 ' gøo...ooU..SUMog*o9..9Só QUMN. o oMSUQ.." 9oUSUQ.9Sxg SS*Z..-' o*o... U9SUQ...
 ' SQ SQ -...-' g-..MU-o3 Xý g ú..Qvi g ..Xv SM..Mg oUQ*..g o..SUMog*SUQú... vv-o9..SU..
 Qøó UgUM.9Sxg SSb*.gMv**..MµU- S*Z..

...

7 óú" v 9* ...+vøó UgUMčàvMg ..X vQo**č.OU- vXič.<v3 Xv*So..SU9Mč.I gúo*SgU...g-oU...
 øg Sgi o.gUg ú*S...

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WrU- v9μMSU..

...

—' o..I oúvU9R+n w..9oi g-o..! g*..! S_Q S_Q -o9...! o..Uo9...!)v' ..3 v' o..M₃ X o' oUk\$_o..3 og*í o*..v)...
ffig S-ú.v)...S_o..! g-..o' -oU9..i oúvU9...- g9SSvUg ..SM₃ o..3 o' SM₄.x7 μi S-üo" *6S.o-..g ZNí - WYZ.
“ ' So... oM_FUv3 SM. S_USM_g-v' *... S_o... Q v*... 9v3 o*-SM. X v9μM... x+n wY.. X vø9_o... g... S₃ So9...
μU9ó *gU9S_Q.v)...” o R. oS_QN-! oú.v)-oU.)gS...v..M_gX-í o..! o..M₃ X o' ..gU9..oøv øS_QU_g-í o.v)...
9oøo vX3 oU...xGS6oUNí - WYZ.G*..g'.. o*XvU*oNM₃ Xv*S_o..S_USM*...! gøo..o3 ó Q9...g*..g...3 v' o...
' v S*-SM_g -ó Ug-S_oN_oUM₃ Xg**S_Q.g...í' vg9ó .. gUQ...v)...*vM_g ..gU9...Q_øó UgUM...9S₃ oU*S_vU*...
xí oú*Ní - WYZ." v" oøó Ng...S_QS M_gU-M_g oUQ...S*..S_UoU*í S_Q..! g-..! o*o..M₃ Xv*S_o..S_USM*...
M_gUM_FU-S_Uμo...v..3 ogUS_Qμi ú.9S*-S_QQ₁S' .i o-” ooU..M_μU- S*No*XoM_g ú.g*..M_USS_vU*..M_gUQ...
vøó ...S₃ o.xí' vμi.o-..g ZNí - WYZ.

...

G*..M_μU- S*..9oøo vXN-! o... o g-S_o..S₃ X_v -gUM...v)...9S₃ó oU...*vM_g ..gU9...Q_øó UgUM...g' og*..S_U..
9S*-S_QQ₁S' S_Q.ffig S-ú.v)...S_o..*! S₃..i g*o9...vU..! v" ..μU_Sv' 3 ú.vμ-M₃ o*..g' o..gMS_øo9..gMv*...
Ug-S_vU*Z(v' ..S_U*-gUMN*v3 o..S_USM_g-v' *N*μM..g*..μU9ó Uv_í S' 3 oU-..v' ..gM_ø*...v..M_gU..” g-ó N..
' gøo.*ooU.S_UMog*o9..μU_Sv' 3 S-ú.gMv*..M_μU- S*.x-2 n wNí -í - YN.o oMS_Qí' vg9ó ..*μM_ø*..S_U..
3 oo-S_Qi g*SM_Uo9*ZrUM_FU- g*-N_Qøó UgUMRo g-o9.g*XoM*N*μM..g*.Xv SSM_g '...oX o*oU-g-S_vU..
v' ...9o3 vM_g-SM.gM_μU-gi SS-úN. o3 gS_U..μUøoU ú...9S*- S μ-o9N.” S' ...*S_QS M_gU...9S*X_g SS*...
Xó *S*-S_Qg3 vU_QU_g-S_vU*x(oo9v3 ..! vμi*oNí -í W_gU' oS₃ .o-..g ZNí -í . YZ-! S*μUøoU.X vQ o*...
o3 X' g*S_{io}*...! o..Uo9...-v..3 og*í o...! o..S₃ X_v -gUM...v)...øó S_μ*..S_USM_g-v' *..S_U.g'.. o g-S_o..gU9...
9úUg3 SM' gúN. oM_QSiS_Q..! v" ..M₃ -gS_U.9S₃ oU*S_vU*..3 gú.i oM₃ o...o*..S_U)v' 3 g-S_o..vøó ...S₃ o...
” ' So.v-! ó *Q_gS_U.X v3 S_UbUMZ- U9ó *gU9S_Q..! o.oøv μ-S_vU.v)...! o*o.*! S₃..v'ó *S_US_Q *-S_U-v...
-! o.í' vg9ó .9oøo vX3 oU-X vM_ø*M_gX-í S_Q..! v" ..M_μU- S*..- gU*S_vU.) v3 .M_g oUQ*..S_Ui g*SM.
' μ3 gU..Lbo9*..v..3 v' o..M₃ X o' ..Q_øó UgUM...Q_g *g*..! oú.X vQ o*Z.

...

—! S*..μ9ú..g99 o**o*..! o..M_g oUQ...v)...3 gS_U-gS_US_Q..! o..9S₃MS₃ S_g-v' ú..Xv" ó ..v)...*vM_g ..gU9...
Q_øó UgUM...3 og*í o*..vøó ...S₃ o.i ú..M_g M_í g-S_Q.oU- vXí..” oS_Q *-..v..o' X_v ó o..! oS ..oøv μ-S_vU..
gMv*..9S₃ó oU..S_USM_g-v' *ZrU..! S*.M_FU-o' -NoU- vXí..o oM*..! o..Xv-oU-S_g ...v**..v)...S_U)v' 3 g-S_vU..
g*..M_μU- S*..M_Uøó Q...vU.i g*SM! μ3 gU..Lbo9*..S_USM_g-v' *N*μM..g*..U_í- SS_vUN*gUS-g-S_vUNgU9...
gM_ø*...-v...o oM S_SúNS_U..M_FU- g*..-v..3 v' o..S_U- S_g-o...Q_øó UgUM...S_USM_g-v' *..S_o..9o3 vM_g-SM.
gM_μU-gi SS-ú..gU9...*g-o..M_gX_gM_íZ.G*..Ug-S_vU*..3 g6o...X vQ o*..S_U..3 oo-S_Qi g*SM_Uo9*N-! o...
gi SS-ú...v)...! o*o..S_USM_g-v' *..-v..9S*-S_QQ₁S' .i o-” ooU..M_μU- S*..3 gú..9S₃ S_S* Z.I ú..- gM_SUQ..
oU- vXí..” oS_Q *-N' o.gS₃ ..v..μU9ó *gU9..” ' o-! ó .g.9úUg3 SM' oS_Q -S_Q*ú*-o3 .M_μ 9..! S_Q S_Q -...
! S₃..S_U..! o..S₃ X_v -gUM...v)...øó S_μ..S_USM_g-v' *N' o XS_Q..-v..oU*í o...! g-..M₃ Xv*S_o..S_USM*...
' o3 gS_U..o oøgU-..gU9..gM_í g-o.vøó ...S₃ oZ.

...

“ o..M_g M_í g-o..3 v9S o9..oU- vXí..” oS_Q *-..! g-..SUM₃ X_v g-o..g...S₃ oP_øoM_gú..)gM_v N9o*S_QU_ø9...-v...
gU_g úüo..M_gUQ*..S_U..9g-g*..X_gUUS_Q..vUQ.Xó S_v9*Z.V_í ..*μ9ú...- gM_ø*...! o..oøv μ-S_vU.v)...! o*o...

oU- vXí..." oSQ -*...gMv**...øg Sµ*...SU9SM-ý *...)v ...W- ...MµU- S*...) v3 ...Wu- ...-v...í - í - Z.-' S*...
o' g3 Sg-SvU.*' v" *!' v" .*' S-*..SU" oSQ -*...o oM.MgUQ*.S.U.MµU- S*flXó)v 3 gUM*.vðó ...S oZ..
I ú...Mðó SUQ..g...9Só *o...g' gú...v)...*vMg ...gU9...Qðó UgUM...SU9SM-ý *N." o...gS ...-v... øøog ...gU..
S Xv -gU-.*' S-...) v3 ...*vMg ...9S oU*SvU*...µM..g*.I g*SM" µ3 gU.2 oo9*..vUM..! o 9...-' o..! SQ o*...
oU- vXí..." oSQ -*Ni ú.í - í - NQðó UgUM..9S oU*SvU*NXg -SM g' ú..n o3 vMg-SMGMMµU-gi SSú...
gU9...à-g-o...<gXgMúN.' gðo...i oM3 o...3 v o...X v3 SvU-...SU.. oX o*oU-SUQ..9Sxg SS*...g3 vUQ..
MµU- S*Z.

...

G99SSvUg ún.-' o...*µ9ú...o3 Xvú*...I gúo*SgU.. g-oU-...øg Sgi o...gUg ú*S*...-v...MU- µM...ogM...
9S oU*SvU.gU9.S*..µi 9S oU*SvU*Nµ*SUQ9g-g.) v3 .o*-gi S' o9.) g3 o" v 6*..µM.g*...! o.àvMg ...
w vQo**..rU9o' ...xàwrY..)v ...*vMg ...9S oU*SvU*..x" g' 3 gM6...o...g ZNí - í . Y.gU9...-' o..I ó QQµoU..
+vðó UgUM.rU9o' .xI +rY.)v ...Qðó UgUM.3 og*µi o*.xGU' oS .o-.g ZNí - í ßY.-' S..SU-oQg-SvU.v)...
àwr.gU9.I +r.g v" *..)v ...g.M3 X o' oU*Sbo..*o..v)..SU9SM-ý *..." ' So..gðv9SUQ..o9µU9gUMN.-' µ*...
oU' gUMSUQ.-' o.gMµi gM..gU9...*MXo.v)...-' o.gUg ú*SZVµi .oU- vXíRg*o9.3 o- v9..S*...-' oU.µ*o9...
-v..øg µg-o...-' o.oðv øSUQ*SUS MgUM.v)..ogM.3 og*µi o.vðó ...S oNoUgi SUQµ*..v.9oU-Sú.*' S-*...
SU.-' o..S Xv -gUM.v)..øg Sµ*..*vMg .gU9..Qðó UgUM.g*XoM*Z.

...

-' o... o3 gSUó ...v)...-' S*.g -SMb..S*.v QgUSio9..g*..v v" *ZàOMSvU.í ..Sv v9µM*...-' o..MUMX-..v)...
oU- vXí..SU.g.í v9ó ..MU-o' -.gU9.o' Xv o*.S*...o g-SvU' SX." S' .µUM -gSU-ú.gU9..MUðó QUM...
SU..*vMg ...gU9...Qðó UgUM..9S oU*SvU*ZàOMSvU.ß...vµ- Sv*...-' o...3 o- v9v vQín9o-gSSUQ.-' o...
gXXSM-SvU.v)..à' gUvUv*..OU- vXí..." oSQ -*.gU9..I gúo*SgU..g-oU-...øg Sgi o.3 v9o SUQZàOMSvU... ..
X o*oU*...-' o...*µ9úfk' o*µ -N.*' v" SUQ.-' o...oðv µ-SvU.v)...oU- vXí..." oSQ -*...gMv**...9Sýo oU-...
9S oU*SvU*...gU9...' oQSVUZ..àOMSvU..%..9SMµ*o*...-' o...S XSM-SvU...v)...-' o*o... U9SUQ...)v ...
µU9ó *-gU9SUQ.-' o...9úUg3 SMUg-µi o...v)...MµU- S*fl.9oðo vX3 oU-...- g;oMv S*..gU9...MU*9ó *...
g99SSvUg .3 o- v9v vQSMg .S XSM-SvU*Z(Sg ún.-' o.MUMµ*SvU.*µ3 3 g' Sio*...-' o.6oú..SU*SQ -*N..
gMUv" o9Q*...-' o.*-µ9ú *...S Sg-SvU*NgU9..X vXv*o*.9SoMSvU*..)v ..)µ-µi o...o*og MZ.

...

í OU- vXíN.-UM -gSU-úNgU9...<vUðó QUM..SU..àvMg ..gU9...+vðó UgUM...
rU9SM-ý *...

...

OU- vXí..S*.g..)µU9g3 oU-g ..MUMX-..µ*o9...-v..ffµgU-Sú..µUM -gSU-ú.gU9.9Sv 9ó ..." S' SU.g..QboU..
ú-o3 ..xà' gUvUNW. 1č.<vðó ...-' v3 g*Ní - - %s gúUo*NW% YZrU.-' o.MU-o' -.v)..*vMg .gU9...
Qðó UgUM..SU9SM-ý *NoU- vXí..MgU.X vð9o..SU*SQ -*..SV-v..! v" ..MµU- S*flXó)v 3 gUM*.øg ú...
gMv**..9Sýo oU-..g*XoM*..v)..9oðo vX3 oU-..vðó ...S o.xf oM..o-..g ZNí - Wč.(v*-ó ..o-..g ZNí - WßY..
" ' oU.gXXúSUQ.oU- vXí...-v..3 og*µi o...-' o..9S- S µ-SvU.v)...vµ-M3 o*..gMv**..MµU- S*N! SQ ó ...
oU- vXí..*SUS o*..Qog-ó ..µUM -gSU-ú..gi vµ-...-' o..9Sýó oUM*..SU.Xó)v 3 gUMNSU9SM-SUQ.-' g-...
-' o..SU9SM-ý ..µ*o9...-v..9Sýó oU-Sg-o..MµU- S*..S*...o**..SU)v 3 g-Sbo..gU9...! g*..v" ..9SxMS Sg-ý ú...
Xv" ó ...xÜ' vµ...o...g ZNí - Wč..Ü' gUQ..` .../ ooNí - - ° YZ.<vUðó *o ún. v" ó ...oU- vXí...3 ogU*...-' g-...

SU9SM-ú *..! gøo..! SQ ó ..SU)ú 3 g-SvU.MU-oU..gi vµ-..! v” ..MµU- S*.Xó)ú 3 ..SU.-! g-... o*XoMSø...
g*XoM.xŮ vµ... ..GUQŃ -- uYZ.

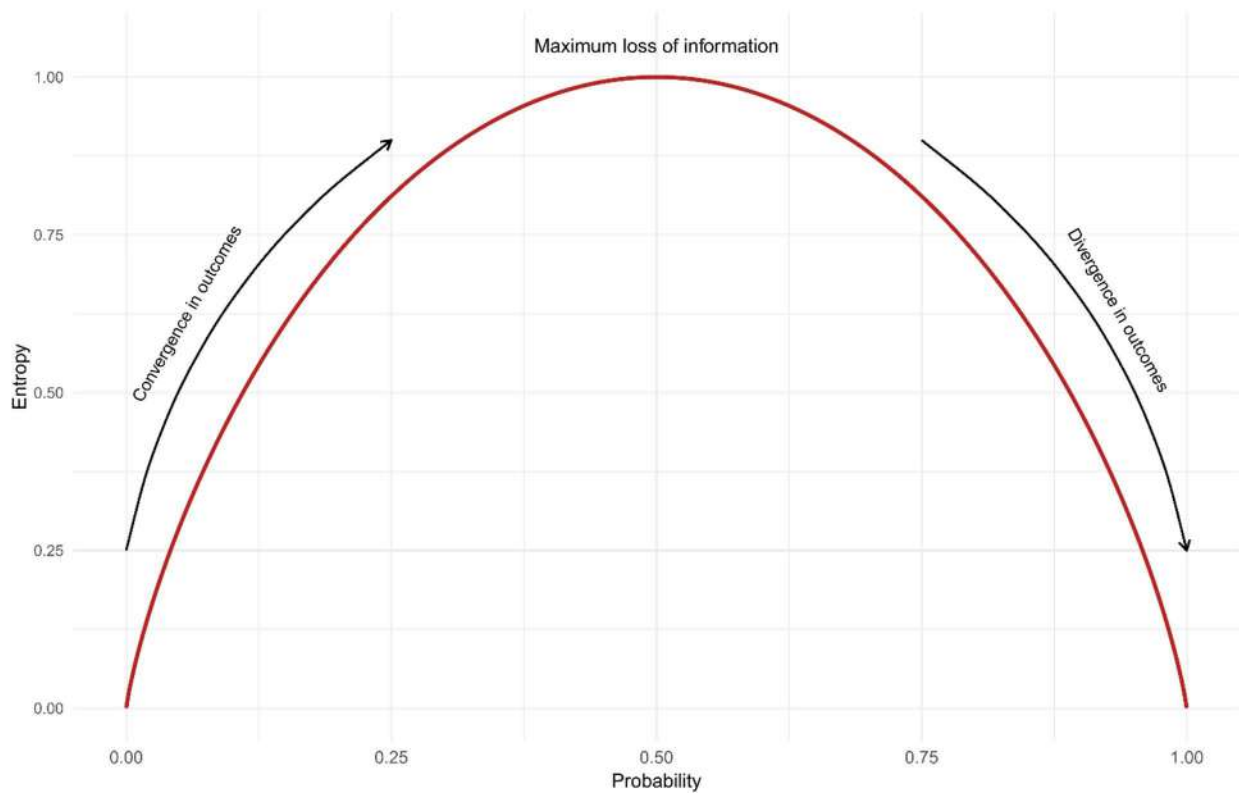
...

rU...! o.gUg ú*S.v).*vNĚ .gU9..Qøó UgUM..SU9SM-ú *N.-! ó...o g-SvU* SXi o-” ooU.oU- vXí.gU9...! o...
MUó QUM...v)..MµU- S* ...vµ-M3 o*..S*..MµNĚ Z.G*..MµU- S* ..Xó)ú 3 gUM*..SU..g..XĚ -SŃ ě ...
*vNĚ ..ú ..Qøó UgUM..g*XoM.i oM3 o.3 ú o..g SoN.-! o.oU- vXí...oU9*...v..SUMog*oN.o oMSUQ.gU...
SUMog*o..SU..µUM -gSU-ú..gi vµ-...! o..9Šýó oUM..SU...! oS...Xó)ú 3 gUM...xn o.t ě v..o-..g ZŃ - WĚ...
àgSgUg..o-..g ZŃ -- %YZ.-! S*..S.i oMµ*o.MUó QUM..SU...! S*.MU-o’ -S XSo*...! g-..MµU- S*..ě o...
3 vøSUQ.-v” ě 9*.g.MU- g ..XvSU-..” ’ ó o...! oS...Xó)ú 3 gUM*..ě o.3 ú o.oøoUú.9S- S µ-o9N” ’ SM...
M’ o*XvU9*...v..Qog-ó .oU- vXí.gU9..µUM -gSU-ú..gi vµ-..” ’ SM..MµU- ú.Xó)ú 3 *i o*-ú. ” ú *-...
xàg -o SŃ -- °č.t µU9g... ..2 ě 9vNí -- uYZ.VU...! o..v-! ó ..! gU9N” ’ oU..MµU- S*..9Só QN.-! oS...
Xó)ú 3 gUM*..i oM3 o.3 ú o.9S-SUMNĚU9.9Šýó oU-Sg-SUQi o-” ooU...! o3 .i oM3 o*..3 ú o.M -gSUN...
’ oUM...! o..v” ó .oU- vXíZ.

...

-v.S µ*- g-o...! S*... o g-SvU* SXN(SQí o.W*’ v” *...! o..Só -o9...-R’ gXo9..MŃ øo...! g-... oX o*oU*...
-! o...à’ gUvU...oU- vXí...SU.. o g-SvU...-v...X vi gi SSú...xt S’ gNí - Wič...- gUv” SMNí -- uYZ.-! o...
’ ú SivU-g ..g’ S*... oX o*oU*...! o...X vi gi SSú...! g-...g...MµU- ú...Xó)ú 3 *..i o-ó ...! gU..gUv-! ó N...
’ gUQSUQ.) v3 ..v..WŃ” ’ So...! o.øó -SĚ .g’ S*...oX o*oU*...! o.M’ o*XvU9SUQ.oU- vXí.øg µoZ.-! o...
3 g’ S µ3 ..oU- vXíNú ...! o.f3 g’ S µ3 ...v**..v)..SU)ú 3 g-SvUN..vMŃ *..g-..g..X vi gi SSú...v)..- ZŃ...
SU9SM-SUQ.-! o..XvSU-...v)..Qog-o*...µUM -gSU-ú...xŮ gU9ě gNí -- 1YZ.-! S*..XvSU-... oX o*oU*...! o...
’ SQ o*-... øo ...v)..µUŠ 3 Sú...gU9...S*...” ’ ó o...MUó QUM...S*...3 v*-...øøøoU-N.g*...MµU- S*fl...
Xó)ú 3 gUM*..ě o.3 v*-...S SĚ ..gU9...! o...µUM -gSU-ú..gi vµ-...! oS...9Šýó oUM..S*...! o...! SQ o*-...
ě vµU9...! S*.X vi gi SSú...xŮ vµ... ..GUQŃ -- uYZ.G*...” o.3 vøo..) v3 .g.X vi gi SSú...v)..-v..- ZŃ” o...
vi *ó øo.gU.SUMog*o..SU.oU- vXíN. oX o*oU-SUQ.MUó QUM..SU.MµU- S*fl.vµ-M3 o*...v” ě 9.gU...
SUMog*o..SU...! o... v**..v)..SU)ú 3 g-SvU..gi vµ-...! o...vµ-M3 oZ.-! S*...3 ogU*...! g-..MµU- S*..ě o...
i oM3 SUQ.3 ú o...S SĚ ..SU...! oS...Xó)ú 3 gUMN.o*µ -SUQ.SU..! SQ ó .9S MŃ -ú..SU.9S-SUQiS’ SUQ..
i o-” ooU...! o3 .xt güüS-g... ..wġ o-vNí - WYZ.

...



(SQí o..Wz+oUö g ...oX o*oU-g-SvU.v)...-! o... o g-SvU*! SX.i o-" ooU..à' gUvU..oU- vXi..gU9...X vi gi SSú..gU9...
-! o..S X Sg-SvU*.vUMFubó QUM.gU9..9Só QUM..SU.*vMg ..gU9...Qóó UgUM..vµ-M3 o*Z.

...

(SQí o..Wg *v.*' v" *..-! g-.g*.. 0.3 vöo..) v3 .g.X vi gi SSú.v)...Z-v" g 9*.oS' ó ..-v' ..WöU- vXi...
9oMog*o*N.oX o*oU-SUQ.g.X vM**..v)..9Só QUM..xí vvú*oNí --í YZ..-! S*.S X S*..-! g-.MµU- S*fl..
vµ-M3 o*..g o..i oM3 SUQ..3 v o...9S-SUM..gU9...og*Sú...9S-SUQíS' gi oN. og9SUQ..-v...g...Móg ó ...
*oXg g-SvU..SU..-! oS ..Xó)v 3 gUM...oöo *..x' g3 gU-S.. -g gU-v gNí -WYZG*..µMN..-! ó o..S..g...
3 vöo3 oU...-v" g 9...o**..µUM -gSU-ú..xQgSU..SU)v 3 g-SvUY..SU..SU9Sg- v *..gU9..g... o9µMSvU..SU..
-! oS ..oU- vXi..xàg -o Sñ -WYZ.

...

-! S*..! o X*...Mg Sú...! v" ...-! o... o g-SvU*! SX.i o-" ooU..oU- vXiN.µUM -gSU-úN.gU9...Fubó QUM...
vXó g-o*..SU..-! o..MU-o' -...v)..*vMg ..gU9...Qóó UgUM..SU9Sg- v *Z.. " ' oU..o' g3 SSUQ.MµU- S* ...
Xó)v 3 gUM*..SU..-! o*o..g og*..vöó ...S oN..-! v*o..SU9Sg- v *..-! g-..*' v" ...! SQ ..oU- vXi...ög µo*..
M' o*XvU9...v..9S oU*SvU*.. " ' ó o..MµU- S*..! göo..Mubó Q9N" S' ..Qog-ó ..S Sg SS*..SU..-! oS ...
vµ-M3 o*.x' oM..o-.g Zñ -WYZ<vUöó *o úNSU9Sg- v *.. S' ...v" ó ..oU- vXi..*SQSú..9S oU*SvU*..
" ' ó o..MµU- S*..! göo..9Só Q9N9SgXgúSUQ.3 v o..9S-SUM.gU9..X o9SMgi o..9Só oUM*..SU..-! oS ...
Xó)v 3 gUM..x" µ..o-.g Zñ -íí YZ.

...

rU..o**oUMNoU- vXi..X vö9o*.gU.vi ;oMSö.3 og*í o.v)..! v" .µUM -gSU.v .ög S9...! o.9S- S µ-SvU..
v)..MµU- S* ..vµ-M3 o*..S..SU.g..QöoU.9S oU*SvU..xt güüSv-g... .wg o-vNí -WYZr-! SQ SQ *..-! g-

" ' So..MÚó QUM.SUMÚ- S* ..*vMg .gU9..Qóó UgUM.Xó)' 3 gUM.S..QÚ g ú.Xó MSó9..g*...
g..9ó*Sgi o..vμ-M3 oNS..SÚv óo*.g..9úUg3 SM*' S...v" ' g' 9*..Qog-ó ..μUM -gSU-úNg*.MμU- S*...
i oM3 o.3 ' v o.*S Sg .SU..-' oS .Xó)' 3 gUM.xÚ' vμ.. ' .GUQÑ - - uYZ..-' S.Xó *XoMSó.o.3 X' g*Sio*...
-' o..óv vSUQ.Ug-μ (o..v)..9óó vX3 oU-N." ' ó o..*' S*..SU..μUM -gSU-ú..gU9..MÚó QUM..Xgú..g...
MU- g '..v o..SU..μUó *gU9SUQ.. v" ..MμU- S*.X vQ o**..gMv**..9S'ó oU-..*vMg .gU9..Qóó UgUM...
g*XoM*.vóó ...S o.xI vvú*oUNí - - í čI gU9μ gNí - - 1 YZ.

...

βZt o-' v9v vQí.gU9..9g-g...

...

βZVh g-g.à ví M*.gU9..w o S SÚg ú...-og-3 oU...

...

-v..3 og*μ (o..Qóó UgUM..9S oU*SvU..v)..9óó vX3 oU-N" o..μ*o...-' o..n o3 vMg-SMGMμU-gi SSú...
gU9.à-g-o.<gXgMSú.XS g' *.v)...-' o.I ó QQ μoU..+vóó UgUM.rU9o' .xI +rYZ..-' o.rU9o' .9 g" *μXvU...
3 μ -SXo..9g-g...*vμ M*N.SUMμ9SUQ..-' o..ö g' S-S*..v)...n o3 vMgM...xö R o3 Y..9g-g...)' ..óg Svμ*...
Qóó UgUM... o g-o9..SU9Sg- v *NrU-ó Ug-SvUg .t vUo-g' ú..(μU9..xt (Y9g-g...)' .. *Mg .MgXgMSú...
óg Sgi o*NgU9...-' o.. " ' v 9..I gU6..9g-g...)' .mFv3 SMgU9.SU) g*- μMμ g .SU9Sg- v *ZrUg99SSvUN.
-v..3 og*μ (o..*vMg .9óó vX3 oU-N" o.SUMμ9o.SU9Sg- v *μ*o9.SU..-' o.àvMg .w vQ o**..rU9o' .xàwrY..
-S o..àó S*..-v.. ' oMU- μM...S*..9S oU*SvU..v)...I g*SM." μ3 gU..2 oo9*..gU9...(vμU9g-SvU..v)...
" o i oSUQZ.. S' ...-' o*o.SU9Sg- v *Nvμ .*-μ9ú.*XgUk..-' o.úóg *.Wiu- ..v.í - í - .gU9.Móó *óg Svμ*...
*vMg .gU9..Qóó UgUM..g*XoM*.gMv**..W- ..MμU- S*Z.

...

-gi o..Wvμ- SÚ*..-' o..M3 Xv*SSvU..v)..ogM..v)...-' o..vμ ..*vMg .gU9..Qóó UgUM..9S oU*SvU*Z(' v ...
Sv-gUMN..-' o..n o3 vMg-SMGMμU-gi SSú..9S oU*SvU.xg..*oMU9Roóo ...g-oU..óg Sgi oYMFU*S*...
v)...-' oo.M3 XvUoU-*x' *-Roóo ..g-oU..óg Sgi o*YNgM.MUgSUQg..*o..v)..SU9Sg- v *xvi *ó óo9...
óg Sgi o*Y..-' g...Mv*o ú.. ' o oM...-' o..μUó úSUQ..MU- μMZ..-' S*.. ' S g' MSg ...*- μMμ o...S*...
MU-S-oU..gMv**..g .9S oU*SvU..." S' SU..-' o..) g3 o" ' v 6Z.

...

" v" óó Ng..MμMg ..*-oX.SU..-' o..X oX vM**SUQ.X' g*o..." g*.. gU9 SUQ.3 S*SUQ.9g-gN" ' SM..." g*...
gMSóo9..μ*SUQ..-' o..3 S*(' v o*-g QY S' 3 ..g*..9óMS o9.i ú..n gU6 ..o-.g Zxí - WY.SU..-' oS ..*-μ9ú...
vU..UvURg g3 o- SM3 S*SUQ.óg μo..S Xμ-g-SvUZ..-' S*..3 o- v9...o3 Xvú*..gU..Só g-Só.. gU9v3 ...
)' o*-3 v9o ..v..S Xμ-o.3 S*SUQ.óg μo*..-' g-MgU.i o.QÚ g ú.*μ3 3 g' Sio9.SU..-' oo.3 gSU*-oX*m

...

VZ rUSg Sig-SvÚt S*SUQ.óg μo*.SU..-' o.9g-g*o- g' o.SSSg ú...oXgM9.i ú..-' o..M μ3 U.3 ogU..
x)' .MU-Sμvμ*..9g-gY. ' v' o.3 v*-..) offμoU..Mg-oQY ú.x)' .Mg-oQY Sg .9g-gYZ...
í Z r-ó g-Só..á gU9v3 ...(' v o*-m(' v ...ogM...Só g-SvUN..-' o.. gU9v3 ...)' o*-3 v9o ...X o9SM*...
3 S*SUQ.óg μo*...)' ..ogM...óg Sgi o..μ*SUQ..-' o..UvUR S*SUQ.óg Sgi o*Z..-' S*..X vM*...
Só g-Só o.ú.S X vóo*..-' o.gMμ gM..v)...-' o.S Xμ-o9.óg μo*..μU-S.MÚó QUM..v '...ogMSUQ..
g.*XoMS o9.3 g' S μ3 ..Uμ3 i ó ..v)..Só g-SvU*Z...

βΖ (*Σg ...n g-g*o-m*—' o..M3 X o-o9..9g-g*o—' o-g*SU**..-' o..*— μMί o..gU9..0έ Σ*gi* SSú..v)..-' o...
 v *Σg*Ug ..9g-gN' S' '...-' o..S Xμ-o9..0g μo*.gMμ g-o ú...o oMSUQo' XoMo9..9S— S μ-S*U**Z.

...

I ú..o3 Xvú*SUQ*..-' o..3 S*(*v o**..g Q*Y* S' 3 ...' S' ..%- ...' oo*.gU9..g v" *SUQ*μX..v..% ..Só g-S*U**N" o...
 oU*ί o9.3 *S*S g .i S*g**..*SU*..-' o..S Xμ-g-S*U*.X vM**N.o*μ -*SUQ*.S*g*'...vi μ*-..9g-g*o-..)v' .*μi *offμoU-..
 gUg ú*S*Z*..-' S*..oM*U*ffμo.." g*.Mv*oU.)v' .S*...o g-S*o* ú.3 v ó...o Σ*gi* o.X o9SMS*U**ZG.M3 X*g* S*v*U..
 v)..-' o..S Xμ-o9..gU9..v' *Σg*Ug ..9S— S μ-S*U**..)v' ..ogM..*SU*9S*g*—v' ..9o3 vU*— g-o9...-' g-...-' o.3 o- v9...
 oýoM*S*o ú.3 g*SU*g*S*o9...-' o.*' gXo..v)..9S— S μ-S*U**.i o)v' o.gU9..g)-ó ..S Xμ-g-S*U*ZG99SS*U*g úN..
 " o..vX-o9..)v' ...' S*.3 μ -S*X*o..S Xμ-g-S*U*.3 o- v9..v0ó ..9g-g.gμQ oU-g-S*U*..oM*U*ffμo*.xt ó 6 oN..
 í - *W*Y*μ*M.g*I gúo*S*U*..g-oU..0έ Σ*gi* o.gUg ú*S*.x*g**.μ*o9..*SU*GU oS .o-g Z*N* - í βY*N*..v.3 g' S *S*io..
 -' o.*Xoo9..v)..-' o.I gúo*S*U*.3 v9o *SUQ*.X vM**..*SU*..-' o..Uo' -.*-oXN*Q*S*o*U..-' g-... -*SUQ**μM.3 v9o *...
 " S' ..3 S**SUQ*9g-g..M*U*..g6o.o' XvUoU-S*g* ú.3 v o...S o.xt ó 6 o... .á v**oo Ní - *W*Z.

...

n S oU*S <i>U</i> ..	àμi <i>θ</i> S oU*S <i>U</i> ..	Vi *ó 0o9.. <i>SU</i> 9S <i>g</i> —v' ...
n o3 vMg-SMGMμU-gi SSú ...	rU*-Sμ-S <i>U</i> g ..GMμU-gi SSú...	sμ9S <i>g</i> ..v0ó *S <i>Q</i> -N. V-' ó .i v9S*.ffμo* S <i>U</i> .o' oM-i-S <i>o</i> ..v))S <i>g</i> *... O' oM-i-S <i>o</i> ...o*XoM*.M <i>U</i> *-Sμ-S <i>U</i> .. /oQ <i>g</i> *g-μi o.o' S*-*...
	O oMv g ..GMμU-gi SSú...	O oMv g . <i>SU</i>) g*— μMί o'..o*S <i>S</i> UM.. àμi) gQ.. O oMo9..! og9..v).o' oM-i-S <i>o</i> .. wv S <i>S</i> g ..X <i>g</i> -S*...
	àvM <i>S</i> -g ..GMμU-gi SSú...	t o9S <i>g</i> ..) oo9v3 ... (' oo9v3 ..v).o' X o*S <i>U</i> .. OU <i>Q</i> Q9..*vM <i>S</i> -ú.. <S <i>S</i> ..*vM <i>S</i> -ú..v' Q <i>g</i> U <i>g</i> -S <i>U</i> *...
à-g-o-<gX <i>g</i> M <i>S</i> -ú ...	(S <i>g</i> ..<gX <i>g</i> M <i>S</i> -ú...	-g' '...o0oUio.. -g' .g93 S <i>S</i> — g-S <i>U</i> .. <oU- g .i gU6'...o*ó 0o*.. rU-ó o*-X <i>g</i> ú3 oU*...
...	<vv 9S <i>g</i> -S <i>U</i> ..<gX <i>g</i> M <i>S</i> -ú...	O So.M' o*S <i>U</i> .. I μ ogμMg-SM.o3 μUó g-S <i>U</i> .. GXv <i>SU</i> -3 oU-.MSó S <i>g</i> .. á S <i>Q</i> vμ*.g93 S <i>S</i> — g-S <i>U</i> .. à-g-o <i>R</i> vM <i>S</i> -ú...o g-S <i>U</i> *...
	n o S <i>o</i> ú..<gX <i>g</i> M <i>S</i> -ú...	á o*ví M.g vM-S <i>U</i> .. Gi *oUM..v)..Xμi SM*oMv ...' o)-... -ó' S <i>v</i> S <i>g</i> .gμ- v' S <i>ú</i> .. v' o9SMgi o.oU)v' M3 oU-...
I g*S <i>M</i> μ3 gU2 oo9*...	2 μ— SS <i>U</i> gU9..I g*S <i>M</i> o9S <i>g</i> ..<g o...	2 μ— SS <i>U</i> g ..9o)S <i>S</i> UM*.. t g-ó U <i>g</i> .3 v' -g S <i>ú</i> ...g-o.. <' S9.3 v' -g S <i>ú</i> ...g-o.. <' S9..*-μU-S <i>UQ</i> .. n og-' *.i) v3 . <i>SU</i>)oMSμ*.9Sog*o*.. n S <i>o</i> ...v" .. <i>SU</i> .) μS*.gU9..0oQ-gi o*...
...	" g-ó .gU9.àgU <i>S</i> g-S <i>U</i> ...	r3 X v0o9..." g-ó .gM <i>o</i> *.. r3 X v0o9..*gU <i>S</i> g-S <i>U</i> .. 2 v.gM <i>o</i> *..v.g...! gU9" g*! <i>SUQ</i>)gM <i>S</i> -ú.. " g*! .3 v' -g S <i>ú</i> .. à' o-ó ...
	à' o-ó ...	GM <i>o</i> *..v..o oM S <i>S</i> -ú...

		" vμ*o' v 9.gS.Xv μ-S'U.g- S μ-gi o.9og-¹ *... wó *vUg .àg)o-ú... rU-ó Xó *vUg .øS' oUM... wv SSg .6S SUQ.gU...-í o... wv SSg .øS' oUM... -g))SM9og-¹ *... wg -Uø .øS' oUM.gQgSU*... v3 oU...
(vμU9g-S'U*.v)...“ o i oSUQ... ...	GMM**..v.I g*SM7 Úv” o9Qp... rU)ý 3 g-S'U.gU9...<v3 3 μUSg-S'U*... " og-¹ .gU9...“ o Uø**... OUøS vU3 oU-g .0 μg S-ú...	wvXμ g-S'U.” S' .Úv.ø9μMg-S'U... +oU9ó .Xg S-ú.SU.i g*SMø9μMg-S'U... t ogU.úog *v).*Mvv SUQ... Offμg .gMM**..v.ffμg S-ú.ø9μMg-S'U... w' vUø*.μi *MSX-S'U*... rU-ó Uø-μ*ó *... G-ó Ug-S'ø.vμi M*.v).SU)ý 3 g-S'U.SU9o' ... /Sø.o' XoMgUM.g-... - ... wó 3 g-í o.9og-¹ *.) v3 .ÚvURW3 3 μUSμi o.9Sog*o*... -Uøó *g ..' og-¹ .Møó gQ... Offμg .gMM**..v.ffμg S-ú..! og-¹ Mg o... Vμ-9v' .gS.Xv μ-S'U.g- S μ-gi o.9og-¹ *... àXoM*.X v-oMS'U.SU9o' ... n og-¹ *.) v3 ...og9.o' Xv*í o... wt .í ZXv μ-S'U...

...
-gi o..Wn S oU*S'U*Nàμi 9S oU*S'U*.gU9..vi *ó øo9..SU9Sg-ý *.SU.v)...-¹ o.I +r.gU9.àwr..) g3 o” v 6*Z.

...
...
BZ ZI gúo*S'U./ g-oU-ð g Sgi o.GUg ú*S...

...
-v..MgX-í o...-¹ o..M3 Xo' ..S-ú Xgú.i o-” ooU..øg Sμ*...g-oU..MU*- μM*N..¹ o.*-μ9ú..o3 Xvúo9..g...
I gúo*S'U.<vU' 3 g-ý ú.(gMv .GUg ú*S*.xI <(GYμ*SUQ..¹ o.qi gøggUq.XgMgQ.xt ó 6 o.o.-g ZN.
í -í - YZ.“ o..*XoM)ú.g..I <(G..3 v9o .i g*o9..vU..¹ o..MUMX-μg ..) g3 o” v 6..* v” U.SU...gi o..W.-v...
o' - gM...¹ o..*M o*.v)...g-oU..øg Sgi o*... oX o*oU-SUQ.6oú..MU*- μM*..*μM..g*..à-g-o...<gXgM\$-úN.
n o3 vMg-SMGMμU-gi SS-úNI g*SM" μ3 gU.2 oo9*.gU9..(vμU9g-S'U*.v)...“ o i oSUQZ..¹ o.3 v9o ...
' g*..g'..oM *Sø..*- μMí oN.” ' ó o... *Roøo ...g-oU..øg Sgi o*..MU- S μ-o...v...! SQ ó Roøo ...g-oU...
øg Sgi o*Z..¹ o.vi *ó øo9.øg Sgi o*.g o.μ*o9...v.o* S g-o...¹ o.*M o*.v)... *...øøo ...g-oU..øg Sgi o*...
xμi P S oU*S'U*.SU...gi o..WgU9...¹ *Roøo ...g-oU..øg Sgi o*.g o.μ*o9...v.o* S g-o...¹ o.*M o*.v)...
-¹ o.*oMU9Roøo ...g-oU..øg Sgi o*.xn S oU*S'U*.SU...gi o..WZ.

...
-¹ o..Xg g3 o-ó *.v)...¹ o.3 v9o ..g o..o* S g-o9..μ*SUQ.t g 6vø...<¹ gSU*.t vU-o...<g v...xt <t <Y..
o* S g-S'U...v...9oU-Sú...¹ o.μU9ó úSUQ.*XoM ø9..MU*- μM*.x" gU*vU..` ..àSQ gUNí -í WZ..¹ S...
3 v9o .M3 i Sù*.3 μ -SXo..gúo *.v)...g-oU..øg Sgi o*N' ' SM...¹ o3 *o øo*.g o.SU)ý 3 o9.i ú.øg Sμ*...
vi *ó øgi o...SU9Sg-ý *N.-v...g**o*...M3 Xo' ...MU*- μM*...¹ g-... o oM...*vMg ...gU9...Qøó UgUM...
Xó)ý 3 gUM.v).MμU- S*Z..¹ S.g v” *μ*..v.MgX-í o.g.M3 X o' oU*Sø..ø.v).9S oU*S'U*...o g-o9...
-v.*-g-o.MgM\$-úN9o3 vMg-SMgMμU-gi SS-úNgU9.í vg9ó .g*XoM*.v)...! μ3 gU..” o R oSUQZ.

...

rU..g99S\$VUN.” o...μ*o...-’ o...9o)gμ -..I / Gö GG2 és G+à...X \$ *N.” ’ SM...ğ o...μUSU)ý 3 g-\$o...gU9...
 9o*\$Qb9...)ý ...9oUS M\$-SvU..Xí Xv*o*...SU...-’ o...I guó*\$gU..gUg ú*\$Sk...x*g3 o...g*...SU..GU’ o\$..o-..g ZN.
 í -í \$YZ..-’ o*o...X \$ *...X vø9o...3 S\$ g ...SU)ý 3 g-SvU...gi vμ-...-’ o...Xg g3 o-ó *N.g v” SUQ..-’ o...
 vi *ó øo9..9g-g...v.Xgú...-’ o..9v3 SgU’...v o..SU.Xg g3 o-ó .o*\$ g-SvUZàXoM\$ M\$ úN..’ o.X \$ *..)ý ...
 -’ o...* vXo..Xg g3 o-ó *.ğ o...o-...” S’ ..g..3 ogU..v)..- .gU9..g...-gU9g 9..9oø\$g-SvU..v)...WNSU9M\$-SUQ..
 -’ g-NX \$ *...v..vi *ó øSUQ..-’ o..9g-gN..-’ o..o’ XoMo9..øg μo..v)..-’ o...* vXo..Sk..MU-ó o9..ğ vμU9... .i μ-...
 ” S’ ..M\$U*9ó gi o... o’ \$ SSú...)ý ..g...” 9o... gUQ...v)...øg μo*Z..-’ Sk...-’ gU* g-o*...-v..g..X oM\$SvU..x-’ o...
 Sjøó *o..v)...øg \$gUMYv)..- Z VZ.

...
 -’ o*o..X \$ *..ğ o...M\$U*9ó o9..fi g-M.3 ogUSUQ..-’ oú..ğ o..Uóğ ú..μUSý 3 ..gU9..9v..Uv-..)gøv ..gUú...
 *XoM\$ MXg g3 o-ó ..øg μo*Z.G*..g... o*μ -N..-’ oú..g v” ...)ý ..X vi gi SSú..3 g**..gMv**...-’ o..oUSo...
 Xg g3 o-ó ..*XgMNQøSUQ..-’ o..3 v9o ..g3 Xo... o’ \$ SSú...-v..g9;μ*-i g*o9..vU..-’ o..vi *ó øo9..9g-gZ..
 -’ Sk..gXX vgM..oU*μi o*...-’ g-...-’ o...o*\$ g-SvU..X vM**..Sk..X \$ g Sús..9g-gPø \$oUN.” S’ vμ-...-’ o...
 X \$ *..\$ Xv*\$UQ*-’ vUQM\$U*-’ gSU*..vU..-’ o..Xg g3 o-ó ..øg μo*Z..-’ Sk...o*μ -o9..SU.g ...-’ o.t <t <...
 MgSU*..*μMø**)μ ú..M\$Uó Q\$U*μi Qø*-SUQ..-’ g-...-’ o..3 v9o f\$..o*\$ g-o*..ğ o...gi o..gU9’...o \$gi o...
 gU9...9o3 vU*-’ g-SUQ..-’ g-...-’ o...Xv*-ó \$ *..9S*-’ S μ-SvU*...)ý ...ogM..Xg g3 o-ó ...” ó o...g9offμg-o ú...
 o’ Xv o9Z.

...
\$Z ZVZ (S*-P/øøo ./g-oU..ð g \$gi o*...

...
 -’ o..M\$UMX..v)..à-g-o..<gXgM\$úNg*.9o Uø9.i ú...-’ o.I +r..) g3 o” ý 6NS..3 og*μi o9...-’ vμQ ...-’ oo...
 6oú...g-oU..9\$ oU*\$vU*Z..-’ o...’ *-9\$ oU*\$vUN(SM\$..<gXgM\$úNg**o**o*...-’ o..Qøó Uø oU- *gi SSú...
 -v...Q\$Uø g-o’... øøUμo..gU9..3 gUgQ... *M\$ ’...o*vμi M*Z..-’ Sk..SUMμ9o*...SU9M\$-v *...o g-o9...-v... *M\$...
 *-’ oUQ’...N..g’ ...M\$ oM\$SvU..o M\$UMN.gU9... UgUM\$ ’...o*ó øo*...3 gUgQ3 oU-Z..-vQ-’ ó N..-’ o*o...
 SU9M\$-v *...o oM... v” ..óyøMSø ú..g...Qøó Uø oU..M\$U.3 vi SSio...o*vμi M*.gU9..μX v 9..S*... *M\$...
 ’ o*XvU*\$ SSSø*Z.

...
 -’ o...*oM\$U9..9\$ oU*\$vUN<v v 9Sg-SvU..<gXgM\$úN..o oM*...-’ o..g93 S\$*-’ g-\$o..o M\$UMi..v)..-’ o...
 g-o..gU9..S..gi SSú...-v..M\$ v 9Sg-o..Xv S\$ø*..óyøMSø úZ..-’ Sk..9\$ oU*\$vU..o’ g3 S\$ø*..)gM\$ *..*μM...
 g*...-’ o’...o \$gi SSú..v)..g93 S\$*-’ g-\$o...*-’ μM\$ o*N..oQμ g-v ú..M\$3 X\$gUMNgU9..g9’ ó oUM...-v...-’ o...
 ’ μ o..v)...g” Z..-’ o*o..SU9M\$-v *M\$ oM\$ø ú..X vø9o..SU\$Q -SU-v..! v” ...” o ..g*..g-o..M\$U.S Xø3 oU...
 Xv S\$ø*.gU9..3 gSU-gSU.ý Q\$USig-SvUg ..M\$’ ó oUM..gMv**..S*..SU*-Sμ-SvU*Z.

...
 -’ o...-’ S9..9\$ oU*\$vUNn o \$ó ú...<gXgM\$úN..øg μg-o*...-’ o...*g-o *...óyøMSøUø**..SU..X vø9SUQ..
 o**oU-\$g ...*ó øM\$*.gU9..Xμi SMQv9*...-v...M\$SioU*Zr-..)vMμ*o*..vU..-’ o...Qøó Uø oU- *gi SSú...-v...
 \$ Xø3 oU..Xv S\$ø*Ni μS9..SU) g*-’ μM\$ oNgU9..oU*μi o..*ó øM\$..9o \$ó ú..gMv**..øg Svμ*..oM\$ *N..
 ” ’ SM..μ -S g-o ú..SU9M\$-o*...-’ o..X gM\$M\$)μUMSvUg Sús..v)..*g-o..SU*-Sμ-SvU*Z.

...

G *v'.. vv-o9..SU..-' o.I +r..) g3 o" v 6N-' o..MUMX-..y)..n o3 vMg-SMGMMU-gi SSú..S..3 og*í o9...
 -' vµQ ...' oo...g-oU..MU* µM*ZrU*-Sµ-SvUg ..GMMU-gi SSú..MX-í o*..-' o..SUoXoU9oUM.gU9...
 oýoMSoUo**..v)..;µ9SMg ..gU9...oQ* g-Sóo..Sµ-Sµ-SvUz..-' S..SUMµ9o*..)gMv *..µM..g*..;µ9SMg ...
 SUoXoU9oUMN. oQ* g-Sóo...vó *SQ -N- gU*Xg oUM..SU.Qvó U3 oU..gMSvU*NgU9...MoM*..gU9...
 i g gUM*.. S' SU..-' o..Xv SSMg ..ú*-o3 NSU9SMg-SUQ.. v" ... o ..9o3 vMg-SMSU*-Sµ-SvU*.. v 9...-' o...
 Qvó U3 oU..gMMU-gi oZ.

...

O oMv g ..GMMU-gi SSú..3 og*í o*..-' o..SU-oQ Sú..gU9...gSUo**..v)..-' o..o oMv g ..X vM**Z..-' S...
 9S oU*SvU.oUM3 Xg**o*..)gMv *...Só.o oMSvU.M3 Xo-SóoUo**N)gS..øv-ó '...oQ* g-SvUNGU9...-' o...
 gi *oUM..v)..o oMv g ..S oQ1 g SS*Z<v oMSóo ún..-' o*o..SU9SMg-v *..o oM..-' o..9oQ oo...v..." ' SM...
 o oMSvU*...oX o*oU..-' o..XovXo *..." S ..gU9..µX v 9..9o3 vMg-SMøg µo*Z.

...

-' o..-' S9..9S oU*SvUNàvMg ..GMMU-gi SSúNoøg µg-o*..-' o'.. v o..v)..MS..*vMS-ún3 o9SgNgU9...
 v-' ó ..UvUQvó U3 oU-g ..oU-SS*.SU.Qvó U3 oU..vó *SQ -Zr..MU*9ó *)gMv *..µM..g*..) oo9v3 ...
 v)..o' X o**SvUN..-' o..X o*oUM..v)..gMSóo..MSMv QUSig-SvU*NgU9...-' o..MSioU ú *..gi SSú..-v..øvSM...
 MUM UZ..-' S..9S oU*SvU.. SQ SQ -*.. v" ..*vMS-g ..)v M*.MU- S µ-o..v..9o3 vMg-SMQvó UgUM...
 vµ-*9o..v)..)v 3 g ..Sµ-Sµ-SvUz.

...

-' o..." v..*vMg ..MU* µM*N3 og*í o9.i g*o9..vU..-' o.àwr..) g3 o" v 6MX-í o..o**oU-Sg ..o o3 oU*...
 v)..! µ3 gU9oøo vX3 oU..xI g*SM. µ3 gU.2 oo9*YgU9..ffµg Sú.v)..Só.x(vµU9g-SvU*.v)..“ o i oSUQN.
 ogM..v)..-' o3 ..MU*S-SUQ.v)..vÍ ...g-oU..9S oU*SvUz...

...

“ S' SU..-' o.I g*SM. µ3 gU.2 oo9*..MUMX-N2 µ- SSVU.gU9..I g*SMt o9SMg ..<g o..g**o**o*..MS9...
 3 v -g Sú.. g-o*..gU9...-' o...3 gUgQ3 oU...v)..SU)oMSµ*..9Sog*o*N. o oMSUQ..-' o..i g*SM.' og -' ...
 S) g*- µMí o.gøgSgi o..v.g.XvXµ g-SvUZ.“ g-ó .gU9.àgUSg-SvU.3 og*í o*..gM**..v.MogU.” g-ó ...
 gU9..g9offµg-o..*gUSg-SvU..)gMSs*N)µU9g3 oU-g ..v..Xµi SM. og -' Zr..MX-í o*.. v" ..oýoMSóo ú...
 M3 3 µUSs*..g o...ó øo9...i ú...o**oU-Sg ..." g-ó ..gU9... úQSo..ó øSM*Z.à' o -ó ... vv6*..SU-v...-' o...
 ' vµ*SUQS*µo*NgU9..oøg µg-o*..-' o.gM**..v..i g*SMg3 oUSs*..µM..g*..o oM S\$úNgU9..MogU..)µo *...
)v ...Mv6SUZ..wó *vUg ...àg)o-ú...g99 o**o*..S*µo*..v)..SU-ó Xó *vUg ...øSv oUMN.- gU*Xv -g-SvU...
 S;í S*N9v3 o*-SMgU9*..g-o..øSv oUM...v..MX-í SUQ.. v" ..*oM o..SU9S9µg *)oo ..." S' SU..-' oS ...
 MµU- S*Z...

...

-U9ó ..-' o.(vµU9g-SvU*.v)..“ o i oSUQMUMX-NGM**..v..I g*SM7 Uv” o9Q...o oM*.ø9µMg-SvUg ...
 vµ-M3 o*.i o v" ...ó -Sg ú...øo Nffµg Sú.v)..o9µMg-SvUNGU9..QU9ó ..Xg SúNg**o**SUQg..*vMS-ú *...
 MgxMSú...-v..X vø9o..vµU9g-SvUg ...o9µMg-SvUg ...vXXv -µUSs*Z.GM**..-v..rU)v 3 g-SvU..gU9...
 <v3 3 µUSg-SvU*..oøg µg-o*..MSioU*fl.gM**..-v..SU)v 3 g-SvU..-' vµQ ..9Sg ..3 ogU*N*µM..g*...
 SU-ó Uo..MUoMS\$ú..gU9..M3 3 µUSg-SvU..-vv *N” ' SM..g o..MµMg ..)v ..3 v9ó U..6Uv” o9QR
 *' g SUQ.gU9..oUgQ3 oU-Z." og -' ..gU9...“ o Uo**..MX-í o*..-' o..XvXµ g-SvU*..! og -' ..vµ-M3 o*N.

SUM₁9SUQ.. So...o' XoMgUMN.UvUM₃ 3 μUSM_i o...9S*og*o*N.gU9...' og -' M_g o...ffig S_úZ.(S_Ug úN.
 OÜSvÜ₃ oU-g ...0 μg S_ú...3 og*₁ o*...gS ...ffig S_ú...gU9...Xv μ-SvUN.X v-oMSvU...v)...*XoM₃*N.gU9...
 oÜSvÜ₃ oU-g !. güg 9.xog9Y₀' Xv*₁ oN.o oMSUQ:-' o.S₃ XgM.v).oÜSvÜ₃ oU-g ..gM_v *.vU..." o R
 i oSUQZ.

...

ßZZZ àoM_U9R/øøo ./g-oU..ðg S_{gi} o*...

...

—' o..3 v9o ...M₃ i SÜ*...-' o..g)ý o3 oU-SvÜ₉...' *Roøo ...g-oU...ðg S_{gi} o*...-v...)ý 3 ...' SQ ó R₉ó ...
 MU₁—' μM*...-' g-X vø9o.g.M₃ X o' oU*S₀o.ðS" ..v).Q₀ó UgUM.gU9..." o R oSUQn

...

- à-g-o...<gXgM₃únn o Uo9..g*..g.M₃ i S_Ug-SvU.v)... *M_g ..M_gXgM₃úNM_v 9S_Ug-SvU.M_gXgM₃úNgU9...
 9o S₀ó ú...M_gXgM₃úNS..M_gX-₁ o*...-' o...g-ofk.vøó g ..gi SS_ú...-v...)μUMSvU.oýoMS₀o úN₃ gUgQ...
 ' o*v₁ M₃NgU9..S₃ X o3 oU-Xv SM₃*Z.

...

- n o3 vMg-SMGMM₁U-gi SS_úm-' o..MU₁—' μM.SU-oQ g-o*.SU*-S_μ-SvUg No oM_v g NgU9...*vM_g ...
 gMM₁U-gi SS_ú...-v..3 og*₁ o...-' o..o' -oU...-v..." ' SM...9o3 vMg-SMX SUMX o*...g₃ o..μX' o 9..gU9...
 Q₀ó Ü₃ oU..gMSvU*.g₃ o..! o 9..SU.M oM₁.i ú.i v-' ..)ý 3 g ..SU*-S_μ-SvU*.gU9...*vM₃-g ..)ý M*Z.

...

- " μ3 gU.I g*SM₂ oo9*m—' o..ðg S_{gi} o...gQQ oQg-o*...-' o..9S₃ oU*SvU*.v)...U₁—' SSvU..gU9...i g*SM₃
 3 o9S_g ..M_g oN" g-ó ..gU9..*gUSg-SvUN*' o-ó NgU9.Xó *vUg ..*g)o-úZr-3 og*₁ o*... v" ...' o ..g...
 vM₃-ú.3 oo-...-' o.3 v*...μU9g3 oU-g ..Loo9*.v).S*.M₃SioU*Z.

...

- (vμU9g-SvU*.v)...“ o R oSUQn-' o..MU₁—' μM.M₃ i SÜ*..gM₀*...-v.i g*SM₆Uv” o9Q₀NgM₀*...-v...
 SU)ý 3 g-SvU..gU9...M₃ 3 μUSM_g-SvUN' og -' ..gU9..." o Uo*NgU9..oÜSvÜ₃ oU-g ..ffig S_úZr-...
 ' o oM*...-' o.μU9ó úSUQ)gM_v *...-' g-..MU- S_μ-o...-v.gU.SU9S₉μg *.gi SS_ú...-v...S₀o.g! og -' úN.
 gU9.SU)ý 3 o9...SoZ.

...

—' o.3 v9o ..M_gX-₁ o*.g'...SM₁.gU9.3 μ-S₉S₃ oU*SvUg ..ðS" ..v).Q₀ó UgUM.gU9...! μ3 gU..." o R oSUQ..
 i ú.g9vX-SUQ_i v-' ...-' o.I +r.gU9..àwr..) g3 o" ' ý 6*ZI ú.M₃ i SSUQ...-' oS ...' *Roøo ..gU9...*oM_U9R
 øøo ...g-oU...ðg S_{gi} o*NS-X vø9o*.g.M₃ X o' oU*S₀o.3 og*₁ o.v)... v" ..Ug-SvU*.Xó)ý 3 ..SU.i v-' ...
 *vM_g ..gU9..Q₀ó UgUM..9S₃ oU*SvU*.v)..9oøo vX₃ oU-Z...-' o.I gúo*S_gU.gXX vgM..oU*₁ o*...-' g-...-' o...
 3 v9o ..SUM₁ X_v g-o*...μUM₀ -gSU-ú..gU9...ðg S_{gi} SS_úNg v" SUQ..)ý ..g...U₁gUM₉..μU9ó *gU9SUQ.v)...
 -' o*.M₃ X o' ..MU₁—' μM*.vøó ...S₃ o.gU9..gMv*.9S₃ó oU..MU-o' -*Z.

...

ßZZ-S oR oM_gú.OU- vX₁.t v9o ...

...

—' o.oU- vX₁..." oSQ -3 o-' v9.xO“ t Y" g*.gXXS₉...-v...- gM₁...-' o.oøv μ-SvU.v)...-' o.S₃ X_v -gUM.v)...
 i v-' ...-' o... ' *R.gU9...*oM_U9Roøo ...g-oU...ðg S_{gi} o*...vøó ...-S₃ oZ...-v...gM₃ 3 v9g-o...-o3 X_v g ...

$\emptyset g \ Sg-SvU*Ng...S \ oP \ oMgú...3 \ oMgUS*3 \ ...'' \ g*..Sv \ v9 \ \mu M9N'' \ ' \ SM..g**SQ*..Q \ og-ó \ ...'' \ oSQ \ -...-v...3 \acute{v} \ o... \\
\acute{v} \ oMU-.vi \ *ó \ \emptyset g-SvU*Z...-! \ o.9 \ oMgú...)gMv \ N\alpha = e^{-0.0001} \approx 1 \ N \ oU*\acute{u} \ o*...! \ g-...oMU-.vi \ *ó \ \emptyset g-SvU*o' \acute{o} \ -... \\
g..*- \ vUQ \ .SU \ \mu oUM..vU...-! \ o.oU- \ vXí...'' \ oSQ \ -*Z...-! \ S*.X \ vM9\acute{u} \ o.o\acute{y}oMS \ o \acute{u}.i \ g \ gUM*...-! \ o.SUSg \acute{u}... \\
9S \ X \ vX\acute{v} \ -SvUg-o \acute{u}...! \ SQ \ ..oU- \ vXí...'' \ oSQ \ -*...'' \ S' \ ...-! \ o..3 \acute{v} \ o...oMU-.vUo*..gU9..9vo*..Uv...g \ -ó \ ...-! \ o... \\
9S\acute{y}ó \ oUM*..SU..oU- \ vXí...'' \ oSQ \ -*..i \ o-'' \ ooU..9S \ oU*SvU*Ng*...-! \ o...S \ oP \ oMgú...)gMv \ ..S*.. \mu US\acute{v} \ 3 \acute{u}... \\
gXXS9..gMv**..g \ .9S \ oU*SvU*..g-..ogM..XvSU-.SU...S \ oZ.$

...

$OgM...g-oU-.\emptyset g \ Sgi \ o \ *..M \ o*..) \acute{v} \ .g..Q \ oU..úog \ ...'' \acute{o} \ o..U\acute{v} \ 3 \ g \ Si \ o9..gMv**..M \mu U- \ S*.g*..) \ v \ v'' \ *m$

...

$$p_{ij}^{(t)} = \frac{X_{ij}^{(t)}}{\sum_{i=1}^n X_{ij}^{(t)}}...$$

...

$'' \ ' \acute{o} \ o..p_{ij}^{(t)}'...oX \ o*oU*...-! \ o..U\acute{v} \ 3 \ g \ Si \ o9.. \emptyset g \ \mu o..) \acute{v} \ .M \mu U- \acute{u}.i..gU9..SU9Sg- \acute{v} \ .j..g-...S \ o.tZ.$

...

$-! \ o...S \ oP \ oMgú...)gMv \ ..(\alpha^{(T-t)})...'' \ g*...-! \ oU..gXXS9N'' \ ' \acute{o} \ o..(T)..S*...-! \ o..3 \ v*-...oMU-...S \ o..XvSU-Z. \\
-! \ o...S \ oP \ oMgúo9.X \ vi \ gi \ SS \ S*...'' \acute{o} \ o..Mg \ M \ g-o9..g*m$

$$\tilde{p}_{ij}^{(t)} = \alpha^{(T-t)} \cdot p_{ij}^{(t)}$$

...

$(\acute{v} \ ..ogM..SU9Sg- \acute{v} \ ..(j)..g-...S \ o..(t)N.-! \ o..oU- \ vXí...'' \ g*..Mg \ M \ g-o9.. \mu *SUQ.-! \ o..Q \ Uó \ g \ ..à' \ gUUvU.. \\
OU- \ vXí..)\acute{v} \ 3 \ \mu \ gm$

$$H_j^{(t)} = -k \sum_{i=1}^n \tilde{p}_{ij}^{(t)} \log \left(\tilde{p}_{ij}^{(t)} \right)...$$

$'' \ ' \acute{o} \ o..(k = \frac{1}{\log n})..oU*\acute{u} \ o*...-! \ o.oU- \ vXí.. \emptyset g \ \mu o..S*.*-gU9\acute{g} \ 9Si \ o9.i \ o-'' \ ooU..gU9..WZ...-! \ o.9S \acute{o} \ *S\acute{u}..v)... \\
SU)\acute{v} \ 3 \ g-SvU..)\acute{v} \ .ogM..SU9Sg- \acute{v} \ ..S*...-! \ oU.9ó \ S \ o9..g*m$

.....

$$D_j^{(t)} = 1 - H_j^{(t)} ...$$

...

$-! \ o... \ Ug \ ...'' \ oSQ \ -...) \acute{v} \ ..ogM...SU9Sg- \acute{v} \ ..(j)..g-...S \ o..(t)....'' \ g*..Mg \ M \ g-o9..i \acute{u}...U\acute{v} \ 3 \ g \ SiSUQ.-! \ o... \\
9S \acute{o} \ *S\acute{u}..v)..SU)\acute{v} \ 3 \ g-SvUm$

...

$$w_j^{(t)} = \frac{D_j^{(t)}}{\sum_{j=1}^m D_j^{(t)}}...$$

...

$-! \ S*...S \ oP \ oMgú..oU- \ vXí..gXX \ vgM..g \ v'' \ o9..\mu*...v..MgX-\acute{u} \ o...-! \ o.o\emptyset v \ \emptyset SUQS \ X\acute{v} \ -gUM..v)..9S\acute{y}ó \ oU... \\
vMg \ .gU9..Q \ \emptyset ó \ UgUM..MU- \ \mu M*..vóó \ ...S \ oN \ oU*\acute{u} \ SUQ.-! \ g-...-! \ o...'' \ oSQ \ -*..g**SQ \ o9...v..ogM...g-oU-... \\
\emptyset g \ Sgi \ o...o \ oMo9'...oMU-...-! \ oU*...'' \ ' \ So..SUM \ X\acute{v} \ g-SUQ! \ S*- \acute{v} \ Sg \ .9g-gZ.$

...

. Z á o * μ - * ...

...

. Z V - ' o . Q v i g . * v M g . g U 9 . Q v o ó U g U M . X ó) v 3 g U M ...

...

G...MμMg ... ' * - * - o X . S U . v í . . g U g ú * S . . S U v o o * . . o ' g 3 S S U Q . - ' o . . . Q v i g . . X g - ó U * . . v) . . * v M g . . g U 9 ...
Q v o ó U g U M . X ó) v 3 g U M . g M v * * . M μ U - S o * Z . - ' S * . g v ' ' * . μ * . - v . . Q g S U . g U . S S S g . . μ U 9 ó * - g U 9 S U Q . v) ...
' v ' ' . . M μ U - S o * . X ó) v 3 . . . S U . . o g S v μ * . . g * X o M * . . v) . . . * v M g . . . X v Q o * * . . g U 9 . . Q v o ó U g U M . . v o ó . . . - S o ...
x G U ' o S o . . o - . . g Z N í - í β Y Z à X o M S M g ú N . ' ' o . .) v M μ * . . v U . . - ' o . . * o M U 9 R o o o . . . g - o U . . M U * - μ M * m à - g - o ...
< g X g M S ú N n o 3 v M g - S M G M M μ U - g i S S ú N I g * S M ' ' μ 3 g U . 2 o o 9 * N g U 9 . (v μ U 9 g - S v U * . v) . . ' ' o R o S U Q Z .
- ' o . * M o * .) v . . o g M . . v) . . - ' o * o . 9 S o U * S v U * . g o . 9 ó S o 9 . g * . - ' o . X o 9 S M o 9 . X v * - ó S ' . 3 o g U * . v) . . - ' o ...
g - o U . . o g S g i o * .) v . . o g M . . M μ U - ú . g M v * * . - ' o . X ó S v 9 .) v 3 . W i u . - v . í - í - Z G) - ó . . - S U Q . - ' o . I < (G ...
3 v 9 o N . - ' o . I g ú o * S g U . g X X v g M . . Q U o g - o * . . * g 3 X o * .) v 3 . . - ' o . . X v * - ó S ' . 9 S ' - S μ - S v U . v) . . o g M ...
g - o U . . o g S g i o * .) v . . o g M . . M μ U - ú . g U 9 . ú o g . . x t ó 6 o . o - . . g Z N í - í - Y Z . - ' S * . X v M * * . . o * μ - * . . S U . g ...
9 S ' - S μ - S v U . v) . . X v * * S o . . o g μ o * .) v . . o g M . . . g - o U . . o g S g i o Z . - ' o . . X v * - ó S ' . 3 o g U . . o X o * o U * . - ' o ...
g o ó g Q . v) . . - ' o * o . * g 3 X o 9 . o g μ o * . g U 9 . * o o o * . g * . g . X v S U . o * - S g - o . v) . . - ' o . . g - o U . . o g S g i o .) v . . o g M ...
M μ U - ú . g U 9 . ú o g Z .

...

- ' o . . X o 9 S M S v U * .) v 3 . . - ' o . I g ú o * S g U . 3 v 9 o . g o . * - g U 9 g 9 S i o 9 . x i R M o * Y . g U 9 . - ' o U . U v 3 g S i o 9 ...
μ * S U Q 3 S U B g ' . 3 o - ' v 9 . - v . o U x í o . M 3 X g g i S S ú . g M v * * . 9 S o U * S v U * Z . - ' o 3 S U . g U 9 . 3 g ' . g o . * o - ...
g * . - ' o . ! S Q o * - . g U 9 . - v ' ' o * - . v i * o o 9 . o g μ o * N S . g X X S 9 . g M v * * . g . . M μ U - S o * . g U 9 . v o ó . - ' o . o U S o ...
X ó S v 9 . x W i u - í - í - Y N o U x í o S U Q . - ' g - - ' o . . o * μ - S U Q . * M o * .) v . . o g M . . 9 S o U * S v U . . o o M . ! v ' ' . 3 μ M ...
M μ U - S o * . 9 o o S g - o .) v 3 . . - ' o . ' ' v * - X ó) v 3 g U M . v i * o o 9 . - ' v μ Q v μ - - ' o . * - μ 9 ú . X ó S v 9 Z . - ' S * ...
* - g U 9 g 9 S i o 9 . g X X v g M . . S * . o * o U - S g .) v . . 9 o U - S ú S U Q . X g - ó U * . v) . . S X v o o 3 o U . . x . * - g Q g - S v U . S U ...
9 S y o o U . 9 S o U * S v U * . g M v * * . M μ U - S o * Z .

...

- ' o . μ * o . v) . I g ú o * S g U . X v * - ó S ' . 3 o g U * . X v o 9 o * . g . * S Q S M g U . g 9 o g U - g Q . v o ó . v - ' ó .) o f f i o U - S * - ...
3 o - ' v 9 * Z . ' ' S o .) o f f i o U - S * - . . o M U S f i o * . . Q U o g - o . g . . * S U Q o . . X v S U . . o * - S g - o . i g * o 9 . v U . v i * o o 9 ...
9 g - g N . - ' o . I g ú o * S g U . g X X v g M . . M X í o * . - ' o .) μ . . 9 S ' - S μ - S v U . v) . . μ U M - g S U - ú N g v ' ' S U Q . μ * . - v ...
9 ó S o . 3 v o . g M M g - o . g U 9 . v i μ * - . o * - S g - o * . v) . . g - o U . . M U * - μ M * . x t ó 6 o . o - . . g Z N í - í - Y Z . - ' S * ...
3 o g U * . - ' g - v μ . . 3 v 9 o . . g M M μ U * .) v . . o g S g i S S ú . . g U 9 . . μ U M - g S U - ú . . S U . - ' o . . μ U 9 ó ú S U Q . 9 g - g N .
X v o 9 S U Q . g . 3 v o . . U μ g U M 9 . g U 9 . . o S g i o . 3 o g * í o . v) . . o g M . . M μ U - ú f * . X ó) v 3 g U M . v o ó . . - S o ...
x G U ' o S o . . o - . . g Z N í - í β Y Z .

...

(S q í o . í . * ' v ' ' * . - ' o . * M o * . 9 S ' - S μ - S v U . g M v * * . U g - S v U * .) v . . o g M . . v) . . - ' o .) v í . 9 S o U * S v U * Z . ' ' S ' S U .
- ' o . à - g - o . . < g X g M S ú . 9 S o U * S v U N * o o ó g . . O í v X o g U . M μ U - S o * . * μ M . . g * . + ó 3 g U í N à ' ' o 9 o U N g U 9 ...
à ' ' S ü o g U 9 . 9 S X g ú . ! S Q . * M o * . x g i v o o . u - Y S U . í - í - N * μ Q Q * - S U Q * - v U Q M X g M S ú . S U . 3 v i S S i S U Q .
' o * v í M * . g U 9 . Q v o ó U 3 o U . M v 9 S g - S v Z r U . M U - g * - N . - ' o . . v ' ' o * - * M o * . S U . í - í - . g o . v i * o o 9 ...

SU.MµU- S*...So.š o3 oU.gU9..ö oUöüno gN.o oMSUQ* µMí g .9o MSUNb*.SU.-' S*.9S oU*SvU.v)...
 Qvó UgUMZI o-" ooU.-' o*o..." v..o' - o3 o*N3 gUí.MµU- S*No*XoMg ú..SU.àµi R'g' g' gU.G) Sg...
 gU9..Xg *-..v)...- o.t 99 o..Og*-N*-S ..)gM..MµU*9ó gi o..Qvó UgUM..S*µo*..M3 Xg o9...-v..3 v' o...
 9o9o vXo9..MµU- S*..SU.Oí vXo.gU9..2 v' -' ..G3 ó SgZ.Vó g NMµU- S* ..Xó)v' 3 gUM..SU.-' o...
 à-g-o...<gXgMú.9S oU*SvU.v)...Qvó UgUM..99...Uv-..S X v9o*..SUS MµU- ú..v9ó ...- o...g*...-' oo...
 9oM9o*N." S' ..gU..SUMog*o..v)...vU ú..í Z% XvSU*..SU.-' o..g9ó gQ*..M oZt v*...S Xv -gU- úN.-' o...
 9S'- S µ-SvU.. o3 gS9o9...9ó ú..9Sxg g-o..i o-" ooU..Wiu- .gU9..í - í - ..xM3 Xg SUQ.-' o.. o*XoMS9o...
 Mo MSU*..v)..9g Sg-SvUZ.

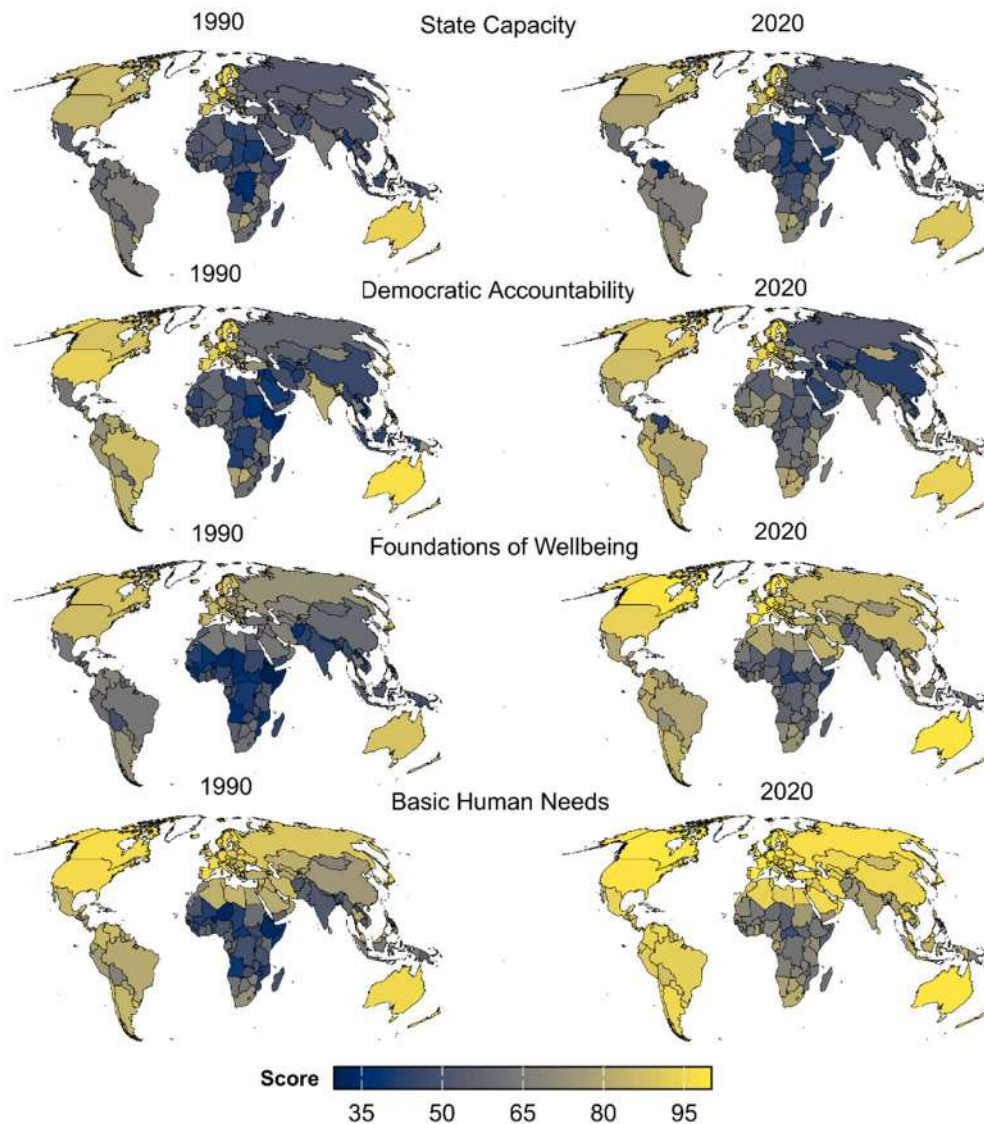
...

(v' .n o3 vMg-SMGMµU-gi SS-úNg.*S Sg' .Xg-ó U.o3 ó Q*N?" S' ..Oí vXogU.MµU- S*..µM..g*...
 n oU3 g' 6N.à" o9oUN.gU9...à" S-üo gU9...gMS9oSUQ.-vX*..M o*...xgi v9o...u%N.SU9Sg-SUQ. vi µ*...
 9o3 vMg-SMSU*Sµ-SvU..gU9..X gMSM*Z<vU9ó *o úNMµU- S*..µM..g*.2 v' -' ..7 v' og..gU9..àú Sg...
 M o..- ' o.. v" o...xi o v" ..β%N9o3 vU*- g-SUQ.*SUS MµU-..QX*..SU.9o3 vMg-SMX vM*o*..gU9...
 gMµU-gi SS-úZ.-' S*..MµU- g*...-' SQ SQ *-...-' o..MµU*9ó gi o...9g Sg-SvU..SU.-' o...ffig S-ú..v)...
 9o3 vMg-SM. Qvó UgUM... " v' 9" 9oN. " S' ... *v3 o.. MµU- S*... 3 gU-gSUQ.-' SQ ... 9o9o *.. v)...
 - gUxg oUMi...gU9...gMµU-gi SS-úN." ' So..v- ' ó *..*- µQQo..." S' ...gµ- ' v' Sg' SgU..Qvó UgUMZ.
 n o3 vMg-SMGMµU-gi SS-ú..." v' 9" 9o..S X v9o9*..SQ - ú..3 v' o..M3 Xg o9...-v..à-g-o...<gXgMú...
 i o-" ooU..Wiu- .gU9..í - í - .." S' .gU.SUMog*o..v)... XvSU*..SU.-' o.g9ó gQ*..M oZG*.)v' -' o..MµU- S* ...
 9Sxg Ss*N.-' o..9oMog*o..S*..g *v...3 v' o..*µi *gU-Sg ...- gU..SU.-' o..Mg*o..v)...à-g-o...<gXgMúN.
 µQQ SUQ*v3 o.9oQ oo..v)..Mµ9ó QUM..SUMµU- S* ..Xó)v' 3 gUM..v9ó ...S oZ.

...

rU.-' o.I g*SM" µ3 gU.2 oo9*..9S oU*SvUNMµU- S*...So.-' o.2 o- ' ó gU9*NrM gU9NgU9..2 v' " gú...
 gMS9o9.-' o.. SQ o*..*M o..SU.í - í - N.-' ó oi ú..* v" SUQ.-' oS .g99gUM9 .gi SS-ú..v..3 oo-.-' o.i g*SM.
 U9o9*..v)...- oS ...MSioU*Z.<vU9ó *o úNMµU- S*..µM..g*...àv3 g Sg..gU9...- o...<oU- g ...G) SgU...
 á oXµi SM*M o..- ' o..v" o*-N*µQQ* SUQXó *S-oU..vUQvSUQMg oUQ*..SUX v99SUQi g*SMó 9SM*...
 So.-' og -' M oNMbgU.." g-ó NgU9...gUSg-SvUZ.-' S*..9S oU*SvU.. 99og *..g*..g' 6...úo-...-úXSMg ...
 Xg-ó U.SU.-' v" ..i g*SMU9o9*..g o.3 o-..Qvi g úN?" S' ..9o9o vXSUQ.Ug-SvU*N3 v*- ú..àµi R'g' g' gU...
 MµU- S*N.v)-oU.. gQQSUQ..i o' SU9Z." v" 99ó N.MµU- S*..SU.-' S*..9S oU*SvU..* v" ...- o..3 v*-...
 *µi *gU-Sg ..S X v9o3 oU..SU..ó 3 *.v)...- o..9oMog*o..SU.9Sxg Ss*..v9ó ...S oN* v" SUQ.gU.99oU...
 - vUQ9 ...oU9oUMi..v)..Mµ9ó QUMZ.G99SSvUg úN.-' o..g9ó gQ..M o..SUMog*o9..i ú..W..XvSU*...
 i o-" ooU..Wiu- .gU9..í - í - Z.

...



(*SQí o.í m+ovQgX' SM9S' S µ-S.U.v*).à-g-o...<gXgMúNn o3 vMg-SMGMµU-gi SS-úNI g*SM" µ3 gU.2 oo9*...
gU9..(vµU9g-S'U*.v)...“ o i oSUQ.*M o..SU..Wiu- .gU9.í-í-Z.

/g*- úNSU..-' o...(vµU9g-S'U*.v)...“ o R oSUQ.9S oU*S'UN-vX.Xó)ý 3 ó *..SUMµ9o..MµU- S*...So...
à” S-üó gU9NrM gU9NgU9..2 ý ” gún.” ' SM..o' M ..SU..X vø9SUQ.ffµg Sú..o9µMg-S'UNGmM**...-v...
SU)ý 3 g-S'UNGU9..g..MbgU..oUøS vU3 oU-Z.VU..-' o..v-' ó ..! gU9NMµU- S*...So..àv3 g Sg..gU9...-' o...
<oU- g ..G) SMU.á oXµi SM' gøo...-' o..v” o*..*M o*Z..-' o.QvQgX' SM ..9S' S µ-S.U.v)..*M o*..SN..
-v..g..Q og-..o' -oU-N*S Sg ..-v...-' g-..v)..I g*SM" µ3 gU.2 oo9*Ni µ-...-' o.9SXg SS*..g o.QUó g ú...
3 ý o..X vUvµUM9ZrU..-' S..9S oU*S'UNMµU- S*..gMSøø9...-' o.3 v*..*SUS MµU-..S X vøø3 oU...
i o-” ooU..Wiu- .gU9.í-í-N” S' .gU.SUMog*o.v)..W%XvSU*..SU..-' o.gøó gQ.*M oZ..

“ ' oUM3 Xg SUQ..o*μ -*.gMv**g ..)vί .9S oUkSV*NM -gSUMμU- S*.9o3 vU*- g-o.MUkS-oU...
 *'- oUQ' *N' ' So..v-' ó *.*' v" ..S i g gUM*Z(' ..S*-gUMNàMgU9SgøSgUMμU- S*...Sò..à" o9oU...
 MUkS-oU-ú...gU6..' SQ ..gMv**g ..9S oUkSV*NSU9Sg-SUQ.." o RvμU9o9..9oøo vX3 oU..SU.i v-' ...
 Qvó UgUM..gU9...*vMg ..SU9Sg-ý *Z.VU...-! o..v-' ó ...! gU9NMμU- S*..*μM...g*..š o3 oU.gU9...-! o...
 n o3 vMg-SMá oXui SMv)...-! o...<vUQy*.*' v" ...v" ..*M o*..gMv**g 3 μ -SXo..9S oUkSV*U*μUQ*..SUQ..
 " S9oX og9..Mg oUQ*..SU.i v-' ..Qvó UgUM..gU9...*vMg ..X vQ o**Z.

...

—! ó o..g o.g *v..Mg*o*.." ' ó o..MμU- S*.Xó)ý 3 ..." o ..SU.vU6..9S oUkSVU.i μ-..Xvν ú..SU.gUv-' ó Z..
 (' ..o' g3 XoNá μ**Sg...*M o*... o g-Sò ú..." o ..SU..à-g-o...<gXgMú...i μ-...! g*..g... v" ó ...*M o..SU..
 n o3 vMg-SM. GMMμU-gi SSún. SU9Sg-SUQ.. *- vUQ.. MgXgMúN. Mv 9Sg-SvUN. gU9... ' o*vί M..
 3 vi SSig-SvU.i μ-..Xvν ..9o3 vMg-SMX gMSM*ZàS Sg úNMμU- S*...Sò..G QvU-Sg..gU9..I' gUS..
 Xó)ý 3 '...o g-Sò ú..." o ..SU.I g*SM' μ3 gU.2 oo9*.i μ-..9v..Uv-..gMSòo..Xg -SM' g' ú...! SQ ..*M o*..SU..
 à-g-o...<gXgMú...ú. .n o3 vMg-SMGMμU-gi SSún*μUQ*..SUQ..-! g-...! oS .gi SSú...v..3 oo-..MSioU* ...
 Uoo9*.3 gú..Uv-..U6M**g Sú.g SU.." S' ..óyOMSò..Qvó UgUM..*- μMí o*Z.

...

—! o...Qvó g ...Xg-ó U.. oøog *...-! g-...MμU- S*...SU..Opí vXo...gU9...2 ' -! ...G3 ó Sg...MUkS-oU-ú...
 Xó)ý 3 ..." o ...gMv**g ..9S oUkSV*U*NSU9Sg-SUQ..g...i g gUM...i o-" ooU..óyOMSò...Qvó UgUMN..
 9o3 vMg-SMX gMSM*NgU9...-! o..gi SSú...v..3 oo-..MSioU*fl.Uoo9*...xGU' oS ..o-..g ZNí -í βYZ-! S..
 Xg-ó U..*μUQ*..*-! g-...-! o*o..MμU- S*...! gøo..o*-gi S' o9...ú*-o3 *...-! g-..oU*í o..i v-' ..Xv SSg ...
 *-gi SSú..gU9...*vMg ..X vQ o**ZrUMμU- g*-NMμU- S*..SU..àμi Rg' g' gU.G') SgNàvμ- ' .G*SgNgU9...
 Xg -*.v)...-! o.t S99 o.Og*..v)-oU...gU6...v" ó .gMv**g 3 μ -SXo..9S oUkSV*U*N. SQ SQ -SUQXó *S-oU...
 S*μio*... o g-o9...-v... Qvó UgUMN.9o3 vMg-SM.gMMμU-gi SSún.gU9...i g*SM. *ó øSM... X vøSvU..
 xGM3 vQμ...` .á vi SvUNí - WYZ.

...

. Z Z-! o.oøv øSUQS Xv -gUM.v)..*vMg ..gU9..Qvó UgUM..SU9Sg-ý *...

...

I óvU9.3 ó o ú.g**o**SUQ.. v" ..MμU- S*.Xó)ý 3 ..SU.*vMg ..gU9..Qvó UgUM.9S oUkSV*U.v)...-! oS ...
 9oøo vX3 oU-NS-..S*.offμg ú..S Xv -gU-...v..oøg μg-o..." ' o-! ó o..3 og*í o*..μ*o9...v..g**o**...-! S..
 Xó)ý 3 gUM..3 gSU-gSU...-! oS .gi SSú...v..9Só oU-Sg-o..i o-" ooU..MμU- S*..vó ..S oZ-..v..Mg Sú...
 -! S*..MUMX-...v)...fbøv øSUQS Xv -gUMN.gU9...MUkSó SUQ..-! o..X øøSμ* ú*.*' v" U..QvQ gX' SM.
 9S'- S μ-SvU.v)..*M o*NS-..S*... og*vUgi o-...v..o' XoM...-! g-...-! o..9S oUkSV*U..xv ..SU9Sg-ý *Y..o**...
 MgXi o...v)...9Só oU-Sg-SUQ..i o-" ooU..MμU- S*...i ú...í -í -...g o...-! v*o..." ' ó o..MμU- S*...! gøo...
 MU6 Q9..SU...-! oS ..Xó)ý 3 gUM...S6ZNI g*SM' μ3 gU.2 oo9*..gU9...(vμU9g-SvU..v)...“ o i oSQN..
 i v-' ..SU..ó 3 *.v)..gi *v μ-o...oøo *.gU9...-! ó...o9μMSvU.v)..9Sxg SS*-..o g-Sò...v..v-' ó ..MμU- S*Z.

...

I μS9SUQ.vU...-! o..Uv-SvU.v)... øv øSUQS Xv -gUMN..oU- vXú..." oSQ -*.X vøS9o.g.3 og*í o.v)...! v" ...
 ogM...9S oUkSVU..MU- S μ-o*...-v...9S-SUQis' SUQ..9Só oUM*...SU...-! o...3 og*í o9...*vMg ...gU9...
 Qvó UgUM..g*XoM*..g3 vUQ..MμU- S*Z.." SQ ó ..oU- vXú..." oSQ -*..SU9Sg-o...-! g-..g...9S oUkSVU..

‘ o-gSÚ..g..! SÚ ó ..9oQ oo.v).9Só *Sú.v).SU) 3 g-SvUN*SU)úSUQS*...o oøgUM..SU.9Só oU-Sg-SUQ..
MµU- ú.Xó) 3 gUM*.x- oM..o-.g ZNí- WYZ(‘ ..SÚ-gUMN.” ‘ oU.n o3 vMg-SMGMMµU-gi SSú..
o’ ‘ S S*.g..! SÚ ..oU- vXú.” oSQ -NS..3 ogU*..! ó o.S*.*µi *gU-Sg ..9Só *Sú..g3 vUQ.MµU- S*.SU..
- ‘ S*...oQ 9NµU9ó *M SUQS*.S Xv -gUM..SU.9S*-SUQúS’ SUQ..oøo *.v)..Qvó UgUM..ffµg S-úZ.

...

— ‘ o...o3 Xv g ..oøv µ-SvU.v)... ‘ o*o...” oSQ -*...S*..9SoM ú...S6o9...-v... ‘ v” ..MµU- S*..MÚó Q...v ...
9Só Q...SU..! oS ...*vMg ..gU9...Qvó UgUM...Xó) 3 gUMZ.G*..MµU- S*..o’ ‘ S S*..3 v o...µU9) 3 ...
S X vøo3 oU*..SUM -gSU.9S oU*SvU*N-! o.9oQ oo.v).9Só oU-Sg-SvU.i o-” ooU..! o3 .9S SÚ’ o*N..
” ‘ SM...og9*...v.g’..o9µMSvU.SU.oU- vXú.” oSQ -*N.o oMSUQ.g..MÚó QUM..SU.Xó) 3 gUMZVU..
-! o.v-! ó !.! gU9N9S oU*SvU*..” S’ ‘...SvUQoU- vXú.” oSQ -*.*µiQQ*-Qv” SUQ9S.Xg S S*NS6ZN.o*..
MÚó QUM..xv ..oøoU.9Só QUMY.g3 vUQ.MµU- S*Z.-! µ*N.-! o.*’ S*..SU..! o*o...” oSQ -*..vó ...
-S o.S µ*- g-o..! v” ..! o.Qvi g .*vMg .gU9..Qvó UgUM..9oøo vX3 oU...gU9*MgXo.S*oøv øSUQ?” S’ ...
Qvó UgUM...9S oU*SvU*..SUMog*SUQú...-g6SUQ..MU-ó ...*gQ...g*..MµU- S*..9SXgú... Qog-ó ...
øg Sgi SSú..SU..! o*o.g*XoM*.M3 Xg o9...v.*vMg .vUo*Z.

...

(SÚ o.ß.X vø9o*.g.Mbó ó .S µ*- g-SvU.v)... ‘ o.oøv øSUQS Xv -gUM..v)..*vMg .gU9..Qvó UgUM..
3 ogµi o*..vó ...-S oZrU.í -í -N-! o.n o3 vMg-SMGMMµU-gi SSú..9S oU*SvU..o3 ó Q9...” S’ ..! o..
‘ SÚ o*...9Só *Sú...v)...SU) 3 g-SvUN.SU9Sg-SUQ.S*..Qog-ó ...gi SSú...-v...9Só oU-Sg-o..i o-” ooU..
MµU- S*..M3 Xg o9...-v...v-! ó ...9S oU*SvU*Z.-! S*..! oSU) M*...! o..)gM...! g-...9S.Xg S S*..SU..
n o3 vMg-SMGMMµU-gi SSúN.” ‘ oU.M3 Xg o9...-v...! o.v-! ó ..9S oU*SvU*N9S..Uv-..MgUQ...! g-..
9 g3 g-Sg ú.i o-” ooU.Wiu- .gU9..í -í -Z.” v” oøó N-! o.3 v*..Uv-gi o.*’ S-..vMµi’ o9.SU..! o.à-g-o..
<gXgNú...9S oU*SvUZ.-USo...n o3 vMg-SM.GMMµU-gi SSúN.” ‘ SM...g’ og9ú...! g9...! o..! SÚ o*...
oU- vXú.” oSQ -.SU.Wiu- Nà-g-o...<gXgNú *..gi SSú...-v..X vø9o..9S.MS SgU-..SU) 3 g-SvU.gi vµ-..
MµU- S* ..Xó) 3 gUM...SUMog*o9...*µi *gU-Sg ú...vó ...-S oN.3 g6SUQ..S...! o...*oMU9...3 v*...
S Xv -gU-9S oU*SvU.i ú...! o.oU9.v)... ‘ o.Xó Sv9Z.

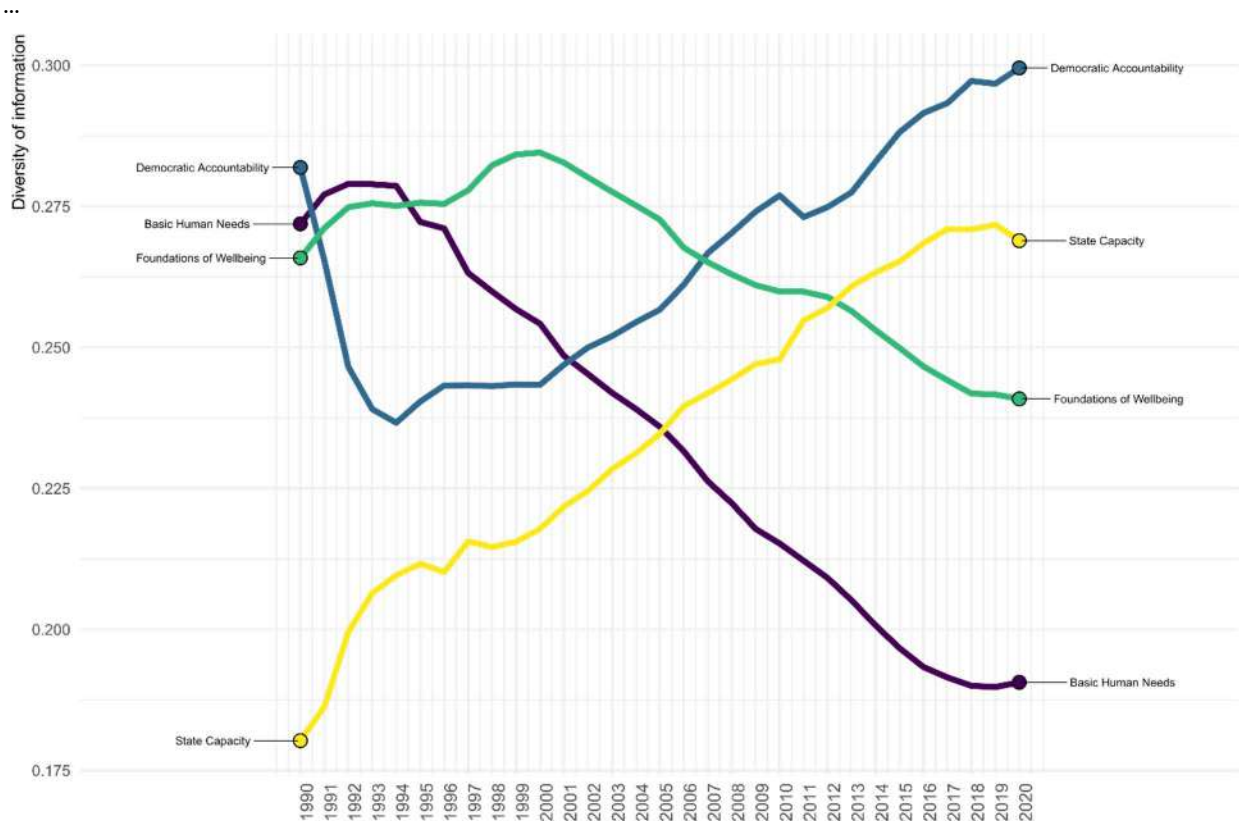
...

<vUk9ó SUQ.*µM..Xg-ó U*N-! ó o..! g*.i ooU.g..Uv-SMgi o.- gUkSSvU..) v3 .*vMg ..-v...Qvó UgUM..
9S oU*SvU*ZrU..Wiu- N*vMg ..9S oU*SvU*..*µM..g*..I g*SM.” µ3 gU.2 oo9*..gU9...(vµU9g-SvU*..v)...
“ o i oSUQ! g9’...o g-Só ú..! SÚ ó ..” oSQ -*N.” ‘ So.à-g-o...<gXgNú...! o 9.g...v” ó ..” oSQ -Zi ú.í -í -N..
‘ v” oøó Ni v-! ..Qvó UgUM..9S oU*SvU*..o’ Xó SµM9.g..Uv-gi o’..Sko..SU..! oS...” oSQ -*N.” ‘ So...! o..
” oSQ -*..v)..i v-! ..*vMg .9S oU*SvU*..9oMSU9Z.-! S*.M3 Xo-o.*’ S-i oM3 o.oø9oU-..SU..! o.í - W*N..
” ‘ oU..! o..Qvó UgUM..9S oU*SvU*..i oM3 o.3 v o..SU) 3 g-Só...! gU..! o..” v.*vMg ..9S oU*SvU*Z..
(v3 ...! S*.XvSU-..vU” g 9NQvó UgUM..9S oU*SvU*..MU*S-oU-ú..! o 9...! SÚ ó ..oU- vXú.” oSQ -*N..
3 ogUSUQ-! g-...! oú.i oM3 o..! o.X S g ú..oU*..! vµQ ..” ‘ SM...! o.9Só oUM*.i o-” ooU.MµU- S* ...
Xó) 3 gUM..MgU.i o.i o-ó .µU9ó *-vv9Z.

...

G..Mv*ó ..o’ g3 Sg-SvU.g-...! o.*µi 9S oU*SvUg ...oøo ..x(SÚ o... Y.. oøog *..! g-..ogM..9S oU*SvU..
o’ ‘ S S*.S*.v” U.- g; oMv ú.v).oøv µ-SvU.vó ...S oZrU.Xg -SM g N-! o.*vMg .g*XoM*..” S’ SU..! o..

I g*SM" μ3 gU.2 oo9*.9S oU*SVU.o' Xó SSM9... o.3 v*.*SUS Mgu.9oMog*o.SU.oU- vXi..." oSQ -*N.
)í -' ó ...S μ*- g-SUQ... o... o9μMSvU..SU... o...gi SSú...v...9Só oU-Sg-o...i o-" ooU..MμU- S*Z... o...
 o' MX-SvU.Sk... o.wó *vUg .àg)o-ú...μi BBS oU*SVUN" ' SM.3 gSU-gSb9..g 3 v*... o.*g3 o...oðo ..v)...
 9Só *Sú...SU..S)ý 3 g-SvU.i o-" ooU..Wiu- ..gU9..í -í -Z.<vUó *o úN.-' o..à' o -ó ...μi BBS oU*SVU..
 μU9ó " oU... o.3 v*...μi *gU-Sg ...v**..SUS*.gi SSú...v..9S-SUQs' ..MμU- ú.Xó)ý 3 gUM*Z... S*...
 μQQ-*... g-MμU- S*... gøo.QUó g ú.MUó Q9.SU.g 3 v*..g .g*XoM*.. S' SU... S.9S oU*SVUZ..



(SQi o..bmOøv μ-SvU..v)...9Só *Sú..v)..S)ý 3 g-SvU.xSbZNoU- vXi..." oSQ -*Y.) v3 ...Wiu- ...v..í -í -...SU..à-g-o...
 <gXgMúNn o3 vMg-SMGMμU-gi SSúN(vμU9g-SvU*.v)...“ o i oSUQgU9..I g*SM" μ3 gU.2 oo9*Z..." ó o... o...
 oU- vXi..." oSQ -*.g' o...o)ó' o9...v.g*... 9Só *Sú..v)..S)ý 3 g-SvU ... ' SM..S..." ' g-... oú.gMμg ú.3 og*í oZr-...
 S.g *v..S Xv -gU...v..Lv-o...- g-oU- vXi..gU9..oU- vXi..." oSQ -*.. gøo.vXv*So.3 ogUSQZ." SQ ó ..oU- vXi...
 " oSQ -*.g' o.g**Qb9...v.øg' Sgi o*..." S' ...v" ó ..oU- vXi..x v**..v)..S)ý 3 g-SvUYgU9..øM.øó *gZ..

rU.MU- g*-N.-' o..(vμU9g-SvU..v)...“ o i oSUQ9S oU*SVUN" ' SM..oUM3 Xg**o..í vg9ó .g*XoM*.v)...
 ffug Sú..v)... SoN* v" *.g... o**..X vUvμUM9...oøv μ-SvU..SU..oU- vXi..." oSQ -*Z.(v' ..o' g3 XoN.-' o...
 oU- vXi..." oSQ -*.v)..g' og*...So..GM**...v..I g*SM7 Uv" o9Q...o3 gSb9...g Q ú.μUMgUQ9N" ' So...
 " og -' .gU9..." o Ub**..o' Xó SSM9..g.* SQ -.9oMSbNgU9..OUbSvU3 oU-g .0 μg Sú...g" ..g.* SQ -...
 SUMog*o.i o-" ooU..Wiu- ..gU9..í -í -Z.GU.SU-ó o*-SUQ- oU9...S*..vi *ó øø9..SU... o..rU)ý 3 g-SvU.gU9...
 <v3 3 μUMg-SvU*..μi BBS oU*SVUN" ' SM...-g' -o9..." S' ...-' o... v" o*-...oU- vXi..." oSQ -...SU..Wiu- N..
 ' oX o*oU-SUQ.μU)ý 3 ..Xó)ý 3 gUM..gMv**..MμU- S*N)v v" o9..i ú.g*..g' X.SUMog*o..SUSMg-SUQ..

g..9Só QUMNgU9... ' oU.g...µi *offioU...9oMUN*SUg SUQMUbó QUM.SU.gMM**..v..SU)3 g-SvU...
gU9..M3 3 µUSMg-SvUZ.. ' S.Xg-ó U.S...úXSMg ..)v .g og*.. ' ' ó o...oMUv vQMg .g9øgUM3 oU*...g6o...
-S o...v...X og9.gMv**..MµU- S*N.og9SUQ..v.gU.SUSg ..X' g*o.v)... 9oUSUQ.9Sxg SSb*..v v" o9...
i ú.g..Mg-MRµX.X' g*o.xw' S SX*..` .àµ Ní - - uYZ.

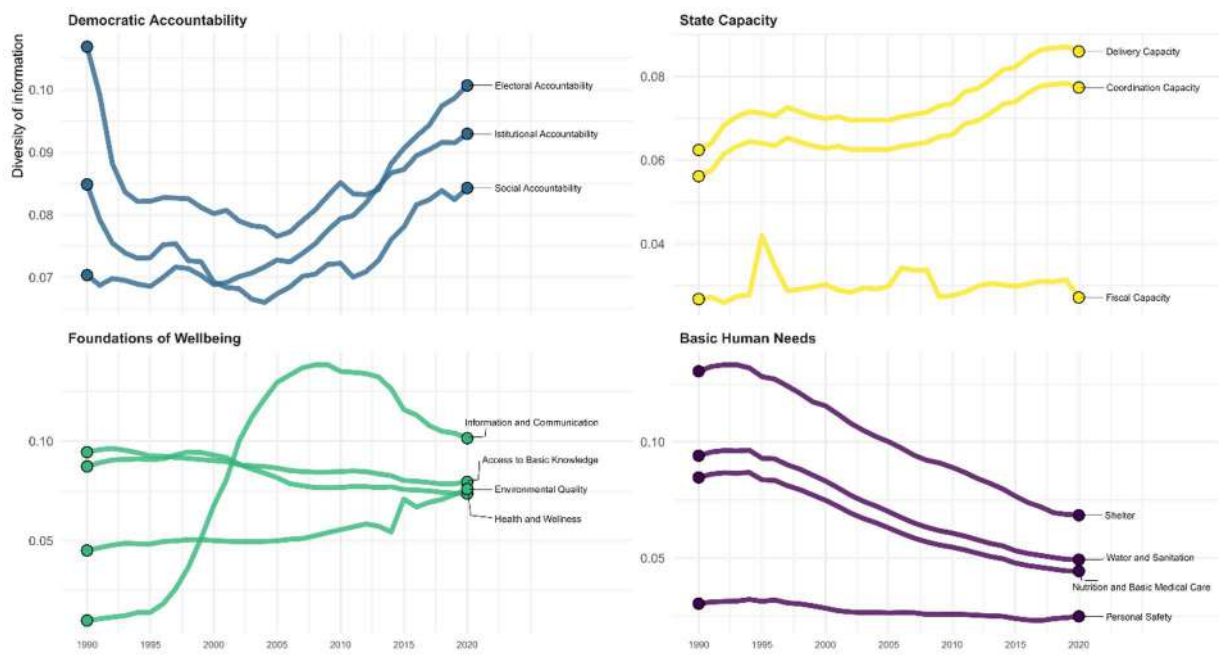
...

OøoU.3 v o..*- S\$UQ.S*.. ' o..M3 X o-o ú.vXXv*So..oøv µ-SvU.vi *ó øo9..SU.. ' o..µi P\$S oU*SvU*.v)...
n o3 vMg-SMGMµU-gi SSúZ.O oMv g ..gU9...vMg ..gMMµU-gi SSú..g og*..v v" o9.g...-P' gXo9...
Xg-ó UN" ' ' ó o.oU- vXú..." oSQ -*..9oMog*o9..v)3 v*..v)... ' o..Xó Sv9..i o)ó o...o-µi USUQ..v... ' oS ...
SUSg ...oøo *Z.GXg -..) v3 ..Sµ-Sµ-SvUg ..gMMµU-gi SSúN" ' ' SM...* v" *.g...og9ú..SUMog*oN.. ' o...
v- ' ó ...- " v...µi P\$S oU*SvU*...SU9Mg-o...g...- ' ooR' g*o...oøv µ-SvU..SU..MµU- S* ...Xó)v 3 gUMZ...
rUSg úN.. ' ó o.. " ó o.*SUS MgU..9Só oUM*N)v v" o9.i ú.g.X' g*o.v)..9oMog*SUQ9Sxg SSb*NgU9...
i ú.g...o-µi U..v..." 9oUSUQ.9Sxg SSb*N* v" SUQ.. ' o...o3 ó QUM..v)..9Só QUM..SU.. ' o*o...µi R
9S\$SvU*.v)..n o3 vMg-SMGMµU-gi SSúZ.

...

- ' o.oøv µ-SvU.v).oU- vXú..." oSQ -*..SU.à-g-o...<gXgMú..µi P\$S oU*SvU*...oøog *.g...og9ú..SUMog*o...
SU..i v- ' ..9o S\$ó ú..gU9..Mv 9SUg-SvU..MgXgMS*N.SU9Mg-SUQ.gU..o' XgU9SUQ.9Só QUM..SU.. ' o...
gi SSú..v)...Qøó U3 oU*...v...v QUSio..M oMSo..gMSvU.gU9..S X o3 oU...Xv S\$*..gMv**..Ug-SvU*...
- ' vµQ vµ-... ' o.. oMU...9oMg9o*Z.rU..MµU- g*N.. *Mg ...MgXgMú...9Sxgú...g...3 v o...*gQUgU...
oøv µ-SvUN*µQ* SUQ..o**..øg Sg-SvU*.SU.. ' S.g*XoM.g3 vUQ.MµU- S*Z.

...



(S\$í o...mOøv µ-SvU.v)... ' o..9Só *Sú..v)..SU)3 g-SvU.xoU- vXú..." oSQ -*Y.SU.. ' o..µi P\$S oU*SvU*.v)..à-g-o...
<gXgMúNn o3 vMg-SMGMµU-gi SSúN(vµU9g-SvU*.v)... " o i oSUQNgU9..I g*S.M" µ3 gU.2 oo9*..v) v3 ..Mµu- ...

-v..í-í-Z.-' o..oU' vXí..." oSQ -*..." ó o..Mg Mí g-o9..gMv**..g ..*pi BBS oU*SvU*N3 ogUSUQ.-' g-...- ' o..." oSQ -v)...
ogM..*pi BBS oU*SvU*S'..o g-S o...v..g ..v-' ó *Z.

...

—' o*o..Xg—ó U..gMv**..-' o..ogé Svμ*..*pi BBS oU*SvU*..)í -' ó ..! SQ SQ -...- ' o..*! S-..) v3 ..*vMg ..-v...
Qvó UgUM..9S oU*SvU*Z.-' oú..S μ*- g-o..Uv-...;μ*..g..QÜ g ..*! S-.i μ-.g *v... v" ...- ' S'- gU*SSvU..
3 gU) o*-o9.." S' SU.*XoM\$ Mg*XoM*.v).ogM..9S oU*SvUZ:" ' So..*vMg ..*pi BBS oU*SvU*..! gøo.oS-' ó ...
9oMog*o9..v' '...o3 gUo9.*-gi o..SU.-' oS ..oU' vXí..." oSQ -*..vó ..S oNQvó UgUM..*pi BBS oU*SvU*..
' gøo.oS-' ó ..SUMog*o9..) v3 ...- ' oS ..SUSg ..oøo *v' .9SXgúo9..g-.-R' gXo9..oøv μ-SvUi o-" ooU..Wiu- ...
gU9..í-í-Z.

...

. BZ-' o..Qv" SUQ9Só QUM..SU.Qvó UgUM..Xó)v 3 gUM..gMv**..." v' 9'...oQvU*...

...

O' Xv SUQ.-' o..oøv μ-SvU..v)..oU' vXí..." oSQ -*..SU..*vMg ..gU9..Qvó UgUM..9S oU*SvU*..vó ..-S o...
MgUi o.gUg úüo9..i ú..." v' 9'...oQvU*Z.-' S'...oQvUg ..gXX vgM!..o X*.SoU-Sú..." ' o-' ó ...- ' o..Xg—ó U*..
vi *ó øo9..g-...- ' o..)μ ..XgÜ ..oøo ..g *v..3 gU) o*-g3 vUQMμU- S*..." S' ..S Sg ..QvQgX' Sg NgU9...
v)-oU..g *v..*vMg ..gU9..oMÜv3 SMMg gMó S-SMZ." v" øó NS..S..S Xv -gU-...v..o3 X' g*Sio.-' g-...
-' o..SUó X o-g-SvU..! ó o..S..MU Uo9...v...- ' o..o' -oU-..v)..9SXg S-S*..x o oMo9..SU.MgUQ*..SU.-' o...
oU' vXí..." oSQ -v)..g...QvU..9S oU*SvUY.g3 vUQMμU- S*..." S' SU..ogM!..oQvUZ.<vUoffioU- ün.
MgUQ*..SU..oU' vXí..." oSQ -v..i *ó øo9.." S' SU.g..XoM\$ M..oQvUg o..SUoXoUoU-..v)..v-' ó '...oQvU*Z..
—' S..Xó *XoMSo..g SU*..3 v' o..Mv*o ú..." S' ...- ' o..MUMX-..v)..MUó QUMNXg -Sμ g' ú..*SQ g...
MU9SSvUg ..MUó QUMN' ' ó o..MμU- S*..." S' SU.g'...oQvU..i oM3 o..SUMog*SUú..! v3 vQÜvμ*...
SU.-' oS ..Xó)v 3 gUM..xl g' v..o-..g ZNWüi čàg gBR g -SUNWü YZ.

...

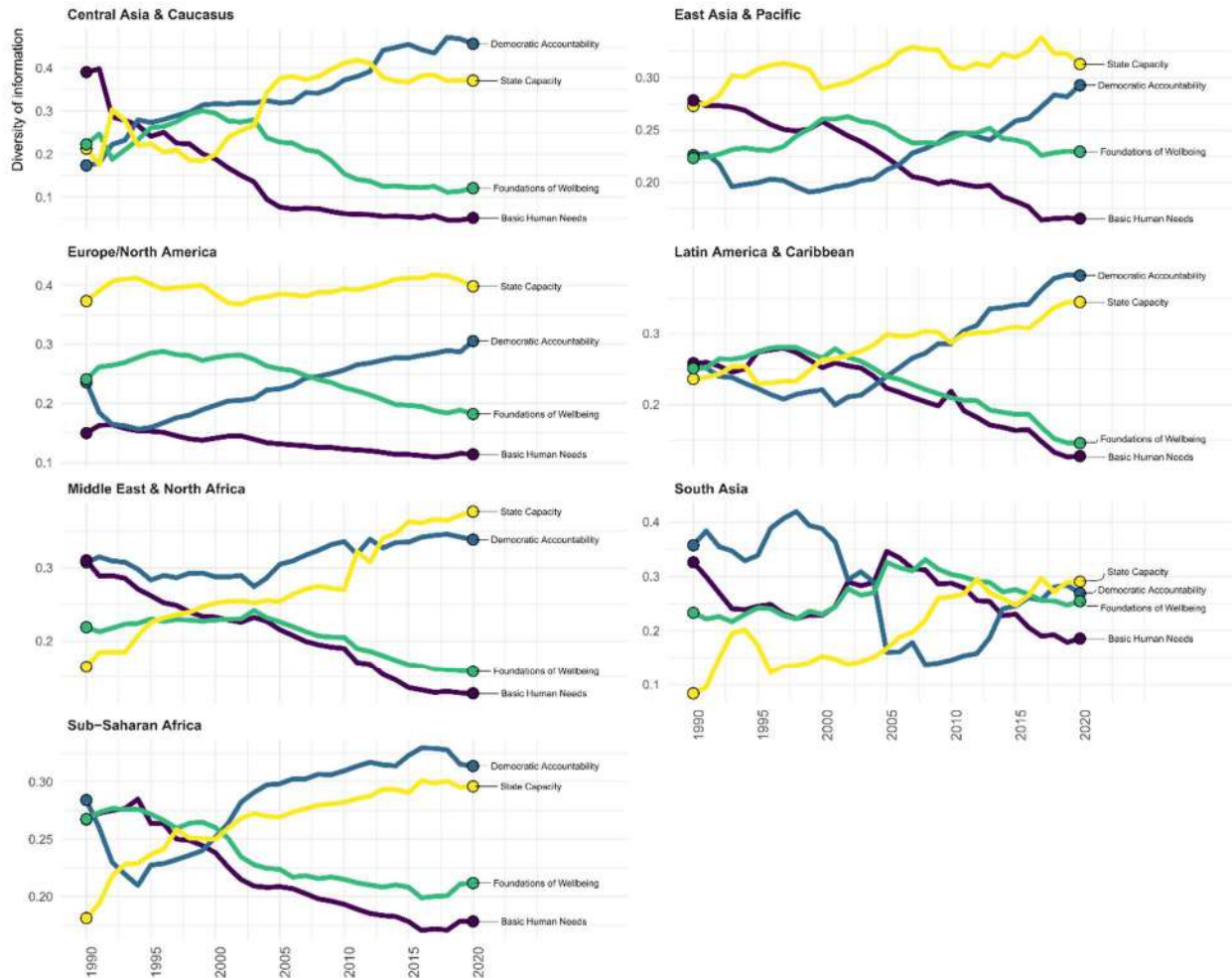
(SQí o..%v'ó *..g..Mog ó ..S μ*- g-SvU..v)..-' S'...oQvUg ..oøv μ-SvUZ(v' ..ogM!..oQvUNS..g v" *..μ*..
-v..SoU-Sú..gU9..3 og*í o..- ' o..*! g' XÜ**..v)..-' o..*! S-..) v3 ..*vMg ..-v..Qvó UgUM..9S oU*SvU*..SU..
-ó 3 *..v)..9Só *Sú..v)..SU)v 3 g-SvUZ(SQí o..%*! v" *..- ' g-..g 3 v*-..g '...oQvU*..o' Xó SUM9...- ' S..
! S-.g-..g..M -gSU.XvSU-..SU..S oZ.-' ó...oQvU..." ' ó o..- ' S..Xg—ó U..MgUi o..vi *ó øo9..g' o..<oU' g ...
G*Sg..` <gμM*μ*N/g-SU.G3 ó SgNt O2 GNapi Rg' g' gU.G' Sg.gU9...v..*v3 o..o' -oU-NOg*-G*Sg...
` ..wgM\$ MZ.-' ó o..S..g..Mog ..gU9...SQS MgU-..*! S-..SU..oU' vXí..." oSQ -*..) v3 ..*vMg ..9S oU*SvU*..
xl g*SM" μ3 gU.2 oø9..gU9..(vμU9g-SvU*..v)..“ o i oSUQY..v" g' 9*..Qvó UgUM..9S oU*SvU*..xà-g-o...
<gXgM\$ú..gU9..n o3 vMg-SMGMμU-gi SSúYZ.

...

—' S..*! S-..S..Xg -Sμ g' ú..oøSoU-..) v3 ...- ' o..3 SFWiu- *..vU" g' 9*N" S' ..Qvó UgUM..SU9Sg-v' *..
SUMog*SUú..*! v" SUQ.-' o..! SQ o*-..." oSQ -*N. o oMSUQ.Qv" SUQ.9SXg S-S*..gU9..9Só QUM..SU..
Qvó UgUM..g*XoM*..gMv**..-' o..MμU- S*..SU.-' S'...oQvUZrU..Wiu- N-' o..*vMg ..9S oU*SvU*..! o 9...
3 v*-..v)..-' o..oU' vXí..." oSQ -Z." v" øó N*-g' -SUQSU.-' o...g-o..Wiu- *Nn o3 vMg-SMGMμU-gi SSú...
gU9..à-g-o..<gXgM\$ú..i oQgU-..v..*! v" ..g'...SQUQ- oU9..SU.-' oS .." oSQ -Z:" S' ..à-g-o..<gXgM\$ú..gU9...
n o3 vMg-SMGMμU-gi SSú..MU*S-oU-ú..o' ' S SUQ.-' o..! SQ o*-..." oSQ -*..gMv**..-' o*o..oQvU*...

i ú...! o..oU9..v)...! o..Xó S9Z..! S...! oU9...µUQ9*...! g...9SXg SS...SU...Q9ó UgUM...Xó)v 3 gUM...
i omg3 o.3 v o..X vUµUM9.gMv**..3 v*..MµU- S*Z..

...
...



(S9í o..µU9v µ-SU.v)..*vMg .gU9..Q9ó UgUM..9S oUkSVUfU- vXú... oSQ -*..) v3 ..Wú- ...v.í-í-í ú... v 9...
oQvUZ<vµU- S*..SU..Opí vXo.gU9..2 v -' ..G3 ó Mf...'' ó o..Q vµXo9...vQ-! ó .g*.fOpí vXoé2 v -' ..G3 ó SgM..
SMD.oU- vXú...'' oSQ -..MfUUV-.i o...o S9í ú..Mf Mf g-o9..i g*o9..vUg..*g3 Xo.v)..vUú...'' v..MµU- S*Z..

...

-! o..*SUS MfU-..SUMog*o..SU..! o..oU- vXú...'' oSQ -.v)..à-g-o...<gXgMfú..SU9Mf-o*...! g...! o..gi vøoR
3 oU-SvU9... oQvU*...o' Xó SUM9...g...Qv'' SUQ..9Só QUM...SU..! v'' ..MµU- S*...v)...! o*o... oQvU*...
9oøo vXo9...! oS ...*g-o..SU*-Sµ-SvU*..gU9...Q9ó U3 oU-...* µMµi o*.x(v -SÚNí- WYZ/ Sö'' SoN-! o...
! g X...So..SU.n o3 vMg-SMGMµU-gi SSú...'' oSQ -..S XSo*.gUSUMog*SUQ9SXg Sú..SU9o3 vMg-SM.
X gMSM*NXv**S ú...o oMSUQ.øg úSUQ..øøo *.v)..Xv SSMf '...o) v 3 *.gU9..9o3 vMg-Sig-SvU.oýv -*...
gMv**..MµU- S*..SU..! S...oQvUZI ú.í-í-N-! o.9v3 SgUM..v)..Q9ó UgUM..9S oUkSVU*No*XoMg ú...
n o3 vMg-SMGMµU-gi SSúN! S9 S9 -*...! g...Q9ó UgUMRo g-o9..9SXg SS*...o3 gSU.g..MSMf ...
gU9..9o USUQMg gMó S-SMv)..MµU- S*..Xó)v 3 gUMZ..! S.Xg-ó UµU9ó *Mf o*...! o.9Só QU...

Xg- ' *...-g6oU...i ú...MµU- S*...SU...- ' o*o... ' oQvU*N.MU- g*-SUQ..” S' ' ...- ' o...3 v' o... ' v3 vQvµµ*...
Xó)v' 3 gUM...vi *ó øø9..SU...- ' o.og' ú...Wiu- *Z.

...

rU..Opí vXoe2 v' - ' ..G3 ó SgNà-g-o...<gXgMú... ' g*...MfU*S*-oU- ú...3 gSU-gSb9...S*... ' SQ o*-...” oSQ -...
SUM...- ' o.i oQSUUQ.v)...- ' o.Xó Sv9Zn o3 vMg-SMGMMµU-gi SSúfk...” oSQ -... ' g...-og9Sú.SUMog*o9...
vøó ...S oNoøoU-µg ú...µí Xg**SUQ.i v- ' ..(vµU9g-SvU*.v)...“ o i oSUQ.gU9..I g*SM” µ3 gU.2 oo9*Z.
“ ' g-S*.Xg -Sµí g' ú...µ' SgSUQ.S*...- ' g-...- ' o.MgUQ..SU..” oSQ -*.gMv**...- ' o.)vµí .9S oU*SvU*.S*...o**...
gí µX-..M3 Xg' o9...v..v- ' ó '...oQvU*NSU9Sg-SUQ..- ' g-..9Sxg SS*..g3 vUQMµU- S*... ' gøø.oøv øø9...
g-..g..3 v' o..Qg9µg ..XgMZ- ' S*..µQQ*...- ' g-..MµU- S*...SU..Opí vXoe2 v' - ' ..G3 ó Sg...o' Xó SUM...
g...o g-Sbo ú...*-og9ú...oøø ..v)..9Só QUM..SU.i v- ' ..Qvøó UgUM..gU9...*vMg ..9S oU*SvU*..vøó ...S oN.
' g- ' ó ...- ' gU.g...gX9...* S-Z- ' S*..oU..MfUi o.o' XgSb9..i ú...- ' o.)gM...- ' g-..MµU- S*..g' o.*-g' -SUQ..
) v3 ' ! SQ ...øøo *.v)..Xó)v' 3 gUM..gMv**..g .9S oU*SvU*ZG*..µMN- ' o.*' S-..SU.oU- vXí...” oSQ -*...
S*..3 v' o...o3 Xó o9N.o oMSUQ.MU*S*-oU- ú...3 v9ó g-o..9Sxg SS*..gMv**..g ..9S oU*SvU*...g- ' ó ...
- ' gU.g.X vUvµUM9'...og vMg-SvU..) v3 ..*vMg ...v..Qvøó UgUM..g*XoM*Z.

...

àvµ- ' ...G*Sg...X o*oU-*...g...*v3 o” ' g-...*S Sg' ...Xg-ó U...SU...ó 3 *...v)...i g gUM9...” oSQ -*...gMv**...
9S oU*SvU*Ni µ-...” S' ' .gU..oU-S o ú...9Sýó oU-..µU9ó úSUQ.MU-o' -Z- ' o.Xó *S*-oU-..X v' S S-ú.v)...
” oSQ -*...3 gQSp9o..SU.g ..9S oU*SvU*..SU9Sg-o*...- ' g-..9Sxg SS*..gMv**..MµU- S*... o3 gSb9...
oøøU ú... 9S- S µ-o9... gMv**... i v- ' ... *vMg ... gU9... Qvøó UgUM... SU9Sg-v' *Z. " v” oøó N. µUSo...
Opí vXoe2 v' - ' ..G3 ó SgNMµU- S*...SU..àvµ- ' ..G*Sg...g' o..vXó g-SUQ..) v3 ..g..Xv*SSvU.v)..SUSg' ú...
Xv' v' ..Xó)v' 3 gUM...SU.g ...- ' o*o...9S oU*SvU*Z- ' S*...MU-o' -... o oM*...- ' g-..MµU- S*..g' o...*S ...
- µQQSUQ.-v...MU9ó Q...-v” g' 9..i o-ó ...vµ-M3 o*NgU9... ' oUMN- ' o...offµg '... oX o*oU-g-SvU.v)...
9Sxg SS*..gMv**..9S oU*SvU*..3 S' v' *...- ' o..vUQvSUQ.Mg oUQ*..SU.gMSøSUQ.µU9' 3 ..X vQ o**...
SU.i v- ' ..*vMg ..gU9..Qvøó UgUM..g*XoM*Z...

...

- ' µ*N- ' o.6oú..9S-SUMSVU.i o-” ooU...- ' o...” v'...oQvU*...S*...SU...- ' oS ...-g' -SUQ.XvSU*..gU9 ...oøøo *.v)...
9oøø vX3 oU-Z. Opí vXoe2 v' - ' ... G3 ó Sg... ' g*... MfU*S*-oU- ú... Xó)v' 3 gUM... ' SQ ú...” S' ' ... o**...
X vUvµUM9...* S-...) v3 ..*vMg ...v..Qvøó UgUM..9S oU*SvU*N” ' So..àvµ- ' ..G*SgN*-g' -SUQ..) v3 ..g...
v” ó ..Xó)v' 3 gUM..i g*o SbN.oM 9*.gU.vUQvSUQ*- µQQo...v.gMSøøo.i g gUM9..X vQ o**..SU.i v- ' ...
Qvøó UgUM..gU9...*vMg ..9S oU*SvU*Z.

...

%Zn S*MµSVU...**

...

rU...- ' S*...*oMSvU...” o...X vø9o...gU...SU9oX- ' ..gUg' ú*S*...v)...- ' o...3 o- ' v9v vQvMg' ...gU9...MfUMX-µg ...
S XSMg-SvU*.v)...vµí ... U9SUQ*N” S' ' ..Xg -Sµí g' ..g-oU-SvU...v... ' v” ...- ' o...oøv øSUQ.S Xv' -gUM...v)...
*vMg ..gU9..Qvøó UgUM..9S oU*SvU*..SU µoUM*...- ' o..MfU*- µMSvU.v)..M3 Xv*S o..SU9Sg-v' *.vøó ...
-S oZ- ' S*...oMSvU... ' *-g99 o**o*...- ' o.3 o- ' v9v vQvMg' .S XSMg-SvU*.xà oMSvU..%ZvN)vµí *SUQ.vU...
- ' o.*SQS MgUM.v).oU- vXí...” oSQ -*.g*..g.9úUg3 SM’ oSQ -SUQ*Mo3 o...- ' g-...o oM*..µUM -gSU-ú...

gU9...* S...SU.SU9SMf-ú ..S Xv -gUMZI ú..M3 Xg SUQ.oU- vXú..." oSQ -*..." S' ...- g9SSvUg ..offig ...
 " oSQ -SUQ.gXX vgMo*N.-' o..9SMi**SvU..! SQ SQ -*..." o..g9øgU-gQ*.v)..oU- vXúR g*o9..." oSQ -SUQ..
 SU..MgX-í SUQ..MgUQ*...SU..MµU- S*fl.Xó)v 3 gUM...gU9... o9µMUQ..i Sg*o*...) v3 ...M' o g-o9...
 SU9SMf-ú *Z.

...
 (v v" SUQ.-' o..3 o- v9v vQMF ..MU*9ó g-SvU*N." o...- oU..o' Xv o...- o..MUMX-µg ..S XSMf-SvU*...
 xàoMSvU..%Z Y.v)..- o..vi *ó øo9...* S-*) v3 ..vMg ...-v..Qøó UgUM..9S oU*SvU*.g*..vMg ..XvSU*..v)...
 9oøo vX3 oU-Z.-' S..9SMi**SvU..µU9ó *Mf o*..! v" ...- o..MgUQSUQ.9S Xg SSo*.SU..- o*o..9S oU*SvU*...
 SU9SMf-o.gU.oøv øSUQ.gU9*MgXo..." ' ó o..Qøó UgUM..S*µo*...So.à-g-o..<gXgMf-ú.gU9..n o3 vMg-SM.
 GMMµU-gi SS-ú..SUMog*SUQú..9o Uo..MµU- S*fl.9oøo vX3 oU-.-' g;oMv S*Z.-' vµQ ...- o*o...- v"
 *µi *oMSvU*N." o..gS ...-v..MU-o' -µg Sio...- o... U9SUQ*..." S' SU..í vg9ó ...- o'v o-SMf ..) g3 o" v 6*N.
 vYó SUQ.SuSQ -*..SU-v...- o..X vQ o**S*o*..* S-*)..SU..- o..)gMv ...- g-..* gXo..ffig S-ú..v)... So..gU9...
 Qøó UgUM.gMv**..MµU- S*Z.

...
 %ZZt o- v9v vQMF ..S XSMf-SvU*...

...
 -' o..øv øSUQ.S Xv -gUM.v)..*vMg ..gU9.Qøó UgUM..9S oU*SvU*..! SQ SQ -*..." o.9úUg3 SMUg-í o...
 v)...- o..3 og*µi o*...µ*o9 ...-v...3 vUS-ú ..MµU- S* X vQ o**..vøó ...-S oN." ' SM...! g*...*SUS MfU...
 S XSMf-SvU*..)v ..MU- µMSUQ.M3 Xv*S o..SU9SMf-ú *... vUQfµ9Sug ú..xGU' oS ..o...g ZNí - í BZ.
 OU- vXú..." oSQ -*..Xgú..g..MµMg ... v o..SU..-! S..X vM**..i ú..gMMµU-SUQ.)v ..µUM -gSU-úZ.G-..gUú...
 QSoU..XvSU-N.-' oú..MfU..ó øo...g*..g... oX o*oU-g-SvU..v)..SU9SMf-ú ..øg Sgi SS-úN.*S Sg ...-v...! v" ...
 w SUMXg ...<v3 XvUoU-..GUg ú*S..o3 Xvú*..)gMv ...vg9SUQ*.g*..." oSQ -*..)v ..SU9S9µg ..SU9SMf-ú *...
 x+ oú SUQ..` ...-oQoUgNí - Wč." µ..o-..g ZNí - í í YZ." v" øó NSU.g...vUQfµ9Sug ..MU-o' -NoU- vXú...
 " oSQ -*..g o..9S*-SUM.SU..-! g-..-! oú..9SoM ú...o oM..MgUQ*..SU.SU9SMf-ú *.SU)v 3 g-SvU.MU-oU-N.
 -' ó oí ú..MgX-í SUQ.* S-*)..SU..MµU- S* ..3 v*-..X o**SUQ.é og*..v)..X vQ o**..g*...-! o..9Só *Sú..v)...
 SU)v 3 g-SvU.9oMog*o*.SU.vUo.g*XoM.gU9..SUMog*o*.SU.gUv-! ó Z.

...
 rU.t µ -R Só Sg..n oMSvU..t g6SUQ.xt <n t Y.3 o- v9*NMGUQ*..SU.SU9SMf-ú *..SU)v 3 g-SvU..
 MU-oU-ó øo.g*.gU.vi ;oMSøo.MSó SvU.)v .." oSQ -9o-ó 3 Sug-SvUN" ' SM.S.Xg -SMf g ú...o øøgU-...
)v ..øv øSUQ.*vMg ..gU9...Qøó UgUM..MU9SSvU*..xU' vµ...` ..GUQní - - uYZ.-USo..*µi ;oMSø..v ...
 g i S- g ú.." oSQ -SUQ3 o- v9*NoU- vXú..." oSQ -*..9ó So.o9SoM ú..) v3 ...- o.9g-gN.o oMSUQgMµg ...
 µUM -gSU-ú.." S' SU.ogM..9S oU*SvU..vøó ...S o..xàg -o SNí - - ° YZ.-! S..gXX vgM..g SU*..." S' ...- o...
 Uo9..)v ...- gU*Xg oUMNoU*µi SUQ.-! g-..-! o..." oSQ -SUQ.S*...oXvU*Søo...v..QUpSb.* S-*)..SU..*vMg ...
 gU9..Qøó UgUM..9S oU*SvU*..g-! ó ...- gU.X o9o-ó 3 Sb9..g**µ3 X-SvU*.x+ oM..o-..g ZNí - WíYZ.

...
 t v ovøó N.SU..-! o...MU-o' -..v)...! SQ ú...µUM -gSU..*vMg ...gU9...Qøó UgUM...vµ-M3 o*N." ' ó o...
 MµU- S* ...Xó)v 3 gUM..MfU..øg ú.." 9o úN.oU- vXú..." oSQ -*..g9gX-...-v...-! o*o...µUM -gSU-S*N.
 oUgi SUQ.3 v o..gMf g-o...- gMSUQ.v)..9úUg3 SMMgUQ*..vøó ...-S oZI ú..MgX-í SUQ.MgUQ*..SU..

SU9SM-´ * .SU)´ 3 g-SvUMUoUN-! Sk.3 o-! v9..vi ;oMSþo ú...o oM*! v” .MþU- Sþ *Xó)´ 3 gUM...
oøv øo*... gMv**... -! o*o... 9S oU*SVU*Z. -! Sk... 9úUg3 SM.g9;µ*-3 oU... 3 g6o*... oU- vXí... ” oSQ -*...
Xg -SMí g´ ú...µSgi o...)´ ...MgX-í SUQ..-! o...M3 Xo’ ...gU9... µMþg-SUQ..Ug-í o...v)...*vMg ...gU9...
Qvøó UgUM...MU9SSvU*.vU.g.Qvi g ..Mg oZ.

...

<v3 Xg´ o9...v...! o.offþg ...” oSQ -SUQgXX vgMN-! o.µ*o.v).oU- vXí...” oSQ -*.výó *.g.3 ´ o.UþgUM9...
gU9...vi ;oMSþo...g -ó Ug-SþoZ.“ ’ So...offþg ...” oSQ -SUQ.Sk..v)-oU...*o oMo9...)´ ...S*...S XSMú...gU9...
Xó MSþo9...)gS Uþ**NS...gM*...! óv o-SM´ .Q vµU9SUQ.gU9..9vo*..Uv-.gMMþU...))´ ...! o..øg´ úSUQ.U´ ...
oøv øSUQ.S Xv´ -gUM..v)...9Sýó oU...SU9SM-´ *Z.-! Sk..gXX vgM..g**µ3 o*...! g-.g ..9S oU*SVU*..v´ ...
SU9SM-´ *...MU- S µ-o...offþg´ ú...-v...! o...M3 Xv*So...3 og*í oN.” ’ SM...Qþo*...Uv... oQ´ 9...-v...! o...
9Sýó oU-Sg´ ...S Xv´ -gUM..v)...! o...SU9SM-´ *...Mþó o9..i ú...! o...M3 Xv*So...3 og*í oZrU.MU- g*-N.
oU- vXí...” oSQ -*.g´ o..9g-gþ SþoUNMg Mþi g-o9..i g*o9..vU...! o..µUM -gSU-ú.X o*oU...SU...! o..9g-gZ..
-! Sk...3 g6o*...! o3 ..g...3 ´ o...vi ;oMSþo...3 og*í oNg*...! oú... o oM...! o...gMþg ..9S´ S µ-SvU.gU9...
*SUS MgUM..v)...ogM..SU9SM-´ .gMv**..MþU- SþZ.

...

t ´ ovøó Ng...SUS MgU...S Sg-SvU.v)...offþg ...” oSQ -SUQ.Sk.S*..Sgi SS-ú...-v.g99 o**...! o.S*µio..v)...
M´ o g-SvU..g3 vUQ..SU9SM-´ *N.” ’ SM...3 gú... oµi -...SU...! o...µUSU-oU9o9...f9vµi o...MþU-SUQí..v)...
M -gSU.9S oU*SVU*Z.-! Sk.vMþi *...” ’ oUM´ o g-o9..SU9SM-´ *.g´ o...- og-o9..g*..*Xg´ g-oN-! ó oi ú...
g3 XSúSUQ.-! oS..S XgM.vU...! o.vøó g .3 og*í oZOU- vXí...” oSQ -*N. v” øó NSU’ ó oU- ú.g9;µ*-...
)´ ...! Sk..i ú...-g6SUQ.SU-v..gMMþU...! o..SU)´ 3 g-SvU.MUoU...SU.ogM..9S oU*SVUNoUþi SUQ.-! g...
M´ o g-o9..SU9SM-´ *.9v..Uv-..9SX vXv´ -SvUg-o ú.SU µoUM...! ó...oµi -*Z.-! Sk.9úUg3 SMUg-í o.v)...
oU- vXí...” oSQ -*.3 g6o*...! o3 .Xg´ -SMí g´ ú..øg µgi o..SU..vUQþµ9Sug .*-µ9SþNg*...! oú.g9gX-..vøó ...
-S oN. oøog SUQ.MgUQ*..SU.9SXg´ Sþ...gU9...* Sþ*..SU.MþU- Sþ*fl.Xó)´ 3 gUM...SU..*vMg´ ..gU9...
Qvøó UgUM...MU9SSvU*...3 ´ o...gMþi g-o ú...! gU...! o...*-g-SM.vUþSioR -*þg´ ...offþg ...” oSQ -SUQ..
gXX vgMZ.

...

t v*...S Xv´ -gU- úNþ*SUQ.oU- vXí...” oSQ -*.g*..g...S oþg´ úSUQ.” oSQ -SUQgXX vgM...o9µM*...! o...
´ S6...v)...M3 Xv*So...SU9o’ ...M´ o*...i oSUQ.vøó ú...SU µoUM9...i ú...MþU- Sþ *Xó)´ 3 gUM...SU...o**...
SU)´ 3 g-Sþo...vµ-M3 o*Z.Vøó ...-S oN.g*...M -gSU...gXoM*...v)...ffþg S-ú...v)... Sþo...i oM3 o...3 ´ o...
MU*Sk-oU- ú...gMSþogi o...! gU..v-! ó *NMþU- ú...*M´ o*...X vø9o...g...3 ´ o..gMþi g-o... o oMSvU..v)...
-! o*o.MgUQ*...! vµQ .gUgQQ oQ-SvUX vM*...! g-SUM´ Xv´ g-o*...! o.oøv øSUQoU- vXí...” oSQ -*Z..
G*..vµ´ ’...oµi -*..SU9SM-oN3 gUú..MþU- Sþ*...! g-...! gøo..gMSþo9...! SQ ..Xó)´ 3 gUM...SU..6oú...*vMg´ ...
gXoM*N.*µM...g*...Uþ´ SsvU.gU9...gUSg-SvUN.*S ...)gM...Xó *Sk-oU...Mg oUQ*..SU...Qvøó UgUM...
9S oU*SVU*...Sþo.o oMv´ g ..gU9...*vMg´ ..gMMþU-gi SS-úZ.G´...o Sgi o..M3 Xv*So...SU9o’ ...M´ o..Sk..vUþ...
-! g´...o3 gSU*..*oUSþo...-v...! o*o.S i g gUM*.gMv**..9Só *o..9S oU*SVU*v)...ffþg S-ú.v)...þoZ.

...

...

...

%Z<vUMX-µg .S XSM-SU...

...

—' o.vi *ó øo9...*' S-.) v3 ...vMg ...v..Qvó UgUM..9S oU*SVU...*SUS o*...-' g-...-' o.6oú.é og*...'' ' ó o...
MµU- S*...gM..9S*Xg SS*...g o.MgUQSUQ.N. o oMSUQ.g.í' vg9ó ..øv µ-SvU.SU...-' o...gMv *..9 S\$SUQ..
MµU- S* ...X vQ o**Z.rUSg úN.MµU- S*...gMv**...-' o...Qvi o...9S*Xgúo9...-' o...3 v*...*SUS MgU-...
øg Sgi SS-ú..SU.i g*Mg*XoM*.v)..ffµg S-ú..v)...SoN*µM..g*..Uµ- SSvUNi g*SM3 o9SMg ..Mg oNv ..gMó**...
-v..." g-ó ..gU9...*gUSg-SvUNi µ-...vóó ...S oN-.' oú...-' gøo...*' v'' U...µi *gU-Sg ...S X vøo3 oU...gU9...
MÚó QUM..SU...-' o*o.é og*ZG*...! S Q S Q -o9..SU...-' ó...o*µ -*N-.' ó o..." g*..g..WBXvSU-..SUMog*o..SU..
-' o...gøó gQ*...M o...)'v ...-' o..I g*SM." µ3 gU..2 oo9*...9S oU*SVU..) v3 ...Wiu- ...-v...í -í -N.gU9...-' o...
9S*Xg SS*...g3 vUQ.MµU- S*...SU...-' S*...9S oU*SVU...-' gøo...Uv-SMgi ú...9oMog*o9N.SU9SMg-SUQ..g...
Ug' v'' SUQ.QX.SU.o**oU-Sg ...vMg ...ó øMó.X vøSvUZ.

...

" v'' øó N-.' o... Q v'' SUQ..o3 X' g*S*...vU.. Qvó UgUM...9S oU*SVU... Sö...à-g-o... <gXgM\$ú...gU9...
n o3 vMg-SM.GMMµU-gi SS-ú...-' o oM*...-' g-... MµU- S*...g o... Uv'' ...)gMUQ.. 3 v' o... X vUvµUM9...
9S'ó oUM*..SU.Qvó UgUM...* µMí o*..gU9..X gMSM*Z...-' o..SUMog*SUQ.oU- vXí..." oSQ -*..SU...-' o*o...
9S oU*SVU...*SUg ...-' g-...9S*Xg SS*...SU...-g-o...óy oMSöUo**N.Qvó U3 oU-...Mv' 9Sg-SvUN.gU9...
9o3 vMg-SMgMµU-gi SS-ú...! gøo..i oM3 o...-' o..9o USUQ.)og-í o*..v)...MU-o3 Xv' g' ú..9oøo vX3 oU-...
Mg oUQ*ZG*...*ooUNà-g-o...<gXgM\$ú...M o*..SUMog*o9..vUú..3 g' QUg' ú..xi ú..í Z%XvSU-*Y.vóó ...
Wiu- R-í -N' S' ...S- o.MgUQ..SU.9S*Xg SS*NSU9SMg-SUQ.g.Xó *S-oU-Mg oUQ..SU*- oUQ' oUSUQ..
Qvó UgUM..." v' 9'' SöZ...-' o*o... U9SUQ*..µQQ*...-' g-..." o..é o..." SÜo**SUQ.g..X' g*o..." ' ó o...-' o...
o3 X' g*S*...S*...*' S-SUQ..) v3 ...3 ó o...)µ 3 oU-...v)...i g*SM.Uoo9*...-v...g99 o**SUQ..3 v' o..M3 Xo' ...
Qvó UgUMRo g-o9..S*µio*N'' ' SM'...offµSo..9S'ó oU-...*-' g-oQ\$*.gU9..Xv S\$*Z.

...

-U9ó *gU9SUQ..-' S*.*' S-.S.MµMg ..)v' .Q\$USUQSU*SQ -..SU-v...-' o.øg' úSUQX' g*o*.v)..9oøo vX3 oU-...
-' g-..MµU- S*..µU9ó QvNogM..3 g' 6o9..i ú..9S'ó oU-...øøo *.v)..µUM -gSU-ú..SU.9S'ó oU-..vµ-M3 o*Z..
-' S*..- gUSvU..! S Q S Q -*...-' o..øv øSUQ.Ug-í o..v)..9oøo vX3 oU-N'' ' ó o..MµU- S*..3 vøo..) v3 ...
gMSøSUQ.M -gSU-ú..SU...-' o..o**oU-Sg *.v)..ffµg S-ú..v)...So...v..QgXXSUQ.." S' ...-' o..µUM -gSU-S*..v)...
Qvó UgUM..Xó)v' 3 gUMZ(v' ..SU*-gUMN'' ' So..vMg ..9S oU*SVU...Sö..I g*SM" µ3 gU..2 oo9*..*g'' ...
*SUS MgU-... MÚó QUMN. Qvó UgUM... 9S oU*SVU...-' gøo... *' v'' U... SUMog*SUQ.. 9Só QUMN..
Xg -SM' g' ú..SU.<oU- g ..G*Sg...` ..<gµM\*µ\*N/-g-SU.G3 ó SMg...` ...-' o..<g' S i ogUNT 99 o.Og*..gU9...
2 v' -' ..G') SMgNgU9..àµi R'g' g' gU.G') SMgZ.

...

—' S*.*' S-...-' µ*...oX o*oU*..g..3 vøo3 oU-..i oúvU9..9S oU*SVU*..v)..ffµg S-ú..v)...So...-' g-..é o..Mv*o ú...
' o g-o9...v..SUM3 oZr-..v'ó *..ø9oUM..v)..MµU- S* ..9oøo vX3 oU-...- g;oMv' S*..øv øSUQ.SU.." gú*...
-' g-...SUM3 o...g vU...MgUv-...MgX-í oZ.<vµU- S*...g o...SUMog*SUQú...9S'ó oU-Sg-o9...i ú...-' oS ...
Qvó UgUM..* µMí o*N9o3 vMg-SMgMµU-gi SS-úNgU9.*-g-o..MgXgM\$ú...g-' ó ...-' gU;µ*-..ø' -oU-...
v)...-' oS'...o*ví M*Z...-' S*.Xó *XoMSö..oU SMo*..v'µ ..µU9ó *gU9SUQ.v)..9oøo vX3 oU-Nó3 X' g*SiSUQ..

—' g—X vQ o**..S*..3 μ —SgM—o9NgU9...—' g—Qvó UgUM...Xgú*..gU...SUMog*SUQú...MU— g '... v o...SU...
' gXSUQ..! v” ..Ug—SvU.9o9o vXZ..

...

“ Z <vUMμ*SvU..

...

—' S*..μ9ú..*o—..vμ—..v..o' Xv' o...! o..o9v øSUQS Xv' —gUM..v)..*vMg ..gU9...Qvó UgUM..9S oU*SvU*...
SU..— gMSUQ.MμU— S* ..X vQ o**..vó ..—S oZI ú..gXX úSUQ.oU— vXí...” oSQ —N..! o..gUg ú*S*..gS o9...
—v..MgX—í o..*! S—*..SU..μUM —gU—ú..gU9..9Sxg SS*..gMv**..! o..)vμ ..9S oU*SvU*..xà—g—o..<gXgM\$—úN..
n o3 vMg—SM. GMMμU—gi SS—úN. I g*SM. " μ3 gU... 2 o99*N. gU9... (vμU9g—SvU*... v)... “ o R oSUQN..
* v” Mg*SUQ..! o..μ*o)μ Uo**..v)..! S*..3 o— v9..g*..g...S oRg úSUQ..” oSQ —SUQ3 o— v9..gU9..X vø9SUQ..
S*SQ —*..SU—v...! v” ..MμU— S*fl.9o9o vX3 oU—: g;oMv S*..! gøo..o9v ø9.) v3 ..Mμ— ..v..í —í —Z.

...

—' o... oμ —*... o9og ..g...SUS MμU—*! S—..SU..S Xv' —gUM..!) v3 ..*vMg ..9S oU*SvU*...—v...Qvó UgUM...
9S oU*SvU*..vó ..! o..*μ9S9.Xó Sv9ZrUSg úNMμU— S*..9Sxgúo9...! o.3 v*..øg Sgi SS—ú..SU..*vMg ...
g*XoM*...i μ—*... v” o9...*μi *gU—Sg ...S X vø3 oU—...gU9...Mμó QUM...vó ..—S oZ..rU...Mμ— g*N..
Qvó UgUM... 9S oU*SvU*N..à—g—o... <gXgM\$—ú... gU9... n o3 vMg—SM. GMMμU—gi SS—úN. o' Xó SUM9...
SUMog*SUQ.oU— vXí...” oSQ —N*SQg SUQ..! g—..9Sxg SS*..SU..Qvó UgUM..X gMSM*..! gøo..i oM3 o...
3 v' o..X vUvμUM9Z..! S*..— gU*SSvU..! SQ SQ —*...! g—..MμU—o3 Xv' g' ú..9o9o vX3 oU—..Mg oUQ*..g' o...
SUMog*SUQú...vv—o9..SU..Qvó UgUM..Xó)v' 3 gUM...g—' ó ..! gU..μ*—..SU3 oo—SUQi g*SM*vMg ..Ubo9*Z..

...

r—..S*..g *v...” v' —' ..Uv—SUQ..! g—..gU...SUMog*o...v' ..9oMog*o...SU..oU— vXí...” oSQ —*...*! vμ 9...Uv—..i o...
SU—ó X o—o9..g*..g..UoQ—Sbo..v' ..Xv*SSbo..— oU9..SU..MμU— S*flXó)v' 3 gUMZrU*—og9NS'...o oM*...! o...
9oQoo...—v...” ' SM...MμU— S*...g' o...Xó)v' 3 SUQ..μU9v' 3 úZ..àXoM\$ Mg' —úN.” ' So...—! o...9oMog*o...SU..
oU— vXí...” oSQ —*..v)..*vMg ..SU9SM—v' *..xM3 Xg' o9...—v..Qvó UgUM..SU9SM—v' *YSU9SM—o*..g'..o9μM9...
gi SS—ú..v)..! o*o..SU9SM—v' *..v...! SQ SQ —.9Sýo oUM*..i o—” ooU..MμU— S*NS..g *v..*! v” *..g..Qvø g ...
' o9μMSvU..SU..9Sxg SS*..g3 vUQ.MμU— S*...xSQ g..Mμó QUMY..” ' SM...3 SQ —..g *v...S Xú..gU..
S X vø3 oU—..SU..MμU— S*flXó)v' 3 gUM..xi o—g..Mμó QUMYZrU..! S*..*oU*oNSU9SM—v' *i oM3 o...
o**..oýoMSbo..g—..9S—SUQiS' SUQi o—” ooU..MμU— S*..g*..! oú..S X vøo..gU9..Mμó QZ.

...

“ ' So...! S*..μ9ú..X vø9o*..øg μgi o..SU*SQ —N..! ó o.g' o..Uv—gi o...S Sg—SvU*...! g—)μ—í o...o*og M...
*! vμ 9..g99 o**Z(S*—úN..! o..Ml' oU—..gUg ú*S*..)vMl*o9..vU..g...S So9...*o—..v)...g—oU—..Mμ*— μM*N..
gU9..o' XgU9SUQ..! o..Mvó gQ...—v..SUMμ9o..v—! ó '...o o9gU—..*vMg ..gU9...Qvó UgUM..g*XoM*...” vμ 9...
X vø9o...g...3 v' o...M3 X o' oU*Sbo...μU9ó *gU9SUQ..v)...MμU— S*fl..9o9o vX3 oU—...— g;oMv S*Z..
àoMμU—úN..! o..oU— vXí..3 og*í o..μ*o9...” g*..9S*Mo—oN? ' SM...3 SQ —..Uv—..)μ —ú..MgX—í o..—! o..UgUM*...
v)..MμU—Sμvμ*..9g—gZO3 XvúSUQ..9Sýo oU—Sg ..oU— vXí..Mμ 9..oU' gUM...! o..gMμl gMl..v)..oU— vXí...
” oSQ —*..SU..! gU9 SUQ.MμU—Sμvμ*..øg Sgi o*Ng v” SUQ.)v' ..g..3 v' o..X oM\$..o..gUg ú*S*..v)..MμU— S*fl..
Xó)v' 3 gUM*Z./ g*—úN..! o..gUg ú*S*..99—Uv—..9Sýo oU—Sg—o..i o—” ooU..MμU— ú..SUM3 o...QvμX*N..
” ' SM...3 gú...3 g*6...S Xv' —gU—..øg Sg—SvU*..SU..! v” ..*vMg ..gU9...Qvó UgUM..9S oU*SvU*...o9v øoZ.

(μ-ί ο...μ9S*.Mμ 9...Sυο*-SQ-o...! v” ..oU- vXί...” oSQ -*.9Šó ..gMv**...v” N3 99 oNgU9...! SQ R
SUM3 ο..MμU- S*..-v..9oU-9ú..μUffμo..Xg-ó U*.v)..Mυó QUM.gU9..9Só QUMZ.

...

ά o)ó oUM...

...

GM3 vQμN.n Z. ` ...ά vi S*vUN.s Z.GZ.xí - WYZ. “ ’ ú...Ug-SvU*...)gSm-! o...v SQU*...v)...Xv” ó N.
X v*Xó S-ú.gU9..Xvóó -úZ/ vU9vUwv v oZ.

...

GS6oUNGZxí - WYZt og*ί SUQ.” o)g o.i oúvU9...+n wZ2 g-SvUg .rU*-Sμ-o.OMUv3 SMá oøS” N.
ί . uNá BR WZ.

...

GU oS N." Z.7 ZN./ gUQN.t Z. ` ...7 Uμ9*oUN.OZ./ Z.xí - í βYZ.rU- v9μMUQ..-! o...I ó QQμoU..
+vóó UgUM.rU9o’ .rm<vUMX-μg .gU9..3 o-! v9v vQNg .) g3 o” v 6Z+ vi g .wv SMNWxàμXXZ.
. YN% WZ.

...

GU oS ..! Z7 ZNâg gMUv.s Z<Z. ` ..7 Uμ9*oU.OZ/ Zxí - í . YZ.-! o.í - í . .I ó QQμoU..+vóó UgUM..
rU9o’n o3 vMgMμ...<’ g oUQ9Z.-</ G.../ μ*6SU..àMvv ..v)...wμi SMGýgS*N/ v*..GUQ o*N.
ί - í . Z.

...

I gU9μ gNá Zxí - - 1YZ.G..àμ oóú..v)...<v3 Xv*Sο..rU9SM*.t og*ί SUQ.<vμU- ú..wó)v 3 gUMm
ί - - 1...-X9g-oZG...-2 n wéVn à...“ v 6SUQ.wgXó N2 o” .š v 6Z.

...

I g’ vNá ZsZ. ` .àg gBR g -SUN. ZxWuί YZ<vUó QUMZs vμ Ug .v).Xv SSMg .OMUv3 ú..W- Z ...
xWuί Ynί í BR %VZ.

...

I oú*NI Z.xí - WYZI oúvU9...+n wm< g**SúSUQ.g -ó Ug-Sο...3 og*ί o*...)v ...X vQ o**Z.àvMg ...
SU9Mg-v *...o*og MNWuNB%VZ Z.

...

I vvú*oUN(Zxí - - í YZ.GU..vóó øS” ..gU9..oøg μg-SvU.v)...M3 Xv*Sο..SU9SM*.v)...9oøo vX3 oU-Z.
àvMg .rU9Mg-v *.á o*og MN%uNW%WVZ.

...

I’ g3 gU-SNGZ. ` ...-g gU-v gNàZxí - WYZá oQvUg ..SUvøg-SvU.SU9o’ά oQvUg ..Mg3 XSvU*..
” S’ SU.Ug-SvUg ..SUvøg-SvU..ú*-o3 *Z/ μ’ o3 i μ QμOμ vXogU..<v3 3 S*SvUNs á <..àNBUS M.
gU9..wv SM.á oXv -*Z.

...

<vóó N- Zt Z. ` ...-! v3 g*Ns ZGZxí - - %ZO o3 oU*..v)..SU)v 3 g-SvU...! ov ú.xí U9..o9YZsv’ U..
“ Sou...` .àvU*Z.

...

n o.t í vNwZnt güüSv—gNt Z.` ..wğ o—vNGZxí - WwZ<v3 Xv*So..S9SM*.v).9oøo vX3 oU-.gU9...
Xvøó -úmGU.gXXSg-SvU.-v.t n +*ZàvMg .rU9Sg-ú *á o*og MNW. NWwZ.

...

(v*-ó NsZOZnt M-S \$ gúNt Z.` ..à o-' NàZxí - WYZ<v3 Xv*So..S9SM*ma gU6'.. vi μ*-Uo**N.
g-S-Sg ..g**vMg-SvUNGU9'...o9μU9gUMZOMUv3 S4m-' o..VXoURGMD**NVXoURG**o**3 oU...
ORvú Ug N° Ní - WwZ.

...

(' -SUNsZxí - WYZG...vv ...v..oøg μg-o.*-g-o..MgXgM'ú..SU.Xv*- M3 3 μU*-MμU- S*NW1u
í -" ZOí vXogU.;vú Ug ..v).Xv S5g '...o*og M... uZ'xí - WYñ % R I Z.

...

(' oo9v3 ..." vμ*oZxí - í WZ(' oo9v3 ..SU.-' o.." ' 9..í - í Wm o3 vMgMl.μU9ó ..àSQZ(' oo9v3 ...
" vμ*oZ.GøgSgi o..g-m' —X*iné) oo9v3 ' vμ*oZ Q' oXv -é) oo9v3 R' ' 9éí - í W9o3 vMgMR
μU9ó RSQ...

...

÷ ou SUQ.-Z.` ..'-oQUgN(Zxí - WYZ<vU*- μMSvU.gU9..gUg ú*S*.v).g.M3 Xv*So.ffiμg Sú.v)...
So.S9o' ..)v .g'...oQU.v).àvμ-' ..G) SgZàvMg .rU9Sg-ú *á o*og MNWwBYN11° uß- ...

...

÷ oMNaZnr* Sig6gNGZnt g-ğ güüvNI Z.` ...-v' S*SN.+Zxí - WYZ.VU.-' o..3 o-' v9v vQSM ...
) g3 o" ' 6..v)..M3 Xv*So..S9SM*mG'.. oøS" ..v)...' o..S*μo*..v)... oSQ -SUQngQQ oQg-SvUNGU9...
' vi μ*-Uo**ZàvMg .rU9Sg-ú *á o*og MNWwWN. Wv. Z.

...

" gU*vUNsZ.7 Z.` ..àSQ gUNá Zxí - í WZ./ oøSg-' gU*...g-oU-..9S oU*SvU*mt og*í SUQ.*-g-o...
MgXgM'ú..)v ..M3 Xg g-Sø.Xv S5g '...o*og MZ.-' o.svú Ug ..v)..wv S4N1βx YNWu%WwZ.

...

" g' 3 gM6NsZn' ú vøgNwZ.` .." -SSMnt Zxí - í . YZí - í . .àvMg ..w' vQo**rU9o' ..n g-gZàvMg ...
w' vQo**r3 Xó g-SøZ:" g*' SUQ-vUNh <Z.

...

sgúUb*NOZ.-ZxWi% YZrU)v 3 g-SvU.-' ov' ú.gU9..à-g-S*-Sg ..t oMgUSMZW' ú*Sg ..á oøS" N.
W x YN. í - Z.

...

7 μi S'üo" *6SnrZn<v*-gUügNá ZN(gUMN<ZN/g" UNwZN-g i ó -' NsZnsGM*vUN.-Z.` ..Gú 3 ó N.
<Zxí - WYZI ouvU9...+n wmt og*í SUQ.gU9..gMSøSUQ.Qvi g ..QUμSb...X vQo**ZOM vQSM ...
oMUv3 S4NußN% R1Z.

...

t güüSv—gNt Z.` ..wğ o—vNGZxí - WYZt o-' v9*..)v ..Mμ'- μMSUQM3 Xv*So..S9SM*mVUo..)v ...
g ..v' ..g ..)v ..vUoffiá S\$S-g.r-g SgUg..9S.OMUv3 Sg..n o3 vQg g..o..à-g-S*-SgN/' ö rrxí YN. °
1- Z.

...

t güüS—gNt Z.` ..wğ o-vNGZxí - WYZt og*í SUQ.“ o H oSUQ.Vøó ...S om—' o..G9;µ*-o9...
t güüS—g wğ o-v...rU9o' ...öó *µ*...V-' ó ...2 vURM3 XoU*g-ý ú...rU9SM*Z..àvMg ...rU9SM-ý *...
á o*og MNW Nü ° u° Z.

...

t ó 6 oNOZ<Zxí - WYZG..M3 Xg S*vU.v)..S Xµ-g-SvU.3 o-' v9*..)ý .I gúo*SgU.)gMv .gUg ú*S...
3 v9o *Zs vµ Ug ..v)..O9µMg-SvUg .gU9.I o' gøSv g .à-g-S-SMN xí YNí % í ° Z.

...

t ó 6 oNOZ<Z.` ..á v**oo Nš Zxí - WYZi gøggUmI gúo*SgU.*' µMí g ..offµg-SvU.3 v9o *.øSg...
Xg g3 o-ó ..o' XgU*SvUZ.g ' S\$.X oX SU-.g ' S\$mWVWZ %- . Z.

...

t ó 6 oNOZ<ZN(Sü*S 3 vU*NOZN-gU' v Ns Z.` ...+vv9 SMNI Zxí - í - YZO MBU..I gúo*SgU..
*' µMí g ..offµg-SvU.3 v9o SUQ.SU.à-gUZ.g ' S\$.X oX SU-.g ' S\$m- - 1Z ° °ßZ.

...

t S' gNàZxí - WiYZà' gUvU.OU- vXí..)ý ..0 µgU-SúSUQ.-UM -gSU-ú.gU9.á S*6..SU.OMUv3 SM.
n Sxg S-úZá S*6..GUg ú*SNBuxuYNWV%WV° . Z.

...

t v go*NsZ.GZ.` ...I ;g NàZ.xí - í ßYZ.O oMv g ...øv g-SS-ú...gU9...Xv SSMg ...Xv g Sig-SvU..SU..
9oøo vXSUQ.9o3 vMgM\$*mOø9oUM..) v3 .. / g-SU..G3 ó SMN.Wuß í - WZwğ -ú...wv SSM.í uZ ...
xí - í ßYñ ß R. ° Z.

...

w' S SX*NwZ.<Z.` ..àµ Nn Zxí - - uYZ.OMUv3 SM- gU*SvU.gU9...Qv” -' Zs vµ Ug ..v)..gXXS9...
oMUv3 o- SMNí . x° YNWVBRWV%Z.

...

àgSgUgNt ZN.-g gU-v gNàZ.` ..àg -o SNGZxí - - %YZ-UM -gSU-ú.gU9...*oU*S\$S-ú...oMUffio*..
g*...-vv *..)ý ...' o..gUg ú*S..gU9..øg 9g-SvU.v)..M3 Xv*So..SU9Mg-ý *Zs vµ Ug ..v)..' o..á vúg ...
à-g-S-SMg .àvM-ú.GNW1NB- ° BíßZ.

...

àg gBR g -SUN. ZxWü YZá oQvUg .M' o*SvUmø9oUM.gU9...! ov S*.v)..oQvUg .Qv” -' .gU9...
MÚó QUMZOí vXogU.oMUv3 SM.øS” ... -Z .xWü YñMí %VW% Z.

...

àg -o SNGZxí - - °YZ<v3 Xv*So..SU9Mg-ý *i o-” ooUgUg ú*S.gU9.g9øvMmZàvMg .rU9SM-ý *...
á o*og MN1WVN. % ° ° Z.

...

àg -o SN. GZ. xí - WYZ. <v3 Xv*So... rU9SMg-ý *... gU9... t µ -SMSó Sg... n oM\$SvU.. GUg ú*SZ..
w o*oUg-SvU.g-...<Vr2 .í - W..RW-' .sá <..GUUµg ...-gSSUQ.vU.<v3 Xv*So..rU9SMg-ý *.gU9...
t <n GZ.

...

à' gUvUN<ZOZxWl. 1YZG.3 g-' o3 g-SMg ...' óv ú.v).M3 3 μUSMg-SvUZI o .àú*-o3 ...-eMUSMg ...
svjí Ug Ní °xßYNB°uRíßZ.

...

à-o6' vøoUNn ZsZ.` ..I ' ' 3 gUUN.wZ.xí - WYZ.t S*('v o*- UvURKg g3 o'- SM3 S*SUQ.øg μo...
S Xμ-g-SvU.)'v .3 S o9RúXo.9g-gNI SvU)'v 3 g-SM.í 1xWYNW WYZ.

...

- gUv' SMNá ZOZxí - - uYZ.-' o.9μg ..Ug-í o.v).oM*ú*-o3 .9úUg3 SMm-v' g 9.gU.o' XgUg-SvU..
v)...! v S-SMgU9'...o9μMSvUS-SM9úUg3 SMZOM vQSMg .t v9o SUQNí-í-xW WYNW1 Wuí Z.

...

-2 n w.x-USo9.2 g-SvU*.n øøo vX3 oU-..w' vQg3 3 oYZí-í-Z." μ3 gU.n øøo vX3 oU-..á oX' -..
í-í-m-' o.2 o' -.(vU-S m' μ3 gU.n øøo vX3 oU-.gU9...! o..GU-' vXvMUoZ2 o' .š v 6Z.

...

“ μNá Z Z ZNÜ' gUQNÜZNS gUN.“ ZN(gUNs ZN+vμNs ZN/ S1NI Zo-.g Zxí - í í YZG.M3 Xg g-Søo..
gUg ú*S..v)...! o..X SUMXg ..M3 XvUoU-..gUg ú*S..gU9..oU- vXí...” oSQ -..3 o-' v9*...v..o*-gi S' ...
-' o..SU9o' SUQ3 og*μí o3 oU-Zw/ Và...V2 ONWxWYN- í í í VZ.

...

Ü' gUQNs Z.` .. / ooN<Zxí - - °YZ.-' o..MUøó QUM..v)...! μ3 gU.9øøo vX3 oU-..SU9SMg- 'v Zsvjí Ug ...
v).n øøo vX3 oU-..OMUv3 SMN1. xWYNWí %Z.

...

Ü' vμNwZ.` ..GUQNI Z.“ Zxí - - uYZ<v3 Xg SUQt <n G.GQQ oQg-SvU.t o-' v9*.SU..<vU*- μMSUQ..
<v3 Xv*S.o.rU9SMg- 'v *-..*SUQ.-' o.à' gUvURXo'g 3 gU.t og*μí oZàvMSg .rU9SMg- 'v *.á o*og MN..
u. N1ß ü Z.

...

Ü' vμNwZN(gUN/ Z.“ Z.` ..Ü' vμNn Z0 Zxí - WYZn g-g.gQQ oQg-SvU.SU.MU*- μMSUQM3 Xv*S.o...
SU9SMg- 'v *mG..Xó *XoMSø..v)..S)'v 3 g-SvU...v**ZO' Xó -..àú*-o3 *...” S' ..GXX SMg-SvU*Nß° xWYN..
ß -B %Z.

...

Ü' vμNwZNGUQNI Z.“ Z.` ..wv' N7 Z/ Zxí - WYZG.3 g-' o3 g-SMg ..X vQg3 3 SUQ.gXX vgM...v...
MU*- μMSUQM3 Xv*S.o..SU9SMg- 'v *ZOM vQSMg ..OMUv3 SMN. uxí YNí uß ß- VZ.

...



Just Transition Score: Measuring the relative sustainability of social progress

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ABSTRACT

Sustainable development of countries necessitates parallel enhancements of societal wellbeing and reductions of environmental impacts. To track how countries perform to achieve these twin objectives, we introduce and calculate a novel metric called the Just Transition Score (JTS) that aims to assess countries' relative sustainability of social progress. Based on the content of environmental impacts per unit of progress, we calculate the JTS for 161 countries from 2011 to 2019. Additionally, we break down the aggregate indicator into two main components, namely the Carbon Just Transition Score, and the Material Just Transition Score. The results show significant disparities across countries both in terms of the overall JTS and its components. Countries with the best JTS performance, such as Portugal, Spain, and Costa Rica achieve the most sustainable social progress, while countries with the lowest JTS scores either fall short on social progress (the poorest countries) or create high environmental damage (such as the Gulf countries). The relative sustainability of social progress of poorer countries can be improved by increasing societal wellbeing while limiting growth of their environmental impacts. In richer countries, improvements would require more aggressive measures aimed at reducing the extent of environmental damage.

1. Introduction

Sustainable development of societies around the world requires improvements of societal wellbeing and reductions of environmental damage, and these twin objectives need to be achieved in parallel. This is clearly reflected in the current global development agenda – while most of the Sustainable Development Goals (SDGs) aim at improving societal wellbeing, two of them (Goals 12 and 13) primarily focus on the reduction of global environmental damage.¹ As evidenced multiple times in the past, the simultaneous achievement of these two objectives is complicated by possible trade-offs (e.g. Neumayer, 2016), which is illustrated by positive correlations between the levels of human wellbeing and environmental impacts (Millward-Hopkins et al., 2020).

It was also confirmed that countries differ in how they are able to pursue these twin objectives (Fanning et al., 2022). This can be analyzed by tracking the environmental efficiency of wellbeing, which shows how

countries are able to transform their environmental resources to foster wellbeing (Fanning et al., 2020). Metrics that measure such efficiency integrate societal outcomes and indicators of environmental impacts, usually in the form of a ratio of wellbeing (output) in the numerator, and environmental impacts (input) in the denominator (Dietz et al., 2009; Knight and Rosa, 2011). It can be argued that countries with higher efficiency have a more sustainable wellbeing, and vice versa.

Existing indices measuring the sustainability of wellbeing often rely on economic proxies (e.g., income) or narrowly defined indicators of wellbeing (e.g., life expectancy). Likewise, global environmental impact indicators frequently focus solely on carbon emissions. However, such narrow measures do not adequately capture the multifaceted nature of societal wellbeing and environmental sustainability. Furthermore, due to a strong association with environmental damage, the use of income as a wellbeing metric can obscure the understanding of the ways in which countries are able to achieve similar levels of wellbeing with

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¹ Apart from Goals 12 (Responsible consumption and production) and 13 (Climate action), there are additional SDGs that focus predominantly on the more local environment, namely Goal 6 (Clean water and sanitation), Goal 7 (Affordable and clean energy), Goal 14 (Life below water), and Goal 15 (Life on land).

significantly different environmental impacts (or vice versa).

To address this, in our paper we define and construct a new measure of sustainable societal wellbeing, which we call the Just Transition Score (JTS). While its theoretical and methodological grounding is derived from the concept of environmental efficiency of wellbeing, its policy-oriented objective is to provide insights on countries' ability to achieve a "Just Transition", i.e., a simultaneous shift of countries towards high societal outcomes for their populations ("Just") and low or no environmental impacts ("Transition" to low impact economies), similarly to Winkler (2020). Additionally, by employing a broader set of social and environmental indicators, and by excluding economic factors, the JTS provides a more nuanced view of how countries balance their societal wellbeing with environmental sustainability.

Our paper therefore responds to the universal need for more comprehensive and geographically representative approaches to measuring countries' performance in the sustainability of wellbeing. By expanding the range of indicators measuring societal wellbeing beyond what is typically examined in the literature (Gough, 2015; O'Neill et al., 2018), our approach goes even further than the Human Needs Theory (Max-Neef, 1991), which forms the basis of the *safe and just space* framework. Consequently, the JTS also addresses the fundamental question raised by Neumayer (2016) of what aspects of wellbeing should be sustained.

In this regard, our paper is novel in at least two ways. First, we work with the Social Progress Index (SPI) which represents one of the most comprehensive efforts to measure societal wellbeing of countries, independent of economic proxies. By using 60 social outcome indicators, it covers 12 aspects of societal performance while no economic indicator is used in the Index framework (Stern et al., 2022). Second, while the rationale of the Just Transition Score is derived from environmental efficiency approaches, our goal is to track the relative sustainability of societal wellbeing (social progress) rather than the input-output efficiency itself. We therefore start off by focusing on the content of environmental impacts in each unit of social progress, i.e., we express the ratio as the environmental impacts over social progress, which is rather an intensity approach (Dietz et al., 2012; Jorgenson, 2014; Jorgenson and Dietz, 2015; Irshad et al., 2021). Countries with relatively high content of environmental damage in one unit of social progress have the least sustainable social progress, and vice versa.²

It needs to be emphasized that the JTS is designed as a measure of relative sustainability of social progress. The best JTS scores imply the most sustainable social progress (compared to others) in the sense that they combine relatively high levels of social progress with relatively low environmental impacts. They do not necessarily mean that social progress of the best performing countries is environmentally sustainable in absolute terms, i.e., that their environmental impacts are below the planetary (per capita) thresholds.

The aim of the paper is to define, design, and construct the Just Transition Score (JTS) as a novel and unprecedentedly comprehensive composite metric of countries' relative sustainability of wellbeing. Our objective is to offer insights into how countries sustain societal wellbeing throughout a pre-Covid period, using measures that exclude income and other economic factors. Based on the scores for 161 countries from 2011 to 2019, we explore and compare global patterns of the JTS and its two sub-indices (Carbon Just Transition Score and Material Just Transition Score). Furthermore, we investigate the relationship between

the JTS of countries and their level of economic development, as measured by the GDP per capita.

The rest of the paper is organized as follows. In the next section, we present the literature review on the environmental efficiency and sustainability of wellbeing. We then outline the conceptual framework of the new metric, describe the indicators, data, and calculation procedures used to create the JTS. The subsequent sections analyze the results and discuss the findings in terms of their empirical and policy implications. The last section concludes.

2. Literature review

To achieve sustainable development, countries need to simultaneously pursue a twin objective of improving societal wellbeing while limiting their environmental impacts. The concept of environmental efficiency (or intensity) of wellbeing has its foundations exactly in this definition of sustainability. That is to minimize anthropogenic environmental impacts³ while simultaneously maximizing human wellbeing, thereby striking a balance between societal demands on the environment and the wellbeing of current and future generations (Dietz et al., 2009; Prescott-Allen, 2001). This conceptualization of sustainability is further justified by the fact that countries may achieve similar levels of wellbeing at widely varying levels of environmental impacts, which makes some countries more environmentally efficient (or more sustainable) than others (Dietz et al., 2009; Knight and Rosa, 2011; Marks et al., 2006).

Historically, researchers have repeatedly attributed these differences to the curvilinear nature of the relationship between measures of wellbeing and measures of environmental damage, with higher levels of environmental impact contributing less and less to wellbeing, i.e., showing diminishing marginal returns (Layard, 2005; Dietz et al., 2001; Inglehart and Klingemann, 2000; Goldstein, 1985; Preston, 1975). These early findings have led to different approaches in the assessment of countries' sustainability, aiming at measuring sustainability in a more synthetic manner. This includes indices focusing on the relative performance of countries in achieving wellbeing with the lowest levels of environmental impact.

The first attempt to consider both wellbeing and environmental damage in a measure of environmental efficiency of countries was carried out by Dietz et al. (2001) and Prescott-Allen (2001). The method consisted of calculating a ratio with infant mortality in the numerator (serving as a proxy of wellbeing) and an index combining the per capita Ecological footprint and the Environmental Systems Indicator in the denominator. Here, the Ecological footprint represented a consumption-based measure of environmental impacts while the Environmental Systems Indicator, a sub-measure of the Environmental Sustainability Index, served as a metric of environmental quality (Samuel-Johnson, 2001). The wellbeing to environmental damage ratio design has been adopted by several other researchers in a variety of measures. The most prominent of these is the Happy Planet Index (Marks et al., 2006; Abdallah et al., 2009), formulated as the ratio of the average life satisfaction (a subjective measure of wellbeing) multiplied by life expectancy in the numerator, and the Ecological footprint in the denominator. The Index was then refined both conceptually and methodologically by Ng (2008).

The main limitation of the ratio approach is that the result is usually disproportionately influenced by the variable with a higher variation. For instance, environmental damage measures such as carbon emissions are significantly skewed (meaning that few countries account for most emissions), and they also have higher variation. This means that the ratio is more influenced by these variables with higher variation, yielding misleading results for countries with the lowest amounts of

² Moreover, unlike other approaches to the sustainability of wellbeing, we attempted to incorporate the aspect of biodiversity into our metric. However, given the conceptual limitations combined with the unavailability of indicators with global coverage, we were only able to employ a measure of countries' performance in preserving biodiversity rather than having biodiversity impact indicators. For this reason, we incorporated the biodiversity indicator into the wellbeing metric of social progress (see below) rather than treating it separately in the calculation of the Just Transition Score.

³ Note that in this paper, we use environmental impact(s) and environmental damage as synonyms.

environmental damage, which are depicted as the most sustainable regardless of their level of wellbeing. The issue was recognized by Marks et al., 2006 and then addressed by Dietz et al. (2009). The proposed solution consisted of equalizing the coefficients of variation of the numerator and denominator by adding a constant to the term with a higher variability, allowing for a linear transformation that adjusts the mean without changing the variance. Knight and Rosa (2011) emphasized that this approach transforms the ratio to an indicator of position in the distribution rather than a measurement of the absolute carbon footprint of wellbeing.

A very similar approach to maximizing societal wellbeing while limiting environmental impacts focuses on the environmental (or ecological) intensity of wellbeing rather than the efficiency (Dietz et al., 2012; Jorgenson, 2014; Jorgenson and Dietz, 2015; Irshad et al., 2021). This intensity is defined as the ratio of the environmental indicator to the wellbeing indicator. To achieve sustainable development, countries need to decrease the environmental intensity of their wellbeing. The lowest intensity values mean that higher wellbeing levels are achieved with lower environmental impacts.

Sustainability metrics, including those based on environmental efficiency and intensity approaches, can be divided in two groups according to weak or strong sustainability principles (Usabiaga-Liaño and Ekins, 2024). Weak sustainability operates under the premise that natural and other types of capital are largely interchangeable, and it focuses on maintaining or increasing the overall value of the capital stock for future generations. This approach quantifies the environmental damage associated with societal wellbeing. It resembles an optimization problem, where environmental impact or resource use indicators are seen as undesirable inputs or costs, while social achievements are treated as desirable outputs (Reinhard et al., 2000). The resulting scores are used to rank and identify countries with optimal or most efficient performances at varying levels of environmental impact (Sun et al., 2019).

A contrasting stream of research is based on the perspective of strong sustainability which rejects the idea of substitutability, particularly regarding natural capital. It asserts that certain forms of natural capital are indispensable and cannot be offset by investment in other forms of capital, such as manufactured or human capital (Hickel, 2020). Sustainability performance of countries is evaluated against stringent thresholds of social shortfalls and environmental overshoot (Gough, 2020; Raworth, 2017). Recent contributions define the boundaries of a “safe and just space” relevant to all countries (Fanning et al., 2020, 2022; O'Neill et al., 2018). This framework combines planetary boundaries (i.e., environmental limits within which humanity can safely operate – see Rockström et al., 2009; Steffen et al., 2015) with societal development targets linked to the SDGs to delineate a space where human needs are met without compromising the sustainability of Earth's systems.

One of the most prominent strong sustainability approaches to environmental efficiency is the Sustainable Development Index (SDI) elaborated by Hickel (2020). The SDI calculation procedure consists of dividing the Human Development Index (HDI) by an “ecological impact index” calculated as the average overshoot of planetary boundaries of carbon emissions and material footprint.⁴ It is the inclusion of this overshoot threshold that aligns the SDI more with the strong sustainability approach to measuring environmental efficiency. Yet, it is still argued that the scope of the HDI as the development index is limited and that more areas of wellbeing should be included in such a metric (particularly indicators related to basic physical needs, such as access to

food, electricity, improved sanitation, and housing) (Hickel, 2020).

The environmental efficiency literature also encompasses other nonparametric approaches. They are generally based on the specification of inputs and outputs, and they measure countries' efficiency as the ability to optimize the outputs (wellbeing) with a given level of inputs (environmental damage). These methods range from Stochastic Frontier Analysis to Data Envelopment Analysis, and while they are statistically more elaborate, they are also prone to misspecification (Reinhard et al., 2000; Corsatea and Giaccaria, 2018; Sun et al., 2019). It is especially the case with wider geographical coverage of countries since these methods assume all countries (or decision-making units) are homogenous in terms of the relationship between inputs and outputs (using the same “technology” or “production function”).

For this reason, as well as to obtain a straightforward interpretation based on a more transparent calculation procedure, the ratio design represents an appropriate approach to the environmental efficiency of wellbeing. However, the composition of indicators both in the numerator and denominator of the ratio should ideally cover a wider range of wellbeing or environmental aspects (O'Neill et al., 2018). In the environmental area, the scope should extend beyond just carbon emissions and include other dimensions of sustainability. One of the options is to use material footprint as it takes into account the impact of material extraction from terrestrial and marine ecosystems (Hickel, 2020). Moreover, due to its robust empirical grounding (Krausmann et al., 2009), this indicator has been widely used in the literature as a proxy of environmental impact (Hickel, 2020; O'Neill et al., 2018).

The Ecological footprint represents another option to extend the environmental measures (Borucke et al., 2013). Moreover, it could be argued that it is a sufficient measure of environmental impacts because of its holistic nature. However, it is also heavily reliant on carbon emissions since it is measured as the capacity of different ecosystems to absorb the emissions. This also means that the Ecological footprint would show no indication of environmental damage in case carbon emission were reduced to zero, even if the ecosystems continue collapsing (Hickel, 2020; Van den Bergh and Grazi, 2014). For this reason, and based on Hickel (2020), the combination of material footprint and carbon emissions constitutes a more adequate way of approximating the environmental damage.

The incorporation of material footprint as an indicator of human environmental impact does not capture directly other key environmental issues, but rather the human impact on ecosystems which result in different environmental damage, such as biodiversity loss (Wilting et al., 2017). There are indicators that take these other issues into account, for example the Environmental Performance Index (EPI). Its 2022 edition consists of three broad dimensions, namely Environmental Health, Ecosystem Vitality, and Climate Change (Wolf et al., 2022). However, the index is not appropriate for measurements of sustainability of wellbeing for at least two reasons: first, the Environmental Health dimension is directly related to wellbeing, consisting of (environmental) wellbeing indicators; and second, the Climate Change dimension focuses on mitigation rather than on environmental impacts. Nevertheless, the holistic nature of the EPI is appealing and some elements, especially from the Ecosystem Vitality dimension, can be considered in a more complex attempt to measure the sustainability of wellbeing.

On the wellbeing side of measurement, a wider range of aspects should be covered as well (Hickel, 2020), ideally including both subjective and objective measures of wellbeing. While there are many indices measuring various aspects of wellbeing, the SPI represents one of the most comprehensive efforts to measure societal progress of countries (Stern et al., 2022). Using 60 social outcome indicators, and independently from economic metrics, it holistically covers 12 key aspects of societal performance (from basic needs, such as access to water or electricity, to rights and freedoms) for 169 countries over 2011–2022. This comprehensiveness makes the Index a suitable indicator for assessing the sustainability of social progress.

⁴ Related efforts were focused on integrating environmental and sustainability indicators into the HDI (Hirai, 2017). For instance, early attempts consisted of including per capita carbon emissions alongside the other HDI indicators and aggregating them using the geometric average (Togtokh and Gaffney, 2010; Bravo, 2014), which later resulted in the Planetary pressures-adjusted HDI (UNDP, 2023).

3. Framework, data, and methods

In this section, we briefly outline the conceptual framework for the construction of the JTS. We then discuss the indicator selection and describe the data. Lastly, we detail the methodological steps and the calculation procedure that we follow to calculate the JTS, considering the principles for constructing composite indices by the European Commission's Joint Research Center (Nardo et al., 2008) and the conceptual recommendations set out in Kwatra et al. (2020).

3.1. Conceptual framework

Sustainable development requires that countries are able to simultaneously pursue improvements in societal wellbeing while limiting their environmental impacts, which is inherent in the concept of environmental efficiency (or intensity) of wellbeing. This is also closely related to the concept of Just Transition which has been defined and used in different contexts (as summarized for example by Wang and Lo, 2021). However, in the context of the global climate agenda, Just Transition is anchored in the notion of leaving no-one behind in the process of transition to climate-neutral, low carbon economies (e.g. UN, 2023; EU, 2021). This rationale also underpins the JTS which we define as a measure of countries' ability to achieve positive societal outcomes for their populations while implying minimal environmental impacts.

The conceptual framework of the JTS is based on the link between social outcomes and biophysical resource use (consumption) manifested through the material and carbon footprints (O'Neill et al., 2018). While it can be argued that the link between societal wellbeing (social progress) and environmental impacts is less evident than in the case of economic wellbeing (income),⁵ there is a fundamental dependence of social outcomes on the planet's ecosystems and the resources they provide, as established, for example, by Daly's (1973) end-means spectrum. Furthermore, this dependence is mediated by complex provisioning systems, which Fanning et al. (2020) define as a set of related elements that work together in the transformation of resources to satisfy a foreseen human need (for example, food and water infrastructures act as provisioning systems for fulfilling nutrition and sanitation needs). The extent to which a society achieves adequate levels of wellbeing with minimal environmental damage primarily depends on whether its provisioning systems use resources sustainably to meet the societal needs. However, it is beyond the scope of this paper to link particular social outcomes to their respective provisioning system.

Instead, we link aggregate measures of environmental impacts and societal wellbeing using the environmental intensity approach, and by following the above-mentioned definition of just transition. As shown further in the text, better social outcomes are on average strongly associated with higher carbon and material footprints, but some countries have relatively less environmentally intensive wellbeing than others. The analysis that follows should provide a better understanding

of global patterns in the relative sustainability of wellbeing.

The JTS represents a measure of relative environmental sustainability of social progress,⁶ and unlike traditional metrics of environmental efficiency of wellbeing (Marks et al., 2006; Abdallah et al., 2009; Dietz et al., 2009; Hickel, 2020), it is expressed as a ratio of the environmental indicators to the wellbeing indicator. It is therefore based on the content of environmental impacts in each unit of social progress, which is rather an environmental intensity of wellbeing approach (Dietz et al., 2012; Jorgenson, 2014; Jorgenson and Dietz, 2015; Irshad et al., 2021). Countries with relatively high content of environmental damage in one unit of social progress have the least sustainable social progress, and vice versa. In this sense, the JTS *per se* needs to be understood as a metric that follows the principles of weak sustainability.

The JTS allows for a measurement of the ability of countries to achieve societal progress for their populations⁷ (which is considered the "just" part of the measurement) while reducing their burden on global environmental sustainability (which is considered the "transition" part of the measurement, emphasizing that countries must transform to economies with low or no environmental impacts). Therefore, the JTS forms an environmental sustainability measure accounting for the performance of countries in societal progress (as measured by the SPI) as well as for the extent of global environmental damage.

3.2. Data

We use the 2022 edition of the SPI to measure social progress of countries (Harmacek et al., 2022). This is a composite index that originally groups 60 social outcome indicators into 12 components to measure social performance of 169 countries globally. The 12 components are aggregated into three dimensions (each of four components) which form the final Index. The performance of countries is measured on a scale from 0 to 100,⁸ and the Index covers the period from 2011 to 2022. The structure of the Index, including the individual indicators, is captured in Fig. 1.

To approximate the environmental impacts, and based on Hickel (2020), we employ two variables – carbon (CO₂) footprint per capita, and material footprint per capita. The carbon footprint variable is consumption-based, meaning that the emissions caused by the production of imported goods are added to domestic ones, while the emissions caused by exported goods are removed, which thereby corrects for spillovers from international trade. The data come from the Global Carbon Project (Friedlingstein et al., 2022) and are measured in tons per capita. They cover only 117 countries, so to increase the number of observations, we imputed missing values for several countries using the random forest method with various fuel-types of production-based CO₂ emissions per capita and material footprint per capita as predictors. With imputed values, the indicator covers 168 countries over 2009–2020.

The material footprint indicator is, by definition, consumption-based since it provides a view of a country's material consumption that fully accounts for extraction in other countries that is used for local consumption, and for domestic extraction that is used for consumption in

⁵ Admittedly, environmental impacts are strongly related to the economic system which, in turn, is also closely connected to social progress. This is empirically documented by high correlations between GDP per capita and both carbon footprint and SPI. However, there is also a strong and positive association between SPI and environmental impacts (see Fig. 8 in the discussion section), which persists (but weakens considerably) even if GDP per capita is controlled. One of the possible explanations may be in the conceptual framework of SPI itself: parts of social progress (water, sanitation, housing, communication means) are more related to the economic system (and therefore also to environmental impacts) than others, which may be more related to human capital (education, health) or societal achievements such as safety, rights, freedom, and inclusiveness.

⁶ The initial version of the Just Transition Score published by the Social Progress Imperative, 2022 measured only the carbon sustainability of social progress. This paper is based on the idea presented in the updated version of the indicator (Social Progress Imperative, 2023).

⁷ The SPI consists of indicators that reflect both objective and subjective perspectives of wellbeing. Whenever feasible, the raw indicators are expressed in terms of population rates, thereby allowing the final index scores to mirror the actual social conditions as experienced and perceived by citizens of a given country at a particular time.

⁸ The Index score is scaled 0–100 where 0 implies the worst- and 100 the best possible performance. The best and worst values are defined for each indicator separately based on the type of indicator. Full methodology for best- and worst-case definition is outlined in Stern et al. (2022).



Figs. 1. 2022 Social Progress Index framework.

Source: Stern et al. (2022). Note: The Index was recalculated by the authors using Biodiversity and habitat protection instead of the Species protection indicator in Environmental Quality to account for the issue of biodiversity (protection) in our measurements.

other countries. The data for this variable come from the OECD database (OECD, 2023) and are provided in tons per capita, covering 163 countries over 2008–2019.

A complex measure of sustainability of wellbeing should ideally encompass other environmental issues as well. As already shown, the SPI includes indicators that directly measure environmental wellbeing (air pollution, water pollution, lead exposure, etc.). Therefore, our focus is shifted particularly to ecosystem-related issues such as biodiversity loss. However, such biodiversity impact indicators with good country-level global coverage are not readily available.⁹ On the other hand, data exist on local biodiversity protection efforts, such as the Biodiversity and Habitat issue category from the 2022 Environmental Performance Index (Wolf et al., 2022). This indicator is available for 192 countries from 2011 to 2022,¹⁰ and given its focus, it conceptually fits into the SPI, and more specifically into its Environmental Quality component. Since it also works statistically with the other indicators within that component, we incorporate this indicator directly into the SPI framework using the standard SPI methodological procedures (Stern et al., 2022) - to capture the issue of biodiversity, at least partially, in our measurement.

We also considered some other indicators for the JTS, such as the Ecological Footprint and the related per capita biocapacity indicator (Footprint Data Foundation York University Ecological Footprint Initiative and Global Footprint Network, 2023). The Ecological Footprint is used as an environmental damage indicator in the Happy Planet Index (Marks et al., 2006; Abdallah et al., 2009). However, both variables were eventually excluded for conceptual reasons since there was a significant

overlap with the carbon footprint indicator.

Upon data completion, all three variables (SPI, CO₂, MF) are combined to eventually produce the Just Transition Score for the nine-year period from 2011 to 2019 (for which data for all three variables are available). Additionally, as the last step prior to the calculation, CO₂ and MF indicators are capped (truncated) at the 99th percentiles (based on their 2011–2019 values) to treat the skewness of the data and to reduce the possible impact of outliers on the final results.

3.3. Methods

Similarly to existing metrics of environmental efficiency of wellbeing (e.g., Hickel, 2020; Dietz et al., 2009; Knight and Rosa, 2011; Tamburino and Bravo, 2024) and environmental intensity of wellbeing (Dietz et al., 2012; Jorgenson, 2014; Jorgenson and Dietz, 2015; Irshad et al., 2021), the JTS is also based on the ratio methodology. Definitionally, we focus on the content of environmental damage in each unit of SPI, and therefore we express the ratio as the environmental damage over SPI. Countries with the highest content of environmental damage in one unit of SPI have the least environmentally sustainable social progress, while countries with the lowest content of environmental damage in one unit of SPI have the most environmentally sustainable social progress.

The methodological choice in favor of the ratio approach is also based on the positive correlations between social progress and carbon footprint, as well as between social progress and material footprint. Higher progress (considered “good”) is associated with higher environmental damage (considered “bad”), and for this reason any additive or multiplicative aggregations are not preferred (e.g., they would result in a lower variability of the aggregated results). Despite this, such approaches to the aggregation of environmental sustainability and development outcomes have also been recently applied, for example in the creation of the Planetary pressures-adjusted Human Development Index (UNDP, 2023).

The JTS is then calculated as the simple arithmetic average of two sub-indices. The Carbon Just Transition Score (JTS_{CO2}) is the ratio of carbon footprint per capita to SPI. Similarly, the second part is the Material Just Transition Score (JTS_{MF}), and it is the ratio of material

⁹ We have explored several options for a possible approximation, such as the IUCN Red List Index (IUCN, 2023; Luedtke et al., 2023). However, we have decided to exclude this indicator for statistical and data availability reasons.

¹⁰ Based on seven individual indicators, the Biodiversity and Habitat scores are calculated and scaled from 0 to 100. They indicate how effectively countries protect their natural ecosystems. The scores are available for 2011 and 2022. According to the original EPI methodology (Wolf et al., 2022), we calculated the scores also for all remaining years in between (2012–2021) and used them to recalculate the SPI scores.

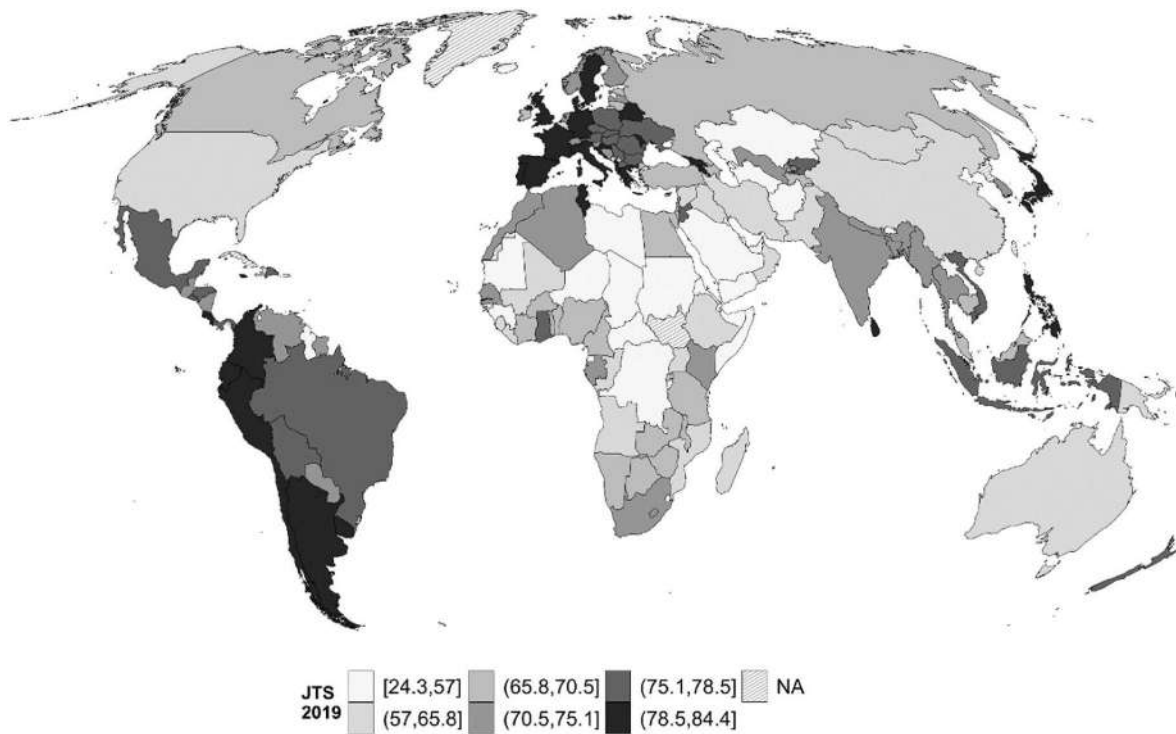


Fig. 2. Geographical distribution of JTS performance in 2019.

Source: Authors.

Table 1

Top 10 and Bottom 10 performers in the JTS in 2019.

Top performers in 2019			Bottom performers in 2019		
1	Portugal	84.43	152	Libya	43.28
2	Spain	83.52	153	Saudi Arabia	37.95
3	Costa Rica	83.46	154	Eritrea	34.24
4	Moldova	83.23	155	Somalia	34.2
5	Armenia	82.46	156	Guyana	33.29
6	Italy	82.17	157	Qatar	32.44
7	France	82.07	158	Kuwait	29.19
8	Sri Lanka	81.86	159	Central African Republic	27.89
9	Barbados	81.75	160	United Arab Emirates	26.76
10	Uruguay	81.46	161	Chad	24.33

Source: Authors.

footprint per capita to SPI. These two ratios are calculated and scaled to 0–100 scores as described below.

To prevent the results from being disproportionately influenced by the variable with higher variation, each of the two ratios is adjusted using a constant that equalizes the coefficient of variations of the denominator and the numerator (Dietz et al., 2012; Jorgenson and Dietz, 2015; Marks et al., 2006). The general formulation (applied to each ratio JTS_i) is as follows:

$$JTS_i = \frac{X_i + const_i}{SPI}$$

Here, X_i denotes the indicators being used in the numerator (per capita carbon footprint or per capita material footprint), and $const_i$ denotes the respective constant that equalizes the coefficient of variation of the indicator X_i and SPI . The $const_i$ is obtained as follows:

$$const = \left(\frac{\sigma_{X_i} \cdot \mu_{SPI}}{\sigma_{SPI}} \right) - \mu_{X_i}$$

In the above equation, σ_{X_i} and μ_{X_i} are the standard deviation and the mean of the indicator X_i which is used in the ratio, and σ_{SPI} and μ_{SPI} are

the standard deviation and mean of the SPI. Each ratio JTS_i is then inverted and scaled from 0 to 100 so that higher values of the scaled JTS_i represent better performance:

$$JTS_i = \frac{\max(JTS_i) - JTS_i}{\max(JTS_i) - \min(JTS_i)}$$

To scale the JTS_i to 0–100 scores, for the carbon footprint indicator, the dystopian value (i.e., worst case scenario) $\max(JTS_i)$ is set to the highest value in the data, while the utopian value (i.e., best case scenario) $\min(JTS_i)$ is set to be equal to $\frac{const_i}{100}$. Similarly, for the material footprint indicator, the dystopian value is equal to the maximum value in the data, and the utopian value is equal to $\frac{const_i}{100}$. Note that in both cases, the dystopian values correspond to the 99th percentiles of the 2011–2019 raw data, as both carbon and material footprint variables were capped (truncated) at these values to treat the indicators' skewness and to reduce the possible impact of outliers on the final results. As previously stated, the overall JTS score is obtained as the arithmetic average of both (scaled) JTS_i :

$$JTS = (JTS_{CO2} + JTS_{MF}) / 2$$

The final JTS is available for 161 countries, and it covers the period of 2011–2019. The JTS can be disaggregated into the Carbon Just Transition Score, and Material Just Transition Score. It needs to be emphasized that the JTS, as well as its sub-indices, are designed to measure the relative sustainability of social progress. This is because the performance of each country relates to the performance of other countries. This also means that even the best-performing countries in terms of JTS can be strictly environmentally unsustainable, in the sense that they have per capita material and carbon footprints above the per capita planetary thresholds. This issue is examined more in the discussion section.

The methodology of JTS underpins its interpretation, where a country's score represents its position (derived from the amount of material and carbon footprint contained in each unit of SPI) vis a vis the best- and worst-case scenarios (i.e., score of 0 and 100, as defined above),

Table 2

Top 10 and Bottom 10 performers in scores and ranks changes over 2011–2019.

Bottom 10 performers in Δ scores		Bottom 10 performers in Δ ranks		Top 10 performers in Δ scores		Top 10 performers in Δ ranks	
Nicaragua	0.62	Egypt	–21	Equatorial Guinea	29.55	Uruguay	56
Latvia	0.01	Lithuania	–22	Somalia	25.29	Myanmar	51
Maldives	–0.44	Thailand	–23	Afghanistan	17.93	Jordan	35
Hungary	–0.91	Kazakhstan	–23	Sierra Leone	16.99	Gambia	33
Kazakhstan	–1.32	Nicaragua	–25	Myanmar	16.95	Gabon	31
Panama	–1.98	Bahrain	–28	Ethiopia	16.39	Switzerland	28
Libya	–3.06	Hungary	–30	Angola	16.26	Sierra Leone	23
Ireland	–5.83	Panama	–30	Chad	16.09	Dominican Republic	21
Bahrain	–7.70	Ireland	–63	Luxembourg	15.88	Luxembourg	21
Trinidad & Tobago	–7.75	Trinidad & Tobago	–69	Oman	15.40	Ethiopia	20

Source: Authors. Note: Negative sign implies a decline in score or rank, positive sign implies an improvement in score or rank.

and its position relative to other countries. The ideal best-case scenario represents a fictitious case where a country achieves the best possible achievement in social progress while producing no environmental impact, and vice versa for the worst case. However, countries achieve different levels of performance across the JTS indicators, where a high score entails that a country is achieving higher social progress while producing lower carbon and material footprint, whereas a low score means that a country is achieving relatively lower social progress with higher carbon and material footprint. The same interpretation of scores also holds for the two sub-indices, i.e. the Carbon JTS and Material JTS.

Furthermore, to check the sensitivity of our results, we have recalculated the JTS using various approaches in different phases of the calculation procedure (Nardo et al., 2008).¹¹ For example, we have first aggregated the two environmental impact variables into a common factor (while applying both arithmetic and geometric aggregations), and only then created the ratio. We have also tested the geometric aggregation in the final step of the calculation procedure. Additionally, we have recalculated the JTS without using any caps on raw data. In all instances, the results are very similar to the ones that are presented in the paper, as evidenced by the rank correlation coefficients that were close to 0.99 in all cases which indicates a reasonable robustness of our results.

4. Results

The JTS was calculated for 161 countries. Due to data unavailability, scores were not calculated for more than 30 countries, mostly small island nations in the Pacific and the Caribbean. The largest countries without the JTS are North Korea, South Sudan, and Cuba. Fig. 2 shows the geographical distribution of the 2019 JTS scores. It is observed that Latin American and European countries have the best JTS, meaning that these countries achieve the highest relative sustainability of social progress. The lowest scores, on the other hand, are mostly found in parts of Sub-Saharan Africa, in the Middle East and North Africa (MENA) region, and in Central Asia.

While countries with high JTS scores achieve relatively high social progress with relatively lower environmental impacts, countries with low JTS scores are either falling short on social progress (Somalia, Yemen) or creating high environmental damage (Qatar, Kuwait). Some other countries record relatively low JTS, despite being among the top-ranked countries in terms of social progress. This is the case of countries such as the United States, Canada, Australia or even Norway, whose low JTS reflects carbon- and material-intensive behavior. On the other hand, some other countries (particularly China) exhibit an even more unsustainable combination of limited social progress and significant environmental damage.

¹¹ It needs to be noted in this context that the SPI itself was extensively tested for sensitivity (besides other things) as part of the Index audit carried out by the Joint Research Center of the European Commission (JRC, 2018).

Table 1 shows the top 10 and bottom 10 performers in the 2019 JTS. Among the top performers, six are in Europe (including Moldova and Armenia), while the others are in Latin America (3) and Asia (1). On the other hand, most countries from the bottom performers are from the MENA region (5) and from Sub-Saharan Africa (4).

In comparison, in 2011, there were five countries from Latin America in the top 10 and five were European. That said, most countries improved their JTS over 2011–2019. Despite the general improvement, countries' performance in JTS over 2011–2019 varies vastly, ranging from declines in scores (Trinidad & Tobago, Bahrain, Ireland or Libya), stagnations (Hungary, Latvia, Nicaragua) to very substantial increases for countries near the bottom of the 2011 global ranking (Equatorial Guinea, Ethiopia or Oman). These score changes are reflected also in the comparison of 2011–2019 performance based on rank changes. The results range significantly, from dramatic drops (Trinidad & Tobago, Ireland) to considerable positive increases (Uruguay, Myanmar or Switzerland). All these changes are captured in Table 2.

Fig. 3 shows the performance of selected countries (i.e., G7 and BRICS) in the JTS over 2011–2019, and several observations can be made. First, it is clear that the European G7 countries (plus Japan) outperform the United States and Canada, whose results are more similar to those of Russia. On the other hand, Brazil's JTS is relatively similar to that of Japan, however stagnating since 2015. Second, China's JTS lags behind all G7 and BRICS countries significantly, slowly coming back from a decline in 2012–2014. And third, the overall 2011–2019 trend for the G7 and the BRICS is positive, however, with fluctuations in different sub-periods for different countries.¹²

Countries' improvements in JTS over time can be explained by increases in social progress that are faster than the increases in the carbon footprint and material footprint components¹³ (i.e., relative decoupling of social progress from environmental impacts – a more common case), and by decreases in the footprint components combined with improvements in social progress (i.e., absolute decoupling – a less common case). Fig. 4 depicts countries' ability to decouple their social progress from carbon and material footprints based on the magnitude and direction of change in the key variables from 2011 to 2019.

It can be observed that some countries improved in social progress as well as in carbon or material footprints (upper-left quadrant of both panels). These developments can be therefore characterized as the

¹² The evolution of scores could be also analyzed in terms of the three indicators entering the calculation of the JTS. For example, the data show that 65 countries improved in all three indicators over 2011–2019 (i.e., they reduced per capita CO₂ and MF, and improved their SPI). Most of these countries belong to the better tiers in terms of SPI performance (i.e., countries with higher SPI scores). On the contrary, 41 countries increased both their per capita CO₂ and MF (none of them from the top SPI performance tier), while 67 countries were able to reduce both CO₂ and MF.

¹³ Carbon and material footprint components are calculated as raw values plus the equalizing constant (used in the JTS ratio calculation), which entails that higher values represent worse performance.

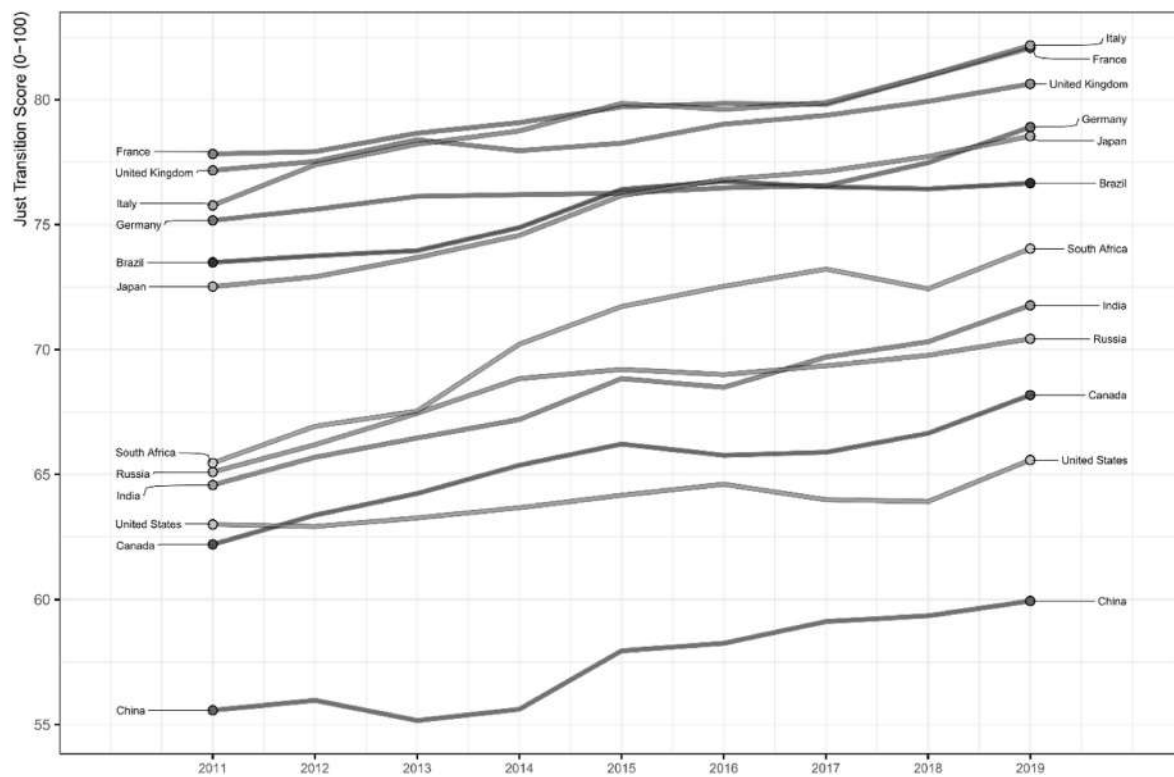


Fig. 3. JTS performance of selected countries 2011–2019.
Source: Authors.

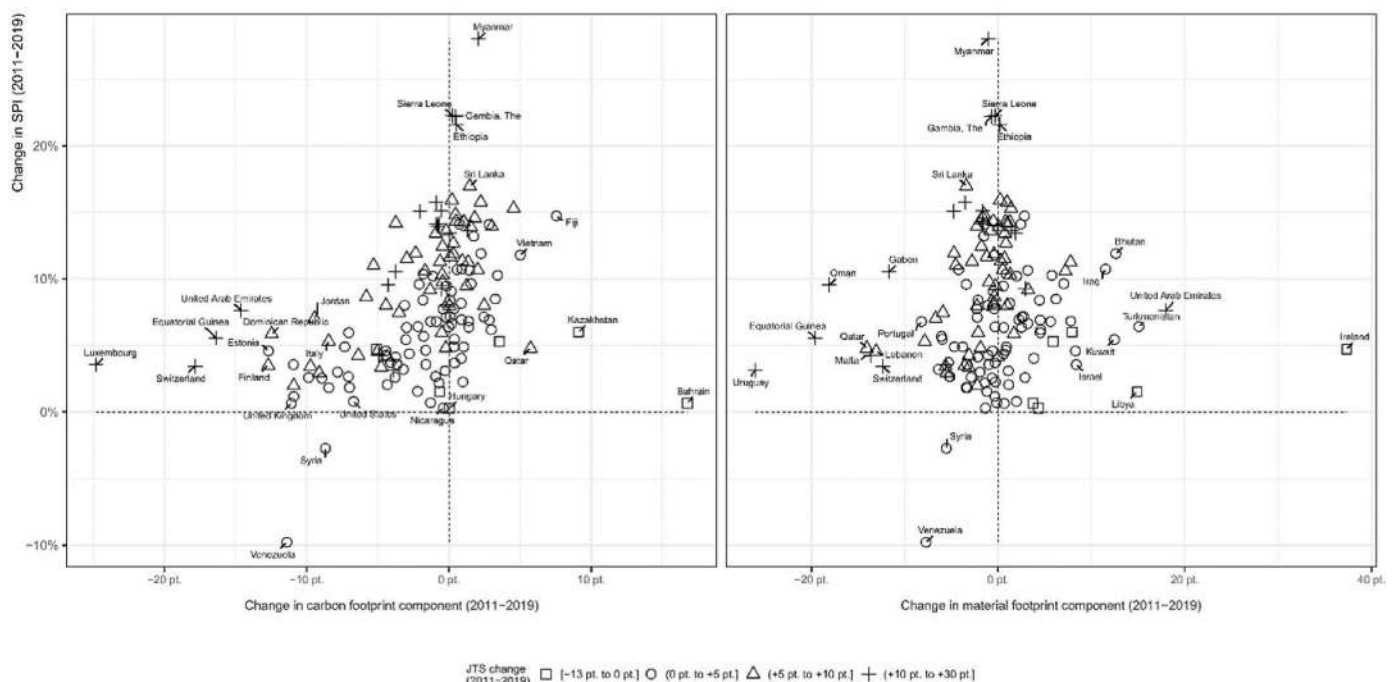


Fig. 4. Absolute and relative decoupling of social progress from material and carbon footprint (2011–2019). Source: Authors. Note: The figure plots the change in SPI against the change in the carbon footprint component (left panel) and material footprint component (right panel). Carbon and material footprints are transformed by adding the equalizing constants used in the JTS ratio and therefore do not reflect the change in absolute levels but rather the change in relative performance. Using the transformed footprint is necessary to appropriately reflect the overall change in JTS.

absolute decoupling trajectory, also resulting in significant improvements in the overall JTS performance. Many other countries were able to improve their JTS performance by following a relative decoupling

trajectory, in which social progress improved at a higher rate than the increase in carbon and material footprint components. The improvements in the JTS of these countries are, however, less substantial

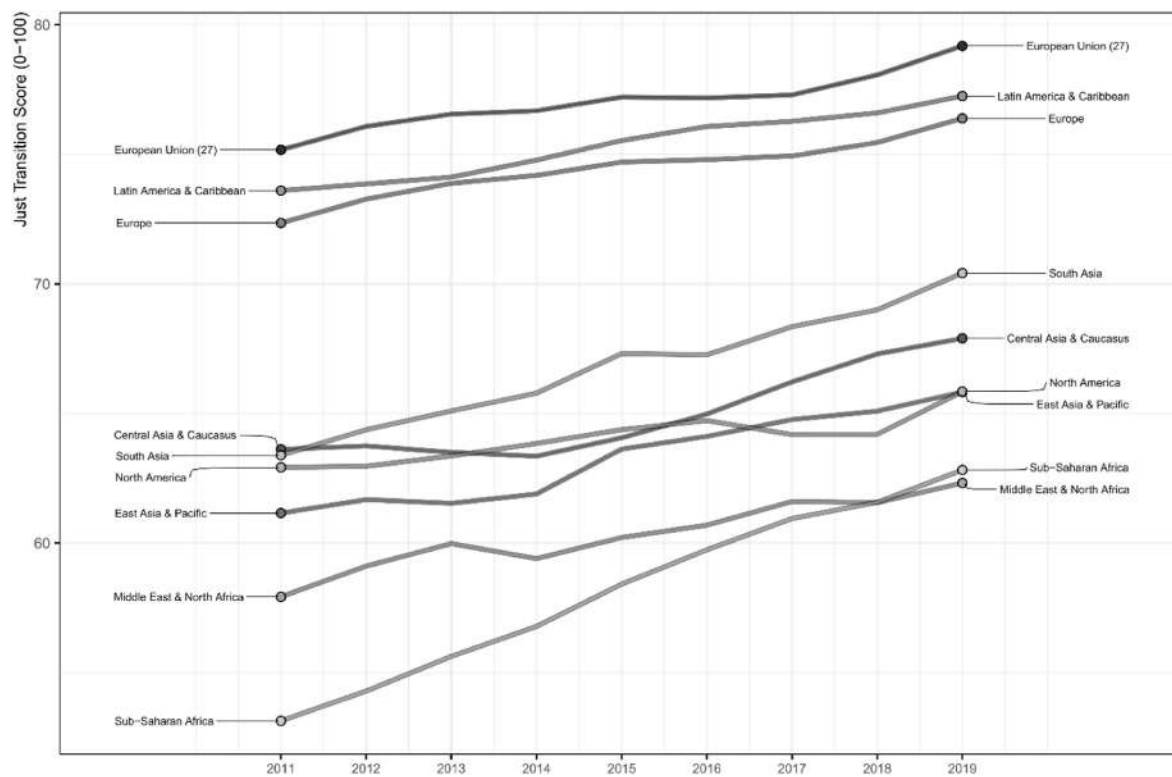


Fig. 5. JTS regional performance 2011–2019.

Source: Authors.

compared to the countries that followed the absolute decoupling trajectory.

It is important to note that while absolute decoupling is the most desirable outcome, it can be achieved in diverse ways, depending on countries' initial levels of wellbeing and environmental impacts. Countries with significant social shortfalls often achieve absolute decoupling since improvements in wellbeing are easier to attain (in the early stages of development) even with lower carbon and material footprints. Conversely, countries with initially very high carbon and material footprints (e.g., Gulf States) can significantly reduce (at least some of) their environmental impacts while continuing their natural trajectory of wellbeing improvement. Absolute decoupling has therefore a more significant effect on overall JTS performance when achieved by countries that neither suffer from substantial social shortfalls nor incur disproportionately high carbon or material footprints.

Apart from the individual countries' performances, it is also worth looking at the regional level. The regional scores are calculated as population-weighted averages of countries that belong to a particular region.¹⁴ Fig. 5 shows the aggregated scores over 2011–2019 for all eight regions as well as the European Union (27). Based on purely geographical classification, the best performing region over 2011–2019 is Latin America & Caribbean, followed by Europe. However, if the European Union was treated as a distinct "region", it would overtake Latin America at the top position. North America, consisting only of two countries (Canada, and USA), fares even worse than Central Asia & Caucasus, on par with East Asia and Pacific in 2019. The worst performing region is MENA, which was surpassed by Sub-Saharan Africa in 2018. Lastly, the JTS increased for all regions over 2011–2019, with various fluctuations and setbacks across regions and over time. The most

improved region is Sub-Saharan Africa, followed by South Asia. The least improved region is North America.

Fig. 6 shows that there is a high correlation between the two JTS sub-indices ($r = 0.7652$ for 2019 scores), with some outliers on both sides of the 45-degree line. There also seems to be a pattern where countries perform generally worse in the (relative) carbon sustainability than in the (relative) material sustainability of social progress.¹⁵ It can also be observed that countries of all income levels are scattered across the chart, meaning that the income level is not a decisive factor for the Carbon, Material, or overall JTS. Indeed, while there is a fair correlation between the JTS metrics and the SPI scores, there is basically no correlation with income.¹⁶

Even more interestingly, the difference between Carbon and Material JTS is higher among the worst performing countries (in terms of the overall JTS) while the better performing countries are the ones with the more similar scores in both sub-indices (the correlation between the overall JTS and the absolute differences of the two sub-indices is -0.4368 , based on 2019 scores).¹⁷ This general pattern indicates that

¹⁴ The regional distribution of countries is based on the World Bank's classification (World Bank, 2023), with few adjustments (for example, Malta is not classified as a MENA country, but rather as a European country).

¹⁵ Based on the JTS results for 2019, more than two thirds of all measured countries (115) achieve better results in the Material JTS, while only 46 are better in the Carbon JTS.

¹⁶ The SPI correlates with all three sustainability indicators reasonably: the correlation coefficients are 0.5410 with Carbon JTS, 0.4847 with Material JTS, and 0.5478 with the overall JTS. All of the correlation coefficients are significant at the 1% level. This is logical since SPI is included in the calculation of the JTS. In contrast, there are no relationships with income: the correlation coefficients are -0.0322 with Carbon JTS, -0.0188 with Material JTS, and -0.0278 with the overall JTS. None of the correlation coefficients is significant at the 10% significance level.

¹⁷ This finding would have been amplified even more if geometric average was used to aggregate the Carbon and Material JTS into the final JTS. Unlike arithmetic average, geometric average allows only for limited compensation between weak and strong performances.

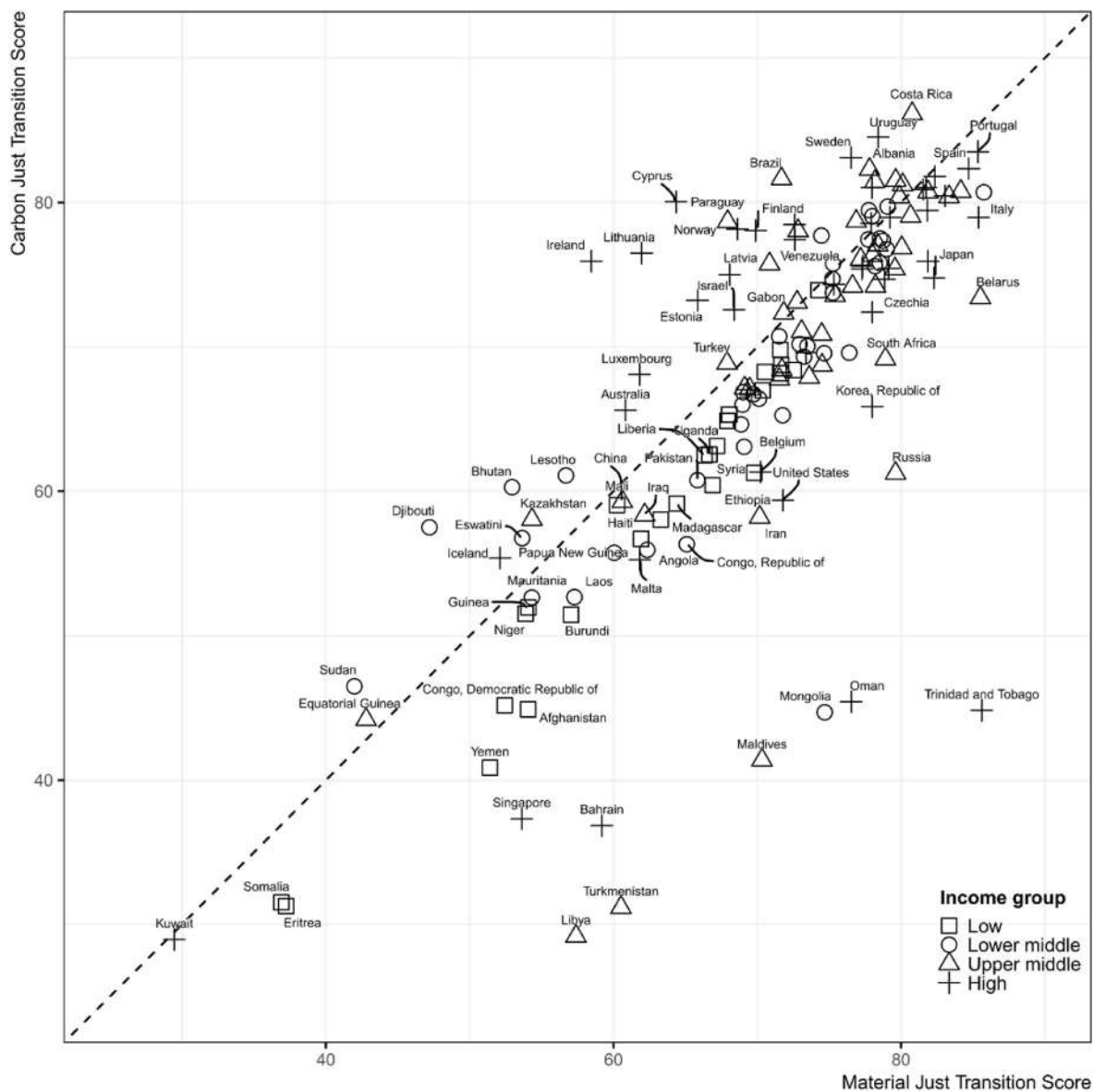


Fig. 6. – Carbon Just Transition Score vs. Material Just Transition Score (2019).

Source: Authors. Note: The 45-degree line shows the most balanced results in terms of relative material sustainability and relative carbon sustainability of social progress.

the highest JTS results require the ability of countries to perform similarly well in both areas, and that the highest JTS cannot be achieved by compensating a carbon-intensive performance with a less materially-intensive one (and vice versa).

Fig. 7 further indicates how scattered countries are in terms of their JTS performance in relation to GDP per capita. Countries with a similar per capita GDP achieve vastly different JTS performances. The best JTS performances are achieved by countries with a GDP per capita at approximately \$45,000 while the lowest JTS performances can be observed along the full range of GDP per capita where both the poorest and the richest countries fall. The main implication of such a pattern is that the overall cross-sectional relationship between the relative sustainability of social progress and income is not linear but features threshold effects where the relationship changes from positive to negative and where higher income is associated with lower JTS.

5. Discussion

The need for a more comprehensive and geographically

representative approach to measuring countries' performance in just transition and sustainability of wellbeing has already been emphasized in the literature (Escobar, 2011; Biggeri and Mauro, 2018). Using the SPI as a measure of wellbeing, we incorporate 60 social and environmental indicators, which cover twelve key areas of social progress across 169 countries over 2011–2019 into a measure of just transition, thus addressing the gap in measurement.

Most importantly, by excluding economic indicators (and particularly income) from the measurement, we address several issues related to the environmental efficiency and sustainability of wellbeing assessment. For example, as raised previously by Hickel (2020), including income as a component of wellbeing makes it harder to identify the prospects of countries' environmental efficiency as it strengthens the relationship between wellbeing and environmental impacts. Our approach allows us to widen the scope of wellbeing indicators while eliminating the income component, revealing more contrasts across countries in environmental sustainability (even among those with similar levels of income).

Furthermore, by employing both carbon and material footprint, we

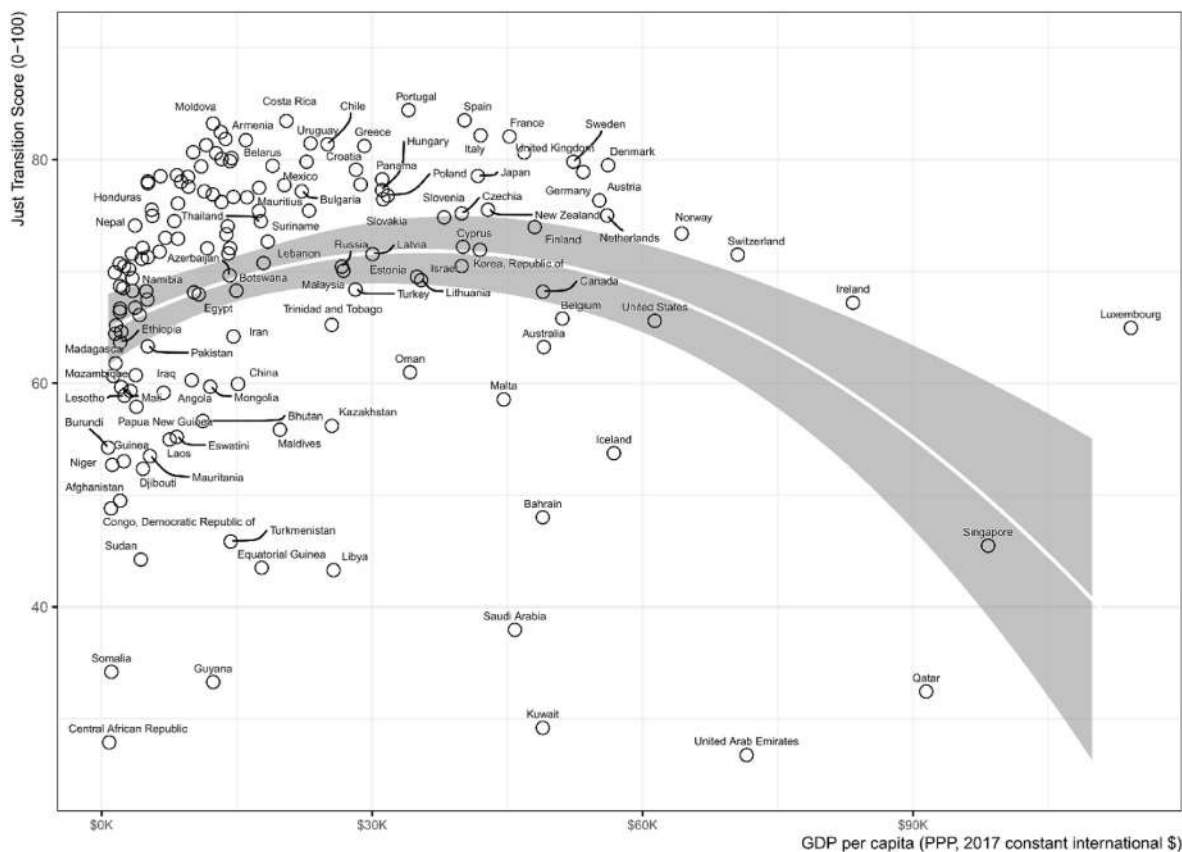


Fig. 7. Association between the JTS and GDP per capita.

Source: Authors. Note: The gray area shows the 95% confidence interval.

incorporate more aspects of global environmental damage into the sustainability measurement. The underlying intuition is that some countries might perform better in carbon footprint than in material footprint (and vice versa), mainly due to their specific characteristics such as the reliance on natural resources and the level of industrialization (Sahoo et al., 2021). This imbalance between the carbon and material (relative) sustainability of wellbeing is well illustrated in our results. We can observe that with higher levels of wellbeing, countries' JTS performance is determined by their increased ability to limit both carbon and material footprint.

Our results show that countries generally perform less well in the Carbon JTS than in the Material JTS. This is also the case for many extractive economies (e.g., many Gulf states, Russia; Hertwich, 2021), which are able to maintain higher scores in Material JTS. On the other hand, material-intensive trends of improving wellbeing can be observed in extractive economies as well, such as in Australia and the UAE (Schaffartzik and Pichler, 2017).

The JTS reveals that countries with the highest scores are not those with the highest incomes, but those that achieve relatively high levels of social progress while maintaining relatively low levels of global environmental damage (e.g., Portugal, Spain, Italy, but also Armenia and Moldova). Furthermore, these countries also exhibit the smallest difference between their Carbon and Material JTS, indicating a low risk of compensation between the two efficiencies. This suggests that having less environmentally intensive wellbeing requires a balanced performance in terms of both carbon and material relative sustainability.

Indeed, as shown in the results, the relationship between the Carbon and Material JTS is more scattered around the lower JTS scores and it gets stronger as the scores increase. In this sense the JTS can also serve as a metric of countries' distance from the desirable scenario in which countries achieve the highest levels of social progress and the lowest

levels of environmental damage both in terms of carbon and material footprint.

It is also worth noting another consequence of using a social wellbeing measure rather than income in the construction of the JTS measure: it shows that some countries labeled mostly as "middle income" (e.g. Moldova, Armenia) are able to record adequate levels of key aspects of social wellbeing with sustainable levels of per capita carbon (below 1.9 tCO₂e; Chancel, 2022) and material footprint (below 7.2 tons; Hickel, 2020). The JTS performance of these countries adheres more to the principles of *strong sustainability* (Neumayer, 2016). This is because they achieve desirable levels of social progress while keeping environmental impacts below critical thresholds.

In contrast, some other countries ranked among the best in JTS (such as Portugal, Spain, France, and Italy) perform more according to the standards of *weak sustainability*. While the environmental impacts of these countries surpass the critical thresholds, the excess is still relatively lower (compared to their peers) and is, at least to some extent, offset by a noteworthy performance in social progress.

This is shown in Fig. 8 that plots countries' SPI scores against their carbon and material footprint. In line with the previously mentioned findings on the association between social progress (and other wellbeing measures) and environmental impacts, the nature of the relationships is strongly positive, but curvilinear. In such a pattern, countries achieve similar SPI scores at significantly different levels of carbon and material footprint, which also implies similar JTS performances at significantly different footprint levels. Countries with the highest JTS performance either achieve relatively high SPI scores while remaining below/at the footprint overshoot values (strong sustainability) or compensate for their incremental overshoot with very good performances in SPI (weak sustainability).

Fig. 8 further demonstrates that countries are able to achieve high

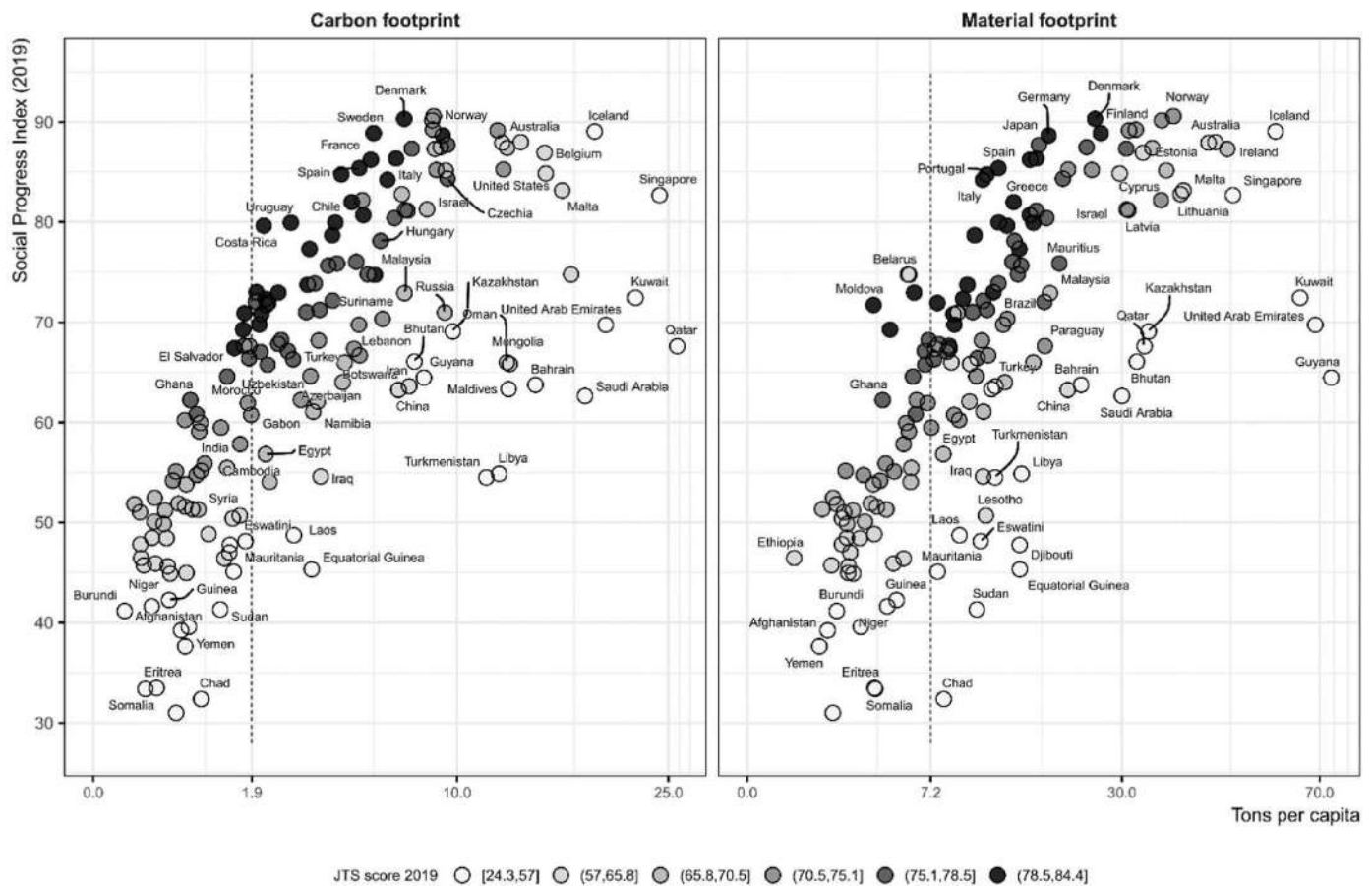


Fig. 8. SPI vs. carbon and material footprints.

Source: Authors. Note: SPI vs. carbon (left panel) and material footprints (right panel) using 2019 values. The vertical lines represent the overshoot threshold levels located at 1.9 and 7.2 tons per capita for carbon and material footprints, respectively (Chancel, 2022; Hickel 2020). Country markers are colored according to the JTS score in 2019.

JTS performance both below and above the overshoot thresholds. However, for countries that are below (or close to) the thresholds, a significantly lower social progress is needed to achieve high JTS. For example, Salvador's SPI is more than 25 points lower than that of Denmark, which has a considerably higher carbon footprint. And yet both countries have a comparable JTS performance (differing by only 1.5 points). It is also observed that no country achieves the top JTS tier with disproportionately high footprint levels (regardless of how high their SPI performance is).

To achieve the twin objective of maximizing wellbeing and minimizing environmental impacts, countries with *strong sustainability* of wellbeing will need to elevate their levels of social progress to match those with weak sustainability. Conversely, countries with *weak sustainability* of wellbeing must strive to decrease their environmental impacts to align with the levels of nations with strong sustainability. This mutual adjustment is essential for the best JTS performers to achieve a balanced approach to sustainable wellbeing, where both social progress and environmental sustainability are prioritized. Additionally, in countries with unsustainable wellbeing, i.e. with low JTS scores, significant improvements in social progress and/or radical reductions in environmental impacts are required.

Our relative approach to sustainability of wellbeing therefore enables the study of various pathways through which countries can achieve high JTS, rather than fixating on a single benchmark that all countries must emulate. For instance, poorer nations, given their low environmental impacts, can still achieve sustainable outcomes by improving wellbeing at a rate that is higher than the increase in environmental impacts. For richer nations, achieving sustainable outcomes

requires a strict reduction in their environmental impacts while at the same time maintaining the current levels of social progress.

The above-discussed findings are of great importance, as they highlight the significant potential of some countries to achieve just transition once we depart from the income lens of measuring wellbeing. That is not to say that income is not a key factor in human development (Pritchett, 2022). Instead, it shows that to balance high social wellbeing with low environmental impacts, there is an utmost need to maximize the effects of income growth on social wellbeing, and not the income growth *per se*.

The sustainability prospects of some less developed countries are emphasized and taken as a benchmark when studying just transition trajectories globally. In this context, the frequently tested hypothesis is whether countries can decouple their environmental impacts from their economic development. While no substantial evidence has been found for an absolute decoupling, there is some evidence of a relative decoupling on a global level (Dittrich et al., 2012; Schandl et al., 2016; UNEP, 2017). However, our results suggest that from a social wellbeing perspective (disregarding income), absolute decoupling could be possible with policies that consider prioritizing other dimensions of wellbeing than income. This shift in policymaking is necessary for promoting environmental sustainability of social progress. While there is a strong relationship between income and environmental impacts, other dimensions of social wellbeing can be improved in a more carbon- and material-efficient way. The JTS serves precisely the purpose of measuring this efficiency and providing valuable insights for policy-makers on both the global and country level.

6. Conclusion

Social progress entails varying levels of environmental impacts. The aim of the newly created Just Transition Score is to assess countries' ability to achieve adequate levels of key aspects of societal wellbeing (including biodiversity protection), as measured by the SPI, while reducing their global environmental impacts, as measured by the per capita carbon and material footprint. The results reveal significant contrasts between countries in terms of their relative sustainability of wellbeing, and allow us to distinguish relatively less sustainable social progress trajectories from the relatively more sustainable ones. Overall, a sustainable social progress performance requires a departure from carbon and material-intensive consumption and production patterns, while maintaining an increasing performance in social progress.

Countries' ability to balance these often-contradicting requirements depends on many factors that cannot be directly identified based on the JTS itself. However, the JTS can be used to measure countries' relative sustainability of wellbeing. It is observed that many less developed countries fall short in key areas of social progress, and their low global environmental damage (as reflected by their carbon and material footprint levels) is not sufficient to qualify them as having sustainable social progress. Similarly, many countries achieving very high levels of social progress at the cost of significant environmental damage are not considered as sustainable either. Societies with relative sustainable wellbeing are those that are neither falling short in social progress nor excessively damaging the global environment. There is significant potential for carbon and material efficient social progress in countries such as Costa Rica, Spain, or Armenia. In contrast, much more effort is required in countries where consumption and production patterns are carbon- and material-intensive (e.g., Qatar, UAE), and where the prospect of higher social progress is stunted (e.g., Yemen, Somalia).

While we stress the importance of other dimensions of wellbeing than income (proxied by GDP per capita) in the relative measurement of social progress sustainability, we do not overlook the role of income in driving wellbeing. Considering the nonlinear relationship between the JTS and income, the sustainability of progress of poorer countries can still be improved by income growth that would lead to better social wellbeing, but the increases in environmental impacts must be limited. In contrast, in wealthy countries, improving sustainability of social progress would require more aggressive measures aimed at reducing the extent of environmental damage while keeping (at least) the same level of income, and maximizing its effects on societal wellbeing.

However, the major implication of departing from income in the JTS measurement is that countries which have, according to the JTS results, relatively the most sustainable social progress, may not represent the most attractive examples for others to follow. It is because countries with the best JTS have in most cases reasonably high - but certainly not the highest - income, and maximizing income is still perceived as one of the dominant development goals. Countries with the highest JTS are able to efficiently turn their adequate levels of income into reasonably high levels of social progress with low global environmental impacts. The exact mechanisms of these links must be further studied. However, the current findings illustrate two things: first, high JTS is hardly achieved by income maximization only, and second, that there may be significant prospects for sustainable social progress in countries with lower income levels.

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CRedit authorship contribution statement

Mohamed Htitch: Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data

curation, Conceptualization. **Petra Krylová:** Writing – review & editing, Supervision, Resources, Funding acquisition, Conceptualization. **Jaromír Harmáček:** Writing – review & editing, Writing – original draft, Validation, Supervision, Software, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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GM SØSUQ.s μ*-.: gU*SSvU.-' vμQ ...<vUó QUM..SU..
 -' o.<g i vU.O))SBUML.v)..àvMg ..w vQ o**...

t v' g3 o9..." -SSM...NiNs g v3 ' ... g 3 o6.BN.N%` ..wo' g..7' ú vøg^{N.N.1} ...

...

Gi *- gM..

r3 X vøo3 oU*...SU...vMg-g ..." o R oSUQ..g o...g**vMg-o9..." S' ...øg úSUQ.. oøo *...v)...
 oUòSvUò oU-g ..S XgM*.gMv**..MμU- S*Z.-v..gMSøo.;μ*-.: gU*SSvUNμUó *-vv9...
 g*..: o.*' S-...v" g 9*..v" Rg i vU.*vMg-S*..SU.. ' SM.Uv.vUo.S*..o)-i o' SØNMμU- S*...
 *' vμ 9...MμUó Q...SU..- oS ...gi SSú...-v...3 g' S Sio..." o R oSUQ.." ' So...3 SSS SiSUQ..
 oUòSvUò oU-g ..S XgM*Z.-' S*..-μ9ú...Søo*-SQ-o*..MμU- S*..MμUó QUM..SU..- o...
 <g i vU.O SBUML.v)..àvMg ..w vQ o**..x<OàwY.gU9..S*..S XSMg-SvU*..)v ..gMSøSUQ..
 ;μ*-.: gU*SSvU.Qvi g úZ.-*SUQg.XgUo .9g-g*o-..." S' ..W-..MμU- S*..vøó ..Mu- R- í- N..
 " o.SU- v9μM.gU9.MU*- μM..: o.<Oàw.g*.g'..g-Sv.v)..: o.Xó ..MgXS-g.Mg i vU.)vv-X SU-...
 gU9...- o..àvMg ..w vQ o**..rU9o' ..xàwrY.-v... o oM..MμU- S*..MgXgMS*..-v..i g gUM...
 *vMg .X vQ o**.." S' .3 SSS g .oUòSvUò oU-g ..S XgMZ-*SUQ..- o...S oRg úSUQ.)gMv ...
 3 v9o *N" o..- oU.gUg úüo..MμUó QUM..SU..- o.<Oàw.v)..MμU- S*..Qvi g úNg*..." o ...
 g*..." S' SU..Q vμX*..v)...MμU- S*..9o Uo9...gMf 9SUQ..-v...- oS ...Xó ..MgXS-g...Mg i vU..
 o3 S*SVU*ZVμ' '...o*μ *-...oøog .9Sýo oU..MμUó QUM...g-o*.i o-" ooU..v" RgU9... SQ R
 o3 S-SUQ.MμU- S*Ni μ-.9Só QUM..g3 vUQ.3 99 oR3 S-SUQ.MμU- S*NSU9SMg-SUQ..
 øg S9 ..MgXgMS*..-v..gMSøo.;μ*-.: gU*SSvU.gMv**..- o*o..MμU- ú..Q vμX*Z:" ' So...
 v" R3 S-SUQ..MμU- S*..* v" ...X v3 S*SUQ.Xg-' " gú*N.3 99 oR.gU9... SQ R3 S-SUQ..
 Ug-SvU*..)gM...MSMg ...vi *-gMb*..- g-...3 gú...S Xo9o...- oS ...X vQ o**..-v" g 9*...;μ*...
 - gU*SSvUZ.Vó g N.-' S*..-μ9ú...oU' gUM*..vμ' ..μUó *-gU9SUQ.v)..MμUó QUM..SU..
 μ-gSgi SSú.3 o- SM.gU9..X vø9o*..S*SQ -*..SU-v... v" ..MμU- S*..X vQ o**..-v" g 9...
 ;μ*-.: gU*SSvUZ.

7 óú" v 9* ..àvMg .X vQ o**Ns μ*-.: gU*SSvUN<g i vUR))SBUMLN<vUó QUM...

^W.w' Z<gU9Sg-o.g-.wg gMú...-Uó *Sú.V v3 vμNN(gMú-ú.v)..àMUMNn oXg -3 oU..v)..n oøo vX3 oU-gU9..OÜSvUò oU-g .à-μ9S*N.
 WZ.S*-vXg9μ..WN°° W' ..V v3 vμNN<üoM.á oXui SZO3 gSm3 v' g3 o9Z -SSM- í- μXv ZMZ.

ⁱ .á o*og M..G**vMg-o.g-..àvMg ..w vQ o**..r3 Xó g-SóNí WW/. .à- oo-2 " NàmSo.ß- - Ní - - ß° ..." g*! SUQvU.n Z<ZN.-àGZ.O3 gSm
 3 ' -SSM- *vMg X vQ o**Z QZ.

^ß .<v' o*XvU9SUQgμ-' v ...

...+ vi g .á o*og M..n oXμ-ú.n SoMv .g-..àvMg ..w vQ o**..r3 Xó g-SóNí WW/. .à- oo-2 " NàmSo.ß- - Ní - - ß° ..." g*! SUQvU.n Z<ZN.-àGZ.
 O3 gSm' g 3 gM6- *vMg X vQ o**Z QZ.

[%] ..G**vMg-o..w v)o**v ..g-..wg gMú...-Uó *Sú.V v3 vμNN(gMú-ú.v)..àMUMNn oXg -3 oU..v)..n oøo vX3 oU-gU9..OÜSvUò oU-g ...
 à-μ9S*NWZ.S*-vXg9μ..WN°° W' ..V v3 vμNN<üoM.á oXui SZO3 gSm3 v3 SZ g 3 gM6- μXv ZMZ.

⁻ ...+ vi g .á o*og M..n SoMv .g-..àvMg ..w vQ o**..r3 Xó g-SóNí WW/. .à- oo-2 " NàmSo.ß- - Ní - - ß° ..." g*! SUQvU.n Z<ZN.-àGZ.O3 gSm
 X6 ú vøg- *vMg X vQ o**Z QZ.

[°] .w' n .MgU9Sg-o.g-...- o...-Uó *Sú.v)..ö g oUMgNo3 gSmXó6 ú- g μ3 SZμZ*Z.

¹ .wv SM../og9ó ..(o v" .í- í í R- í ß..g-..Oí vXogU.-Uó *Sú.rU*-Sμ-oNàMvv ..v)..- gU*Ug-SvUg ...+vøó UgUMNö Sg..9oSá vMM-SUS.n.
 àgU.n v3 oSMf.9S(S*v o.x(rYnr-g úZO3 gSmXó- gZ6 ú vøg- oμSμZ

...

W rU- v9µMSU...

GMŠøSUQ;µ*-∑ gUkSSvU...offµS o*...- g-..Lv.vUb.Sk...o)-i o' SÜ9.x ;µ*- YSU...- o.*' Š-..x - gUkSSvU Y...
-v" g' 9*...v" Rg i vU.*vMŠ-Š*..x" o)) vUNí - í WZ.-' Šk.3 ogUk...- g-..MµU- Š*...*' vµ 9.gŠ ..g-...- o...
X vøŠkSvU..v)...g9offµg-o... øø o *...v)... " o R oSUQ..)v' ...- oS ...XvXµ g-SvUk..." ' So... o9µMŠUQ...- oS ...
oUøSvUß oU-g ...)vv-X ŠU-Z.G*...*' v" U...g' og9ún.N Š X vøø3 oU*...SU...*vMŠ-g ... " o R oSUQ..g' o...
g**vMŠ-o9..." S' ...µi *gU-Šg ú.9S)ó oU...øø o *...v)...oUøSvUß oU-g ..vøó *' vv-..gMv**..MµU- Š*...
xGi 9g g' ..o-..g ZNí -- uč.(gUŠUQ.o-..g ZNí - í í č.t g' -Šbü.gU9..Oi oU' gMŠNí -- 1YZ.-' Šk.-' g9oRv))...
' ŠQ ŠQ -*...- o...Š Xv -gUM...v)...gMŠøSUQ.X v*Xó S-ú...- g-..Šk...oUøSvUß oU-g ú...o))ŠŠU-...ŠZ.N.
3 g' Š Šio*..." o R oSUQ.." ' So...3 ŠŠ ŠiSUQ.g**vMŠg-o9...oUøSvUß oU-g ...X o**µi o*..xn Š-ü...o-..g ZN.
í - - uč.7 UŠQ -..gU9..á v*gNí - WYZ.-' o...<g' i vU.O))ŠŠUM...v)...àvMŠg ..w' vQ o**..x<OàvY.o3 i v9Š*...
- ' Šk..Xó *XoMŠo..gŠ SUQ.-v..M3 X o' oUŠo ú.3 og*µi o...- o..vi ;oMŠo..gU9...µi ;oMŠo..g' og*..v)...
" o R oSUQ.µ*SUQ.-' o...àvMŠg ..w' vQ o**..rU9o' ...xàwrYN." ' So..gMµU-SUQ..)v' ...MµU- Š* ...Qvi g ...
oUøSvUß oU-g ..X o**µi o..g*..3 og*µi o9..i ú...- oS ...Xó ..MŠXS-g..Mš i vU..)vv-X ŠU-Z.-' Šk..gXX vgM...
ffµgU-ŠŠ*...- o...9oQ oo...-v..." ' SM...g...*vMŠ-ú...gMŠøo*...oUøSvUß oU-g ...o))ŠŠUM...SU..g-gŠSUQ..
9o*Šgi o...øø o *..v)...*vMŠg ..X vQ o**..x Š " g' 9R vX6ŠU*..o-..g ZNí - í - YN.-' ó oi ú..oU*µi SUQ.-' g-...- o...
- gUkSSvU..v..g..*µ*-gŠgi o..*vMŠ-ú..Šk.i v- ' .offµŠgi o.gU9.SUMµ*ŠoNŠZ;µ*-Z.

GXX vgMSUQ;µ*-∑ gUkSSvU.) v3 .gU.oUøSvUß oU-g .o))ŠŠUM...Xó *XoMŠo..! g*..v)-oUMUŠk-o9...
SU... o g-SUQ.vi ;oMŠo...v' ...µi ;oMŠo...3 og*µi o*..v)...- o..ffµg S-ú..v)...Šo...-v..9S)ó oU...3 ó- ŠM..v)...
gU-' vXvQUM.oUøSvUß oU-g ...Š XgM...xw' o*M-ŔG oUNí - - W...àg3 µo Rv' UkvU..gU9...O*-ún.
í - - WZ.-' o.3 gSU.3 v-Šg-SvU.Sk...- g-...- o..Uo' µ*..v)...*µ*-gŠgi o..9øø vX3 oU- *..oUøSvUß oU-g ...
gU9...*vMŠg ..XS g' *..Šk..o**oU-Šg ..g*..S..)vMµ*o*..vU.-' o..ŠU-ó gMSvU.i o-" ooU..*vMŠg ..MÜŠSvUk..gU9...
oUøSvUß oU-g ..ŠU-oQ S-ú..xàSUQ.gU9..G ŠNí - WYZrU.-' Šk...oQ' 9N.-' o..Lv-SvU.v)... oUøSvUß oU-g ...
o))ŠŠUM...v)... " o R oSUQ ...xn Š-ü...o-...g ZNí - - uč.7 UŠQ -..gU9...á v*gNí - WYZ..Xv*µ g-o*...- g-...
Š X vøSUQ.ffµg S-ú..v)...Šo.*' vµ 9..Lv-...og9-v..Lbo9 o**..oUøSvUß oU-g ..9o*- µMSvU.i µ-..*' vµ 9...
ŠU*-og9.3 g' Š Šio.." o R oSUQ.." S' SU.-' o.XgUo-g' ú.i vµU9g Š*Zx7 µ3 g' .o-..g ZNí - WčàMXo ŠS..
o-..g ZNí - WYZ.

G-gŠSUQ.g...;µ*-∑ gUkSSvU..SU.-' Šk..MU-o' -∑. o Š*..vU.-' o..9úUg3 SMSU-ó Xgú...i o-" ooU.-' o...
µ-SSig-SvU.v)...i ŠX ú*Šg' ∑ o*vµi M*..gU9...- o... og Šig-SvU.v)...*vMŠg ..vµ-M3 o*..xV 2 oS ..o-..g ZN.
í - WYZ..àvMŠg ...vµ-M3 o*...g' o...Š' ó oU-ú...9oXoU9oU-...vU.-' o...XgUo-Ŕk...oM*ú*-o3 *...gU9...- o...
' o*vµi M*...- ' oú...*µXXú...xn g ún.N.Wi°ßYZ.-' Šk...9oXoU9oUM...Šk...)gMŠSg-o9...- ' vµQ ...ŠU- Šg-o...
X vøŠkSvUŠUQ.*ú*-o3 *N.9o)ŠU9...g*..Uo-" v' 6*...v)...o o3 oU*..." v' 6SUQ..-vQ.-' ó ...-v...- gU*)v' 3 ...
' o*vµi M*...-v.3 oo-..g... gUQ...v)...! µ3 gU..Uo9*..x(gUŠUQ.o-..g ZNí - í - YZ.-' ó o)v' oNg..MµU- ú *...
gi ŠS-ú...v..gMŠøo.g...;µ*-∑ gUkSSvU.9oXoU9*..vU.-' o.o' -oU-...v..." ' SM..Š*..X vøŠkSvUŠUQ.*ú*-o3 *...
i oM3 o.3 v' o.o))ŠŠU-..gU9..µ*o...o*vµi M*..*µ*-gŠgi ún?" ' So..Qig' gU-ooSUQ.-' g-...- o..Uo9*..v)...
g ..MŠŠioUk.g' o.3 o-..." S' vµ-...ogøSUQgUúvU.i o' SÜ9Z.

2 g-SvUkN. ' v" øó N.MU) vU-...MU- g*-SUQ.. øø o *...v)...*vMŠg ...*' v' -)g *...gU9...oUøSvUß oU-g ...
vøó *' vv-..x(gUŠUQ.o-..g ZNí - í í YZ(v' ...- ' Šk...og*vUNgMŠøSUQ.g;µ*-∑ gUkSSvU.Mšg *..)v' .øg' úSUQ..

9oQoo*...v)...X vQo**...SU...oUkí SUQ..-' g-..." o RoSUQ.S*...gMSbøø9..." S' ...Qog-ó ...oUßSVÜB oU-g ...
o))SbSUMZxV 2 oS ..o-.g ZNí - WYZrU.X gMSMN-' S*..oUgS*..-' g-..Ug-SvU*NS o*XoMSbo..v)..-' oS ...
oøø ..v).9oøø vX3 oU-.gU9...-' o.ø' -oU-.v)..-' oS ..X o**í o*v.U...-' o.øg' -' *oM*ú*-o3 *NB µ*..-' Sbo...
-v...3 g' S Sio..." o RoSUQ.." ' So...o9µMQUQ..-' o.oUßSVÜB oU-g ...S XgM...v...-' o...µ*-gSgi o...oøø *...
x<' gUMö Ní - í í č.. Söo Ní - í - YZ.

(µí -' ó 3 v' oNo3 XS Sg ..oø9oUM..! g*...vUQo*-gi S' o9...-' g-...-' o...o g-SvU* SX.i o-" ooU.øg Svµ*...
*vMg ..gU9..oUßSVÜB oU-g ..SU9Sg-á *..S..Mí øSSubg' ..x(gUUSUQ.o-.g ZNí - í í č.7 UQ -..gU9..á v*gN.
í - WYNSU9Sg-SUQ..-' g-..MµU- S*..MgU.gMSbøø.vX-S g ..Xó)v' 3 gUM*.SU.øg Svµ*..vMg ..g*XoM*...
xoZZN. So...o' XoMgUMiNo9µMg-SvUN.o-MY..g-...µi *gU-Sg ú...9S)ó oU-... oøø *...v)...oUßSVÜB oU-g ...
X o**í oZ-! S*..Xg-ó U..9o3 vU*- g-o*...-' g-..." ' So...M -gSU..Ug-SvU*..gMSbøø..9o*Sgi o...oøø *...v)...
*vMg-g ..." o RoSUQ.." S' '...o g-Sbo ú..3 SSS g ..oUßSVÜB oU-g ..X o**í oNv-' ó *..o' ó -..SUSSgU-...
oUßSVÜB oU-g ..X o**í o...v..gMSbøø..*S Sg' ..vMg ..vµ-M3 o*ZàµM..g..Xg-ó U..gSo*...-' v..3 gSU...
ffµo*-SvUm

VZ -v..." ' g-...o' -oU-..g' o...MµU- S*..gi o...-v...S X vøø...-' oS...<g' i vU..O))SbSUMi..v)..àvMg ...
w' vQo** -' g-..S*N' v" ..g' o...-' oú..oU' gUMQUQ.." o RoSUQ.." ' So..6ooXSUQ.oUßSVÜB oU-g ...
S XgM*.g*...v" ..g*..Xv**S offi.

í Z r*...-' ó o.g..M-MSUCRXX vM**..xSZNMUó QUMYg3 vUQMµU- S*..vøø ...S o..SU..-' oS ...
<g' i vU..O))SbSUMi..v)..àvMg ..w' vQo**NgU9... v" ..)g*..S*...-' S*..X vM**ffi.

“ ' So...-' o..v' 3 ó .g v" *..µ*...v.g**o**..! v" ..MµU- S*..)g' o..SU..ó 3 *..v)..-' oS ..;µ*...- gUSSvUN..-' o...
g-ó ..oUgi o*..µ*...v..9o-ó 3 Sbo..." ' o-' ó NgU9...! v" '...gXS ú..MµU- S*..! gøø..i ooU..MÜBó QUQ..
-v" 'g' 9*..SZ-..v.g99 o**..-' o*o...-' v'...o*og' M..ffµo*-SvU*N" o.gUg úüo.g..Qvi g ..9g-g*o-..Møó SUQ..
W-..MµU- S*..Nµ-SSiSUQ..-' o.àvMg ..w' vQo**rU9o' ..xàwY..-S o.àó S*x" g' 3 gM6.gU9..7' ú vøgN.
í - í ßYgU9.Xó ..MgXSg..Mg i vU..)vv-X SU-..x(S9 SUQ-..oSU..-g ZNí - í í YNi v-' ..XgUUSUQ.) v3 ..Wiu- ...
-v..í - í - ZI ú..SU-oQg-SUQ..-' o*o...-' v..3 o' SMN" o..MU*- µM...-' o..<OàwNó øSUQg*..gU..SU9Sg-á ...
v)...MµU- S* ..MgXgMú...-v...g9øgUM...*vMg ...X vQo**..." ' So...3 SSS SiSUQ..Xó ...MgXSg...Mg i vU..
)vv-X SU-Z.“ o...-' oU..µ*o...-' o...<Oàw...-v..Sbo*-SQ-..o..MµU- S* ..MÜBó QUM...-v...;µ*...- gUSSvU..
-! vµQ vµ...-' S*..oU-S.o.Xó S9Zt v' o.*XoMSg úN" o.gS ..-v..MÜ9µM.gU.SÜBóX-! .o' g3 Sg-SvU..
v)..-' o...o g-SvU* SX.i o-" ooU..*vMg ..X vQo**..xàwY.gU9...-' o.Xó ..MgXSg..Mg i vU..)vv-X SU-Z.Ví ...
Qyg ..S*..v..9oU-Sú...-' o...í' og6XvSU- ...oøø *..v).Xó ..MgXSg..Mg i vU..)vv-X SU-N" ' SM..." S ..)gMSg-o...
-! o..MÜBó QUM.gUg ú*S..i v-' .gMv**...-' o.Qvi g ..XgUo ..v)..MµU- S*..gU9..." S' SU.*XoMSM.gUQ*...
v)..Mg i vU..)vv-X SU-Z-! S*..S..MµMg ..g*..S..oUgi o*..µ*...v..9o-ó 3 Sbo..." ' o-' ó ..MÜBó Q..vMµi *..SU..
-! o.*g3 o..." gú..." S' SU.9S)ó oU-..MµU- ú..Q vµX*NgU9...-v..o' X v' o..." ' o-' ó ..MµU- S*..MÜBó Q..g-...
g..)g*-ó ..xv ..* v" 'ó Y..g-o..." S' '...! SQ ó ...oøø *..v).Xó ..MgXSg..Mg i vU..)vv-X SU-Z.

-U9ó *gU9SUQ..-' o..SU-ó *oMSvU..v)..*vMg ..X vQo**..gU9...;µ*...- gUSSvU..S*..o**oU-Sg Ng*...-' o*o..
MUMX-..N.9oXS...i oSUQ..9ooX ú..SU-ó SÜbø9N.' gøø...v)-oU..i ooU..- og-o9...g*...*oXg g-o...SU...-' o...
Só g-µí o.x2 oµ3 gúó Ní - WYZ! v" øó Ng-..S*..M oN*vMg ..X vQo**...oX o*oU*...-' o.øó ú..o**oUM...
v)...-' g-...;µ*...- gUSSvU.g9øvMg-o*..gS ..-v..X o*ó øo..)v' ..)µ-µí o..QÜB g-SvU*..gMv**..g ..*vMg-S*Z..
“ S' vµ-...;µ*...- gUSSvUNQÜµiSbo...*vMg ..X vQo**..MgUÜv-..i o.gMSbøø9Z-..v..o))oMSbo ú...-gMö o...

—' S..S*uoN" o.3 μ*..g99 o**..Uv~.vUú..-' o..MμMg ..ffio*-SvU.v)...' v" ..-v..gMSðo..;μ*~-' gU*SSvU..
i μ~.g *v..." 'g~.g*XoM*.v)..! μ3 gU.." o i oSUQ;μ*~-' gU*SSvU.gS *~.v.X o*o øZ.

—' o..ffio*-SvU.v).."' ' SM..g*XoM.v)..! μ3 gU.." o R oSUQ.*' vμ 9..i o..*μ*-gSb9.." g*.gXX vgMo9..SU..
9S)ó oU~.." gú*ZG3 S9..SUMog*SUQ.)vMμ*.vU..! μ3 gU.9oøo vX3 oU~.gU9~-' o..gMÚv" o9Q3 oU~.v)..
—' o...*' v -M3 SUQ...v)..-' o úSUQ.. o' Mμ*Sbo ú...vU... SUM3 oR.g*o9... 3 o~ SM...)v ... *μ*-gSgi SS-ú..
g**o**3 oU~...xG 6So..gU9...(v*-ó Ní - WYN*v3 o..*Mv g *~' gðo...*' S-o9...-v..μ*SUQ..-' o..." μ3 gU..
n oøo vX3 oU~...rU9o' ...x" n rY..-v...SU-oQg-o...g...í vg9ó .. gUQ...v)..SU9SM-ý *~' o) oMSUQ..*vMg ...
Xó)v 3 gUMZ.x" SMo Ní-í-č..àg 3 gU..o...g ZNí-í-í YZ." v" øó N..-' o..." n r...g vUb...3 gú...Uv~..
g9offiug-o ú..MgX-í o...-' o..M3 Xo' ..gU9..3 μ -SgM-o9..Ug-í o..v)..*vMg ..g*XoM*.xí oUgS ..o~.g ZN..
í - - 1č.I SQ3 SgU9..t gú vNí - Wč.àgUó ..o~.g ZNí-í- YZ.

á oMU~..o))v -*~.v...í vg9oU~-' o...MxO..v)..*vMg ..SU9SM-ý *~' gðo...g9vX-o9...-' o..! μ3 gU..Ubo9*..
—' óv ún:" ' SM..X vXv*o*.g...S So9..*o~.v)..)μU9g3 oU~.g ..Ubo9*~-' g~.g o..μUó *g ú..gXXSMí o..
~v...g ...' μ3 gU*x+vμQ Ní - Wč..V 2 oS ..o~.g ZNí - WYZ.n' g" SUQ.vU~-' S*~-' óv ú..gU9...vU~-' o..
) g3 o" v 6..X vXv*o9..í ú..á g" v -' ..xí - WYN o øoU..*vMg ..SU9SM-ý *~' g o..X vXv*o9...-v..9o)Sb..g..
g)o..gU9..;μ~.*XgM Z." v" øó NoøoU..! ó NvUb.." vμ 9.*S ..g Qio...-' g~..-' o.3 g;v S-ú.v)..-' o*o..
SU9SM-ý *X S g S-ú.3 og*í o..! μ3 gU.." o R oSUQ.) v3 .g.3 g-ó Sg ..Xó *XoMSbo..xoZYNu-í SS-UN..
gUSg-SvUNgU9...SUM3 oYN..-' ó oi ú...vøó vv6SUQ..-' o..3 v o..ffig Sg-Sbo..gU9...MμMg ..g og~.v)..
ffig S-ú.v)..)So..*μM..g*~.g)o-ú..gU9.Xó *vUg ..) oøv3 *Z.

Vøó g Ng..sμ*~-' gU*SSvU.S*.g**o**o9..i ú..g..MμU- úfk..MgXgMú~.v..oU*í o..*vMg-g ..." o R oSUQ..
)v ..S*..XvXμ g-SvU.x-' o..fμ*~.fM3 XvUbU-Y.." ' So..MUMí' oU-ú..3 SSS SiSUQ.S*..S XgM.vU~-' o..
oUòSvU3 oU~.x-' o..f gU*SSvU.H.M3 XvUbU-YZ..-' o...Só g-í o..MgU.i o..í vg9 ú..Mg-oQ Sio9..SU~v..
—" v..M3 X*..g*..)v ..! v" ..-v..gMSðo..;μ*~-' gU*SSvU~-' v*o.." ' v..g SU.3 v o..Mv*o ú.." S' .." og6..
μ-gSgi SS-ú.X SUMX oNgU9~-' v*o.." ' v..ogU~.v" g 9.g.*~' vUQ*μ*-gSgi SS-ú.Xg g9SQ3 .xO6S*..
o~.g ZNí - - βč.2 oμ3 gúó Ní - WNí - - βYZ." og6..*μ*-gSgi SS-ú.S*.i g*o9..vU~-' o..g**μ3 X-SvU~-' g..
Ug-í g ..MgXSg .gU9..v-' ó ..)v 3 *.v)..MgXSg ..g o..g Q ú..SU-ó MgUQgi oN" S' ..g.X S g ú..vMμ*..
vU.3 gUgSUQ.ý ..Sog ú..SUMog*SUQ..-' o..vøó g ..øg μo.v)..-' o..MgXSg ..*~.vM..)v ..! o..i oUò)S.v)..
)μ-í o..QÚ g-SvUxZ<vUò *o úN~' vUQ*μ*-gSgi SS-ú...o;om*~-' o..Uv-SvU.v)..*μi *-Sμ-gi SS-ú.ý ...
M3 XoU*g-SvUNXg -SMí g ú.. oQ 9SUQ.Ug-í g ..MgXSg No3 X' g*SiSUQ..-' g~..M -gSU..)v 3 *.v)..
Ug-í g ..MgXSg ..g o..o**oU-Sg NgU9~-' oS ..9oX o-SvUMgUv~.i o..M3 XoU*g-o9..)v ..i ú..Sb o~.3 oU~..
SU.v-' ó ..úXo*.v)..MgXSg N*μM..g*.3 gUμ)gMí o9..ý ..! μ3 gU.MgXSg .x" SMo Ní-í- YZ.

G9øvMg-o*.v).."' og6..*μ*-gSgi SS-ú.xg~...og*~.) v3 .gU.o3 XS SMg ..*gU9XvSU-Y! gðo..X vXv*o9...-' o..
oUòSvU3 oU~.g ..o))SbUMí.v).."' o R oSUQ...g*.gU.gXX vgMí...v..3 og*í o..MμU- S* ..*μ*-gSgi SS-ú..
Xó)v 3 gUM...xn Sb-ü..o~.g ZNí - - uč..7 USQ ~..gU9..á v*gNí - WYZ..-' o..MÚ g ..MUMX~.v)..-' S*..
gXX vgMí..S*~.v..ffigU-Sú..-' o..oUòSvU3 oU~.g ..9g3 gQ..SU' ó oU~.SU.ogM..μU~.v)..*øó g ..! μ3 gU..
" o R oSUQS9SM-ý *Z..-' o.gXX vgMí...o*o3 i o*.gU.vX-S Sig-SvUX vi o3 N" ' ó o.S9SM-ý *.v)..
oUòSvU3 oU~.g ..S XgM.ý ..o*ví M..μ*o..g o~' og-o9..g*.μU9o*Sgi o..SUXμ~.*ý ..M*~.NgU9..*vMg ...
gMSðo3 oU~.g o..MÚ*S9ó o9..9o*Sgi o..vμ-Xμ~.x<v *g-og..gU9..+SgMg SgNí - Wč.á oU' g 9..o~..
g ZNí - - - YZ..-' ó...o*μ -SUQ.*M o*.g o..μ*o9...v'..gU6.gU9..S9oU-Sú..MμU- S*..gMSðSUQ.vX-S g .ý ...

' SŶ ú..o))SŠU...Xó)' 3 gUM...g...9S))ó oU...oóo *.v)..SUXp...µ-SSig-SvU.xoUoSvUo oU-g ..S XgMY...
x<v' *g-og.gU9...+SgMŷ SgNí - Wč.á oSU' g' 9..o-.g ZNí - - - č.àµU.o-.g ZNí - WYZ.

<vUóó *o úNg9øvMŷ-o*.v)..*- vUQ.*µ*-gSŷgi SS-ú..))vMŷ..vU.g**o**SUQ.MµU- S*fl.*µ*-gSŷgi SS-ú...
Xó)' 3 gUM...gQgSU*...*- SM...-' o*' v 9*...)' ...g99 o**SUQ..*vMŷ ...9o)SŠUMŠ...gU9...gøv9SUQ..
oUoSvUo oU-g ..vóó *' vv-.x+vµQ Ní - í - č.á g" ' v' - Ní - WYZ.á oMU..g9øgUM3 oU*..SU..-' S*)Sb 9...
vµ-Sb..g..fŷg)o..gU9...;µ*...XgMŷi.) g3 o" ' v' 6..gXXSŷgi o...-v..g ..ŷg-SvU*..x(gUUSUQ.o-.g ZNí - í í N.
í - í - č.V 2 oS ..o-.g ZNí - WYZ.-' S*.gXX vgM.SU-oQg-o*.XgUo-g' ú.i vµU9g S*N" ' SM.9o)Sb...-' o...
oUoSvUo oU-g ...S S*..." S' SU..." ' SM..." µ3 gUS-ú..MŷU.*g)o ú..vXó g-oN" S' ...*vMŷ ...i vµU9g S*...
g SŶb9..." S' ...-' o.àµ*-gSŷgi o..n oóo vX3 oU...+vg *.xàn +*Y..v..9oU-Sú..g..iivUo..." ' ó o..! µ3 gU..
Uoo9*.g' o.3 o-..." S' vµ-µU9ó 3 SŶSUQ.Og' - fŷ.*ú*-o3 *ZG*.g'...o*µ -N- g9oRv))*.v' .*µi *Sµ-SvU*...
i o-" ooU.oUoSvUo oU-g .gU9..*vMŷ ..Xó)' 3 gUM*.g' o.9oo3 o9 .µUgMŷX-gi oZ.

" v" oóó N.-' o*o.o))v' -*.oUMµU-ó ..SŶSUŠMU...S Sg-SvU*NX S g' Sú..SU..-' oo.g*XoM*Z(S*- úN.
-' ó o *.g...gMŷ..v)...g-oU-SvU...QšoU...-v...-' o...-o3 Xv g ..9úUg3 SM..v)..MµU- S* ...µ*-gSŷgi SS-ú...
Xó)' 3 gUMNXg' -Mŷi g' ú..SU.g**o**SUQ.. v" ..ŷg-SvU*..." S' .SŶSg .9Sxg' SŠ*.SUgMŠoSUQ! SŶ ó ...
oóo *.v)..." o R oSUQgU9...o9µSUQoUoSvUo oU-g ..S XgM*.Mŷ-M.µX..." S' .ogM..v-' ó .vóó ...S oZ..
à oMU9 úN.-' ó o *.g.9o)SŠUMŷ.SU..ó 3 *.v)..g.3 ' v' o.M3 X o' oUšo.Móó gQ.v)..*vMŷ .SŶSŷg-v' *...
SU...3 og*µ SUQ..MµU- S* ...9oóo vX3 oU...Xó)' 3 gUMZ. / g*- úN.-' o... ' o g-SvU* SX...i o-" ooU..
oUoSvUo oU-g ...gU9...*vMŷ ...SŶSŷg-v' *N.g*...o' Xv o9...SU...X ošSµ*...-µ9SbN" g' gU*...)µ' -' ó ...
o' g3 Sŷg-SvUZ(' v' .o' g3 XoN" ' So.(gUUSUQ.o-.g Zxí - í í Y.vi *ó øo9.g.Mv*o.g**vMŷ-SvU.i o-" ooU..
*vMŷ .SŶSŷg-v' *.gU9..Mŷ i vU.o3 S*SvU*N.-' o.S XSMŷ-SvU*.v)...-' o... Mŷ øSSbóg ..ŷg-µi o.v)...-' S*...
' o g-SvU* SX...SU..-ó 3 *.v)...*- vUQ..óó *µ*..." og6...µ*-gSŷgi SS-ú...Xó)' 3 gUM...g' o...*S ...Uv...
g9offµg-o ú..µU9ó *-vv9Z.

rU.g99SvU..v..3 og*µ SUQ.MµU- S* ...µ*-gSŷgi SS-ú..Xó)' 3 gUMNo' g3 SŶSUQ..-' o.MUóó QUM...
v)...-' oS ..Mŷ i vU.o))SŠUMŷ..v)..*vMŷ ..X vQ o**..S*.6oú..-v..g**o**SUQ..-' oS ..gi SS-ú..-v..gMŠoó..;µ*...
- gUšSvUZ.<vUóó QUM...S XŠ*.i v-' ...- gUšSvUZ..v" ' g' 9*...3 ' v' o...Mŷ i vU..o))SŠU...*vMŷ ...
X vQ o**..xŶv" Ug*.βRvUóó QUM..xŷ gµ3 v Ní - - βYgU9...o9µSUQMv**RvU- ú.9Sxg' SŠ*.SU..
oUoSvUo oU-g ..S XgM..gU9...*vMŷ ..gMŠoó3 oU*..x' o)ó' o9...-v..g*...oRvUóó QUM..xŷ g' v..gU9...
àg gR g' -SUNWú YZ.-' g9SvUg' úN.-' o.MUMX..v)..Mŷoó QUM..! g*.i ooU.*-µ9S9.X S g' Sú...
SU..o g-SvU..v.SUM3 o...oóo *.xŷ gµ3 v Ní - - βčt' ú 9g .gU9.àSv' gUQNWi%čàv v" NWi% YNí µ-S...
' g*...g' o ú.i ooU.o' Xv o9.MUM USUQMµU- S* .oUoSvUo oU-g .o))SŠUMŷ..v)..! µ3 gU.." o R oSUQ..
xàg 3 gUo-.g ZNí - í í YZ.-U9ó *gU9SUQ..-' o*o.9úUg3 SM.S.MµMŷ ..)v' .gMŠoSUQg.;µ*...- gUšSvUN..
g*..S..g v" *.µ*...-v..3 vøo.i oúvU9...-g-SMg**o**3 oU*..v)..Xó)' 3 gUM...-v..9SŷM U.*µ*-gSŷgi SS-ú...
9oQoo*.vóó ...S oZi ú.gŷg' úüSUQ! v" ..MµU- S*..Mŷoó Q.SU..-' oS ..µ*-gSŷgi SS-ú..Xó)' 3 gUMN..
" o..MŷU..9o-ó 3 Sb..." ' o-' ó ...-' oú..g' o..Mŷ oMSšo ú..3 vøSUQ..-v" g' 9*...g...)µ-µi o..." ' ó o...*vMŷ ...
X vQ o**..S*.gMŠoó9..." S' vµ-M3 X v3 SŶSUQoUoSvUo oU-g ..SU-oQsúNoU*µi SUQ..-' g-..Uv..ŷg-SvU..
S*..o)-.i o' SŶ.SU..-' o.Qvi g ..*' S-...v" g' 9*.*µ*-gSŷgi SS-úZ.

àv..)g N.-' o..! úXv-' o*S.v)..MµU- S* .oUoSvUo oU-g .Mŷoó QUM..! g*.X S g' Sú..i ooU.o' g3 Sb9...
SU..-ó 3 *.v)..Mŷ i vU..9S' SŶo..o3 S*SvU*..Xó ..MŷXSg..xŷ ó 6...o-.g ZNí - í í č.2 QúoU..ö gUNí - - %..
à- gŷSMŷ.gU9.../ S-Ní - - βYZ.-' o..vi ;oMSšo..! g*.i ooU..-v..9o-ó 3 Sb..." ' o-' ó ..Xv' ó ..MµU- S*N.

SSSg ú..." S' ...v" ó ...oøo *..v)...Xó ..MgXSg..o3 S*SvUkN-oU...-v..SUMog*o...-' oS ...o3 S*SvUk...3 v o...
 ' gX9 úN.og9SUQ.-v.β..MFUó QUM..v)...-' o...og*..Xv μ-SUQ.MμU- S*..." S' ...-' o..3 v*..Xv μ-SUQ..
 vUo*Z." v" oøó Nβ..MFUó QUMN." ' So..LbM**g úNS..MU*9ó o9..S(μ))SBU-..)v ..σ..MFUó QUMN..
 " ' SM..S.øS" o9..g*.g.3 v ó...SQ vμ*.gXX vgM...v.gUg úüo...-' o...o3 Xv g .9úUg3 SM.v)..MμU- S* ...
 μ-gSgi SS-ú...Xó)v 3 gUM...xwo-ó **vU..o-...g ZNí - WYZ.-' S*..gXX vgM...)gMSg-o*...g...9ooXó ...
 Sbo*-SQ-SvU.SU-v...-' o.oøv μ-SvU.v)..MμU- S*..Mv**RoMSvUg .9S'- S μ-SvU.gU9..oUgi o*...- gMSUQ..
 -' o...- gUkSSvU.- g;oMv S*..v)..S9S9μg ..MμU- S*..vøó ...S o.xw' S SX*.gU9..àμ Ní - - °č...-v3 g N..
 í-íβYZr-.g *v.g v" *..v) ..M3 Xg SUQ..-' o...- gUkSSvU.i o' gøS' ..v)..MμU- S*..v" g 9*.g..M3 3 vU..
 μ-gSgi SS-ú...Xó)v 3 gUM...- g;oMv úNXv-oU-Sg ú...9S-SUQis' SUQ.i o-" ooU..MFUó QSUQ.gU9...
 9Só QSUQMμU- S* ..i o' gøS' Z.

-' o.*- μMí o.v)...-' S*.XgXó .S*.g*..v v" *màoMSvUí .9o-gS*...-' o.9g-g..*vμ M*.gU9..o' XgSU*...-' o...
 o3 XS Sg .*- g-oQín." S' ..ogM..9S-SUM.3 o-' v9..X o*oU-o9..SU.g..9o9Sg-o9..*μi *oMSvUZàoMSvU..
 β..o' g3 Sbo*...-' o.Qvi g .9S'- S μ-SvU.v)..<Oàw..*M o*No' Xv o*...-' o..MFUoMSvU.i o-" ooU.Mg i vU..
)vv-X SU-.gU9...-' o..àwrNgU9..Sbo*-SQ-o*...-' o..MFUó QUM..gU9... o g-Sbo...- gUkSSvU.Xg- ' *..v)...
 MμU- S*..MFUM USUQ..-' o...<OàwZàoMSvU... 9S Ml**o*...-' o..)S9SUQNgU9..àMSvU... ..! SQ SQ -*...
 -' o.QvμUí og6SUQ.SUSQ -*..." ' So.g99 o**SUQ.Xv-oU-Sg ...S Sg-SvU*Z.

í t o-' v9*...

Vμ .o3 XS Sg .*- g-oQí..MgU.i o.vμ- Sbo9..SU...-' oo.3 gSU*-oX*Z.-' o.)S*..*-oX.MFU*S*..SUMFU*- μMSUQ..-' o...
 <Oàw...*M o*Z.-' o...*oMFU9...*oX...MFU*S*..*..SU..MFU9μMSUQ..g...*oQ oU-o9... oQ o**SvU..gUg úS*..v)...-' o...
 ' o g-SvU* SX.i o-" ooU...-' o..àwr..gU9..Xó ..MgXSg..Mg i vU..)vv-X SU-Ni g*o9..vU..." ' SM..." o.9S9o..MμU- S*..SU-v...
 9S)ó oU..*oQ oU*Z.-' S*.g v" *..μNSU...-' o... S9..*oXN-v..Mg' ú..vμ-...-' o..MFUó QUM..gUg úS*..*oXg g-o ú...
 " S' SU...-' o*o..*oQ oU*..v)..MμU- S*Z.

í ZVn g-g..*vμ M*.gU9.- og-3 oU...

-v..3 og*μi o..*vMg .X vQ o**N?" o..μ*o...-' o...oMU-ú..Mog-o9..àvMg ..w vQ o**rU9o' ...-S o.àó S*N..
 Møó SUQ..-' o..Xó S9..v) v3 ..Wiu- ..v.í-í-Zn g-g..v)..-' o..S9o' N?" ' SM..M3 i Sbo*..% ..S9Sg-v *..SU..
 S*..M3 Xv*SvUN?" ó o..X vø9o9..i ú...-' o..àvMg ..w vQ o**r3 Xó g-Sbo..x" g 3 gM6..gU9..7' ú vøgN..
 í-íβYZ.-' o..S9o' ..) g3 o" v 6..S*..*- μMí o9..g vμU9...-' oo..M o..9S oU*SvU*..v)..*vMg .X vQ o**m
*I g*SM." μ3 gU.2 oo9*N.(vμU9g-SvU*..v)...“ o i oSUQNgU9...VXXv -μUSú..x*oo...(SQí o..WZ.OgM...
 9S oU*SvU.M3 X S*o..)vμi ..M3 XvUoU*N?" ' SM..g o.gUM v o9..SU..*XoMSMMFUMX-μg .ffμo*-SvU*Z..
 -' o*o..M3 XvUoU*..g o..)μi -' ó ..9o-gSo9...-' vμQ ..g...*o-..v)..vμ-M3 o..S9Sg-v *..9o*SQbo9...-v...
 g99 o**...-' o..M' o*XvU9SUQ..ffμo*-SvU*..x*oo...(SQí o..Vg..gU9...(SQí o..àZVZSU..àμXXo3 oU-g ú...
 3 g-ó Sg YZ<v oMSo úN.-' o*o..SU-ó MFUoMo9..o o3 oU-*..X vø9o..g..M3 X o' oU*Sbo.3 og*μi o..v)...
 MμU- S*fl*vMg .X vQ o**N.oX o*oU-o9..vU.g..- RW- .*Mg oZ.*

-' o..SUMμ*SvU.v)...-' o..àwr..SU.MFU*- μMSUQ..-' o...<Oàw..9S oM ú.g99 o**o*.g.6oú..ffμo*-SvU.Xv*o9...
 i ú.2 oμ3 guó .xí- WYnff' ' g-.*' vμ 9.i o.*μ*-gSbo9ffμZr-...oX o*oU-*..gU.μUX oM9oU-o9..o))v -..v...
 M3 X o' oU*Sbo ú..g**o**..MμU- S*..*vNS-g ..Xó)v 3 gUM..gMv**..øg Svμ*..9S oU*SvU*..v)..*vMg ...
 X vQ o**..vøó ..3 v o...-' gU...-' oo..9oM9o*Z-USo..MFUoU-SvUg ..3 o- SM..*μM .g*..SUM3 o..xoZVZ..
 † v**..n v3 o*-SMw v9μMYN.-' o..àwr.gSg *..v..MgX-í o...-' o..3 μ-SgM-o9..g*XoM*..v)..-' o..ffμg S-ú...

v)...SogMv**..Mpu- S*Zr3 Xv -gU- úNS..Qv**i oúvU9...! o...S S*.v)...! o...! μ3 gU..Uo9*...! óv ú...
 xt g' P oo)N.WiuWN." ' SM...)v 3 *...! o...i g*S*...v)...! o... *g)o...gU9...;μ*...*XgM ...) g3 o" v 6N.i ú...
 o' XgU9SUQ...! o...gUQ...v)...*vMg ..SU9Mg-v *-úXSMg ú.o' g3 Su9..SU...! o...Só g-μi o.x+vμQ Ní -Wč...
 V 2 oS ..o-g ZNí - WYZ..



(Sqi o..Wia vMg ..w vQo**rU9o' .) g3 o" v 6 Z.

wó ..MgXSg..Mg i vU..)vv-X SU-...xS6ZNo3 S*SvU*..) v3 ...! o..Mfuμ3 X-SvU..Xó *XoMSóoY.S*..μ*o9...-v...
 3 og*μi o.oU9SvU3 oU-g ..S XgM*N-v.gMfuU-.)v .i v-! ...ó' S'v Sg .gU9... g9o.SU9μM9.o3 S*SvU*Z..
 rU...! S*.Mfu-o' -S..Uo9*...v.i o.*- o**o9...! g-...! ó...o g-SvU*' SX.i o-" ooU.àwr.gU9..Mg i vU.o3 S*SvU*...
 3 gú.i o.9oXoU9oU-..vU...! o..." gú..Mg i vU.o3 S*SvU*..g o.3 og*μi o9..xn gøS*.gU9...<g 9oSgNí - WYZ..
 (v ..SU*-gUMN-! o... o g-SvU*' SX.S*..." og6ó ..μ*SUQ.X v9μMSvUR g*o9..Mg i vU.o3 S*SvU*...SUM..g...
 SU9SMgU-...Xv -SvU.v)...! o...3 v-...9o9o vXo9...MfuU- S* ...o3 S*SvU*...v SUg-o*...SU..v-! ó ... o**...
 9o9o vXo9..MfuU- S*..9μo...v..SU-ó Ug-SvUg ... g9o.xà-oSü ó Q .o-g ZNí - WYZ..! ó o)v oN?" o.μ*o...
 SU.vμi .gUg ú*S*.Mfu*μ3 X-SvUR g*o9.Xó ..MgXSg..Mg i vU.o3 S*SvU*..x)vv-X SU-Y9g-g.X vø9o9..i ú...
 -! o..+ vi g ..Mg i vU.w v;oM.x(S9 SUQ-oSU..o-g ZNí -í í YZ..! o..S oRó S*..)v ..Mg i vU..)vv-X SU-...
 9g-g..." g*.*' S-o9..)v " g 9.i ú.vU..úog ..v.3 g-M...! o.àwr.úog .g SUB oU-Zt S*SUQøg μo*..." ó o...
 S Xμ-o9..μ*SUQ..oQ o**SvU.gUg ú*o*...oMUSffμo*..." S' ..3 v9o o9..Mg i vU..)vv-X SU-..9g-g..) v3 ...! o...
 Óv g..+ vi g .àμXX ú...<' gSU.n g-gi g*o.*ó øSUQg*...! o.X o9SMv .x/ oUioU..o-g ZNí - WYZ..

í Z Z-! o..<Oàw..*XoMSMg-SvU.gU9..Mg S' g-SvU..

G9vX-SUQ..! o... OÚ9SvU3 oU-g ... O))SBSUM... v)... " o R oSUQ.. gXX vgM...) v3 ... gU... SU-oU*S-ú...
 Xó *XoMSóoN?" o.9o)Süb...! o..<Oàw.g*...! o..Mg i vU..)vv-X SU-..Xó ..μUS..v).àwr.xn S-ü..o-g ZNí - Wč..
 s'v QvU*vUNí - Wč.s'v QvU*vU.gU9..n S-üNí - Wč.í *' g9..o..g ZNí -í WZ..! S*.S*.Mg Mμ g-o9..g*...! o...
 ' g-Sv.v).Mg i vU..)vv-X SU-..v.àwrZ-..v.oU*μi o...! g-...! ó...g-Sv.S*.Uv-.9S*X vXv -SvUg-o ú.SU) μoUM9...
 i ú...! o.øg Sgi o..." S' ..Qog-ó .9S*Xó *SvU.xXó ..MgXSg..Mg i vU..)vv-X SU-..SU...! o.Uμ3 ó g-v .v .àwr...
 M o...SU...! o...9oUv3 Sg-v YN..! o..Mfo))SBSU...v)...øg Sg-SvU..g o..offμg Sio9Z..! S*..g9;μ*-3 oU...

SUØv øo*..SÚ v9µMÚQ.g..MÚ*·gU...¹ g-..)gMSSg-o*..g...SÚó gU*)ý 3 g-SÚNg -ó SUQ.-¹ o..3 ogU...
 ” ’ So.X o*o øSUQ.-¹ o..øg SgUM.xn S-ü.o-.g ZNí - Wč.s.v QpU*vU.o-.g ZNí - Wč.t g 6*Ní - ” YZ.

—¹ o...g-SÚ...g6o*...¹ o..)v v” SUQ.)ý 3 m

$$\dots \lambda_{it} = \frac{CO_{2it} + c}{SPI_{it}} \dots \quad xW..$$

“ ’ ó o.λ_{it}.9oUv-o*...¹ o..g3 vµU-...v)..Mg i vU..MÚgSÚ9...SU..ogM...µUS-...v)..àwrZCO_{2it}.gU9..SPI_{it}...
 ’ oX o*oU-N..o*XoMSøó úN.-¹ o.Xó ..MgXSg..Mg i vU..)vv-X SU-.gU9..àwr.*Mf o*..)ý ..MµU- ú.i.g-úóg ...
 tZ.-¹ o.offµg SiSUQMÚ*·gU-.c.Sk.vi -gSÚ9..g*..)v v” *Z.

$$\dots c = \frac{\sigma_{CO_2} \mu_{SPI}}{\sigma_{SPI}} - \mu_{CO_2} \dots \quad xY..$$

“ ’ ó o.σ_{CO₂}.gU9..µCO₂’...oX o*oU-...¹ o...·gU9g 9..9oøSg-SÚ.gU9...¹ o..3 ogU..v)..Mg i vU..)vv-X SU-...
 Xó ..MgXSgN..o*XoMSøó úNgU9..σSPI.gU9..µSPI.9oUv-o...¹ o...·gU9g 9..9oøSg-SÚ.gU9..3 ogU..v)..¹ o...
 àwr..*Mf o..gMv**..g .i.gU9...vøó ..g .tZ.-¹ o... o*µ -SUQ.øg µo*..v)...¹ o... g-SÚ.ég o...¹ oU.SÚó *o ú...
 Úv 3 g Sio9...) v3 ...-v...W-N.” ’ ó o...! SQ ó ..*Mf o*..SU9Mf-o...v” ó ..àwr..Mg i vU..MÚ-oU-N.-¹ µ*...
 ’ o) oMSUQ..! SQ ó ..Mg i vU.o))SgUMZ.-¹ Sk.Úv 3 g Sig-SÚ.Sk.9vUo.µ*SUQ.-¹ o.3 SÚB g’ .3 o-¹ v9.g*...
)v v” *m

$$\dots CESP_{it} = \frac{\max(\lambda_{it}) - \lambda_{it}}{\max(\lambda_{it}) - \min(\lambda_{it})} \times 100 \dots \quad xBY..$$

—¹ o.CESP_{it}’...oX o*oU*.SÚó *o ú..Úv 3 g Sio9..øg µo*..v)...¹ o.λ_{it}..)ý ..MµU- ú.i.g-Xó S9.tZ.” ó oN.
 max(λ_{it}).gU9..min(λ_{it}).9oUv-o...¹ o.3 g’ S µ3 .gU9..3 SÚB µ3 .øg µo*..v)...¹ o.λ_{it}..øg µo*..gMv**..g ...
 MµU- S*.gU9..g .úóg *NoUgi SUQi v-¹ ..Mv**RoMSÚg .gU9...o3 Xv g ..M3 Xg gi SS-úZG.<Oàw...
 Mf o..v)...W- ...SQSSS...¹ o...! úXv-¹ o-Sg ...MÚg Sv...” ’ ó o...g..MµU- ú.i.gMSSøo*...¹ o...! SQ o*...
 Xv**S o..àwr..*Mf o..3 g’ xà wrYP ..xW- Y.” ’ So.3 gSUgSUUQ.Mg i vU.Uoµ- g S-úNSZmin(λ_{it}) =
 c/max(SPI)Z.<vUó *o úNg...<Oàw...*Mf o..v)..- ... o) oM*..g...MÚg Sv...” ’ ó o.λ_{it}..offµg *.15Z.-¹ Sk...
 -¹ o*¹ v 9..gXX v’ S g-o ú..offµg ...v...¹ o...! SQ o*...øg µo..v)...¹ o... g-SÚ.x” ’ SM...” g*.1.37..)ý .0 g-ég ...
 SU..Wu° YZ.

rU.gi *v µ-o...ó 3 *.x” S-¹ vµ-...¹ o.offµg SiSUQMÚ*·gU-YN-¹ o.<Oàw...*Mf o.Sk.gXX v’ S g-o ú..offµg ...
 -v..(1 - $\frac{CO_{2it}}{SP_{it}}$)Z.-¹ Sk...)ý 3 µ g-SÚ..ffµgU-SS*..MµU- S* ..Mg i vU..o))SgUM...i ú...3 og*µ SUQ.-¹ o...
 9S*·gUM..) v3 ...¹ o...” ý *-Mg*o..v)..3 g’ S µ3 ..Mg i vU.SÚ-oUkS-ú...” ’ ó o.vUo.µUS..v)..*vMg .X vQ o*...
 UoM**Sg-o*..vUo...vU..v)..Xó ..MgXSg..Mg i vU..)vv-X SU-Z.

—¹ o.SUMµSÚ.v)...¹ o.MÚ*·gU-.3 g6o*...¹ o.g**o**3 oU-..v)..MµU- S* .oUøSvU3 oU-g .o))SgUM...v)...
 ” o RoSUQ.’ g-¹ ó ...¹ o g-SøZ.-¹ Sk...3 ogU...¹ g-...¹ o...<Oàw...3 og*µ o*...MµU- S* ...¹ o g-Sø...
 Xó)ý 3 gUM.SÚ.;µ*-...¹ gUkSSU.i ú.g**o**SUQ..! v” ..Mg i vUo))SgU..MµU- S* ..*vMg .X vQ o*...S...
 øSRBSk.v-¹ ó ..MµU- S*Z.

í Z Z' og6XvSU*.9oU-SSM-SvU.SU.-' o'..o g-SvU*' SX.i o-" ooU.àwr.gU9..Xó .MgXSg...
Mg i vU.)vv-X SU...

—' o..Mí øSSUg' ..o g-SvU*' SX.i o-" ooU.àwr..gU9..Mg i vU.)vv-X SU-..*pQQ*-...! v" øó ...! g-...! o...
i o*-...<Oàw...Xó)v 3 gUM...3 SQ -..i o..vi *ó øø9..g-...*SQS MgU-ú..9Sýó oU-...øøo *.v)...Xó ..MgXSg...
Mg i vU.)vv-X SU-Z.“ o...! ó o)v o..)pí -! ó ...-pú9...! S'.. o g-SvU*' SXNi ú..o3 XvúSUQ.*oQ3 oU-o9...
' oQ o**SvU.3 v9o *-...! g-..oUgi o...! o..9oU-S Mg-SvU.v)...í og6XvSU-...øøo *.v)...Xó ..MgXSg..Mg i vU...
)vv-X SU-." ' ó o..*SQS MgU..MgUQ*.SU-...! o..* vXo.v)...! o...Subg ... -..vMí Z-...! o*o..* vXo*.X vø9o...
S*SQ -*.SU-v...! o..QÜ g ..Mv**RoMSvUg ..- oU9*.v)...! o..<Oàw..." S' SUlogM...*ui *-o-..v)..Mpu- S*...
gMv**..9Sýó oU-..Mg i vU.)vv-X SU-...gUQ*Z-SSISUQ-...! o*o..í' og6XvSU-*N" o..Mg-oQ Sio-...! o..)pí ...
XgÜb ..v)..Mpu- S*..SU-v...! oo..Q vµX*NÜg3 o ú...v" R3 99 oRNgU9..! SQ R3 S-SUQ.Mpu- S*Z...

—' o..*oQ3 oU-o9'..oQ o**SvU.3 o-! v9..S..Xó)v 3 o9..µ*SÜQ-...! o..á ..XgMgQ... *oQ3 oU-o9 ..xó *SvU...
VZBYxt µQqv..gU9..t µQqvNí - WYNMFU*S- SUQ.v)...gU.Só g-Sóo... -SUQ.g Q S' 3 ...v..9o-oM...
SQS MgU-...MgUQ...SU-...! o..* vXo..gU9NMU-offioU- ün-...! o..o' S*-oUM...v)...! í' og6XvSU*..SU-...! o...
' o g-SvU*' SX.xt µQqvNí - í - Ní - - ßYZ-...! o*o..í' og6XvSU*..g o..9oU-S o9..g..X S' S.i g*o9..vU.gU...
vX-S g Sig-SvU.v)...! o.I gúo*SgUrU)v 3 g-SvU..< Só SvU.xl r<Y.xàM" g üNW°1YgU9-...! o.G6gSo...
rU)v 3 g-SvU..< Só SvU.xGr<Y.xG6gSoNW° . YZ-...! o..9o-gSo9..X vM9pí o..v)...! o..*oQ3 oU-g-SvU.Sk...
vµ-Sub9.SUàµXXo3 oU-g ú.3 g-ó Sg .àZY.

í Z Zµ*-... gU*SSvU...o g-Só.Xg-! *.9ó Sg-SvU.gU9..MÜó QUM.3 v9o SUQ..

—' o..MÜó QUM.3 v9o'...o S*.vUg...S oRg úSUQ)gMv' *-o-SUQxw' S SX*.gU9.àµ Ní - - °YN' ' SM...
S*..o' oMí-o9-...! vµQ ...! o..µ-SSig-SvU.v)...! o..á ..XgMgQ... <vÜó QUM< µi * ..xó *SvU.í Z Z Y..
xàSMó g..o-..g ZNí - WYZ-...! S*.3 o-! v9v vQi..oUgi o*..µ*-v..3 v9o ...! o..SU9S9µg ..gU9-...o3 Xv g ...
' o-ó vQÜbS-ú.v)...! gU*SvUZr-...! g*.i ooU.gXXS9..SU.o' g3 SUSQ.MÜó QUM..SU.oÜbSvÜ3 oU-g ...
Xó)v 3 gUM...xl ' g-gMg' úg...o-..g ZNí - í - č..wgUvXvµ vµ..gU9...wgU-o S9SNí - - uY.gU9...! µ3 gU...
9øøo vX3 oU-..xàg 3 gU.o-..g ZNí - í í YZ-...! o..X vM**..SÜv øo*..í' og6SUQ9v" U-...! o..<Oàw..SU-v...! v...
-S oRg' úSUQM3 XvÜbU-*m

$$\dots \qquad CESP_{it} = v_{it} \theta_{t\dots} \qquad \text{x Y..}$$

" ó oN-...! o..CESP_{it}..S*...! o..Mg i vU.o))SSUM...v)..*vMg ..X vQ o**..)v' ..Mpu- ú..i..9pí SUQ.Xó Sv9..tNøt...
' oX o*oU*..S*..*! g' o9..Xó)v 3 gUM..M3 XvÜbU-NgU9..v_{it}..9oÜv-o*..S*..9Sv*úUMg-SMM3 XvÜbU-Z..
“ ' So..θ_t..MgU...i o...µÜó *-vv9...g*..i oSUQ..9oXoU9oU-...vU-...! o...M3 3 vU...*vMg ...gU9...oMFUv3 SM..
Mg' gMó S-SMN-...! o..9Sv*úUMg-SMM3 XvÜbU..v_{it}..3 og*ípí o*...! o..o' -oU-...v..." ' SM...Mpu- ú..i...
9øøS-o*..) v3 ...! o..M3 3 vU.Xó)v 3 gUM..xw' S SX*.gU9.àµ Ní - - uYZ-...! o.Xg' g3 o-ó ..v_{it}'...o) oM*...
-! o...! gU*SSvU.v)...Mpu- ú..i *..<Oàw...-v" g' 9*...! o..M3 3 vU..Xó)v 3 gUMZ..àµi *offioU- ünNg...
' o g-Só-...! gU*SSvU.Mo))SSU-..S*.MU*- µMo9.g*..)v v" *m

$$\dots \qquad h_{it} = \frac{CESP_{it}}{N^{-1} \sum_{i=1}^N CESP_{it}} = \frac{v_{it}}{N^{-1} \sum_{i=1}^N v_{it}} \dots \qquad \text{x}^{\circ} \text{N}..$$

—' S*..)v 3 µ g-SvU...o3 vøø*...! o..M3 3 vU-...oU9..Xg' g3 o-ó ...! vµQ ..Mg SUQ.gU9..3 og*ípí o*...! o...
< gU*SSvU.v)..Mpu- ú..SS..o g-Sóo-..v...! o..Mv**RoMSvUg ..gøø gQ.g-..ogM-..S o-..Z“ o..9oÜv-o..h_{it}...

g*...! o...;µ*...! gU*SSvU...o g-Sō.Xg-! .g*.S...! gM*.ogM..MµU- ú *...<Oàw..oøv µ-SvU...! g;oMv ú...
 ' o g-Sō...v...! o...gøó gQ...v)...g ...MµU- S*Z.<vU*offioU- úNh_{it}..g *v... oøog *.MµU- S*...! o g-Sō...
 9oøSg-SvU.) v3 ...! o..M3 3 vU.Xó)v 3 gUM...Xg-! Z.-! µ*NgUú..gXXg oU...9Só QU...i o' gøSv ...S*...
 MgX-µi o9...i ú.h_{it}Zr)...MµU- S*.o' ' S S..µUšv 3 ...;µ*...! gU*SSvU..i o' gøSv N.-! oU.h_{it} = h_t..." ' SM...
 µ-S g-o ú...3 ogU*...! g-...! o...<Oàw...MUpó QUM...oU-gS*.h_{it} → 1 ..)v ...g ..i .g*..t → ∞ Z.-! o...
 ffµg9 g-SM9S-gUM..) v3 ...! o..M3 3 vU.XgUo ...S S..S*...! oU.o' X o**o9.g*...! o..ffµg o.3 ogU.v)...! o...
 9S)ó oU-Sg ..v)...h_{it}Z.

$$... \quad H_t = N^{-1} \sum_{i=1}^N (h_{it} - 1)^2 \quad \ddot{x} \ Y.$$

“ ' oU...! ó o.S...Uv...MUpó QUMN-! o..9S-gUM...o3 gSU...Xv*SSō..g*.t → ∞Z." v" oøó N.-! ó o.g o...
 *oøó g ..Xv**S SS S*..)v ...! o..Mg*(o.v)..UvUMUpó QUMmH_t..MgUMUpó Q...v.g..UvURío v..MµU-gU-N.
 S...MgU...o3 gSU..i vµU9o9..gi vøo..iio v..i µ-..Uv-..MUpó QNv ...S...MgU.9Só QZ.-! o..MUpó QUM...
 ' úXv-! o*S..S*...! oU...o*-o9..µ*SUQg...vQR...o*-vU.g.*o3 SXg g3 o- SM3 v9o ..v)...! o.Xg g3 o-ó *.v_{it}...
 gU9.H_t..x*oo.àµXXo3 oU-g ú.3 g-ó Sg .àZ YZ.

ß á o*µ -*...

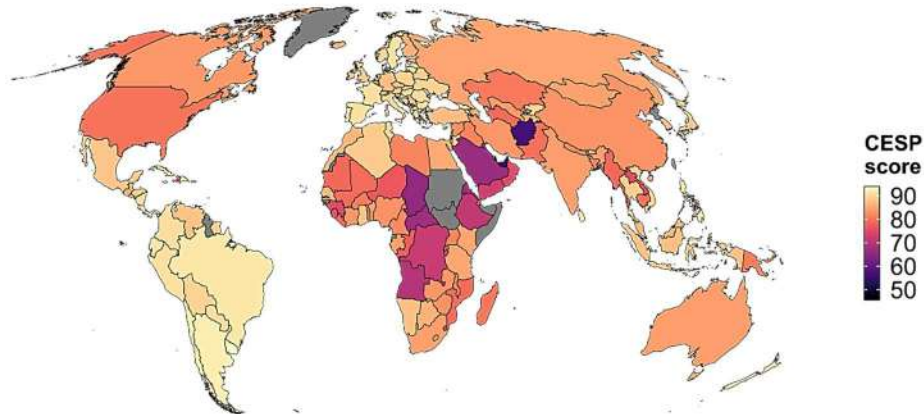
—! o... o*µ -*...*oMSvU.v))ó *...g...M3 X o' oU*Sō...gUg ú*S...v)...! o...<g i vU.O))SMUM...v)...àvMg ...
 w vQ o**..x<OàwY.gMv**..W- ...MµU- S*...vøó ...! o..ß- Ríog ...Xó S9...) v3 ...Wu- ...v...í -í - Z.-! o...
 gUg ú*S...i oQU*..." S' .gU.o' Xv g-SvU.v)...! o.Qvi g .9S- S µ-SvU.v)...<Oàw.*M o*N)v v" o9..i ú.g...
 9o-gSo9..SUpo*-SQ-SvU.v)...! o..*oQ oU-o9'...o g-SvU* SX.i o-" ooU.*vMg ..X vQ o**..x3 ogµi o9..i ú...
 -! o.àvMg ..w vQ o**..rU9o' YgU9.Xó .MgXSg..Mg i vU.)vv-X SU-N9oU-SúSUQ6oú.í og6XvSU...oøo *...
 " ' ó o..* S-*..SU.o))SMUM...! oU9*..g o...vi *ó øo9Zàµi *offioU- úN.-! o..MUpó QUM..gUg ú*S*..S*...
 X o*oU-o9N' S' ...! ó...o*µ -*..*oQ oU-o9..i ú.o3 S*SVU..oøo *N* v" SUQ9Só *o.MUpó QUM.*Xoo9*...
 gU9...! g;oMv S*Z.

ßZV-! o...<g i vU.O))SMUM...v)...àvMg ..w vQ o**...

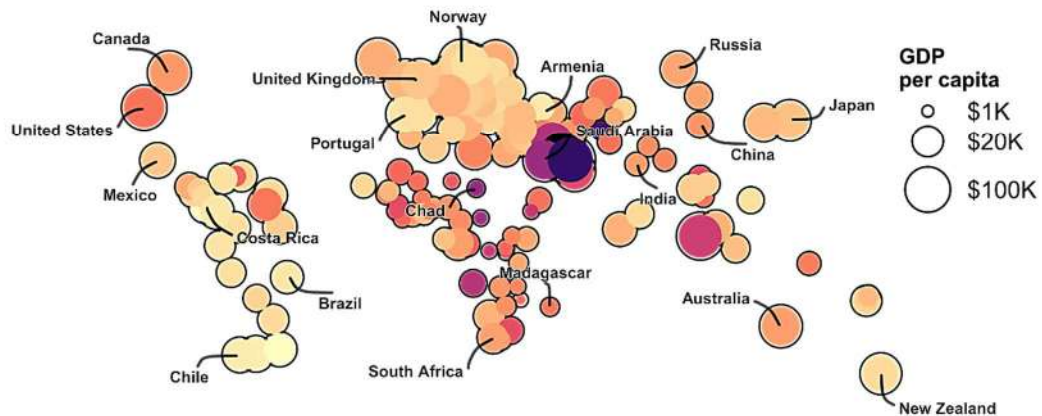
—' vµQ vµ-...! o...Xó S9...) v3 ...Wu- ...v...í -í - N.MµU- S*..." S' ...! o...! SQ o*-...gøó gQ...<g i vU...
 O))SMUM...v)...àvMg ..w vQ o**..x<OàwY.*M o* *µM..g*...<v*g..á SgN-! µQigúnNgU9..G 3 oUg
 o' ' S S-o9...v" ..Xó .MgXSg..Mg i vU.)vv-X SU-...o g-Sō...v...! oS ...oøo *.v)...*vMg ..X vQ o**ZàS Sg úN.
 MµU- S*...Sō..wv -µQ Nà" o9oUNGU9.àXgSUN" ' SM.gMSøo9...! SQ .àwr.*M o*...o g-Sō...v...! oS ...
 Mg i vU.)vv-X SU-...oøo *Ng *v...9o3 vU*-g-o9...! SQ ..gøó gQ...<Oàw.*M o*Z.VU...! o..MµU- g úN.
 MµU- S*..." S' ...! o...v" o*-...<Oàw.*M o*..oS' ó ...! gøo.9SX vXv -SvUg-o ú...! SQ .Mg i vU.)vv-X SU-...
 ' o g-Sō...v...! oS ..àwr...xozN0 g-g N/µ' o3 i vµi QNàSUQXv oNgU9...àgµ9S.G gi SgY.v ...! gøo...
 SUSSMU-.' v -)g *.SU.*vMg ..X vQ o**..gU9...! µ*..MgUv-..gMSøo...! SQ ...<Oàw.*M o*..9oXSō...
 -! oS ...v" ..Mg i vU.)vv-X SU-Ng*..*ooU..SU..G)Q gUS-gUNš o3 oUNGU9..3 gUú..MµU- S*...v)...àµi R
 àg' g gU.G) SMZG3 vUQ...! o..+° ..Ug-SvU*N(gUM...gU6*...! o...! SQ o*-..xí í U9YN)v v" o9..i ú.r-g ú...
 x ß 9YN.-! o...-7 ..x7d-! YNs gXgU.ä i U9YNgU9...+ó 3 gUú..ä 1- YN" ' So...<gU9g.xWí U9YgU9...! o...
 -à.xW -! Y..gU6...! o...v" o*-Z2 v-gi úNà" Süo gU9N9o*XS.o.i oSUQ...! o.i o*-FXó)v 3 SUQMµU- ú...
 vU...! o.àwr.SU.í -í - N.gU6*..1ß 9..vU...! o...<Oàw.gøó gQ...*M oNXgMUQS..i o' SU9...o**..9oøo vXo9...
 MµU- S*..*µM..g*...! o..w' SSXSUo*..xí -! YgU9...-µUSg..xí u-! Yx*oo..(SQí o.í gYZ.

(SQí o.íi.*' v'' *MpuU S*.gðó gQ.+.n w.Xó .MgXSg..) v3 ..Wiu- ..v.í-í-Zr-.)í -' ó .S μ'-g-o*...
 -' g-..MpuU S*.. S' ..! SQ ..<Oàw..*M o*..g o..Uv-... o..'' og -' S*-i μ-... v*o...- g-..g o..i o-ó ..g-...
 -í USUQ..-! oS .SUM3 o..SU-v..*vMg .X vQ o**Z((v ..S*-gUMN<v*-g.á Mg.gU9..G 3 oUg.é o..μXXó R
 3 99 oBUM3 o..MpuU S*Núo-...-! oú...vμ-Xó)v 3 ..g ...! SQ BUM3 o..MpuU S*..SU-ó 3 *..v)...-! o...
 <Oàw..*M oZrUMfU- g*-N..! o..'' og6o*-...<Oàw..Xó)v 3 gUM.S*.*S μ -gUovμ*ú.vi *ó øo9..SU-...-! o...
 Xvú o*-..gU9..'' og -' S*-..MpuU S*Z((v ..-! o..)v 3 ó NSUM3 o...oøo *.9v..Uv-..g v'' ..)v ..g9offμg-o...
 *vMg .X vQ o**...oøo *.v.i o..MU*9ó o9..*μ*-gSugi oč.)v ..-! o...g-ó Nøó ú..! SQ BUM3 o...oøo *.g o...
 g**vMg-o9..'' S' ..*SUSSMgU..oUoSvU3 oU-g .S XgM*.gU9..-! μ*.Mg i vUBU-oU*Sø..*vMg .X vQ o**Z..
 -! S*..)í -' ó ...* ' v'' *...-! g-...i g gUMUQ..*μ*-gSugi o...9oøo vX3 oU-...*vMg N..oMUv3 SM.gU9...
 oUoSvU3 oU-g .XS g *.MgUv-i o.gMSøøo9.i ú..*v o ú.Xí μ*SUQQog-ó .SUM3 o...oøo *.i μ'-g-! ó ...
 i ú..-! o..o' -oU-..v..'' ' SM.SUM3 o...oøo *.9 Söo..*vMg .X vQ o**Z.

a



b



(SQí o.íi.m+ovQgX Mg .Xg-ó U.v)...-! o..<Oàw..*M o..xgYgU9..+.n w.Xó .MgXSg..xi YZ-! o..)SQí o.*' v'' *gðó gQ*...
 vðó ...-! o..Xó S9..Wiu- R-í-Z-! o..XvSU-*..Sio.SU.xi YS..i g*o9..vU-... o..ffμg ó...vv-...oMg o9.øg μo*.v)...-! o..+.n w.Xó ...
 MgXSg..v..S X vøo...-! o..øSS SS-úZ:“ v 9.3 gX.Xv-o9..μ*SUQt v ” o9o.X v;oMSvUZ.

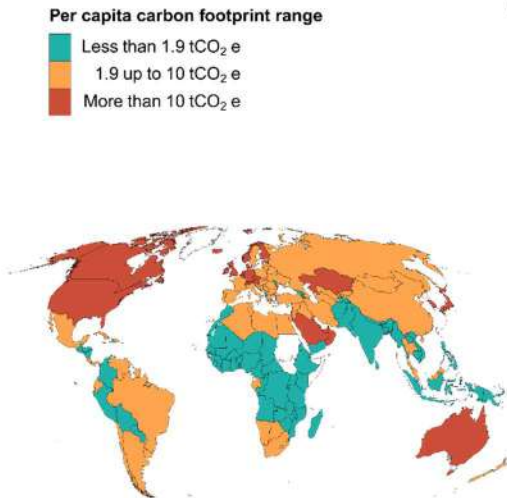
Ví μ .. o*μ -*...-! μ*..μXXv -...-! o..)SU9SUQ...v)...X øoSμ*...μ9S*.. oQ 9SUQ.MpuU S* ..gi SSú-..v...
 i g gUM...i v-! ...*vMg ..gU9...oUoSvU3 oU-g ...Xó)v 3 gUM*Z.((v ..S*-gUMN.9o*XS o...-! o...μ*o...v)...
 9S)ó oU-..*vMg .gU9..oUoSvU3 oU-g .SU9Mg-v *N! SMö .xí-í-YgU9..(gUUSUQ-o-g Zxí-í íY.)vμU9...

M₁U₁ S₁*.μM₁.g₁*.<v₁*g₁.á S₁g₁.gU₁..G i gU₁g₁...v.i o..M₁U₁S₁*oU₁ ú.3 v o.o))S₁U₁..SU₁.. gU₁)v 3 SU₁..
 ' o*v₁í M₁..μo₁..SU₁..v..*vM₁g₁..gM₁S₁o₁o3 oU₁..*..M₁3 X₁g₁ o₁9...-v..." og -' S₁ ..M₁U₁ S₁*.μM₁..g₁*..-' o...-àGN..
 <gU₁g₁g₁.v₁ ..G₁μ₁* g S₁gZ₁..-' o*o.M₁U₁ g₁*..SU₁..-' o..<Oàw₁..*M₁ o.vøó ...' o...g₁*..-' oo.9oM₁g₁o*.M₁g₁..)v₁ ...
 g₁..3 v o..SU₁oX₁..-' ..*..μ9ú..v)...-' o... o g-S₁U₁*' SX₁.i o-" ooU₁..*vM₁g₁ ..X vQ o**..gU₁...Xó ..M₁XSg₁..M₁g₁ i vU₁..
)vv-X SU₁-Z.

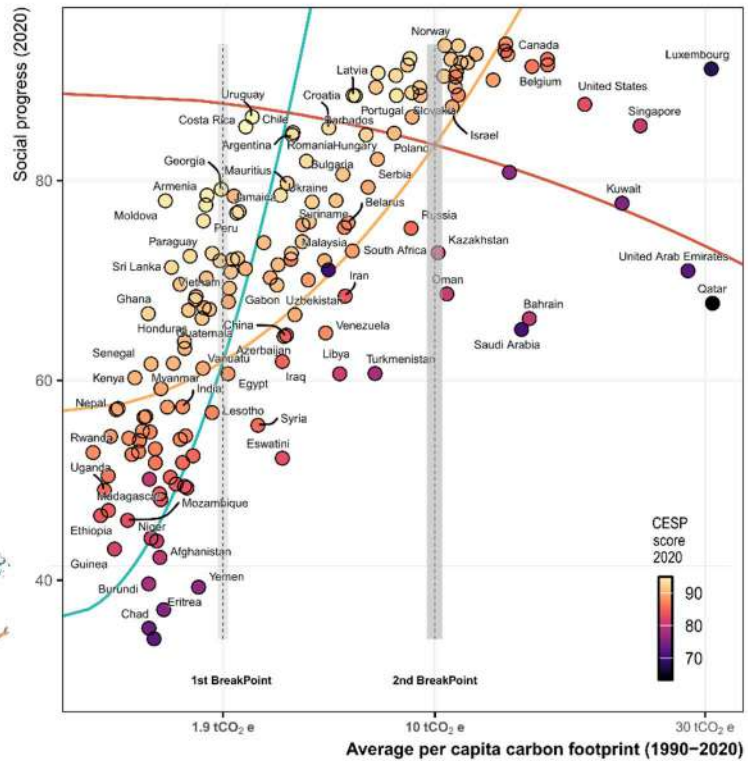
BZ Z<g i vU.O))S₁U₁M₁..wg-ó U₁*.GMv**..O3 S₁*S₁U₁./ oøo *....

G₁*..* v" U₁.gi vøoN₁..-' o..! S₁Q o*-...<Oàw₁..*M₁ o*.M₁gU₁.i o..gM₁S₁o₁o9..g--9S))ó oU₁..M₁g₁ i vU₁..)vv-X SU₁..
 oøo *NSU₁S₁g₁-SU₁vU₁..v₁ .3 v o..." o* v 9.o))oM₁*.SU₁..-' o...o g-S₁U₁*' SX₁.i o-" ooU₁.Xó ..M₁XSg₁..M₁g₁ i vU₁..
)vv-X SU₁..gU₁..*vM₁g₁ ..X vQ o**..Xó)v 3 gUMZ₁..-' S₁*..ú Sio₁9..Xg-ó U₁.S₁.S μ₁* g-o9..SU₁..(S₁Q i o..Bi N₁..
 " ' ó o..." o..*oQ₁ oU₁-o9... o g-S₁U₁*' SX₁..μU₁o₁oS₁..-' o..9S))ó oU₁..-)S-o9..M₁g₁ oøo*..*XoM₁g₁SM₁-v..9S))ó oU₁..
 ' gU₁Q*.v)..M₁g₁ i vU₁..)vv-X SU₁-Z..-' o..-)S-o9..M₁g₁ oøo*..M₁gU₁Q*.S₁U₁SS₁g₁U₁-ú..SU₁..ó 3 *.v)...-' o..* vXo.gMv**..
 -' o..9S))ó oU₁..- gU₁Q*.v)..M₁g₁ i vU₁..o3 S₁*S₁U₁Z₁..-' o..i' og6XvSU₁*.." ' ' ó o..." o*o..M₁gU₁Q*.vM₁g₁ ..g₁ o...
 9o-oMo9..g-..M₁u₁.3 o' SM₁-vU₁*.xSE = 0.06Y.gU₁..W₁.3 o' SM₁-vU₁*.xSE = 0.21Y.x*oo..àμXXo3 oU₁-g₁ ú...
 3 g-ó S₁g₁ .àZM₁Y₁Z₁..

a



b



(S₁Q i o..Bm<v₁U₁ S₁*f₁gøó gQ₁..M₁g₁ i vU₁..)vv-X SU₁..vøó ..M₁u₁-R₁-í -..xgYNgU₁...-' oS₁.. o g-S₁U₁*' SX₁..-' S₁ ' ...' o..àwr..
 M₁ o..SU₁.í -í -NSUM₁μ9SU₁..-' o..9S₁- S μ₁-S₁U₁.v)..M₁U₁ S₁..SU₁..ogM₁...*oQ₁ oU₁..v)...-' o... o g-S₁U₁*' SX₁.xi Y Z₁..-' o...
 i' og6XvSU₁*.gU₁..* vXo*.g₁ o.o*S₁ g-o9..μ*SU₁Q*.oQ₁ oU₁-o9...oQ o*S₁U₁.i g*o9..vU₁..-' o..9-g₁.v)...-' o..oU₁-S o..Xó S/9₁..v₁ ...
 i v-' ..àwr..*M₁ o..gU₁...Xó ..M₁XSg₁..M₁g₁ i vU₁..)vv-X SU₁-Zàffμg₁ o... vv-- gU₁)v 3 g-S₁U₁..-' g₁*.Xó)v 3 o9..vU₁..-' o..! ..g' S₁*..
 M₁g₁ o..v..S X vøo.oSS SSú..v)..M₁U₁ S₁..Xv*SS₁U₁..-' o.Xv-Z₁.. v 9.3 gX.Xv-o9..μ*SU₁Qt v " o9o..X v;OMS₁U₁Z₁..

r...S_N... ó o)ý oNXv**S o...v...9S-SUQ_iS' ...' oo...Qv_iX*...v)...M₁U- S*.i g*o9...vU...-! o..gðó gQ...Xó ...
M_gXSg..M_g i vU.)vv-X SU...vðó ..Wu- R- í - m-! o...v" Ró3 S-SUQM₁U- S*.xn = 67Y.." S' .gU.gðó gQ...
i o v" ..W₁..3 ó- SM-vU*N...! o.3 S99 oR3 S-SUQM₁U- S*.xn = 63Y.." S' .gU.gðó gQ...i o-" ooU..W₁...
gU9..W..3 ó- SM-vU*NgU9...! o..! SQ R3 S-SUQM₁U- S*.xn = 30Y.." S' .gU.gðó gQ...o' Mo9SUQ..W...
3 ó- SM-vU*Z.

—! o..)S*...í' og6XvSU...S*...So ú...v...SU9S_g-o..g..9S))ó oUM...SU..M₁U*₁3 X-SvU...oðo *...Q₁SoU...-! g-...! o...
v" Ró3 S-SUQM₁U- S*.g o.3 v*- ú...v" B₁U₁M₃ oZOo₁U.3 v o.*- S₁SUQ₁N...! o*o.M₁U- S*.gM₁U-...
)ý ..Uóg ú...! g)...! o.." v 9 *.XvX₁ g-SvUZ...! oS...gðó gQ...Xó ..M_gXSg..M_g i vU.)vv-X SU...vðó ...! o...
g*...! oo.9oM₁9o*..S₁i o v" ...! o...! o* v 9.v)...W₁..3 ó- SM-vU*N? ' SM..S*...! o.gðó gQ...oðo ..Uo9o9...
-v..6ooX..Qvi g ...o3 Xó g-í' o..SUMog*o.i o v" ..W%<. <..x<' g'UM N'-í'íYZ...! o..*oM₁U9..í' og6XvSU...
' oX o*oU*...! o.gðó gQ...M_g i vU.)vv-X SU...oðo .g v₁U9..." ' SM...! o..! SQ o*...vM₁g ..X vQ o**.*M₁ o*...
g o...gMS₁o9N.gU9...i oúvU9..." ' SM...M₁U- S*...M₁U...Uv... vUQ₁ ..SUMog*o...vM₁g ...X vQ o**..." S' ...
g99SvUg ..M₁ i vU.)vv-X SU-Z.

I o v" ...! o...! o* v 9.v)...W₁..3 ó- SM-vU*N₁M₁U- S*.gMS₁o9...! o.3 v*...S₁U₁S₁M₁U-SUMog*o*..SU...
*vM₁g ...X vQ o**..x3 og*₁ o9...SU..àwr...₁U*Y.Xó ..g99SvUg ..₁U*...v)...M₁ i vU.)vv-X SU...x₁>1,9 =
13.57čSE = 0.46YNSU9S₁g-SUQ! SQ ú..M₁ i vU₁))S₁SU-Qv" -! .v)...vM₁g ..X vQ o**Z2 v-gi úN3 gUú...
v" Ró3 S-SUQ..M₁U- S*...g-S₁U₁9...àwr...*M₁ o*...gi vðo... - ...SU..í - í - N.SU9S₁g-SUQ...₁U* *gU-S₁g ...
S₁ X vðo3 oU*..SU...! oS ...vM₁g ...X vQ o**... o g-S₁o...v...! oS ..gðó gQ...M₁ i vU.)vv-X SU-Z...! o.i o*...
Xó)ý 3 SUQM₁U- S*..." S' SU...! S*.Qv₁X.9o3 vU* g-o.g.i o—ó .gi SSú...v.i g gUM..i o-" ooU...! o...
oU₁SvU₁ oU-g .gU9..vM₁g ..XS g *.v)...₁U* gS₁gi o.9oðo vX3 oU...xg *v.6Uv" U.g*...! o..+v 9o3 i ó Q*...
<v Uó č.à-oS₁i ó Q₁ .gU9..á vi ó -*N'- WYZ.

rU..M₁U- g*-N3 S99 oR3 S-SUQM₁U- S*...g o.3 v o...QvQgX' S₁g ú..9S₁Xó *o9..gU9...oUM3 Xg*...
i v-! ..3 S99 oRgU9...! SQ B₁U₁M₃ o...Ug-SvU*Z:" S' SU...! o.. gUQ...v)...Xó ..M_gXSg..M_g i vU.)vv-X SU...
xi o-" ooU..W₁..gU9..W..3 ó- SM-vU*Y₁N...! o..SUMog*o..SU..M₁ i vU.)vv-X SU...X S₁ g S₁ú...*o3 *) v3 ...
' SQ ó ..SUM3 o...oðo *NgU9..M₁U*off₁oU- úN! SQ ó ..M₁U*₁3 X-SvU...oðo *ZG*..g'...o₁U* -Nàwr.*M₁ o*...
" S' SU...! S*... gUQ...M₁U-S₁U₁o...-v... SoNi ₁U...SU...g... o**..M₁ i vU₁))S₁SU-..3 gU₁U₁ N3 ogUSUQ...! g-...
M₁U- S*...Q₁U₁ g-o...S₁U₁S₁M₁U- ú...o**..vM₁g ...X vQ o**..Xó ..g99SvUg ..₁U*...v)...M₁ i vU.)vv-X SU...
x₁>1,9≤x≤10 = 2.63čSE = 0.09YZ...! o*o.M₁U- S*...XgU.gMv*...! oQ₁SvU*...₁U*...g*.../ g-SU..G3 ó S₁gN.
O₁ vXoNgU9...<oU- g R₁v₁U-! ..G*S₁gNM₁oó SUQ.g.9S₁ó *o..g' gú.v)...Ug-SvU*...gUQ₁UQ.) v3 ..à" o9oU...
x" S' ...! o..! SQ o*-àwr.*M₁ o.SU...! o.Qv₁XY...v..OQ₁X-x" S' ...! o...v" o*...àwr.*M₁ o.SU...! o.Qv₁XYZ.

rU...! o..M₁g*o.v)...! SQ R3 S-SUQM₁U- S*...xgi vðo..W..3 ó- SM-vU*YNg99SvUg ..M₁ i vU.)vv-X SU...
9vo*..Uv-... o₁U* -SU.gUú..g99SvUg ...Q₁SU*..SU..vM₁g ...X vQ o**Z...! S*..SU9S₁g-o*..M₁ i vU₁U-oU*S₁o...
9oðo vX3 oU...Xg-! " gú...gU9...Xv*o*...g*...S₁U₁S₁M₁U-M₁U* gSU...!v ...gMS₁o9SUQ...;U*...-! gU*SSvUZ.
“ S' SU...! S*... gUQ...v)...M₁ i vU.)vv-X SU-NM₁U- S*...So.2 v ” gúNà” S-üó gU9NgU9...+ó 3 gUú...
o' ' S S...i v-! ...! o...! SQ o*...vM₁g ...X vQ o**..Xó)ý 3 gUM...gU9...! o... v" o*...M₁ i vU.)vv-X SU...
M₁3 Xg o9...v...v-! ó ..M₁U- S*...SU...! S*... gUQZ<vUðó *o úNM₁U- S*..." S' ...! o..! SQ o*...M₁ i vU...
)vv-X SU...gU9... o g-S₁o ú...v" ...vM₁g ...X vQ o**..g o.X S₁ g S₁ú...vM₁g-o9..SU...! o..+₁U)..à-g-o*Z...! S*...
Xg—ó U.úS₁9*..g*..- SM ú..UoQ-S₁o... o g-SvU* SX.x₁>1 = -0.5; SE = 0.04Y.gMv*...! o.ß- ...! SQ R
o3 S-SUQM₁U- S*Z.

...

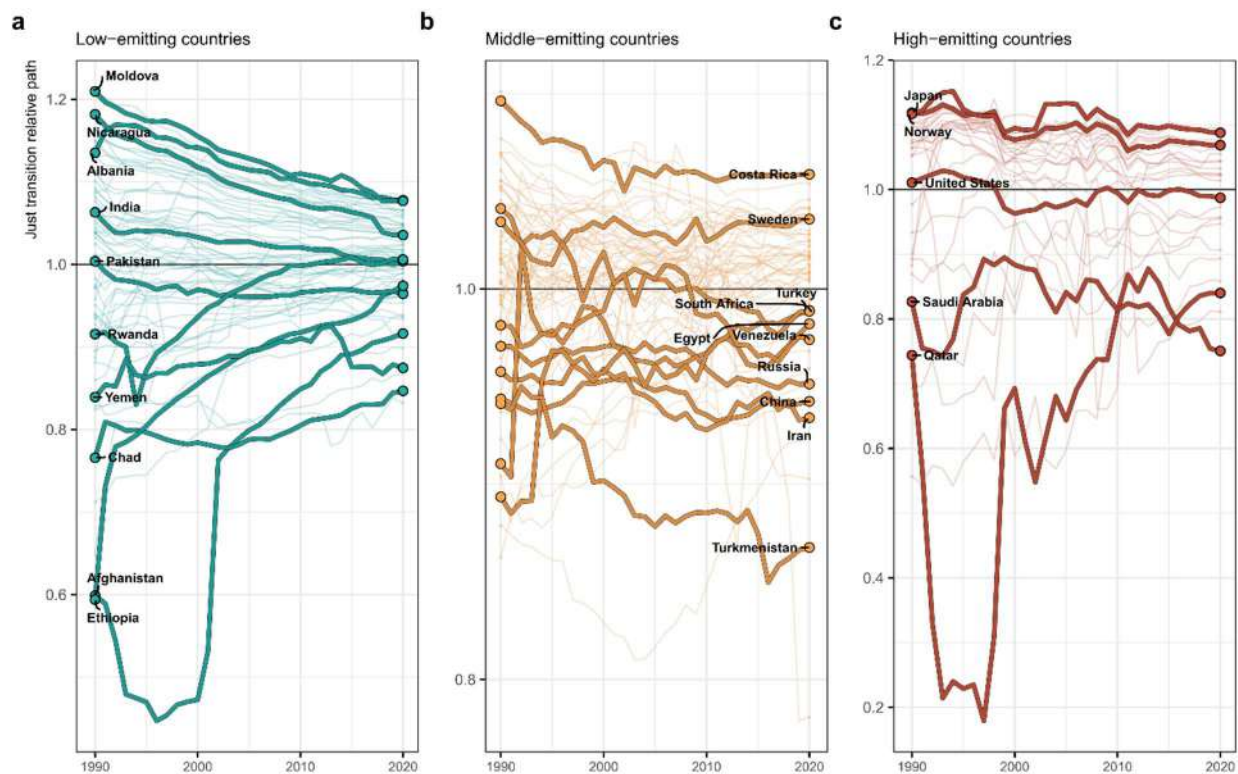
βΖΖ-¹ o.sµ*...´gU*SSU.á o g-Sðo.wg-¹ *....

<vµU- Sð*...o' Xó SðUM...ðg´ úSUQ. g-o*...v)...S X vðo3 oU...SU...¹ o...<g´ i vU...O))SðUM...v)...àvMg´ ...
 w´ vQ o**..x<OàwY.vðó ...S oNSJ) µoUM9..i ú...¹ oS ..SSSg´ ...øðo *..v)...*vMg´ ..X vQ o**..gU9..Mg´ i vU...
)vv-X SU-Z.<vUðó QðUM...¹ vµ 9...i o...Xó MSðo9...g*..g...3 ogU*...-v...9S SUS´ ...9Sxg´ Sð*...i o-” ooU...
 MµU- Sð*...SU...-ó 3 *..v)...¹ o...<OàwN.µ -S g-o ú... o*µ -SUQ..SU...g...QðU g ...3 vðo3 oU...-v” g´ 9*...
 MµU- Sð* ...;µ*...´ gU*SSvUZ.“ o...3 og*µ´ o...¹ Sð*...3 vðo3 oU...µ*SUQ...¹ o... o g-Sðo...Xg-¹ ...v)...;µ*...
 ´ gU*SSUN?” ’ SM...´ gM*..ogM...MµU- úfk...<Oàw...´ g; oMv´ ú... o g-Sðo...-v...¹ o.gðó gQ...<Oàw...g...
 ogM...XvSU...SU...S oZG...QðU g ..SUMog*o..SU...<Oàw...gU9..g..9oMog*o..SU.Mv**RµU- ú..9S)ó oUM*...
 ´ o*µ -..SU.MUðó QðUM.gU9..*SU)ú.X vQ o**...v” g´ 9*..g..Qvi g ..;µ*...´ gU*SSvUZ.

I g*o9...vU...¹ SðN.” o...o*...¹ o...MUðó QðUM...¹ úXv-¹ o*S...g...¹ o...)µ ...XgUð ...xQvi g Y.. øðo ...gU9...
 *oXg´ g-o ú...´v ...¹ o... v” Rñ3 S99 oRñ.gU9...¹ SQ R3 S-SUQ..MµU- Sð*Z...¹ o... o*µ -*...µXXv´ -...¹ o...
 MUðó QðUM...¹ úXv-¹ o*S...¹)´v ...¹ o...)µ ...XgUð ...v)...MµU- Sð*Z...¹ Sð*...µQð*...¹ g...MµU- Sð*...g´ o...
 3 vðSUQ...v” g´ 9*...;µ*...´ gU*SSvU.vU...¹ o.Qvi g ...øðo .9µo...-v...¹ o.9S SUS´ SUQ.9Sxg´ Sð*...SU...¹ o...
 Mg´-MSUQµX.v)...¹ o...v” .Xó)v´ 3 SUQ.MµU- Sð*...¹ S´ ...¹ o.i o-ó .Xó)v´ 3 SUQ.vUð*..SU...ó 3 *..v)...¹ o...
 <OàwZ." v” øðó N-¹ Sð.MUðó QðUM..9vo*..Uv...µU)v 9..µUSv´ 3 ú..gMv**..g´ ...øðo *..v)...Mg´ i vU.Xó ...
 MgXSg...o3 Sð*SSUZ.G*..vµ´ ...µi *offµoU...gUg´ ú*S...¹)µ´ -¹ ó ... øðog *NvU ú...v” RgU9...¹ SQ R3 S-SUQ..
 MµU- Sð*...g´ o.o' Xó SðUMUQ.MUðó QðUMN.” ’ So.g...SUSSMgU...Uµ3 i ó .v)...MµU- Sð*...x-¹ o.3 S99 oR
 o3 S-SUQ.vUð*Y.g´ o..SU.g...*g-o.v)...9Só QðUMZ...¹ Sð*...Sµg-SvU.X o*oU*...SUSSMgU...vi *gMð*..SU..
 gMISðSUQ...;µ*...´ gU*SSvU.Qvi g´ úZ.

(SQ´ o... .9oXSM*.MµU- Sð* ...;µ*...´ gU*SSvU...o g-Sðo.Xg-¹ N)v´ ...v” Rñ3 S99 oRñ.gU9...¹ SQ R3 S-SUQ..
 MµU- Sð*ZàXoM)SMg´ úN(SQ´ o... .g.S µ*´ g-o*...¹ g...v” R3 S-SUQMµU- Sð*...g´ o.µU9ó QvSUQ..gX9...
 MUðó QðUMNg*..øð9oUM9.i ú...¹ oS ...´ gU*SSvU...v” g´ 9*..µUS-úN.” ’ ó o...¹ ó o.Sð.Uv.Mv**RoMSvUg´ ...
 ' o-ó vQðUðS-ú...SU...¹ o...<Oàw...Xó)v´ 3 gUMZ...¹ o...MUðó QðUM...Xoo9...Xg´ g3 o-ó ...¹)´v ...¹ o... v” R
 o3 S-SUQ..MµU- Sð*N.o*-S g-o9...g-..β = 0.5 .xSE = 0.047YN.Sð*...SUSSMgU- ú...Xv*SðoNX vð9SUQ..
 *´ vUQøð9oUM..SU...µXXv´ -..v)...¹ o...MUðó QðUM...¹ úXv-¹ o*SðZ.

" v” øðó N.3 S99 oR3 S-SUQ..MµU- Sð*... o' ' S S... Uv... *SU*... v)... MUðó QðUMč... SU*og9N...¹ oú...
 9o3 vU*´ g-o...g...9Só QðUM...SU...¹ o...<Oàw...´ oU9*...x*oo...(SQ´ o... i YZrU9oo9N...¹ o...MUðó QðUM...
 ' úXv-¹ o*S...Mµ 9...Uv...i o...ðó Sð9...)´v .3 S99 oR3 S-SUQ..MµU- Sð*Ng*...¹ o...MUðó QðUM...Xoo9...
 Xg´ g3 o-ó .Sð*...SUSSMgU- ú..UðQ-Sðo.xβ = -0.58č.SE = 0.1YZrU-ó o*-SUQúNMUðó QðUM.gXXó g´ *...
 -v... oo3 ó Qð...g3 vUQ..¹ SQ R3 S-SUQ..MµU- Sð*...xβ = 0.12č.SE = 0.17YZ." v” øðó N-¹ Sð...MgU..i o...
 9o*MS o9.g*..gU.o´g´ úR-gQ..MUðó QðUMN9 SðoU.i ú...¹ o...gX9..Mg´-MSUQµX.v)...g..o) ” .MµU- Sð*...
 ” S´ SU...¹ Sð*...Q vµX...” S´ ...v-¹ ó *...x*oo...(SQ´ o... i YZ.<vU*offµoU- úN...¹ o...MUðó QðUM...Xoo9...Sð*...
 -¹ ó o)v´ o.3 µM...* v” ó .M3 Xg´ o9...-v...¹ g-v)...¹ o...v” R3 S-SUQMµU- Sð*Z.



(Sq o...msp*...gUSsvU...o g-Sw.Xg-í *vðó ..Wu-R-í- Z<vpuŦ S*ğ o.QvpuXo9.gMŦ 9SUQ..v-ı' o.X o9o)Sü9...
Xö .MGSg.Mğ i vU.)vv-X SU'...gUQp*SZN.v" o3 S-SUQ3 999 o o3 S-SUQgU...SQ o3 S-SUQMpUŦ S*No3 S-SUQ..
o'xoMŦso ú...o*...ı' gU.WuNi o" ooU.Wu.gU...WNgU.3 ý o...ı' gU.W.3 o- SM-vU*.vU.gðó gQp.vðó ...ı' o.Wu-R-í- ...
Xö S9Z<vUðó QpUM...vPR...o*...*g-S-SMS..Q.gog-ó ...ı' gU-ı' o.MSSğ ...ı' o* v9...)... WZ%ı' ...ı' o..v" o3 S-SUQ..
gU...ı' SQ o3 S-SUQ..MpUŦ S*N.v-ı' ó " So...ı' ó o..S*...Uv...MFUðó QpUM...xı' ...ı' o..3 999 o o3 S-SUQ..MpUŦ S*YZ..
<vUðó QpUM...S XSğ-SvU..vU-ı' o.gðó gQp.Qv" -ı' 'g-o*..v)...ı' o...<Oàw...*MŦ o*..ğ o.*' v" U.SU.(SQàZ ZVSU-ı' o...
àpXXo3 oU-ğ ú.3 g-ó Sğ Z.

Vðó g Nvíp ...)SU9SUQ...oQg 9SUQ...! o..MÚþó QUM...Xg—ó U*..v)...i v-! ...v” R3 S—SUQ.gU9...! SQ R
o3 S—SUQ.MÚU— S*..M3 Xó3 oU...! oMU...))SU9SUQ...) v3 ...! o... *g)o..gU9...;µ*—...XgM ...) g3 o” ́ v 6...
x(*gUUSUQ.o...g ZNí-í-íYZàXoMSMg* ún.N! oú...! SQ SQ ...-! o..X v3 S3SUQ.*µ*—gSgi SS-ú...́ g;oMv S*..
v)...MÚU— S*...))gMUQ...SQUSSgU...*vMg ...*! ́ -)g *NMU— g*—SUQ.” S-! ...! o... gM...v)...X vQo**..SU..
’ o9µMQU...oUþSvU3 oU-g ...vðó *! vv...vi *ó ðo9...SU...3 gUú...g)) µoU... Ug—S U*...x+*vµQ N.í-í-č*..
“ *S93 gUU.o...g ZNí-í-íYZ-! S*.9SMv-v3 ú.S**” o .S µ*— g-o9..i ú...! o...SQUSSgU...9S)ó oUM...SU..
-! o...Xoo9..v)...MÚþó QUM...i o—” ooU...! o...v” RgU9...! SQ R3 S—SUQ.MÚU— S*Z.

VUo.v)...! o.3 gSUmU- S μ-SvU*.v)...!)S9SUQ...S*.SU...! o.xUvUMFUpó QUM.Xg—ó U.vi *ó øo9...
g3 vUQ3 99 oR3 S-SUQMμU- S*Z...! o.Sgi SS-ú...v.óó Sjú...! o.MFUpó QUM...! úXv-' o*S...) ' S*...
Q vμX... gSo*...*oóó g...MUM U*... oQg 9SUQ...! oS...gi SS-ú...-v.gMSøo...;μ*-...- gU*SSvUZàμM...gU...
S Xv -gU-.)S9SUQMμ 9...! gøø.og*Sú.i ooU.vøó vv6o9.S)...! o.MFUpó QUM...! úXv-' o*S...) g9.i ooU...
-o*-o9..." S' vμ-...X S' ...oQ3 oU-g-SvU.i ú...Mg i vU.o3 S*SvU... gUQZrU9oo9N." ' So...MFUpó QUM...
g3 vUQ.v" R3 S-SUQgU...! SQ R3 S-SUQMμU- S*.S*.μ))SBU...v...oXý -Q.vi g...MFUpó QUM.v)...!

Vðó ...' o...g*-9oM9o.v)...' o.Xó Sv9Ng.MU*9ó gi o.Uú3 i ó .v).3 99 oR3 S-SUQMú- S*NgU9...
 < µi .β.gU9... Mú- S*.SU.Xg -SMí g N! gðo..9oðg-o9..) v3 ...' o..9o*S09...<Oàw... g;oMv' ú.gU9...
 g o.Mí' oU-ú.vU.g.Xg-' .v).SUMog*SUQú.µU*µ-gSgi o.*vMg .X vQ o**Z... ' S...' ' v' úSUQ... oU9.S...
 ' o) oMo9.SU.<Oàw.*M o*N' ' SM...! gðo.*ooU.Uv.S X vðo3 oU-ú' ..! gðo..)g oU.*' g Xú.*SUM.i - W...
 x(*SQí o..%YZ* OðoU.3 v' o.*- S\$SUQúN< µi .β.gU9... Mú- S*.g vUo.gMúU-.)v' .g 3 v*-g... ' S9...
 v)...' o..." v' 9 *..XvXµ g-SUNSUMµ9SUQ.Mú- S*...µM..g*...<' SgNá µ**SgNí gU..gU9...-µ 6oúZ.
 GMSðSUQ;µ*... gUS\$U.Qvi g ú.3 SQ -N.v.g.Qog-ó' -oU-Ni o.µU9ó 3 Sù9.i ú... ' o... g;oMv' S*...
 v)...' o*o.Mú- S*Z.

. n S*Mú**SvU...

-v.gMISðo...;µ*... gUS\$UNUg-SvU..3 µ*..oU' gUM... ' oS .MgXgMú...v..o))SSU-ú.MUðó -... ' oS...
 ' o*vµ M*.SU-v.gMISðSUQ... ' o.UoM**g ú...oðo *.v)...*vMg .X vQ o**x" *Mo Ní-í-č.V 2 oS ..o-.g ZN*
í- WYZ. +SòU... ' o... *µi *gU-g ... 9S.Xg SS*... SU... oUòSvU3 oU-g ... X o**í o*... gU9... *vMg-g ...
 gMISðo3 oU*...g3 vUQ..Ug-SvU.N.g99 o**SUQ... ' o...S*µio..v)...µ*µ-gSgi SSú...o))oMSò ú... offµS o*...
 MU*9ó SUQMú- S* ...oðo *.v).9oðo vX3 oU..gU9.oUòSvU3 oU-g .S XgMZ... ' o.<Oàw.oðg µg-o*...
 Mú- S* .Xó)v' 3 gUM... o g-Sò...v..ogM..v)... ' o*o.Mú- úRxoM\$SMg- S µ-o*.gU9.MU... ' µ*.i o...
 ' oQg 9o9.g*.gU.gXX vX g-o.3 og*í o.v).Mú- S* .;µ*... gUS\$U.Xó)v' 3 gUMZ.

<vUðó QUM.SU... ' o.<Oàw.S*... ' o.6oú.MU9S\$U.)v' .gMISðSUQ... ' o.;µ*... gUS\$U.Qvi g ú.*SUM...
 S..S*... ' o... o*µ -v...).g...Qú g .S X vðo3 oU-NgU9..g..9oMog*o..SU... ' o..9S.Xg SS*...SU.Mú- S* ...
 gi SSú...-v..g-gSU.*vMg .X vQ o**..." ' So..9oMog*SUQ... ' oS .Mg i vU.)vv-X SU-ZrU.g99SS\$UN... ' S*...
 MUðó QUM.gUg ú*S*.S.MU9µMo9.i v- ' .vU... ' o.Qvi g ...oðo .gU9..." S' SU.9S-SUM...gUQ*.v).Xó ...
 MgXSg..Mg i vU.)vv-X SU-NoUgi SUQ.µ*...v... oðog ... ' o.*SUSSMU-MU- g*...SU... ' o..MUðó QUM...
 *Xoo9*Z... ' S*.)í - ' ó .S µ'- g-o*... ' g... ' o.Xv-oU-g .v) ' .gMISðSUQ;µ*... gUS\$U.ðg S*.gMv**...
 9S)ó oU...oðo *.v).oUòSvU3 oU-g .S XgMZ.

rU... ' S*.XgXó ...' o.*' v" ...' g-... ' o.SS\$g .9S.Xg SS*...vi *ó ðo9..9oMog*o9..Uv-gi ú.vðó ...S o.g*...
 3 gUú... Mú- S*... MgµQ -... µX..." S' ... ' oS ... i o-ó Ró)v' 3 SUQ.. MúU-ó Xg -Z... ' S*... ' o) oM*...
 *µi *gU-g .S X vðo3 oU*..SU.*vMg .X vQ o**..." ' So.6ooXSUQ... ' o.Xó .MgXSg..Mg i vU.)vv-X SU*...
 v" ..x+*vµQ Ní-í-č.. S93 gUU.o-.g ZNí-í-YZ*... ' S*..S.Xg -SMí g ú... µo..v) ' o...v" R3 S-SUQ..
 Mú- S*N' ' SM..SU9Mg-o*..g.*- vUQ.Xv-oU-g .v) ' oS .;µ*... gUS\$U.Xg- ' *Zàµ*µ-gSUQ... ' S*...
 X v3 S\$SUQ... g;oMv' ú...offµS o*.SUMog*o9.Sùo*-3 oU..SU.µUðó *g .Qv9*..µM..g*.Xµi SM' og - ' ...
 gU9..o9µMg-SvU...v...))í - ' ó ..X v3 v-o..*vMg .X vQ o**x(*gUivUS.gU9..à UMoüRGUMMogNí- Wč..*
" Mo Ní-í-YZ.

r-.S.S Xv -gU...v...! SQ SQ -... ' g-...v" R3 S-SUQMú- S*N' ' SM.gMúU-.)v' .Uó g ú..! g .v)... ' o...
 " v' 9 *..XvXµ g-SUN3 gSU-gSù9.gU.gðó gQ.Xó .MgXSg..Mg i vU.)vv-X SU..i o v" ... ' o.Mú...<Ví o...
 -' o*' v 9.9µ SUQ... ' o.Wiu- í-í-.Xó S9Z... ' S*... ' o*' v 9'...oX o*oU*... ' o...oðo .UoM**g ú...v...S S...
 Qvi g ...-ó3 Xó g-µi o... Sò...v...W%. <..i ú..í - β- ..x<' *gUM Ní-í-YZ* GMSðSUQ.MUðó QUM.SU... ' o...
 <Oàw..g..g..*µ))SSU-XgM..." S' SU... ' S*.Q vµX.S*...o*oU-g .v) ' ..ogMSUQg.*-og9ú.*-g-oN" ' ó o...
 ' g .v)... ' o..." v' 9 *..XvXµ g-SvU.g-gSU... ' o... offµS o9...oðo .v)...*vMg .X vQ o**..." S' SU.XgUo-g ú...
 i vµU9g S*.xV 2 oS ..o-.g *ZNí- WYZ*.

" v" oðo N-' o.9S)ó SUQ.Xg—ó U*.v)..MÚó QUM.gMv**..oðo *.v)..Xó ..MgXSg..Mg i vU..)vv-X SU...
 ' gSo.*SUSSMgU..ffio* SvU*.gi vµ-! v" .g.;µ*-! gU*SSvU.MgUi o...og Sio9ZrUMµU- S*." S' .ðó ú...
 v" ..Xó ..MgXSg..Mg i vU..)vv-X SU-NX S g' Sú..v" BUM3 o.Ug-SvU*Ng.;µ*-! gU*SSvU.S*.3 v o...Só ú...
 -v...vMµi ...-! vµQ ..S X vøSUQ.*vMg ..X vQ o**..g-..g-..g-o-...! g-..o' Mo9*...-! o... So...SU..Xó ..MgXSg...
 Mg i vU..)vv-X SU-N. o) oMSUQ.g..X vM**..v)... o g-Só..9oMµX SUQ.i o-" ooU..*vMg ..X vQ o**..gU9...
 oUøS vU3 oU-g .X o**í o*ZG*..*vMg ..X vQ o**..g9øgUM*.gU9.S*...g-o.v)..SUMog*o.* v" *NgMSøSUQ..
 g...;µ*-! gU*SSvU..UoM**S-g-o*...g-.. o9µMSvU..SU..Xó ..MgXSg..Mg i vU..)vv-X SU-N.*SUúSUQ.gU..
 gi *v µ-o...9oMµX SUQ..X vM** gU...oU9ogøv ...-! g-...S*..MÚSó gi ú...3 v o...Mg oUQSUQ..-v...
 gMM3 XS' .x" *Só Ní- WYZ.*

rU..)gMN-' o...* v" ...MÚó QUM..v)...! SQ R3 S-SUQ.MµU- S*..MgU..i o...g- S µ-o9...3 gSU ú...-v...
 9S SUS' SUQ.*vMg '...o-µi U*.g*...o*vµi M.µ*o.SUMog*o.*x(*gUUSUQgU9..V 2 oS Ní- Wč.ö vQ .o-g ZN*
í-í WZ.-! S.)*SUSUQ..gSo*..MUM U*...oQ 9SUQ..! o...;µ*-! gU*SSvU.Xv-oU-Sg ..v)...! o*o.Ug-SvU*...
 gU9.µUó *M o*..! o...*µMM**9o)S(.v)...! o.3 v*..*vMg ú.X vQ o**o9.MµU- S*..x" *Só Ní-í- YZ.*
 G99SSvUg úN..o*og M.i ú...(*gUUSUQgU9..."* *Só .xí-í BY.* oðog *...! g-...! SQ R3 S-SUQ.MµU- S*N..
 MÚS-SUQ.v)..Bu...+ vi g .2 v -! .Ug-SvU*N! gøo.o' Mo9o9...! oS ..)gS ..*! g o.v)...! o.Mg i vU.i µ9Q-...
 i ú.vøó .í Z- S o*Zt v ovøó NÚvU..v)...! o*o.MµU- S*..g' o...o9µMUQ.Mg i vU.o3 S*SVU*.g-...g-o*...
 g SUø9..." S' ...! o...g Q-*.o-..i ú...! o.wg S..GQ oo3 oU..xö vQ .*gU9..."* *Só Ní-í BYZ*oøoU.µUó ...
 -! o.3 v*...vX-S S-SM*MUg Sv*..v)..gMSøSUQ.Uo-...üo v...o3 S*SVU*.i ú..í - % N-' oS ...M3 µ g-Sø...
 o3 S*SVU*.g' o.X v;oMo9...v..i o.Lög ú...! oo...S o*..! SQ ó ...! gU...! o..)gS ..*! g o.M3 Xg-S o..." S' ...
 -! o..*W%*<...S S.x(*gUUSUQgU9..."* *Só Ní-í BYZ.*

rUg99SSvU..v...! o.* v" ..MÚó QUM.v)...! o...! SQ R3 S-SUQMµU- S*N" ' g-..." o.)SU9.Xg -Sµi g' ú...
 MUM USUQ.S*..! o.9Só QUMNv ..Mµi ..MÚó QUM..v)...! o.3 99 oR3 S-SUQ.MµU- S*N" ' SM...
 X o*oU*..g.*SUSSMgU..vi *gMb...v..gMSøSUQ.;µ*-! gU*SSvU.Qvi g' úZ.-! S.9Só QUM.MgU.i o...
 o' XgSø9.i ú...! o...o g-Só ú..Mg i vUvU-oU*Sø..X v9µMSvU.Xg-ó U*.gU9.g...S So9..vXXv -µUú...
)v ..S X vøø9..*vMg ..X vQ o**..x/g3 i .o-g ZNí- WYZt 99 oR3 S-SUQ.MµU- S*..g' o...! ó o)v o...
 µUó QSUQ." 9oUSUQ.9SXg SS*..SU..! oS ..gi SSú...v...*µ*-gSgi ú...! gU*)v 3 '...o*vµi M.µ*o.SU-v...
 *vMg ..gMSøø3 oU*Z.-! S*..! oU9..*µQQ*...! g-...! ó o.S..Uv..SU9Mg-SvU.v)..g.Xv-oU-Sg ..Mg-MRµX..
 SU..! o.*' v -v ..3 o9µ3 ..ó 3 Ng*..! S.µUµ*-gSgi o...! g;oMv ú...! g*.Xó *S-o9..)v ..3 v o...! gUg...
 9oM9oZ.

“ ' So...3 gUú...3 99 oR3 S-SUQ..Ug-SvU*N.v)-oU...o3 ó QUQ..oMvU3 S*N.g' o...Mg gMó Sio9...i ú...
 ' o*vµi MµU-oU*Sø..X v9µMSvU.Xg-ó U*.x“ *gUQgU9..sSgUQNí-í- YN.*! o...! SQ R3 S-SUQMµU- S*...
 g *v...gM...-! o... S6..v)...i oSUQ.µUgi o...v..3 vøo...v" g' 9*..;µ*-! gU*SSvU.9µo...v...! oS ..Mg i vUR
 SU-oU*Sø...MÚµ3 X-SvU..Xg-ó U*...x" *Só ...gU9... 7 g' S.N.í-í- YZ.-! S*..*Sµg-SvU.. 3 g6o*...S...
 SUMog*SUQú.9S)Sµi -...v..9oMµXo.*vMg ..X vQ o**..v3 ..Mg i vU.o3 S*SVU*.gU9..S.g *v'..o) oMo9...
 SU..! o.* v" ..MÚó QUM.v' .* S.9Só QUM..) v3 ...! o.9o*Sø9...! g;oMv ú...v...;µ*-! gU*SSvUZ.

(v3 .g..Xv Sµ..*gU9XvSU-N-' o*o.)SU9SUQ..Mg oUQ..MÚoU-SvUg ..Xó *XoMSø*vU.9oMµX SUQ..
 9oøo vX3 oU..) v3 ..Mg i vU.o3 S*SVU*NµiM.g*..! o.OøS vU3 oU-g .7 µüUo-*.<µi øoN. SQ SQ -SUQ..
 -! o.S Xó g-Sø..)v ..SU-oU*SS9..Xv Sµ..SU-ó øoU-SvU*.gU9..i o' gøSv g ..* S-ZrU.g99SSvU..v...! o...
 µUX v3 S SUQ- g;oMv S*..v)...! o...! SQ R3 S-SUQMµU- S*NXv Sµ..3 g6ó *.3 µ*-Xgú..Xg -Sµi g' ...

g—oU—SvU...v...9Só QSU.3 99 oR3 S—SUQ.MpU— S*...xo*XoMg ú...)vMh*SUQ.vU...Mpi ...ßYZ.—' oS ...
 µU*µ*—gSgi o.— g;omV S*.3 gú.g *v.i o.g.— S µ—o9...—v...oU...o' — gMSvU.X vM**o*...x(gUUSUQ.o—
 g ZNí-í- N." ' SM...X S S Sio...—' o...o' XvSg—SvU.v)... o*ví M*...))v ...)SgUNG ...QSU. g—' ó ...—' gU...
 g99 o**SUQ. µ3 gU.Uo9*N." ' So...o úSUQ.vU.3 oMgUS3 *.v).MU— v .gU9.9v3 SgUM...v.3 gSU—gSU...
 vMg ..gi SSú...xn G Sg.gU9..7 g Sñ-í-č." Mo N— WYZ.

—' ó o)v oN.—' o.X S g ú.vi *gMb.SU.—' o.)gM.v).gMSøSUQ.;µ*— gU*SSvU.9vo*.Uv—.*v o ú.é So...
) v3 ...—' o... gX9.SUMog*o.SU.MU*µ3 X—SvU...o9o *..vi *ó øo9.SU.9o9o vXSUQ.MpU— S*...xÜ' oUQ.o—
 g ZNí-íßYZ.—' o.g—oU—SvU.*' vµ 9..g *v.i o..9SoMo9...—v" g 9*...—' o..3 99 oRgU9..! SQ R3 S—SUQ..
 MpU— S*N." ' SM.o' ' S S.*— µMí g ú.3 v o.Mg i vU—U—oU*So.9o9o vX3 oU—Xg—' " gú.gU9..! gøo...
 S So9..gi SSú...—v...9oMµXo..) v3 ..Mg i vU..o3 S*—SvU.Z.—' S*..µU9ó *M o*...—' o..MµMg ..Uo9...))v ...
 Xv SM3 g6ó *..v...X S S Sio..." o i oSUQ.S X vøo3 oU—... g—' ó ...—' gU..oMvU3 SMQv"—' ..g*..g..M o...
 9o9o vX3 oU...vi ;oMSø.o.x" Mo ..o—g ZNí-í WsgM*UNí-í WZ.

—v..gMSøo...;µ*— gU*SSvUN.—' o...v" R3 S—SUQ.MpU— S*..MgU.*S ..SQSSM—ú..SUMog*o...—' oS ...
 <Oàw...M o*...—' vµQ ...—' o... o g—So...9oMµXSUQ.v)...*vMg ...X vQo**...)) v3 ..Mg i vU..o3 S*—SvU.N.
 S XúSUQ...o**..MU*— gSUQ.— g9oRv)).M3 Xg o9...v.3 v o.9o9o vXo9.3 99 oRgU9..! SQ R3 S—SUQ..
 MpU— S*Zt v ovó N*— µMí g ..MgUQ*.X v3 v—SUQ.*µ*—gSgi o..*vMg ..X vQo**..gU9.g9vX—SUQ..
 g... Qv" ..MogU '...g—' ó ...—' gU... Qv" ..Uv" NMogU.µX..g—ó ..øS" ..v)..9o9o vX3 oU—...g o.3 v o...So ú...
 —v...—g6o...XgM...SU... o**...9o9o vXo9...MU—o' —Z.rU...—' o*o...MU—o' —N." ' ' ó o...X v9µMSvU...gU9...
 MU*µ3 X—SvU.Xg—ó U*.g o...o**..M3 Xo' ..gU9..MS g—o..MgUQ..S XgM*.vU.*vMg ..gU9..oMvU3 SM.
 MU9SSvU*.g o.3 v o...øó oN.—' ó o..S*..)µ —' ó ..3 v—Sg—SvU..))v ..*µ*—gSgi o..*— µMí g ..MgUQ*...
 x(gUivISgU9.à UMoiRGUMMogNí- WZ.

% <vUMµ*—SvU...

I óg SUQSU.3 SU9...—' o.*— vUQ...o g—SvU* SXi o—" ooUMµpU— S* ..SUM3 o.o9v µ—SvU.gU9...—' o.o' —oU...
 v)...—' oS ...oU9SvU3 oU—g ..9g3 gQNVí ..X o3 So..S*...—' g—..MpU— S* ..*vMg ..X vQo**..MgUNvU...—' o...
 v—' ó ...—' gU9Ni o...oU9SvU3 oU—g ú..o))SBU...gU9...—' g...—' ó o...S*...Xv—oU—Sg ...)v ...;µ*— gU*SSvU...
 —' vµQ ...—' o.MpU— S* ..MUó QUM...v" g 9*.oU9SvU3 oU—g ú..o))SBU...*vMg ..vµ—M3 o*.xó vQ ...
 gU9..." Mo Ní-íßYZrU.—' S*.XgXó N.—' o...<Oàw...ó øo*.X oMS oú...v..o9g µg—o.MpU— S* ..gi SSú...v...
)µ)S ...—' o.Uo9*.v)...—' oS ..SSioU*.gU9...v..Mog—o.*vMg ..MU9SSvU*..))góv gi o...v...—' o.S X vøo3 oU...
 v)...—' oS ...—' o R oSUQ." S' vµ—..M3 X v3 S—SUQ.—' v*o.v)..)µ—µ o..QÜ g—SvU*...—' vµQ .µU*µ*—gSgi o...
 Mg i vU..))vv—X SU...o9o *Z.

rU.—' S*.XgXó N." o...o9og ...—' o.X v3 S—SUQ.— g;omV ú.v)...—' o...v" R3 S—SUQ.MpU— S*...v" g 9*..µ*—...
 — gU*SSvUN.gU9...—' o...SU*µ))SBU...9oMµXSUQ..gi SSú...v)...—' o...—' SQ R3 S—SUQ..MpU— S*..." ' SM...
 ' SU9ó *...—' oS ..X vM**..v)..;µ*— gU*SSvUZO9oU.3 v o.S Xv —gU—úN' o.g *v.µUMóó ...—' o..." v' úSUQ..
 µU*µ*—gSgi o.— oU9*.v)...—' o..3 99 oR3 S—SUQ.MpU— S*ZG*.X øSvµ* ú.9SMh**o9N." S' SU.—' S*...
 QvµXNg..3 v o..Mg i vU9))SBU...*vMg ..X vQo**...offµS o*.g.*S µ —gUovµ*..o))v —...v... o9µM...—' o...
 Mg i vU..))vv—X SU..gU9..oU*µ o..*vMg ..X vQo**Zàv...g N.—' o...Só g—µi o..vó vv6o9...—' S*.Xg —Sµ g ...
 QvµX.v).MpU— S*NgU9..! g*.v)—oU..o3 X' g*Sio9...—' o.9µg ..)vMh*.vU.X øoU—SUQ.*vMg ..9oX Sg—SvU...

SU.Xv' N" ' So...S SSUQ.-' o.o' M**So.MU*13 X-SvU.gU9..g)) pUM..i ú...-' o..." og -' ú..MµU- S*...
x+vmQ N'-í-č.V*" g 9..o-g ZN'-í W.." S93 gUU..o-g ZN'-í -YZ.

Vµ ...SU9SUQ..Mµ 9N! v" oó Ni o..)µ -' ó '...o)Sb9..S)..g99SSvUg ..oUßsvUß oU-g ..SU9Sµ-ý *.g o...
MU*S9ó o9..SU..9o)SSUQ.gU9..3 og*µ SUQ.;µ*-... gU*SvU.x" -SSM..o..g ZN'-í. YZrU.g99SSvUN" o...
9v..Uv-..o' X'v o..-' o'..o g-SvU*' SX.i o-" ooU..-' o.Mg i vU..)vv-X SU-.gU9..9S*-SUM.g*XoM*.v)..*vMg ...
X vQo**..MgX-µ o9..i ú...-' o..SU9S9µg ..9S oU*SvU*Nm3 XvUßU*..ý ..ooU.SU9Sµ-ý *.v)..-' o.àwrZ..
rU..vµ ..gUg ú*S*..." o..µ*o...-' o..gQQoQ-o..SU9o' Ni µ-..Mg' úSUQ.vµ-..-' S*..*µ9ú..." S' ..g*..o-..v)...
SU9S9µg ...o o3 oU*..v)..-' o..àwr..." vµ 9...Qßo...3 v o...9o-gSo9...SU*SQ -*..SU-v...MµU- S* ...;µ*-...
- gU*SvU.Xó)v 3 gUM..." S' '...o*XoM...v..9S*-SUM.g*XoM*.v)..*vMg ..X vQo**Z(Sµg úNvµ ..*µ9ú...
9vo*..Uv-..gS ..g-..o' X'v SUQ.MµU- S* ..)µ-µ o.-' g;oMv S*NgU9...-' o.MUßó QUM...o*µ -*.*' vµ 9...
i o..SU-ó X o-o9..SU...3 *.v)..MµU- S* ..! S*-ý Sµg ...- oU9*Z.

à-g-o3 oU*.gU9.n oMg g-SvU*...

- (µU9SUQ.9o-gS*m-! S*... o*og M'.. oMS9o9..Uv...XoM\$SMQgU-..) v3 ..gUú...))µU9SUQ.gQUM..SU..-' o...
Xµi SMm3 3 ó Mg Nv ..Uv-ßý Bx v)S.*oMv *Z..
- n g-g.gøgSgi SS-ú nm g-g.." S .i o.3 g9o.gøgSgi o.µXvU...og*vUgi o...offµo*-Z...
- <vU) SM.v)..SU-ó o*-mGµ-! v *.9v..Uv-..9oMg o.gUú..MU) SM.v)..SU-ó o*-*Z..

...

á o)ó oUM*...

...

Gi 9g g' NàZN.-! v3 X*vUNàZnt SMgo *vUNsZnt g 6*N2 ZNà-opú N2 ZNí -- uZ.-! o..! gXXí.XgUß-...
SU9o' .í Z nt' ' ú..Qv9...Sxo*.9vU-! gøo..v..M*-...! o.og -! Z..

...

G6gSoN" ZNW°. ZG..Uß" ...vv6..g-...! o.*-g-S-Sµg .3 v9o ..9oU-SSµg-SvUZrOOO.-' gU*gMSvU*.vU...
gµ-v3 g-SMMU- v ..Wm° W...íßZ.

...

G 6SoNàZN(v*-ó Ns ZNí -WZ- U9ó *-gU9SUQ*.gU9..3 SµU9ó *-gU9SUQ*.v)..3 µ -9S oU*SvUg
Xvøó -ú.3 og*µ o3 oU-Z.-! o.svµ Ug ..v)..OMUv3 SMrUßµg S-ú.uNí 1u ßWZ.

...

I g' vNá Z ZNàg gBR g -SUN: ZNWú Z<vUßó QUMZs vµ Ug ..v)..Xv Sµg ..OMUv3 ú..W- Ní í ß ...
í %WZ...

...

I gµ3 v N:" ZNí -- ßZw v9µMSßS-ú.Qv" -! NMUßó QUMNgU9..." o)g onf' ' g-...! o...vUQRµU.9g-g....
' v" NUm+ v" -! NrU9µ- Sg ..V QgUSig-SvU.gU9..OMUv3 SM+oUß g SS*ZO9" g 9..O Qg
wµi S' SUQXXXZß WZ.

...

I oUgS NGZN<v SU*NGZÁ g)-SN/ ZNí -- 1ZàvMg .9S oU*SvU.v)..*µ*-gSµgi o.9oøo vX3 oU-m..
+µ9gUM.gU9.gXXSµg-SvUZ.

...

I ó 6NrZNVUg-ó R*í ó 6NOZñs o-6Sß N" ZNí -íí ZG..µUS9...! ov' ú.gU9..oo9oUM.vU.<Ví

o3 S*SvU*...MÚó QUMZ.OUóS vUó oU-g ..àN\$UM..gU9...wv µ-SvU.á o*og M...í uNí ¨ °%
 í ¨ ußZ.

...

I ' g—gMg úgNt ZNtU6” oNs Z ZNag9v *6úNwZÑ-í-Z<vU*µ3 X-SvUR g*o9.gU9...ó’ Sv úR g*o9....
 Mg i vU...o3 S*SvU*...SU-oU*Súmn o-ó 3 SgU*...gU9...)v oMg*-SUQ..µ*SUQ..Mµi ...MÚó QUM...
 gMv**..MµU- S*ZOUó Qí..OMFv3 S4.I NW” Bí Z.

...

I SQS Snt Znt gµ vNö ZÑ- WZ.-v” g 9*.g.3 v o...µ*-gSgi o ' µ3 gU.9oóo vX3 oU..SUo’ m..
 rU-oQg-SUQ.-’ o.oUóSvUó oU..gU9..) oo9v3 ZOM vQ\$g ..SU\$g-v *..uWÑí í- íßVZ.

...

<’ gUM N/ ZÑ- í í Z+ vi g .Mg i vU.Súffig Sú.vóó ..Wu- í- WZ2 g-µi o.àµ*-gSgi SS-ú..W1Z.

...

<v *g-ogN- Zn Zn+ \$Mg \$NàZÑ- WZt g 6o-’..oQ1 g-SvU.gU9..oUóSvUó oU-g ..X v9µMS\$-ú....
 MgUQ*.SU.-’ o..o oM S\$-ú..gU9..Q*..*oMv ..v)..W.vi *ó øo9..O—..MµU- S*ZOUó Qí..W. N.
 W1 Wu° Z.

...

n G SgN+ ZN7 g S*N+ ZÑ- í- Zn oQv” -’ .gU9...’ o.*-g-oZOM vQ\$g ..oMFv3 S4..WuNW . I Z.

...

n g úN” ZDNW°ßZ.-v” g 9.g.à-og9úRà-g-o..OMFv3 úNW-...” gX*.o9S-SvUZo9Z“ Z Z(’ oo3 gU..’
 <vZ.

...

n GUQ vN2 ZNw \$µ gNGZÑ-’ ó *Ñ-í- ZO*-S g-SUQ.-’ o.Uµ3 i ó .v)..MgUQXvSU*..SU.*oQ3 oU-o9.....
 ’ oQo**SvU.3 v9o *m<v3 Xg g-Sóo.*-µ9ú.gU9..gXX\$g-SvUZ9éàog*...” v 6..wgXó *Z.

...

n gøS-NàZ ZN<g 9oSgN7 ZÑ- WZ<vU*µ3 X-SvUR g*o9.gMµU-SUQ.v)...<Ví .o3 S*SvU*Z...
 w vMo9SUQ*.v)...’ o..Ug-SvUg ..gM9o3 ú.v)..*N\$UM*.W°N% 1° % uí Z.

...

n S-üN- ZNà v*gNOZGN\$ v 6Nà ZÑ- - -uZOUóSvUó oU-g ú.o))S\$U-...” o R oSUQmá o-’ SÚSUQ...
 µ-gSgi SS-ú...g*...-’ o.. o g-SvU*’ SX..i o-” ooU...’ µ3 gU...” o R oSUQ..gU9...oUóSvUó oU-g ...
 S XgM*Z.” µ3 gU.OM vQ1.á oøS” ..WV WßZ.

...

O6S*NwZNàS vUNàZÑ oµ-*M/N/ ZN(v 6oN<ZÑ o..’ vv-Nà ZÑ- - -ßZG..) g3 o” v 6..)v ...’ o....
 X gMS\$g ... gXX\$g-SvU.. v)... -’ o... MUMX*... v)... MS\$g ... Ug-µi g ... M\$X\$g ... gU9... *-’ vUQ..
 µ-gSgi SS-úZOM vQ\$g ..oMFv3 S4... . NW% W%Z.

...

O6S*NwZÑÜoUQ o S*Nn ZÑ- í VZ.-’ o.M**..gU9..i oUó)S*.v)..oUóSvUó oU-g ..µ*-gSgi SS-úZ...
 àµ*-gSgi SS-ú..àN\$UM..WNu. u ü %Z.

...

(gUUSQNGZ/ ZN” S6o Ns ZÑ- íßZ<v3 XoU*g-SvU..)v .g-3 v*X’ ó SMgXX vX \$g-SvUZ2 g-µi o....
 àµ*-gSgi SS-ú..WWZ.

...

(gUUSUQNGZ/ ZNV 2 oS Nh Z' ZN' - WZ.-' o." o i oSUQ MU*µ3 X-SvU.Xg g9v' n! gXXSUb**N'.og -' N...
SUM3 oNgU9..Mg i vU..o3 S*SvU*.SU.Q v" SUQ.øó *µ*..UvUQ v" SUQ.oMvUv3 S*Zs vµ Ug ..v)...
< ogUó ..w v9µMSvU.í WNIW 1í VZ.

...

(gUUSUQNGZ/ ZNV 2 oS Nh Z' ZN' M*Nt ZN' -í - Zw vøSvUSUQ.*ú*-o3 *..)v ..g..Qv9...So..." S' SU....
XgUó-g ú.i vµU9g S*Z+ vi g ..OUøSvU3 oU-g ..<' gUQ... . NWí W%Z.

...

(gUUSUQNGZ/ ZNV 2 oS Nh Z' ZN' SMo Ns ZNá vµ' N2 ZN' -í í Z.-' o.*vMg ..*' v -)g ..gU9..oM vQMg
vøó *' vv-..v)..Ug-SvU*Z2 g-í o.àµ*-gSgi SS-ú..%N' ß Z.

...

(' gUivUSNs Z ZNà UMoiRGUMMogNh ZN' - WZ.-' o.ffiø*..)v ..µUøó *g ..*vMg ..Xv SM..SU.-' o....
*vµ- ' mGMv *N9og*.gU9.g MSomµi o*Z<g3 í 9Q...-Uøó *Sú..w o**Z.

...

(' S9 SUQ*-oSUNwZNs vUo*Nt Z' ZNV àµ SgUNt ZNGU9 o" Ná Z ZNI g66ó Nh Z<ZN' gµMNs ZN/ o....
0 µ' N<ZNwo-ó *N+ ZvZNwo-ó *N': ZNwvUQg-üNs ZNv- ' ó *N' -í í Z+ vi g .Mg i vU.i µ9Q-...
í -í VZÓg -' .àú*-o3 .àN\$UM.n g-g..WNMW í - - %Z.

...

+vµQ NrZN' -í - Zn o)SUSUQ.) v' *.gU9..MSSUQm- ' o.MU- S µ-SvU.v)... µ3 gU.Ubo9*..- ' óv úZ...
àµ*-gSgi SS-ú..àN\$UMNw gMSM.gU9..wv SM..WN' - 1 í WZ.

...

+vµQ NrZN' - WZ< S g-o.MgUQ.gU9..*µ*-gSgi o..." o)g om- ' o.MU- g Sú.v)... µ3 gU.Ubo9*Z...
<g3 í 9Q.s vµ Ug ..v)..OMvUv3 SM.ßuNWWWWWZ.

...

í *' g9N" ZN' µ**gSUNGZnt g S\$Nt ZrZí -í VZ.-' o.OM vQMg .rU-oU*Sú.v)...“ o H oSUQSU....
n oøo vXSUQ.<vµU- S*nG.wgUó .n g-g.GUg ú*SZ" µ3 gU.OM vQi.á oøS" .í °xWN° uRW- Z.
' -X*iné" " " Z*-v Z Q*-gi oéí °WW° u...

...

" g 3 gM6Ns ZN7' ú vøgNwZN' -í ßZàvMg .X vQo**SU9o' ...S o.*ó S*nt og*í SUQ.*vMg
vµ-M3 o*..Wu- R-í - Z.

...

" SMo Ns ZN' -í - Z.-' o.*µ*-gSgi o.9øøo vX3 oU..SU9o' nt og*í SUQ.-' o.oM vQMg ..o))SN\$UMi..v)...
' µ3 gU.9øøo vX3 oU..SU.-' o.gU-' vXvMUøZOM vQMg ..oMvUv3 SM.W° NW ßßVZ.

...

" SMo Ns ZN' - WZr*.S..Xv**S o..v.gMSøø.g..Qv9...So..)v ..g ..." S' SU.XgUó-g ú.i vµU9g S*ffi...
- ' S9..." v 9.0 µg -ó ú... - NW ß%Z.

...

" SMo Ns ZN' - WZ.-' o.9\$9om+ vi g ..Soffµg Sú..) v3 ..MUFFµo*-..v..) oo.3 g 6o-*Z:" " .2 v -vU....
` ..<v3 XgUúZ.

...

" SMo Ns ZN' vM" gúNwZN7 g S*N+ZN7 ou ó N/ ZN/ oUioUNt ZNà g3 ó g6NGZNà-oSú ó Q Ns ZN..

' QpRó v *g-üNn ZNí - í VZ.-' QpU-..Uoo9..)v' ..Xv*-RQ v" -' ..MS g-o..3 SSQ-SvU..*MUg Sv*Z.
 2 g-í o..OUö Qí... N° " ° 1Z.

...

" SMo Ns ZN7 g S+N+ ZNí - í - Zr*.Q ooU.Q v" -' ..Xv**S offi2 o" ..Xv SSMg .oMFv3 ú.í %N" u . I Z.

...

" -SSMINt ZN7' ú vø NwZN: .." g 3 o6Ns Zxí - í . YZsµ*...-gU*SSvU.àM ont og*í SUQ.-' o....
 ' o g-Söo.*µ*-gSUi SS-ú.v).*vMg .X vQ o**ZOUö SvUB oU-g .gU9.àµ*-gSUi SS-ú.rU9Mg-v' *N.
 í BNW-... - Z.

...

sgM*vUN- ZNí - í VZwv*-..Q v" -' m/ So.g)-ó .MgXSg S3 Zs v' U.. Soú...` .àvU*Z.

...

sv QpU*vUNGZ7 Zí - WZOMFv3 SM9oø o vX3 oU-.gU9...-' o.Mg i vU.SU-oU*S-ú..v)...! µ3 gU.." o R.
 i oSUQZ.2 g-í o.< S g-o.<' gUQN. xßYNY RWuZ! -X*ré9vSZ QWZWß1éUMS g-oí VW...

...

sv QpU*vUNGZ7 ZN S-üN- Zxí - WYZOMFv3 SMQ v" -' .9vo*.Üv-...o9µM...-' o.oMf vQMg .SU-oU*S-ú....
 v)...! µ3 gU.." o R oSUQZàµ*-gSUi SS-ú.àNBUMNWxWNWu W% Z9vSZ QWZW- ° é*VWí %R
 - WRí . R...

...

7 USQ -N7 Z' ZNá v*gNOZGN- WZ.-' o.oUö SvUB oU-g .o))SMBUM..v)... o R oSUQG.Mv**Rg-SvUg
 gUg ú*SZàvMg ...àNBUM.á o*og M... - NußWu. uZ.

...

7 µ3 g NàZNá gSig9gNGZN S* g*N" ZNí - WZw S' SS-SUQ.9oø o vX3 oU-.XgUUSUQ.SU.-' o.SU9gU....
 *o3 Sg S9..9oMgU.µ*SUQ.µ*-gSUi o...So S vv9...*oMí S-ú..SUo' .gXX vgMZrU-ó Ug-SvUg ...
 sví Ug .v).àµ*-gSUi o.n oø o vX3 oU-... ' " v 9..OM vQí.í Wßßí ß. %Z.

...

/g3 i N:" Z ZNà-oSü ó Qp Ns Z' ZNI v" *R' g 6SUNGZNwo-ó *N+ ZvZNá vi ó -*Ns Z-ZN:" vv9N(Z ZN..
 í - WZ.-' gU*SSvU...SU...Xg-' " gú*...v)...! µ3 gU...9oø o vX3 oU-...gU9...Mg i vU...o3 S*SvU*Z.
 OUö SvUB oU-g .á o*og M../ o-ó *.uN- W- WZ.

...

/oÜioUNt ZNt v' gUNn ZN7 gUö3 v-vN7 ZN+o*M6oNGZN- WZI µS9SUQ.óv gmG..Qvi g .3 µ -R.
 ' oQvU...SUXµ- vµ-Xµ-.....9g-gi g*o...g-...' SQ ...MµU- ú...gU9...*oMv '... o*v µ-SvUZ.OMFv3 SM.
 àú*-o3 *.á o*og M.í %Ní - . uZ.

...

t g 6*N2 ZNGi 9g g' NàZNáS 3 *NGZN- v3 X*vUNàZí - " Z.-' o.xµUY' gXXí..w gUö-rU9o' nGU..
 rU9o' ...v)...! µ3 gU..." o R oSUQ.gU9...OMf vQMg ...r3 XgMZ.2 o" ...OMFv3 SM...(vµU9g-SvUN.
 /vU9vUZ.

...

t g -SüüNn Z ZNOi oU gMINI Z' ZNí -- 1Z.-U9ó *gU9SUQ.-' ó...v o.v)..oUö Qí.MFµµ3 X-SvU.SU....
 ' µ3 gU..9oø o vX3 oU-...-' vµQ ...-' o..µ*o..v)...*g-í g-SvU..X' oUv3 oUgZ.OUö Qí...wv SM...ß N.
 Wß- Wß%Z.

...

t g' $\mathbb{R}$ oo)Nt ZGNWuVZ." μ_3 gU.*Mg o..9o $\emptyset$ o vX3 oU-m<vUMX-SvUNgXXSg-SvU.gU9..)í -' ó

´ o) oMSvU*Z.

...

t S " g 9R vX6S $\mathbb{U}$ *Ns Z $\mathbb{N}$ -oS $\mathbb{U}$ ó Q $\emptyset$ Ns Z Z $\mathbb{N}$ á gvN2 Z $\mathbb{N}$ V*" g 9N $\mathbb{S}$ Z $\mathbb{N}$ -í -Zw v $\emptyset$ 9SUQ9oM $\mathbb{U}$

S $\emptyset$ SUQ.." S' ..3 S $\mathbb{S}$ μ_3 ..oU $\emptyset$ QimG..Qvi g ..*MUg SvZ.+ vi g ..OU $\emptyset$ SvU $\mathbb{B}$ oU-g ...<' gUQ $\emptyset$... % $\mathbb{N}$.

Wí W1Z.

...

t μ Q $\emptyset$ vN $\mathbb{S}$ Z Z $\mathbb{N}$ -í -Zào oMSUQ.U μ_3 i ó ..v)..í' og6XvSU-*..SU.*oQ $\emptyset$ oU-o9'...oQ o**SvUm..

r3 X o3 oU-g-SvU.SU..-' ó...XgMgQ $\emptyset$.*oQ $\emptyset$ oU-o9Z.

...

t μ Q $\emptyset$ vN $\mathbb{S}$ Z Z $\mathbb{N}$ -- β ZO* S g-SUQ..oQ o**SvU.3 v9o *..." S' . μ U6Uv" U.í' og6XvSU-*Zà-g-S-S $\mathbb{M}$.SU.....

3 o9S $\mathbb{U}$ b.í í N $\mathbb{B}$ - %% β - ° VZ.

...

t μ Q $\emptyset$ vN $\mathbb{S}$ Z Z $\mathbb{N}$ t μ Q $\emptyset$ vNt Z Z $\mathbb{N}$ -WZwgMgQ $\emptyset$... *oQ $\emptyset$ oU-o9Z..I S'3 ó' Sg.% $\mathbb{N}$ WZ...

...

t μ Q $\emptyset$ vN $\mathbb{S}$ Z Z $\mathbb{N}$ v-' ó * $\mathbb{N}$ - -1ZàoQ $\emptyset$ oU-o9mGU...XgMgQ $\emptyset$...v..)S'...oQ o**SvU.3 v9o *..." S' .í' v6oUR.

S $\mathbb{U}$...o g-SvU*' S $\mathbb{X}$ *Zá ..Lb" *.1Ní - í %Z.

...

t ú 9g N+Z $\mathbb{N}$ àSv' gUQNwZ $\mathbb{N}$ Wí% ZOMFv3 SM.-' óv ú.gU9. μ U9ó $\mathbb{R}$ o $\emptyset$ o vXo9'...oQ $\emptyset$ vU*Z.

...

2 op3 gúo NOZ $\mathbb{N}$ - WZ." μ_3 gU.9o $\emptyset$ o vX3 oU-.gU9.* μ *-gS $\mathbb{U}$ gi SS-úZ.-' o..<gXgi SS-ú..GXX vgM.gU9.....

à μ *-gS $\mathbb{U}$ gi SS-ú..W% Wí Z.

...

2 op3 gúo NOZ $\mathbb{N}$ -- β Z:" og6. $\emptyset$ ó * μ *.*' vUQ.* μ *-gS $\mathbb{U}$ gi SS-únO' X'v SUQ.-' o...S S*.v)... v.vXXv*SUQ...

Xg g9S $\mathbb{Q}$ *ZO9" g 9..O Qg ..w μ i S' SUQZ.

...

2 QúoU.ö gUNwZ $\mathbb{N}$ í - - %Zn S' S μ -SvU.9úUg3 S $\mathbb{M}$.v)..<Ví ..o3 S*SvU*ZO $\mathbb{U}$ $\emptyset$ SvU $\mathbb{B}$ oU-g .gU9.....

á o*v μ í M..OMFv3 S $\mathbb{M}$.Bí N. u% % 1Z.

...

V 2 oS Nn Z' Z $\mathbb{N}$ (gUUSUQNGZ/ Z $\mathbb{N}$ / g3 i N:' Z Z $\mathbb{N}$ à-oS $\mathbb{U}$ ó Q $\emptyset$ Ns Z Z $\mathbb{N}$ -WZG.Qv9...S $\emptyset$..)v .g ." S' SU.....

XgU $\emptyset$ -g ú.i v μ U9g S*Z2 g- μ í o..* μ *-gS $\mathbb{U}$ gi SS-ú..W $\mathbb{N}$ 11 u%Z.

...

V*" g 9N $\mathbb{S}$ Z $\mathbb{N}$ à-oS $\mathbb{U}$ ó Q $\emptyset$ Ns Z Z $\mathbb{N}$ øgUvøgNn Z $\mathbb{N}$ S " g 9R vX6S $\mathbb{U}$ *Ns Z $\mathbb{N}$ -í VZ+ vi g'...o9S' S μ -SvU....

v)..SUM3 o.gU9.! v μ *o' v 9..oU $\emptyset$ Qí..)vv-X SU-*mG..M3 X μ -g-SvUg ...' v μ Q -.o' Xó S oU-Z...

+ vi g .à μ *-gS $\mathbb{U}$ gi SS-ú... No. Z.

...

wgUvXv μ v μ NOZ $\mathbb{N}$ wgU-o 9S $\mathbb{N}$ - Z $\mathbb{N}$ í - - uZ< μ i .M $\mathbb{U}$ $\emptyset$ ó Q $\emptyset$ UM.SU.Mg i vU.9Sv' 9o..o3 S*SvU*Z...

OU $\emptyset$ SvU $\mathbb{B}$ oU-g .gU9.á o*v μ í M..OMFv3 S $\mathbb{M}$... N. ° ° - Z.

...

wo-ó **vUN(Z $\mathbb{N}$ g99SvUNn Z Z $\mathbb{N}$ GMg NàZ $\mathbb{N}$ 9ó ' v 3 NwZ $\mathbb{N}$ -WZ<vU $\emptyset$ ó Q $\emptyset$ UM.v)..Mg i vU.9Sv' 9o.....

o3 S*SvU*mG'...oøSb" .v)...! o...Só g-í oZ.

...

w' S SX*NwZ<Nàµ Nn ZÑ -- uZOMUv3 SM- gU*SvU.gU9..Qv" -' Zsví Ug ..v)..gXXSb9....
oMUv3 o- SM.í . NWWß WW%Z.

...

w' S SX*NwZ<Nàµ Nn ZÑ -- °Z.-' gU*SvU.3 v9o SUgU9..oMUv3 o- SMMUó QUM...o*-Z...
OMUv3 o- Sg...° %NW° WW%Z.

...

w o*M- RG oUNá ZÑ -- VZ.-' o..'' o i oSUQ.v)..Ug-SvU*mG.MµU- úR.úRµU- ú.SUo' .v)..ffug S-ú.v)....
So.gU9...! o.oUòSvU3 oU-Zr* gU9..X o**Z.

...

á g'' v -' N7 ZÑ - WZn vµQ Uµ-.oMUv3 SMàøoU..'' gú*...v...! SÜ...So.g.í W-RMU-í ú.oMUv3 S*-Z...
<' o *og...f ooU.wµi S' SUZ.

...

á oU' g 9NàZ/ vøo N<Z ZÑ.-' S**oUN+ Z ZÑ -- -ZOUòSvU3 oU-g .o))SbUM..'' S' .3 µ -SXo....
oUòSvU3 oU-g ú.9o- S oU-g .øg Sgi o*č.o*-S g-o9..'' S' .à(G.gU9..n OGZOí vXogU....
sví Ug ..v)..VXó g-SUg .á o*og M..WVN 1° ß-ßZ.

...

àg 3 gUNT ZÑ' gUQN+ZÑ' gNn ZÑ -í í Zt v9o SUQ.-' o.MUó QUM.gUg ú*S.v)..*µ*-gSgi o....
Xv9µMSvU.. gU9... Mµµ3 X-SvU.. SU.. -ó 3 *... v)... oM vQNg ...)vv-X SU*-... gU9... ' µ3 gU...
9oøo vX3 oU..SUo' .SU.i o-.gU9'..vg9..SUSg-Sø.o.MµU- S*Zàµ*-gSgi o.w v9µMSvU.gU9...
<vUµ3 X-SvU.ß- Ní ßß í % Z.

...

àg3 µo Bv' U*vUN7 ZNO*-úNn Z<ZÑ -- VZOUòSvU3 oU-g .*µ*-gSgi SS-ú.SUo' Zn gøv*N...
*' S-üo gU9NSUn' v 9..OMUv3 SM(v µ3 Z.

...

àgUò Ná ZÑ SµN/ ZN2 QúoUNT ZÑ -í -Zt vUS-ú SUQ.-' o.àn +*mn SgSg .gU9..*vMg ...oMUv vQb*....
-v..oUµí o..SSioU.Xg -SNXg-SvUNSUMµS-oUò**..gU9...- gU*Xg oUMZn oøo vX3 oU..wv SM...
á oøSb" .ß1N.1ß %-Z.

...

àM'' g ün+ZNW° 1ZO*-S g-SUQ.-' o.9S oU*SvU.v)..g.3 v9o Z.-' o.gUg *.v)..*-g-S-SM..'' W..'' .Z.

...

àMXo SSNt ZÑ v Ug S'NOZÑ vUgSµ-vN ZÑ vUò*Nt ZÑ<SM vN/ ZÑ o.n v3 SUSNàZÑ v Ug gN...
(ZNG93 Sgg Ns ZÑ..

...

à' gvNs ZNWu° ZGU.g*ú3 X-v-SM.-' ov ú..v) ...Süó .3 v9o ..*o oMSvUZà-g-S-SM..*SUSg.í í Wí . í Z.

...

à' SNwZÑ-*gSN<Z/ ZÑ -- í Zà oQo**SvU.3 v9o ..*o oMSvU g'..o*9µg ...So S vv9.gXX vgMZ...
sví Ug ..v)....! o.á vúg .à-g-S-SMg ..àvMö-ú..àó S*.I mà-g-S-SMg .t o- v9v vQí... Ní ß°
í % Z.

...

àSMó gNá ZNwSiüü-vNwZnv-' ó *Ní - WZ<vUó QUM< µi *mG.XgMgQ.)'v ..Xó)'v 3 SUQ.-' o....
X' S SX*.gU9.*µi *.Mµi ..MÜó QUM.Mµ*-ó SUQ.X vM9µi oZá .sZWNWí Z.

...

àSUQt ZNG SN(ZNí - WZ+ vi g ..oUMMvXo9Sg..v)..Xµi SMg93 SUS' g-SvUNXµi SMXv SM.gU9.....
Qyóó UgUMZ.

...

àv v" Ná Z ZNW% ZG.MU- S µ-SvU...v...-' o...-' óv ú.v)..oMÜv3 SMQv" -' Z.-' o.fµg -ó ú.;vµi Ug
v)..oMÜv3 SM.- N. % u. Z.

...

à-oSü ó Q NsZ ZNá vi ó -*NsZ-ZNí - WZ(v3 ..MU*- gSU...v..*µi))SbUMm-' o..9oMµXSUQ.v)....
oUó Qí.gU9..Mg i vU.) v3 ..! µ3 gU.Uoo9*NW°%í-- %ZOM vQNg ..OMÜv3 SM.- N. í % . ββZ.

...

à-oSü ó Q NsZ ZNá vi ó -*NsZ-ZNwo-ó *N+ZvZNI gSvMISN+ZNI - WZwg-' " gú*.v)..! µ3 gU....
9oøo vX3 oU..gU9..Mg i vU.o3 S*SvU..o3 i v9Sb9..SU- g9oZ2 g-µi o.< S g-o.<' gUQ.í NlW
1%Z.

...

à- güSMvNt Z<ZN/ S*-NsZGNí - - βZG o.<Ví .o3 S*SvU...oøo *.MÜó QUQg3 vUQSUµ*- Sg
MµU- S*fiOUøSvU3 oU-g .gU9.á o*vµi M..OMÜv3 SM.í . Ní β í° VZ.

...

àµUN" ZNO9üSg' NI Z ZNµUN<ZN7 Xv *µNGZ ZNí - WiZrU*-Sµ-SvUg .ffµg S-úNQ ooU.SUvøg-SvU....
gU9..oUó Qí..o))SbUMZOUó Qí..Xv SM..W%NWWW-í Z.

...

-v3 g Nt ZNí - í βZG'...oøS" ..v)..X' S SX*Rµi .gXX vgMR g*o9.Mµi ..MÜó QUM...o*- *Zs vµi Ug ..v)....
OMÜv3 SMàµi øóu*Z.

...

-USo9.2 g-SvU*.OUøSvU3 oU..w vQg3 3 oNí - í βZ.O3 S*SvU..QX..oXv -í-í βmí' v6oU..oM 9
-o3 Xó g-µi o*..! S..Lb" ..! SQ *Núo-..." v 9..)gS*..v..Mí-.o3 S*SvU..xgQgUYZ2 gSvi SZ.

...

ö vQ NsZN" SMo NsZNí - í βZr*..Q ooU..Qv" -' ..! gXXoUSUQfiGU..o3 XS SMg ..gUg ú*S*..v)..gMSøo9
... øó *µ*..Xg SSM3 XgU...<Ví +n w..9oMµXSUQ.SU..! SQ BUM3 o..MµU- S*Z.-' o../gUM-
... w gUó-g ú..! og -' ..°No°%u o° uZ.

...

ö vQ NsZNà-oSü ó Q NsZ ZNV 2 oS Nn Z' ZN/ g3 i N.“ Z ZN7 S' Ug6µ3 g NsZNí - í VZàvMv
... oMÜv3 SMMÜSSvU*.)'v ..*g-S)úSUQ.! µ3 gU.Uoo9*.g-...v" ..oUó Qí..µ*omGU.SU-ó Ug-SvUg
... gUg ú*S*..v)..*vMg .X vøSvUSUQZ+ vi g ..OUøSvU3 oU-g ..<' gUQ... uNWí í 1° Z.

...

“ gUQN0 ZNsSgUQNá ZNí - í - Zr*..Mg i vU..o3 S*SvU..Qv" -' ..9oMµXo9..) v3 ..oMÜv3 SMQv" -' ..SU
... o3 ó QUQ.MµU- S*fi.2 o" ..SU*SQ -*..) v3 ... gi v ..gU9...Süo*-3 oU-...o))oM*Zs vµi Ug ...v)
... < ogUó ..w v9µMSvU.í . 1NWWW1Z.

...

“ \$93 gUUN.—Z/ oUioUNt ZN7 ou ó N/ Z—Zà—oSi ó Q NsZ ZNí - í - ZàNBU-S** ...” g USUQ.vU
... g)) μoUMZ2 g—í o.M3 3 μUSg—SvU*.WNBW° Z.

...

Ů' oUQN! ZN!“ vv9Ná ZNt v gUNn ZN(oUQN7 ZN—S*ó gU—NGZNs gUQNt ZN! ó —” SMINOZ—ZNí - í βZ
... á S\$SUQ..M i vU...Subffμg Sú...gU9...S*...9 \$SUQ..)gMv *...) v3 ...í -- %..—v...í - WZ..+ vi g
... OUøSvUB oU-g ..<' gUQp..lí NWí ° - . Z.

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GM S~~ø~~SUQs μ*...[´] gU~~S~~SvU...[´] vμQ ...<vU~~ø~~ó Q~~U~~M..SU..
⁻ o...<g i vU.O))S~~B~~UM..v).àvM~~g~~ ..w vQ o**...

àμXXo3 oU-g ú.3 g-ó S~~g~~ ...

t v' g3 o9..." -SSMNs~~g~~ v3' ..." g 3 o6... ..wo' g..7' ú vøg...

...

àZWr9oU-SúSUQ.i' og6XvSU-*..SU...⁻ o'.. o g-SvU*' SX.i o-" ooU..àwr..gU9..Xó ...
M~~g~~XS-g.M~~g~~ i vU.)vv-X SU-...

àoQ~~ø~~ oU-o9'...oQ o**SvU.3 v9o *Nøg μgi o.gMv**..9S~~M~~X~~S~~U~~ø~~..*μM..g*..oX9o3 Sv vQí..gU9..oM vQíN.
g o..μ*o9...)v ...⁻ oS ..gi SS-ú...v...9oU-Sú...i' og6XvSU- vM~~g~~-SvU*..." ' o o...⁻ o...S~~U~~ó~~g~~ ... o g-SvU*' SX..
i o-" ooU..ø~~g~~ S~~g~~i o*..M~~g~~UQ*..xn GUQ v...o...g ZNí'-í- YZ...⁻ o...oQ~~ø~~ oU-o9'... oQ o**SvU.3 o⁻ v9...S...
Xó)v 3 o9..μ*SUQ...⁻ o..á ..XgM~~g~~Q~~ø~~... *oQ~~ø~~ oU-o9 ..xó~~ø~~ *SvU..W~~B~~Y..xt μQ~~Q~~v..gU9..t μQ~~Q~~vNí'- WYN.
M~~U~~S-SUQ.v)..gU..Só g-S~~ø~~o...S-SUQ.g Q' S' 3 ...v..9o-oM...S~~U~~S~~S~~M~~U~~..M~~g~~UQ*..SU...⁻ o...vXo..gU9N.
M~~U~~*offμoU-úN...⁻ o..o' S*-oUM..v)..i' og6XvSU-*..SU...⁻ o'..o g-SvU*' SX.xt μQ~~Q~~vNí'-í-Ní'- -BYZ...⁻ o*o...
í' og6XvSU-*..." ó o..9oU-S~~S~~9...g...X S' Si g*o9...vU..vX-S~~S~~ g Sig-SvU..v)...⁻ o..I gúo*S~~g~~U.rU)v 3 g-SvU..
< S~~ó~~ SvU.xl r<YxàM" g üMM^o IYgU9...⁻ o.G6gS~~ø~~o.rU)v 3 g-SvU.< S~~ó~~ SvU.xGr<YxG6gS~~ø~~oMM^o. YZ..
⁻ o..Q~~U~~ó g ..)v 3 μ g-SvU.v)...⁻ o...oQ~~ø~~ oU-o9...S~~U~~ó~~g~~ ...oQ o**SvU.Sk.o' X o**o9.g*...

$$... \qquad g(E[Y|x_i, z_i]) = \alpha + z_i^T \theta + \beta x_i + \sum_{k=1}^{K_0} \delta_k(x_i - \psi_k)_+ \dots \qquad x^o Y..$$

" ó oNg...ó øo*g*...⁻ o...S~~U~~ó..μUMSvU.xv 9S~~g~~ ú...og*...ffμ~~g~~ o*.SU.ví .M~~g~~*oYN~~x~~i..9oUv-o*g.Mø~~g~~ S~~g~~-o...
o' ' S S~~S~~UQg.i' v6oURS~~U~~..Xg-ó U.xXó .M~~g~~XS-g.M~~g~~ i vU.)vv-X SU-YN" ' So.zi'...oX o*oU-*..gUú..v-⁻ ó ...
Mø~~g~~ S~~g~~-o..." S' vμ...*μM..9S~~M~~U-S~~U~~μS~~S~~o...S~~S~~...⁻ o g-SvU*' SX.." S' ...⁻ o'..oXvU*o.ø~~g~~ S~~g~~i oZ/ o-K~~0~~...
9oUv-o...⁻ o'.. og ...U~~μ~~3 i ó ..v)...i' og6XvSU-*NgU9..ψ~~k~~'...oX o*oU...⁻ o...vM~~g~~-SvU*..v)...⁻ o*o.M~~g~~UQ*Z..
⁻ o*o..g o...oMo9..) v3 ...⁻ o..oU-S o'.. gUQ...v)..x.øg μo*Z...⁻ o...ó 3 ..(x~~i~~ - ψ~~k~~) + .S...9o)S~~U~~ø9..g*...
I(xj > ψ~~k~~)NoffμS~~g~~ oU...v..(x~~i~~ - ψ~~k~~)I(x~~i~~ > ψ~~k~~)Z...⁻ o.Mo))S~~B~~U..θ...S~~U~~S~~S~~o...⁻ o.MU-S~~U~~μvμ*o))oM..
v).ziN~~ø~~..9oUv-o*...⁻ o.o))oM..)v .x~~i~~ < ψ~~1~~N~~g~~U9.δ~~k~~...*gU9*..)v ...⁻ o.øoM~~v~~ ..v)..9S)ó oUM*..SU.o))oM*Z..

(v ..o*-S~~S~~ g-SvU.Xí Xv*o*N" o..vX-...)v ..g'.. oX~~g~~ g3 o' Sig-SvU..v)...⁻ o...oQ~~ø~~ oU-o9...3 v9o N" ' SM...
v))ó *...⁻ o..g9øgU-gQ...v)..gU.o))S~~B~~U..o*-S~~S~~ g-SUQ.gXX vgM..μ*SUQ...⁻ o..g Q' S' 3 ..9S~~M~~μ*o9..SU..
t μQ~~Q~~v...xí' - -Ič...í' - -BY..gU9...n GUQ v...o...g Z.xí'-í- YZ...⁻ S...S~~U~~øv øo*...Só g-S~~ø~~o ú...))S-SUQ...⁻ o...
Q~~U~~ó g Sio9...S~~U~~ó~~g~~ ..3 v9o m

$$... \qquad g(E[Y|x_i]) = \beta_1 x_i + \sum_k \delta_k \tilde{U}_{ik} + \sum_k \gamma_k \tilde{V}_{ik}^- \dots \qquad x_1 Y..$$

o" ' ó o... $\tilde{U}_{ik} = (x_i - \tilde{\psi}_k)_+$, $\tilde{V}_{ik}^- = -I(x_i > \tilde{\psi}_k)$ Z...⁻ o...X~~g~~ g3 o-ó *..β .gU9...δ~~k~~ .g o...⁻ o...*g3 o...v)...
Offμ~~g~~-SvU.x^o YN" ' So...⁻ o.γ..g o...⁻ o..." v 6SUQ.Mo))S~~B~~U-*..μ*o)μ ..)v ...⁻ o.o*-S~~S~~ g-SvU.X vM9í oZ..
G...ogM...*oX...⁻ o..." v 6SUQ.3 v9o ...SU...Offμ~~g~~-SvU..x1 Y..S*..))S-o9...gU9...Uo" ...o*-S~~S~~ g-o*...v)...⁻ o...
í' og6XvSU-*..g o..vi -gS~~U~~ø9..øS~~g~~m

$$\hat{\psi}_k = \tilde{\psi}_k + \frac{\hat{\gamma}_k}{\hat{\delta}_k} \dots$$

Só g-SUQ.-' o.X vM**..µX..v.MUó QUM..xSU.*-g-S* Sg *oU*oYZ..

—v..9o-ó 3 Sb...! o..Uµ3 i ó ..v)..í' og6XvSU-*..SU...! o... o g-SvU*' SX.i o—" ooU..àwr..gU9..Xó ..MgXSg...
Mg i vU.)vv-X SU-N' o.µ*o.-! o.I r<.gU9...! o.Gr<..)v' 3 v9o .#o oMSvUgU9..vX-S Sig-SvUxt µQQvN
í-í-YZ.-! o*o..SU) v' 3 g-SvU.MSó Sg..i g gUM..3 v9o ..Qv9Uo**..v)..)S..." S' 3 v9o ..M3 Xo' S-ú...v...
X oðoU...vó)S-SUQZrU..*oQ oU-o9'... oQ o**SvUN.-! o.I r<.gU9..Gr<..g' o..vX-S Sio9..i ú..*o oMSUQ..
-! o...3 v9o ..." S' ...! o... v" o*-...I r<...v' ...Gr<...øg µoZ.-! S*..X vM**...oU-gS*...)S-SUQ..*oQ oU-o9...
' oQ o**SvU.3 v9o *..." S' .øg úSUQUµ3 i ó *.v)..í' og6XvSU-*..µX..v.g.3 g' S µ3 ..v)..W.í' og6XvSU-*Y..
gU9...M3 Xg SUQ.-! o..I r<...v' ...Gr<...øg µo*..v)...! o*o..3 v9o *...v...9oU-Sú...! o..vX-S g ...3 v9o ...
xt µQQvNí-í-Y.x*oo...GXXoUS ..GZVWZ.-! o.g QY S' 3 ..*g -*..." S' ..gU.SUSg ..Qio**..)v' ...! o...
í' og6XvSU-*..gU9...! oU.Só g-Só ú...o)Sb*...! o.o*-S g-o*..µU-S.MUó QUM..S*..ogMo9ZG-..ogM...
Só g-SvUN.-! o...g QY S' 3 ...µX9g-o*...! o...o*-S g-o*..v)...! o...í' og6XvSU-*..gU9...v-! ó ...3 v9o ...
Xg g3 o-ó *.gU9..øøg µg-o*...! o..Qv9Uo**..v)..)S-µ*SUQ.g..9oøSgUM..*-g-S* SMx*oo..àµXXo3 oU-g' ú...
3 g-ó Sg .àZV YZ.-! o.Gr<..SU.)v' 3 µ g-o9..g*..)g v" *m

$$AIC = -2\log L + 2p \dots$$

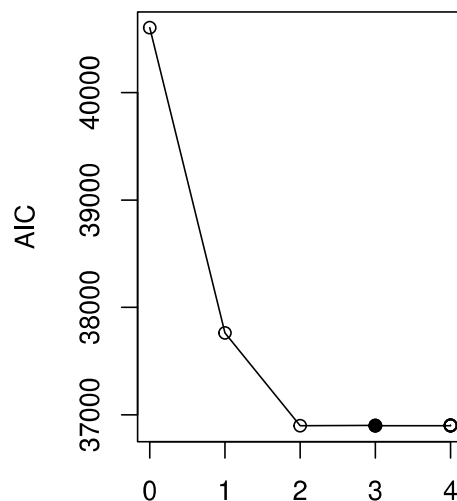
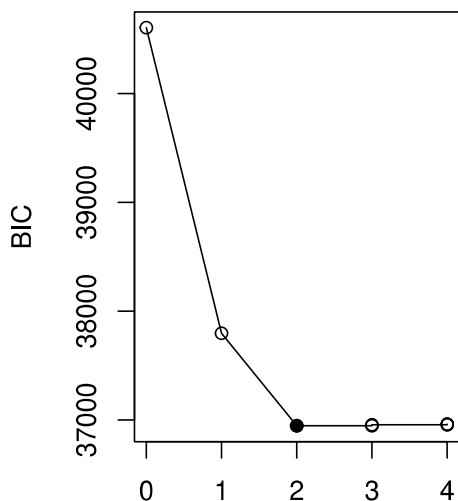
“ ' ó o.L.*ú3 i v Sio*...! o... So S vv9..)µUMSvUN.” ' So.p.9oUv-o*...! o..gMµg ..3 v9o ..9S oU*SvUN.
9o-ó 3 Sb9..i ú...! o..MµU-..v)..o*-S g-o9..Xg g3 o-ó *Z.-! o*o..Xg g3 o-ó *.SUMµ9o.βNôNgU9..ψ...
øoMv *..." S' SU...! o...oQ oU-o9'... oQ o**SvU..3 v9o *N*µM...! g-.p = 1 + 2KZ.G3 vUQ.g...o-..v)...
MgU99g-o..3 v9o ..)v' ...! o..9g-gN.-! o..gøv o9..3 v9o ..S*..9oU-S99..i ú..S*..3 SUS µ3 ..Gr<..øg µoZ..
<vU*offµoU- úNgr<...øøg µg-o*...! o..Qv9Uo**..v)..)S-Ng*..øøg µg-o9..i ú...! o...So S vv9..)µUMSvUN.
” ' So.g *v..SUM Xv g-SUQg.XoUg -ú...! g-..o*Mg g-o*..." S' ...! o..Uµ3 i ó ..v)..o*-S g-o9..Xg g3 o-ó *Z..
-! S*..XoUg -ú..9SMµ gQ*..vó)S-SUQNg..X gMSM..QUó g ú..µU9o*Sgi o..i oMµ*o..gµQ oU-SUQ..
-! o.3 v9o *.Xg g3 o-ó ..MµU-...úXSg' ú..oU' gUM*...! o..Qv9Uo**..v)..)S-SUSMS Sg-o úZ..
—! o.I r<..vU.-! o..v-! ó ...! gU9..S*..)v' 3 µ g-o9..g*..)v v" *m

$$BIC = n\log\hat{\sigma}^2 + p\log(n) \dots$$

“ ' ó o.δ²'...oX o*oU*...! o.ó' v' .øg SgUMN' ' SM..S*9o)Sb9..g*... $\frac{1}{n-p} \sum_{i=1}^n (y_i - \hat{\mu}_i)^2 Z$." v" øó N.-! S*...
S*..g..i S*o9..o*-S g-v' ..)v' ...! o... µo..øg SgUMZrU...ó 3 *.v)...! o...o*Sµg ..*µ3 ..v)..ffµg o*.xà ààYN..
-! o.9o)SUSvU..i oM3 o*.BIC = nlog(RSS/n) + plog(n)Z.“ ' oU..Mvv*SUQg3 vUQ.øg Sµ*..3 v9o *N..
-! o..vUo..." S' ...! o...v" o*-..I r<..S*..)gøv o9ZI r<..SUMog*o*..." S' ..i v-! ...! o.ó' v' .øg SgUM..δ²..gU9...
-! o..Uµ3 i ó ..v)..Xg g3 o-ó *.pZ.-! µ*N. SQ ó ..µU' XgSb9..øg Sg-SvU..SU.-! o..9oXoU9oU-..øg Sgi o...
gU9..gU.SUMog*o..SU.-! o..Uµ3 i ó ..v)..o' XgUg-v' ú..øg Sgi o*.o øg-o...! o.I r<..øg µoZ<vU*offµoU- úN..
g...v" ó ..I r<..SUSMg-o*..oS' ó ..)o" ó ..o' XgUg-v' ú..øg Sgi o*Ng..i o-ó ..)S-Nv' ..i v-! Z+oUó g úN..
I r<..XoUg Sio*..Xg g3 o-ó *.3 v' o...SQY vµ*ú...! gU.Gr<Ng -! vµQ ...! S*..MgU.øg ú..9oXoU9SUQ.vU..
-! o..øg µo*..v)..n.gU9..pNoUgi SUQ.S...v..MUS*oU-ú..9oU-Sú...! o... µo..3 v9o ..xà' gvMñu°č.à' S..
gU9...-gSNí--íYZ..

àZWWào oMSUQ.-' o..Uµ3 i ó ..v).í' og6XvSU-*.SU.-' o... o g-SvU*' SX.i o-' ooU.àwr..gU9...
<Ví .Xó .MgXSg..)vv-X SU-...

...



...

(SQí o.àZWWí' og6XvSU-*.o oMSU.gU9..I r<..gU9..Gr<..øg µo* ZI vv-µ' gXXSUQ." g*.µ*o9...v..o* S g-o.-' o...
MU)9oUM..SU-ó øg *.v)... o..oQ oU-o9'...oQ o**SVU.3 v9o *Z.-' o..)Sg .gU9..vX-S g ..Uµ3 i ó ..v).í' og6XvSU-*.S...
i g*o9..vU.W'...o*g3 Xo9..9g-g*o-*Z..

...

-v..o oM.-' o..Uµ3 i ó ..v).í' og6XvSU-*.SU.-' o... o g-SvU*' SX.i o-' ooU.àwr..gU9..Xó .MgXSg..Mg i vU...
)vv-X SU-N." o..µ*o.-' o..I gúo*SgU.rU)ý 3 g-SvU.< S ó SvU.xl r<Y.gU9...- o..G6gSo..rU)ý 3 g-SvU...
< S ó SvU.xGr<Y.)ý .3 v9o ..o oMSvU.gU9..vX-S Sig-SvUZI r<..gU9..Gr<..g o.SU)ý 3 g-SvU.MSó Sg...
-' g-.i g gUM.3 v9o ..Qv9Ub**..v)...S..." S' .3 v9o ..M3 Xo' S-ú...v..X øoU..vøó)S-SUQZ.

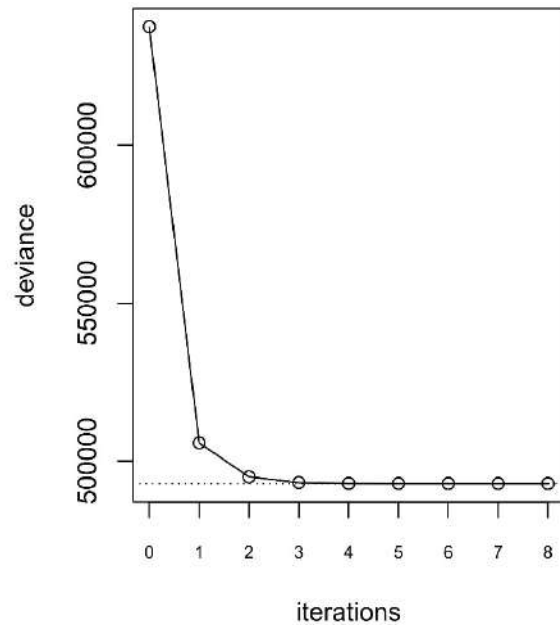
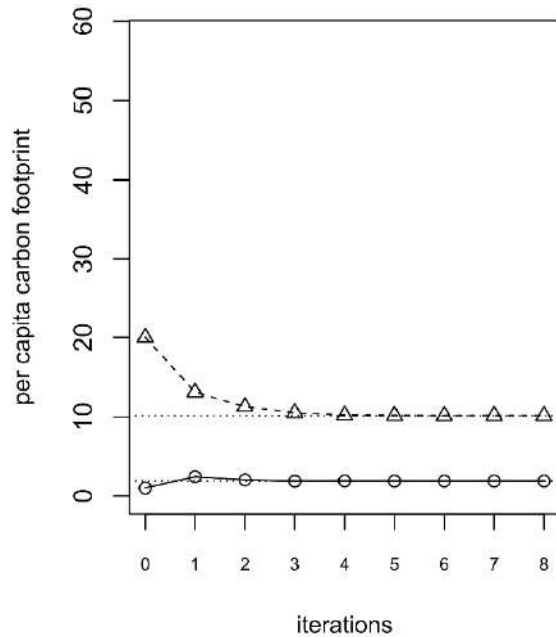
-' o..I r<..gU9..Gr<..g o..vX-S Sio9..SU.-' o..oQ oU-o9'...oQ o**SVU.i ú...o oMSUQ.-' o..3 v9o ..." S' ...
-' o..v" o*-I r<..v ..Gr<..øg µoZ.-' o.X vM**..Sµv øo*..)S-SUQ*oQ oU-o9'...oQ o**SVU.3 v9o *..." S' ...
9S)ó oU..Uµ3 i ó *.v).í' og6XvSU-*.x" S' .g.3 g' S µ3 ..v)..W..í' og6XvSU-*Y.gU9...- oU.M3 Xg SUQ..
-' o..I r<..v ..Gr<..øg µo*.v)... o*o.3 v9o *-v..9oU-Sú...- o.vX-S g .3 v9o Z.

(SQí o.àZWW*' v" *-.-' g-.-' o.3 v9o ..." S' ...- o..v" o*-I r<..øg µo..S..g**vMg-o9..." S' ...- o.3 v9o ...
-' g-.-' g*-.-' v..í' og6XvSU-*ZG*..)ý ...- o..Gr<NS-.*' v" *-.-' g-.-' oo.í' og6XvSU-*)µí -' ó .S X vøo...
-' o..)SZ." v" øó N" o...o-gSU.-" v..í' og6XvSU-*.SUM.-' o.* vXo..M' o*XvU9SUQ..v.-' o.Xó .MgXSg...
<Ví..)vv-X SU..gi vøo.-' o.-' S9..í' og6XvSU-*.S..Uv-..*SUSSgU-ú..9S)ó oU.-' gU.. Ng*.*' v" U.SU...
-gi o..VZ.

àZWW...r9oU-SúSUQ.-' o.í' og6XvSU-*.øg µo*.-' vµQ .Só g-Sóo..)S-SUQ..

rU.-' o..oQ oU-o9'...oQ o**SVU.3 v9o SUQX vM**NgU.Só g-Sóo.g Qy S' 3 .o*-S g-o*.xt µQQvNí-í-Ní--BY..
-' o..í' og6XvSU-*N9o)SUQ.-' o..Xó .MgXSg..Mg i vU..)vv-X SU-..oQ oU-*Z.-' o..g Qy S' 3 ..*g *-..." S' ..gU..
SSSg .Qµo*..)ý ...- o.í' og6XvSU-*gU9...- oU.Só g-Sóo ú...o)Sµo*.-' o..o*-S g-o*.µU-S.MUó QUM.S...ogMo9Z.

G...ogM.Só g-S'UN-' o.g Q' S' 3 .µX9g-o*...- o.o*-S g-o*.v)...- o.í' og6XvSU*.gU9..v-' ó .3 v9o .Xg g3 o-ó *...
gU9..oøg µg-o*...- o...Qv9Ub**..v)...S..µ*SUQ..- o..9oøSgUM..*-g-S*-SZ..- o...o)-..XgUb ..v)...(SQí o..º ..*' v" *...- o...
í' og6XvSU*..o*-S g-o*...-' vµQ vµ-..oSQ -..Só g-S'U*Zr-.g *v..Mbó ú..*' v" *...- g-...- o.í' og6XvSU-..øg µo*...
-gi SSio..g-..1.8807..gU9..10.0886N-' ó oi ú..9S9SUQ..- o... o g-S'U SX.i o-" ooU..àwr..gU9...<VÍ ..o3 S*S'U*...
SU-v...-' oo..*oQ oU*.x" S' ...-' oo..9S)ó oU-.* vXo*YZ...



(SQí o..àZV ml' og6XvSU*..o*-S g-o*...-' vµQ vµ-..*oøó g ..Só g-S'U* ZO*-S g-o*..MÚó QUM..g-gSb9..SU..
oSQ -..Só g-S'U*Zà-é -SUQ.øg µo*..v)...- o.í' og6XvSU*...- ó o..*o-..-v...)g ..i o-" ooU..WgU9..í - ..3 o- SM-vU*..Xó ...
MgXSgZ..- S'..gUQ..S'..- ' ó o...- o..M øg-µi o..v)...- o...Súó g ..S..vMµi *Z..- o.í' og6XvSU*..o*-S g-o..MÚó Q..g-...
Vl1..gU9..WZ1...

-' o...SQ -..XgUb ..v)...(SQí o..GZV ..*' v" *...- o..9oøSgUM..*-g-S*-SM" ' SM..3 og*µi o*... v" ...- o ...- o...
*oQ oU-o9'..oQ o**S'U..3 v9o ..)S*...- o..9g-g..M3 Xg o9...v...- o..Uµi ..3 v9o ..x- o..3 v9o ..." S' ..Uv...
í' og6XvSU*YZ.

-gi o...W.*' v" *...- o...Xg g3 o-ó ...o*-S g-o*...-v) ...- oo...3 v9o *m-' o...Uµi ...3 v9o ...x" S' ...Uv...
í' og6XvSU*YNg..3 v9o ..." S' ...- v.í' og6XvSU*.gU9..g..3 v9o ..." S' ...- oo.í' og6XvSU*Z..- o...g-ó ...
S..SUMµi9o9.*SUM..- o..Gr<..vX-S Sig-S'U.*' v" *...- g-g99SUQ..- o...- S9.í' og6XvSU-..S X vøo*...- o...
)SZ" v" oøó Ng99SUQ..- o...- S9.í' og6XvSU-..9vo*.Uv-..S X vøo...- o..vøó g ..)S..*SUSSgU-úNgU9...
-' o.* vXo..MgUQ..S..Uv-..*SUSSgU-ú..9S)ó oU-..) v3 ..Z..- ó o)v oN" o..µ*o...- o..." v.í' og6XvSU*...
3 v9o .Xg g3 o-ó *...v..*oQ oU-...- o...o g-S'U* SX.i o-" ooU..àwr..gU9..Xó .MgXSg..Mg i vU..)vv-X SU-Z.

...
...
...
...

—gi o.àZVá o*₁ —*.v)...! o..*oQ oU-o9'...oQ o**SvU.μ*SUQàwr.g*..! o.9oXoU9oU-.øg Sgi o.gU9...
X6 .MgXS-g.Mg i vU.)vv-X SU-.g*..! o.SU9oXoU9oU-.øg Sgi o...

...

... t v9o m			
...	Uv.i' og6XvSU-*	í .i' og6XvSU-*	ß.i' og6XvSU-*
xrU-ó MX-Y..	%Z °° ... x- Z ° Y..	ß Zu%.. x- Z . - Y..	ß Z°° ... x- Z β° Y..
à vXo...	VZ% ... x- Z bí Y..	VZ% ... x- Z °%..	VZ ... x- Z' Y..
à vXo.g)-ó .W*.i' og6XvSU-...	...	í'Z β1 ... x- Z uW%..	í'ZβW ... x- Z 1%..
W*.i' og6XvSU-...	...	Vβ1W ... x- Z Y..	Vβ1 ... x- Z W%..
à vXo.g)-ó .í U9.i' og6XvSU-...	...	RZ% ° ... x- Z . ° Y..	RZ1. ... x- Z 1W%..
í U9.i' og6XvSU-...	...	WZ1 ... x- Z WY..	WZ' % ... x- Z í Y..
à vXo.g)-ó .β' 9.i' og6XvSU-...	...	...	- ZWí ... x- ZW. Y..
β' 9.i' og6XvSU-...	...	...	β- Z u... xí Z β. Y..

2 v-onà-gU9g 9..ó' v *.g o'..oXv -o9..SU.Xg oU' o*o*Z^{hh}N^{hh}N^{hh}.SU9Sg-o*..*SU9SgUM.g-...! o...
u- y N.u%y N.gU9...uuy ... oøo N. o*XoMSøo úZ.I vv- *' gXXSUQ.." g*...μ*o9...-v...o* S g-o...! o...
MfU)9oUM.SU-ó øg *.v)...! o..*oQ oU-o9'...oQ o**SvU.3 v9o *Z-! o.)Sg .gU9.vX-S g .Uμ3 í ó ...
v).i' og6XvSU-*.S.i g*o9 .vU.W...o*g3 X o9 .9g-g*o-Z.

...

àZ ... —' o... MÜó QUM... ' úXv-' o*S... vQR t ...o*... gU9... Mui *...
Mü*ó SUQg Q S' 3 ...

—' o..MÜó QUM...! úXv-' o*S...S...o*-o9..µSUQg...vQtRo*...vU...-! o..*o3 SXg g3 o' SM3 v9o ..v)...
—' o... gUSSU.Xg g3 o-ó ..v_{it}..)v 3 µ g-o9..g*...

$$\dots \qquad v_{it} = v_i + \frac{\sigma_i \xi_{it}}{L(t)t^\alpha} \dots \qquad \text{xGZW..}$$

” ' ó o.i v-' .ξ_{it}..H..S9(0,1)..gMv**..iNgU9..σ_i..g o..Ss'úUMg-SM*Mg o..Xg g3 o-ó *NL(t)..S..g..* v” ú...
øg úSUQ..)µUMSVU...)v ...” ' SM...L(t) → ∞.g*.t → ∞Zα..9oÜv-o*...-! o... g-o...g-...” ' SM...-! o...Mv**R
oMSvUg ...! o-ó vQUoS-ú..9oMú...v..üó vč...! ó o)v oNv_{it}..MÜó Q*...v..v_i...” ' oU.α..S...Xv*SSoč...-! o...
)µUMSVU.L(t)N. v” øó Ng v” *.MÜó QUM...v...! v 9..g *v...” ' oU.α = 0Z...

—' o..Uµ ..xH₀YgU9..g -ó Ug-Sóo...! úXv-' o*o*xH_AYg o..)v 3 µ g-o9..g*..)v v” *m

$$\dots \qquad \mathcal{H}_0: v_i = v \ \& \ \alpha \geq 0 \dots \qquad \text{xGZY..}$$

GQSU*...

$$\mathcal{H}_A: \{v_i = v \text{ for all } i \text{ with } \alpha < 0\} \text{ or } \{v_i \neq v \text{ for some } i \text{ with } \alpha \geq 0 \text{ or } \alpha < 0\}$$

... xGZY..

...

“ ' So.H₀..S XS*.MÜó QUM..v)..g ..MµU- S*NH_A..S XS*.i v-' ...! o..M*o..v)...! oS..9Só QUMN..
gU9...-! oS...MÜó QUM...” S' SU...µi QvµX*...” S' ...Xv*SSo...MÜó QUM...*Xoo9*N.SZ.N.Mui ...
MÜó QUMZ...

w' S SX*.gU9..àµ ..x'-- °Y.9o3 vU* g-o...-! g-..µU9ó ..MÜó QUM...xH₀YN...! o... gUSSU..9S-gUM...
H_t...! g*...! o..)v v” SUQ...S SUQ..)v 3 m

$$\dots \qquad H_t \sim \frac{A}{L(t)^2 t^{2\alpha}} \text{ , as } t \rightarrow \infty \dots \qquad \text{xGZY..}$$

“ ' ó o...-! o..MU*gU..A > 0Z...-! o... vQR ...oQ o**SVU.3 v9o ...S..g... o*µ ...v)...*o—SUQL(t) = log t...
gU9..S...! ó o)v o..)v 3 µ g-o9..g*..)v v” *m

$$\dots \qquad \log \frac{H_1}{Ht} - 2 \log L(t) = \hat{b} + \hat{\beta} \log t + u_t \text{ , } t = [rT], \dots, T \dots \qquad \text{xGZY..}$$

“ ' ó o.r..9oÜv-o*...! o..) gMSvU.v)..t...v.i o.9SMg 9o9..SU...! o...vQt...oQ o**SVUZI g*o9..vU.ó -oU*Sóo...
t vU-o...<g v...S µ g-SvUNw' S SX*.gU9..àµ ..x'-- °Y..µQQ*...-! g-r.i o.i vµU9o9..i o-” ooU...Z ...
gU9...- ZNg*...S...)vM*o*...vU...! o...g-ó ..Xg ...v)...! o..9g-g...g3 XoN...! ó oi ú...oU*µ SUQ...-! o...o*...
MU*S-oUM..SU.Qv” -! ..MÜó QUM.gXXMg-SvUZ-Ü9ó .H₀...! o..Mó))SMU..β..MÜó Q*...v...! o...
MÜó QUM.Xg g3 o-ó .2αZ.

—USóo.SU...! oQUó g .β..MÜó QUM.SU-ó X o-g-SvU.xI gp3 v N--βYN...! o.tR-g-S*SM' v” *...! g-...
-! o.β..S...oS' ó ..Xv*SSo...v ..offµg ...v..üó v...S.tβ > -1.65ZrU...! S...M*oN” o..g**µ3 o...! ó o..S...g...

MU₀ QUM...v)...-' o...XgU₀...v)...M₁U₁ S*NgU₀...-' o...-' S_Q ó ...-' S... β ..M₀))S₀U₁N...-' o...g*-ó ...-' o... MU₀ QUMZV₁-' ó " S₀NS...-' o...o*-..S₀U₀S₀g-o*...-' g...-' o...S_QU...v)... β ..S...L₀Q₀-S₀N...-' o...MU₀ QUM... ' úXv₁-' o*S₀H₀...S₀...o;oMo9Z...-' μ *NS'...o₃ gS₀...v... ϕ ó S₀ú.S₀H₀.M' o*XvU₀*...v.g.X₀ o.9S₀ QUM... ' v...M₁ui ..MU₀ QUMZ(' v...-' S...X₀ Xv*oNw' S S₀*.gU₀..à μ ..xí-- °Y₀g v" .. μ *...v...S₀U₀S₀ú..M₁*-ó *... v)..M₁ui ..MU₀ QUMZ.

“ ' oU...-' o..MU₀ QUM... úXv₁-' o*S₀S₀...o;oMo9NS'...o₃ gS₀...v... ϕ ó S₀ú.S₀H₀.M₀U₁*-S ... v 9..S₀U₀M₀*o... v)..M₁ui ..MU₀ QUMZ...-' o..M₁ui ..MU₀ QUM..M₁*-ó S₀Q₀g Q₀ S' 3 ..M₀U₀S₀*...v)... ..-oX*m

- à-oX.W₀ < v**R₀MSvU₀ ..v 9₀ S₀Q₀i g*o9.vU...<Oàw...M₀ o*.g...-' o..)S₀g ... g).X₀ S₀vZ.
- à-oX₀i m₀9oU₀S₀úS₀Q₀g.M₀ o.Q v μ X.v)..M₁U₁ S*...-' g...MU₀ Q₀.i ú...off μ oU₀S₀g .M₀ M₀ g-SvU... v)... o.t₀R₀-g-S₀SM₀t _{β,k} ..v ..vQt'...oQ o**SvU₀.i g*o9.vU₀g-g.v)...-' o.k...vXRgU₀o9..M₁U₁ S*... SU...oX.W₀v' .2 $\leq k < NZ$...-' o.M₀ o.Q v μ X.S*... o.vU₀...-' g...-' g*...-' o.3 g' S₀ μ 3 ..t _{β,k} N...-' ó oi ú... oU₀*₁ S₀Q₀MU₀ QUM...v)...-' o.Q v μ X*...og ..SUM₀*SvU.v)..M₁U₁ S*Z.
- à-oX.B₀màS₀øS₀Q₀...-' o.9g-g...v' ..L₀b" ..M₁ui ..3 o₃ i ó *i ú...g99S₀Q₀vU₀..M₁U₁ ú..S₀...-' o.M₀ o... Q v μ X.g...g...S₀ o.gU₀...-' oU...ó μ U₀S₀Q₀...-' o...vQt'...o*-Z...-' o.L₀b" ..g99o9..M₁U₁ ú..S₀...-' oU... M₀U₀S₀ o9...v.i o vU₀...v...-' o.M₀ o.Q v μ X.S₀.t _{β,k} .S₀.Q og-ó ...-' gU...-' o.9o)S₀b9..MS₀S₀g .. ϕ g μ o... c*Z₀+S₀oU...-' o...S₀ o.X₀ S₀v9.v)...-' o.* μ 9ú..." o...o-c* = 0.gU₀...v...g ϕ v9...v ϕ ó o*-S₀ g-S₀Q₀v' ... μ U₀ó o*-S₀ g-S₀Q₀...-' o.U₀ μ 3 i ó ..v)..M₁U₁ S*...i o vU₀S₀Q₀...v...-' o.M₀ o.Q v μ XZw' S S₀*.gU₀... à μ ..xí-- uY₀* μ Q₀*o9...-' g...v' ..3 g ...S₀ o.X₀ S₀v9*.xT' $\leq 50Y₀c*$.*' v μ 9..i o.off μ g ...v...xg... ' S₀Q ..M₀U₀ó ϕ g-S₀o. ϕ g μ oYNgU₀..v' ...g Q...S₀ o.X₀ S₀v9*.xT' $\geq 100Y₀...v...-' o..g*ú3 X-v-S₀M₀%₀.MS₀S₀g .. ϕ g μ oN...-' g-S₀...-1.65Z.$
- à-oX... má oM₀ *SvU₀.gU₀...*vXXS₀Q₀.. μ omMog-S₀Q₀g...oM₀U₀...Q v μ X..v' ..M₁U₁ S*..." ' ó o... 9g-g.*S₀øS₀Q₀S₀*-oX.B₀..gS*Z₀...-' S₀.Q v μ X.*g-S₀)S*...-' o..MU₀ QUM..M₀U₀S₀S₀UNS₀Z₀Nt _{β,k} > -1.65N...-' ó o.g o..." v..MU₀ QUM..M₁ui *xM₀ o.gU₀...-' o.L₀b" ..ú..v' 3 o9.Q v μ XYZV₁-' ó " S₀N... *oX*...W₀Ní NgU₀... β ...g o... oXog-o9...v... ϕ ó S₀ú.S₀...-' o...oM₀U₀...Q v μ X.M₀U₀.i o.9S₀S₀o9...Sv... MU₀ QUM..M₁*-ó *ZrU₀*-oX..." vN...-' o...o₃ gS₀S₀Q₀M₁U₁ S*..9S₀ Q₀.S₀.t _{β,k} < -1.65Z.

àZ ZW.<vU₀ QUM.../ vQRt...o*-...o* μ -*.gU₀.S₀ X₀S₀g-SvU₀*.vU...<Oàw..g ϕ ó gQ₀.Qv" -' ... g-o*...

-gi o.GZ ZW* v" *...-' o...o* μ -*.v)...-' o.../ vQRt...o*-Z...-' o..UvU₀o;oMSvU.v)...-' o..U μ ...' úXv₁-' o*S₀H₀... xg*..S₀U₀S₀g-o9..i ú...-' o..wR₀ g μ o*Y₀S₀ X₀S*..MU₀ QUM...S₀...-' o...<Oàw...M₀ oZ₀H₀.S₀Uv-'... o;oMo9... " ' oU...-' o...vQRt...o*-..S₀.X₀)v' 3 o9..vU...-' o..) μ ..XgU₀...v)..M₁U₁ S*Z." v" ϕ ó N" ' ' oU...-' o...o*-..S₀... X₀)v' 3 o9..vU...ogM₀...oQ₀ oU...v)..M₁U₁ S*...oX₀g g-o úN₀H₀.S₀...o;oMo9...v' ...-' o.3 S₀9 oR₀3 S-S₀Q₀.. M₁U₁ S*NS₀ X₀úS₀Q*'- S₀M₀9S₀ QUM..." S' ..L₀bQ₀-S₀o..MU₀ QUM..X₀o9.X₀g g3 o-ó .. β Z...-' o.../ vQR t...o*-.*' v" *..Uv... ϕ o9oUM..v' ..H₀...o;oMSvU..v' ...v" RgU₀... S₀Q R₀3 S-S₀Q₀M₁U₁ S*Z." v" ϕ ó N...-' o... MU₀ QUM..X₀o9.S₀.3 μ M₀... S₀Q ó ..v' ...v" R₀3 S-S₀Q₀M₁U₁ S*...-' gU...v' .. S₀Q R₀3 S-S₀Q₀vU₀*Z.

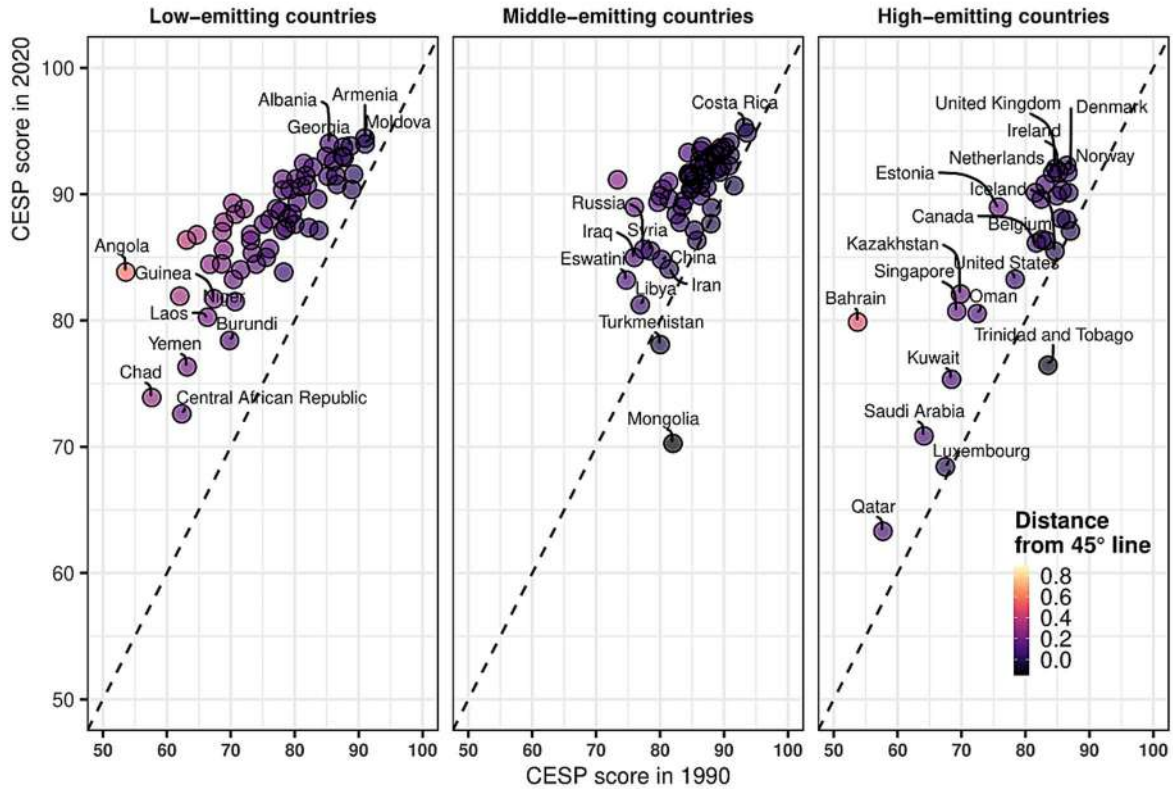
(S₀Q₀ o.àZ ZWXv-*...-' o...<Oàw...M₀ o..S₀...-' o..)S₀g ..úo ϕ g ..í-í-..gQ₀S₀*...-' o..S₀S₀S₀g ...<Oàw...M₀ o..S₀... W₀U...Z...-' o.9g*₀ o9...S₀b..S₀...-' o..)S₀Q₀ o.S₀...-' o... %₀Q₀oo...S₀bN*v...-' o..9S₀*-gUM₀.i o-" ooU₀ogM₀..XvSv... gU₀...-' S₀...S₀b.S₀ X₀S*...-' o.g ϕ ó gQ₀.Qv" -' '...g-o.v ϕ ó ...-' o..oU₀S₀o.X₀ S₀vZ...-' o..)g*-..MU₀ QUM...v)... -' o...v" R₀3 S-S₀Q₀M₁U₁ S*..S₀ X₀S*.. S₀Q ó .Qv" -' '...g-o*.SUM₀U₁ S*..." S' ..S₀S₀S₀g ..ú..v" ó ...<Oàw... *M₀ o*NS₀ μ *'-g-S₀Q₀g...Xg-ó U.v)..." ' v oR₀X₀)v' 3 S₀Q₀M₁U₁ S*..M₀g-M₀S₀Q₀ μ X..." S' ...-' o..S₀S₀S₀g ..ú...

i o-ó Ró)v 3 SUQvUo*Z.

—gi o..GZ ZW<vUó QUM./vQR...o*...o*μ...*)v ...' o..)μ ..XgUb .gU9...oQ3 oU...v)...
MμU- S*Z.

...	$\hat{\beta}$...	à-9Z' ..	—Ró g μo.	wRó g μo.
(μ ..XgUb ..v)..MμU- S*.xUP ..W- Y	- Z Bü ..	- Z ° ...	βZ% W...	- Zuu1...
/v" R3 S-SUQMμU- S*.xUP"... ° Y.	- Z% - β...	- Z . ° ...	WZ% 1...	VZ --- ...
t 99 oR3 S-SUQMμU- S*.xUP ...	R Z1. ° .	- ZW11...	R Z1-í ...	- Z --- ...
" βY..				
" SQ R3 S-SUQMμU- S*.xUP .β- Y.	- ZW% ..	- ZW11...	- Z-í β...	- Z %1° ...

2 v-om<vμU- S*..MUó QUM...S..ó SS9...μU9ó ...' o..Uμ ...' úXv-1 o*S..H₀.gU9... o;oMo9 ...
μU9ó ..H₄Z.-1 o...-o*...S...vUoR9o9Z.-1 o...gU9ó 9..ó' v *..g o... o-ó v*M9g*-Sú..gU9 ...
gμ-vM' o g-SvU.MU*S* oU..x' G<Y.-1 S.gXX vgM.gMμU*..)v .i v-1 ' o-ó v*M9g*-Sú...
xUoffug .óg SgUM*YgU9.gμ-vM' o g-SvU.xM' o g-SvU.i o-" ooU.ó' v ...3 *YSL...1 o.9g-gZ.



(S_q i o..àZ ZW rUSg ..gU9...)Sg ..Xó S9...<Oàw...M o*..gMv**...o3 S*SvU..MμU- ú...QvμX*Z ...' o... %... Sb...
' oX o*oU*...1 o..M*o..." ' ó o...1 o...<Oàw...M o...o3 gSU*..μUMgUQ9...SU.í - í - ..M3 Xg o9...v...Wiu- Z.-1 o..9S-gUM...
) v3 ...' g...Sb.S μ*- g-o*...1 o..SMog*o.xgi vóo...1 o..SbY.v ...' o.9oMog*o.xi o v" ...' o...SbYSL...1 o...<Oàw...M o...
vóó ...' o.Xó S9Z.-1 o.9S-gUM.S..M μi g-o9.g*..($\frac{score_{CESP2020}}{score_{CESP1990}}$) - 1Z.

(v ...' o..3 99 oR3 S-SUQMμU- S*N(S_q i o..1...* v" *..Uv...o9oUM...v)...' o...g3 o..M-MSUQ.μX...
Xg-ó U..xUv..β..MUó QUMYZ.<vμU- S*..SU.-1 S*..QvμX*...oo3 ...-v...o' Xó SUM...S Sg ..góó gQ...
Qv" -1 '...g-o*..SU...1 o...<Oàw...M o..." ' SM.3 gSU-gSU*...1 o.9S-Xg SS*i o-" ooU...1 o.3 99 oR3 S-SUQ..

M_μU_τ S_τ.xUv.σ.MU_δ QUMYZ.

G*.)v_τ ...' o..! SQ R3 S-SUQM_μU_τ S*N(SQ_τ o..1.S μ*_τ g-o*_τ... o..S XSM_τ-SvU_τ.v)* v_τ” ..MU_δ QUM...
i ú.*' v_τ” SUQ_τ... g-...! o.9S)ó oUM..SU...! o.góó gQ_τ.Q v_τ” -' ...g-o.i o-” ooUSSSg_τ ú.i o-ó .gU9...” v_τ *o...
Xó)v_τ 3 SUQ.M_μU_τ S*..SU...! o...<Oàw...M_τ o..S*...o**...SQSSM_τU-Z...! S*..Xg-ó U..)j_τ -' ó ..MU)S3 *...
-! g-N_μU_τS_τo...! o... v_τ” R3 S-SUQ.M_μU_τ S*N...! o...MU_δ QUM...v)...! o...! SQ R3 S-SUQ.M_μU_τ S*...
' off_μS o*..g...*_μi *g-U-Sg_τ ... o9_μMSvU..SU..Xó ..M_τXSg...M_τ i vU..)vv-X SU-Z...! ó o)v_τ oNSU...! S*..Q v_μXN.
” v_τ *oR_τó)v_τ 3 SUQ.M_μU_τ S*..SU...! o...<Oàw...M_τ o..o' Xó S_τUM..Q og-ó ..9S)SM_τ -ú..SU.M_τ-MSUQ.μX...
” S' ...! o..SSSg_τ ú.i o-ó .Xó)v_τ 3 SUQ.vU_τ*Z.

àZ Z ...< μi ..MU_δ QUM.v)...! o.3 99 oR3 S-SUQM_μU_τ S*...

(SQ_τ o..11.S μ*_τ g-o*_τ...! o...;μ*..._τ gU_τSSvU... o g-S_τo...Xg-! *..v)...! o...)v_τi ..MU_δ QUM..M_μi *Z...! o...
9oMog*o..SU.MU_δ QUM..*Xoo9..S*..o9_τoU...g*...” o.3 vøo..) v3 ..M_μi ..W-v..M_μi ..β...xg*...*' v_τ” U..SU...
-gi o.βYZrU.M_μi ..M_μM_μU_τ S*...*' v_τ” ..g..Lv-SM_τgi o..gU9...*' g_τ X.*' S_τ-v_τ” g_τ 9*..μUS-ú...! v_μQ v_μ-...
-! o..Xó S_τ9ZàS_τ S_τg_τ úNM_μi ..β...M_μU_τ S*..o' ' S S...g...*S_τ S_τg_τ ...*' S_τ-i μ-...v..g...o**ó ..o' -oU-Z...! o...
* v_τ” ó ..MU_δ QUM..*Xoo9.v)..M_μi ..β...M_μU_τ S*..S*..o) oMo9.i ú.g.3 v_τ o.Xó *S_τ-oU..QgX.) v3 ..μUS-úZ.
VU...! o.v-! ó ..! gU9NM_μiM_μU_τ S*..! gøo...! o..! SQ o*-..MU_δ QUM..*Xoo9N_τ μ-...! o.._τ gU_τSSvU...
- g;oM_τv_τ ú..S*...v_τ” g_τ 9*..LbQ_τ-S_τo..Q v_τ” -' ...g-o*..v)...! o...<OàwZ.

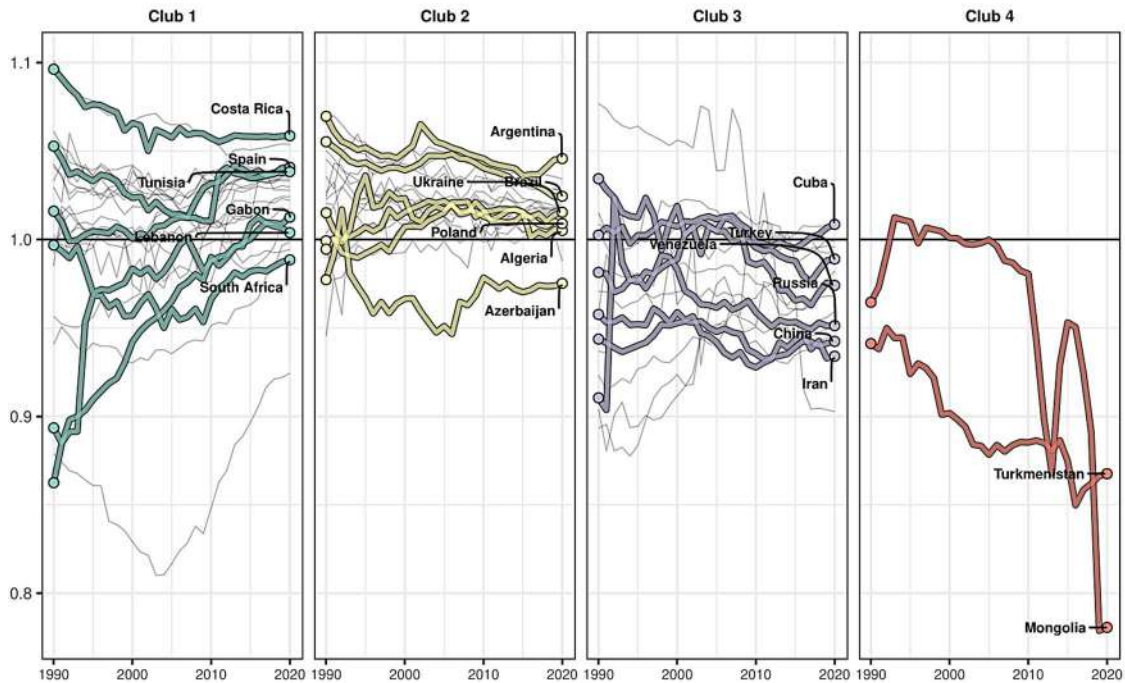
-gi o..àZ Z m< μi ...<vU_δ QUM..G Q_τ S' 3 ..á o*_μ -*...

< μi ...	<v _μ U _τ S*...	$\hat{\beta}$...	à-9ZD'	-R _τ g μo	wR _τ g μo
< μi ... W.	<v*g...á S _τ GN... μQ _τ gúN.† ooMN.wv _τ -μQ _τ N.à XgSU _τ sg3 gS _τ GN...-μUS _τ S _τ N. OM _τ g9v _τ N.á v3 gUS _τ N.à” o9oU _τ (' gUMN.< vg-S _τ N.<úX μ*N.I g _τ i g9v*N.á oX _μ i SM.v) 2 v _τ -' ..t gM9vUS _τ Nr-g úN. o' SMN.s.v _τ 9gUN.+gi vU _τ t g 9S _τ o*N/oi gUvUN.-üi o6S _τ -gUN. 2 g3 S S _τ Nà v _μ -! ..G) S _τ GN O*” g-SUS..	-Z β 1.	- ZW- ° ...	βZ βW...	- Zuuu...
< μi ... í ...	G Q _τ U-S _τ GN. <' SoN. /g-øS _τ N. t g _μ í S _τ q _τ *N. I' güS _τ n v3 SUS _τ U...á oRX _μ i SMN.2 o” ...Üog gU9N./S' μgUS _τ (SSN.I μ Q _τ S _τ N.à _μ í S _τ g3 oN.-6 gS _τ ubN.7 ú Q _τ ü*-gU _τ wv gU9N! μUQ _τ úNà vøoUS _τ NG Q _τ S _τ N. à vøg6S _τ NI o g _τ μ*NGüó i gS _τ gU..	-Zí ..	- ZW% _τ ...	VZ _τ β...	- Z _τ % í ...
< μi ... β...	<μi gNwgUg3 gN...! gS _τ gU9Nàó i S _τ NI v*US _τ .gU9... " ó üoQ _τ øS _τ GN. -μ _τ 6oúNOQ _τ iX-Nö oUü _μ o gNt g gú*S _τ NI v-*” gU _τ N. á μ*S _τ Nà ú S _τ N. gffN.<' S _τ gN _τ gUN/S úg...	-Z βuβ.	- ZW% _τ %.	- Z _τ % 1...	- Z _τ uul...
< μi	-μ _τ 63 oUS _τ -gUNt vUQ _τ S _τ ...	-Zuβ ...	VZ βW.	-Z _τ -1...	-Z VW.

...

-gi o..àZ Z ...*' v_τ” *...! o..M_μU_τ ú..M3 Xv*SSvU.v)...ogM_τ..v)...! o...)v_τi ..M_μi *...” S' SU...! o..3 99 oR
o3 S-SUQM_μU_τ S*Z...! o..MU_δ QUM..*Xoo9..o*-S_τ g-o*..g_τ o.Xv*S_τSo..)v_τ ..g_τ ..< μi *...” ' SM_τ.S XS*...
-! g-...! ó o..S*..MU_δ QUM...” S' SU..g_τ ..M_μi *..i μ-...! o..MU_δ QUM..*Xoo9..øg_τ S*..SQSSM_τU-ú...

gMv**...-' o3 Z.



(SQi o...àZ Z m- ' o...)vpi ...Mpi *...v)...-' o...<Oàw...MUpó QUM...g3 vUQ...-' o...3 99 o o3 S-SUQ.MpiU- S* Z.
 <vUpó QUM.Mpi *... ó o...9oU-SS9.µ*SUQw' S S*.gU9.àµ .xí-- uYg Q' S' 3 Z...-' o...vQR...o*...g-S-SMS.Qog-ó ...
 -' gU...-' o.MSSMg .øg po.v).RV %)v' .g .Mpi *... ' SM.SS XS*.Mpi .MUpó QUM.v)...-' o3 99 oR3 S-SUQ.MpiU- S*Z.
 ào oMo9.MpiU- S*.g o...! SQ SQ -o9..)v' ..< µi ...Mxi .gU9.βZ.

àB... —' o.àvMg .w vQo**rU9o' ...—S o.ào S*

àBZW.(g3 o" v 6.gU9.Mó gQ...

rU...-' S*.µ9ú... o.µ*o...-' o.àvMg .w vQo**...—S o.rU9o' .ào S*.9o9o vXo9.i ú...-' o.àvMg .w vQo**...
 r3 Xo g-Sxo.x" g' 3 gM6.gU9.7' ú vøgM-í βZ...-' S.rU9o' .M3 i Suo*.% .vMg .vµ-M3 o.SU9Mg-v *...
 -v.3 og*µi o.*vMg .X vQo**..v)...W- .MpiU- S*.vóó .Wiu- R-í - Z.

—' o.rU9o' ..)vM1*o*.o' XSMS-ú.vU.UvURMfUv3 SMg*XoM*.v)..Ug-SvUg .Xó)v' 3 gUMZr-.*úU-' o*Sio*...
 -' oo.9S*-SUM.i µ-..SU-ó MUUoMo9.ffiio*-SvU*..v.X vø9o.gU.SU*SQ -..SU-v...-' o...o9o ..v)..MpiU- S*...
 *vMg .X vQo**m

OgM...v)...-' o*o.ffiio*-SvU*... oX o*oU*..g..9S*-SUM... 9S oU*SvU ..SU...-' o.rU9o' ..) g3 o" v 6ZOgM...
 9S oU*SvU..! g*..)vpi .M3 XvUoU*... ' SM.MUS*..v)..SU9S9µg .SU9Mg-v *.x(SQi o.GBZWZ.

àBZ ...ào oMo9.SU9Mg-v *.gU9.gQQoQ-SvU.X vM9í o...

—' o.àvMg .w vQo**rU9o' ...—S o.ào S*..) g3 o" v 6..M3 X So*..g...v-g ..v)...% .vMg .vµ-M3 o...
 SU9Mg-v *N' S' .β...v... .SU9Mg-v *.Xó .M3 XvUoU-..x(SQi o.GBZWZ.

Basic Human Needs	Foundations of Wellbeing	Opportunity
Nutrition and Basic Medical Care Deaths from infectious diseases Child mortality Child stunting Maternal mortality Nutritional deficiencies Diet low in fruits and vegetables Water and Sanitation Improved sanitation Improved water source No access to a handwashing facility Deaths from unsafe water, sanitation and hygiene Shelter Deaths from household air pollution Access to electricity Prevalence of cooking with coal/biomass Personal Safety Interpersonal violence Deaths from road injuries Political killings and torture Intimate partner violence against women Political violence	Access to Basic Knowledge Population with no education Equal access to quality education Gender parity in basic education Mean years of schooling Access to information and Communications Internet users Mobile and landline telephone subscriptions Alternative sources of information Health and Wellness Life expectancy at 60 Premature deaths from non-communicable diseases Equal access to quality healthcare Universal health coverage Environmental Quality Deaths from outdoor air pollution Deaths from lead exposure Particulate matter (2.5) pollution Species protection	Personal Rights Access to justice Freedom of religion Political rights Property rights for women Freedom of assembly Freedom of discussion Personal Freedom and Choice Satisfied demand for contraception Public sector corruption Early marriage Vulnerable employment Freedom of domestic movement Inclusiveness Equal protection of social groups Equal access to power Power distributed by sexual orientation Access to public services distributed by social group Access to Advanced Education Respect for academic freedom Population with advanced education Years of tertiary schooling Gender parity in advanced education

(S_Q o.à₂WàvMg .w vQo**rUo' :-S o.ó S*.SU9M-ý * Z.-' o.M3 XvUoU-*.v).- ' o.rUo' .g o.SU.i v 9...

—' o..SU9M-ý *.g o.Mg o)u ú..*o oMo9..SU-v.-' o..) g3 o" v 6..i g*o9..vU.3 μ -SXo..ffug Sú..MSó \$g...
gU9... ' o.9g-g..g o.*μi ;oM.-v.*ó S*.v).3 v9SSMg-SvU*.. ' ó o.Uoo9o9.x3 S*SUQog μo*.S Xμ-g-SvU*N.
— gU*)v 3 g-SvU*N*-gU9g 9Sig-SvU.o-MYX S' ...v..)Sug ..Mg Mμ g-SvUZ.-' o.àvMg .w vQo**rUo' ...
—S o.àó S*.t o- ' v9v vQí.àμ3 3 g' ú.x" g' 3 gM6.gU9..7 ú vøgM-í BY.vμ-SvU*.-' o*o.*-oX*.SU.g...
Qog-ó .9o-gSZ.

rU.x 9ó ...v..Mg Mμ g-o.M3 XvUoU-*.M o*N- ' o.*o-..v)..SU9M-ý *.v) .ogM..M3 XvUoU-..S*.Q vμXo9...
SU-v..g..)gMv ..μ*SUQ.X SUMXg ..M3 XvUoU-..)gMv ..xw<(Y.gUg ú*S.Nμ*SUQ.-' o.βWúog *.v)..9g-g...
gøgSgi oZw<(..M3 i SvU*..SU9M-ý *.SU.*μM .g.." gú..g*..v..MgX-μ o.-' o.3 g' S μ3 ..øg \$UM..SU..
—' o.9g-g.." ' So..3 SSS SiSUQ..o9μU9gUM..i o—" ooU..SU9M-ý *Z.-' S*.Svøøo*.g**SUQU.." oSQ -*...
—v..ogM..SU9M-ý NoU*μ SUQ.-' g-.-' oú..Mμ S μ-o..*SU9SMU-ú.-v.-' o.M3 XvUoU-*.M o.." ' So...
—g6SUQSv.gMμU-.-' oS ..S Sg SS*Z.

—' o.w<(.*M o*.g ó...o*Mg o9..) v3 ..-v..W-..μ*SUQ.-' o.3 SUB g' .3 o- ' v9ZOGM.9S oU*SvU.*M o...
S*.Mg Mμ g-o9..g*.-' o..g S' 3 o-SMgóó gQ..v)..S*.. o*XoMSo..M3 XvUoU-..*M o*ZàS Sg ún.-' o...
vóó g .rUo' ..*M o.S*.M3 Xμ-o9..g*.-' o.g S' 3 o-SMgóó gQ..v)..- ' o.9S oU*SvU.*M o*Z.

Multidimensional Cross-Country Measurement of Climate Change Perceptions

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ABSTRACT

Understanding public perceptions of climate change is crucial for more targeted communication and better-informed policymaking. Moreover, the perceptions of climate change encompass different aspects and thus need to be defined and measured using a multidimensional approach. In this paper, we introduce the Climate Perceptions Index (CPI), a composite measure that comprehensively assesses the public perceptions of climate change, based on a sample of over 100 thousand active Facebook users across 107 countries. We construct the CPI as an aggregate of three distinct dimensions that quantify the awareness of climate change, risk perception, and commitment to action. The results show that the extent of climate change perceptions varies significantly across countries and across dimensions. Countries with the highest and lowest scores globally can be found in almost all regions, and across all levels of socio-economic development. Furthermore, we analyze the relationships between the CPI dimensions and find that the influence of risk perception on commitment to action is the strongest at the lowest levels of climate change awareness. This highlights the possibility of climate change risk normalization at higher levels of awareness, and further shows that effective policies and strategies must not only focus on raising knowledge about climate change, but also overcome the normalization of its threats.

KEYWORDS

Climate change; perception measurement; composite index; social media

Introduction

Perceptions of climate change encompass awareness, risk perception, and commitment to action – three intertwined elements, whose relationships have been explored in diverse ways in the literature (Maartensson & Loi, 2022; O'Connor et al., 1999). Understanding these elements and their relationships is crucial for effective climate communication and policy making. The Climate Perception Index (CPI)¹ can be viewed as an attempt to provide a comprehensive assessment of the public opinions on climate change globally. It measures countries' climate change perception levels on the basis of awareness, risk perception, and commitment to action.

The awareness of climate change has always been a straightforward concept, proxied as the level of self-reported knowledge about the issue, and believed to be shaped mainly by the level of education (Metzger et al., 2010). The risk perception, on the other hand, refers to the way individuals perceive the likelihood, severity, immediacy, and personal relevance of climate-related threats (van der Linden, 2014). It can vary significantly across countries due to the multitude of factors that affect it, such as the differences in exposure to climate impacts, or cultural beliefs (Lee et al., 2015). As for the commitment

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to climate action, it is defined as the willingness to engage in climate action and advocate for pro-environmental policies (Xie et al., 2019).

There is a crucial need for a more comprehensive approach to measuring the public perception of climate change. It is because the link between climate change awareness and the general perception is uncertain due to the mismatch between subjective information (beliefs) and objective evidence (such as the scientific agreement that fossil fuel combustion contributes to climate change). Single-item assessments like “I know a lot about climate change” often yield inconsistent findings (Leiserowitz, 2006). It is therefore necessary to consider not only whether an individual is “aware” of climate change, but also the extent to which climate change is perceived as a serious threat. The intersection with awareness is important since it allows a clear demarcation between the case where individuals report a high level of knowledge about climate change while downplaying its risks, and the case where high knowledge implies a higher perception of risks and ultimately increased commitment to action and environmentally friendly behaviors.

Apart from the potential overlaps between awareness and risk perception, the commitment to action is considered to be a unique and important component of the general climate change perception. Individuals can still be reluctant to engage in pro-environmental action despite “knowing a lot about climate change” and perceiving it as a “serious threat.” This is due to the interplay of other significant factors such as the perceived cost of mitigation behaviors and low efficacy which can largely undermine the willingness to act even in cases where individuals have experience with extreme weather events and are aware of climate change. Indeed, the sense of self efficacy and belief in the usefulness of one’s actions is a necessary condition for behavioral willingness (Grothmann et al., 2013). This can therefore lead to a clear divide in the proportion of individuals willing to take mitigation action across countries and would depend mainly on whether civic engagement is encouraged or constrained.

In this paper, we measure the public perception of climate change across different countries in a comprehensive manner that covers the above-discussed three dimensions (i.e., awareness, risk perception and commitment to action). Most importantly, we construct the Climate Perceptions Index (CPI), a composite indicator that ranks countries based on the level of perception in all the three dimensions. This allows for a more straightforward insight into the extent to which the public is aware of climate change, perceives its risks and is committed to act against it. Furthermore, it is possible to assess countries’ performance across the three defined dimensions separately which allows for a better understanding of the potential imbalances between awareness, risk perception, and commitment to action. For instance, countries might score the highest in the awareness dimension of the index but not necessarily in others, and the same applies to the risk perception and the commitment to action. Such insight is of great importance and policy relevance as it highlights the areas where public perception is not adequately high. Most importantly, it raises key questions about the way the three dimensions of the index interact with each other.

In addition to the more comprehensive approach of measuring climate change perception across nations based on the CPI, we use the index dimensions to explore the influence of awareness on the relationship between risk perception and commitment to action. This helps to verify whether higher scores in the awareness dimension translate into a stronger relationship between risk perception and commitment to action. Testing this hypothesis is also a step forward in understanding the role of knowledge about climate change in shaping individuals’ behaviors and attitudes toward it.

We carried out this analysis using data from a survey of Facebook users in 107 countries, thereby allowing for an unprecedented overview of the global pattern of public perception on social media among over 100 thousand respondents. The survey was conducted by the Yale program of climate change communication and Meta (Leiserowitz et al., 2022). It investigates climate change knowledge, beliefs, attitudes, policy preference and behavior among Facebook users.

The use of this kind of data has multiple implications compared to traditional survey data. On social media, homophily (the tendency for people to interact with others who share similar beliefs and values) can largely contribute to the formation of echo chambers. This leads to a higher risk

that individuals are less likely to encounter opposing viewpoints and only receive information confirming their existing beliefs (McPherson et al., 2001). Self-reported knowledge about climate change might therefore be associated with the denial of its occurrence since expressive activities on social media (such as voicing one's opinions or concerns) may promote awareness but can also reinforce existing beliefs if conversations remain within the same social network (Metzger et al., 2010).

We further review and discuss these implications in the following literature review section, with special attention paid to the current knowledge about the inter-relationship between awareness, risk perception and the willingness to action. We devote the methodology section to the CPI construction procedure and the description of its underlying framework. We then describe the CPI global distribution of scores with a focus on regional disparities both in terms of the overall CPI score and its dimensions. Moreover, we go beyond the general description of the CPI performance and investigate changes in the cross-country relationship between risk perception and commitment to action depending on the level (scores) of awareness. We then discuss policy implications of the findings and raise some possible limitations in the discussion and conclusion sections respectively.

Literature review: the interplay between awareness, risk perception and commitment to action

Awareness and risk perception

In recent years, there has been a growing interest in understanding public perception of climate change (Lee et al., 2015; Leiserowitz et al., 2009; van der Linden et al., 2015), as it is seen as a crucial factor in effective climate change communication and policy making. Previous research has identified three key elements that summarize public climate change perception: awareness, risk perception, and commitment to action (O'Connor et al., 1999). Awareness of climate change is an essential factor in shaping public perception. Studies have shown that individuals who are more "aware" of climate change are more likely to perceive it as a serious threat (Lorenzoni et al., 2007). This awareness can come from various sources, including the media, educational programs, and personal experiences. Research has also found that there is variation in awareness levels across different nations. For example, individuals in developed countries tend to have higher levels of awareness compared to those in developing countries (Lorenzoni et al., 2007). However, higher levels of self-reported knowledge about climate change can also entail the risk of increased polarization regarding the causes, the risks and policy preferences.

Such discrepancy between the levels of self-reported knowledge about climate change and the general attitude toward climate change is best reflected on social media platforms. On social media, admitting that climate change is happening does not necessarily imply believing in its anthropogenic origins. The view that climate change has no human causation extends beyond awareness and can be linked to scientific skepticism or ignorance as well as ideological and political affiliations (Kahan et al., 2012; Metzger et al., 2010; Nisbet, 2009).

In the literature, it is assumed that individuals with a higher level of education have a greater understanding of the physics behind climate change and a stronger perception of the associated risks (Leiserowitz, 2005). However, cultural values and beliefs significantly influence risk perception. For instance, people with more individualistic values, such as personal achievement and independence, are less likely to perceive climate change as a serious threat. Conversely, those with more communitarian values, such as concern for the welfare of the community and the environment, are more likely to view climate change as a threat (Kahan et al., 2012). In this sense, even highly educated individuals may hold differing opinions based on their beliefs and political affiliations. For instance, a study by Kahan (2015) supports this notion, revealing that among individuals with higher education levels, those who

identified as politically conservative were less likely to perceive the risks of climate change compared to their politically liberal counterparts.

Risk perception and commitment to action

The study of climate change risk perception has received substantial attention in recent decades, with researchers examining this topic extensively (e.g., Capstick et al., 2015; Egan & Mullin, 2017). A significant body of research has focused on identifying the factors that influence how individuals perceive the risks associated with climate change. These factors include natural hazards (Frondel et al., 2017), cues from influential figures (Carmichael & Brulle, 2017), and optimistic views regarding technology (Fletcher et al., 2021). Furthermore, an increasing amount of research has explored the consequences of climate change risk perception. Studies have shown a positive correlation between climate change risk perception and actions related to climate change mitigation and adaptation (Azadi et al., 2019; Jakučionytė-Skodienė & Liobikienė, 2021). This suggests that climate change risk perception plays an important role in encouraging actions that contribute to more effective efforts in addressing climate change.

Indeed, a decline in the perception of climate change risk would undermine the overall commitment to contribute to climate change mitigation efforts (Wang et al., 2021). This decline poses a challenge in translating general intentions into concrete actions, mainly due to the relationship between specific determinants of behavior (e.g., less favorable attitudes, reduced perceived control, and increased perceived situational constraints) and precise behavioral intentions. Empirical evidence has shown that lower levels of climate change risk perception are associated with not only less positive attitudes toward pro-environmental actions (Mase et al., 2015) but also a reduced willingness to engage in such actions, and a decrease in the frequency of environmental-friendly behaviors (e.g., Lacroix & Gifford, 2018; Xie et al., 2019).

Despite the positive relationship between the perception of risk and the commitment to action, the interplay may still be fundamentally mediated by self-efficacy (Bandura, 2006; Bandura & Locke, 2003). Generally, risk perception and awareness alone are not sufficient motivations for climate action if individuals lack the sense of self-efficacy and faith in the outcomes of actions (Grothmann et al., 2013). Wang et al. (2021) define self-efficacy in the context of climate change perception as “environmental efficacy.” That is individuals’ belief in their capacity to take actions that contribute to combating climate change. Generally, increasing environmental efficacy could boost intentions to engage in pro-environmental actions (Huang, 2016; Jugert et al., 2016; Lauren et al., 2016; Steinhorst et al., 2015).

Mediation factors of the relationship between risk perception and commitment to action

Theoretical and empirical foundations suggesting that climate change belief and environmental efficacy mediate the relationship between climate change risk perception and commitment to action can be drawn from the Value-Belief-Norm (VBN) theory proposed by Stern (2000) and Stern et al. (1999). According to the latter, individuals who possess stronger beliefs regarding the natural environment and the environmental consequences of human actions are more likely to recognize the adverse outcomes of not adopting pro-environmental behavior. They also tend to believe that they can mitigate negative environmental impacts by altering their behavior. These convictions, in turn, are likely to activate norms related to their moral obligation to take pro-environmental action and engagement.

Furthermore, individuals with stronger environmental beliefs (as captured also in the data we use in this paper, for example in the question “Climate change is caused mainly by human activities”) are more likely to believe in the necessity of climate change mitigation (e.g., “Climate change should be a high, or very high priority for the government of the country where I live”). More recently, an investigation using data from the Round 8 of the European Social Survey by Verschoor et al. (2020)

demonstrated that stronger climate change beliefs were associated with a heightened belief that reducing one's own energy consumption could combat climate change. Building upon the VBN theory and the empirical evidence, it can be inferred that belief in the anthropogenic origins of climate change, recognition of its negative impacts, and concern about its consequences are positively linked to a stronger conviction that individual actions can contribute to climate change mitigation. Consequently, this heightened sense of environmental efficacy may induce a sense of moral obligation to act, promoting climate change action. In summary, an increased perception of climate change risk may amplify climate change beliefs, which, in turn, could improve climate change action by fostering a stronger sense of environmental efficacy (Wang et al., 2021).

Materials and methods

Conceptual framework

The Climate Perceptions Index is built upon the data collected by Meta in its Facebook International Public Opinion on Climate Change Survey (Leiserowitz et al., 2022). In partnership with the Yale Program on Climate Change Communication, Meta conducts an annual climate change opinion survey that explores public climate change knowledge, attitudes, policy preferences, and behaviors. The data collection methods, translations, sampling characteristics etc. were undertaken by Meta, and together with simple descriptive statistics of the survey results, they are described in Leiserowitz et al. (2022). There are sixteen questions in the questionnaire, each consisting of multiple response options, out of which only one could have been selected by the respondents. Survey data are provided by respondents for each of the 107 countries (and three additional regional groupings) by Data for Good department of Meta.

After assessing the nature of the questions, we construct the CPI theoretical framework centered around the three concepts which we refer to as CPI “dimensions:” Awareness, Risk Perception, and the Commitment to Action. Based on conceptual fit and statistical testing we select the most appropriate questions from the questionnaire. We choose to create a symmetric index structure, having four questions in each of the three dimensions. This ensures equal weighting for each dimension.

While the questions broadly determine the variables used in the CPI framework, it still needs to be decided how we treat the response categories of each question. To do this, we develop a systematic approach that assigns weights to responses indicating some extent of awareness, risk perception, and commitment to action. These responses with weights are then included in the Index calculation while the rest is disregarded. We prefer this approach over standardizing the individual responses since not all of them can be considered ordinal. Therefore, we give a weight of one to the responses that approximate the highest awareness, risk perception, and commitment to action (usually containing words such as “very high,” “great deal,” “a lot”). Weight of 0.5 is given to the second “best” category (if applicable), usually consisting of words such as “moderate,” “somewhat” and “high.”

However, some questions do not have an entirely comparable scale, and we have to treat these individually. In the Commitment to Action dimension, the “personal importance of climate change” question includes response categories of “extremely important,” “very important,” and “somewhat important.” Therefore, we give the first and “somewhat” categories weights of 1 and 0.5, respectively, which is consistent with our general approach, and assign the “very important” category in the middle a weight of 0.75. Additionally, for the question on responsibility for pollution causing climate change, we set the weights equal for all three non-denying responses (since it is an example of non-ordinal responses). Lastly, for four questions, we include one response category that best reflects the desired extent of awareness, risk perception, and commitment to action. The structure of the Index, with the response categories (and their weights) included for each question, is visualized in [Figure 1](#).

The Awareness dimension consists of four questions and measures the level of knowledge, the belief that climate change is a real phenomenon,² the ideas about the causes, and the frequency of hearing about climate change. The Risk Perception dimension measures the extent of the perceive

Awareness	Risk perception	Commitment to Action
How much do you know about climate change? - I have never heard of it - I know a little about it I know a moderate amount about it (0.5) - I know a lot about it (1)	How worried are you about climate change? Very worried (1) Somewhat worried (0.5) - Not very worried - Not at all worried	How important is the issue of climate change to you personally? Extremely important (1) Very important (0.75) Somewhat important (0.5) - Not too important - Not at all important
What do you think: Do you think that climate change is happening? Yes (1) - No	How much do you think climate change will harm you personally? A great deal (1) A moderate amount (0.5) - Only a little - Not at all	Do you think climate change should be a very high, high, medium, or low priority for the government of the country where you live? Very high (1) High (0.5) - Medium - Low
Assuming climate change is happening, do you think it is... Caused mostly by human activities (1) - Caused mostly by natural changes in the environment - Caused about equally by human activities and natural changes - None of the above because climate change isn't happening	Do you think that climate change is a very serious threat, a somewhat serious threat, or not a threat at all to the people in the country where you live, over the next 20 years? Very serious (1) Somewhat serious (0.5) - Not a threat at all	Do you think that the country where you live should reduce its pollution that causes climate change? Regardless of what other countries do (1) - Only if the countries that produce the most pollution (such as the United States, China, and India) reduce their pollution - Only if most other countries around the world reduce their pollution - The country where I live should not reduce its pollution
About how often do you hear about climate change in your daily life (for example from TV, newspapers, social media, or conversations with friends and family)? - Never - Once a year or less often - Several times a year - At least once a month At least once a week (1) - Don't know	How much do you think climate change will harm future generations of people? A great deal (1) A moderate amount (0.5) - Only a little - Not at all	In the country where you live, who do you think is most responsible for reducing the pollution that causes climate change? The government (1) Businesses (1) Individual people (1) - The country where I live should not reduce its pollution

Figure 1. Structure of the CPI.

Source: Authors. Note: Responses highlighted in bold are used in the CPI calculation. The weights assigned to the responses in the calculation procedure are in brackets.

risk of climate change from a narrow, personal perspective, where the respondents report the level of concern that climate change will harm them personally, and from an intergenerational perspective, where respondents report the level of concern about the harm that climate change will cause for future generations. And finally, the Commitment to Action dimension measures the willingness to adopt a pro-environmental behavior. The questions capture the importance people place on the issue of climate change and policy preferences regarding the government's involvement and their country's accountability in addressing the issue of climate change.

Data treatment and CPI calculation

Survey data is provided by respondents in each participating country. We aggregate the respondent-level data by countries and create country-level proportions for all response categories of each question included in the Index framework.³ For the aggregation, we apply the survey weight (Leiserowitz et al., 2022). We compute the variables as the weighted average of the country-level proportions of the included questions' response categories as shown in Figure 1 above.

To allow for better comparability across countries and indicators, each of these variables is scaled to 0–100 scores using a theoretical best-case (100) and worst-case (0) method combined with a min-max standardization procedure. This is done by expanding the dataset of two fictitious cases – best and worst – which represent the 100 and 0 scores respectively that are then used in the min-max standardization. For example, the best case is where 100% of respondents agree climate change is happening, and the worst case is where 0% of respondents agree climate change is happening. If a country has 57% of respondents agreeing, their score will be 57. Moreover, scaling the individual variables to 0–100 scores means that also the CPI and its dimensions are measured on the 0–100 scale, where 0 represents the worst possible performance, and 100 the best possible performance.

We use the arithmetic average for the aggregation of individual variable scores into dimension scores, and dimension scores to CPI scores. Being aware of the full compensability of the arithmetic average aggregation (Mazziotta & Pareto, 2016), we opted for this method as it is more commonly understood. Moreover, we also tested other methods of aggregation (geometric average and principal component factor's derived weights), but their results were very similar to arithmetic average.

Table 1. Multivariate tests results.

CPI Dimension	Factor 1 eigenvalue	Factor 2 eigenvalue	Cronbach's alpha	Mean KMO
Awareness	2.90	0.70	0.87	0.74
Risk Perception	3.42	0.37	0.94	0.85
Commitment to Action	2.72	0.87	0.84	0.63

Source: Authors. Note: Unidimensionality occurs when only one factor's eigenvalue is larger than 1. Cronbach's alpha value should be above 0.7 (Bland & Altman, 1997). The goodness of fit of the factor should be generally higher than 0.5 (Manly, 2004). All of these thresholds are safely met for all three dimensions. When we perform the PCF with all variables, the results show that two to three factors are present.

We performed basic multivariate analyses (both on the underlying microdata, as well as on the country level values) which validated the groupings of questions, as it ensured a good statistical fit. For each dimension, the analyses tested for correlations between indicators (using the Pearson correlation coefficients) and unidimensionality (using the Principal Component Factor, PCF). We also calculated Cronbach's Alpha (Tavakol & Dennick, 2011) and Kaiser-Meyer-Olkin measure of sampling adequacy (Shrestha, 2021) to evaluate the internal consistency across indicators and the goodness of fit, respectively. As for the correlations, out of the 18 correlation coefficients in total (six in each dimension), 17 were reasonably high (>0.38 , the highest value was 0.92) and statistically significant at the 1% level. The remaining coefficient was 0.16 and it was significant at the 10% level. The other multivariate test results are shown in Table 1 and they indicate unidimensionality (based on the PCF results), internal consistency across indicators (based on the Cronbach's alpha values) and a good statistical fit (based on the KMO results) of each dimension.

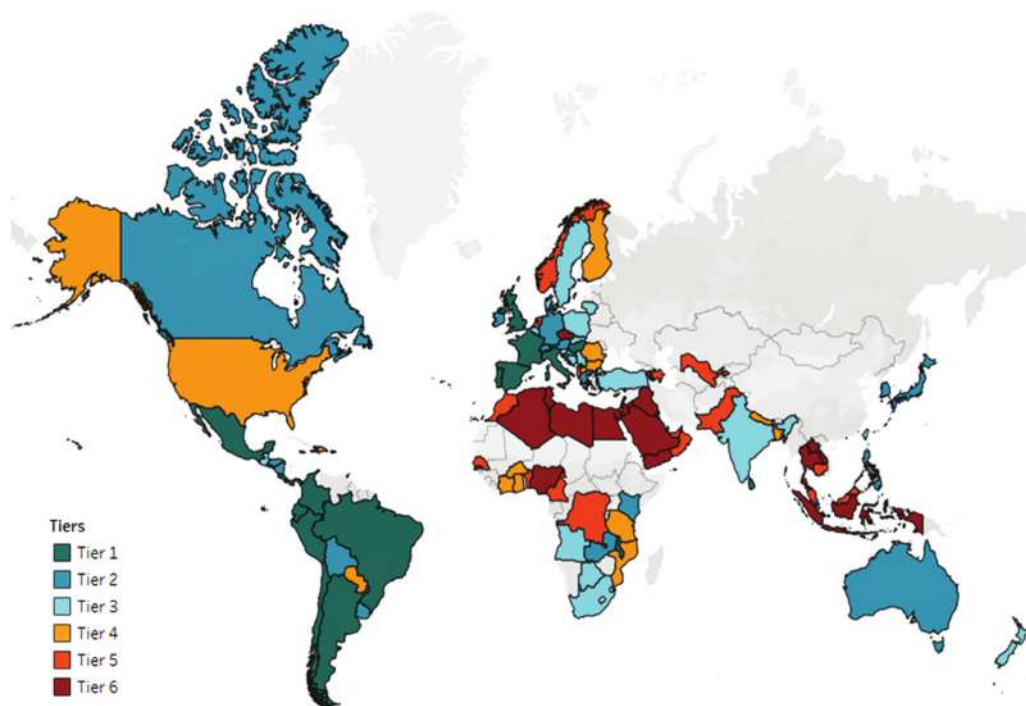


Figure 2. Geographical pattern of the CPI scores. Source: Htitich et al. (2022).

Results

The Climate Perceptions Index

The CPI covers 107 countries and 3 additional regional groupings of countries. We created six performance tiers that were calculated as sextiles based on the CPI's ranking. Tier 1 denotes the best-performing countries, while Tier 6 indicates the worst-performing countries on the aggregate index. [Figure 2](#) shows the geographical distribution of scores where the higher the score, the higher is the degree of the overall perception of climate change. The scores serve therefore as a composite measure of countries' awareness, risk perception and the commitment to action. Tier 1 category (the highest sextile) consists of Western Europe and Latin American countries. Tier 2 and 3 categories are geographically more scattered as they include Canada, Australia and India as well as predominantly European countries such as Germany and Poland (plus several Sub-Saharan African countries, including South Africa). Similarly, Tier 4 and 5 categories are geographically dispersed and consist of countries such as the United States, Finland and Norway. Countries with the lowest scores (Tier 6) are predominantly found in the Middle East and North Africa (MENA) region, but also include countries from other parts of the world (for example Indonesia, Thailand, or the Czech Republic).

Clearly, the level of climate change perception (as measured by the CPI scores) varies significantly across countries. The highest and lowest performance can be observed across regions, and simultaneously in developed and developing countries. In addition to the extent of cross-country disparities, the CPI also establishes how the public's view of climate change matches with the hazards that it poses to countries. For instance, the MENA countries respondents report the lowest scores despite being relatively more vulnerable to droughts and substantial increase in temperatures (Waha et al., 2017). While in some of these cases it can be due to the lack of general knowledge about climate change and its risk, the observed low CPI scores in more developed countries such as Norway, Finland, and the Czech Republic reflect a higher level of polarization on the issue (Kahan et al., 2012; Nisbet, 2009), which might then be exacerbated, especially on social media, due to the lack of exposure to opposing viewpoints. As a result, individuals may become less receptive to alternative viewpoints and more rigid in their preexisting beliefs (Martin, 2018).

Low CPI scores in some European countries are mainly due to low performance in the Risk perception and Commitment to action dimensions. For instance, countries such as Finland, Norway, and the Czech Republic achieve some of the highest scores in the Awareness dimension but the lowest scores in the other two dimensions. Such a combination of performance further illustrates that high levels of awareness about climate change do not necessarily translate to a higher perception of its risks nor a higher commitment to action. In more developed countries, higher levels of education translate into higher knowledge about climate change, yet the lack of experience with extreme weather events (or with the destructive consequences of those) might limit the perception of risks. Furthermore, higher education has been found to be associated with increased climate change denial (Kahan, 2015) which should undermine the commitment to action as well.

As shown in [Figure 3](#), the highest scores of the Risk perception dimension are therefore observed in less developed contexts. For instance, while Malawi (clearly an outlier compared to other regional peers) has the highest scores of Risk perception, Sub-Saharan countries have generally moderate scores in the Risk perception and Commitment to action dimensions. Latin American countries appear to have generally high levels of risk perception and commitment to action but, strikingly, significantly lower levels of awareness. However, as a result of having the best scores in both Risk perception and Commitment to action dimensions, Latin American countries achieve the highest scores in the overall CPI. On the contrary, the MENA region countries' low CPI scores are the result of low performance across all dimensions.

One of the most important findings is that countries' perception varies significantly across the three dimensions. Latin American and European countries exhibit the greatest gap of scores across the dimensions. For instance, while the Awareness score is the highest among European countries, the Risk perception and Commitment to action scores are generally lower. The same is true for Latin

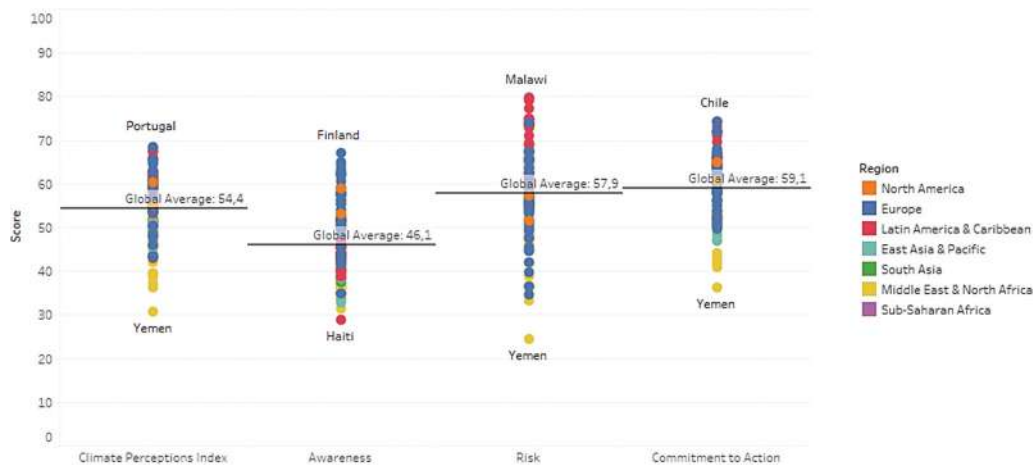


Figure 3. Scores distribution of the CPI and its dimensions. Source: Httich et al. (2022).

American countries where the Risk perception and the Commitment to action are the highest whereas the Awareness scores are significantly lower. Such imbalances raise questions about the interrelations between the dimensions, especially if we consider the level of awareness as the discriminant factor shaping the relationship between the risk perception and the commitment to action.

The influence of awareness on the relationship between risk perception and commitment to action

We further investigate the dimensional interrelationships by constructing a linear model tree. This allows us to model the relationship between Risk perception and Commitment to action within different subsets of countries based on the score in the Awareness dimension. We are, therefore, able to compare how risk perception is associated with the commitment to action across different levels of awareness in order to determine whether this association increases or decreases with higher levels of awareness about climate change.

Figure 4 shows the relationship between the risk perception and the commitment to action across different levels of awareness. Countries are divided into two groups: countries with an awareness score strictly higher than 50.64, and countries with a score lower or equal to 50.64. The latter is then split into two groups again: countries with an awareness score strictly higher than 38.8, and countries with a score lower or equal to 38.8. All three split values are calculated as levels resulting in a significant change in the parameters of the models. The effect of the risk perception on the commitment to action is then assessed for each of these 3 groups and summarized by the scatterplots (terminal nodes) in Figure 4.

Overall, the relationship between risk perception and commitment to action is positive but its strength (slope) varies across the levels of awareness. Strikingly, the relationship is the strongest among countries with the lowest level of awareness (i.e., less, or equal to 38.8) with a slope equal to 0.56. For countries with slightly higher levels of awareness (a score between 38.8 and 50.64), the association between risk perception and commitment to action weakens, with a slope of 0.45. As for the countries with the highest level of awareness (a score higher than 50.64), the relationship is stronger (slope equal to 0.54) but still weaker than that of countries with the lowest levels of awareness. We find therefore that the effect of risk perception on commitment to action does not increase with higher levels of awareness. And what is even more striking: in countries for which the awareness score is lower than 50.64, this effect actually decreases with higher levels of awareness.

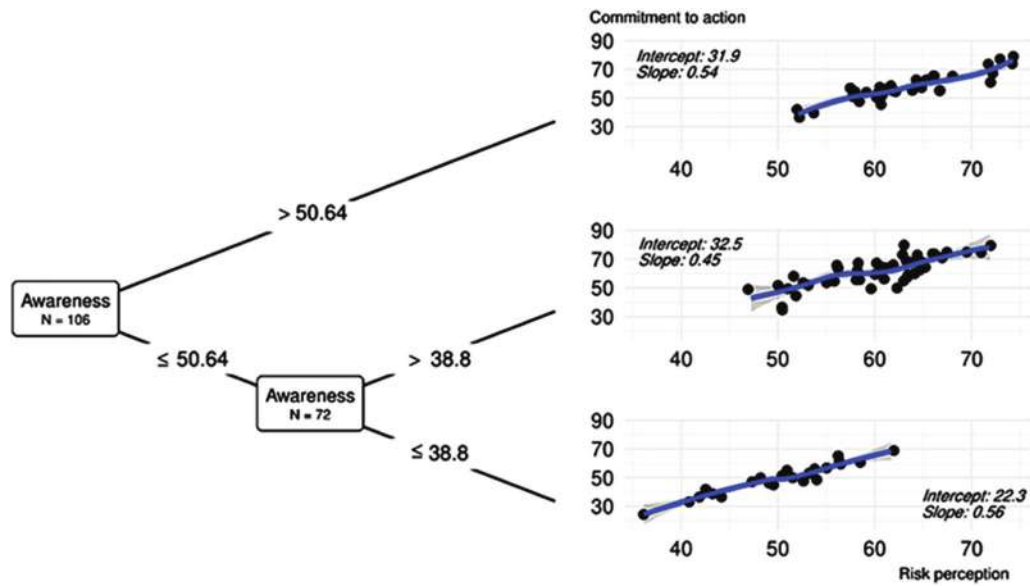


Figure 4. Linear model tree: Risk perception vs. Commitment to action. Source: Authors. Note: Figure 4 shows the linear model tree of the relationship between Risk perception (the x axis of the terminal nodes) and the Commitment to action (the y axis) split by levels of the Awareness dimension. The split levels are identified as the ones that result in a significant change in the parameters of the models. The parameters (intercept and slope) are all significant at the 5% significance level and are based on OLS regression. The fit curve is obtained using loess regression.

Such findings provide further evidence that higher levels of awareness about climate change are not necessarily associated with better commitment to action against it. Indeed, self-reported knowledge about climate change does not necessarily imply concerns about its risks or willingness to engage in pro-environmental actions. In fact, various factors can influence the latter, such as political ideology, values, and beliefs that can be shaped (to a great extent) by the level of education (McCright & Dunlap, 2011). In this sense, individuals might have negative attitudes toward climate change while at the same time reporting high levels of knowledge about it.

The overall CPI score serves therefore as a comprehensive measure of how responsive individuals are to climate change. Most importantly, it considers not only the level of awareness about the issue but also the extent to which individuals are concerned about its risks, and how much they are committed to engage in environmental action. As a result, countries such as Portugal, Costa Rica and Spain achieve the highest scores due to a combination of several factors. Individuals in these countries have relatively higher levels of education directly affecting the level of knowledge about climate change. At the same time, they are more exposed to the consequences of climate change and have a stronger commitment to engage in civic pro-environmental action.

On the other hand, lower CPI scores (e.g., MENA region countries particularly) are mainly due to lower levels of awareness and risk perception, combined with restrictions to engage in pro-environmental action. Unlike MENA, countries in Sub-Saharan Africa exhibit moderate performance that is mainly driven by the risk perception and the commitment to action dimensions. Indeed, the higher vulnerability to extreme weather events generally results in a higher intention of individuals to engage in pro-environmental action. This highlights the importance of considering not only individual knowledge and awareness, but also the contextual factors that can influence attitudes and behaviors toward climate change (Shi et al., 2015).

Discussion

There is a disconnect between awareness and risk perception of climate change

The CPI reveals how individuals perceive climate change in different geographical locations around the world. One of the most striking findings is the significant contrast of countries' performance in the Awareness dimension and, particularly, in the Risk perception dimension. Prior research has established that higher risk perception is associated with the experience with extreme weather events (Howe, et al., 2019; Zhang, 2022). Our results show that countries with the lowest performance in this dimension are not only European countries, but the MENA countries as well. For the former, it can be argued to some extent that individuals do not necessarily have a significant exposure to extreme weather changes over the last few years. Compared to the MENA countries however, the results are surprising and raise a number of questions about the ways the perception of climate change risks is shaped.

Indeed, the "psychological distance" to climate change (Jones et al., 2017; Spence et al., 2012) in some contexts seems more rigid and personal experiences with extreme weather may not have a significant impact on public engagement with climate change. These experiences might not necessarily increase the cognitive salience of climate change or trigger an emotional response (Demski et al., 2017). Therefore, it could be that personal experiences with extreme weather do not consistently lead to heightened feelings of personal vulnerability and concern, as they may not make potential risks more concrete.

While it could be argued that low awareness leads to low-risk perception, we observe that risk perception scores are low even among countries with generally high awareness scores (e.g., European countries). This shows there is a disconnect between awareness and risk perception, illustrating that there are other factors (than education and experiences with extreme weather) that distort the expected simple relationship between the two dimensions. Numerous studies emphasize the pervasive influence of political ideology and partisan preferences in various contexts (Brulle et al., 2012; Guber, 2013; Krosnick et al., 2000). These factors not only diminish the significance of education (Hamilton, 2011; Malka et al., 2009) but also cast a shadow over the significance of individuals' personal encounters with extreme weather events (Brulle et al., 2012; Carmichael & Brulle, 2017; Marquart-Pyatt et al., 2014; McCright et al., 2014; Ogunbode et al., 2017; Zahran et al., 2006). This holds particularly in contexts where individuals are more politically engaged and where voters have been observed to adjust their beliefs and attitudes to align with the positions of their favored political party (for example, Dunlap & McCright, 2008; Guber, 2013; Linde, 2018).

It is worth noting, however, that the relationship between awareness and risk perception might depend largely on the way awareness is measured. In research, employing subjective measures of knowledge, where respondents self-assess their level of knowledge (as in the present study), findings have indicated a mix of positive, negative, and context-dependent effects on levels of concern (Malka et al., 2009). In contrast, studies relying on objective measures of knowledge, involving respondents answering factual questions, have consistently demonstrated a positive correlation between knowledge and concern regarding climate change (O'Connor et al., 1999; Shi et al., 2015). However, these investigations have also revealed that the influence of knowledge on concern varies depending on the type of knowledge. For instance, while causal knowledge tends to be positively associated with concern, knowledge concerning the physical attributes of climate change has exhibited both negative and inconsequential associations with concern (Shi et al., 2016).

To bridge the gap between awareness and risk perception, policies and initiatives should not only focus on disseminating information, but also on addressing the ideological and partisan divides that hinder climate action. Policymakers may need to employ strategies that appeal to diverse political perspectives and encourage bipartisan cooperation to effectively tackle climate change.

Higher levels of awareness are not associated with a stronger relationship between risk perception and commitment to action

Furthermore, our research shows that no country achieves high scores across the Awareness, Risk perception, and Commitment to action dimensions. Instead, our findings reveal an intriguing pattern: countries with the highest Awareness scores, such as those in Europe, exhibit only moderate levels of Risk perception. Conversely, countries that score the highest in both Risk perception and Commitment to action, many in Latin America, achieve only moderate Awareness levels. This suggests a notable discontinuity in the impact of awareness on both risk perception and commitment to action, where higher awareness does not necessarily translate into higher levels of risk perception nor commitment to action. Our results further support this observation, revealing that the relationship between risk perception and commitment to action varies across different awareness levels. Surprisingly, we find that among countries with higher awareness scores, this relationship is weaker compared to countries with lower awareness scores.

This may be due to risk perception “normalization” which has significant implications on commitment to action. When individuals are repeatedly exposed to alarming communication about climate change, they may tend to adapt to its presence, leading to a weaker connection between their perception of risks and their commitment to action. This effect is particularly relevant in the contexts where the consequences of climate change are often perceived as distant in both space and time (European countries), making it challenging to grasp their immediacy. As a result, climate change related communication aiming at raising risk perception may have little to no real impact on commitment to action.

Such a mediation effect of awareness in the relationship between risk perception and commitment to action was previously established by Lima et al. (2005). They found that indicators of technological prevalence, such as CO₂ emissions and chemical use in agriculture, were associated with lower risk perception. This relationship was mediated by increased awareness of environmental hazards linked to these technologies. Higher technological prevalence led to greater awareness of environmental risks due to advancements in policy and risk management. However, this heightened awareness was paradoxically linked to reduced perceived risks associated with those technologies, such as climate change and pollution from chemical use in farming. It appears that individuals tend to develop psychological strategies to minimize perceived threats, which, unfortunately, do not contribute to solving environmental hazards.

In addition, individuals who possess knowledge about climate change may not translate this awareness into action, leading to implicative denial. This suggests a disconnection between abstract climate change information and its integration into everyday life. Interpretative denial also comes into play as individuals may reinterpret climate change information, perceiving it as a natural occurrence or underestimating its severity. Furthermore, as we use data from social media users, our analysis underscores the potential effect of vested-interest groups engaging in misinformation campaigns further contributing to climate change denial and undermining public understanding of scientific consensus and impeding policy progress (Oreskes & Conway, 2010).

In the realm of climate change policy, it is imperative to recognize and address the “normalization” of climate change risks resulting from increased awareness. Effective policies and strategies must overcome the psychological adaptation to threats and the associated disconnect between knowledge and action. Furthermore, confronting climate change denial necessitates countering the reinterpretation of climate information and mitigating the influence of vested-interest groups. Policymakers must consider not only the scientific and economic aspects but also the psychological and sociopolitical dimensions in order to foster meaningful commitment to climate action and mitigation behaviors.

Conclusion

The Climate Perceptions Index offers a comprehensive view of how countries perceive climate change across the globe. Our results show that climate change is perceived differently across countries. Thei

are significant disparities in the extent to which people are aware of climate change, perceive it as a threat and are willing to act against it. Generally, the Latin American countries are the most perceptive of climate change, while countries from the MENA region are the least. The performance of countries from other regions varies significantly across dimensions. For instance, while European countries achieve high levels of awareness, they perform moderately in terms of the risk perception and commitment to action. In contrast, the risk perception levels in Sub-Saharan African countries are higher than the awareness and commitment to action.

However, in this paper we move beyond the general description of country scores and use the Index to reveal the complexity of the relationship between awareness, risk perception and commitment to action. In particular, we study how the strength of the relationship between risk perception and commitment to action varies based on the levels of awareness. Surprisingly, the strongest relationship is found among countries with lower performance in awareness. In contrast, countries with higher awareness do not necessarily exhibit a stronger connection between risk perception and commitment to action. This finding underscores the notion that high awareness does not always translate into proactive environmental engagement (Shi et al., 2015). Multiple factors, including political ideology and values, can influence a person's attitude toward climate change. As a result, individuals may hold views denying climate change despite reporting high levels of knowledge about it.

This mismatch between the CPI dimensions highlights the need for a deeper understanding of individuals' climate change perception across countries, or more precisely, to identify the factors that shape each of the dimensions: awareness, risk perception and commitment to action. This would allow for a better understanding of the key differences between countries in terms of how climate change is perceived and what factors influence it (Lee et al., 2015; van der Linden, 2014; van der Linden et al., 2015). Furthermore, there is also a need for a better understanding of the causal links between awareness, risk perception and commitment to action, and possible mediation effects and feedback shaping the relationships.

Finally, it should be stressed that despite its wide geographical coverage, the climate change perception assessment in this study is based exclusively on samples of Facebook users from different countries. While the sampling and entry data treatment for each country is carried out by authors of the original survey in a way that minimizes the possible biases (Leiserowitz et al., 2022), it still needs to be borne in mind that some social groups (typically older people) may be underrepresented, especially in countries where Facebook is a less common social media type. Our results should therefore be interpreted while accounting for these special features of the data.

Notes

1. This paper examines in detail, and further elaborates upon the (primarily) policy-oriented work undertaken by the nonprofit Social Progress Imperative, and with the support of the Meta corporation (Htitch et al., 2022).
2. Respondents were given also a short description of climate change before being asked whether they believe climate change is happening. The complete survey question is as follows: "Climate change refers to the idea that the world's average temperature has been increasing over the past 150 years, will increase more in the future, and that the world's climate will change as a result. What do you think: Do you think climate change is happening?"
3. By doing this, we are able to establish, for each country in the survey, the exact percentage of respondents in each response category of all survey questions.

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n S*S Sg S-S*.SU.-' o.*vMvRMUv3 SMX o9SMv *.v)...
 MS g-o.MgUQ.." v' ú.gU9.gMSvU.gMv*.β- .MμU- S*...

t v' g3 o9..." -SSM^{Wí}..... .sg v3 ' ... g 3 o6^{BN.N%}

...
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Gi *- gM...

...

r9oU-SúSUQ.-' o...vMvRMUv3 SM.)gMv *.v)...MS g-o...MgUQ...MUM U*..x" v' úY.gU9...
 " S SUQb*...-v.Xg -SXg-o...SU.MS g-o...gMSvU*.xgMSvUY.S*.MμMg ..)v' ..μU9ó *-gU9SUQ..
 ' v" ..SU9S9μg *..." S' ..9S)ó oU-...vMg ..i gMgQvμU9...gU9...MU9SSvU*.. o*XvU9...-v...-' o...
 MS g-o.MgUQ..S*μo*Z.-' S*..μ9ú.ó' g3 SU*...-' o.*vMvRMUv3 SMX o9SMv *.v)...MS g-o...
 MgUQ.." v' ú.gU9.gMSvU.gMv*.β- .MμU- S*Nμ*SUQ9g-g.) v3 .g.M3 X o' oU*Sbo.Mv**R
 Ug-SvUg *.μi øóú.MU9μMo9.i ú.t o-g *.n g-g..)v' ..+vv9...og3 .vU.(gMi vv6ZO3 XvúSUQ..
 g9øgUM9.3 o-' v9*..μM..g*...g-oU-øg Sgi o.3 v9o SUQX.gU9v3 ..)v' o*-NgU9..LvU3 o- SM.
 9S oU*SvUg *.Mg SUQ?" o.Xó)v' 3 .g...-' v' vμQ .gUg ú*S*..v.xSYo*-S g-o...oøo *.v)...MS g-o...
 MgUQ.." v' ú.gU9..gMSvUN.xSY.g**o*...-' o..SU) μoUM..v)...*vMvRMUv3 SMg- S μ-o*..vU...
 -' o*o...oøo *NgU9..xSY.o' Xv o.Xv-oU-Sg ..9S)ó oUM*.i g*o9..vU.MμU- S*fløμ Uó gi SS-ú...
 -v...MS g-o.MgUQZ.-' o...SU9SUQ*... oøog ...SUSSgU-..9Sxg S-S*.i o-" ooU.MμU- S*..SU..
 -ó 3 *...v)... oøo *...v)...MS g-o...MgUQ.." v' ú.gU9...gMSvUZ.t v' ovøó N.-' ó o...g *v...
 *μi *-gU-Sg ..9S)ó oUM*..SU.*vMvRMUv3 SMX o9SMv *.gMv*.MμU- S*..." S' ..9S)ó oU-...
 øμ Uó gi SS-ú...v.MS g-o.MgUQZ." SQ Rμ Uó gi SS-ú.MμU- S*.ó' ' S S-g.í vg9ó '...gUQ...
 v)..SU) μoU-Sg ...X o9SMv *NSU9Sg-SUQ.9Só *o...vMvRMUv3 SM.)gMv *.i o' SU9..MS g-o...
 MgUQ.." v' ú.gU9..gMSvUZ/v" Rμ Uó gi SS-ú.MμU- S*..9Sxgú.3 v' o.μU9v 3 ..*vMvR
 oMUv3 SMSU) μoUM*N*μQQ*-SUQ.-' g-..g.3 v' o.μU9v 3 ..gXX vgM...-v...X v3 v-SUQ.X vR
 oUoSvU3 oU-g .i o' gøSv .3 gú.i o.3 v' o.o))oMSoZ.

...

7 óú..." v' 9*m< S g-o...MgUQ...Xó MX-SvUN.àvMvRMUv3 SM.X o9SMv *N.< S g-o...gMSvUN.
 < S g-o.gMSvUN< S g-o.øμ Uó gi SS-úNá gU9v3 ..(v' o*..gUg ú*S*...

...
 ...

^W.w' Zh Z<gU9Sg-o.g-.wg gMú...-Uóó *S-ú.V v3 vμM(gMú-ú.v).àMUMNn oXg -3 oU-.v).n oøo vX3 oU-gU9.OUoSvU3 oU-g .à-μ9S*N.
 WZ.S*-vXg9μ..WN°°W° ..V v3 vμM<üoM.á oXμi SZO3 gSm3 v' g3 o9Z -SSM-i- μXv ZMZ.

ⁱ...á o*og M...G**vMg-o.g-...àvMg ...v' vQo**..r3 Xó g-SboNí WW/ ..à'-oo-...2 " NàmSo..β- -Ní--β°..." g*' SUQvU.n Z<Zn.-àGZ.O3 gSm
 3 ' -SSM- *vMg X vQo**Z QZ.

^h..<v' o*XvU9SUQgμ- v' ...

..+ vi g .á o*og M..n oXμ-ú..n SoMv .g-..àvMg ..v' vQo**..r3 Xó g-SboNí WW/ ..à'-oo-...2 " NàmSo..β- -Ní--β°..." g*' SUQvU.n Z<Zn.-àGZ.
 O3 gSm' g 3 gM6- *vMg X vQo**Z QZ.

[%]G**vMg-o.w' v)o**v' .g-.wg gMú...-Uóó *S-ú.V v3 vμM(gMú-ú.v).àMUMNn oXg -3 oU-.v).n oøo vX3 oU-gU9.OUoSvU3 oU-g .à-μ9S*N.
 WZ.S*-vXg9μ..WN°°W° ..V v3 vμM<üoM.á oXμi SZO3 gSm3 v3 SZ g 3 gM6- μXv ZMZ.

W rU- v9µMSvU...

r9oU-SúSUQ.-' o.6ou...vMvRMUv3 SM9o-ó 3 SgU-*.v)...MS g-o.MgUQ...Xó MX-SvU..S..MµMg ...)v ...
 X v3 v-SUQ.oUßSvUß oU-g ú...o*XvU*S o.i o' gøS' .xà-ó UNí ---č.2 Sxi o-Ní -- uč.øgU.ö g 6oUQv9...
 ` ..à-oQNi - WYZ.-U9ó \*gU9SUQ.. v" ...MS g-o.MgUQ..." v' ú...xàXoUM..o-..g ZNi - WZ.< gú-vU..` ...
 t gUUSQNi - WY.gU9..gMSvU..xà-oQ.gU9..ö o6Ni -- uč.I g3 i ó Q.o-..g ZNi - WZ.g o..*' gXo9..gMv**...
 9S)ó oU...MµU- S*...gU9...*vMg ...MvU-o' -*...S*...g...UoM**g ú...-g*6..." ' SM... offµSo*...g...X vXó ...
 3 og*µi o3 oU-Z.-v.9SoM ú.3 og*µi o...- o*o.MUMX-*N9S)ó oU..g*XoM*.3 µ*..i o.MvU9ó o9...- g-...
 ' o g-o..v..! v" .SU9S9µg *Xó MSo.MS g-o.MgUQ...S6*gU9...- o.ó' -oU-..v..." ' SM...- oú.g o.." S SUQ..
 -v..oUQgQ..SU.X vRUpSvUß oU-g ..gMSvU.gU9...Xv SßZ(µi -' ó 3 v oN.-' o..QÜß g ..Xó MX-SvU..v)...
 MS g-o.MgUQ..ó' ' S S.*SUSSMgU..øg Sgi SSú.gMv**..Ug-SvU..x/ v oUivUSo-..g ZNi -- °č./ oo.o-..g ZNi.
 í - WvNUoM**Sg-SUQg..- v vµQ .ó' Xv g-SvU..v)...- o.µU9ó úSUQXg-ó U..v)...- o.)gMv *..gXSUQ..
 SZwíg -Mµ g ú..S Xv -gU-..S..QgSUSUQ..SU-v...- o.9S)ó oUM*.SU..- o*o.)gMv *..gMv**..Q vµX*...
 v).MµU- S*.." S' .*S Sg ..øøo *.v).øµ Uß gi SSú..v.MS g-o.MgUQ..o))oM*.vU.*vMg .gU9.oMvUv3 SM.
 MvUSsvU..xv-v..o-..g ZNi - í - YZ.

àµM..Sßo*-SQ-SvU..MgU.X vø9o.Xv SM3 g6ó *.." S' .g.9ooXó .µU9ó *gU9SUQ.v).MµU- úRxoM\$SM.
 *vMvRMUv3 SM)gMv *NoUgi SUQ.-' o.9o*SU.v).3 v o...gSv o9..SU-ó øoU-SvU..gU9.M3 XgSU*ZI ú...
 ' oMvUSiSUQ.gU9..gMµU-SUQ..v) ...- o*o..øg Sg-SvU.NXv SM3 g6ó *..MgU..o))oMSo ú...g99 o**...- o...
 µUffµo..Mg oUQ*..gU9..vXXv -µUSs*..X o*oU-..SU.9S)ó oU-..*vMvRMUv3 SMvU-o' -*Nµ -S g-o ú...
 oU' gUMUQ.-' o..o))SMµi...v)...v) -v...X v3 v-o..oUßSvUß oU-g ú...o*XvU*S o..i o' gøS' Zt v o...
 *XoM\$Mg úNo' Xv SUQ.. v" .SU9S9µg *Xó MSo..- o...- og-*Xv*o9.i ú..MS g-o.MgUQ..S..MµMg ...
)v ...o))oMSo..M3 3 µUsg-SvU..gU9...Xv SM3 g6SUZ.ö g Svµ...SU9S9µg ...)gMv *N.SUMµ9SUQ.gQvN.
 QvU9ó N.øøo ..v)..o9µMg-SvUNXv SSMg ..9ov vQíNgU9..Xó *vUg ..ó' Xó SßUM.." S' ..ó' - o3 o.." og-! ó ...
 øøoU-*NXgú..*SUSSMgU-..v o*.SU.*' gXSUQXó MX-SvU..v).MS g-o.MgUQ...S6.xn o**gSo-..g ZNi -- .č..
 àXoUM..o-..g ZNi - WZ.øgU.9ó ./ SU9oU..o-..g ZNi - 2 WZ...

(v .SU-gUMN.o*og M.SU9SMg-o*..- g-SU9S9µg *.." S' ..! SQ ó ..øøo *.v).o9µMg-SvU-..oU9-..v.Xv**o**...
 g..i o-ó ..µU9ó *gU9SUQ.v)...- o..*MSU-SMX SUXo*..µU9ó úSUQ.MS g-o.MgUQ..gU9..g o..3 v o...
 Sso ú...v..Xó MSo..g**vMg-o9'.. S6*..x/ oSó v" Süní - - %Zt v ovøó NMµ -µi g ..øg µo*..gU9..i o S)*...
 o' ó -...MvU9ó gi o...SU) µoUM...vU.. S6...Xó MX-SvUZ.-' v*o..." S' ...3 v o...SU9S9µg S-SMøg µo*N.
 o3 X' g*SiSUQXó *vUg .gMSøø3 oU..gU9..SU9oXoU9oUMNv)-oU.Xó MSo.MS g-o.MgUQ..g*..g...o**ó ...
 -' og-Z.<vUßó *o úNSU9S9µg *.. v 9SUQ.3 v o..M3 3 µUsg SgU..øg µo*NX S' SSiSUQ.M3 3 µUú...
 " o)g o..gU9..oUßSvUß oU-g ...MUM U.N.g o..3 v o...SUMv9...-v...Xó MSo..MS g-o...MgUQ...g*..g...
 *SUSSMgU-...- og-.x7 g' gU..o-..g ZNi - WYZ.

Vi ;oMSo..SU)v 3 g-SvU.gU9...µi ;oMSo..i o S)*.g o..v)-oU.MvU) g-o9N.og9SUQ..v..SUMvU*-oUMS*.SU..
 *SUQoßo3 ...g**o**3 oU*... Sso...fr...6Uv" ...g... v...gi vµ-...MS g-o...MgUQfi..x/ oSó v" Süní - - YZ.
 -! ó o)v oNSU..-! S*..*µ9ú..." o..vMµ...X S g Sú..vU..-! o..ó' -oU-..v..." ' SM..SU9S9µg *..g o.." v' S9...
 gi vµ-...MS g-o.MgUQ..Mµ*o*..g-! ó ...-! gU..-! oS..*o)RoXv -o9..6Uv" o9Q..gi vµ-..SZrU.g99SvUN.
 " o.g *v..3 og*µi o.gU9..*µ9ú...-! o..øøo ..v).SU9S9µg *.X vRUpSvUß oU-g ...oU9oUMi...-! g-... ó...o)ó ...

-v...’ vμQ vμ-...’ o.XgXó .g*...gMSvU Z.

(’ ’.ogM...v)...’ o*o...’ v..g*XoM*N” o.gS -v..MfU- μM.g...g-oU...øg Sgi o...v..i o-ó .gXX v’ S g-o...
gU9.3 og*í o.MμU- S*...oøo .v)...’ ’ ’ ’.gU9.x” S SUQb**...vY..gMSvU ’...oQ 9SUQMS g-o.MgUQZ.
“ o.*-μ9ú...’ o..SU) μoUM...v)..9S)ó oU...*vMvRMUv3 SMX o9SMv *..vU.ogM...v)...’ o*o...’ v..g*XoM*Z.
—’ S*.g v” *.μ*...v’...oøog ...’ o..9S**S Sg S S*.i o-” ooU..9S)ó oU...MμU- ú..Q vμX*.SU...ó 3 *.v)...’ o...
3 v*-..S Xv -gU...X o9SMv *.v)..MS g-o.MgUQ...’ ’ ’.gU9.gMSvUZ.“ o..μ*o..9g-g..) v3 .vUo..v)...’ o...
3 v*-..o’ -oU*Sbo.Mv**Rug-SvUg .*í oóú*.v)..MS g-o.MgUQ.Xó MX-SvU*.vU.*vMg .3 o9Sg.MfU9μMo9...
i ú...(gMi vv6...SU.Xg -Uó *’ SX...” S’ ...’ o..š g o..w vQg3 ...vU...< S g-o...<’ gUQ...<v3 3 μUSg-SvU...
xrU-ó Ug-SvUg .Xμi SMvXSUSvU.vU.MS g-o.MgUQNi -í WZ.

—’ o..)Sug .vi ;oMSbo.S*..’ ó o)ý o..v..o’ ’ gμ*-Sbo ú.g**o**..’ o.MfU9SSvUg .SU) μoUM...v)..*oøó g .*vMvR
oMfUv3 SMg-’ S μ-o*...vU.MS g-o.MgUQ...’ ’ ’.gU9.gMSvUZ.“ o...o*...’ o..’ úXv-’ o*S*..’ g-...’ o...
SU) μoUM...v)...’ o*o...*vMvRMUv3 SMg-’ S μ-o*...MgUQ*...gMf 9SUQ...v...’ o..MμU- ú *.. oøo ...v)...
øμ Uó gi SSú...v.MS g-o.MgUQ.g*.3 og*í o9.i ú...’ o.< S g-o.<’ gUQ.ö μ Uó gi SSú.rUo’ .x<’ oU...
o..g ZNí -í . YZ...’ S*.S*.MμMg ...’)v ..g..i o-ó ..μU9ó *gU9SUQ.v)...’ o...” gú...*vMvRMUv3 SM.)gMv *...
SU) μoUM.MS g-o.MgUQ...’ ’ ’.gU9.gMSvUg3 vUQgMSbo.*vMg .3 o9Sg.μ*ó *gMv**β- .MμU- S*Z.
(’ ’..’ S*.Xí Xv*oN-’ o.gUg ú*S*..’ g*.Mg’ S9.vμ-.*oXg g-o ú..’v .ogM.MμU- ú.gU9..’v .ogM...v)...’ o...
—’ v..øg Sgi o*Z.

—’ o...o3 gSU9ó .v)...’ S*.XgXó .S*.v QUSio9.g*..v v” *nàoMSvU.í ’...oøSb” *..’ o...o oøgU...Só g-í o...
gU9..9oU-Sb*.S*.Mf o...S Sg-SvU*N” ’ SM...’ S*..μ9ú.gS *..v.g99 o**ZàoMSvU.β..Sf v9μM*..’ o...
9g-g...*vμi M*...gU9...X vø9o*...g..9o-gSo9...vμ- Sbo..v)...’ o..o3 XS SMg ...*’ g-oQin.” S’ ..g...*μi *oMSvU...
9o9SMg-o9 ...v.ogM...3 o-’ v9 .μ*o9ZrU.àoMSvU... N” o..9oU-Sú...’ o.3 v*-..S Xv -gU...*vMvRMUv3 SM.
)gMv *.SU) μoUMUQMS g-o.MgUQ...’ ’ ’.gU9.gMSvU.gMv**β- .MμU- S*NgU9...” o..o’ Xv o...’ o...
9S)ó oUM*.SU...’ o*o..)gMv *.i o-” ooU.MμU- S*...” S’ ...v” .gU9...’ SQ .MS g-o.MgUQ.øμ Uó gi SSúZ.
àoMSvU.%9SMi**o*...’ o...o*μi -*.gU9.àoMSvU... .MfUμ9o*Z.

í —’ o...v o.v)..*vMvRMUv3 SMMg gMó S*-SM.SU.*’ gXSUQMS g-o.MgUQ...
Xó MX-SvU*...

< S g-o.MgUQ.Xó MX-SvU...o*og MNg*..9o Sbg-o9.i ú..V <vUŭv ..o..g ZxWuuY.gU9../ ’ ’ oUivUS..
o..g Zxi --° YNí vg9 ú..oUM3 Xg**o*...’ oo..SU-ó’ o g-o9..9S oU*SvU*ng” g’ oUo**N.S6.Xó MX-SvUN..
gU9.M3 3 S3 oU...v.gMSvUZ...’ o*o.9S oU*SvU*.oUMX*μ g-o..Uv...vUú.gU.SU9S9μg f*.6Uv” o9Q...
gi vμ-..MS g-o.MgUQ..i μ-..g *v...’ oS.Xó MSbo9..Xó *vUg ...’ og...gU9...” S SUQb**...v.gMZ/ oo..o-...
g Zxi -WY..’ SQ SQ -...’ g-..g” g’ oUo*...úXSMg ú..øg S*..gMv**..MμU- S*N” S’ ..9oøo vXo9..Ug-SvU*...
QUó g ’ ’.S SSUQ..’ SQ ó ...oøo *.v)..MS g-o.MgUQ..6Uv” o9Q...’ gU..9oøo vXSUQ.vUo*Zš o-Ng...
Xó *S-oU...QX.o’ S*..i o-” ooU.g” g’ oUo*..gU9.gMμg .MfUM U.ý ’..S6.Xó MX-SvUNSU) μoUM9..i ú...
)gMv *.μiM.g*.Xv SSMg .9ov vQb*.gU9.3 o9Sg.MfUμ3 X-SvUN.” ’ SM.g))oM...’ o..SU-ó Ug Sig-SvU.v)...
MS g-o.MgUQ.SU)ý 3 g-SvU.x7 g’ gU.o-..g ZNí -WYZ.

á S6...Xó MX-SvU..! g*...i ooU..g...)vMg ...XvSU...v)... o*og M...9po...v...S*... S6..." S' ...MS g-o...MgUQ...
 3 S5Q-SvU.i o' gøSv *Zà-µ9S*.i ú...<gX*-SM...o-.g Zxi - WYgU9..Güg9S.o-.g Zxi - WY.SU9Sg-o-...! g-...
 -! v*o...Xó MS5UQ.MS g-o...MgUQ...g*...g...SQUSSgU-...-! og-...g o..3 v o...S6o ú...v...µU9ó -g6o...X vR
 oU9SvU3 oU-g ..gMSvU*Z." v" oðó N-! S*.M' o g-SvU.S*.v)-oU.3 v9ó g-o9.i ú..gU.SU9S9µg fk...oU*o...
 v)...o)R))SgMINSZNI-! oS .i o S6).SU-! o.o))oMS6oUo**..v)...! oS .gMSvU*..v.3 S5Q-o.MS g-o.S XgM*...
 xI gU9µi gNí -" YZ/ gMvS .gU9..+S)ý 9.xí - WYg *v.9SMi**..! v" '...S6..Uv 3 g Sig-SvUNo*XoMg ú.SU...
 MU-o' -*.v)...! oSQ -oU9.g" g oUo**N3 gú.9S S5S' .Xó MS6o9.µi QUMi..)v .gMSvUN*µiQQ*-SUQ-! g-...
 ' S6...Xó MX-SvU..9vo*...Uv-...*- gSQ -)ý " g 9 ú...- gU* g-o..SU-v...MS g-o..gMSvU..9po...v...3 o9Sg-SUQ..
)gMv *...S6o.*vMvRv S5g .MU-o' -*.gU9..Xó *vUg .øg µo*Z.

—! o.M3 3 S3 oU-...v...MS g-o.gMSvU.S*.SU) µoUM9.i ú..*vMg NX*úMv vQSM NgU9..Xv S5g ..)gMv *N.
 g*.à-ó U.xí --- YgU9-...f v-! 3 gUU.o-.g Zxi - WY.S µ*- g-oZøoU.SU...oQSVU*..." S' '...! SQ .g" g oUo**N.
 µM.g..Oµi vXoN-! ó o.3 gú..Uv-.g " gú*.i o.g.*- vUQM3 3 S3 oU-...v...MS g-o.gMSvUZrU.MU- g*-N.
 Ug-SvU*..SU./ g-SU.G3 ó SgN" ' SMi.3 SQ -...oXv -...v" ó .g" g oUo**.*M o*Nv)-oU.o' ' S S-! SQ ó ...
 oðo *..v)... S6...Xó MX-SvU.gU9..M3 3 S3 oU-...v...gMSvUZ-! S..9Sxg S-ú..µU9ó *M o*...! o.M3 Xo' ...
 SU-ó Xgú.i o-! ooUMi -µi g .gU9..*vMvRMUv3 SM)gMv *...! g-..MgUg))oM-! ó...o g-SvU* SXi o-! ooU...
 6Uv" o9Q..gU9..i o' gøSv NUbM**Sg-SUQ.UµgUM9..MS g-o..M3 3 µUMg-SvU.*- g-oQ6*..xI' µ o..o-...
 g ZNí - WYZ.

àvMvRMUv3 SM)gMv *..Xgú..g..MS5g '...v o..SU.*' gXSUQ.Xó MX-SvU*..v)..MS g-o..MgUQZGQ..gU9...
 QoU9ó .g o...SQUSSgU-N" S' '...úvµUQ6 ..XovXo.gU9..." v3 oU..QoU6 g ú..*! v" SUQ.3 v o..MUM U..9po...
 -v...*vMg Sig-SvU.X vM**o*...! g-..o3 X' g*Sio..Mg o.gU9'...o*XvU*SSú.xt M' SQ -...! .n µUgXNí - WYZ..
 O9µMg-SvU.S*.g *v...S6o9...v..Q og-ó .g" g oUo**..gU9..MUM UNg*.S..oU' gUM*.MS5g ...! S6SUQgU9...
 M3 X o' oU*SvU..v)..M3 Xo' ..oU9SvU3 oU-g ..S*µio*Ng -! vµQ ..MQSS6o.i Sg*o*...S6o..MU)S3 g-SvU...
 i Sg*.gU9..3 v-S6g-o9'...og*vUSUQ.MgU.g))oM-! v" ..SU)ý 3 g-SvU.S*.X vM**o9..x<v U6 ..o-..g ZNí - WYZ..
 á o*og M...! SQ SQ -*...QoU9ó ...gU9...Xv S5g ...9ov vQí...g*...6oú...X o9SMv *N." S' '...' v3 oU..gU9...
 SU9S9µg *...! v 9SUQ.. S ó g ...Xv S5g ...øS" *...Xó MS5UQ..! SQ ó '... S6*...) v3 ...MS g-o...MgUQN.
 MU*S-oU-...! S' '.*-µ9S*..9oU-SúSUQ-! o*o.9o3 vQgX' SM.g*..S Xv -gU..SU.*' gXSUQoU9SvU3 oU-g ...
 MUM U*.x/oSó v" SüNí -" č.t g 6g..o-.g ZNí - - uYZ.

OMUv3 SMU9SSvU*.gU9..Xó *vUg ..)SgUMg .Sµg-SvU*.g o.MµMg ...vvNg*...! v*o.SUoMv3 Sg ú...
 øµ U6 gi o... Xv*SSvU*... 3 gú... X S' SSio... S 3 o9Sg-o... oMUv3 SM. MUM U*... vøó ... vUQ6ó 3 ...
 oU9SvU3 oU-g ..S*µio*..x' ' S3 g *! Ní - WYZ.O' Xó SUM*..." S' '...MS g-oRo g-o9...oðoU-*...*µM...g*...
 o' - o3 o..." og-! ó .MgU.)µi -! ó '...oSQ -oU.MUM U.gU9.g" g oUo**N.oSU)ý MUQ-! o.Xó MS6o9'...og S-ú...
 gU9...µi QUMi...v)...! o...S*µio...xàXoUM...o-...g ZNí - WYZ..n o3 *6S..o-...g ZNí - WYZ.-! S*...3 µ -SgM-o9...
 µU9ó *gU9SUQ.v)..MS g-o..MgUQ..Xó MX-SvU..! SQ SQ -*...! o.Uo9..)ý .g.M3 X o' oU*S6o.gXX vgM...
 -v..gUg úüSUQ-! o..9 S6ó *..v)..g" g oUo**N. S6...Xó MX-SvUNgU9..gMSvU..X vXoU*S-úNoUM3 Xg**SUQ..
 o9µMg-SvUg No' Xó S6U-Sg NX*úMv vQSM NgU9...*vMvRMi -µi g ..)gMv *..xwgSU-ó ..gU9..G*! oNí - Wč..
 I vú6v)).gU9..I vú6v))Ní - - .č.I g o" ..o-.g ZNí - í - č.2 Si o-Ní - - uYZ.

—! o..Ug-µi o..v)..MS g-o..MgUQ...Xó MX-SvU..S*...! ó o)ý o..3 µ -SgM-o9..gU9...*! gX69..Uv-...vUú..i ú...

*vMvRMUv3 SM)gMv *.i μ-..g *v..i ú..6Uv” o9Qn*vMg ..Uv 3 *NgU9..øg μo..v SöU-g-SvU*Z.“ ‘ So...
6Uv” o9Q..gi vμ-..MS g-o..MgUQ..Mμ*o*..gU9...S XgM*..M’ o g-o*..*- vUQú...” S’ ..*vMg-g .. S6...
Xó Mx-SvU*Ng..Uv-gi o..QX..o3 gSú..i o-” ooU.QUö g .g” g oUo**gU9.Xó *vUg ..MUM UN.o) oMSUQ..
-’ o..M3 Xó’ S-ú..v)..-’ gU* g-SUQ.SU) v 3 g-SvU..SU-v..gMSvU..xøgU.9ó .. / SUoUNí - WZàvMg ..Uv 3 *...
gU9..Mí -í g ..øg μo*NXg -SMí g ú..i Sv*X’ ó SMøg μo*N.)í -’ ó ..SU) μoUM..SU9S9μg ..Xó Mx-SvU*N..
9o3 vU*- g-SUQ.-’ g-..M’ oMSöo.g-Sμ9o*..gU9..9ooXú... o 9..i o Sö)*.gi vμ-...’ o..oUöS vUö oU-..Xgú...
MμMg .. v o*..SU.*’ gXSUQ.MS g-o..MgUQ..MUM U.gU9..i o’ gøSv ..xà3 S’ ...` .. / oSó v” S-üNí - Wč..
à-ó UNh S-üN’ ..7 g v)NWuöYZ.

...

ß t g-ó Sg *.gU9.3 o-’ v9*...

...

—’ o..3 o-’ v9v vQSmf ..gXX vgM ..v)..-’ S*..XgXó ..MU*S*..v)..MU*- μMSUQ.-’ o..øg Sgi o*..v)..SU-ó o*N..
Ug3 o ú...” v’ ú.gU9..gMSvU..à oMSvU.í ZYZ.-’ o*o.øg Sgi o*..g o.MU*- μMo9.g*..g-oU-øg Sgi o*NøgM...
i g*o9..vU.MUMX-μg ú...o øøgU-..μí øóú..ffμo*-SvU*..-’ g-..g o.g *v..*-g-S-Sg ú..øg Sg-o9Ng*...” S .i o...
’ v” U.)í -’ ó ..SU.-’ S..oMSvUZ.

...

—’ o..*oMU9..*-oX.SUö v øo*..i μS9SUQ.. gU9v3 ..)v o*..3 v9o *N” ‘ SM..MU*S*..v)..g...g Q..Uμ3 i ó ..v)..
MU9SSvUg ..SU)ó oUM.-’ oo*..)v ..ogM..MμU- úNμ*SUQ.*vMvDö3 vQgX’ SMøg Sgi o*..g*..X o9SMv *Z..
—’ o..S Xv -gUM..v)..ogM...*vMvRMUv3 SMøg Sgi o..S*..g**o**o9..μ*SUQ.MU9SSvUg ..Xó 3 μ-g-SvUN..
X vøS9SUQg.3 v o.gMμí g-o..øøg μg-SvU.v)..-’ oS .S Xv -gUM..SU.X o9SMUQ..øøo *v)..MS g-o..MgUQ...
” v’ ú.gU9..gMSvU.x)í -’ ó ..o’ XgSö9..SU..à oMSvU.í ZYZ.

...

—’ o.)Sg ..*-oX.)vMμ*o*..vU.SöU-SúSUQ9S*S Sg SS*..SU.-’ o.*vMvRMUv3 SM)gMv *.*’ gXSUQMS g-o...
MgUQ...” v’ ú.gU9...gMSvU.i o-” ooU.MμU- S*...” S’ ..øg úSUQ..øøo *..v)..øμ Uö gi SS-ú..-v..MS g-o...
MgUQZ.-’ S*..oXS.S.MμMg Ng*.S! o X*.9o-ó 3 Sb.” ‘ o-’ ó ..-’ o.*vMvRMUv3 SM)gMv *.SU) μoUMUQ..
SU9S9μg *fl.MS g-o..MgUQ...” v’ ú..gU9...gMSvU..MgUQ...9oXoU9SUQ..vU..g...MμU- úfl... øøo ...v)..
øμ Uö gi SS-ú..-v..MS g-o..MgUQZ.

ßZWn g-g...

—’ o..9g-g..μ*o9..SU.-’ S*..*μ9ú..M3 o*..) v3 ..g..*í øóú..v)..” Ní 1..3 vU-’ ú..gMSöo..(gMi vv6..μ*ó *...
v 9ó ..-’ gU..WZ.-’ o..*í øóú...” g*..MU9μMo9..i ú..-’ o..t o-g *..n g-g..)v ..+vv9...og3 ..vU..(gMi vv6...
i o-” ooU.W..(oí’ μg ú.gU9..ß.t g M..í -í WSU.ßWMμU- S*..gU9...ó’ S’ S*..xrU-ó Ug-SvUg ..Xμi SM..
vXSvU..vU.MS g-o..MgUQNí -í WZG-...-’ o..-vX.v)..-’ oS ..(gMi vv6..2 o” *..(oo9N(gMi vv6..μ*ó *...
*g” .gU.SöSg-SvU..v.M3 Xó-o.g.í Sö)..*í øóú.gU9..Mμ 9.MSM..vU.-’ o.SöSg-SvU..v.M3 Xó-o..-’ o...
*í øóú..vU..(gMi vv6Z.-’ o.*g3 Xó..” g*.9 g” U.) v3 ..-’ o.XvXμ g-SvU.v)..3 vU-’ ú.gMSöo..(gMi vv6...
μ*ó *N9o)Sö9..g*...oQ*-ó o9..gU9...vQö9BU..μ*ó *...” ‘ v..! g9..øSSö9..(gMi vv6..øSg.-’ o..” oi *Söo.v’ ...
g.3 vi Sö..9oøSM...” S’ SU.-’ o.X øøS7μ*.3 vU-’ ZrU.ogM..MμU- ú.v’ ..-’ S’ S’ ú..o’ g3 Sö9Ng.*g3 Xó...
X vXv -SvUg ...v.gQ.gU9..QUö ..MSó Sg...” g*..*XoMS9Z.

—’ o..*g3 Xó.XvXμ g-SvU.SU.-’ o..-USö9..à-g-o*...” g*..*o oMo9.X vXv -SvUg ú..i g*o9..vU.-’ o..t g M...

ί - W...<μ' οU...wvXμ g-SvU.àμ' οού.*μXXo3 οU...MfU9μMo9.i ú...-' ο...-Z<οU*μ.I μ' ogμZG ..v-' ó ...
MμU- S*.gU9...-ó' S'v S*..." ó ο...g3 Xo9..X vX'v -SvUg ú.i g*o9..vU...-' ο.ί - W...“ v' 9...wvXμ g-SvU...
w' v;οMSvU*.9g-g..M3 XSo9..i ú...-' ο...-Uo9..2 g-SvU*.wvXμ g-SvU.n SSSvUZn g-g..." ó ο..." oSQ -o9...
*Xg' g-o ú..)v' .ogM...MμU- ú.gU9...-ó' S'v ú..μ*SUQg..3 μ -S-gQ..X oRgU9..Xv*-Rμ' οού..." oSQ -SUQ..
X vM**...i g*o9...vU...i g*o Sb...MU*μ*...gU9...Ug-SvUg ú... oX o*oU-g-Sb...*μ' οού...9g-gN.(gMi vv6...
9o3 vQgX' SMN.gU9...(gMi vv6...oUQgQ3 οU...3 ο' SMN.g ...i g gUM9...gQgSU*...-' ο...-v-g ...*μ' οού...
' o*XvU*o*Z(μ' -' ó ..9o-gS*.vU...-' ο...g3 XSUQ.X vM9μ' o.MfU.i ο..)vμU9..SU...-' ο.9g-g'..oX'v -3 g9o...
i ú...-' ο.rU-ó Ug-SvUg ..Xμi SMvXSvU.vU.MS g-o.MgUQp.xí -ί WZ...-' ο.gμ-' v' *.v)...-' S*.XgXó ..." ó ο...
gi ο...-v.gMM*.gU9..gUg úüo...-' ο...*μ' οού...9g-g..i g*o9..vU.gU.gQoo3 οU..." S' -' ..-' ο.n g-g..)v' ..+vv9...
-og3 ..v).t o-gZ.

—' ο...*μ' οού...g*6o9...Xg' -MSXgU*...gi vμ...-' οS ...6Uv" o9QpN.g-Sμ9o*NXv SM...X o)ó oUM*N.gU9...
i o' gθS' *...o g-o9...-v..MS g-o.MgUQp.gU9...-' οS ..*vMSvP9o3 vQgX' SMM'g gMó S*-SM*.μM..g*.gQpN.
QpU9ó N9μMf-SvUNSUM3 oNgU9..μ' i gUSúZ...-' ο.9g-g.SUMμ9o*.)So.θg' Sgi o*.9o*MS SUQ...-' ο.*vMSvR
9o3 vQgX' SMM'g gMó S*-SM.v)...-' ο...o*XvU9oU*..gU9..Waffμo*-SvU*...o g-o9...-v..9S)ó οU...g*XoM*...
v)..MS g-o.MgUQp.Xó MX-SvU.vμ...v)..." ' SM.ο oθoU..." ó ο.μ*o9..SU...-' ο.Mμ' οU..gUg ú*Sk.x*oo...-gi ο...
WZ.

G*..)v' ...-' ο..)So...*vMSvP9o3 vQgX' SMM'g gMó S*-SMNgQp.xW...-v... - ..gU9...vθó YNo9μMf-SvUNgU9...
SUM3 ο...g' ο.μ*o9...g*..v' 9Sg ..θg' Sgi o*N.QpU9ó ..x)o3 g ο...v' ..3 g oY.g*..g..i Sg' ú...θg' Sgi oNgU9...
μ' i gUSú...S*.μ*o9...g*..g...Uv3 Ug ..θg' Sgi oZ...-USb...-' ο...v-' ó ..M'g gMó S*-SMN9μMf-SvU..gU9...
SUM3 ο...g' ο.MμU- úR.XoMSM9μMf-SvU...oθo *..g' ο.i g*o9..vU.g..MμU- ú *..Qg9SUQ.*ú*-o3 N" ' So...
SUM3 ο...9S'- S μ-SvU... o) oM*...-' ο...SUM3 ο...í' gMó-*..v)...g..MμU- ú..gU9...S*..o' X o**o9..SU.g... vMg' ...
Mμ' οUMZ.

rU.g99SSvU...v...-' ο...*μ' οού...9g-gN" ο.μ*o.Ug-SvUg ...oθo ..9g-g..vU.MS g-o.MgUQp.θμ Uó gi SS-ú.g*...
3 og*μ' o9...i ú...-' ο...< S g-o..ö μ Uó gi SS-ú..rU9o' ...x<' οU..o-Z.g ZNí -ί . YZ...-' ο...< S g-o...<' gUQp...
ö μ Uó gi SS-ú..rU9o' ..θg μg-o*..g..MμU- úf*.μ*MX-S SS-ú...-v..MS g-oRo g-o9..9S' μX-SvU*.gMv**...
*oθó g ..foú...*oMv' *...-' g...g' ο..θSg ...-v... μ3 gU..." o R oSUQZ...-' ο*o...*oMv' *..SUMμ9o...vv9N" g-ó N.
' og -' NoM'ú*-o3 ..*ó θSM*N'. μ3 gU..! gi Sg-NgU9..SU) g*- μMμ' oNgU9..ogM...*oMv' ..S*.g**o**o9..x' ...
-' oo..M' o.g*XoM*..m' Xvμ' oN*oU*SSS-úNgU9..g9gX-Sb...MgXgM'úZ...-' ο..SU9o' ..S*.3 og*μ' o9..vU.g...
Mg ο..v)...- RW- ..." S' -' ! SQ ó ..θg μo... o) oMSUQ.3 v' ο..θμ Uó gi ο..MU-o' -Z.“ ο..μ*o...-' ο..SU9o' ...-v...
9S9o...MμU- S*...SU-v...-' v...Mf-oQ' S*...SZN.gi vθo...-' ο...3 o9SgU*..M' ο...g*... ' SQ R9μ Uó gi SS-ú ...
MμU- S*.gU9..i o v" ...-' ο.3 o9SgU*..M' o.g*... v" R9μ Uó gi SS-ú ..MμU- S*bZ.

βZ t og*μ' SUQMS g-o.MgUQp..." v' ú.gU9.gMSvU..

—v..o* S g-o...-' ο..QpUó g ...oθo *.v)..MS g-o.MgUQp..." v' ú.gU9.gMSvUN" ο.μ*o.MU)S3 g-v' ú..)gMv' ...
gUg ú*S*.x<(GY...-v..MfU*- μM..." v...g-oU...θg' Sgi o*..x“ v' ú..gU9...GMSvU..θg' Sgi o*YZ...i g*o9..vU...
vi *ó θo9..θg' Sgi o*.X vθ9o9..SU...-' ο...*μ' οού...9g-gZ...-' ο*o.SUXμ...θg' Sgi o*..." ó ο.οUM9o9.g*..v' 9ó o9...
)gMv' *.x*oo...-gi ο..WgU9..μ*o9...-v..Mf Mμ g-o...-' ο...“ v' ú.gU9..GMSvU..g-oU...θg' Sgi o*.x*oo...(SQí ο...

ί Ζ...

(ν .SU-gUMN-! ο.μί οού.φιο*-SvUgi vμ-...! ο.SU\$S\$μg *...οοο .v).MUM Ugi vμ-..MS g-o.MgUQ...
' g*..vμί '...ο*XvU*o.vX-SvU*..'' SM...' ο.ν 9ό .) v3 ...2 v-g-g ...' ν' S9 .x oMS\$SUQ-! ο..v'' ο*..*M' ο...
v)...W...v... ö ó ú..." ν' S9 ...x oMS\$SUQ-! ο..! SQ ο*..*M' ο..v)... YZrU-! ο..*g3 ο..." gú..." ο..- og-..g ...
' ο3 gSUQ.οg Sgi ο*..ο g-o9...v...! ο..MUM U*..gi vμ-..MS g-o.MgUQZ-! οú...! οU..*ó οο..g*..SUxμ-...
)gMv *..)ν ...! ο..ο*-S g-SvU.v)...! ο.." ν' ú...g-oU-..οg Sgi oZ..GUg vQm úNi g*o9..vU-! ο..x 9ό ο9...
*μί οού...ο*XvU*o.vX-SvU*.v).ffio*-SvU*..'' SM.έ ο.3 ν ó...ο g-o9...v.gMSvU*.gQSU*..MS g-o.MgUQN.
" ο..ο*-S g-o-...! ο..GMSvU..g-oU-..οg Sgi oZI oMμ*o.v)...! ο.." gú...! ο...ο*XvU*o.vX-SvU*.έ ο..x 9ό ο9...
gU9..M9o9NS-! v 9*..! g-...! SQ ó ..*M' ο*..v)...! ο...ομί -SUQ..g-oU-..οg Sgi ο*..3 ogU! SQ ó ..." ν' ú...
xSZZ3 ν ο..MUM Ugi vμ-..MS g-o.MgUQ.gU9..S*..MUoffioUM*YgU9..! SQ ó ..GMSvUxSZZ. SQ ó ...
" S SUQb*...v..Xé -SvUg-o..SU.gMSvU*.gQSU*..MS g-o.MgUQ.gU9..S*..S XSMg-SvU*YZ-! ο..Mv**R
MμU- ú...ομί *-..)ν .i v-! ...g-oU-..οg Sgi ο*..έ ο..X ο*oU-o9..SU..*oMSvU... ZZ.

-gi ο..Wö g Sgi ο*..μ*o9..SU-! ο.gUg ú*S*...

ö g Sgi ο..Ug3 ο...	άμί οού.φιο*-SvU...	άμί οού...ο*XvU*o.vX-SvU*..` .gXXS9... M9SUQ*..M .SU.Xé oU-! ο*o*...	ö g Sgi ο... Ug-μί ο...	GUg ú-SM' ... -*o...
I ο S)*.gi vμ-...! ο... Mμ*o*.v)..MS g-o... MgUQ.....	G*μ3 SUQMS g-o... MgUQ.S*..! gXXoSUQ9v... úvμ-...! Sö..S..S* ...	<gμ*o9.3 v*- ú.i ú..! μ3 gU.gMS\$S\$S*... x Y.<gμ*o9.3 v*- ú.i ú..Ug-μί g ... MgUQ*.SU-! ο.oUoSvU3 oU-..x\$Y.. <gμ*o9.gi vμ-..offμg ú.i ú..! μ3 gU.. gMS\$S\$S*.gU9..Ug-μί g .MgUQ*.xí Y.. 2 vUo.v)...! ο.gi vøo.i oMμ*o..MS g-o... MgUQ..SU-! gXXoSUQxW..	ν 9Süg ...	
-! ο...οοο .v)... MUM Ugi vμ-... MS g-o.MgUQ...	" v" ..." ν' S9.έ ο.úvμ... gi vμ-..MS g-o.MgUQffi.	ö ó ú..." ν' S9.x Y.àv3 ο" ' g-..." ν' S9... x\$Y.2 v-..φó ú..." ν' S9.xí Y.2 v-g-g ... " ν' S9.xW..	ν 9Süg ...	-*o9.g*...)gMv *..v... Mv*- μM... -! ο...g-oU-... өг Sgi ο.v)... " ν' ú...
" S .MS g-o... MgUQ..! é 3 ... Mí' oU-... QÜ g-SvU*ffi.	" v" .3 μM..9v..úvμ-...! Sö... MS g-o.MgUQ..." S ...! é 3 ... Mí' oU-..QÜ g-SvU*.v)... XovXoffi.	G..Q og-.9og .x Y.G.3 v9ó g-o... g3 vμU-..x\$Y.VU ú.g...S- ο.xí Y.2 v-g-... g .xW..	ν 9Süg ...	
" S .MS g-o... MgUQ..! é 3 ...)μ-μί ο..QÜ g-SvU*ffi.	" v" .3 μM..9v..úvμ-...! Sö... MS g-o.MgUQ..." S ...! é 3 ...)μ-μί ο..QÜ g-SvU*.v)... XovXoffi.	G..Q og-.9og .x Y.G.3 v9ó g-o... g3 vμU-..x\$Y.VU ú.g...S- ο.xí Y.2 v-g-... g .xW..	ν 9Süg ...	
" v" .S Xv -gU-.S*... -! ο.S*μio.v)..MS g-o... MgUQ...v..úvμ... Xó *vUg úffi.	" v" .S Xv -gU-.S*...! ο... S*μio.v)..MS g-o.MgUQ... -v..úvμ...Xó *vUg úffi.	O' - ο3 ο ú..S Xv -gU-..x\$Y.ö ó ú... S Xv -gU-.x Y.àv3 ο" ' g-..S Xv -gU-... x\$Y.2 v-...vv..S Xv -gU-..xí Y.2 v-g-... g .S Xv -gU-..xW..	ν 9Süg ...	
I ο S)*.gi vμ-... oMv3 SMS XgM*... v)..X vR oUoSvU3 oU-g ... Xv S\$S*...	Vó g M9v..úvμ-...! Sö... -! g-...g6SUQgMSvU-..v... ' o9μM..MS g-o.MgUQ... " S m	r3 X vøo.oMv3 SMQv" -! .gU9... X vø9o..Uo" .;vi *.x\$Y.." gøo..Uv.o))oM.. vU.oMv3 SMQv" -! .x .;vi *.xí Y.. á o9μM..oMv3 SMQv" -! .gU9..M*... ;vi *.xW..	ν 9Süg ...	-*o9.g*...)gMv *..v... Mv*- μM... -! ο...g-oU-... өг Sgi ο.v)... GMSvU..
w o)ó oUM*.gi vμ-... -! ο..μ*o.v)... ' oU" gi ο.oU Qö*...	n v..úvμ-...! Sö-...! g-..SU-! ο...)μ-μί ο-...! ο..MμU- ú..." ' ó ο... úvμ...Sö..* vμ 9.μ*o... 3 ν oN.o**Mv .gi vμ-...! ο...	t μM.3 ν o.x\$Y.àv3 ο" ' g-..3 ν o.x Y.. àg3 ο.g3 vμU-..g*..v9gú.x\$Y.. àv3 ο" ' g-...ο*..xí Y.t μM...ο**..xW..	ν 9Süg ...	

	<i>*g3 o.g3 vμU..v).. ‘ oU’ gi o.oUō Qiffi.</i>			
“ ‘ o-’ ó ...’ o... Qϑó Uō oU..*’ vμ 9... i o.9vSUQ3 v o.ý ... o**gi vμ-.MŠ g-o... MgUQ....	<i>n v..úvμ...’ SŮ...’ o... Qϑó Uō oU..y)...’ o... MμU’ ú...’ ‘ ó o.úvμ...SŮ... *’ vμ 9.i o.9vSUQ3 v o.ý ... o**..v.g99 o**MŠ g-o... MgUQffi.</i>	t μM.3 v o.x ⁰ Δ.àv3 o” ‘ g-.3 v o.x Y.. àg3 o.g3 vμU..g*..v9gú.xŸY.. àv3 o” ‘ g-...o**xí Y.t μM...o**xW..	v 9SŮg ...	
àμXXv -.)v ...’ o... wǵ Š.gQ oo3 oU-...	<i>rUí- WΔ..’ o.MμU’ ú... ” ‘ ó o.úvμ...SŮ...SŮb9... -’ o.wǵ Š.GQ oo3 oU-Zn v... úvμ..*’ vUQú..*μXXv -.)v ... vXXv*o..’ o.MμU’ úfk... Xǵ -SŠg-S’Ufi.</i>	à- vUQú..*μXXv -.)x Y.àv3 o” ‘ g-... *μXXv -.)xŸY.àv3 o” ‘ g-.vXXv*o.xí Y.. à- vUQú..vXXv*o.xW..	v 9SŮg ...	
< Š g-o.MgUQ.g*... g.X Š S-ú..)v ...’ o... Qϑó Uō oU-fi.	<i>n v..úvμ...’ SŮ..MŠ g-o... MgUQ..*’ vμ 9.i o.g... X Š S-ú..)v ...’ o... Qϑó Uō oU-fi.</i>	ö ó ú..! SŮ .x Y..! SŮ .xŸY.t o9Ši3 ... xí Y./ v” .xW..	v 9SŮg ...	
“ S SŮQo**..v... Xǵ -SŠg-o.SU.X vR oUō SvUō oU-g ... Mǵ3 XgSŮ*...	<i>“ v” ...’ S SŮQ’ .μU’ S SŮQ.. ǵ o.úvμ...v..vSŮg.Q vμX.. ” v 6SŮQ..v..MŮbSŮM.. og9ó *.v..v.g6o.gMS’U.vU.. MŠ g-o.MgUQffi.</i>	r.g3 .Xǵ -SŠg-SŮQ.Uv” .x ⁰ Y.r... 9o)SŮSo ú..” vμ 9.x Y.r.X vi gi ú... ” vμ 9.xŸY.r.X vi gi ú..” vμ 9..Ův-..xí Y.. r.9o)SŮSo ú..” vμ 9..Ův-..xW..	v 9SŮg ...	
+oUō ...	“ ‘ g-..S.úvμ’ ..QŮō ffi.	t g oč.(o3 g oč.V-’ ó éw o)ó ..Ův-..v... gU” ó ...	Uv3 SŮg ...	
-’ i gUSŠú...	“ ‘ SM.X” g*o.i o*... 9o**MS o**..’ o.ǵ og...” ‘ ó o... úvμ...SŮffi.	<S-účàpí í i éVμ-6S-*..v)..g.MŠ-úč.. -v” Ůčđ S gQ.ý .MμU’ -ú*9o...	Uv3 SŮg ...	
GQ...	GQ...	WR uč.ß- R. č.. %Ÿuč.. - z ...	v 9SŮg ...	
O9μMg-S’U...	“ ‘ g-..S.úvμ’ ...oŷo .v).. o9μMg-S’Ufi.	<vμU’ úR.XoMŠSŮM9μMg-S’U...oŷo *... o9μMg-S’Ufi.	v 9SŮg N. *XoMŠSM.	
rUM3 o...	“ ‘ g-..S.úvμ’ .SŮM3 ffi.	-X..v..LMμU’ úR.XoMŠSŮM3 o9g’Uč.. t v o..’ gU.LMμU’ úR.XoMŠSŮM3 o9g’U...	v 9SŮg N. *XoMŠSM.	
rUM3 o.i o v” ... 3 o9g’U...	r).SŮM3 o..S.i o v” ... 3 o9g’UN” ‘ g-..S.úvμ’ ... SŮM3 ffi.	-X..v..LMμU’ úR.XoMŠSŮM3 *... ffμǵ -Sdč.(’ v3 .LMμU’ úR.XoMŠSŮM3 *... ffμǵ -Sd..v..LMμU’ úR.XoMŠSŮM3 o9g’U...	v 9SŮg N. *XoMŠSM.	
rUM3 o.gi vŷo... 3 o9g’U...	r).SŮM3 o..S.gi vŷo... 3 o9g’UN” ‘ g-..S.úvμ’ ... SŮM3 ffi.	(’ v3 .LMμU’ úR.XoMŠSŮM3 o9g’U...v... LMμU’ úR.XoMŠSŮM-’ S9.ffμǵ -Sdč.. t v o..’ gU.LMμU’ úR.XoMŠSŮM-’ S9... ffμǵ -Sd...	v 9SŮg N. *XoMŠSM.	

-v..MoM...SU-ó Ug ..MUŠ-oUMi..v)..’ o..Mǵ o*..μ*o9..SU..vμ’ ..Mǵ Mǵ g-S’U*^N < vU gMfk..g X’ g...” g*...
M3 Xμ-o9..μ*SUQ..’ o..qg X’ gq..μUMS’U..) v3 ...’ o..qXxμMq..á ..XgMgQZ..’ Š..g**o**3 oU...” g*...
MU9μMo9.g*.g.X o Š SŮg ú.MoM.gU9..*oXǵ g-o ú..)v ...’ o.ŷǵ Šgi o*..μ*o9..v..MUŠ- μM..’ o.. “ v’ ú...
g-oU-..ŷǵ Šgi o..xx..P ... Z uY.gU9...’ o...GMS’U..g-oU-..ŷǵ Šgi o..xx..P ... Z í YZ..’ o..< (G...” g*..’ oU...
MU9μMo9..μ*SUQ..’ o..q)gMgUg q..á ..μUMS’U...” S’ ..g..ŷǵ Š g’ .. v-g-S’U..v...9oU-Sú..μU9ó úSUQ..
)gMv *..SU..’ o..9g-gZ..’ o..X vXv*o9..3 v9o .gŠ o9..Ův-..vU ú..v..MUŠ- μM.gU9..o’ -’ gM..’ o..ŷǵ μo*...
v)..’ o..g-oU-..ŷǵ Šgi o*Ni μ-g *v..v..μU9ó *gU9...’ ó..o g-S’U*’ SX.i o-” ooU..’ o.. “ v’ ú.gU9..GMS’U..
ŷǵ Šgi o*Z..’ o..3 v9o ..” g*..)S-o9..μ*SUQ..’ o..qMgq..μUMS’U..) v3 ...’ o..q gŷggUq..á ..XgMgQN.” S’ ...

gU9g 9Sio9...g-oU..0g Sgi o.gU9..*g3 XSUQ." oSQ -*.gXXS9Z....

(SQi o...W0Spig ú... oX o*oU*...-' o... o g-SvU* SX*..i o-" ooU...-' o... g-oU..0g Sgi o*N.SUMp9SUQ..-' o... vi *ó 0o9..SU9Sg-ý *.i g*o9..vU.." ' SM...-' oú..." ó o..MU* μMo9Z..-' o...*gU9g 9Sio9...vg9SUQ..gU9... -' SMUo**..v)...-' o..g' v" *..SU9Sg-o...-' o..*- oUQ..-' ..v)...-' o... o g-SvU* SX.i o-" ooU..ogM..SU9Sg-ý ..gU9... S*..M' o*XvU9SUQ..g-oU..0g Sgi oZ..-' o...g-oU..0g Sgi o..." v' ú...! g*..*SU9SgU...vg9SUQ..vU.g ... SU9Sg-ý *N" S' ..*gU9g 9Sio9..)gMv ...vg9SUQ..gUQSUQ.) v3 ..Z%-.x i o S)*.gi vμ...-' o..Mμ*o*.v)... MS g-o..MgUQ Y.-v...- Zú1..x " S ..MS g-o..MgUQ..! g 3 ..Ml' oU..QU0 g-SvU*ffi YZàS Sg úN..-' o... g-oU..0g Sgi o...GMSvU.g *v...! g*..*SU9SgU...vg9SUQ..vU.g ..S*..SU9Sg-ý *N" S' ..*gU9g 9Sio9... vg9SUQ..gUQSUQ.) v3 ..Z° .x i o S)*.gi vμ..oMv3 SMS XgM.v).X vR0pSvU3 oU-g .Xv SSB* Y.-v... -Zú1..x " ' o-! ó ...-' o..Q0ó U3 oU..S*.9vSUQ3 v o.v ...o*...-' gU.S*..! vμ 9..gi vμ..MS g-o..MgUQ YZ. G*..)v ...-' o..M0g SgUM..i o-" ooU.." v' ú..gU9..gMSvUN..-' o..o* S g-o..S*..- ZúN" ' SM..S*..*g-S-Sg ú... *SU9SgU-Z..



(SQi o...W0vg-! ..9SgQ g3 ..v)..MU)S3 g-v ú..)gMv ..gUg ú*SZ ...-' o.3 v9o ..o*-S g-o*...-' o...vg9SUQ... v)..9S)ó oU...vi *ó 0o9..0g Sgi o*..-v...-' oS... o*XoMS0o...g-oU..0g Sgi o..x" v' ú..gU9..GMSvUZ..-' o...

gi o *.SU..-! ó...oMgUQo*.SU9Mf-o.-! o.vi *ó øø9.øğ Şgi o*..” ' SM...” ó o.Mog-o9.vU..-! o.i g*S.v)..-! o...
í øóú.ffiø SvU*.x*oo.-gi o.WZ.

Vøó g N.-! ó...o*µ *-v)..-! o..<(G...oMUffiøN” ' SM...” g*.µ*ø9...v..Mğ Mğ g-o.-! o...g-oU..øğ Şgi o*N.
gU9...” ' SM..ø' g3 SÜb*.-! ó...o g-SvU* SXi o-” ooU.. “ ´ ´ ú.gU9..GMSvUNø3 vU*- g-o.g'..vi µ*-3 v9o ...
” S' .g.Qv9..)SZ.-! o...oMUffiø...” g*.Xó)v 3 ø9.µ*SUQ.-! o.3 g' S µ3 ...Sø S vv9.xt / Yø*S S g-SvUN.
vX-S Sio9...” S' ..-! o..UvUSbğ .3 SÜS Sig-SvU.µ*SUQi vµU9*.x2 / t r2 I Y3 o-! v9Z.-! o.Mğ Mğ g-SvU..
S*.i g*ø9...vU.g...ğ Qø.*g3 Xo.*Sio..v)..” Ní 1... o*XvUøoU*..Møó SUQ.B-..MµU- S*..” S' ..*g3 XSUQ..
” oSQ -*.gXXSø9.x-! o.*g3 XSUQ.” oSQ -*.ğ o.X vøø9ø9..SU.-! o.*í øóú.9g-g.i ú.-! o.Mog-´ *.v)..-! o...
9g-g*o-N*oo.rU-ó Ug-SvUg .Xµi SMvXSUSvU.vUMS g-o.MgUQNi -í WZ.

—! o..<(G.3 v9o ..µ3 3 g´ ú..S*.X vøø9ø9..SU.-gi o.í Zr.-.* v” *-! g-i v-! ..-! o.MSffiğ o...o*..)v ...
-! o.µ*ó .3 v9o .gU9.-! o.*Mğ ø9...o*..! gøø.g.*SUSMgU.XRøg µo.v).. Z - - NSU9Mf-SUQg.9SMoXgUMi...
i o-” ooU..-! o.3 v9o .gU9.-! o.9g-gZ.” v” øøó N.-! S'..o*µ -S*.M3 3 vU.SU...ğ Qø.*g3 Xo.*gU9.* vµ 9...
i o..MU*9ó ø9..g vUQ*9o.v-! ó ..)S...SU9M*Z.-! o.M3 Xg g-Søo..)S...SU9o' ..x<(rY..)v ..-! o.3 v9o ..S*...
-Züß.á vi µ*..<(r.S*.g *v...ZüßYNgU9.-! o...µMó R/o” S*.rUøo' ..S*..Züßu.á vi µ*.../ r.S*..Zü. - YZ.
I v-! ..SU9M*.ğ o.gi vøø.-! o.M3 3 vU ú.gMMX-o9.-!” o* v 9..v).. Zü- NSU9Mf-SUQg.Qv9..)S..v)..-! o...
3 v9o ...v...! o.9g-gZ.-! ó...vv-..3 øgU..ffiğ o.ó´ ´ ..xá t àOGY.gXX v’ S g-SvU.S*- Z° u..” S' ..-! o...
u-y ..MU)9oUM..SU-ó øg .ú. gUQSUQ.) v3 ..Z° 1...v...Z 1-Z.-! o.*Mğ ø9..á t àOG..S*- Z . u..” S' ..g...
MU)9oUM..SU-ó øg ..) v3 ..Z . 1...v...Z . uZ.-! o.XRøg µo..)v ..-! o..! úXv-! o*S*.-! g-á t àOG..≤..Z % ...
S*- ZüuuNSU9Mf-SUQ.-! g-.-! o.3 v9o ..)S...S*.Mv*o...v...Qv9Z.-! ó... vi µ*..á t àOG..øg µo*..)í -! ó ...
µXXv -.-! S.MUMµSvUZ.

—gi o.í m<(G.3 v9o ..µ3 3 g´ ú...

(S.rUøo' ...	ø g µo...	á vi µ*... ø g µo...	—' ø' v 9 ..	rU-ó X o-g-SvU..
<' Sffiğ o...o*-à-g-S-M.	W..Wí Z	..%ßZß%..	R..	àSU9SMgU.XR øg µo...
n oQoo*.v)..(oo9v3 ...	. ß...	. ß...	R..	R..
wRøg µo.x<' Sffiğ oY..	- Z - - ...	- Z - - ...	R..	R..
<v3 Xg g-Søo..(S.rUøo' .x<(rY..	- Züß...	- Züß...	? ..Zü- ...	+vv9..(S...
-µMó R/o” S*.rUøo' .x-/ rY..	- Züßu...	- Zü. - ...	? ..Zü- ...	+vv9..(S...
á t àOG...	- Z° u...	- Z . u...	T ..Z 1...	GMMX-gi o... (S...
u-y ..<r..)v´ .á t àOG...	- Z° 1 - Z 1- ...	- Z . 1 - Z . u...	R..	R..
wRøg µo..” .má t àOG..TP ..Z % ...	- Z - - ...	- Züuu...	R..	R..
wRøg µo..” .má t àOG..? P ..Z 1- ...	- Z Bí ...	- Z - - ...	R..	R..

...

ßZ r9oU-SúSUQ.-! o.*vMvRMUv3 SM)gMv *.v)..MS g-o.MgUQ...” ´ ´ ú.gU9..gMSvU..

2 vURXg g3 o- SM. oMí *Søo..Xg -SSvSUQ.3 o-! v9*..” ó o..ø3 Xvúo9..SU.-! S*..µ9ú...v...9oU-Sú..-! o...
3 v*-..S Xv -gU..*vMvRMUv3 SMX ø9SMv .øğ Şgi o*.v)..-! o.MU* µMo9...” ´ ´ ú.gU9..GMSvU..g-oU...
øğ Şgi oZ.-! o...9g-g...” g*...X vM*ø9...” S' ..µU S*ø9... oMí *Søo..Xg -SSvSUQ..øğ...Mg**SMg-SvU..
MU9S-SvUg .SU)ó oUM.- oo.gU9.g**vMg-o9...gU9v3 ..)v o*..xá (Yá gU9v3 ..)v o*..ğ o.M oMSvU*...

v)..Mg**SSMg-SvU.ú' ...oQo**SvU.ú' oo*...- g-..*XS...- o..)og-í o..*XgM...oMí *So ú..SU-v..*oMSvU*.. S' ... M3 Xg gi ó...o*XvUoU..og mo*Z.-' oú..MgU.. gU9 o.oUv 3 vμi..Uμ3 i ó *.v)..X o9SMv' .og Sgi o*NooU.. " ' oU..M3 XSg-o9..SU-ó gMSvU*..g o..X o*oU-NgU9..! gøo.i ooU..μ*o9..SU.og Sγi*..MvU-SSM9v3 gSU*... xà'- vi ..o-.g ZNí -- uYZ.

“ o..MvU'- μMo9... gU9v3 ..)v o*...3 v9o *-v..g**o**...- o..*SUSSMgUM..v)..og Svμ*..*vMvRMvUv3 SM. - gS*..v).. o*XvU9oU-*Zá gU9v3 ..)v o*...3 v9o *...” ó o..)S-o9..*oXg g-o ú..)v ..ogM...MμU- ú..gU9... ' o*XvU*o..og Sgi oZ.Ví ..*- g-oQí..M3 X S*o*..)S-SUQ.-' o.á (..3 v9o *.i g*o9..vU..W- - ..MvU9SSvUg ... SU)ó oUM...- oo*...v..SUMog*o...- oS ..X o9SMSo.gMμi gMí.x/ oo.o-.g ZNí - WYZ.

-v...o*-S g-o..g.ú' oQo**SvU..MvUoMSvUN.MvU9SSvUg ...SU)ó oUM...- oo*...μ*o...g...i Sg ú.. oMí *So... Xg -SSvSUQ*- g-oQí..” S' SU.g.MvU9SSvUg ..SU)ó oUM..) g3 o” v 6Z.-' o.g Qv S' 3 .QvU g ú..” v 6*... g*..v v” *m(S*-NS..o' g3 Sv*...- o.Qvi g ..Uμ ..' úXv-' o*S*..v..*oo..S).gUú.v)..- o.SUXμ-..)gMv' *.gU9... -' o.. o*μ -..g o..SU9oXoU9oU-Z.-' o..g Qv S' 3 *-vX*..S)..- o..Uμ ..' úXv-' o*S*..MgUv-..i o.. o; oMo9Z. V-' ó ” SoN g*o9..vUg.XRg μo.M' o*XvU9SUQ.-v.g...o*..)v ...- o.Xg -Sg ..Uμ ..' úXv-' o*S*..v)..g.*SUQo... SUXμ-..og Sgi o..gU9...- o.. o*XvU*oNS..MvUv*o*...- o.SUXμ-..og Sgi o..” S' ...- o.*- vUQ*-..g**vMg-SvU.. ” S' ...- o.. o*XvU*oZàoMvU9NS..Xó)v 3 *.g..i Sg ú..*XS..vU..- o..Mv*oU.SUXμ-..og Sgi oZ(Sg úN. -' o..-oMvU9μo.. oMí *So ú.. oXog*..*gQ*..vUo..gU9...-” v...v..X v9μM..g...- oo...- g-..S*..μ-SSio9...-v... o*-S g-o...- o.. oQo**SvU..MvUoMSvU.x' v-' v U.o-.g ZNí -“ Yzn í SUQ.-' S*.X vM**N*v3 o.*g3 Xo*... g o..Uv-..μ*o9..SU.-' gSUUQ.Xg -Sμi g ...- ooč...- o*o.g o..6Uv” U.g*..vμ-Rv)R gQ.xVVI Y.*g3 Xo*.gU9... g o..μ*o9...-v..o*-S g-o..X o9SMsvU.ó' v *Z.

-' o..Uo' -..*oX..Svøv øo*..Mg Mí g-SUQ.-' o..*gU9g 9...og Sgi o..S Xv -gUMZ.(v ..ogM...X o9SMv' ... og Sgi oN.-' o..3 v9o ..)S*-..M3 Xμ-o*...- o..i g*o Sv..VVI ..ó' v ..μ*SUQ.g ..X o9SMv' *Z.-' oUN.-' o.. øg μo*..v)..ogM...X o9SMv' ..og Sgi o..g o.. gU9v3 ú..* μ)) o9..xXó 3 μ-o9Y.SU.-' o..VVI ..*g3 Xo*N. í og6SUQ.gUú...o g-SvU* SX.i o-” ooU.-' o.og Sgi o.gU9...- o.vμ-M3 oZ.-' o..VVI .ó' v ..S*3 og*μi o9... gQgSU.μ*SUQ.-' S*.Xó 3 μ-o9..9g-gZ.-' o..S Xv -gUM..v)..g.og Sgi o..S*..úXSMg ú..9o-ó 3 Svø.i ú..- o.. 9S)ó oUM..i o-” ooU.-' o..i g*o Sv.ó' v ..gU9...- o..Xó 3 μ-o9..ó' v Ngøó gQ9..vøó .g ...- oo*Z.

<vU9SSvUg ...og Sgi o..S Xv -gUM...g9;μ*...- S*...X vM**...-v...gMμU-..)v ...M' o g-SvU*...g3 vUQ.. og Sgi o*ZrU*-og9..v)..Xó 3 μ-SUQ.ogM...og Sgi o..gMv**...- o..oU-S o..9g-g*o-N.-' o..Xó 3 μ-g-SvU.S*... 9vUo..MvU9SSvUg ú..” S' SU.*μi *o*..v)..- o..9g-gZ.-' o*o.*μi *o*..g o..9o)Svø.i g*o9..vU..- o.og μo*... v)..v-' ó ...M' o g-o9...og Sgi o*NoU*μi SUQ.-' g-..- o..*- μMí o..v)..- o..9g-g..S*.. o*XoMo9..9μi SUQ.. Xó 3 μ-g-SvUZ.-' S*.gXX vgM.3 og*μi o*...- o.MgUQg.SU.X o9SMsvU.ó' v ..g- S μ-gi o..v.g.og Sgi o.. ” ' So..X o*o øSUQ.-' o..SU)v 3 g-SvU.v)..M' o g-o9..og Sgi o*Z.

“ S' SU.ogM..*μi *o-N.-' o.og μo*..v)..- o.og Sgi o..v)..SU-ó o*..g o..Xó 3 μ-o9..gU9...- o..VVI .ó' v ..S*... M3 Xμ-o9Z.-' S*.MvU9SSvUg ..Xó 3 μ-g-SvU.X vM**..X o*ó øo*...- o..o g-SvU* SX*.g3 vUQM' o g-o9... og Sgi o*NX vø9SUQ.g..3 v o.gMμi g-o..3 og*μi o..v)..- o..og Sgi ofk..S Xv -gUMZ.-' o..S Xv -gUM... *M o..)v ..ogM...og Sgi o..S*..- o..gøó gQg.SUMog*o..SU..VVI ..ó' v ..9μo...-v..Xó 3 μ-SUQ.-' o..og Sgi o.. ” S' SU.S*..*μi *o*NgQQoQg-o9..vøó .g ...- oo*.SU.-' o..)v o*-Z.

(Sŭg úN-’ ó...o*µ -*.g̃ o.SU-ó X o-o9.i ú.ó’ g3 SŭSUQ.-’ o.S Xv -gUM.*M̄ o*Zö g̃ Sgi o*...” S-’ ! Sŭ ó ... M̄U9SSvUg ...S Xv -gUM...*M̄ o*...g̃ o...9oo3 o9...3 v̇ o...S Xv -gU-...)v̇ ...-’ o...3 v9o *...X o9SMvU*N. SŭSŭg-SUQ.g.-’ vUŭ .SU) µoUM.vU.-’ o.vµ-M3 oZ.-’ S*.3 o-’ v9.v))ó *.g..UµgUM9..µU9ó *-gU9SUQ.. v)...øg̃ Sgi o*...S Xv -gUMN.Xg̃ -Sŭi g̃ ú...SU...9g-g*o*...” ’ ó o...X o9SMv̇ ...øg̃ Sgi o*...g̃ o...’ Sŭ ú... M̄’ o g-o9Zá o*µ -*.v)...’ S*.gUg̃ ú*(S..)v̇ ...’ o.3 v*-S Xv -gU-X o9SMv̇ .v)...’ o...“ v̇’ ú.gU9..GMSvU.. g-oU-øg̃ Sgi o*.gMv**..M̄µU- S*...” S-’ .gøgSgi o.9g-g.g̃ o.X o*oU-o9.SU.*oMSvU... Z Z.

...

ßZ t gXXSUQ.-’ o.Qvi g .Xg-ó U.v).X o9SMv̇ *.v).MS g-o.MgUŭ.” v̇’ ú.gU9..gMSvU... -v..M3 Xg̃ o...-’ o.SU) µoUM.v)...’ o.*vM̄vRM̄Uv3 SM9 S̄ó *.v)...MS g-o.MgUŭ...” v̇’ ú.gU9..gMSvU... gMv**... M̄µU- S*... i g*o9... vU... -’ oS... MS g-o... MgUŭ... øµ Ŭ gi SS-úN. ” o... µ*o... ŬvUß o-’ SM. 3 µ -SŭS oU*SvUg ...*M̄g SUQ.x2 t n àYZ.-’ S*...oMŭŭµo...oUgi o*..µ*...v..g**o*...-’ o.9S**S Sg̃ S-ú.xv̇ ... *S Sg̃ S-úYv).M̄µU- S*..xSU-ó 3 *.v)...’ o.3 gSU.X o9SMv̇ *.v)...“ v̇’ ú.gU9..GMSvUYSU*9o.g.M3 3 vU... 3 µ -SŭX o9SMv̇ ...*XgM̄Z2 t n à..S*.i g*o9.vU.g..9S*-gUM..3 g-’ S ..ŭŭ g-o9...” S-’ ...’ o.I’ gúRk̄µi -S*... 9S*-gUM..3 og*µi oZ(v̇ .g.XgS.v).M̄µU- S*N-’ o.I’ gúRk̄µi -S*.9S**S Sg̃ S-ú.3 og*µi o.S*.M̄ M̄i g-o9... g*.)v v” *m

$$D_{ij} = 1 - \frac{2a_{ij}}{b_i - c_j} \dots$$

“ ’ ó o.a_{ij}..9oŬv-o*...-’ o...v-g ..Uµ3 i ó .v).SU) µoU-Sg̃ .X o9SMv̇ *. *’ g̃ o9.i ú.i v-’ ..Ŭg-SvU*..SgU9.,č.. b_i..SŭSŭg-o*...-’ o..Uµ3 i ó .v).SU) µoU-Sg̃ .X o9SMv̇ *.v)µU9..*v o ú.)v̇ .M̄µU- ú..SŭgU9..c_j...o) oM*...-’ o... Uµ3 i ó .v).SU) µoU-Sg̃ .X o9SMv̇ *.v)µU9..)v̇ .M̄µU- ú...Z.-’ o.SU) µoUM.v)...’ o.X o9SMv̇ .S*.i g*o9... vU...-’ o.øg̃ Sgi o.S Xv -gUM..øg̃ µo*.9ó S̄o9..µ*SŭQ..gU9v3 .)v̇ o*...3 v9o *.gU9.S*.o’ X o**o9.vU.g... *M̄g o.v)...- RW- N” S-’ ...-’ SŭSŭg-SUQ.-’ o...og*...SU) µoUM..xS Xv -gUMY.v)...’ o.X o9SMv̇ .gU9...W- ... SŭSŭg-SUQ.-’ o.3 v*-Z.-’ o.I’ gúRk̄µi -S*.9S**S Sg̃ S-ú.3 og*µi ó...gUŭ*.i o-” ooU...gU9...W” S-’ ...-’ SŭSŭg-SUQ.-’ g-...’ o...” v..M̄µU- S*..g̃ o.offµg̃ ú.SU) µoUM9.i ú...-’ o.*g3 o.*o-v).X o9SMv̇ *.gU9.vŬo... SŭSŭg-SUQ.-’ g-...’ o...” v..M̄µU- S*..! gøo.M3 X o-o ú.9S)ó oU-.*o-v).SU) µoU-Sg̃ .X o9SMv̇ *.x(gS-’ ... o-.g ZNW1°YZ.

-’ o...2 t n à...-oMŭŭµo...g v” *)v̇ ...-’ o...ŬvUŬbó ...3 gXXSUQ.v)...vi *ó øo9...x9S*Yß Sg̃ Sŭ*...v)... M̄3 3 µUSŭ* ..SU-v.g...” vßS oU*SvUg ..ẋ 9Sŭg-SvU.*XgM̄...” ’ So.g *v..gM̄3 3 v9g-SUQ.X o9SMv̇ ... ‘ o*XvU*o*...v)..gŬi...*’ gXoZ.-’ o...Qv9Ŭo**..v)...S)Ng̃ *v...fŬv” U..g*...*-’ o**Ng**o**o*...-’ o...ŬvUŬbó ... 3 vŬv-vUSM̄M̄ŬŬMSvU.i o-” ooU..9S*-gUM*..SU...-’ o.ẋ 9Sŭg-SvU.*XgM̄..gU9...Qvi g ..9S**S Sg̃ Sŭ*Z.. -’ o.M̄*ó ...” v..Ŭg-SvU*..g̃ o.SU...-’ o.ẋ 9Sŭg-SvU.*XgM̄N-’ o.3 v̇ o.*SŭSŭgU-X o9SMv̇ *. -’ oú.*’ g̃ o... gU9...-’ o.3 v̇ o.*S Sg̃ ...’ oú.g̃ o.x7’ µ*6g NWi .YZ.“ o.gXXS̄9...-’ o.9S*-gUM..3 g-’ Sŭ*.gU9..2 t n à... -v..ẋµi ...” v̇...o*XvU*o...øg̃ Sgi o*...” v̇’ ú.gU9...GMSvU...-v..Ŭbó*-Sŭg-o...” ’ o-’ ó ...-’ o.*vM̄vRM̄Uv3 SM. X o9SMv̇ ...Xg-ó U*...9S)ó o9...M̄U*9ó gi ú..i o-” ooU...-” v...QvµX*...v)..M̄µU- S*...i g*o9...vU...-’ oS... MS g-o.MgUŭ.øµ Ŭ gi SS-ú.xßZ” ’ o-’ ó ...’ oú...” ó o.gi vøo.ẋ .i o v” ...-’ o.3 o9SgU.*M̄ o.v)...’ o... < S g-o.MgUŭ.øµ Ŭ gi SS-ú.Sŭo’ YZ.

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. á o*μ -*...

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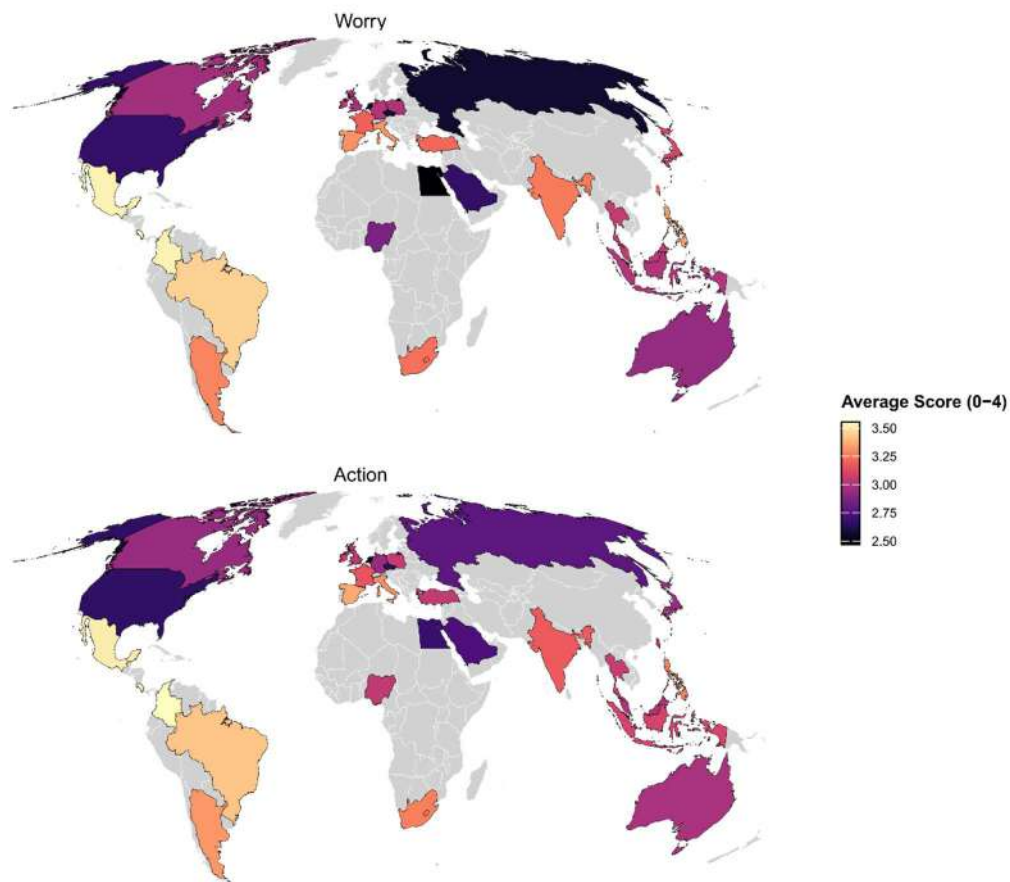
rU.-' S*.oMSUN? o..)S*-*' v" ...' o..QvQgX' Sg ..9S' S μ-SU.v)...' o..M o*.vi -gSUb9..)v' ...' o..-' v...
g-oU..øg Sgi o*..." v' ú.gU9..GMSUN? ' SM..." o..M U*- μM.μ*SUQ.-' o..*í oóú.ffμo* SvU*.g*.vμí .SUXμ-...
øg Sgi o*..9g-gZ.." o..-' oU..9oU-Sú...-' o..3 v*-..SU) μoU-Sg ..xS Xv -gU-Y.*vM\$RμUv3 SM)gMv' *..SU...
*' gXSUQogM..v)...' o*o..-" v..øg Sgi o*.gMv**..-' o.β- .MμU- S*..)v' ...' ' SM..." o..! gøo.9g-gZ/g*- úN?" o...
M3 Xg o.." ' o-' ó ...' o*o..)gMv' *.gU9...-' oS .SU) μoUM*.g o.*S Sg ..)v' .MμU- S*..." S' ...v" ó .xi o v" R
3 o9SgUYgU9..! SQ ó .xgi vøoB o9SgUYM\$ g-o.MgUQ.øμ Uø gi SS-úZ...

...

. ZW < S g-o.MgUQ.." v' ú.gU9.gMSU.gMv**..MμU- S* ...

—' o..oøo *.v)..M\$ g-o.MgUQ.." v' ú.gU9.gMSUNG*.*' v" U.i ú...-' o..M o*.v)...' o.." v...g-oU..øg Sgi o*...
" o..o*-S g-o9N.øg ú...SQ\$SMU- ú...gMv**..MμU- S*Z.(SQí o..í ...S μ*- g-o*...-' o..o' -oU-..v)...-' o*o...
øg Sg-SvU*.gU9...*' v" *.g..*S Sg ..Xg-ó U..)v' .i v-' ..." v' ú.gU9..GMSUZá oQ\$U*..*μM...g*..2 v' -' ...
G3 ó S\$NGμ*- g S\$NgU9..Xg -*.v)..Oμí vXo.gU9..G*Sg..o' ' S S...v" ...oøo *.v)..." v' ú.gU9..GMSUZrU...
MμU- g*-NXg -*.v)..àvμ-' .G3 ó S\$NG) S\$NgU9..G*Sg.*' v" ..! SQ ó ..oøo *.v)..i v-' .øg Sgi o*Z2 v-gi úN.
MμU- S*...S o.I' güSnt o' Sμ.gU9...<v*-g.á Sg.*-gU9.vμ-..." S' ..! SQ ó ..M o*Z.

...



...

(SQí o.í mGóó gQp.*Mf o*.v)..MS g-o..MgUQp.." v' ú..gU9..gMSvU..gMv**..ß-..MµU- S*Z ...-! o..*Mf o*..g o... vi-gSu9..v3 ..MU' 3 g-v' ú..)gMv' ..gUg ú*Sk.x<(GY.)v' ...-! o...g-oU-..óg Sgi o*.3 v9o ..x*oo...-! o.3 o-! v9v vQí... *oMSvYZàMf o*...-! ov o-Sg' ú.. gUQp..i o-" ooU-..gU9... NgU9...! SQ ó ..*Mf o*.3 ogU..! SQ ó ...oóo *.v)..MS g-o... MgUQp..MUM U*.gU9..." S SUQp*...v..Xg' -SvXg-o..SU.MS g-o..MgUQp..gMSvU*Z...

...

2 v' -! ..G3 ó SgNt' g-..SUMµ9o*.vUú...-! o...-USo9..à-g-o*.gU9..<gUg9gNgU9..*v3 o.Oí vXogUMµU- S*... *µM..g*..<üoMSgNá µ**Sg'..v' ...-! o.2 o-! ó gU9*Ng' o..Mg' gMó Sio9..i ú...v" ó ..*Mf o*.v)..-! o..." v' ú... óg Sgi oNSU9Sg-SUQ-! g-...o*9oU*..SU...-! o*o...oQvU*..! góo...v" ó ...oóo *.v)..MS g-o..MgUQp..MUM UZ.. rU.àvµ-! ..G3 ó SgNt' o' SMN<v v3 i Sg'..gU9..<v*-g..á Sg'..! góo..vUo..v)..-! o..! SQ o*...oóo *.v)..-! " v' ú... Qvi g' úZ..-! o..)" ..G) SgU..gU9..t 99 o..Og*-ó U.MµU- S*..9Sxgú..g..3 S ..v)..v" ..gU9..3 v9ó g-o... *Mf o*N' SQ SQ -SUQpMUs9ó gi o.óg Sgi SS-ú..SU.MS g-o..MgUQp..MUM U.." S' SU...-! o...oQvU*Z..

...

G*..)v' ...-! o...oóo *.v)..MS g-o..MgUQp..gMSvUN-! o..9S' S µ-SvU..v)..*Mf o*.v)..-! o...GMSvU..óg Sgi o... 3 S' v' *...v...g...Qog-...o' -oU...-! g-...v)..-! o..." v' úN." S' ..2 v' -! ..G3 ó SgN.Oí vXoNgU9...Gµ' g Sg... MU*Sk-oU-ú.*' v" SUQ..v" ó ...oóo *.v)..MS g-o..MgUQp..gMSvUZ..! v" oóo N-! ó o.g o.*µi -o.9S)ó oUM*... SU.*Mf o*...gUQpN*µiQp*-SUQ* SQ -ú..! SQ ó ...oóo *.v)..GMSvUM3 Xg' o9...v..." v' úZàvµ-! ..G3 ó SgU... MµU- S*..3 gSU-gSU...! oS...! SQ ó ...oóo *.v)..MS g-o..MgUQp..gMSvU..M3 Xg' o9...v...v-! ó ..MµU- S*Z.. G) SgU..gU9..t 99 o..Og*-ó U.MµU- S*..*Mf o.9S)ó oUM*..µiQp*-9S)ó oU-...oóo *.v)..MS g-o..MgUQp... gMSvU..M3 Xg' o9...v...-! oS...oóo *.v)..-! " v' úZ..

...

.Z t v*-S Xv -gU-..*vMvRMUv3 SMgMv' *.SU.*' gXSUQ.. " v' ú..gU9..GMSvU..

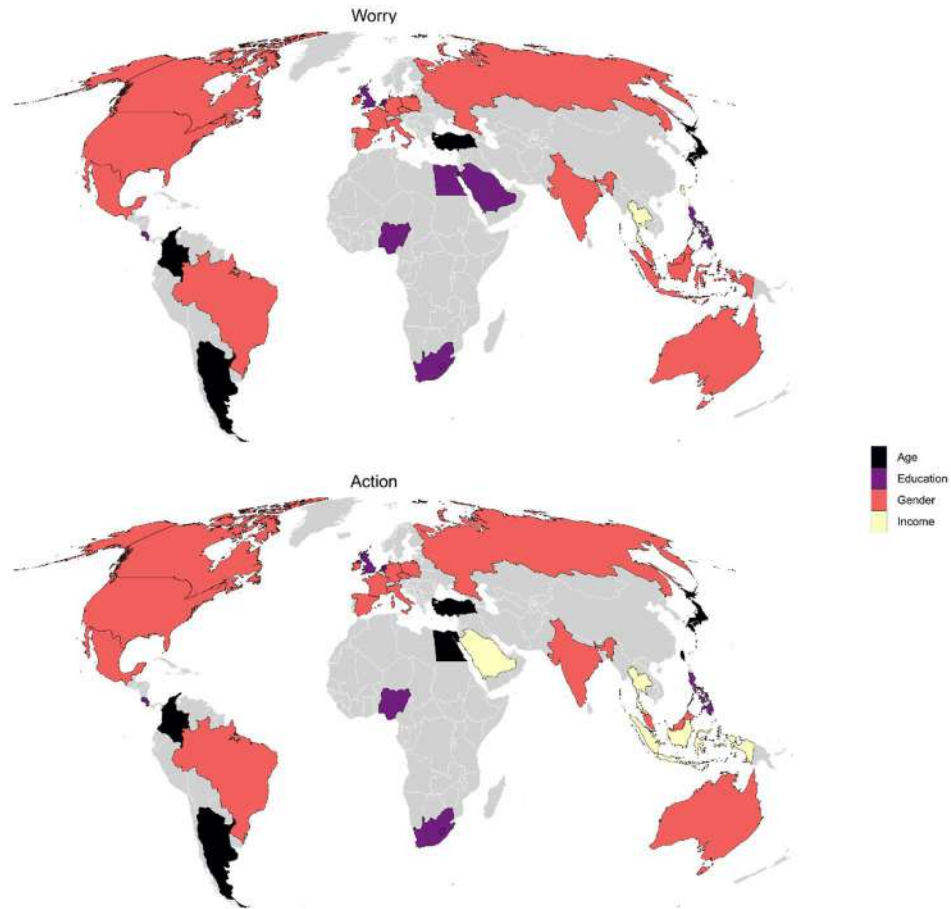
-*SUQ-! o.á gU9v3 ..(v' o*..3 v9o *NgU9..MU9SSvUg ..Xó 3 µ-g-SvU..v..g**o*..óg Sgi o..S Xv -gUMN. " o..Mg Mµ g-o...-! o.S Xv -gUM.v).g ..)So..*vMvRMUv3 SMgMv' *.x' g-g' o.gogSgi o..)v' .xµi' .gUg ú*SkN. i g*o9.vU..-! o.*µi oóú..ffµo*-SvU*Y.)v' .ogM..v)..-! o..." v...g-oU-..óg Sgi o*.gU9..gMv**..g ..MµU- S*..." S' ... o' S-SUQ9g-gZrU..(SQí o.ß..." o.*' v" ...-! o.3 v*-S Xv -gU-..)gMv' ..)v' ..ogM..MµU- úZ...

...

(v' ...-! o..." v' ú..óg Sgi oNQpU9ó ..o3 ó Qp*.g*...-! o.3 v*-..) offµoU-ú..9oU-9S9..)gMv' Ni oSUQ-! o.6oú... 9o-ó 3 SgU-..SU.W.MµU- S*..xàXgSUN<gUg9gNrU9SgNwv gU9Nt' g gú*SkN-USo9..à-g-o*NGµ' g SgN. +ó 3 gUúN(gUMNt' o' SMNrU9vUo*SkNt' güSN<üoM.á oXµi SMNá µ**SkNr-g' ú..gU9..f' o gU9YZ..-! S*... S*..v v" o9..i ú..o9µMg-SvUN" ' SM..S*...-! o...og9SUQ..)gMv' ..SU..oSQ -..MµU- S*..xàgµ9S.G gi Sg'..<v*-g... á Sg'..-USo9..7 SUQv3 .2 SQ Sg'..2 o-! ó gU9*..OQíX-..w' SSXSUo*.àvµ-! ..G) SgYZGQ.S*...-! o.X S' g' ú...)gMv' ..SU... MµU- S*..xs gXgUN<v v3 i SgNG QpU-SgNgU9...-! µi 6oúY.." ' So..SUM3 o.S*...-! o...vX..)gMv' ... SU...-gS' gU.gU9...-! gSgU9Z..

...

àS Sg' úN.)v' ...-! o...GMSvU..óg Sgi oNQpU9ó ..o3 gSU*...-! o..9v3 SgU-..)gMv' ..SU..W.MµU- S*..." ' SM... SUMµ9o..àXgSUN<gUg9gNrU9SgNwv gU9Nt' g gú*SkN-USo9..à-g-o*NGµ' g Sg'..+ó 3 gUúN(gUMN. t' o' SMNt' güSN.<üoM.N.á oXµi SMNá µ**SkNr-g' úN.f' o gU9Z..GQp..gU9...o9µMg-SvU..g' o...offµg' ú... SU) µoU-Sg' ..)v' ..GMSvUNogM..i oSUQ-! o.3 v*-S Xv -gU-..)gMv' ..SU... MµU- S*ZGQp...og9*.SU.s gXgUN. <v v3 i SgNG QpU-SgN-µi 6oúN-..gS' gU.gU9..OQíX-N" ' So..o9µMg-SvUS*..3 v*-..SQSSgU-..SU.<v*-g... á SgN-..USo9..7 SUQv3 N2 SQ SgN2 o-! ó gU9*Nw' SSXSUo*..gU9..àvµ-! ..G) SgZrUM3 o..gXXog' *... *SQ -ú.3 v' o..v)-oU.g*..g.6oú..)gMv' ..SU..GMSvUxß.MµU- S*YM3 Xg' o9...v..." v' úNi oSUQ-! o.3 v*-... S Xv -gU-..SU.àgµ9S.G gi SgN-! gSgU9NgU9..rU9vUo*SkZ..



...
 (SQí o..bmt v*...S Xv -gU...vMvRMUv3 SM)gMv *..SU.X o9SMUQ.MS g-o..MgUQ... “ v’ ú..gU9...GMSvU...
 gMv**..MμU- S*Z.-’ o..vMvRMUv3 SM)gMv * ..S Xv -gUM..” g*.3 og*ú o9..μ*SUQ.MU9SSvUg ..Xó 3 μ-g-SvU...
 v)...gU9v3 ..)v o*...3 v9o *..X o9SMv *Z.VUú...’ o..3 v*...S Xv -gU...vMvRMUv3 SM)gMv ..S*.*’ v” U..)v ..ogM...
 MμU- úZ...

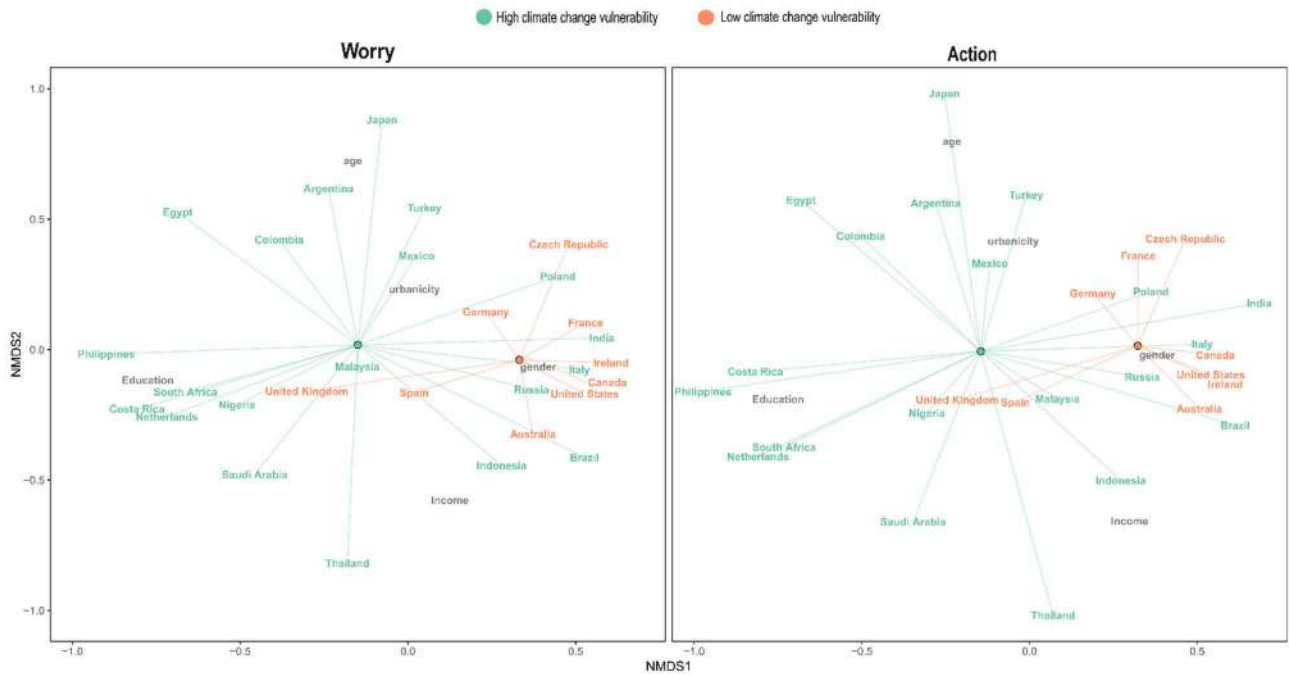
...
 —’ o..M3 Xg SvU.i o-” ooU...“ v’ ú..gU9...GMSvU...o9og *...’ g-...” ’ So..QvU9ó ..MU*S-oU-ú..Xgú*...’ o...
 3 v*...SQUSSvU’..v o..SU.i v-’ No9μMg-SvU! g*.g.* SQ -ú.*’ vUQ .SU) μoUM..vU...“ v’ úN’ ’ ó og*.gQ...
 SU) μoUM*..i v-’ ...“ v’ ú..gU9...GMSvU...S Sg úZ.-’ S*..Xg-ó U..*μQQ*...’ g-...” ’ So..o9μMg-SvUg ...
 i gMvQvμU9.3 gú.i o.3 v o.MSSvU .SU.*’ gXSUQMUM U*.gi vμ-MS g-o..MgUQNgQ..SU) μoUM*..i v-’ ...
 MUM U*..gU9...’ o..” S SUQb*...v..gM..SU.g’.. vμQ ú..offμg ..3 gUÜ Z.Vóó g N-’ o... o*μ -*.SU9SM-o...
 -’ g-...vMvRMUv3 SM)gMv *..So..QvU9ó No9μMg-SvUngQ..gU9..SUM3 o..3 gú.i o..MU*9ó o9’..vi μ*...
 X o9SMv *.v)..MS g-oRo g-o9..g-Sμ9o*.gU9..i o’ gøSv *Z.-’ o..MU9SSvUg ..g**o**3 oU-..μ*o9..SU.-’ S*...
 gUg ú*S*..! SQ SQ -*...’ o..μUffμo..MU- S μ-SvU*.v)...’ o*o..)gMv *..SU.9S)ó oU-..MU-o’ -*.xMμU- S*YN.
 o3 X’ g*SiSUQ.-’ o..Uoo9..)v ..gSv o9..Xv Svb*...’ g-..MU*9ó .i v-’ ...’ o..vMvRMUv3 SM)MU9SSvU*.gU9...
 -’ o..*XoM)SMi o’ gøSv *...’ ou.ég o..SU-oU9o9...v..SU) μoUMZ.

. Z n S*S Sg SS*.SU.-’ o..vMvRMUv3 SM)gMv *... ..

I ú..XSUXvSU-SUQ.-’ o..Mv**RMμU- ú..9S)ó oUM*..SU.-’ o..3 v*...S Xv -gU-..)gMv *.g))oMSUQ.MS g-o...

MgUQ...“ v' ú.gU9...GMS'UN” o.MgU.9oU.Sú.Mµ*ó *.v).MµU- S*...! g-.*' g o.*S Sg .SU) µoU-Sg ...
 *vMvRMUv3 SM)gMv *Z: ' So...! o.X oðSµµ*.oMS'U.*' v” o9.vU ú...! o.3 v*..S Xv -gU-.)gMv .)v ...
 SÜS9µg .MµU- S*N-! S.gUg ú*S...g6o*.SU-v.gMMµU-g .)gMv *µU9ó '...oðS” N-! ó oi ú.g v” SUQ..
 µ*..v.µUMøó ...! o.3 v*..µU9g3 oU-g .o o3 oU-.*' gXSUQMS g-o.MgUQ.MFUM U*.gU9...” S SUQo*...
 -v.gM.gMv*.MµU- S*Z...

t v o.*XoMSMg ún” o.M3 Xg o...! o.SU) µoUM.v)...! o.*-µ9S9.*vMvRMUv3 SM)gMv *.vU...! o...“ v' ú...
 gU9...GMS'U..g-oU..øg Sgi o*.)v ...” v..Q vµX*.v).MµU- S*Ni g*o9.vU...! oS ...oðo *.v).øµ Uð gi SSú...
 -v...MS g-o...MgUQZ.(v' ...-! S*...Xí Xv*oN.” o...9S9o...MµU- S*...SU-v... ' SQ ...MS g-o...MgUQ...
 øµ Uð gi SSú .gU9... v” .MS g-o.MgUQ.øµ Uð gi SSú .MµU- S*Ni g*o9.vU...! oS .Xv*SS'U.SU...! o...
 < S g-o.<' gUQ.ð µ Uð gi SSú.rU9o' .*M o*.9S- S µ-SU.xSZNgi vðo.v .i o v” ...! o.3 o9SgU.*M o...
 SU.í -í í YZ.-! oU...” o..Sðo*..Sg-o...” ' o-! ó ...! o..9S)ó oU...oðo *.v)..MS g-o.MgUQ.øµ Uð gi SSú...
 - gU* g-o..SU-v..g..x9S*Y3 Sg ..S Xv -gUM..v)..*vMvRMUv3 SM)gMv *.v)...! o...“ v' ú.gU9...GMS'U..
 øg Sgi o*Z.-! o.3 gSU.9og.S*..v..)SÜ.vµ...” ' o-! ó .MµU- S*...! g-.*' g o.*S Sg ...oðo *.v)..MS g-o...
 MgUQ.øµ Uð gi SSúN*! g o.g *.v.*S Sg .)gMv *.v)..MS g-o.MgUQ.MFUM U*NgU9...” S SUQo*...v...
 Xg -MSXg-o.SU.X vRÜßSvÜ3 oU-g .gMS'U*Z...



(SQí o... mV 9SÜg-S'U.v)..3 v*..S Xv -gU-.*vMvRMUv3 SMX o9SMv *.v)..MS g-o.MgUQ... “ v' ú.x o)...
 XgÜb Y.gU9...GMS'U.* SQ -XgÜb Y.µ*SUQ.UvÜB o- SM9S oU*S'Ug ..Mg SUQZ.-! o...” vÞS oU*S'Ug ..*’ o*...
 3 og*µí o..)v ..i v-! ...“ v' ú.gU9...GMS'U.S*..gXX v' S g-o ú.offµg ..v..- ZW*! v” SUQ.g.Qv9...” vÞS oU*S'Ug ...
 ' oX o*oU-g-S'U.v)...! o.Xg-ó ÜK v' S SSS*..xg µo*..v” ó ...! gU..Z - .g o.QÜb g ú.MU*9ó o9.Qv9YZ.-! o...
 9S-gUM.v).ogM.X o9SMv ..v.g.MµU- ú *.Ug3 o.SÜSg-o*S*..S Xv -gUM..)v ...! g-MµU- ú.xSZN-! o.Ubó ó N..
 -! o.3 v o.S Xv -gU-YZ.

t o-! v9v vQSMg ún.” o...µo...-! o...UvÜB o- SM.3 µ -9S oU*S'Ug ...*Mg SUQ..x2 n t à Y..gXX vgM...
 x7 µ*6g N.Wi . Y..v... oX o*oU...-! o... o g-S'U* SX.i o-” ooU..MµU- S*..gU9...X o9SMv ...Q vµXSÜQ...

øSµpg úZ.-' o..2 t n à..3 og*µi o*...-' o..9S*Š Sg SS*...i o-" ooU..MµU- Š*...SU..g...M3 3 vU..3 µ -SR X o9SMV *XgM..µ*SUQ..-' o.I' gúR-µi -Š..9S-gUM..3 g- S NgU9..3 gX*...-' o3 ..LvUSóg ú..vU.g...-' vR 9S oU*SVg *XgM..xoo..3 o- v9v vQí..*oMSvU.v)/ oo.ø..g ŽŃ - WŹU..µM..g.*XgMN..-' o.9S-gUM.. i o-" ooU..MµU- Š*..*ø o*.g*.gU.S9Sg-ú .v)..." ' o- ó ..MµU- Š*..*g o...-' o.*g3 o.*o-..v).6oú..*vMvR oMv3 SMX o9SMV *Z.

-' o..2 t n à..gUg ú*Š..Xv-..x(SŹi o... Y.X vø9o*..g..øSµpg '... oX o*oU-g-SvU..v)..MµU- Š* ..6oú..X o9SMV *..v)... MŠ g-o..MgUQ..." ' ú..gU9..gMSvUZ..-' o.2 t n à..Xv-Š..9S9o9..SV-..." v..XgUo *mvUo.9oXMSUQ..-' o.*vMvR oMv3 SM.)gMv *..SU) µoUMUQ..MŠ g-o..MgUQ..." ' ú..x o)-...XgUo YN.gU9...-' o...v-' ó ...9oXMSUQ..)gMv *.. SU) µoUMUQMŠ g-o..MgUQ..gMSvU.š SŹ -XgUo YZ<vµU- Š*..g o.M v RŹ9o9.i g*o9..vU..-' oS..MŠ g-o..MgUQ... øµ Uó gi SS-ú...oøo *N' S' ..QooU.S9Sg-SUQ.. SŹ ..øµ Uó gi SS-ú..gU9'..o9..S9Sg-SUQ..v" ..øµ Uó gi SS-úZ..-' o... gøø gQp.Mv 9Sg-o*..)v '...-' o..v" RgU9..! SŹ Rµ Uó gi SS-ú..MµU- Š*..g ó...oX o*oU-o9.i ú..-' o.QooU.gU9'..o9... Mv- v9S*x9v-Y..v.i o-ó .S µ- g-o...-' o.9S-gUM..i o-" ooU..-' o..." v..QvµX*..v)..MµU-Š*Z.

rU..-' o...o)-...XgUo N'" o..vi *ó øo...-' g-...! SŹ Rµ Uó gi SS-ú..MµU- Š*...Šo..sgXgUNG QpU-SgN..-µi 6oúNgU9... t o' SM'..g o...Xv*SSvUo9...-v" g 9*...-' o...vµ-ó ...o9Qp.N.S9Sg-SUQ..-' g-...-' o*o...MµU- Š*...! gøø...SŹSSgU-... X o9SMV *..SU) µoUMUQ..-' oS..." ' ú..gi vµ-...MŠ g-o..MgUQZGQp..gXXog *..-v..i o..g...SŹSSgU-...)gMv ..)v ... sgXgU.gU9..G QpU-SgN'" ' So..µi i gUSŹú..Š..MµMg ...v '...-µi 6oú..gU9..t o' SMZ<vµU- Š*...Šo...<v v3 i SgN. w' SSXXSb*Nàvµ-! ..G) SŹN2 SŹ Sg..gU9...<v*-g..á SŹ..g o..g *v...Xv*SSvUo9...)µi -' ó ...vµ-N.S9Sg-SUQ..-' o... Š Xv -gUM..v).o9µMg-SvU.SU.SU) µoUMUQMŠ g-o..MgUQ..." ' ú..SU..-' o*o..Ug-SvU*Z.

rU..Mv- g*-NOµi vXgU...v" Rµ Uó gi SS-ú..MµU- Š*...µM..g*...-' o...-USo9..7 SUQv3 ..š ..àXgSU.g o..)µi -' ó ... g" gú...) v3 ...3 v*-...X o9SMV *N..µiQp*SUQ..g...3 v o...3 v9ó g-o..SU) µoUM...v)...-' o...-µ9S9...*vMvRMv3 SM. X o9SMV *..vUMŠ g-o..MgUQ..." ' úZ..-' ó...o*..v)...v" ..MŠ g-o..MgUQ..øµ Uó gi SS-ú..MµU- Š*..g o.Mµ-ó o9... Mv*ó ..v..QpUó .g*.g.X o9SMV NgU9...-' ó o)v o.* v" ...o**..9Sxó *SvU.SU..-' oS..X o9SMV *..M3 Xg o9...v..! SŹ R øµ Uó gi SS-ú..MµU- Š*Z.

-' ó...SŹ -XgUo .*' v" *..-' o..)gMv *..SU) µoUMUQMŠ g-o..MgUQ..gMSvUZ..! ó oN. SŹ Rµ Uó gi SS-ú..MµU- Š*... Šo..sgXgUNG QpU-SgN..-µi 6oúNgU9..t o' SM'..g o..gQgSU.Xv*SSvUo9...-v" g 9*...-' o...vµ-ó ...o9Qp.N. oSU)v MUQ.. -' o...SŹSSgU-... v o..v)..gQp..gU9..µi i gUSŹú..SU..-' o*o'.. oQSVU*Z..-' o..Xv-..g *v..! SŹ SŹ -*..-' g-...GMSvU.SU.. MµU- Š*...µM..g*...<v*-g..á SŹN..-' o.w' SSXXSb*NgU9..àvµ-! ..G) SŹ.S.3 gSUú..*' gXo9.i ú..o9µMg-SvUZ.

<vµU- Š*...-' g-..g o...o**..øµ Uó gi o...v..MŠ g-o..MgUQ..*' v" ..g..Mµ-ó SUQ.g vµU9..QpUó ..g*.g.X o9SMV Z.. -' Š..vøø g ..Mµ-ó SUQ..oU9oUM..v)...v" Rµ Uó gi SS-ú..MµU- Š*...µiQp*..g...3 v o..µUš 3 ..gXX vgM...-v... MŠ g-o..MgUQ..." ' ú..gU9..gMSvU.." S' SU..-' o*o..Ug-SvU*ZrUMv- g*-N. SŹ Rµ Uó gi SS-ú..MµU- Š*..9Sxgú... g..." 9ó '...gUQp..v)..SU) µoU-Sg ..X o9SMV *NS9Sg-SUQ..g..3 v o.9Só *o.*o-..v)..)gMv *.9 SŹSUQMŠ g-o..MgUQ... " ' ú..gU9..gMSvUZ.

% n ŠMµ**SvU...

-' o...SU-ó *oMSvU..i o-" ooU..MŠ g-o...MgUQ...øµ Uó gi SS-ú...gU9...Xó MX-SvU..! SŹ SŹ -*..-' o...Qv" SUQ.. ' oMŹSSvU.v).oUšvU3 oU-g..Mg oUQ*..Mµ*o9.i ú..µi 3 gUgMSŠS*N' ' SM..! gøø.X v)vµU9..Mv*offµoUM*... vU..Qvi g ..oM*ú-ó3 *Z..-' o...! µi 3 gUŹU9µM9...* Š*...SU..MŠ g-o...g o...og9SUQ..-v...SŹSSgU-..9S µX-SvU*N. UoM**Sg-SUQµi QpU-... gU* v 3 g-SvU*.SU.*vMš-g..š QgUSig-SvU..v.3 SŹg-o...-' o.o))oM*.xà-o))oU.o-g ŽŃ - - ° YZ. rU.3 gUí...oQSVU*N..-' o.S XgM..v)..MŠ g-o..MgUQ..! gøø..g' og9ú..3 gU9o*-o9NoXoMg ú..SU..-' o.gøgSgi SS-ú...

v)...” g-ó ... o*ví M*.gU9...’ o...SUMog*SUQ.) offioUMi.v)...o’ ‘ o3 o...” og-’ ó ...oøoU*...x<OwG/ Ní - WYZ.—’ o*o... 9S* µX-SvU*.g’ o.o’ XoMo9...v... o*µ -..SU...µi *g-U-Sg ..oMv3 SMM*...v) ..g))oMo9...XvXi g-SvU*.gU9...*oMv *N. SUMi9SUQgQ Sµi -í oN-’ ó oi ú.g))oMSUQ.vv9...*oMí S-ú.gU9...Só S vv9*x(GVNí - WYZ(í -’ ó 3 v’ oN-’ o*o... oUøSvU3 oU-g ... S6*...g’ o...Mv*o ú...-S9...-v...*vMg ...øµ Uø gi SSó*...*µM...g*...Xvøó -úN.Süffig S-úN.gU9... 9S*MS Sg-SvUN’ ‘ SM.g3 X9ú...’ ó...oQSV*fl*µ*MX-S SSú...v..MS g-o.MgUQ.x<OwG/ Ní - Wč.GUó *ó ..o... g ZNí - WYZ.

wµi SMXó MX-SvU.v)...MS g-o..MgUQ..Xgú*..g..MµMg’ ..v o...SU.*’ gXSUQ.*vMg-g’ ..o*XvU*o*..gU9...g9gX-Só... MgXgMS*Zà-µ9S*...µQ*...-’ g-..’ v” ..XovXo.Xó MSó..MS g-ó...S6*...SQSSgU-ú.g))oM*...’ oS...” S SUQb*... -v..oUQgQ..SU.g9gX-g-SvU.gU9.3 Sg-SvU.*-’ g-oQ*...x<gUvU..’ .t’ ó R’ g’ UNí - Wč.V” µµi..o-g ZNí - WYZ. " v” oøó N-’ ó o.S*.g.Xó *S-oU...QgXi o-” ooU.*MSv-SMø9oUM.vU.MS g-o.MgUQ.gU9.Xµi SMg” g’ oUo*... v’ ..MUM UN’ S’ ..*6oX-S*3 NgXg-’ úNv’ .9oUg’ .MvU-SµSUQ..v..µU9ó 3 Sö.gMSvU.SU3 gUí...oQSV*...xOUQ *... o...g ZNí - Wč.2 Si o...o...g ZNí - Wč.Zt’ v’ o..M3 X o’ oU*Só..Xµi SMXó MX-SvU.*-µ9S*...g’ o.*-S ...S So9NgU9... -’ v*o.gøgSgi o...oU9...v..v)Mµ.vU.*XoMSM. SQ RS6.Q vµX*NµM.g*..SU9Qvµµi.M3 3 µUSó*..gU9..)g’ 3 ó *N. ogøSUQ’ v9ó NMv**RMµU-’ ú.M3 Xg’ g-Só*..µ9S*...g’ Q’ ú..µU’ Xv’ o9.x(v’ ó v..o-g ZNí - Wč.àgXgS*...’ ... -Q’ -oNí - WYZ.

Ví µ-µ9ú.)S *...’ S*.QgXi ú.v))ó SUQgUgMµi g-o.Mv**RMµU-’ ú.vøó øS” .v)...’ o.Xg-ó U*.v)...*vMSRMv3 SM. X o9SMv’ .v)...MS g-o.MgUQ...” v’ ú.gU9.gMSvU..-’ o..)SU9SUQ..µU9ó *M’ o...’ o*..SQSSgU-9S*3 Sg’ SS*..SU... *vMSRMv3 SM.X o9SMv’ *...v)...MS g-o..MgUQ...” v’ ú..gU9...gMSvU..gMv*...MµU-’ S*N.o3 X’ g*SiSUQ..-’ o... UoM**S-ú.v)...µU9ó *gU9SUQ..-’ o*o..9S))ó oUM*...v) ..o))oMSó..MS g-o...Xv SM...9o*SQZ.—SSiSUQ..-’ o...g-oU-... øg’ Sgi o...gXX vgM...-v...3 og*µi o... “ v’ ú..gU9...GMSvU..X vø9o9...g...UµgUM9...gUg’ ú*S’N. oøog SUQ..-’ g-... 9o3 vQgX’ SMX o9SMv’ *...µM...g*...QU9ó No9µMg-SvUNgQ..gU9...SUM3 o..Xgú...S Xv’ -gU-’ v o*..SU.*’ gXSUQ.. MS g-o.MgUQ...” v’ ú.gU9.gMSvU.gMv*..MµU-’ S*Z.

GQ..o3 ó Q9.g*...’ o.3 v*...SQSSgU-..X o9SMv’ .v)...’ o...“ v’ ú.gU9...GMSvU..øg’ Sgi o*..v) ..MµU-’ S*...’ g-..g’ o... ‘ SQ’ ú..øµ Uø gi o...v..MS g-o.MgUQZ..-’ S*..µQ*...’ g-..SU..’ o*o..MµU-’ S*NvµUQ’ .SU9S9µg’ *..o’ ‘ S S... ‘ SQ’ ó ...oøo*v)...MUM U.gU9.g’ o.3 v’ o...Só ú...v..oUQgQ..SU.MS g-o.gMSvU..M3 Xg’ o9...v..v 9ó .gQ..Q vµX*Z. —’ S*..)SU9SUQ.g SQ*...” S’ ..X oøSµ*...µ9S*...µQ*...SUQ..-’ g-..úvµUQ’ ...QÜ g-SvU*.g’ o.3 v’ o..g” g’ o.gU9... X vgMSó...oQ’ 9SUQ.MS g-o..MgUQ..9µo...v...’ oS..o’ Xvµi o...v..MS g-o..o9µMg-SvU.gU9...3 o9Sg..Møó gQ... 9í SUQ.v’ 3 g-Só..úog’ *x/oSó v” Sü..o-g ZNí - í - YZ.

O9µMg-SvU.” g*..g *v..gUv-’ ó ...S Xv’ -gU-..)gMv’ ..SU) µoUMSUQ.MS g-o.MgUQ...” v’ ú..gU9..gMSvU..SU..’ SQ’ ú... øµ Uø gi o..MµU-’ S*Z.” SQ’ ó .o9µMg-SvU.g v” *..v) ..g.i o-ó .g” g’ oUo*..v)...’ o..MS g-o.MgUQ..S*µoNi o-ó ... Xó MX-SvU.v)...’ ó... S6*...g*vMg-o9...” S’ ..MS g-o..MgUQNgU9...µXXv’ -..v) ..X vRÜpSvU3 oU-g ...Xv SM*Z. O9µMg-SvUg’ ..SSg-Só*..MgU..-’ ó o)v’ o...SQSSgU-ú..S X vøo..Xµi SMgMSvU.gU9...MUM U..gi vµ-..MS g-o.. MgUQ..x/oo..o-g ZNí - Wč.Z.” v” oøó N-’ ó...o g-SvU*’ SX.i o-” ooU..o9µMg-SvU.gU9...MS g-o..Xó MX-SvU.S*.g *v... 3 v9ó g-o9..i ú..Xv SSg’ .Sov vQíNXg’ -Sµi g’ ú..SU.Xv g’ Sio9..oUøSvU3 oU*N” ‘ ó o..’ SQ’ ó ..o9µMg-SvU.3 gú... ‘ oSU)v’ M..X oR’ S-SUQi o S)*...g-’ ó ...’ gU.X v3 v-o..lb” .µU9ó *gU9SUQxt M’ SQ’ -gU9..n µUgXNí - WYZ.

rUg99S-SvU..v.gQ.gU9..o9µMg-SvUNí i gUSú..*oo3 *...v..Xgú.gU.S Xv’ -gU-’ v o..SU.*’ gXSUQMS g-o.MgUQ... ” v’ ú..gU9...gMSvU..SU..3 v’ o...øµ Uø gi o...MvU-o’ -Z..-’ i gU..’ o*9oU*...’ v” ...QÜ g’ ú...’ SQ’ ó ... oøo *...v)... oUQgQ3 oU-SU.X vRÜpSvU3 oU-g ..i o’ gøS’ *..M3 Xg’ o9...v...’ oS’..í g’ ..MµU-ó Xg’ -Z..-’ S*..-’ oU9..MgU.i o... g-’ S µ-o9...v..Qog-ó .o’ Xvµi o...v..X vRÜpSvU3 oU-g .M3 XgSQ*.gU9..oUøSvU3 oU-g .SSg-Só*..SU.í i gU... g’ og*N.g*...” o ...g*...’ SQ’ ó ... oøo *...v)...*vMg’ ..X o*µi o...-v..g9vX...oUøSvU3 oU-g’ ú... o*XvU*S o..i o’ gøS’ *... x“ ‘ S3 g’ *’ Ní - WYZ.—’ o...SU) g*..µMí o...gU9...’ o*ví M*...gøgSgi o...SU..í i gU...*o-SUQ..g *v...))gMSg-o... Xg’ -Sg-SvU.SU.MS g-o.gMSvUNµM.g*..gM*...v..Xµi SM-’ gU*Xv’ -g-SvU.gU9...oMMSUQ.X vQg3 *Z.

OMFv3 SMFv3SvU*Ng*.X v' S9..i ú..SUM3 oN*í X S\$UQú..*oo3 ..-v..! gðo..g..” og6..SU) μoUM..vU..MS g-o... MgUQ...” v' ú..gU9..gMSvU..SU..MμU' S*..-! g-..g o..! S\$ ú..øμ Uð gi o..-v..MS g-o..MgUQNi μ-..-! oú..*oo3 ..-v... Xgú..g-...og*..*v3 ó..v o..SU..o**..øμ Uð gi o..MFU-o' -*Zr-..Mμ 9..i o..-! g-..SU9\$9μg *.SU..oMFv3 S\$ ú..9S)Sμi -... *Sμg-SvU*.3 gú.X S' S\$io.S 3 o9Sg-o..oMFv3 SMbo9*.vðó ...vUQRó 3 .oUðSvU3 oU-g .MFUM U*N..og9SUQ-..v... v” ó ...oðo *.v)...“ v' ú..gU9...GMSvUZ.<vUðó *o úM. o*9oU*..v)...” og -! S\$..MμU' S*..v' ..-! v*o..” S' ..! S\$ ó ... Xó *vUg .SUM3 o...oðo *..oU9..-v..* v” ..Q og-ó .MS g-o..g” g oUo**..gU9..MFUM U*NgU9..g o.3 v' o..*μXXv -S\$oo... v)..MS g-o..Xv S\$*..xwμQS*o..gU9..á gúNí -- uYZ..-! S*.3 gú..*μQQ*..-! g-..i o-ó ...S\$UQ.*-gU9g 9*..oUgi o... SU9\$9μg *.v..v)Mμ*.3 v' o..vUí' vg9ó .S*μo*..*μM..g*..MS g-o..MgUQZ..

Ví ..)SU9SUQ*.M3 Xo3 oU-..X oðSμ*..vUo..SU.3 gUú..” gú*Z(v' ..SU*-gUMN*-μ9S*..vMμ*o9..vU..QvUó ..! gðo... * v” U..-! g-..” v3 oU..g o.3 v' o...S\$o ú..-v..i o..g” g o..v)..MS g-o..MgUQ...S6*..-! gU.3 oUNXg -Sμi g' ú..SU..í g ... *-o-SUQ*N” ' ó o..oUðSvU3 oU-g .MgUQ*.9SoM ú..g))oM...S\$o S vv9*.xG6v3 Xgi ..o-..g ZNí - Wčà3 S' Ní - WYZ. " v” oðó Nv-! ó ..-μ9S*..*μQQ*..-! g-..í i gU..” v3 oU.3 gú..i o...o**..g” g o..v)..MS g-o..MgUQ...S6*.M3 Xg' o9... -v..-! oS'..í g .MμU-o Xg' -*xI v-üoU..o-..g ZNí -- uYZa\$ Sg' úN” ' So..gQ..g *v..Xgú*..g'..v o..SUMS g-o..MgUQ... Xó MX-SvU*N.” S' ..úvμUQ ..XovXo..QvU g' ú..i oSUQ.3 v' o..g-μUo9...-v..MS g-o.. S6*N.v 9ó ..XvXμ g-SvU*... *v3 o-S\$ o*..o' ' S S..-! oSQ -oUo9...MFUM U*..v) ... vUQRó 3 ...oUðSvU3 oU-g ...MgUQ*...xá vM...o-..g ZNí - WYZ. O9μMg-SvUgU9..SUM3 o...oðo *)..í -! ó .M3 XSMg-o..-! S.XSMí oNg*..*v3 o*..μ9S*..S6..! S\$ ó .o9μMg-SvU..” S' ... SUMog*o9..MS g-o..g” g oUo**N” ' So..v-! ó *..* v” ..Uv...S\$USMgU-..o g-SvU* SX.x" g3 S-vU.. 7 oS Ní -- uYZ.

rU..-! S.XgXó N” o..! S\$ S\$ -..-! o.9S-SUM.Xg-ó U*.SU..! v” ..*vMSvRMFv3 SMX o9SMv' *.SU) μoUM..SU9\$9μg * ... MFUM U*.gi vμ-..MS g-o..MgUQNgU9..-! oS ..” S SUQo*..-v..Xg' -S\$Xg-o..SUMS g-o..MgUQ..gMSvU*N9oXoU9SUQ.. vU..MμU' S* ...MS g-o..MgUQ...øμ Uð gi SS-ú... oðo Z..” S\$ Rμ Uð gi SS-ú...MμU' S*N.” ' SM...v)-oU..)gM... S 3 o9Sg-o..gU9..*oðó o..MS g-o..S XgM*Nb' ' S S..g..í' vg9ó ..gUQ..v)..SU) μoU-S\$.X o9SMv' *NSU9SMg-SUQ.3 v' o... 9Só *o...*vMSvRMFv3 SM.9 S\$ó *..i o' SU9...MS g-o...MgUQ...MFUM U*...gU9...gMSvU*Z..rU..MμU' g*-N. v” R øμ Uð gi SS-ú..MμU' S*..9S.Xgú..3 v' o..μU9v 3 ..*vMSvRMFv3 SMSU) μoUM*N*μQQ*-SUQ..-! g-..g..MFU*-oU-... gXX vgM...-v..X v3 v-SUQ.X vRvUðSvU3 oU-g ..i o' gðS' ..3 gú..i o.3 v' o..o))oMSo..SU..-! o*o..MμU' S*Zt v' o... QvU g' úN. v” oðó N-! S..9Só QvU..i o-” ooU..v” RgU9..! S\$ Rμ Uð gi SS-ú..MμU' S*..μU9ó *M o*..-! o..Ubo9...)v' ..gSv' o9..MS g-o..Xv S\$*..-! g-..gMμU-..v) ..*XoMSMg-SvUg .MFU-o' -*..gU9..øg' úSUQ..oðo *.v)..o' Xv*í o... -v..-! o..*vMg' .gU9..oMFv3 SMS XgM*.v)..MS g-o..MgUQZ..

...

.. <vUMμ*SvU..

-! S*..*μ9ú...X vð9o*...øg μgi o...Mv**BμU' ú...SU*SQ -*..SU-v...-! o...*vMSvRMFv3 SM.)gMv' *.SU) μoUMUQ.. SU9\$9μg * ..MFUM U*..gi vμ-..MS g-o..MgUQNgU9..-! oS ..” S SUQo*..-v..Xg' -S\$Xg-o..SU..MS g-o..MgUQ... gMSvU*Z..-! o..XgXó ..M3 Xg' o*..-! o..v o*..v)..gQvNQvU9ó No9μMg-SvUNí i gUS\$úNgU9..SUM3 o..SU..* gXSUQ.. MS g-o..MgUQ..MFUM U*.gU9..gMSvU*.SU..MμU' S*..” S' ..9S)ó oU-...oðo *.v)..øμ Uð gi SS-ú..-v..MS g-o..MgUQZ.. -! o.3 gSU..)SU9SUQ.v)..ví ..XgXó ..S*..-! g-..-! o..*vMSvRMFv3 SM.)gMv' *..-! g-..SU) μoUM..MS g-o..MgUQ...” v' ú... gU9..gMSvU..g o.3 v' o.9Só *o..SU..MμU' S*..-! g-..g o..! S\$ ú..øμ Uð gi o..-v..MS g-o..MgUQZ...

...

-U9ó *gU9SUQ..-! o.9S-SUM..SU) μoUM*..v)..*vMSvRMFv3 SM.)gMv' *.gMv**..MμU' S*..” S' ..9S)ó oU-...oðo *.v).. MS g-o...MgUQ...øμ Uð gi SS-ú...S*..o**oU-S\$..)v' ...Mg)-SUQ..-gSv' o9...Xv S\$*..-v..X v3 v-o...oUðSvU3 oU-g' ú... *μ*-gSgi o..i o' gðS' *Z..” S\$ Rμ Uð gi SS-ú..MμU' S*...offμSo..g..MFU-o' -RxoMSMgXX vgM..-! g'-..o) oM*..-! o... 9Só *Sú.v)..-! ó...o oðgU-..X o9SMv' *.SU..-! o*o..MμU' S*N” ' So..v” Rμ Uð gi SS-ú..Ug-SvU*.Mμ 9..i oUo)S..v) v3 ... 3 v' o..μU9v 3 ..*-! g-oQð*Z...

r-..g *v..Ubo9*..-v..i o..*-! o**o9..-! g-..-! o..gUg úüo9..Xó MX-SvU*.xMS g-o..MgUQ...” v' ú..gU9..gMSvU*Yg' o..Uv-...

*μ))SbU..vU..-! oS..v" U..v..X v3 v-o.o))oMSbo.g9gX-g-SvU.gU9..3 SSQg-SvU..v..MSB g-o..MgUQZ:" ' So.i v-! ...
 g o..UoM**g ú..v..SUSg-o..Xv*SSbo.MSB g-o..MgUQ..vμ-M3 o*N-! oú.g o..v)-oU.3 o9Sg-o9.i ú.í' vg9ó .Xv SSMg N.
 oMFUv3 SNGU9..SU*-Sμ-SvUg ..MFU-o' -*.x+S))v 9..o..g ZNí - WYZrU.3 v o.øμ Uó gi o..MFU-o' -N?" ' ó o.SUM3 o...
 Soffiug S-úNXv SSMg ..SU*-gi SS-úNgU9..." og6...Qvóó UgUM...- μMj o*..3 gú..g *v..i o..X oøg oU-Ng99 o**SUQ..
 MSB g-o..MgUQ..o))oM*...offiSo*.g.3 μ -SgM-o9..gXX vgM...-! g-.SU-oQg-o*.Xpi SMo9μMg-SvUN.vi μ*-..Xv SM...
) g3 o" v 6*NgU9..SU*-Sμ-SvUg '...o*SSUMZà-μ9S*.v)..MSB g-o..MgUQ..Xó Mx-SvU*.3 μ*-..-! ó o)v o.gMMμU-...
)v '...-! o*o..MFU-o' -μg ...)gMv *...-v...i o-ó ..SU)v 3 ...MSB g-o..g9gX-g-SvU...-! g-oQb*...SU..SU9S9μg ...MμU- S*...
 xGü Mg Ní - WYZ.

...

n o*XS o.vj .M3 X o' oUSo.gXX vgMN-! o.*-μ9ú! g*.*v3 o...S Sg-SvU*Z-! ó...o SgUM.vU.*o)RoXv -o9.9g-g...
) v3 ..(gMi vv6..μ*o *..3 gú..SU- v9μM..i Sg*o*.. o g-o9...-v...*vMg ..9o*Sgi SS-ú..gU9... oX o*oU-g-SboUo*..x)v ...
 SU*-gUM..SU..ó 3 *.v)..gQp..v *vMg ..Mg-oQ S*.gMv**g ..MμU- S*.SU..-! o.9g-g*o-YZ(μ-μí o...o*og M..* vμ 9...
 SUM Xv g-o...vUQSμ9Sug .gU9..3 v o...oX o*oU-g-Sbo.9g-g...v..o' g3 Sbo.MgUQ*.SUMSB g-o..Xó Mx-SvU*.vóó ...
 -S o..gU9..o' Xv o...-! o..S XgM..v)..v-! ó ..)gMv *N*μM ..g*..-! o..o3 ó QSUQ.MSB g-oBU9μM9..3 SQg-SvU..gU9...
 -oMUv vQMg .g9øgUM3 oU*..vU.Xpi SMg-Sμ9o*Z..

...

á o)ó oUM*...

G6v3 Xgi Nn ZNI SNwZNI" S Sg3 *NàZN+ gU-NsZNI" g 6ó NrZNI" ..GpQμ*-Sv*nt Zxí - WYZ." og-..." gøo*.gU9...
 MSB g-o..MgUQmGXX úSUQ..-! o..! og -! .i o S).3 v9o ...v..9oU-Sú..X o9SMv *.v)...S6..Xó Mx-SvU.gU9..g9gX-Sbo...
 i o' gøSv *.SU.G9o g9oNGμ*- g SgZrU-ó Ug-SvUg .s vj Ug ..v)..OUbSvU3 oU-g .á o*og M..gU9..wpi SM" og -! N.
 Wx YNí W. í W. Z.

GU9ó *ó N/ZNó ó Uó Nn ZN. " " Si o -Nt Zxí - WYZ.+oU9ó ..gU9..MSB g-o..MgUQ..SU../g-SU.G3 ó SgmGU...
 gUg ú*S.v).øμ Uó gi SS-úNg9gX-g-SvUNgU9...o*SSUM.i g*o9.vU! vμ*o' v 9.*j øóú*Zn oøo vX3 oU-á o*og M...
 " v 6SUQ.wgXó .àó S*N2 vZ- léí - WNrU*-Sμ-o..jv ..G9øgUM9..n oøo vX3 oU-à-μ9S*.xr2 OàGn YN/ g..wgüZ.

Güg9Sš Zš gü9gUXgUg' Nt ZN. .t g' 3 vμ9SN" Zxí - WYZ.-U9ó *gU9SUQ*3 g ' v 9ó ..)g 3 ó * .g9gX-g-SvU..
 i o' gøSv *..-! vμQ ..MSB g-o..MgUQ..i o S)*N.S6..Xó Mx-SvUN- μ*-NgU9..X*úMv vQMg ..9S*-gUMmOø9oUM...
) v3 ... " ' og-... Qv" ó *.. SU.. í gUZ. svj Ug ... v).. OUbSvU3 oU-g ... t gUgQ3 oU-N. í %N. Wu. % Z.
 ' -X*úé9vSv QgWZVWé;ZoU3 gUZ - WIZVu. % ...

Gü Mg N.+Zxí - WYZ.ö μ Uó gi SS9g9...ú.. o*SSUMg...M3 v...MFUSbUo*...9o...SU-ó øoUM\$ U..9o...MSS*...*vMvR
 oM QMg*ZrU-ó øoUM\$ UNíxí YN. . uVZ.

I g3 i ó QNàZNá oo*NsZNI" .àooi gμó NàZxí - WYnf<v oMSbo.MSB g-o.gMSvUmn o-ó 3 SgU*..v)..Xg -SMXg-SvU..
 SU-oU-SvU.SUM3 3 μUS-úR g*o9..X vRUbSvU3 oU-g ..SUSg-Sbo*Zis vj Ug ..v)..OUbSvU3 oU-g ..w*úMv vQi...

I g o" Nt Z- ZNwoğ *vUNGZá ZN+v 9i ó QNt Z." ZNá v*oU-! g NàZ.GZN. " /oSó v" S-üNGZxí - í - YZn vo*...
 vMboMFUv3 SM-g-μ*..3 v9ó g-o..-! o..Xv SSMg .9S9o.vU.MSB g-o..MgUQffi..-! ó...v o*.v)..o9μMg-SvUNSUM3 oN.
 gU9..SU9S9μg S3 Z+ vi g ..OUbSvU3 oU-g ..<! gUQN. - NWí - í. Z...

I v-üoUN." ZN.Gó -*NsZNI" ...øgU..9oU...I ó Q N.sZxí - - uYZ.n oXoUoUM...v)... v99... S6...Xó Mx-SvU*...vU..
 *vMboMFUv3 SMgU9..vi ;oMSbo..S6..)gMv *Z:" g-ó .á o*vj M*.á o*og MN. %NWVYZ.

I vú6v))Nt Z-ZgU9.I vú6v))Ns Z Zxí --. Y.I g gUM.g*.i S*mt+ vi g .." g 3 SUQgU9... ' o...à..w o*SQ.w o** N.
+ vi g ..OUpSvU3 oU-g ..<' gUQNWxí YXXZW% W Z9vSWZWVé;ZvoUøMgZ --ßZVZ -WZ...

<OwG/ .xí - WYZ/ g.oMfUv3 g.9o .Mg3 i Sv.MS -Sm.oU.G3 ' Sg./ g-SUg.ú.o ..<g S omwé g9v;g*.ú.9o*g) v*...
9o .9o*g' v v.*v*-oUS oZ<OwG/ Z.

<OwG/ .xí - WYZwgUv g3 g.*vMg .9o..G3 ' Sg./ g-SUg.í - WZ<OwG/ Z.

<gUUVUN- ZN. .t ó R g' UNn Zxí - WYZö µ Uö gi SS-úN.o*SSUM.gU9.9oøo vX3 oU-.9SMí *o*.SUMU-o' -...
v).MS g-o..MgUQZ2 g-µ g ..." güg 9*N%ßYN. í W ßZ.

<' oUN<ZN2 vi oNrZN" o 3 gUNs ZN<v))ooNs ZNt µ S vNt ZN. ' ..<' g" gN2 Zxí - í. YZ.-USó *S-ú.v)..2 v' o...
n g3 o.Qvi g .g9gX-g-SvU.SUSg-SøRMµU- ú..SU9o' ...oMUSMg '...oXv -Z.

<v Uö NGZo-.g Zxí - WY.. " v" ..9v..úvµUQ.XovXo..oUQgQ..." S' ..MS g-o..MgUQffi.. ' o... v o..v)..6Uv" o9QN.
øg µo*N3 o**gQ...) g3 SUQNgU9...- µ*-o9...M3 3 µUSMg-v *N:" rá O*...< S g-o...<' gUQN. x%ANXXZ.% ß %B. Z.
9vSWZW- í é" Mß%ßZ.

<gú-vUNàZN. .t gUUSQN<Zxí - WYmfw*úMv vQi..gU9...< S g-o...<' gUQm" µ3 gU.wó MX-SvU*Nr3 XgM*N.
gU9.á o*XvU*o*Zi.GMg9o3 SMw o**Z.

n o**gSàZo-.g Zxí --. Y.n o)SSUQgU9.o' Xó SUMUQ9gUQ vµ*.MS g-o..MgUQ N< S g-SM<' gUQN.. xWí YN.
XXZWVí %Z9vSWZWVí Béi mS Z-----í. ° 1VZ 1u- . Z %Z...

n µUgXNá ZN. .t M SQ -NGZxí -- 1YZG.." 9oUSUQ.QgXmá oXpi SMgU.gU9..n o3 vMg-SMøS" *.vU..MS g-o...
MgUQZ. OUpSvU3 oU-m àSUM... gU9... wv SM...)v ... àµ*-gSgi o... n oøo vX3 oU-N. %x%N. í ßZ.
' -Xmé9vSZ QWZí --éO2 ö -Z%Z B%.

OUp *NGZN" µo-' ó NVZàMgo)ó Nt ZN. ' ..." o 9N" Zxí - WYZwpi SMMS g-oRMgUQ...*6oX-Sß3 NoUö Qi...
X o)ó oUM*.gU9..Xv SSMg ..Xg -SMXg-SvUZ+ vi g ..OUpSvU3 oU-g ..<' gUQNí Bx%ANWW Wí ° Z.

(gS' Nn ZwZt SUMSUNwZ ZgU9.I o i SUN/ ZxWí1° Y..<v3 Xv*SSvUg ..9S*S Sg S-ú.g*.g'.. vi µ*-3 og*µí o..v)...
oM vQMg .9S-gUM Nö oQ-g-SvN. uxWßYXXZ%" 1Z9vSWZW- °éi)--ß1 1° Z.

(v' ó vN.OZN" ó U U9öüNš ZN. ' ..Üg) gN.<Zxí - WYZ.wó MxMS U.. g-Svvg3 ó SMgU...9o..Mg3 i Sv...MS -Sm
t o-v9v vQg*N.' ó' g3 S-U-g*...ú...o*- g-oQg*...9o...g9gX-gMS U...oU...M3 µU9g9o*... vMg o*Z.á øS-g...-n <G...
GMµg 9g9..ú.n Sµ QMS U.<SU-)SgNWxWN.ß 1%Z.

+9)ý 9Ná ZN7 v 3 v*N<ZN. .t MU-ú oNGZxí - WYZI o' gøSv g ..9S oU*SvU*..v)..MS g-o..MgUQmní Só *N.
' o*XvU*o*Ní g' S *NgU9.SU-ó øoU-SvU*Z:" Sou.rU-ó 9SMXsUg ú.á øøS" *m< S g-o...<' gUQNí x YNl- Wí1° Z.

÷ v-' 3 gUUN- ZN÷ oM*MN7 ZN' SUQ*Nt ZN. àSi oU' Uö Nl Zxí - WYZG**o**SUQSU-Sµ-SvUg .MgXgMSs*...
-v..g9gX-...v..MS g-o..MgUQmrU-oQg-SU.X-úMv vQMg ..9S oU*SvU*..SU... ' o..g9gX-Sø..MgXgMS-ú..." ' oo Z.
2 g-µ g ..." güg 9*..gU9...Og -' ..àú*-o3 ..àSUM*N.WxWYNßß u ßß1. Z.' -Xmé9vSZ QWZW. éU o**WR
ßß uR- W...

" g3 S-vUN/ ZN. .7 oS NI Zxi - - uYZá oQvUg .oég Sg-SvU.SU.Xó Mx-SvU*.gi vµ-.MS g-o.MgUQZrU-ó Ug-SvUg ... svjí Ug ..v)...< S g-v vQíNí uxWvNí B. 1 í B% Z.

" v- ' v UN.-ZN' v USN7 ZgU9.ÜoSoSNGZxi - - Y.-Ui Sg*o9'...oMí *So.Xg -SSvSUQnG.MU9SSvUg .SU)ó oUM...) g3 o" v' 6 N. svjí Ug ... v)... <v3 Xµ-g-SvUg ... gU9... + gX' Sg ... à-g-S-SMN. W%BYN. XXZ. " %W °. Z. 9vSWZWíéW W - - ' WßußßZ...

rU-ó Qvóó U3 oU-g .wgUo .vU.< S g-o.<' gUQ.xí - WY.< S g-o.MgUQ.í - Wnt SSG-SvU.v).MS g-o.MgUQ... lw oX SU-HZ9vSWZWwéMí vu° 1WV°. W% WZ...

rU-ó Ug-SvUg ... Xµi SM. vXSUSvU... vU... MS g-o... MgUQ... xí - í W. š g o... w vQ g3 ... vU... < S g-o... <' gUQ... <v3 3 µUSg-SvUZ. GøgSgi o... g-m ' -X*réMS g-oM3 3 µUSg-SvUZig oZ9méXµi Sg-SvU*éSU-ó Ug-SvUg R Xµi SMvXSUSvURvUMS g-oRMgUQé.xGMí*o9mí u.GµQµ*-í - í BvZ...

7 g' gUNn Zt ZNwo-ó *NOZN' S-SUNt ZNà vøSMwZNVµo o-oN/ Z/ ZN' g3 gUNn ZN' .t gU9o N+Zxi - WYZ. -' o..Xv g SiSUQ.S XgM..v)...*MSUM...Só gMí..gU9...Uµ3 ó gMí..vU..Xó MSø9...MS g-o...MgUQ'... S6*Z2 g-í o... < S g-o.<' gUQ.Ní xWYN. Bí ° B%Z'. -X*ré9vSv QvWZvBíéUMS g-oW% ° ...

7 g' gUNn Z ZNs oU6SU* à3 S' N' ZgU9.I' g3 gUNn Zxi - WY..<µ -í g ...<vQSSvU.v).àMSU-SSM<vU*oU*µ* N. svjí Ug ..v).á S6.á o*oég MNWxí YNXXZW° W. Z9vSWZW1-éWß ul°° Z - WZvWV: Z.

7 µ*6g Ns Z ZxWí . Y.2 vU3 o' SM µ -9S oU*SvUg .àMg SUQnG.Uµ3 ó Sg .3 o-' v9 Nw*úMv3 o' SgNí uxí YN. XXZWV% WuZ9vSWZV- °éi)-í í lü u. Z...

/ooN.-Zt ZNt g 6v" SüNGZGZxi - - Y..< S g-o.MgUQ'... S6..Xó Mx-SvU.gU9..Xv SMí..X o)ó oUM*m- ' o'..v o..v)...g))oMN. MS g-o.MgUQ.g" g oUo*.gU9'..S6..Xó Mx-SvU.g vµU9...' o.." v' 9Z2 g-í o.< S g-o.<' gUQ.N%WvNvW Wí - Z'. -X*ré9vSv QvWZvBíéUMS g-oí ° í 1...

/oSó v" SüNGZGZxi - - Y..< S g-o.MgUQ'... S6..Xó Mx-SvU.gU9..Xv SMí..X o)ó oUM*m- ' o'..v o..v)...g))oMN. S gQ úNgU9.oég µo* N< S g-SM<' gUQ.N' ° xWí YNXXZ. % ° í Z9vSWZW- °é*W%l. R. - Ru- %uRuZ...

/oSó v" SüNGZGZxi - - %Y..G3 ó SgU.. S6..Xó Mx-SvU*mr*..MS g-o.MgUQ...9gUQ vµ*fiNá S6...GUg ú*S.N. í %x YNXXZWßß W. í Z9vSWZWVWV;ZV% - Rí VÍ - - %Z - u- Z Z...

/oSó v" SüNGZGZxi g-o*Ná Z' ZgU9..wég' S-N.-Z Zxi - - %Y..n v..Qvi g ..g-Sµ9o*.gU9..i o' gøS' *..µiXXv -... *µ*gSµgi o..9oøo vX3 oU-ffiNOUøSvU3 oU-màMSUM..gU9..wv SMí..)v .àµ*gSµgi o..n oøo vX3 oU-N. ° xüYNXXZ. í í B1Z9vSWZBí - - éoUø-Z ° ZíZ í B1Z...

/v oUivUSN.Z2 SMv *vUR<v oN.ZgU9.." ' S3 g *' N/ Zxi - - ° Y.I g' S *..Xó MSø9...v.oUQ-QUQ." S' .MS g-o... MgUQ..g3 vUQ..' o...-7 .Xµi SMgU9...' oS ..Xv SMí..S X Sg-SvU* N+ vi g ..OUøSvU3 oU-g ...<' gUQ.NWxß . YN. XXZ. . % . %uZ9vSWZVWé;ZQvoUøMgZ - - ° Z VZ - . Z...

t g 6gNGZN7 v*USMNsZGZN' ./gUQ N+Zxi - - uYZ.-' o..g*vNsg-SvU.v)..6Uv" o9Q..." S' ..MUM U.gi vµ-... Qvi g ...' g 3 SUQn-µ*o9.SU)v 3 g-SvU.*vµi M*.*' gXo.Xµi SMí.' SU6SUQZá S6..GUg ú*S.Ní uxvN. BßR. ° Z.

t Mē SQ -NGZ ZgU9.n pUgXNá ZOZxí - WY...-! o.Xv SSMig-SvU.v).MS g-o.MgUQp.gU9.Xv g Sig-SvU.SU.-! o...
G3 ó SgU.Xpi SM*.øS" *.v)...+ vi g ...“ g 3 SUQní -- Wí - W N.-! o.àvMv vQNg .0 µg -ó ún% xí YNXXZ.W%
W. Z9vSWZWVW;ZVBBR% %Z - WZ Ww1Z Z...

2 Si o-Nt Z.<Z.xí -- uYZ.<v3 3 pUSM-SUQ.MS g-o...MgUQm“ ' ú...) g3 o*.3 g-ó ...)v ...Xpi SMoUQp3 oU-Z.
OUpSvU3 oU-m àMUM... gU9... wv SM...)v ... àµ*-gSgi o... n oøo vX3 oU-N. %M YN. W í BZ.
' -X*é9vSv QWZí - -éO2 ö -ZM ZVRB...

2 Si o-Nt Z.<Z.<vvXó N7 ZOZN' ..O S' v XoNt Zxí - WYZrQv gUM..v .i S*fiOøg µg-SUQ.-! o..9ov vQNg ...
gU9..SU)v 3 g-SvUg .9 S6 *.v)...*MUM..Xó MX-SvU*.SU.g..Xv g Sio9..oUpSvU3 oU-Zwpi SM-U9ó *gU9SUQ.v)...
àMUMNí . xBYNí 1% B- VZ.

V" µ*µN+ZNGQioR oU*g' NàZN' ./µU9Ná Zxí - WYZ+oU9ó N. og -! NgU9.MS g-o.MgUQp.SU.µ i gU.+! gUgZ.
OUpSvU3 oU-Nn oøo vX3 oU-gU9.àµ*-gSgi SS-úNí W. YNWBBWW. °Z.

V <vUUv Ná ZOZN' v 9Ná ZsZN' .(S' ó NGZxWuuYZá S6.Xó MX-SvU*NQpUó g .oUpSvU3 oU-g .i o S)*NgU9 ...
" S SUQp**..v..g99 o**..MS g-o..MgUQZá S6..GUg ú*S*NWxBYn." W. ° VZ. -X*é9vSv QWZWVW;ZVBBR
" uí . ZWuuZi -- . í VZ ...

V-vNrZt ZNn vUQ*NsZ(ZN< o3 g9o*Ná ZN' ' v" 3 SNGZN' o" S-Ná ZsZN/µM-N' ZN. .àMo U µi ó N' Z.
sZxí - í - YnfàvMg ...SXXSUQ9úUg3 SM..v) . *gi SSiSUQOg -! *.MS g-o.i ú.í - % Zi.w vMo9SUQ.v)...! o.2 g-SvUg ...
GM9o3 ú.v).àMUM*Z.

wgSU-ó NsZgU9..G*' oN- Zxí - WY..< v**Rg-SvUg .M3 Xg SvU.v)...! o.X o*oUM.v).MS g-o.*MX-SM3 .SU.-! o...
X SU... 3 o9Sg... SU... *S ... MµU- S*N. í -- ° W N. OUpSvU3 oU-g ... á o*og M... / o-ó *N. °x YN. XZ. - . . - - %Z.
9vSWZW11éW. 1RuBí é°é. é- . . - - %Z...

wµQS*oNGZN' ..á gúNsZxí -- uYZ.G..! og-o9..9oi g-om+ vi g ..g-Sµ9o*...v" g 9..MS g-o..MgUQpZ." g óg 9...
rU-ó Ug-SvUg .á oøS" NBWBYN. . R1Z.

á vMN/ ZNOUQó NGZN' gøvR' o-gNI ZOZN' ..s g gR v;g*Ná Zxí - WYZ(g 3 ó * ..Xó MX-SvU.v)...MS g-o...
MgUQp.SU.t o9S6' gUgU.<' SoZá oQvUg ..OUpSvU3 oU-g ...<' gUQNW%ANI ° 1° uZ.

àgXSgSUNá ZN' ..-Q -oN+Zxí - WYZG99 o**SUQMS g-o..MgUQp.SU./g-SU.G3 ó Sgmá o*og MNXv SMNgU9...
Xpi SMvXSUSvUZ+ vi g ..OUpSvU3 oU-g ...<' gUQNWxBYn. %u . 1Z.

à3 S' N2 ZN' ./oSó v" S-üNGZxí - WYZ.-! o...S(o.v)..Qvi g ..." g 3 SUQ.*6oX-SM3 mO' X v SUQ.g))oMS o.S gQ...
g**vMg-SvU*.SU.-! o...-USo9.à-g-o*.vøó ...S oZá S6..GUg ú*S*Nbí x YNWí VWBí Z.

à3 S' NwZxí - WYZ< S g-o..MgUQmí v3 oU.3 v o.øµ Uó gi o..v.S*.S XgMZ.“ v 9..." og -! ..V QUSig-SvUZ.

àXoUMNGZo-g Zxí - WY..wó MX-SvU.v).MS g-o..MgUQp.gU9.." S SUQp**..v...gøo.oU Qí...o g-o9...v..) vv9...
o' Xó SUM N2 g-µi o...< S g-o...<' gUQNWVWXXXZ." . uZ9vSWZWV1éUMS g-oW%uZ...

àXoUMNGZNwv -SUQN' ZgU9..w9QpVN2 Zxí - WY...-! o.XúMv vQNg .9S-gUM.v).MS g-o..MgUQ Ná S6...
GUg ú*S*Nbí x YNXXZu% u' í Z9vSWZWVW;ZVBBRuí . Z - WZ Wu%Z Z...

à-o))oUN: ZN< μ-üoUNwZsZN. .t M oS NsZá Zxí--°YZ.-' o.GU-' vXvMUnG o.. μ3 gU*.Uv" .vøó " ' o 3 SUQ..
 -' o..Qog-.)v M*.v)..Ug-í offiGt I rVmG.sví Ug ..v)..-' o.. μ3 gU.OUøSvU3 oU-Nß xlYN. W" í VZ.

à-oQN/ZgU9..ö o6N<Zxí--uY..OUMí gQUQ.X vRÜøSvU3 oU-g ..i o' gøSví mGU..SU-oQg-Søó..øøS" ..gU9 ...
 ' o*og M... gQU9g N. sví Ug ... v)... OUøSvU3 oU-g ... w*úMv vQín. í uxßYN. XXZ. ß-u ßWZ.
 9vSWZWVé;ZøUøXZ--1ZVZ- . Z...

à-ó UN.wZ.<Zxí---YZ.2 o" ...oUøSvU3 oU-g ...-' óv S*m-v" g 9...g...M' ó oU-...-' óv ú...v)...oUøSvU3 oU-g ú...
 *SUSSgU..i o' gøS Zsví Ug ..v)..àvMg .r**μo*N% xßYN. -° . í . Z. -X*é9vSv QWZWVé--í í R%ß°Z- W%..

à-ó UNwZ.<Zn S-üN-ZN` ..7 g v)N/ ZxWußYZö g μo..ý SÜ-g-S*U*NQÜ9ó NgU9..oUøSvU3 oU-g ..MUM UZ.
 OUøSvU3 oU..gU9.I o' gøS Ní %%%Nßí í B. 1Z.

à- vi N.<Zn.t g ouNsZ.gU9...-μ-üN.+Zxí--uY..GU..SÜ- v9μMSvU...-v... oMí *Sø...Xg -SSvSUQmá g-SvUg oN.
 gXXMg-SvUNgU9..Mg gMó S-SM..v)...Mg**SMg-SvU..gU9.. oQo**SvU..- oo*Ni gQUQNgU9...gU9v3 ..)v o*-ZN.
 w*úMv vQm .t o-' v9*NWx YNXXZßí ß ß. 1Z9vSWZWVé°ég-- Wu°ßZ...

øgU.9ó ./ SU9oUNàZxí - WøZ.-' o..*vMg R*úMv vQm .9o-ó 3 SÜgU*..v)..MS g-o..MgUQ... S6..Xó Mx-SvUm
 -v" g 9*.g..M3 X o' oU*Sø..3 v9o Zsví Ug ..v)..OUøSvU3 oU-g ..w*úMv vQín. WWWWV. Z.

øgU.9ó ./ SU9oUNàZn gS gMINOZN. ./ oSó v" S-üNGZxí - WYmfr3 X vøSUQXui SMoUgQ3 oU-..." S' .MS g-o...
 MgUQm(Sø...i o*-X gMSM .SUSQ -*.) v3 .X*úMv vQm .*MSUMZi.wó *XoMSø..vU.w*úMv vQm .àMSUMZ.

øgU..ö g 6oUQyo9N.GZ.t ZN.` ..à-oQN./Zxí - WYmft o-gRgUg ú*o*...v)...gMv *...3 v-Sg-SUQ..MS g-o...MgUQ...
 g9gXg-SvU.i o' gøS Zi2 g-í o.< S g-o...<' gUQZ.

...

Analysis of Sustainable Development Patterns Across Countries

Doctoral Thesis Summary

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1 Introduction

Sustainable development is a multidimensional challenge that demands an integrated understanding of social progress and environmental constraints. It requires balancing the fulfillment of human needs and social goals with the safeguarding of environmental integrity for future generations. Without a holistic approach, efforts to improve human well-being can lead to unsustainable resource use, undermining long-term sustainability and intergenerational equity.

Research in sustainability therefore must ask how societies can achieve social progress within ecological limits, ensuring that gains in well-being do not come at the expense of the environment or future generations. This thesis embraces such a holistic framework, examining the intersections between human development, environmental sustainability, and public engagement. This binding research brings together three core themes that are often treated separately: (i) developing better measures of broad human well-being (beyond purely economic metrics), (ii) evaluating the environmental efficiency of achieving that well-being, and (iii) understanding public perceptions of climate change as a factor that can enable or impede sustainability efforts.

The overarching goal is to advance methods for assessing sustainability that maintain a balance between environmental and social dimensions of development. Although each theme addresses distinct questions, they share a common focus on sustainability assessment and policy relevance. By exploring their interconnections, the research reinforces that sustainability must be evaluated holistically to capture its multifaceted nature. Together, the three research themes contribute to a more comprehensive understanding of sustainability – integrating what

we strive for (broad human well-being), how we achieve it (with maximal environmental efficiency, i.e. the least possible environmental impacts), and why it ultimately succeeds or fails (public perception and support for change).

This integrated perspective aligns with the Brundtland Commission's vision of meeting present needs without compromising future generations, highlighting that environmental health and human prosperity must advance hand-in-hand (WCED 1987). Public perception plays a pivotal role: even the most well-designed policies or technologies will falter without public support and engagement (Weber 2010; Lee et al. 2015). In the following chapters, each of the three themes is examined in turn, before drawing together conclusions and implications for sustainable development.

2 Composite Well-Being Measurement

Composite well-being measurement addresses the complexities of evaluating societal progress beyond GDP. Economic growth alone does not guarantee broader improvements in quality of life, especially when social inequalities persist. Thus, composite indicators have gained prominence as more comprehensive tools for assessing development, integrating multiple dimensions of well-being (health, education, equity, environment, etc.) into a single framework. This thesis builds on the “beyond GDP” movement (Stiglitz et al. 2009; Fleurbaey 2009) by refining composite well-being metrics, particularly through the Social Progress Index (SPI) as a key measure of social performance independent of income.

Methodological innovations are explored to improve these indices: for example, introducing time-varying weighting schemes that adjust to evolving societal priorities, and using non-compensatory aggregation techniques so that poor outcomes in one dimension (say, health) cannot be completely masked by excellent outcomes in another (education or income).

These refinements help ensure that composite indicators remain robust and relevant over time, addressing common critiques of arbitrariness in weighting and aggregation. Overall, the aim is to provide policymakers with more nuanced and adaptable measures of broad human well-being.

The thesis's contributions to well-being measurement are anchored in several studies that apply and extend composite indices across countries and over time:

Social Progress Index 1990-2020: Measuring Societal Wellbeing Over 31 years – This study provides a longitudinal analysis of social progress for 172+ countries from 1990 to 2020 using the SPI framework. It highlights global trends in well-being, showing that while most countries have improved social outcomes (e.g. in basic education, health, sanitation), the rate of progress has slowed in recent years. Some nations that started at low levels of development achieved remarkable gains, whereas others stagnated or even experienced reversals in certain dimensions. An important insight is that measuring social outcomes independently of economic output reveals dynamics that GDP growth alone would overlook – for instance, cases where income grew but social indicators did not.

Methodologically, this paper demonstrates how the SPI can be adapted over three decades, requiring adjustments in indicators and weights to maintain comparability over time. The results

expose regional disparities and sustainability challenges (such as plateauing of improvement in high-income countries) and illustrate the value of a consistent multi-dimensional index for tracking social progress. Notably, the research underscores that GDP-based assessments often omit crucial aspects of human development, and that long-term trends in well-being can diverge significantly from economic growth patterns.

Inequalities Beyond Income: A Worldwide Longitudinal Perspective through the Lens of the SPI – This study expands on the SPI approach to examine non-economic inequalities in well-being. Even among wealthy nations, it finds persistent disparities in outcomes like education quality, healthcare access, personal rights, and inclusiveness.

Using a panel of data for 172 countries over 1990–2020, the analysis shows that while certain basic aspects of well-being (such as nutrition, basic education, and access to electricity and clean water) have improved globally – narrowing gaps between countries – other facets (such as personal freedoms, inclusion of marginalized groups, and gender equity) have stagnated or even worsened in some regions. Notably, high-income countries are not immune to social shortfalls: many affluent nations continue to struggle with issues of inequality and social justice despite their economic wealth.

The study's findings challenge the notion that economic growth automatically translates into social progress or reduced inequality. It provides empirical evidence that composite well-being indicators must incorporate distributional aspects – not just national averages – to truly reflect whether development is inclusive. By revealing where progress has been uneven, this work stresses the need for policies that specifically target the social dimensions lagging behind, even as overall national performance might look strong.

The Evolving Importance of Social and Governance Measures Over Time – This paper addresses how the relative importance of different well-being dimensions may change as global conditions evolve. It introduces dynamic weighting methodologies that allow composite indices to adjust the weights of their components over time in response to shifting development priorities or emerging issues.

Using entropy-based and Bayesian techniques, the study analyzes how social and governance indicators' influence has changed in recent decades. One key finding is that governance-related measures – such as state capacity and democratic accountability – have grown more influential in assessing overall social progress in the 21st century. This suggests that factors like good governance and strong institutions are increasingly recognized as vital to sustained improvements in well-being.

The paper also illustrates the methodological challenges in determining weights: different weighting approaches can lead to different interpretations of which countries are “doing well.” By comparing static versus time-varying weighting schemes, the study shows that allowing indicator weights to adapt can provide a more responsive and context-sensitive picture of progress. This work highlights how composite indices can be pioneered to capture changing realities, for example by elevating the importance of newly salient issues (like governance or environmental quality) as societies develop.

Together, these three studies provide a comprehensive empirical foundation for understanding and improving composite well-being measurement. They reinforce the argument that social progress cannot be adequately captured by static, one-dimensional metrics. Instead, adaptive and multidimensional indicators are needed to reflect evolving societal values and priorities. In particular, the

findings demonstrate that broad human well-being must be tracked with tools that are sensitive to change over time and across dimensions. This ensures that critical aspects (such as equality, freedom, or governance) are not overlooked in favor of simpler averages.

By developing long-term, adaptable composite indices, the thesis contributes to more robust measurement frameworks for well-being. This advances the beyond-GDP agenda by showing concretely how to measure what truly matters for people, in a way that keeps pace with social change. Indeed, the research echoes the call by Stiglitz et al. (2009) to move “beyond GDP” and provides methods to do so. Ultimately, a key message from this theme is that human well-being is multidimensional and dynamic – and our metrics must be as well.

3 Environmental Efficiency of Well-Being

Achieving sustainability requires not only improving human well-being but doing so with minimal environmental cost. The second core theme of this thesis examines the environmental efficiency of social progress – essentially, how well countries balance improvements in well-being with the preservation of environmental resources.

Environmental efficiency, often described as the inverse of environmental impact per unit of well-being (Dietz et al. 2009; Knight and Rosa 2011), embodies the ideal of “doing more with less” in development. It asks: to what extent can a society increase health, education, and prosperity for its people while using fewer resources and emitting less pollution? This perspective is crucial in the context of climate change and ecological limits. If well-being

improvements continue to be coupled with high emissions and resource depletion, they will be short-lived.

Therefore, measuring and comparing environmental efficiency helps identify paths toward a just transition – where broad human development is achieved in an equitable way without exceeding planetary boundaries. In this thesis, novel composite metrics were developed to assess environmental efficiency at the country level. Two key frameworks introduced are the Just Transition Score (JTS) and the Carbon Efficiency of Social Progress (CESP). These metrics integrate the SPI with environmental indicators (like carbon emissions or material footprint per capita) to produce a ratio of social progress to environmental impact.

By taking a ratio form, they effectively show how much social outcome is gained per unit of environmental pressure. Such measures allow direct cross-country comparisons of sustainability performance: they highlight which countries manage to attain high well-being with low impacts (leading in sustainability), and which countries incur heavy environmental costs for their level of social progress. By explicitly factoring in ecological efficiency, this approach provides policymakers with a more nuanced picture of development success. It also sheds light on structural differences: for instance, how governance models or economic structures might affect a country's ability to decouple well-being from resource use.

In short, these tools make it possible to quantify and track the degree of decoupling of social progress from environmental degradation. The thesis applies these frameworks in comparative studies to uncover patterns and drivers of environmental efficiency across nations:

Just Transition Score: Measuring the Relative Sustainability of Social Progress – This study introduces the Just Transition Score

(JTS) as a new metric evaluating how well countries convert natural resources and emissions into societal well-being. The JTS is calculated as a ratio of a country's social progress (using the SPI) to its environmental impact (combining per capita carbon emissions and material footprint). An analysis of 161 countries for the period 2011–2019 reveals striking disparities in performance. Some countries – for example, Portugal, Spain, and Costa Rica – achieve relatively high levels of social progress with modest environmental impacts, thus scoring highly on the JTS.

These cases demonstrate that it is possible to sustain a good quality of life at a lower environmental cost, often thanks to cleaner energy mixes, efficient resource use, or proactive sustainability policies. In contrast, other countries – particularly some oil-rich states and high-emission economies – have very poor JTS scores, indicating that they generate considerable environmental harm for the amount of social progress attained. These include nations that rely heavily on fossil fuels or those with rapid industrialization lacking environmental controls.

The findings underscore the trade-offs many countries face: pursuing social progress can either be done in a way that is efficient (minimal ecological degradation) or inefficient (high degradation), with policy choices often determining the outcome. By highlighting both the leaders and laggards in sustainable development, the JTS provides practical insight into best practices. It suggests that countries with similar income levels can have very different sustainability outcomes, and learning from high-efficiency performers could inform policy in lower-scoring countries. In sum, this paper's contribution is a concrete metric for the elusive concept of "sustainable development," giving it empirical teeth and exposing where improvement is most needed.

Achieving Just Transition Through Convergence in the Carbon Efficiency of Social Progress – This study extends the examination by looking at trends over a longer period (1990-2020) and focusing specifically on carbon efficiency, i.e. social progress per unit of CO₂ emissions. It introduces the Carbon Efficiency of Social Progress (CESP) indicator and investigates whether countries are converging towards similar levels of carbon efficiency as sustainability becomes a more prominent global goal.

Using data for ~160 countries, the analysis applies time-varying factor models to determine if high and low performers are moving closer together or farther apart. The results show a nuanced pattern of convergence and divergence. On one hand, many low-emitting countries (often lower-income nations) have improved their CESP and are catching up toward the efficiency levels of higher-performing countries – a positive sign indicating that development in these countries is becoming less carbon-intensive over time. On the other hand, a segment of middle-emitting countries (which include several emerging economies) are not converging; instead, they exhibit divergent trends where some improve their carbon efficiency while others stagnate or worsen. This suggests structural barriers in certain nations that prevent decoupling of emissions from well-being – for instance, dependence on coal or other fossil fuels for growth, or lack of access to clean technology. Meanwhile, the highest-emitting countries (typically industrialized nations) show slow improvements and slight convergence at the top, likely due to technological innovation and stronger climate policies in the last decade.

The study's overall finding is that there is no automatic or uniform movement towards higher sustainability; progress is uneven. This has important policy implications: countries starting from behind can improve with the right support and technology transfer, but middle-income countries might need targeted interventions to

overcome specific obstacles to decarbonizing their development path. The lack of uniform convergence also means that global inequality in sustainability persists. By identifying which groups of countries are lagging, the research points to where international cooperation and differentiated strategies (as envisioned in global agreements under the principle of common but differentiated responsibilities) are most critical. Ultimately, this work provides a dynamic view of just transition, emphasizing that improving efficiency is necessary but must be accompanied by efforts to ensure all countries can participate in that transition.

Together, these studies contribute to a deeper understanding of the Environmental Efficiency of Well-Being. They offer quantitative assessments of how different countries manage the dual goals of social advancement and environmental protection. A clear takeaway is that improving the environmental efficiency of well-being is essential for sustainable development. However, it must occur in a way that is fair across different economies and societies. In other words, the path to sustainable development requires both technological and policy innovation to decouple well-being from environmental harm and attention to the disparities between countries in their capacity to do so. By integrating these insights, this thesis situates environmental efficiency within a broader sustainability framework, linking it back to composite well-being measurement and policy goals.

Importantly, the research demonstrates the value of robust indicators in guiding policy: indices like JTS and CESP can be used to monitor progress toward international targets (for example, the Sustainable Development Goals, United Nations 2015), and to hold countries accountable not just for how much well-being they create, but how they create it. In sum, this theme's contributions show that sustainable development performance can and should be measured by looking at outcomes per unit of environmental cost.

Such an approach shines light on success stories where quality of life is achieved at low ecological expense, and it flags unsustainable trajectories where environmental impacts remain unjustifiably high. These insights directly inform debates on climate and development policy, illustrating practical pathways for countries to reduce their environmental impacts without compromising social progress.

4 Climate Change Perception

Scientific research and policy design are critical to addressing climate change, but their success ultimately hinges on public perception and engagement. The third core theme of this thesis delves into climate change perception – the ways people understand, interpret, and react to climate change – and how these perceptions vary across societies. Public perception is a crucial, yet often underestimated, factor in shaping sustainability efforts and climate policy effectiveness.

While climate action is driven by data and economics, it is the public's awareness of the issue, sense of risk, and willingness to support solutions that determine whether policies are implemented and behavioral changes occur. If large segments of the population do not perceive climate change as an urgent threat or do not buy into proposed solutions, even well-crafted policies may face resistance or apathy, limiting their impact. Understanding these social and cognitive dimensions is therefore vital for a successful transition to sustainability.

This thesis approaches climate change perception through a cross-country comparative lens, recognizing that cultural, economic, and informational contexts lead to very different attitudes and levels of concern around the world. It develops a multidimensional

framework to measure climate change perceptions, integrating environmental and social data to provide a comprehensive view of how societies engage with climate challenges. Key aspects examined include general awareness of climate change (have people heard of it?), risk perception (do they believe it is a serious threat to themselves or their country?), and willingness to act (are they inclined to support policies or take personal action to mitigate climate change). By identifying the socio-economic factors that shape these dimensions – such as education levels, income levels, gender, age and urbanicity– the research sheds light on the social complexities influencing climate action.

Importantly, this work bridges attitudinal data with sustainability indicators: for example, it considers how the factors of public perceptions vary with the level of vulnerability to climate change, offering insight into feedbacks between opinion and outcome. This approach acknowledges that achieving sustainability is not just about technology or economics, but also about the collective will to change. The thesis contributes new empirical studies on climate change perception, each focusing on different facets of this issue:

Multidimensional Cross-Country Measurement of Climate Change Perceptions– This study introduces the Climate Perceptions Index (CPI), a composite indicator designed to quantify public climate change perception across 107 countries. The CPI aggregates information on three dimensions: awareness of climate change, risk perception (understanding of its severity and impacts), and commitment to action (willingness to support climate-friendly policies or personal actions). Using a large-scale survey dataset of over 100,000 respondents collected via social media (Facebook), the study constructs the CPI for each country and uncovers significant global variability. Notably, there is no simple rich-poor divide in climate perception: higher economic development does not automatically equate to higher awareness or concern.

For example, many European countries score very high on awareness – most of their population knows about climate change – but comparatively lower on perceived risk and on commitment to act. In contrast, several Latin American countries and other developing nations show the opposite pattern: moderate awareness levels but relatively high concern about climate impacts and willingness to take action. This indicates that cultural and regional factors strongly influence how people translate knowledge into concern and motivation. A key finding is the existence of an awareness-action gap: higher awareness does not necessarily translate into higher risk perception or greater willingness to act. Simply put, just because people have heard of climate change doesn't mean they feel threatened by it or are ready to change their behavior.

This gap suggests that information alone (raising awareness) is insufficient; factors like personal experience, trust, and perceived efficacy play a role in whether awareness leads to action. The CPI provides a holistic measure that makes these gaps visible. By combining multiple facets of perception, it allows researchers and policymakers to identify where the bottleneck is in public engagement – for instance, a country might need to focus on communicating risks more vividly, or on boosting public trust in solutions, rather than just disseminating basic facts which people may already know.

Dissimilarities in the Socio-Economic Predictors of Climate Change Worry and Action Across 30 Countries – This paper digs deeper into what drives climate change concern and pro-environmental action in different contexts. While the first study established levels of perception, this second study examines the determinants of those perceptions using a subset of 30 countries with detailed data. It employs advanced statistical techniques (latent variable models to capture underlying “worry” and “action”

tendencies, and machine learning methods like random forests to handle numerous predictors) to analyze how socio-economic factors influence climate attitudes.

The results reveal that the predictors of climate concern and action are heterogeneous across countries – there is no one-size-fits-all model. In highly vulnerable countries, age and education emerge as particularly influential: younger individuals and those with higher education levels exhibit greater concern about climate change and are more likely to engage in climate action. These findings reflect generational exposure to climate discourse and the empowering effect of education in shaping risk perception and policy support. Urban residents in these settings also tend to be more engaged, likely due to higher exposure to climate initiatives and social norms that encourage pro-environmental behavior.

In contrast, economic factors like income appear to play a more modest role in highly vulnerable countries, where immediate survival concerns may take precedence over long-term environmental issues. Conversely, in less vulnerable countries, income has a stronger association with climate concern and action, suggesting that higher living standards can afford individuals greater cognitive and material bandwidth to address environmental issues. Notably, socio-economic predictors are more diverse and complex in high-vulnerability contexts, whereas they are more consistent in low-vulnerability countries, where political ideology or general environmental values often dominate.

Overall, this study underscores the importance of context-specific communication and policies. It validates the need for a composite approach like the CPI by showing that different dimensions of perception (knowledge, worry, action) have different drivers. By identifying these drivers, policymakers can better design interventions – whether it's climate education curricula, public

awareness campaigns, or community engagement initiatives – that resonate with the specific barriers and motivators present in their society.

Together, these studies advance our understanding of climate change perception as a multifaceted phenomenon. They break new ground by moving beyond single-country or single-factor analyses and offering a broad comparative perspective. One of the central insights is that public engagement with climate change is not a straightforward linear process: greater awareness and knowledge (while generally positive) do not automatically lead to proportional increases in concern or behavior change (Weber 2010; Jugert et al. 2016). Psychological factors such as perceived efficacy (believing that one's actions can make a difference) and social norms (seeing peers and leaders take climate change seriously) mediate the translation of concern into action.

This means that bridging the awareness-action gap requires addressing those psychological and social factors, not just providing more scientific facts. The thesis contributes a new tool – the CPI – to quantify these dynamics and offers empirical evidence on the patterns of perception across a diverse set of countries. By integrating climate perception data with traditional sustainability indicators, the research broadens the scope of sustainability assessment to explicitly include societal readiness and support for change. This is an often overlooked but crucial component: even as nations develop green technologies or enact climate policies, the long-term success of such measures will depend on public support.

In essence, this theme reminds us that climate change is not only a technical or economic problem but also a social one. The findings emphasize that improving public understanding and engagement is an integral part of the sustainability transition. Policies aimed at climate mitigation and adaptation stand a much better chance

if they are informed by insights into public perception – for example, knowing which misconceptions to correct, which values to appeal to, and which groups to involve in dialogue. By shedding light on these aspects, the thesis contributes to designing more effective climate communication strategies and more inclusive policies that account for diverse public attitudes.

5 Conclusion

This dissertation provides several key advancements to the field of sustainability science by integrating social well-being metrics, environmental efficiency analysis, and climate change perception into a unified assessment framework.

First, the thesis refines composite well-being measurement techniques. Building on the beyond-GDP paradigm (Stiglitz et al. 2009), it expands the temporal and conceptual scope of social progress measurement. By constructing and analyzing a multi-decade Social Progress Index dataset (1990-2020), the research provides an unprecedented long-term view of how global social conditions have evolved. This enables a detailed examination of trends and disparities across key dimensions of quality of life. In doing so, the work also advances the methodology of composite indices: it pioneers the use of time-varying weights to reflect shifting societal priorities and explores non-compensatory aggregation to ensure that shortcomings in one area of well-being are not obscured by strengths in another. These innovations address common critiques of composite indicators – such as arbitrary weighting or insensitivity to context – by increasing the indices' responsiveness and fairness.

The well-being indices emerging from this thesis are more robust and adaptable tools for policy analysis. They allow us to detect

when progress in, say, health or education is stagnating even if income is rising, or to adjust our measures as new social challenges become important. By enhancing composite well-being metrics in these ways, the research contributes to a richer and more reliable understanding of broad human development. It emphasizes that sustainable development must consider not just average outcomes, but also distribution (inequality) and changing values – thereby echoing and extending the recommendations of international efforts to measure “what matters” for society (Stiglitz et al. 2018).

Second, it introduces innovative metrics for evaluating the environmental efficiency of development – notably the Just Transition Score (JTS) and the Carbon Efficiency of Social Progress (CESP). These indices fill a critical gap by extending traditional development measures to include ecological efficiency, offering a new way to compare countries’ sustainable development performance (Dietz et al. 2009; Hickel 2020). By capturing how well countries translate resources and emissions into improved social outcomes, JTS and CESP highlight examples of “smart” development (high well-being achieved with low environmental impact) as well as cases where social progress remains tightly coupled with unsustainable resource use.

This contribution is both methodological (designing new composite indices that blend social and environmental data) and substantive (revealing the large global variability in efficiency). It equips policymakers with better tools beyond GDP or HDI rankings, directly showing that some countries manage to attain high well-being at much lower ecological cost than others. Such insights chart practical pathways for efficient, low-carbon social progress, aligning with calls to achieve human development within planetary boundaries (Knight and Rosa 2011; O’Neill et al. 2018).

Third, the thesis breaks new ground in climate change perception research by developing a multidimensional, comparative approach. It introduces the Climate Perception Index (CPI) as one of the first composite indicators to assess public climate awareness, risk perception, and willingness to act across many countries. Previously, studies of climate opinion were often limited to single countries or focused on one aspect of perception (Leiserowitz 2006; Lee et al. 2015). By combining survey data on knowledge, concern, and behavior, this research offers a holistic index of how societies view climate change. This is a notable contribution to climate social science, filling a need for consistent international metrics on public engagement with climate issues.

Furthermore, by examining socio-economic predictors of climate concern and action, the thesis illuminates why perceptions differ from place to place – for example, why people in some regions might be complacent despite high exposure to climate information, or why others are motivated to act even with moderate awareness. These findings have direct practical relevance: they inform how policymakers and communicators might tailor their strategies to different audiences. For instance, the evidence that higher awareness usually correlates with greater climate awareness but doesn't guarantee willingness to act highlights a “last mile” problem in climate communication (Weber 2010; Jugert et al. 2016).

Bridging that gap may require focusing on building public trust, highlighting local climate impacts, or fostering collective efficacy, rather than simply increasing knowledge. By incorporating public perception into the sustainability framework, the thesis broadens the discussion beyond technical and economic solutions, stressing that the human dimension – attitudes, beliefs, and social support – is a critical pillar of effective climate action and sustainability transitions.

Collectively, these contributions demonstrate the value of an interdisciplinary approach to sustainability. The research bridges traditionally separate domains – environmental efficiency analysis, social indicator development, and environmental psychology – to show that integrating these perspectives yields richer insights than examining each in isolation. For scholars, the thesis provides improved metrics and analytical methods to study the links between human well-being, environmental impact, and societal factors. For policymakers, it offers actionable tools and findings: for example, the new efficiency metrics (JTS/CESP) can help identify exemplars of sustainable development and realistic benchmarks for others to aim for; the enhanced well-being indices ensure that quality of life is tracked in a way that accounts for inequality and changing needs; and the climate perception insights indicate how public support (or lack thereof) can make or break policy initiatives, thereby guiding how to design and communicate climate policies.

In pursuing these advances, the thesis contributes to a more evidence-based and comprehensive toolkit for achieving the Sustainable Development Goals (United Nations 2015). Ultimately, the overarching message is that achieving sustainability is not a one-dimensional endeavor. Lasting progress requires concurrent advances on multiple fronts: improving human well-being broadly, reducing our ecological footprint, and cultivating an informed and supportive public. This dissertation operationalizes that integrated vision with concrete measures and empirical evidence. By linking social, environmental, and perceptual dimensions of sustainable development, it paints a more complete picture of what a sustainable society entails and how we might get there.

In summary, human prosperity, environmental integrity, and public engagement must go hand-in-hand. Sustainability can only be realized by simultaneously meeting human needs, respecting

planetary boundaries, and harnessing public will – a triad of goals that this research has helped to quantify and bring into focus.

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