Czech University of Life Sciences Prague

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Master's Thesis

The relationship between inequality and sustainable growth

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DIPLOMA THESIS ASSIGNMENT

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Economics and Management

Thesis title

The relationship between inequality and sustainable growth

Objectives of thesis

The thesis aims to compare selected socio-economic indices across chosen countries to highlight the basis of inequalities across the board and identify prerequisites for sustainable growth.

Methodology

The processing of the thesis can be divided into a few steps.

In the Introduction, the author will shortly introduce the topic and explain why this topic is relevant to be studied.

In the following section, Aim of the thesis, the author will specify his aim, research question and hypothesis. An integral part of this chapter is also the potential contribution of his work to the current research.

The creation of the literature review will follow. This part will provide a detailed overview of the literature and the current state of knowledge focusing on income inequality and economic growth in chosen countries. It will include critically analysing the most relevant studies, including methods used, results found, and limitations. Methodologically, this part of the thesis will be the analysis of documents.

The literature review creates a background for the author to specify the methods used for the analytical part of the thesis. The chapter Methodology will describe all the methods; it will also include a description of the obtaining data and its processing before the analysis.

In the following step (analytical part), the author will use the knowledge gained during the literature study with the methods specified in the previous section to analyse the obtained data. This part is the core component of the thesis. This part of the thesis will include the analysis results and comparison (discussion) of the results with other authors focusing on the same topic. This part can also include recommendations for policymakers or other stakeholders.

In the final part (conclusion), the author will summarise his findings, mention the limitation of the research and include possible further investigation.

The proposed extent of the thesis
60 – 80 pages

Keywords
Poverty, income inequality, economic growht, disparity

Recommended information sources

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Declaration

I declare that I have worked on my master's thesis titled " The relationship between inequality and sustainable growth " by myself and I have used only the sources mentioned at the end of the thesis. As the author of the master's thesis, I declare that the thesis does not break any copyrights.

In Prague on 31st of March   _____

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The relationship between inequality and sustainable growth

Abstract

Inequality and economic sustainability are of global concern within and among countries. In other to assess the relationship between inequality and sustainable growth, 10 countries Brazil, Canada, Colombia, Czech Republic, Egypt, Germany, India, Mexico, South Africa and Vietnam were selected from 5 continents. Economic indices (population living below international poverty line ($1.90 a day), unemployment rate (% of economically active population), inflation, median disposable income per household (USD), the real gross domestic product at purchasing power parity (GDP-PPP), imports and exports (USD) were selected with real GDP (PPP) used as the dependent of the 7 variables spanning 1993 to 2022. Linear regressions were run for all 10 countries providing 10 linear regression equations pointing out which of the variables were important to each country's real GDP(PPP). It was also shown in the case study that reduction in the poverty rate of developing /emerging nations were paramount to their sustainable growth. It also showed that median disposable income per household was important in the control of the real GDP and in turn can be used in the control of sustainability.

Vztah mezi nerovností a udržitelným růstem

Abstrakt

Nerovnost a ekonomická udržitelnost jsou v rámci zemí i v>rámci porovnání zemí navzájem globálně znepokojivé. Pro posouzení vztahu mezi nerovností a udržitelným růstem bylo z pětikontinentů vybráno 10 zemí, a to Brazílie, Kanada, Kolumbie, Česká republika, Egypt, Německo, Indie, Mexiko, Jižní Afrika a Vietnam. Ekonomické indexy (populace žijící pod mezinárodní hranicí chudoby (1,90 USD denně), míra nezaměstnanosti (procento ekonomicky aktivní populace), inflace, medián disponibilního příjmu na domácnost (USD), skutečný hrubý domácí produkt v paritě kupní síly (HDP-PPP), dovoz a vývoz (USD) byly vybrány s reálným HDP (PPP) použitým jako závislý ze 7 proměnných v letech 1993 až 2022.Lineární regrese byly spuštěny pro všech 10 zemí poskytujících 10 lineárních regresních rovnic poukazujících na to, která z proměnných byla důležitá pro reálný HDP(PPP) každé z>vybraných zemí. V případové studii bylo také prokázáno, že snížení míry chudoby rozvojových /rozvíjejících se zemí bylo rozhodující pro jejich udržitelný růst. Ukázalo se také, že medián disponibilního příjmu na domácnost byl důležitý při kontrole reálného HDP anásledně jej lze použít při kontrole udržitelnosti

Klíčová slova: Nerovnost, udržitelný růst, HDP, disponibilní příjem, chudoba, míra nezaměstnanosti, inflace, dovoz, vývoz

Table of Contents

1. Introduction

Equality is a concept that cuts across the fabric of society. It has long been a serious bone of contention in various sectors. Put simply, equality refers to even distribution of resources among a population. It's antithesis, inequality, refers to an uneven distribution of resources. There is no economic debate that does not mention inequality in some shape or form.

There is a complex relationship between economic inequality and sustainable growth of a nation, thus inequality is not detested in its entirety by economists. Perfect equality, i.e., every individual getting the same amount of resources irrespective of status, skill or effort promotes laziness and reduces productivity. The degree of inequality that exists is however crucial to economists.

Slight economic inequality often promotes economic growth by providing incentives for innovation, risk taking and investment, which can drive economic growth. In contrast, marked inequality could contribute to economic and political instability including but not limited to social unrest, violence, increased crime rates, and protests which hinder economic growth and development.

There is also a nexus between poverty and conflicts at both national and international level, most national conflicts in the world can be traced to economic deprivation and poverty (Mueller & Techasunthornwat, 2020). Poverty and economic vulnerabilities exacerbate environmental degradation and impact negatively on the resilience of communities to adapt to the extremes of climate change (Adeniyi, 2017).

The United Nations has set up seventeen (17) sustainable development goals (SDGs) which it hopes to achieve by the year 2030. The first goal is to end world poverty, the eight SDG demands economic growth, goal 10 is aimed at reducing inequality, and goal 11 is to maintain sustainable cities and communities. All these push the entire world towards achieving equality and sustainable growth (United Nations, 2021).

Without proper planning and implementation, there is a risk of increased inequality which will impact sustainability in a negative way. Therefore, policies aimed at reducing economic inequality while promoting growth are vital to achieving sustainable development. This study focuses on economic inequality and explores the complex role it plays as a critical determinant of economic sustainability.

Ten countries across five continents were randomly selected for this study.

The United Nations has set up 17 sustainable development goals (SDGs) to help to end world poverty, to protect the planet and that by the year 2030 of which goal 8 is Economic growth, goal 10 is reduce inequalities goal 1 is No poverty, all which push towards equality and sustainable growth (United Nations, 2021).

2. Objectives and Methodology

2.1 Objectives

The aim is to compare selected socio-economic indices across chosen countries by highlighting the basis of inequality across board and identifying prerequisites for sustainable growth. The socio-economic indices which are of concern to this study are poverty rate, unemployment rate, inflation, average household income and GDP per capital. The hypothesized statements are generated from the socio-economic indices highlighted above. The chosen countries are Czech and Germany in Europe, South Africa and Egypt in Africa, Mexico and Canada in North America, Colombia, and Brazil in South America, then finally in Asia, India and Vietnam.

2.1.1 Hypotheses

1. There will be no significant difference in poverty rate among the selected countries.

2. Unemployment rate among selected countries will not be significantly different.

3. There will be no significant difference in inflation rate among the selected countries.

4. There will be no significant difference in average household income among the selected countries.

5. There will be no significant difference in real GDP per capita among the selected countries.

6. Imports and exports were not significantly different among the selected countries.

2.2 Methodology

Ten countries across 5 continents were selected for this case study, two from each continent. The countries and continents are, Egypt and South Africa (Africa); India and Vietnam (Asia); Czech Republic and Germany (Europe); Brazil and Colombia (South America); Canada and Mexico (North America). The selected countries were randomly chosen across continents as global representatives of different socio-economic levels of development. Availability and reliability of data were also considered.

Brazil is a South American country and the third largest economy in the Americas, a developing mixed economy with a middle income, Brazil as at 2022 has the world's 12th largest GDP and the world's 8th largest purchasing power parity (PPP) (IMF, 2022).

Canada the North American country is a highly developed mixed economy, which has the world's eighth-largest nominal GDP and 15th-largest PPP GDP (IMF, 2022).

Colombia like Brazil is a South American country, it has the fourth largest in Latin America in terms of gross domestic product and regarded as a developing/emerging economy (Statista, 2022).

Czech Republic's economy is a developed high-income export-oriented social market economy. Czech Republic is a European country and is ranked 48th and 47th in the world in terms of nominal GDP and GDP purchasing power parity (PPP) (Aspalter, et al., 2009).

Egypt is a Northern African country, it is the second largest in Africa after Nigeria, and the 33rd largest in the world and referred to as developing/emerging economy (The World Bank , 2022).

Germany, the largest national economy in Europe, the world's fourth largest by nominal GDP, and the fifth largest by GDP (PPP). Germany like the Czech Republic is a developed economy (IMF, 2022).

India is a Southern Asian nation, it has the world's fifth-largest nominal GDP and third-largest purchasing power parity (PPP) and is regarded as a developing/emerging economy (The World Bank , 2022).

Mexico, like Canada is a North American nation. It is considered a developing/emerging economy, it is 15th largest in the world in terms of nominal GDP and the 13th largest in terms of purchasing power parity (PPP) (Statista, 2022).

South Africa like Egypt is an African country and the continent third largest economy, it   is also the world's 36th largest nominal GDP and the 33rd in terms of GDP (PPP) and is regarded as a developing/emerging economy (IMF, 2022).

Vietnam the second of the Asian countries in this study is a developing/emerging economy and the 36th largest in the world in terms of nominal GDP and the 26th largest in terms of purchasing power parity (PPP) (The World Bank , 2022).

Secondary data were sourced from Passport spanning through 1993 -2022. The main data used are population living below international poverty line ($1.90 a Day), unemployment rate (% of economically active population), inflation, median disposable income per household (USD), the real gross domestic product at purchasing power parity (GDP-PPP) as the imports and exports (USD) of 10 the countries used in the study.

Of note, is that I tried nominal GDP, GDP growth term, none of them worked. Therefore, I used real GDP in this study.

The data obtained were analyzed using SAS and SPSS statistical software tools. Linear regression was used after curve fitting test showed it was best fit for the data set in this study. The knowledge gained from the literature review were used to discuss the results obtained from the analysis as well as recommendations for policymakers and stakeholders.

The conclusion was used to summarize the key points in the thesis, and set the ball rolling for future research endeavours.

2.2.1 Definition of Terms

Indices	Description	source	hypothesis
Real GDP (PPP) in USD million)	Real GDP is simply nominal GDP divided by the GDP deflator. Gross domestic product (GDP) is the sum of the gross value added by all resident producers in the economy, plus any product taxes and minus any subsidies not included in the product value. It is estimated without accounting for the depreciation of manufactured assets or the depletion and deterioration of natural resources.	(Passport, 2023)	
Median disposable income per household (USD) **(disp)**	The median income is the number that separates the distribution of household income into two equal groups, with half having disposable income above that level and the other half having income below that amount.	(Passport, 2023)	+ (positive)
Unemployment Rate (% of economically active population) **(unemp)**	The unemployed population is represented by the unemployment rate as a proportion of the economically active population, also known as the labor force (the total number of people employed plus unemployed). The ILO international standard definition of unemployment is based on the following three criteria which should be satisfied simultaneously: "without work", "currently available for work" and "seeking work", so	(Passport, 2023)	- (negative)

	unemployment rate are the percentage of the labor force who are "seeking work", and are "without work" who are "currently available for work".		
Population Living Below International Poverty Line ($1.90 a Day) **(pov)**	Since 1999, the World Bank has evaluated as a "$1 a day" poverty limit, and the percentages of the population living on less than this agreed-upon quantity per day. According to the International Comparison Program, "$1 a day" refers to $1.08 in purchasing power parities (PPPs) in 1993 and $1.25 in 2005 prices, which has already been replaced by $1.90 in 2011 international pricing.	(Passport, 2023)	- (negative)
Inflation (% growth over previous period) **(inf)**	The annual average inflation rate represents the average percentage increase in the price of goods and services when comparing each month of the year to the same month the previous year. The information is updated twice a month.	(Passport, 2023)	- (negative)
Imports (USD million) (**imp**)	Imports encompass all goods that enter a country's economic territory. CIF (cost, insurance, and freight price) prices are used to value imported products.	(Passport, 2023)	+ (positive)
Exports (USD million) **(Exp)**	Exports encompass all goods that leave a country's economic territory. FOB (free on board) prices are used to value exported goods. FOB values include the transaction value of the commodities as well as the value of services performed to convey items to the exporting country's border.	(Passport, 2023)	+ (positive)

Table 1 – Definition of Terms

3. Literature Review

3.1 Economic inequality

Inequality can be defined as the disparity in economic conditions between different individuals or groups of people. Inequality is caused by the uneven distribution of income and opportunity, not by extremes of poverty or affluence, this unequal distribution may be the result of various societal circumstances (Champernowne & Cowell, 1998).

According to Knoop (2020), the real area of contention about how we measure inequality largely revolves around five eternal questions: "Who are we talking about? Where are we talking about? What are we talking about? When are we talking about? and how are we going to talk about it"? He asserted further these questions relate to inequality as it does to other empirical debates in the social sciences.

The most fundamental "who" question concerns whether we are attempting to measure inequality across individuals or households (Knoop, 2020). Individual inequality can be measured in a variety of ways which includes measuring wage and salary inequality across individual workers. It could also be measured in terms of gender (Hasanbasri, et al., 2022). The measurement of inequality across all individuals considering resources available to them, regardless of whether they work or not provides a more complete picture of welfarism (Knoop, 2020).

According to Kanbur (2016), household inequality postulated as intra-household inequality, is the most important "who" when measuring inequality, he supported this claim by saying neglection of intra-household inequality could lead to the following.

"(i) an understatement of inequality and an overstatement of the impact of growth on poverty reduction; (ii) a misstatement of the potential impact of minimum wage policies on poverty; (iii) mis-design of transfer policies to reduce inequality and poverty". He stressed further that, it will be unwise to discuss inequality while ignoring household inequality (Kanbur, 2016).

Women represent approximately 60 % of individual taxpayers in the bottom 50 % income bracket (Burkinshaw, et al., 2022).

Women's income growth in the top percentiles has counterbalanced the increase in income inequality that would otherwise have occurred over the last few decades. Critical analysis revealed that the increase in female employment between 1987 and 2004 reduced the increase in household earnings inequality (Burkinshaw, et al., 2022).

The role of geography in the context of inequality has been grossly underreported. Geography according to Knoop, is not only about country to country but also within the country and looking at the world as a whole (global inequality) (Knoop, 2020). Inequality among countries is decreasing in relative terms. After a period of rising international inequality, the relative gap in mean national incomes is narrowing (United Nations, 2021).The Gini coefficient of international inequality, calculated using population-weighted national incomes per capita, has dropped from nearly 63 in 1980 to 53 in 2010 (Milanovic, 2013). Between 1988 and 2008, the top 1% became significantly richer which in turn increased the rate to global inequality, on the other hand inequality was reduced by strong growth among large segments of the world population residing between the 40th and 60th percentiles (Milanovic, 2016).

In contrast to the position of Milanovic (2016), Knoop (2020) stated that the level of domestic inequality is much less than the difference among countries stating that the per capita income in the Democratic Republic of Congo is 180 times in favour of the USA. He also stated that between countries inequality is getting worse. This is obvious when a comparison between incomes of the richest and poorest countries are made.

3.2 Sustainable growth

Sustainability is the ability to continue or be continued for a long time while growth is an increase in economic activity. Sustainable growth can thus be defined as national output growth that meets current needs without jeopardizing future generations' ability to meet their own (Hornby, 1995).

3.2.1. Sustainable development goals

The sustainable development goals (SDGs) were introduced for implementation by the United Nations in the year 2015, the reasons behind the goals are a means to end world poverty, to protect the planet and that by the year 2030 everyone will enjoy peace and prosperity (United Nations Development Programme, 2022). There are 17 SDGs, as listed below:

1. No Poverty: The number one objective is to end extreme poverty by reducing among others poverty related vulnerabilities in all ramifications.

2. Zero Hunger: By ending hunger and achieving food security through promotion of sustainable agriculture so that there will be improved nutrition.

3. Good Health and Well-Being: The essence is to increase life expectancy by ensuring healthy living lives in order to promote good and sustainable healthy lives for all ages.

4. Quality Education: This is to ensure free quality education at both primary and secondary levels of education. The rationale is to bring about early childhood development and promote lifelong learning for all.

5. Gender Equality: This is to ensure gender equality and empowerment of the girl child through putting a stop to discriminating tendencies/policies against women by promoting equal opportunities to leadership roles.

6. Clean Water and Sanitation: This will be attainable through promotion of safe quality water for everyday use and to ensure proper hygiene.

7. Affordable and Clean Energy: This is the promotion of affordable, reliable and sustainable modern energy by eradicating dangerous cooking techniques.

8. Decent Work and Economic Growth: This is the enablement of sustainable economic growth and protection of labour right through ending of force labour.

9. Industry, Innovation, and Infrastructure: This is the enablement of sustainable and improved technology and industrialisation.

10. Reduced Inequalities: The import is to ensure reduction of inequalities through countries i.e. within and across countries and regions. This is to help in eradicating the dichotomy of living standard across regions and within countries.

11. Sustainable Cities and Communities: This is to make human settlements safer and green through usage of sustainable policies.

12. Responsible Consumption and Production: Ensuring sustainability in production and consumption through reduction of the impacts of negative environmental influences.

13. Climate Action: Through raising/increasing climate change awareness.

14. Life Below Water: By ensuring sustainability in the use of oceans, seas and marine resources for improved development.

15. Life on Land: This is to promote healthy living on land and ensuring sustainability of the land ecosystems.

16. Peace, Justice, and Strong Institutions: The essence is reduction of conflicts, insecurity and weak institutions by promoting peace and justice for all.

17. Partnership for the Goals: This is to ensure strong partnership and economic stability through global cooperation for the SDGs (United Nations, 2021).

3.3 Sustainable economic growth and Sustainable Development

Sustainable economic growth means a level of expansion that can be maintained without causing significant economic problems, especially for future generations. According to Espinosa et al., (2021) redistribution of goods by taxes, regulations, debt accumulation, deficit spending can be used to stimulate the economy post COVID-19. Economic growth is recognized as a crucial condition for poverty reduction because of its capacity to generate wealth and employment, however it is grossly inadequate to distribute income in a balanced manner (Stiglitz , 2016).

To achieve the goals of sustainable development, an implementation strategy is required, which should focus on five aspects: equity, participation, diversity, integration, and long-term perspectives (Ginting, 2020).

Sustainable growth is essentially the non-decreasing path of consumption or GDP, or other indicators of economic well-being, whereas, sustainable development, is the non-decreasing path of well-being over time. It necessitates not only economic but also environmental and social sustainability. Thus, the pursuit of sustainable development is dependent on governance's ability to ensure economic growth that is compatible with social equity and ecosystems via an appropriate trade-off between the economy, society, and environment (Dragulanescu & Dragulanescu, 2014).

3.3.1 Why is sustainable growth important?

In the last 40 years we have seen strong increment in economic growth in most parts of the world except the Caribbeans, Latin America and the advanced world. According to Asafu-Adjaye & Mahadevan (2012) the average growth rate in the East Asia and Pacific (EAP) region has increased from 6.6 percent per year in the 1970s to 9.0 percent in the 2000s, the South Asian economic growth has more than doubled in the last decade, from an average of 3 % per year in the 1970s, while growth in Sub-Saharan Africa (SSA) has been less spectacular during this period but has picked up in the last decade. The early stages of economic growth according to the theories of economic growth, see both poverty reduction and increased inequality. However, the degree of inequality in any country reflects the type of political-economic system in place. When a country invests in human capital and institutions to promote socio-economic mobility, the degree of absolute poverty decreases and income distribution becomes more equitable, making economic growth more probable to be shared (Hess, 2016).

3.4 Measuring economic growth.

Economic growth occurs when there is an increase in real national income per capita i.e., $\frac{\partial y}{y} > 0$. This presupposes that to have economic growth the real national income has to increase much rapidly than population. Hess (2016) opined that if real income grows more rapidly than population, we have positive economic growth including an increase in per capita income. However, albeit with positive output growth, we can have negative economic growth or economic decline if population increase surpasses income growth i.e.

$\frac{\partial p}{p} > \frac{\partial y}{y} > 0$– Economic growth

$then \ \frac{\partial y}{y} < 0$ – Economic decline

When, $\frac{\partial y}{y}$ – is change in real national income.

$\frac{\partial p}{p}$ – is the change in population

3.5 National income

National income measures the overall economic activity at a given time (Krabbe & Heijman, 2012). National income can be measured in one of two ways according to Kurihara (2012). On one hand, it can be done by adding all profits, rents, interest and wages received by all the factors of production in a given time. The sum of the income factors (i.e., all profits, rents, interest, and wages) equals the net national product (NNP). NNP is determined by calculating the aggregate expenses incurred by producers for using specific factors of production (including direct taxes levied on productive factors such as corporate profit tax and social-insurance contributions). On the other hand by subtracting from net national product (at market prices) the following (a) indirect taxes, such as cigarette sales taxes (b) business transfer payments, such as Christmas bonuses paid by private employers to their employees and business contributions to non-profit organizations such as churches, schools, and charities, and (c) the accounting profits of government-operated enterprises such as nationalized railways, but with government subsidies such as those paid to shipbuilders, airlines, and farmers added. The net national product is typically measured in terms of current market prices; however, the principle of avoidance requires the deduction of indirect taxes that are included in consumer prices (Kurihara, 2012).

Income mobility is the ability of individuals to move up and down income tree over time and during their lifetime. If there is little income mobility, people's stations in life are predefined to a large extent, and their incomes are not simply a consequence of their very own work, effort, and abilities, but as a result of the income class into which they have been born. More churning and greater income mobility may be more consistent with a meritocratic system in which people's income class reflects their socioeconomic contributions (Schad, 2016).

3.5.1. Income poverty

The headcount index (the absolute number of poor in a country or region), the incidence of poverty (the percentage of a population that is poor), and the poverty gap (the mean shortfall as a percentage of income from the poverty line) are all measures of income poverty (Odekon, 2006). The poor's income tends to rise in tandem with economic growth. Economic growth rates, on the other hand, vary over time and across nations. Furthermore, the magnitude of poverty reduces with respect to economic growth is determined in part by income distributions within respective nations, as well as the structures in place and fiscal and monetary policies implemented (Hess, 2016).

3.6 Measurement of economic inequality

3.6.1. What are measured in economic inequality?

Income data, pay (earnings) data, wealth data, and consumption data are the most commonly used data to measure economic inequality (Knoop, 2020). Further buttressing this point (Trapeznikova, 2019) elucidated that significant consideration of what to measure such as pre-tax and after-tax income, consumption, and wealth are useful indicators, and multiple sources of income such as wages, capital gains, taxes, and benefits can be reviewed.

In terms of income, this is an index that will serve to represent a person's overall well-being in society. A number of personal economic characteristics come to mind, such as wealth, lifetime income, weekly or monthly income (Cowell, 2011).

Income inequality could be measured in different ways, such as, income decile ratio, Gini coefficient, Atkinson index, coefficient of variation, generalized entropy, Kakwani index, proportion of total income earned, Robin Hood index and Sen index of poverty (De Maio, 2007).

Income decile ratio according to (The World Bank , 2022) is a simple and popular measure of inequality that uses and compares the ratio of the average income or consumption of the

richest 10 % to that of the poorest 10 %. This ratio is easily understood by multiplying the rich income by the poor.

Another well used measure is the Gini coefficient (Graph 1) utilizes the Lorenz curve framework which says that in a perfectly equal society, the poorest 25 % of the population should stand to get 25 % of the over-all income, the poorest 50 % should stand to get 50 % of the over-all income, and the Lorenz curve would take the route of the 45° line of equality, but as inequality increases the more the curve will move from the base line meaning less of the over-all income will go to the poorer people (De Maio, 2007).
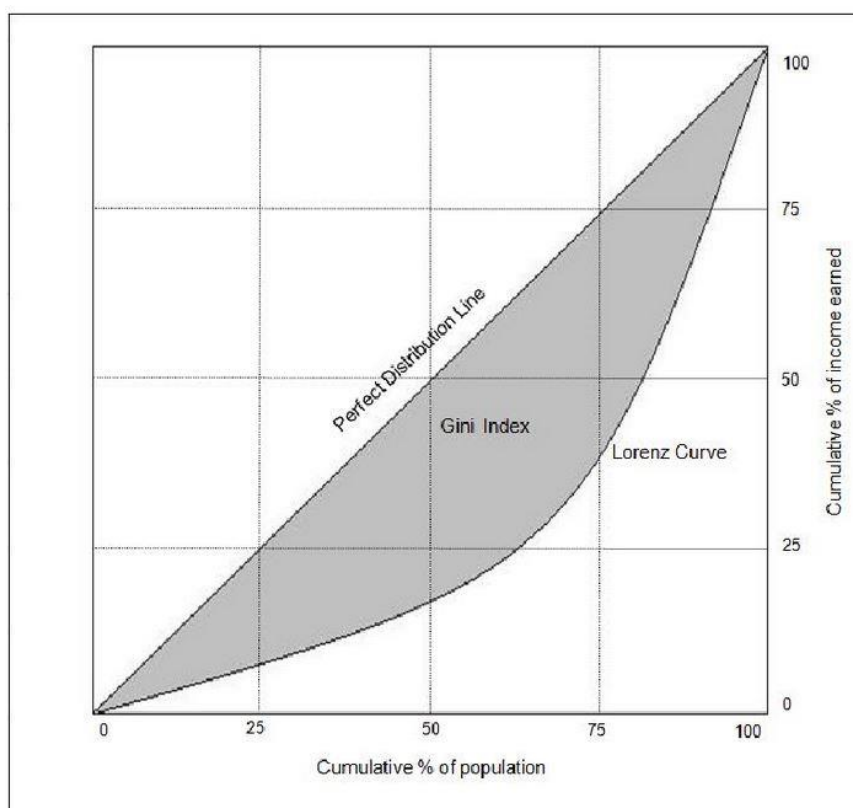
Lorenz Curve and Gini Index

(De Maio, 2007)

Graph 1 - Lorenz Curve and Gini Index

Pay, also known as earnings, is monetary compensation for labour. Wages and salaries are included in pay data, but capital income from savings and corporate profits are not. It is data related to the job, not necessarily a specific individual (Knoop, 2020).

3.6.2. When are we **measuring economic inequality?**

Time is important because our inequality data are always associated with a specific point in time, they are usually snapshots, not films therefore, time must always be considered. As a result, if we made a graph of everyone's incomes from lowest income to highest, this graph could look the same year in year out, but different groups of individuals would have moved to different points on the graph (Knoop, 2020).

In the United States, well-being has declined over the last quarter of the century, while in the United Kingdom, life satisfaction has remained relatively constant over time (Blanchflower & Oswald, 2004). Many people begin with low incomes, and gradually see their incomes rise until they approach retirement age, and from then start to see their incomes fall. This implies that individual income seems to be hump-shaped over a lifetime, and demographic characteristics such as population age can influence overall income inequality at any given time (Huggett, et al., 2011).

3.6.3. How are we going to **measure economic inequality?**

There are three notable ways of measuring inequality. The first which is the most popular, is the summary inequality measure, the next is the quantile- based measure. The third is the less used relative distribution method (Hao & Naiman, 2010).

The summary inequality measures have been widely used by researchers they include logarithm variance, Gini coefficient, the Theil inequality index, the Atkinson index, the coefficient of variation, and the generalized entropy among others (Silber, 1999).

The quantile-based measure makes use of quantile regression to show a more detailed understanding of inequality (Hao & Naiman, 2007).

Relative distribution methods are a nonparametric statistical framework that can be used to analyse data in a fully distributional context. The framework combines exploratory data analysis graphical tools with decomposition, statistical summaries, and inference. A density ratio is analogous to the relative distribution (Handcock & Morris, 1998).

Atkinson index is in the broadest sense, the normalised ratio of the equally distributed equivalent level of wealth to the mean of the actual wealth distribution (Atkinson, 1970).

The Atkinson index ranges from 0 to 1 and rises with inequality. It is equal to zero in the case of complete equality, that is, when all individuals have the same (positive) wealth and tends to one in the case of complete inequality, that is, when one person has all of the wealth and everyone else has nothing (Costa & Pérez-Duarte, 2019).

The Atkinson index value can be interpreted in terms of the previously described equally distributed equivalent. For example, an Atkinson index of 0.6 implies that if wealth were dispersed equally, the same level of social welfare could be achieved with only 40% of total wealth (Costa & Pérez-Duarte, 2019).

Coefficient of variation is another measure of income inequality as mentioned above, it is simply estimated by dividing the standard deviation of income distribution by its mean, the more equal the income distributions the smaller standard deviations will be which results in a smaller coefficient of variation in more equal societies (Cowell, 2011).

The generalized entropy index (GE) measures the inequality in benefit b for the predicted label compared to the observed label. A benefit occurs when a false positive is predicted. (Tamás & Zoltan , 2020). In the case of complete equality, that is when all individuals have the same wealth, the Generalised Entropy indicators are equal to zero (Costa & Pérez-Duarte, 2019).

The Gini framework serves as the foundation for the Kakwani index, also known as the Kakwani progressivity index was originally designed to assess the progressivity of taxation systems, a higher index value indicates greater inequality in the distribution (Kakwani, 1977). In theory, Kakwani index values range from 2 (indicating severe regressivity) to +1 (indicating no regressivity or strong progressivity), meaning the closer to 2 the value the more inequality there is in the system (Wagstaff & Eddy, 1992).

Robin Hood index (Graph 2) is also known as Pietra ratio or Hoover index or the Schutz index is the maximum vertical distance between the Lorenz curve and the 45° line of equality as shown in graph 8 (Atkinson & Micklewright, 1992). The Robin Hood index is so named because it can be interpreted as the proportion of income that must be transferred from those above the mean to those below the mean in order to achieve an equal distribution (Kondor, 1971).

As a result, higher Robin Hood values indicate a more unequal society in which a larger share of income is required to achieve equality. Unlike the Atkinson and GE indexes, the Robin Hood framework does not include a sensitivity parameter and as such it has been utilized effectively in several studies of the income inequality hypothesis. (De Maio, 2007).
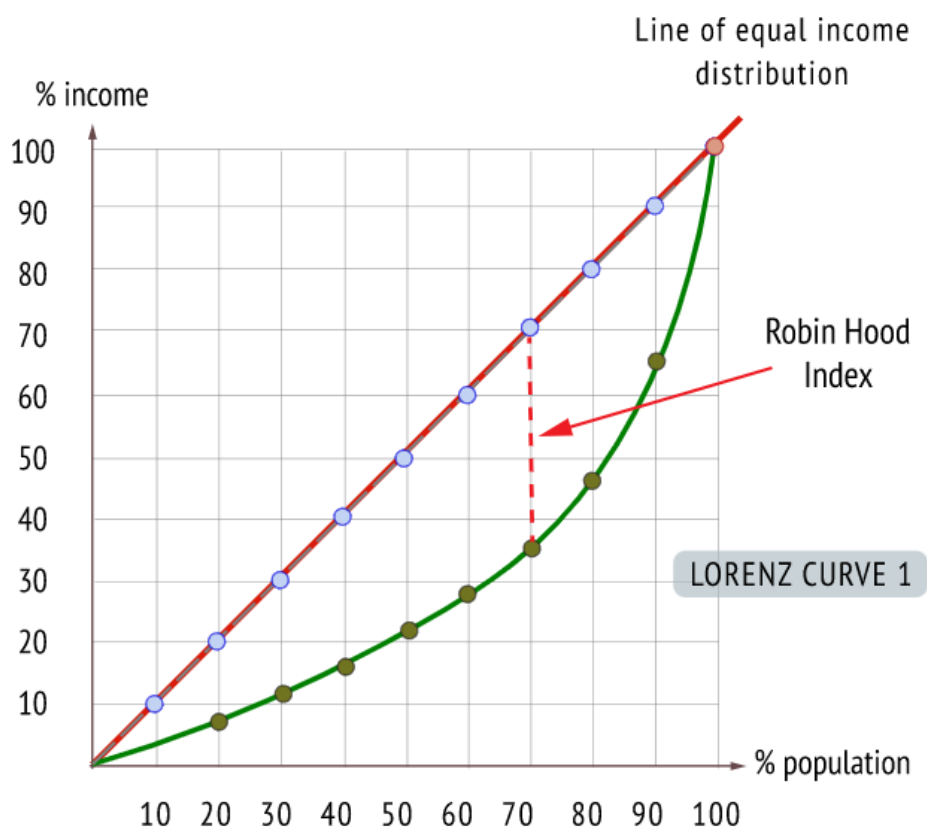
Graph 2 - Robinhood index

3.6.4. Inequality Profile across the globe

Within the EU, on an average, inequality within countries has hardly increased, the average of the national S80/S20 ratios has remained at about 5 (Carmo, et al., 2018). Carmo, et al. (2018) further explained that although the averages remained at about 5, this hides the substantial disparities seen within the EU. Carmo, et al. (2018) stated that between the years 2007 and 2013, the S80/S20 ratios increased by over 15 % in Croatia, Denmark, and France, and by about 10 % in Greece, while it had decreased by more than 10 % in countries like Romania, and the Netherlands.

In Africa, the richest 0.0001 % own 40 % of the continent's wealth. Africa's three richest billionaire men (Aliko Dangote, Nicky Oppenheimer and Nassef Sawiris) are worth more than the bottom 50 % of Africa's population, or almost 650 million people. Africa is quickly becoming the ground zero of the world's extreme poverty (Seery, et al., 2019).

26

While Asia has seen tremendous declines in the number of people living on less than USD1.90 per day, Africa is seeing an upsurge, if current patterns continue, the World Bank estimates that 87 % of the world's extreme poor will be in Africa by 2030 (Seery, et al., 2019). Since 2017, the lowest three income quintiles in Canada have experienced the fastest growth as shown in Graph 3. In the same breath, households in the lowest income quintile have seen the greatest increase in financial assets as can be seen in Graph 6 with more than double between 2010 and 2021 (Burkinshaw, et al., 2022).
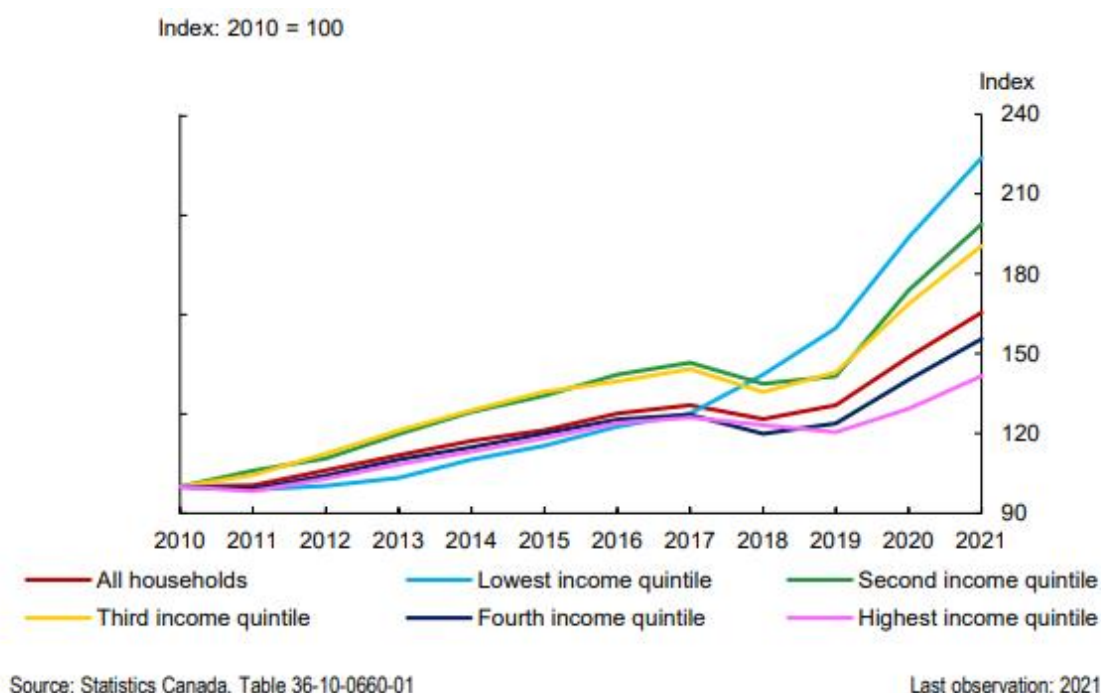
Graph 3- Wealth per household in Canada 2010-2021

In Colombia, the Gini coefficient as of 2020 stands at 54.2 percent an increase from 2017 figures of 49.7 percent which is the lowest point since world bank started collecting Gini index data in Colombia 1999. While in Brazil, the Gini coefficient as of 2020 is at its lowest since world bank started collecting Gini index figures in Brazil which was in 1992 (Worldbank, 2020).

Generally, within Latin America, between 2003 and 2012, the region's indicators of global inequality fell significantly. The reduction in global inequality is primarily explained by the reduction in inequality within Latin American countries. Although differences in average incomes between countries have increased, the incomes of Latin Americans are now more equal in relative terms than a decade ago (Amarante, et al., 2016).

27

Income Share Held by Lowest 20 % from 2009 to 2020 in Colombia
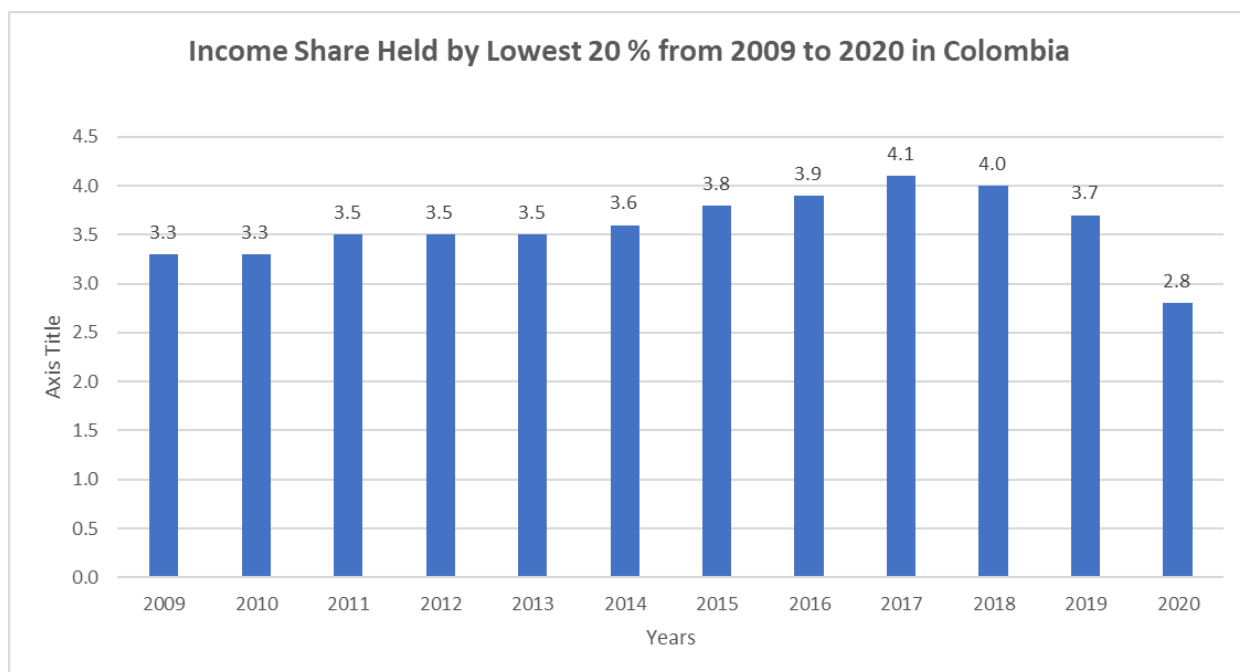
Graph 4 -Income Share Held by Lowest 20 % from 2009 to 2020 in Colombia

Graph 4 shows the income share recorded for Colombia between 2009 and 2020. Income share held by lowest 20% was reported at 2.8 % in 2020, that is the bottom 20 % made only 2.8 % of the income. In Colombia, these figures are less than the previous year figures of 3.7 %. Colombia income share held by lowest 20 % has an average of 3.5 % from Dec 1992 to 2020, with 22 observations. The highest figure within the 20 observations was in 2017 with 4.1 % and the lowest figure of 1.9 % was achieved in 2000 (CEIC, 2020).

Colombia had a gender gap index score of 0.71 in year 2022, with 0.73, 0.76 and 0,73 in the years 2021, 2020 and 2018 respectively. The gender gap index score of 0.71in year 2022 represents a 29 percent gender disparity (i.e., women are 29 percent less likely than men to have equal opportunities) the score is lower than the previous year, indicating that gender equality has deteriorated slightly (Statista, 2022).
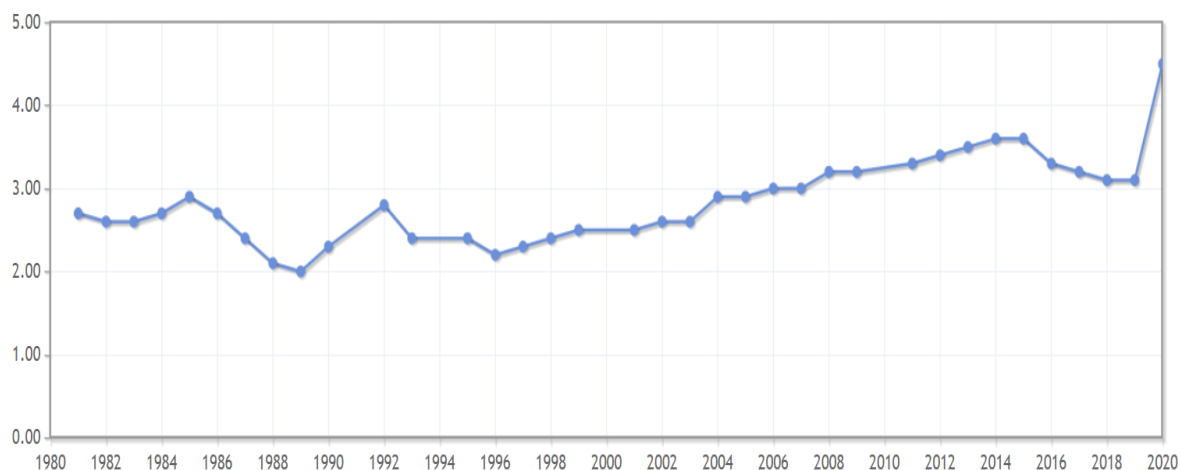
Graph 5- Income share held by lowest 20 % in Brazil from 1981 to 2020

As can be seen in Graph 5 the income share held by lowest 20 % in Brazil was reported at 4.5 % in 2020, that is the bottom 20 % made only 4.5 % of the income in Brazil. These figures are more than the previous year of 3.1 %, the figures also stood at 3.1 % also in 2018, and 3.2 % and 3.3 % in 2017 and 2016 respectively (Worldbank, 2020).

Brazil in 2022, had an overall gender gap index score of 0.696, indicating a gender gap of approximately 30 % i.e., women are 30 percent less likely to have the same opportunities as men). Brazil also having similar figures in 2016, 2017, 2018, 2020 and 2021 as 0.69, 0.68, 0.68, 0.69 and 0.7 respectively (Statista, 2022).

Income quintiles share ratio (S80/S20) in the Czech Republic was 3.43 in December of 2021, it was at its highest ever in December of 2005 with a ratio of 3.67 and lowest in December of 2018 with a ratio of 3.32 (Eurostat, 2022). Women in the Czech Republic earn 21.8 % less than their men counterparts on average; while we have 64 % of women working as compared to 79 % of men who work (Lánský & Tomková, 2018). In 2019, income share held by lowest 20 % was reported at 10.1 % in the Czech Republic, that is the bottom 20 % made only 10.1 % of the income, these figures are less than 2017 figures of 10.2 % but greater than the 2016 figures of 10% (Worldbank, 2020).

While in Germany, the income quintiles share ratio (S80/S20) was 4.88 in December of 2021, it was at its highest ever in December of 2014 with a ratio of 5.12 and lowest in December of 2005 with a ratio of 3.79 (Eurostat, 2022). In terms of gender, the quintile share ratio in 2021 showed a ratio of 4.96 in males and 4.81 in females (Eurostat, 2022). Between 2009 and 2021, wealth inequality slightly decreased, however it remains high overall. Over the

evaluation period of 2009 till 2021, the top 10 % of the net wealth distribution held more than 50 % of households' total net wealth in Germany, while the bottom half of the wealth distribution accounted for an extremely small share, averaging 0.6 % based on the current monthly report posted at the end of 2021. However, the share of total net wealth held by the less wealthy 50% of households increased from 0.2 % in 2009 to more than 1.2 % in 2021, according to the report (Deutsche Bundesbank, 2022). In 2018, income share held by lowest 20 % was reported at 7.8 % in the Germany, that is the bottom 20 % made only 7.8 % of the income, these figures have remained the same since 2015 (Worldbank, 2020).

Power of Parity Report done by McKinsey's Global Institute, reported by Moodley, et al., 2019 posited that Africa's gender parity is 0.58. (1 would be full parity), it further stated that in Africa, 70 % of women are financially excluded. The continent's financing gap between men and women is over USD 42 billion as at 2019 (Moodley, et al., 2019).

In South Africa, the income quintiles share ratio (S80/S20) was 32.4 in December of 2021 which was the highest of the selected countries picked by OECD as shown in Graph 6 (OECD, 2021).
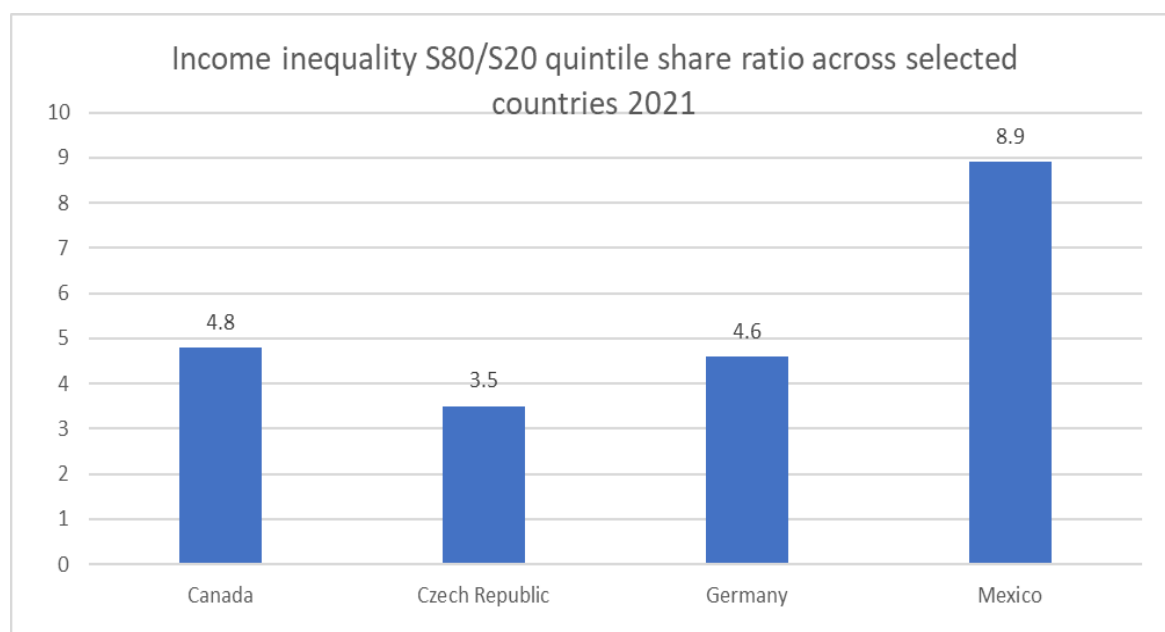
Source - (OECD, 2021), Collated by me

Graph 6 - Income inequality S80/S20 quintile share, ratio across selected countries
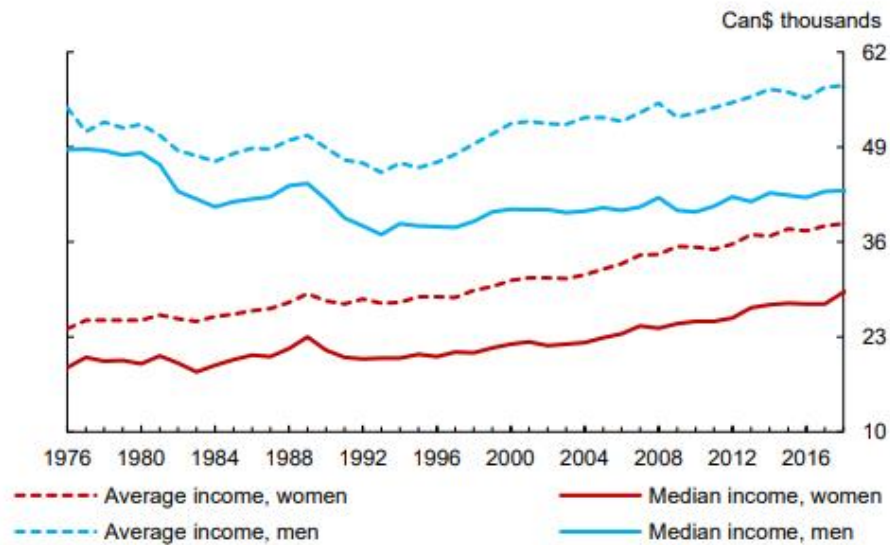
Source: Statistics Canada, Table 11-10-0239-01   Last observation: 2019

Graph 7 - Market income for men and women, 16 years and over in Canada

In Mexico, inequality increased between 1989 and 1994, then declined between 1994 and 2006, and thereafter increased again between 2006 and 2014 (Campos-Vázquez, et al., 2018). However, Amendolara (2022) had a slightly different outlook to inequality. She opined that from 1996 to 2018, Mexico experienced a slight reduction in inequality, as evidenced by the Gini coefficient falling from 54.8 percent in 1996 to 45.4 percent in 2018 (Amendolara, 2022).

In Mexico, the income of the wealthiest 10 % of the population is 2.25 times that of the poorest 40 % of the population, whether male or female (Ramos, et al., 2020). Furthermore, Mexicans received 0.5 wage equality for comparable work, indicating a gender disparity of approximately 50 % i.e., women are 50 percent less likely than men to receive an equal wage for similar work (Statista, 2022).

The same situation plays out in Canada as depicted in Graph 7. These numbers also varied along different professions in Mexico as seen in the graph 8, with an average overall score of 0.6 showing a massive wage disparity in terms of gender pay gap in Mexico (Statista, 2022).
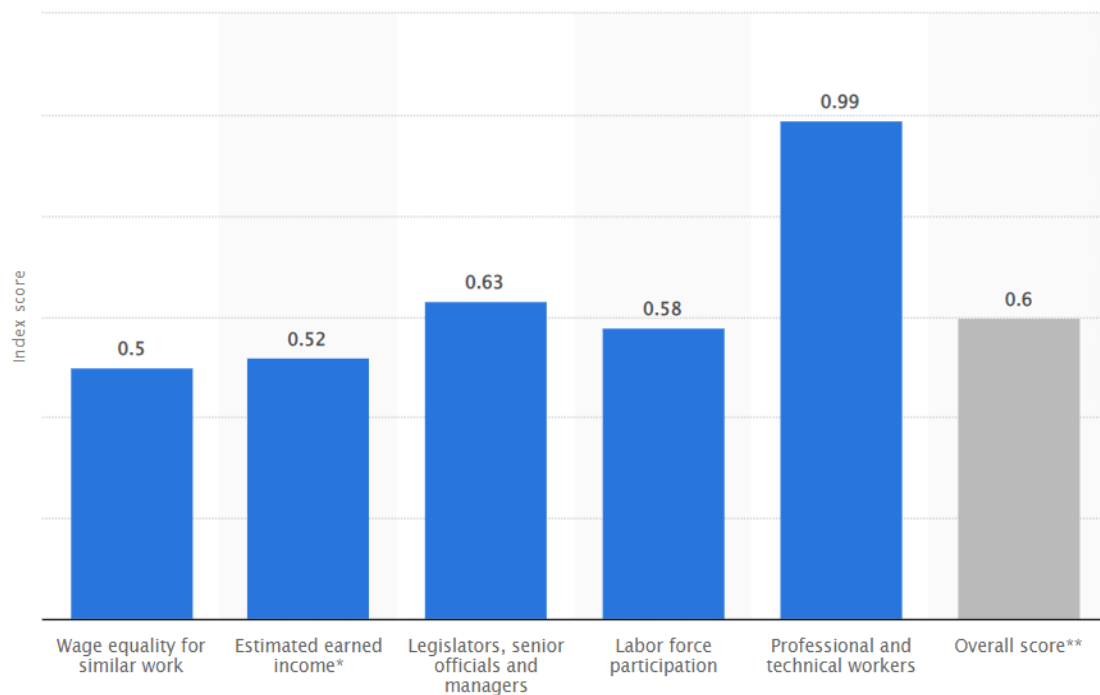
Graph 8 - Mexico: labour market gender gap index 2022, by area

According to the World Economic Forum's Global Gender Gap Report 2022, India ranks 136th out of 146 countries, with a score of 0.629, the Global Gender Gap Report includes scores on the Global Gender Gap Index (GGGI), which examines the gender gap in four dimensions: economic participation and opportunity, educational attainment, health and survival, and political empowerment (Weforum, 2022). In contrast to 2021 when India had a score of 0.625, and 2020 with 0.668 India's score has declined dramatically, owing primarily to the Political Empowerment dimension (Weforum, 2021).

Graph 9 shows the initial increase of the income share for the lowest 20% from 8.7% in 1987 to 8.9% in 1993 then went on a steady decline till 2011 with figures of 8.1% (The World Bank, 2018).
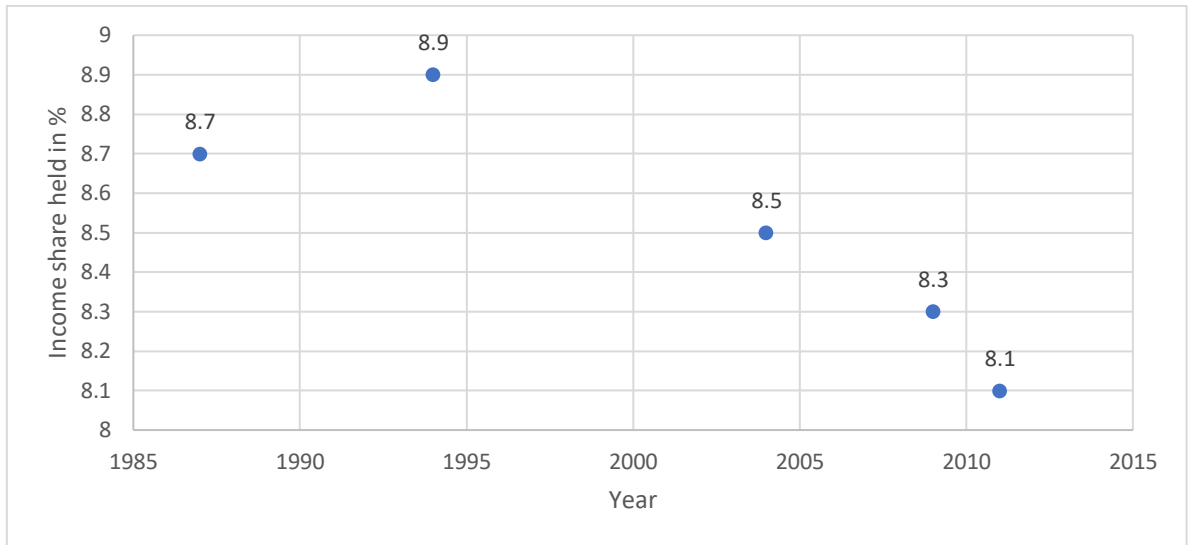
Graph 9 - Income share held by lowest 20% in India from 1987- 2011.

In Vietnam the wage disparity between men and women has persisted, and it is now 13.7% for formal workers with the gender earnings gap is 29.5% in general with a gap of 21.5% in urban areas and 35.2% in rural areas according to the Vietnam General Statistics Office (United Nations, 2021).

Liu (2004) opined that the Doi Moi reforms (the renovation" or "innovation" reform done in 1986 in Vietnam with the goal of creating a socialist-oriented market economy) appear to have been associated with a noteworthy decrease in wage disparities between men and women.

Between the years 1993 and 2002, the average gender pay gap in this sector was cut in half, with the majority of the reduction visible by 1998, Also gender pay gap has also narrowed at most selected points along the conditional wage distribution, with the effect being most pronounced at the top of the conditional wage distribution , with all this positives the decomposition analysis indicates that the treatment effect is relatively stable across the conditional wage distribution and that there is little evidence of a treatment effect (Liu, 2004).

Graph 10 - Income share held by lowest 20% from 1992 to 2014 in Vietnam.
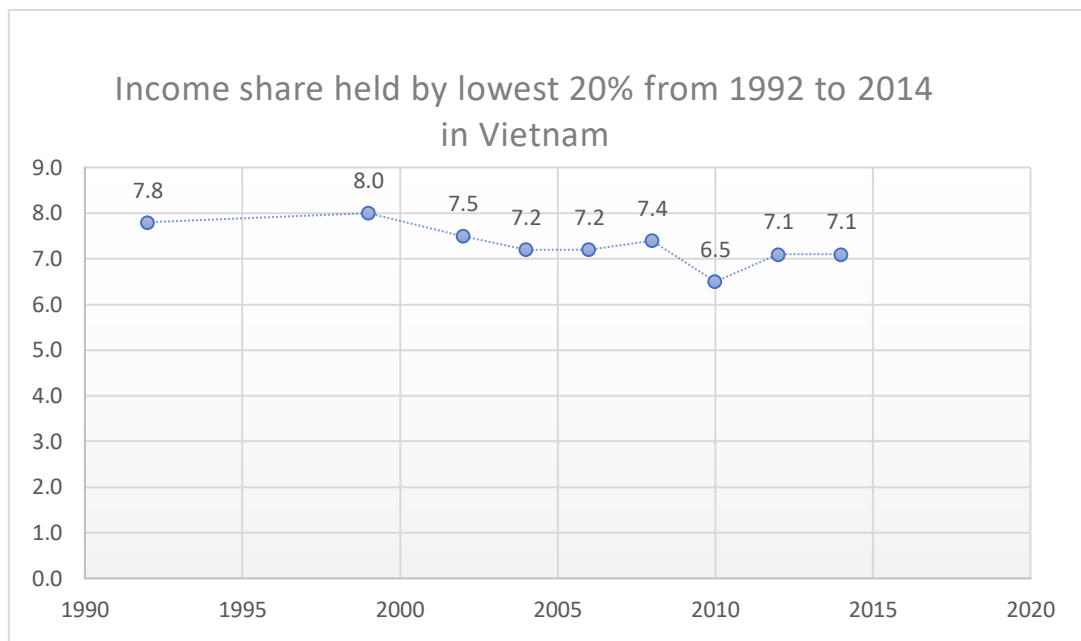
Source - (World bank, 2018) collated by me

Graph 10 - Income share held by lowest 20% from 1992 to 2014 in Vietnam.

The graph 10 above shows the Income share held by lowest 20% from 1992 to 2014 in Vietnam, the income share for the lowest 20% was at its highest levels 8% in 1998 and the lowest in 2010 with 6.5% and with the latest figure at 6.7% (World bank, 2018).

As can be seen from graph 11, North America has closed the greatest proportion of its gender gap, at 76.9% and is closely followed by Europe, which has closed 76.6% of the gap, Latin America and the Caribbean have closed their own gap by 72.6%, we then have Central Asia, East Asia and the Pacific, with 69.1% and 69% respectively, Sub-Saharan Africa ranks sixth with a parity rate of 67.8%, Middle East and North Africa trail Sub-Saharan Africa by more than 4 percentage points, having closed 63.4% of its gender gap. Lastly, with a gender parity measure of 62.4%, South Asia has the lowest performance of any region

Gender Gap Closed to date , by region

Region	Percentage Points
South Asia	62.4
Middle East and North Africa	63.4
Sub Saharan Africa	67.8
East Asia and the Pacific	69
Central Asia	69.1
Latin American and the Caribbean	72.6
Europe	76.6
North America	76.9
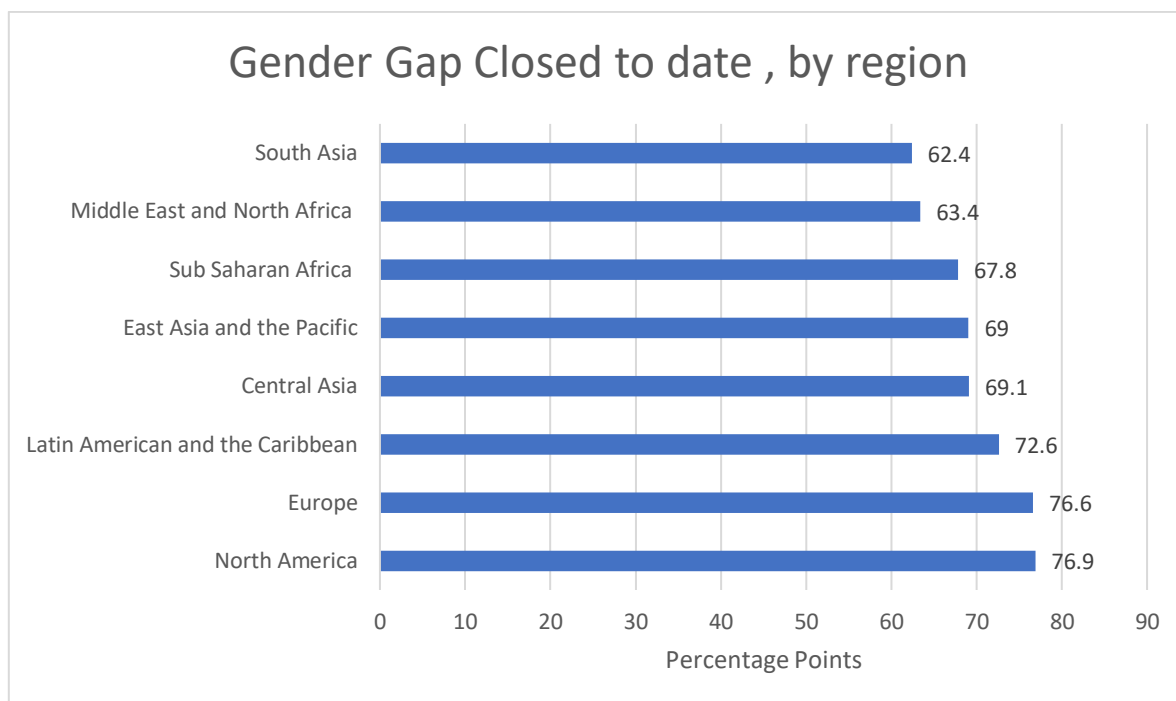
(Weforum, 2022)

Graph 11- Gender gap closed by region for 2022

The graph 12 below shows the income share ratio of bottom 40% / top 10% for the world for the year 2021. It shows the income share of the bottom 40% of the 115 countries used in the study to stand at 8.4% while the top 10% had 47.5% of the income, the income share ratio of the income share ratio bottom 40% / top 10% is 0.189 (all for the 115 countries) (UNDP, 2022).
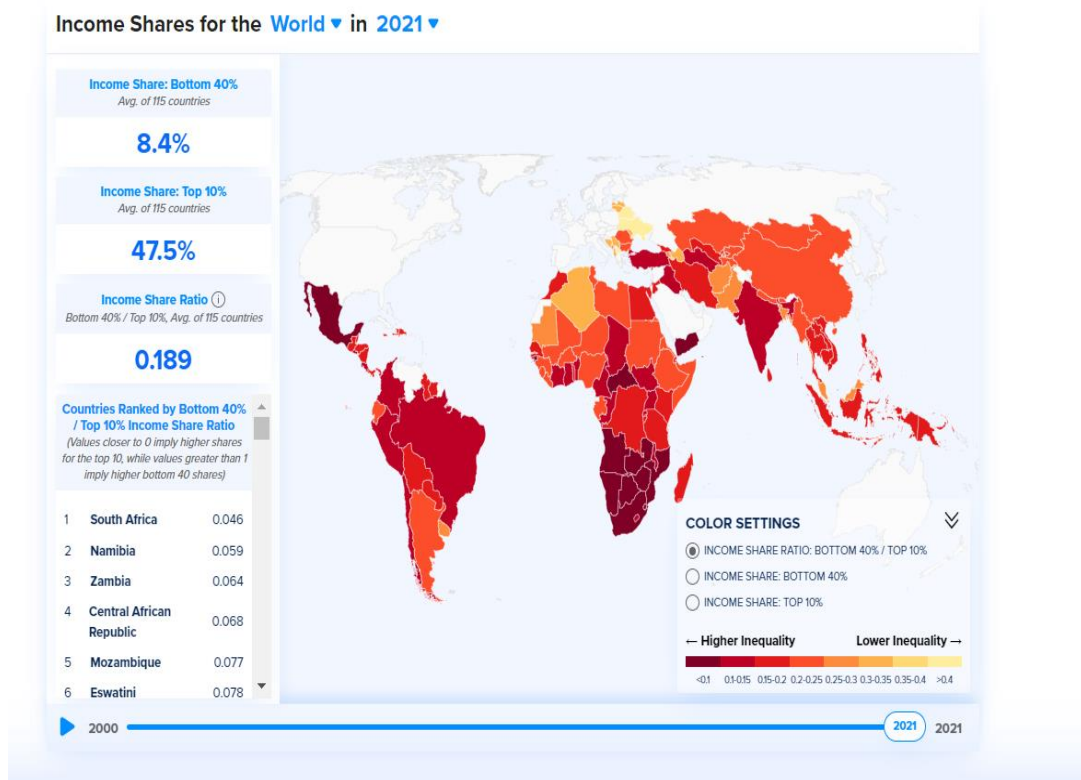
Graph 12 - Income share for the world bottom 40% to the top 10%

The graph 12 also shows the density of the inequality on the map for the 115 countries, with the lighter red/yellow countries lowest inequality (income share ratio of bottom 40% / top 10%) and the darker red being the countries with the highest inequality (income share ratio of bottom 40% / top 10%) (UNDP, 2022).

4. Practical Part

The Practical aspect of this study showed the relationship between inequality and sustainable growth in 10 countries Brazil, Canada, Colombia, Czech Republic, Egypt, Germany, India, Mexico, South Africa and Vietnam selected across 5 continents.

4.1 Brazil

Brazil's economy has historically been known to be the largest in Latin America (Teresa Romero, 2022).

Brazil has the third largest economy in the Americas, the economy is a developing mixed economy with a middle income, according to the International Monetary Fund (IMF). Brazil will have the world's 12th largest GDP and the world's 8th largest purchasing power parity in 2022, Also a member of the World Trade Organization (WTO), BRICS, and G20 (IMF, 2022).

As can be seen in Graph 13 below Brazil had a steep rise in its real GDP from 2002 and hit its highest figures at 2011 with 2,616,808.2 million USD with a gradual decline and rises from then to the present 1,907,380.9 million USD in 2022.
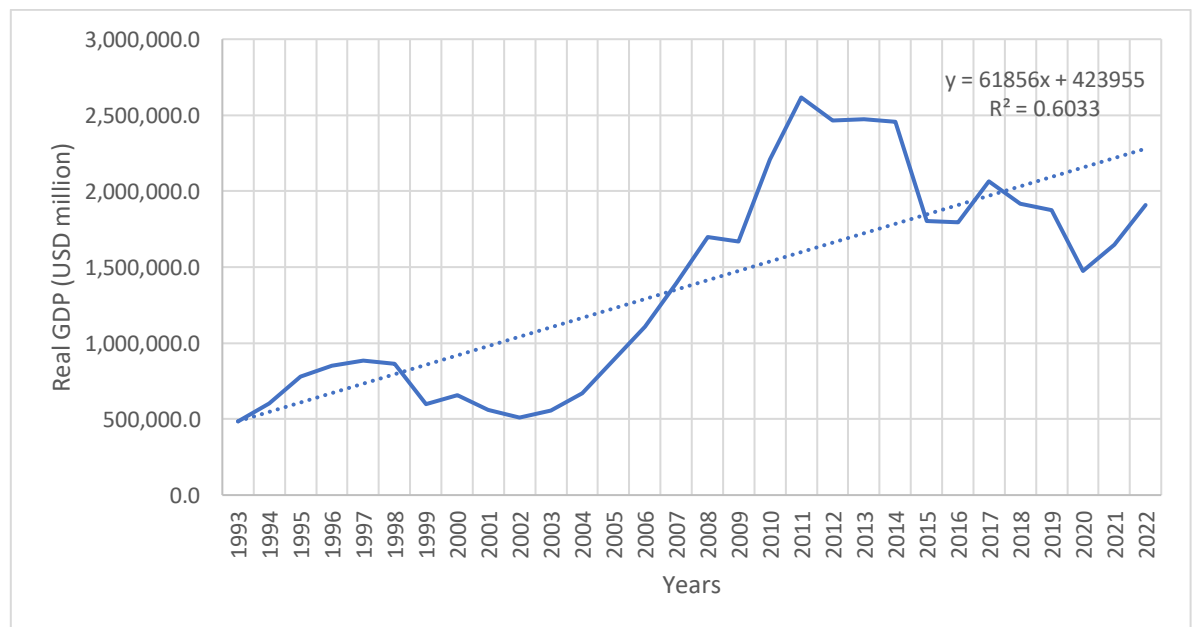
(Passport, 2023) collated by me

Graph 13 -Brazil Real Gross Domestic Product (GDP) (USD million) for 1993-2022

Brazil Inflation for *1993-1997*

y = -607.16x + 2669.2
R² = 0.733
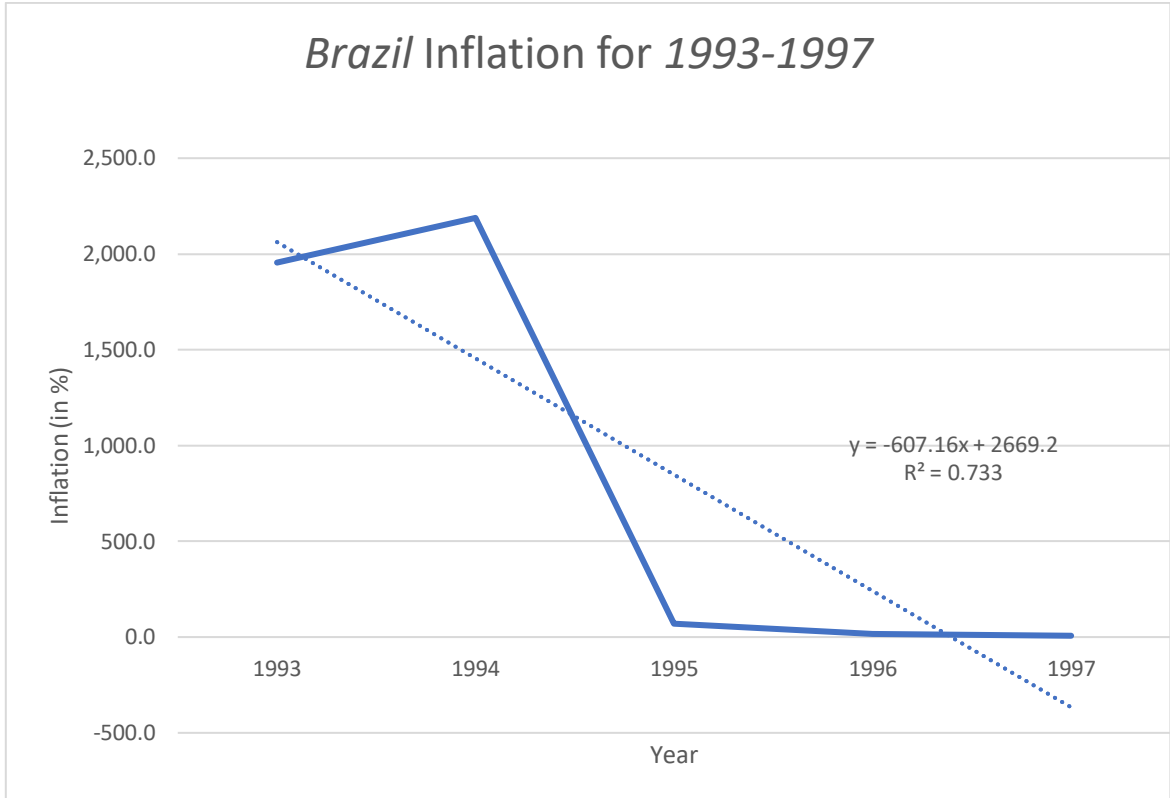
(Passport, 2023) *collated by me*

Graph 14 a Brazil inflation rate (in %) for 1993-1997

Brazil Inflation for *1996-2022*

y = 7669.4x + 29824
R² = 0.7071
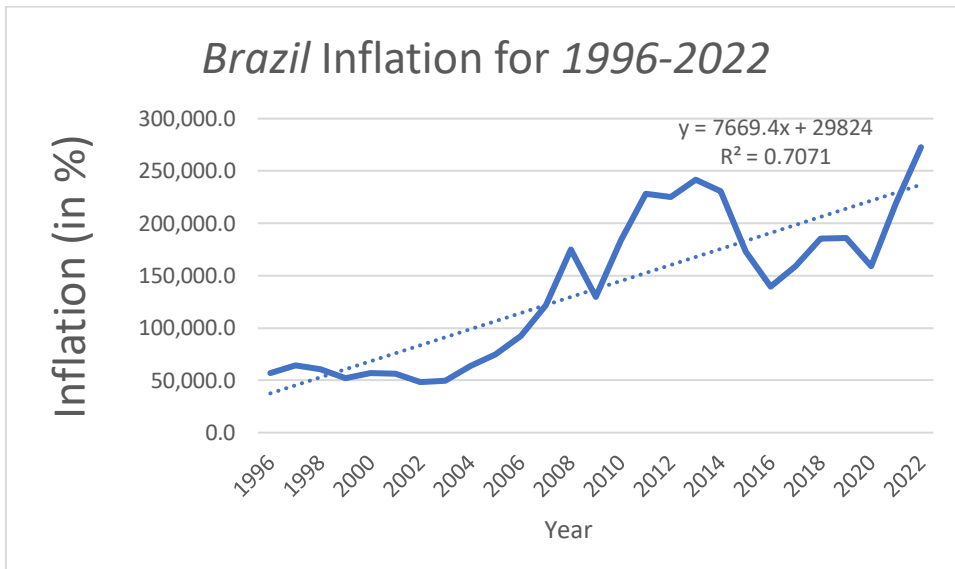
(Passport, 2023) *collated by me*

Graph 15 b Brazil inflation rate (in %) for 1996-2022

In the Graph 14a above we can also see the steep drop in 1994 from 2,188.4% to 7.1% in 1995 and was on a gradual decline with little ups and down and is currently 9.3 %.

Variable	Mean	Std Dev	Variance	Median	Coeff of Variation
Real GDP (USD million)	1382726.35	701053.9	4.91477E+11	1435147.3	50.7008441
Median Disposable Incom	10248.84	4465.64	19941912.38	10239.55	43.5721339
Unemployment Rate (% o	9.8145667	2.046593	4.1885428	9.752	20.8526066
Population Living Below I	5.5966667	2.123186	4.5079195	4.95	37.9366202
Inflation	146.4847333	524.5522	275155.02	6.6165	358.0934292
Imports (USD million)	127406.9	74856.08	5603433008	125719.75	58.7535526
Exports (USD million)	147980.46	86767.42	7528584908	155804.05	58.6343741

Source Result of Data from SAS done by me

Table 2 - Summary Statistics of Brazil data from 1993-2022

In table 2 above we can see the summary statistics of the population living below international poverty line ($1.90 a Day), unemployment rate (% of economically active population), inflation, median disposable income per household (USD), the real gross domestic product at purchasing power parity (GDP-PPP) as the imports and exports (USD). We have all but inflation with a coefficient of variation greater than 100 meaning the standard deviation exceeds the mean value as can also be seen in table 2 above and also in graph 14 above. The table shows also relatively high standard deviation values meaning the data are more spread out which also can be explained in the graph 13 and 14 above.

Correlation of Estimates							
Variable	Intercept	Median Di:	Unemploy	Populatior	Inflation	Imports (US	Exports (USD million)
Intercept	1	-0.6685	-0.6939	-0.9068	0.1757	-0.096	-0.1164
Median Disposable Inc	-0.6685	1	0.3693	0.5771	-0.1331	-0.4272	0.3441
Unemployment Rate (9	-0.6939	0.3693	1	0.3532	0.344	0.4646	-0.4407
Population Living Belov	-0.9068	0.5771	0.3532	1	-0.4713	-0.0711	0.3561
Inflation	0.1757	-0.1331	0.344	-0.4713	1	0.3247	-0.4813
Imports (USD million)	-0.096	-0.4272	0.4646	-0.0711	0.3247	1	-0.899
Exports (USD million)	-0.1164	0.3441	-0.4407	0.3561	-0.4813	-0.899	1

Source Result of Data from SAS done by me

Table 3- Brazil correlation table

Table 3 shows correlation between the independent variables. All are all weak (0.2-0.39) or moderate (0.4-0.59) positive or negative correlations meaning the correlation except the correlation between import and export which is a strong negative correlation.

Below in table 4 we have the linear regression model analysis of Brazil; Equation of the Linear Regression is;

$$y = 431799 + 113.0813\ disp - 2365.78\ unemp - 66015\ pov$$
$$+ 102.0517\ \text{inf} + 0.84461\ imp + 0.41966\ exp$$

Y - Real GDP (USD million)

Disp - Median disposable income per household (USD)

Unemp - Unemployment Rate (% of economically active population)

Pov - Population living below international poverty line ($1.90 a Day)

Inf - Inflation

Imp - Imports (USD million)

Exp - Exports (USD million)

Number of Obse	30					
Number of Obse	30					
Analysis of Variance						
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	
Model	6	1.42E+13	2.37E+12	1229.44	<.0001	
Error	23	4.43E+10	1.93E+09			
Corrected Total	29	1.43E+13				
Root MSE	43888	R-Square	0.9969			
Dependent Mea	1382726	Adj R-Sq	0.9961			
Coeff Var	3.17401					
Parameter Estimates						
Variable		DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept		1	431799	183042	2.36	0.0272
Median Disposable Income		1	113.0813	5.68397	19.89	<.0001
Unemployment Rate (% of		1	-2365.78	7062.313	-0.33	0.7407
Population Living Below Int		1	-66015	15164	-4.35	0.0002
Inflation		1	102.0517	24.01319	4.25	0.0003
Imports (USD million)		1	0.84461	0.74052	1.14	0.2658
Exports (USD million)		1	0.41966	0.59537	0.7	0.488

Source Result of Data from SAS done by me

Table 4 - linear regression model analysis of Brazil

Assess the fit of the function.

To assess the fit of the function we make use of Coefficient of determination (R^2) and power of dependency or correlation of coefficient (R).

R^2 here is 99.7 % meaning 99.7 % of the dependent variable (Real GDP (USD million)) is explained by the independent variables.

R here is 0.9984 which means there is a positive very strong dependency between the variables.

Results for testing

ANOVA

H_o: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6$ 0

H_1:at least one $\beta \neq 0$

F = 1229.44

P= < 0.0001

$\alpha = 0.05$

$p > \alpha \Rightarrow$ we reject hypothesis H_o and accept H_1

Meaning at least one of the variables is statically significant.

t- Test

$H_0 = B1 = 0$	$H_0 = B2 = 0$	$H_0 = B3 = 0$
$H_1 = B1 \neq 0$	$H_1 = B2 \neq 0$	$H_1 = B3 \neq 0$
T value = 19.89	T value = -0.33	T value = -4.35
P value (0.0001) <Alpha (0.05)	P value (0.7407) > Alpha (0.05)	P value (0.0002) < Alpha (0.05)
Reject Ho	Accept Ho	Reject Ho
$H_0 = B4 = 0$	$H_0 = B5 = 0$	$H_0 = B6 = 0$
$H_1 = B4 \neq 0$	$H_1 = B5 \neq 0$	$H_1 = B6 \neq 0$
T value = 4.25	T value = 1.14	T value = 0.7
P value (0.003) <Alpha (0.05)	P value (0.2658) > Alpha (0.05)	P value (0.488)> Alpha (0.05)
Reject Ho	Accept Ho	Accept Ho

Source Result of Data from SAS done by me

Table 5 T-test table for Brazil

From Table 5 above we can see that, median disposable income per household (USD), population living below international poverty line ($1.90 a Day) and inflation are statistically significant while unemployment rate (% of economically active population) as well as the imports and exports (USD million) are insignificant and need to be removed from the equation.

Number of Obse	30					
Number of Obse	30					
Analysis of Variance						
Source	DF	Sum of	Mean	F Value	Pr > F	
		Squares	Square			
Model	3	1.42E+13	4.72E+12	1576.4	<.0001	
Error	26	7.79E+10	3E+09			
Corrected Total	29	1.43E+13				
Root MSE	54748	R-Square	0.9945			
Dependent Mean	1382726	Adj R-Sq	0.9939			
Coeff Var	3.95941					
Parameter Estimates						
Variable		DF	Parameter	Standard	t Value	Pr > |t|
			Estimate	Error		
Intercept		1	682922	101015	6.76	<.0001
Median Disposable Income		1	120.5903	4.50439	26.77	<.0001
Population Living Below Int		1	-99392	10742	-9.25	<.0001
Inflation		1	137.613	24.5285	5.61	<.0001

Source Result of Data from SAS done by me

Table 6 Adjusted linear regression model analysis of Brazil.

After removing the insignificant variables from the equation, we have a new equation of the linear regression which is:

$$y = 682922 + 120.5903\ disp - 99392\ pov + 137.613\ inf$$

4.2 Canada

Canada according to the IMF is a highly developed mixed economy, it has the world's eighth-largest nominal GDP and 15th-largest PPP GDP. Canada is a member of WTO, the Organisation for Economic Co-operation and Development (OECD), United States–Mexico–Canada Agreement (USMCA), Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), Asia-Pacific Economic Cooperation (APEC), G20 and G7 (IMF, 2022).

As can be seen from the graph 15 below the real GDP of Canada has been on the rise with dips in 2009, 2015,2016 and 2020.
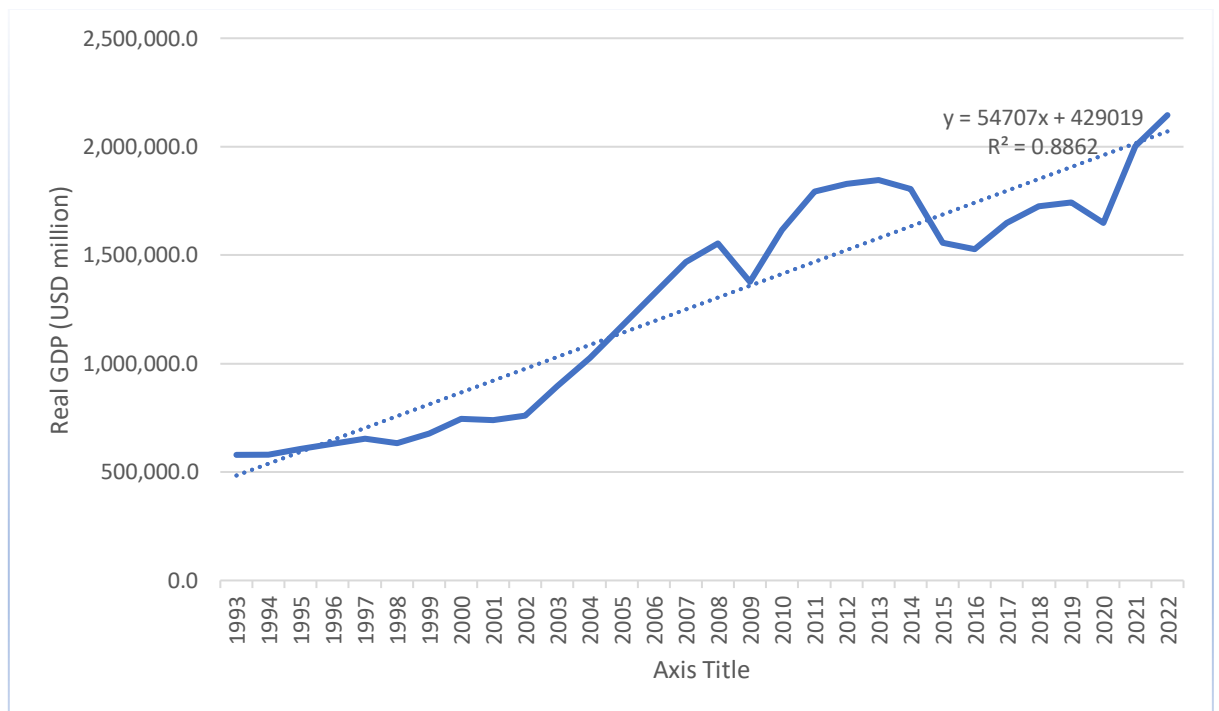
(Passport, 2023) collated by me

Graph 16 Canada Real Gross Domestic Product (GDP) (USD million) for 1993-2022

Variable	Mean	Std Dev	Variance	Median	Coeff of Variation
Real GDP (USD million)	1276978.14	511585.7	2.6172E+11	1422826.3	40.0622159
Median Disposable Incom	42386.65	12514.34	156608803	47497.7	29.5242603
Unemployment Rate (% o	7.6063	1.424439	2.0290266	7.3085	18.7270954
Population Living Below I	0.3933333	0.239156	0.0571954	0.3	60.8022719
Inflation	1.9863667	1.167676	1.3634671	1.882	58.7845122
Imports (USD million)	336921.83	121733.4	14819011676	365492.85	36.1310409
Exports (USD million)	351196.62	115719.3	13390965282	387896	32.9500152

Table 7- Summary Statistics of Canada data from 1993-2022

In table 7 above we can see the summary statistics of the population living below international poverty line ($1.90 a Day), unemployment rate (% of economically active population), inflation, median disposable income per household (USD), the real gross domestic product at purchasing power parity (GDP-PPP) as the imports and exports (USD). We have all with a coefficient of variation less than 100 meaning none has a standard deviation exceeding the mean value, with population living below international poverty line ($1.90 a Day) being the highest.

				Correlation of Estimates			
Variable	Intercept	Median Di:	Unemploy	Populatior	Inflation	Imports (U	Exports (USD million)
Intercept	1	0.6033	-0.7822	-0.0236	0.4188	0.1101	-0.7318
Median Disposable Inc	0.6033	1	-0.859	0.4539	0.4123	-0.2656	-0.6069
Unemployment Rate (9	-0.7822	-0.859	1	-0.5676	-0.2871	-0.0043	0.7079
Population Living Belov	-0.0236	0.4539	-0.5676	1	-0.168	0.0728	-0.2381
Inflation	0.4188	0.4123	-0.2871	-0.168	1	0.1972	-0.6098
Imports (USD million)	0.1101	-0.2656	-0.0043	0.0728	0.1972	1	-0.5647
Exports (USD million)	-0.7318	-0.6069	0.7079	-0.2381	-0.6098	-0.5647	1

Table 8 Canada correlation table

Table 8 shows correlation between the independent variables we have some positive and negative strong correlations(0.6-0.79) and 1 negative strong correlation between population living below international poverty line ($1.90 a Day) and unemployment rate (% of

economically active population), meaning normally one of them should be removed from the model, but will not be removed on the first regression model as will later be seen that unemployment rate (% of economically active population) will be insignificant.

Below in table 9 we have the linear regression model analysis of Canada, Equation of the Linear Regression is;

$$y = -262375 + 19.79309\,disp - 4507.364\,unemp - 79060\,pov + 6017.22\,inf$$
$$+ 2.38521\,imp - 0.33707\,exp$$

Y - Real GDP (USD million)

Disp - Median disposable income per household (USD)

Unemp - Unemployment Rate (% of economically active population)

Pov - Population living below international poverty line ($1.90 a Day)

Inf - Inflation

Imp - Imports (USD million)

Exp - Exports (USD million)

Number of Obse		30				
Number of Obse		30				
Analysis of Variance						
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	
Model	6	7.57E+12	1.26E+12	1615.7	<.0001	
Error	23	1.8E+10	7.81E+08			
Corrected Total	29	7.59E+12				
Root MSE		27948	R-Square	0.9976		
Dependent Mear		1276978	Adj R-Sq	0.997		
Coeff Var		2.18858				
Parameter Estimates						
Variable		DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept		1	-262375	99471	-2.64	0.0147
Median Disposable Income		1	19.79309	3.46059	5.72	<.0001
Unemployment Rate (% of e		1	4507.364	12935	0.35	0.7307
Population Living Below Inte		1	-79060	69232	-1.14	0.2652
Inflation		1	6017.22	7250.22	0.83	0.4151
Imports (USD million)		1	2.38521	0.36726	6.49	<.0001
Exports (USD million)		1	-0.33707	0.50488	-0.67	0.511

Table 9 - linear regression analysis of Canada

Assess the fit of the function.

To assess the fit of the function we make use of Coefficient of determination (R^2) and power of dependency or correlation of coefficient (R).

R^2 here is 99.76% meaning 99.76% of the dependent variable (Real GDP (USD million)) is explained by the independent variables.

R here is 0.9988 which means there is a positive very strong dependency between the variables.

Results for testing

ANOVA

H_o: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$

H_1:at least one $\beta \neq 0$

F = 1615.7

P= < 0.0001

$\alpha = 0.05$

$p > \alpha$ => we reject hypothesis H_o and accept H_1

Meaning at least one of the variables is statically significant.

t- Test

3.0. $H_0 = B1 = 0$	$H_0 = B2 = 0$	$H_0 = B3 = 0$
$H_1 = B1 \neq 0$	$H_1 = B2 \neq 0$	$H_1 = B3 \neq 0$
T value = 5.72	T value = -0.35	T value = -1.14
P value (0.0001) <Alpha (0.05)	P value (0.7307) > Alpha (0.05)	P value (0.2652) > Alpha (0.05)
Reject Ho	Accept Ho	Accept Ho
$H_0 = B4 = 0$	$H_0 = B5 = 0$	$H_0 = B6 = 0$
$H_1 = B4 \neq 0$	$H_1 = B5 \neq 0$	$H_1 = B6 \neq 0$
T value = 0.83	T value = 6.49	T value =- 0.67
P value (0.4151) > Alpha (0.05)	P value (0.0001) < Alpha (0.05)	P value (0.511)> Alpha (0.05)
Accept Ho	Reject Ho	Accept Ho

Source Result of Data from SAS done by me

Table 10 T-test table for Canada

From Table 10 above we can see that, median disposable income per household (USD) and imports (USD million), are statistically significant while unemployment rate (% of economically active population), exports (USD Million), population living below international poverty line ($1.90 a Day) and inflation are insignificant and need to be removed from the model.

Number of Obse		30					
Number of Obse		30					
Analysis of Variance							
Source	DF	Sum of	Mean	F Value	Pr > F		
		Squares	Square				
Model	2	7.57E+12	3.78E+12	5138.45	<.0001		
Error	27	1.99E+10	7.37E+08				
Corrected Total	29	7.59E+12					
Root MSE	27140	R-Square	0.9974				
Dependent Mean	1276978	Adj R-Sq	0.9972				
Coeff Var	2.12536						
Parameter Estimates							
Variable		DF	Parameter	Standard	t Value	Pr > |t|	
			Estimate	Error			
Intercept		1	-310017	20296	-15.27	<.0001	
Median Disposable Income		1	20.73447	1.55437	13.34	<.0001	
Imports (USD million)		1	2.10176	0.15979	13.15	<.0001	

Source Result of Data from SAS done by me

*Table 11 Adjusted linear regression model analysis of Canada.*

After removing the insignificant variables from the equation, we have a new equation of the linear regression which is:

$$y = -310017 + 20.734477 \; disp + 2.10176 \; imp$$

4.3 Colombia

Colombia's economy is the fourth largest in Latin America in terms of gross domestic product and regarded as a developing/emerging economy. Throughout the previous decade, Colombia has undergone a historic economic boom which has seen Colombia become Latin America's fourth largest economy by nominal GDP, real GDP, and GDP (PPP). It is a member of the WTO, OECD, Pacific Alliance and Andean Community which is Comunidad Andina in Spanish (CAN) (IMF, 2022).

Graph 16 below shows the real GDP and export of Colombia , we can see a steep rise in the real GDP of Colombia from 2003 to highest level of 381,670 million USD in 2013 with a little drop in the trajectory in 2009 , when this is juxtaposed with the data of export we can see a steady increase in exports from 2002 till the highest levels till date in 2012 60,125.2 million USD with a similar drop in 2009, we could infer from this that exports is the major driving force of the of the Colombian but we will be able to determine that soon when we do the linear regression.
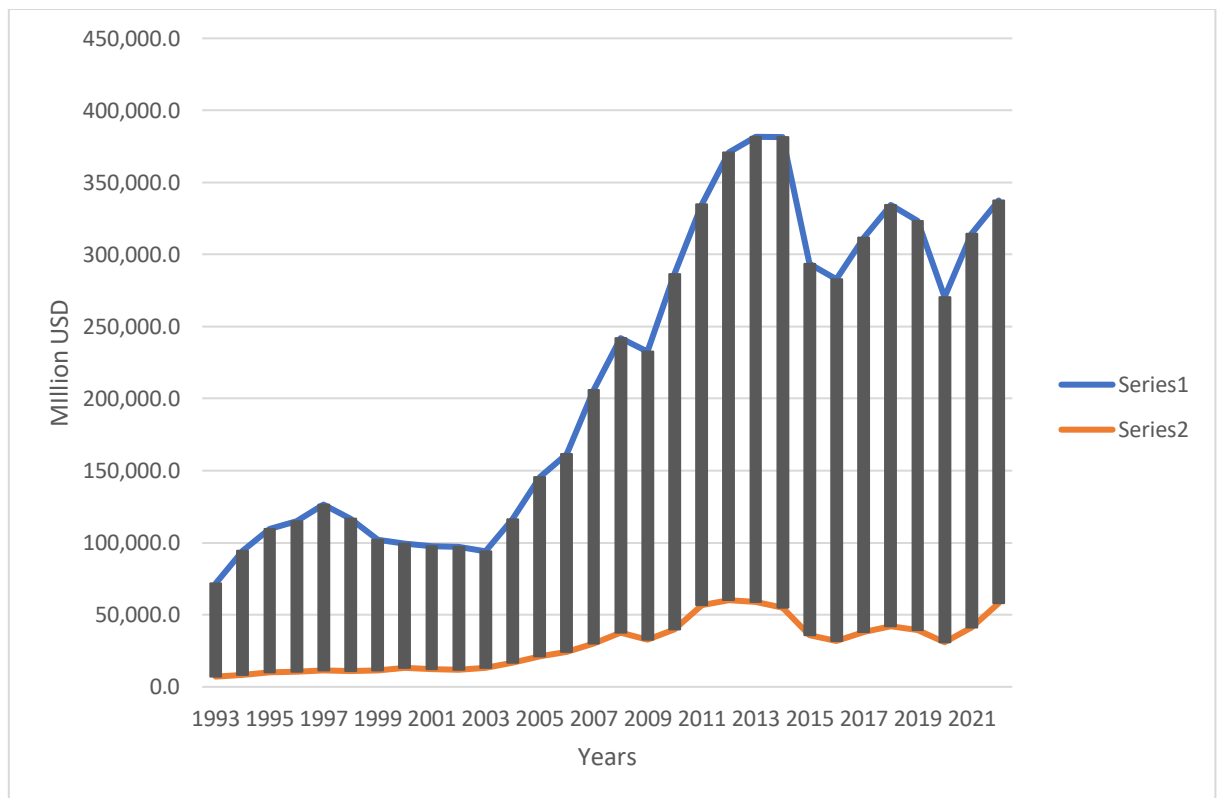
Graph 17 - Colombia Real Gross Domestic Product (GDP) and exports (USD million) for 1993-2022

series 1 – Real GDP, series 2 exports

In table 12 below we can see the summary statistics of the population living below international poverty line ($1.90 a Day), unemployment rate (% of economically active population), inflation, median disposable income per household (USD), the real gross domestic product at purchasing power parity (GDP-PPP) as the imports and exports (USD). We have all with a coefficient of variation less than 100 meaning none has a standard deviation exceeding the mean value, with inflation being the highest.

Variable	Mean	Std Dev	Variance	Median	Coeff of Variation	
Real GDP (USD million)	215073.14	107289.6	11511060811	219322.1	49.8851756	
Median Disposable Incom	7522.19	2264.26	5126866.3	7336.35	30.1010403	
Unemployment Rate (% o	10.8190667	2.875104	8.2662206	11.0115	26.5744142	
Population Living Below I	6.0133333	3.368488	11.3467126	5.65	56.0169875	
Inflation	8.3735	6.693867	44.8078576	5.724	79.9410899	
Imports (USD million)	33985.94	20559.81	422705843	32894	60.495044	
Exports (USD million)	29054.41	17375.93	301923007	30523.85	59.804807	

Source Result of Data from SAS done by me

Table 12 Summary Statistics of Colombia data from 1993-2022

Table 13 shows correlation between the independent variables we have some positive and negative strong correlations(0.6-0.79) and 1 positive strong correlation between population living below international poverty line ($1.90 a Day) and import meaning normally one of them should be removed from the model because it had the largest correlation with another of the variable when compared to population living below international poverty line ($1.90 a day), but will not be removed on the first regression model so that we could see the significance levels.

Correlation of Estimates							
Variable	Intercept	Median Disposable Incom	Unemployment F	Populatior	Inflation	Imports (USD	Exports (USD million)
Intercept	1	-0.8059	-0.7638	-0.2162	-0.3561	-0.0904	0.3245
Median Disposabl	-0.8059	1	0.6112	0.0881	0.1434	-0.0222	-0.4881
Unemployment Ra	-0.7638	0.6112	1	-0.4218	0.7729	-0.4402	0.1243
Population Living I	-0.2162	0.0881	-0.4218	1	-0.726	0.8619	-0.6528
Inflation	-0.3561	0.1434	0.7729	-0.726	1	-0.6857	0.5818
Imports (USD milli	-0.0904	-0.0222	-0.4402	0.8619	-0.6857	1	-0.7947
Exports (USD milli	0.3245	-0.4881	0.1243	-0.6528	0.5818	-0.7947	1

Table 13 -Colombia correlation table

Below in table 9 we have the linear regression model analysis of Colombia, Equation of the Linear Regression is;

$$y = -43311 + 28.56512\ disp + 3942.871\ unemp - 5448.83\ pov - 962.259\ inf + 1.14972\ imp - 0.08957\ exp$$

Y - Real GDP (USD million)

Disp - Median disposable income per household (USD)

Unemp - Unemployment Rate (% of economically active population)

Pov - Population living below international poverty line ($1.90 a Day)

Inf - Inflation

Imp - Imports (USD million)

Exp - Exports (USD million)

Number of Obser	30					
Number of Obser	30					
Analysis of Variance						
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	
Model	6	3.32E+11	5.54E+10	889.49	<.0001	
Error	23	1.43E+09	62280687			
Corrected Total	29	3.34E+11				
Root MSE	7891.811	R-Square	0.9957			
Dependent Mean	215073	Adj R-Sq	0.9946			
Coeff Var	3.66936					
Parameter Estimates						
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	
Intercept	1	-43311	28557	-1.52	0.143	
Median Disposable Income p	1	28.56512	2.65071	10.78	<.0001	
Unemployment Rate (% of e	1	3942.871	1355.178	2.91	0.0079	
Population Living Below Inte	1	-5448.83	1819.303	-3	0.0065	
Inflation	1	-962.259	764.9542	-1.26	0.221	
Imports (USD million)	1	1.14972	0.48522	2.37	0.0266	
Exports (USD million)	1	0.08957	0.52193	0.17	0.8652	

Source Result of Data from SAS done by me

Table 14 linear regression model analysis of Colombia

Assess the fit of the function.

To assess the fit of the function we make use of Coefficient of determination (R^2) and power of dependency or correlation of coefficient (R).

R^2 here is 99.57 % meaning 99.57 % of the dependent variable (Real GDP (USD million)) is explained by the independent variables.

R here is 0.9978 which means there is a positive very strong dependency between the variables.

Results for testing

ANOVA

H_o: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$

H_1:at least one $\beta \neq 0$

F = 889.49

P= < 0.0001

$\alpha = 0.05$

$p > \alpha$ => we reject hypothesis H_o and accept H_1

Meaning at least one of the variables is statically significant.

t- Test

H₀= B1 = 0	H₀= B2 = 0	H₀= B3 = 0
H₁= B1 ≠ 0	H₁= B2 ≠ 0	H₁= B3 ≠ 0
T value = 10.78	T value = 2.91	T value = -3
P value (0.0001) <Alpha (0.05)	P value (0.0079) < Alpha (0.05)	P value (0.0065) < Alpha (0.05)
Reject Ho	Reject Ho	Reject Ho
H₀= B4 = 0	H₀= B5 = 0	H₀= B6 = 0
H₁= B4 ≠ 0	H₁= B5 ≠ 0	H₁= B6 ≠ 0
T value = -1.26	T value = 2.37	T value =- 0.17
P value (0.221) > Alpha (0.05)	P value (0.0266) > Alpha (0.05)	P value (0.8652)> Alpha (0.05)
Accept Ho	Reject Ho	Accept Ho

Source Result of Data from SAS done by me

Table 15 t-Test table for Colombia

From Table 15 above we can see that, median disposable income per household (USD) unemployment rate (% of economically active population), population living below international poverty line ($1.90 a Day) and imports (USD million), are statistically significant while exports (USD Million), and inflation are insignificant and need to be removed from the model. But as previously stated, from the output of table 13 removing imports will make it less significant, compared to population living below international poverty line of $1.90 a day.

After removing the insignificant variables from the equation as seen in table 16 below, we have a new equation of the linear regression which is:

$$y = -735577 + 36.03547\, disp + 6855.256\, unemp - 9412.9\, pov$$

|						
Number of Obse		30				
Number of Obse		30				
Analysis of Variance						
Source	DF	Sum of	Mean	F Value	Pr > F	
		Squares	Square			
Model	3	3.31E+11	1.10E+11	1149.06	<.0001	
Error	26	2.5E+09	96113566			
Corrected Total	29	3.34E+11				
Root MSE	9803.753	R-Square	0.9925			
Dependent Mea	215073	Adj R-Sq	0.9917			
Coeff Var	4.55833					
Parameter Estimates						
Variable	Label	DF	Parameter	Standard	t Value	Pr > |t|
			Estimate	Error		
Intercept	Intercept	1	-73557	23665	-3.11	0.0045
Median Disposa	Median Di:	1	36.03547	1.62833	22.13	<.0001
Unemployment	Unemploy	1	6855.265	762.6519	8.99	<.0001
Population Livin	Population	1	-9412.9	1055.518	-8.92	<.0001

Source Result of Data from SAS done by me

Table 16 Adjusted linear regression model analysis of Colombia.

4.4 Czech Republic

The Czech Republic's economy is a developed high-income export-oriented social market economy (Aspalter, et al., 2009).

As a member of the European Union (EU), the Czech Republic participates in the European Single Market and thereby contributes to the European Union's economy. It is ranked 48th and 47th in the world in terms of nominal GDP and GDP purchasing power parity (PPP). It is also a member of the WTO and OECD (IMF, 2022).
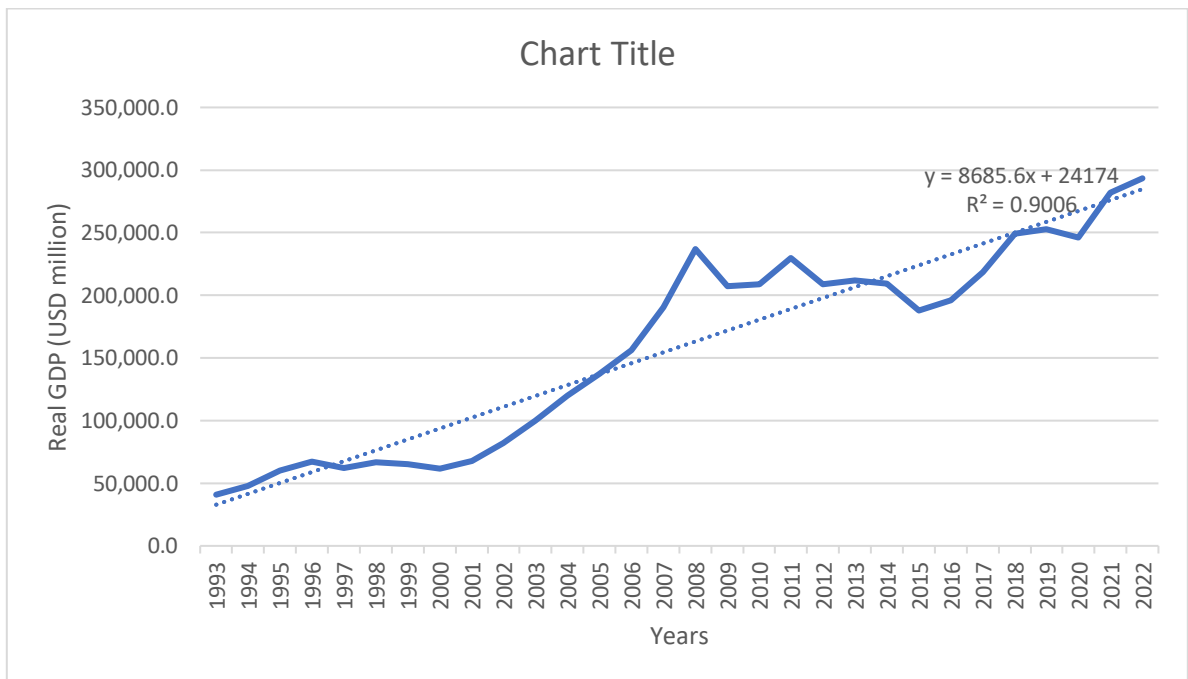
(Passport, 2023) collated by me

Graph 18 Czech Republic Real Gross Domestic Product (GDP) (USD million) for 1993-2022

From graph 17 above which is the Real Gross Domestic Product (GDP) (USD million) for the Czech Republic from 1993 till 2022, we can see a gradual rise till 2001 and a steep rise till the year 2008 with a figure of 236,816.9 million USD after which are fluctuations in the GDP to the present highest point of 293,419 million USD seen in the year 2022.

$$y = -3.722\ln(x) + 13.839$$
$$R^2 = 0.4412$$
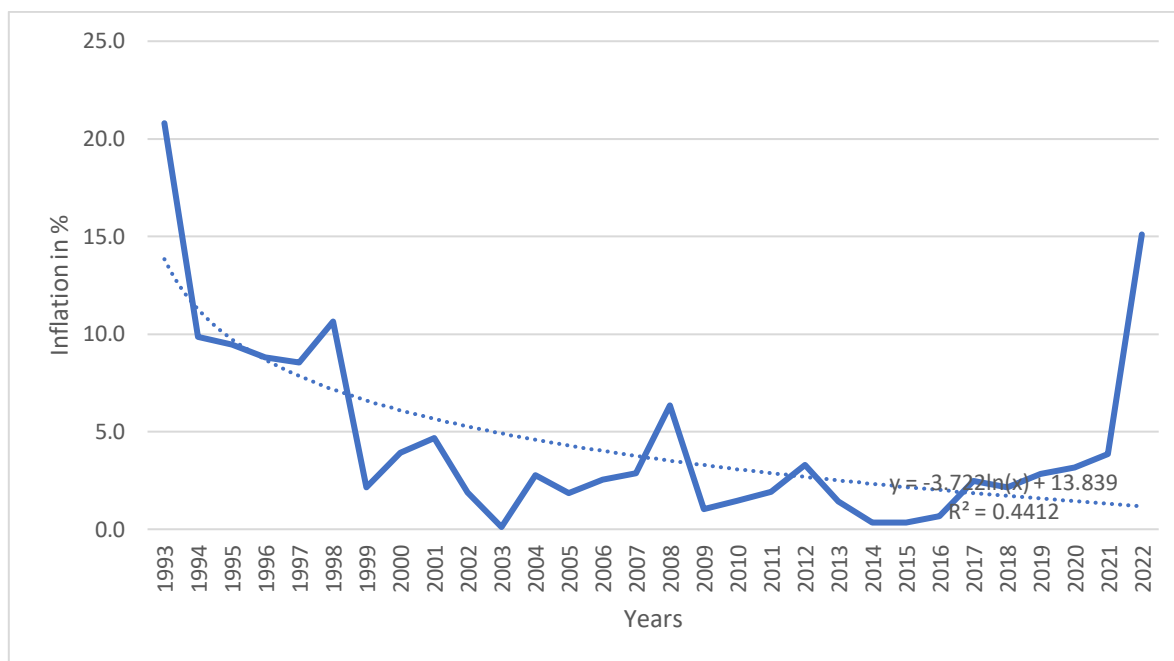
Graph 19 Czech Republic inflation rate (in %) for 1993-2022

In graph 18 above we can see a steep drop in the inflation from 1993 to 1994 as 20.8 % to 9.9 % another steep drop from 1998 to 1999 as 10.6 to 2.1 and then a gradual descent and upward spirals till 2013 with an inflation rate of 0.4 %, the Czech Republic inflation rate remained steady two year after with 0.3 and 0.7 in 2015 and 2016 before an upward trajectory to the 2022 figures of 15.1%

In table 17 below we can see the summary statistics of the population living below international poverty line ($1.90 a Day), unemployment rate (% of economically active population), inflation, median disposable income per household (USD), the real gross domestic product at purchasing power parity (GDP-PPP) as the imports and exports (USD). We have all with a coefficient of variation less than 100 except that of inflation meaning inflation has a standard deviation exceeding the mean value as can be seen in the table below and explained as well in graph 18 above, we can see that population living below international poverty line ($1.90 a Day) being the is also quite high.

Variable	Mean	Std Dev	Variance	Median	Coeff of Variation
Real GDP (USD million)	158800.49	80573.5	6492089306	189107	50.7388259
Median Disposable Incom	17565.93	8789.62	77257381.49	19959.95	50.037864
Unemployment Rate (% o	5.4997333	2.117697	4.4846401	5.6145	38.5054465
Population Living Below I	0.17	0.139333	0.0194138	0.15	81.9608167
Inflation	4.5750333	4.76594	22.7141849	2.8085	104.1727947
Imports (USD million)	95557.97	56565.02	3199601684	110857.2	59.1944573
Exports (USD million)	95621.11	59118.78	3495029801	111101.6	61.8260728

Table 17 Summary Statistics of Czech Republic data from 1993-2022

Table 18 shows correlation between the independent variables. In this, we have some positive and negative strong correlations (0.6-0.79) and 1 negative strong correlation between imports (USD million) and exports (USD million), meaning one of them should be removed from the model. However, this will not be removed on the first regression model since both are statistically insignificant and will leave the model unchanged.

	Correlation of Estimates						
Variable	Intercept	Median Di	Unemployment F	Population Liv	Inflation	Imports (USD	Exports (USD million
Intercept	1	-0.3813	-0.5541	-0.5937	-0.2412	0.2332	-0.2307
Median Disposable Income per Hou	-0.3813	1	0.0546	0.106	0.0861	-0.5189	0.2209
Unemployment Rate (% of economic	-0.5541	0.0546	1	-0.2208	0.6578	-0.2789	0.3211
Population Living Below Internat	-0.5937	0.106	-0.2208	1	-0.4694	0.0825	-0.0277
Inflation	-0.2412	0.0861	0.6578	-0.4694	1	-0.4857	0.5092
Imports (USD million)	0.2332	-0.5189	-0.2789	0.0825	-0.4857	1	-0.9409
Exports (USD million)	-0.2307	0.2209	0.3211	-0.0277	0.5092	-0.9409	1

Table 18 Czech Republic correlation table

Below in table 19 we have the linear regression model analysis of Czech Republic;

Equation of the Linear Regression is;

$$y = 4542.884 + 8.0703\, disp - 767.785\, unemp + 16367\, pov - 486.557\, inf$$
$$- 0.09604\, imp + 0.26499\, exp$$

56

Y - Real GDP (USD million)

Disp - Median disposable income per household (USD)

Unemp - Unemployment Rate (% of economically active population)

Pov - Population living below international poverty line ($1.90 a Day)

Inf - Inflation

Imp - Imports (USD million)

Exp - Exports (USD million)

Number of Obse	30				
Number of Obse	30				
Analysis of Variance					
Source	DF	Sum of	Mean	F Value	Pr > F
		Squares	Square		
Model	6	1.88E+11	3.13E+10	1788.29	<.0001
Error	23	4.03E+08	17509119		
Corrected Total	29	1.88E+11			
Root MSE	4184.39	R-Square	0.9979		
Dependent Mean	158800	Adj R-Sq	0.9973		
Coeff Var	2.635				
Parameter Estimates					
Variable	DF	Parameter	Standard	t Value	Pr > |t|
		Estimate	Error		
Intercept	1	4542.884	6840.01	0.66	0.5132
Median Disposable Income	1	8.0703	0.6375	12.66	<.0001
Unemployment Rate (% of (	1	-767.785	547.5554	-1.4	0.1742
Population Living Below Int	1	16367	14955	1.09	0.2851
Inflation	1	-486.557	293.3097	-1.66	0.1107
Imports (USD million)	1	-0.09604	0.28901	-0.33	0.7427
Exports (USD million)	1	0.26499	0.24586	1.08	0.2923

Source Result of Data from SAS done by me

Table 19 linear regression model analysis of Czech Republic

Assess the fit of the function.

To assess the fit of the function we make use of Coefficient of determination (R^2) and power of dependency or correlation of coefficient (R).

R^2 here is 99.79 % meaning 99.79 % of the dependent variable (Real GDP (USD million)) is explained by the independent variables.

R here is 0.9989 which means there is a positive very strong dependency between the variables.

Results for testing

ANOVA

H_o: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$

H_1: at least one $\beta \neq 0$

$F = 1788.29$

$P = < 0.0001$

$\alpha = 0.05$

$p > \alpha \Rightarrow$ we reject hypothesis H_o and accept H_1

Meaning at least one of the variables is statically significant.

t- Test

3.1. $H_0 = B1 = 0$	$H_0 = B2 = 0$	$H_0 = B3 = 0$
$H_1 = B1 \neq 0$	$H_1 = B2 \neq 0$	$H_1 = B3 \neq 0$
T value = 12.66	T value = -1.4	T value = 1.09
P value (0.0001) <Alpha (0.05)	P value (0.1742) > Alpha (0.05)	P value (0.2851) > Alpha (0.05)
Reject Ho	Accept Ho	Accept Ho
$H_0 = B4 = 0$	$H_0 = B5 = 0$	$H_0 = B6 = 0$
$H_1 = B4 \neq 0$	$H_1 = B5 \neq 0$	$H_1 = B6 \neq 0$
T value = -1.66	T value = -0.33	T value = 1.08
P value (0.1107) >Alpha (0.05)	P value (0.7427) > Alpha (0.05)	P value (0.2923)> Alpha (0.05)
Accept Ho	Accept Ho	Accept Ho

Source Result of Data from SAS done by me

Table 20 T-test table for Czech Republic

From Table 20 above we can see that, median disposable income per household (USD) is the only statistically significant variable while unemployment rate (% of economically active population), exports (USD Million), population living below international poverty line ($1.90 a Day) imports (USD million), and inflation are insignificant and need to be removed from the model.

Number of Obse	30				
Number of Obse	30				

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1.88E+11	1.88E+11	8519.04	<.0001
Error	28	6.17E+08	22027586		
Corrected Total	29	1.88E+11			

Root MSE	4693.355	R-Square	0.9967
Dependent Meaı	158800	Adj R-Sq	0.9966
Coeff Var	2.9555		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-1960.6	1941.119	-1.01	0.3211
Median Disposable Income	1	9.15187	0.09915	92.3	<.0001

Table 21 Adjusted linear regression model analysis of Czech Republic

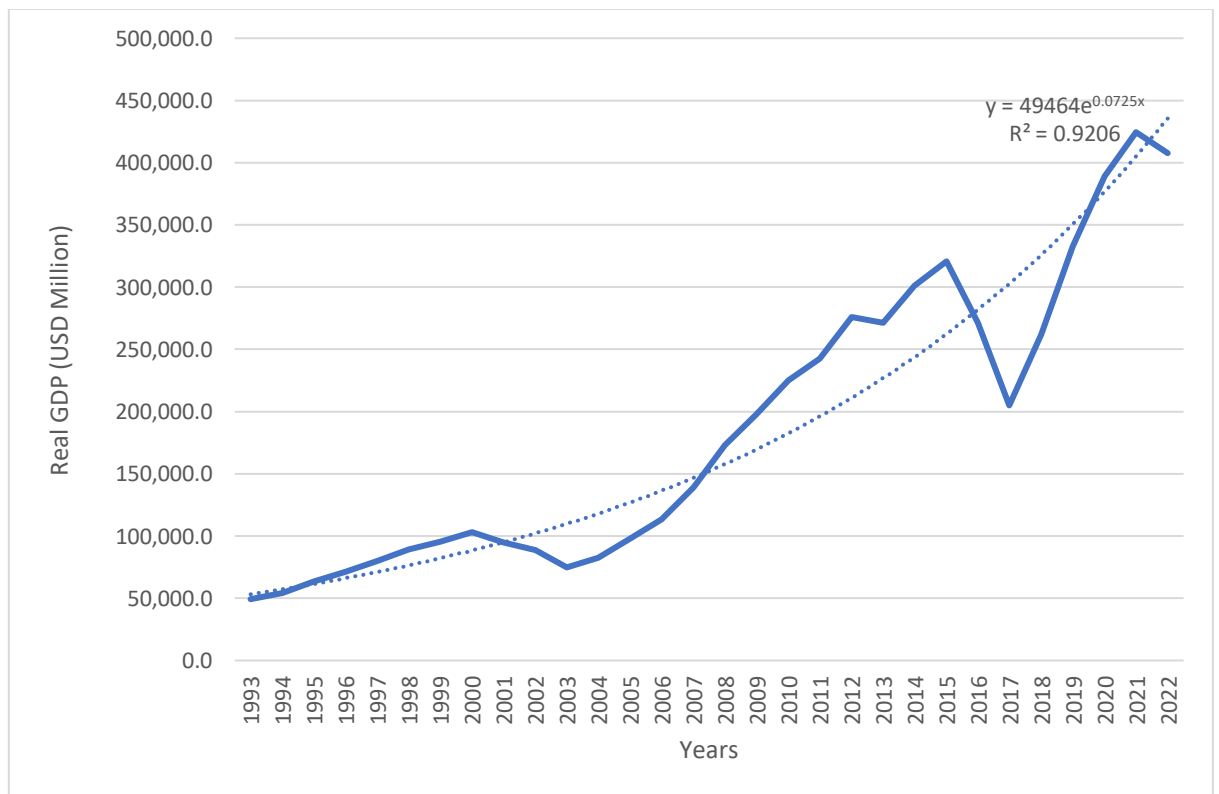After removing the insignificant variables from the equation, we have a new equation of the linear regression which is:

$$y = -1960.6 + 9.15187\ disp$$

4.5 Egypt

The northern African country Egypt, in terms of nominal GDP, it is the second largest in Africa after Nigeria, and the 33rd largest in the world. It is regarded as a developing/emerging economy. Egypt is a member of WTO, African Union (AU), African Continental Free Trade Area (AfCFTA), Council of Arab Economic Unity (CAEU), Common Market for Eastern and Southern Africa (COMESA) (IMF, 2022).

The graph 19 below shows the Real Gross Domestic Product (GDP) (USD million) for Egypt from 1993 till 2022 we can see a steep rise from 2005 till 6016 and another steep rise from 2017 till 2021 the highest point at 424,535.7 million USD.

The graph shows Real GDP (USD Million) on the y-axis (0.0 to 500,000.0) and Years on the x-axis (1993 to 2022), with trendline equation $y = 49464e^{0.0725x}$ and $R^2 = 0.9206$.

Graph 20 - Egypt Real Gross Domestic Product (GDP) (USD million) for 1993-2022

In table 22 below we can see the summary statistics of the population living below international poverty line ($1.90 a Day), unemployment rate (% of economically active population), inflation, median disposable income per household (USD), the real gross domestic product at purchasing power parity (GDP-PPP) as the imports and exports (USD). We have all with a coefficient of variation less than 100 meaning none has a standard deviation exceeding the mean value, with exports (USD million) being the highest.

Variable	Mean	Std Dev	Variance	Median	Coeff of Variation
Real GDP (USD million)	186509.52	115976.3	13450509334	155957.75	62.1825261
Median Disposable Incom	5967.6	2477.82	6139587.3	5097.2	41.5211756
Unemployment Rate (% o	9.9158667	1.846161	3.4083092	9.666	18.618248
Population Living Below Ii	1.9666667	0.67022	0.4491954	1.8	34.0790041
Inflation	9.3085667	5.686791	32.3395881	9.233	61.092012
Imports (USD million)	38445.79	25476.66	649060448	36004.8	66.2664676
Exports (USD million)	17371.51	12849.83	165118258	18495.45	73.9707284

Table 22 Summary Statistics of Egypt data from 1993-2022

Table 23 below shows correlation between the independent variables we have some positive and negative strong correlations (0.6-0.79). this means no multicollinearity and no variable needs to be removed.

	Correlation of Estimates						
Variable	Intercept	Median Dis	Unemploy	Populatior	Inflation	Imports (U	Exports (USD million)
Intercept	1	-0.6729	-0.1839	-0.6553	-0.2713	0.1561	0.0893
Median Disposable	-0.6729	1	-0.0039	0.2501	0.6155	-0.5734	0.0218
Unemployment Ra	-0.1839	-0.0039	1	-0.4804	-0.098	-0.4389	0.4557
Population Living E	-0.6553	0.2501	-0.4804	1	-0.0512	0.4106	-0.411
Inflation	-0.2713	0.6155	-0.098	-0.0512	1	-0.4743	0.0274
Imports (USD milli	0.1561	-0.5734	-0.4389	0.4106	-0.4743	1	-0.7634
Exports (USD millic	0.0893	0.0218	0.4557	-0.411	0.0274	-0.7634	1

Table 23 Egypt correlation table

Below in table 24 we have the linear regression model analysis of Egypt, Equation of the Linear Regression is;

$$y = -55776 + 34.98488\ disp - 2414.75\ unemp + 4491.967\ pov + 229.1424\ inf + 0.3595\ imp + 1.8804\ exp$$

Y - Real GDP (USD million)

Disp - Median disposable income per household (USD)

Unemp - Unemployment Rate (% of economically active population)

Pov - Population living below international poverty line ($1.90 a Day)

Inf - Inflation

Imp - Imports (USD million)

Exp - Exports (USD million)

Number of Obse	30				
Number of Obse	30				
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	3.82E+11	6.37E+10	179.82	<.0001
Error	23	8.14E+09	3.54E+08		
Corrected Total	29	3.90E+11			
Root MSE	18815	R-Square	0.9791		
Dependent Mear	186510	Adj R-Sq	0.9737		
Coeff Var	10.08778				

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-55776	36435	-1.53	0.1395
Median Disposable Income	1	34.98488	5.36782	6.52	<.0001
Unemployment Rate (% of e	1	-2414.75	2425.829	-1	0.3299
Population Living Below Inte	1	4491.967	11306	0.4	0.6948
Inflation	1	229.1424	923.4632	0.25	0.8062
Imports (USD million)	1	0.3595	0.84752	0.42	0.6754
Exports (USD million)	1	1.8804	1.08589	1.73	0.0967

Source Result of Data from SAS done by me

Table 24 linear regression model analysis of Egypt

Assess the fit of the function.

To assess the fit of the function we make use of Coefficient of determination (R^2) and power of dependency or correlation of coefficient (R).

R^2 here is 97.91 % meaning 97.91 % of the dependent variable (Real GDP (USD million)) is explained by the independent variables.

R here is 0.9895 which means there is a positive very strong dependency between the variables.

Results for testing

ANOVA

H_o: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$

H_1:at least one $\beta \neq 0$

F = 179.82

P= < 0.0001

$\alpha = 0.05$

$p > \alpha \Rightarrow$ we reject hypothesis H_o and accept H_1

Meaning at least one of the variables is statically significant.

t- Test

3.2. $H_0 = B1 = 0$	$H_0 = B2 = 0$	$H_0 = B3 = 0$
$H_1 = B1 \neq 0$	$H_1 = B2 \neq 0$	$H_1 = B3 \neq 0$
T value = 6.52	T value = -1	T value = 0.4
P value (0.0001) <Alpha (0.05)	P value (0.3299) > Alpha (0.05)	P value (0.6948) > Alpha (0.05)
Reject Ho	Accept Ho	Accept Ho
$H_0 = B4 = 0$	$H_0 = B5 = 0$	$H_0 = B6 = 0$
$H_1 = B4 \neq 0$	$H_1 = B5 \neq 0$	$H_1 = B6 \neq 0$
T value = 0.25	T value = 0.42	T value = 1.73
P value (0.8062) > Alpha (0.05)	P value (0.6754) > Alpha (0.05)	P value (0.0967)> Alpha (0.05)
Accept Ho	Accept Ho	Accept Ho

Source Result of Data from SAS done by me

Table 25 T-test table for Egypt.

Number of Obser		30				
Number of Obser		30				
Analysis of Variance						
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	
Model	1	3.75E+11	3.75E+11	698.11	<.0001	
Error	28	1.5E+10	5.37E+08			
Corrected Total	29	3.90E+11				
Root MSE		23177	R-Square	0.9614		
Dependent Mear		186510	Adj R-Sq	0.9601		
Coeff Var	12.42697					
Parameter Estimates						
Variable		DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept		1	-87371	11196	-7.8	<.0001
Median Disposable Income (		1	45.89449	1.73699	26.42	<.0001

Table 26 Adjusted linear regression model analysis of Egypt.

From Table 26 above we can see that, median disposable income per household (USD) is the only statistically significant variable while unemployment rate (% of economically active population), exports (USD Million), population living below international poverty line ($1.90 a Day) imports (USD million) and inflation are insignificant and need to be removed from the model.

After removing the insignificant variables from the equation, we have a new equation of the linear regression which is:

$$y = -87371 + 45.89449 \, disp$$

4.6 Germany

Germany is a developed economy, it has the largest national economy in Europe, the world's fourth largest by nominal GDP, and the fifth largest by GDP (PPP), it is a member of the EU, WTO, G20, G7 and OECD (IMF, 2022).

From graph 20 we can see a gradual increase in the real GDP of Germany the highest figure being 4,260,527.4 million USD in 2021.
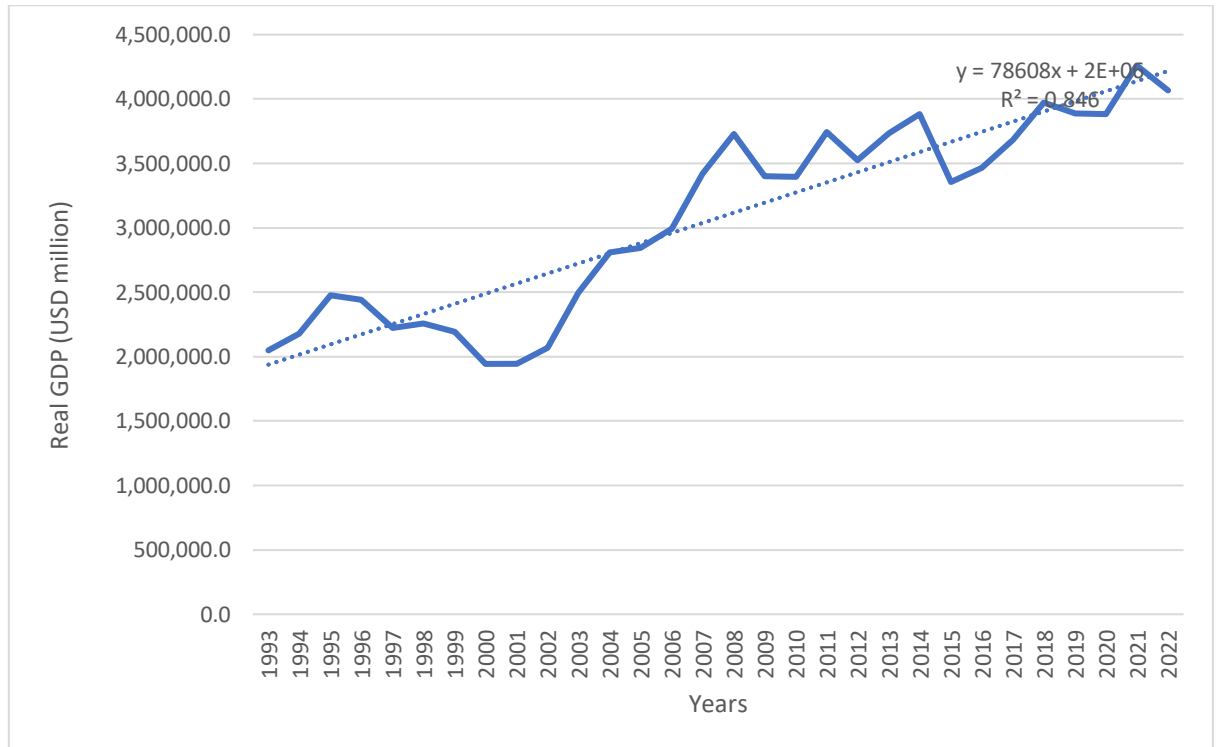
(Passport, 2023) collated by me

Graph 21 Germany Real Gross Domestic Product (GDP) (USD million) for 1993-2022

In table 27 below we can see the summary statistics of the population living below international poverty line ($1.90 a Day), unemployment rate (% of economically active population), inflation, median disposable income per household (USD), the real gross domestic product at purchasing power parity (GDP-PPP) as the imports and exports (USD). We have all with a coefficient of variation less than 100 meaning none has a standard deviation exceeding the mean value, with inflation being the highest.

Variable	Mean	Std Dev	Variance	Median	Coeff of Variation
Real GDP (USD million)	3077654.18	752384.2	5.66082E+11	3376193.7	24.4466779
Median Disposable Incom	41459.39	7886.46	62196279.25	43101.9	19.0221365
Unemployment Rate (% o	6.9325	2.642876	6.9847957	7.636	38.1229918
Population Living Below I	0.2433333	0.062606	0.0039195	0.2	25.7285883
Inflation	1.8186667	1.439166	2.0711989	1.52	79.1330293
Imports (USD million)	851403.49	353343.4	1.24852E+11	935814.3	41.5012912
Exports (USD million)	1029929.17	427759.2	1.82978E+11	1143519.15	41.5328713

Table 27 Summary Statistics of Germany data from 1993-2022

Table 28 shows correlation between the independent variables we have some positive and negative strong correlations (0.6-0.79) and 1 negative strong correlation between imports and exports (USD million), meaning normally one of them should be removed from the model, but will not be removed on the first regression model as will later be seen that both will be insignificant.

			Correlation of Estimates				
Variable	Intercept	Median Di	Unemploy	Populatior	Inflation	Imports (U	Exports (USD million)
Intercept	1	-0.6603	-0.465	0.2483	-0.0914	0.0732	-0.0059
Median Disposable	-0.6603	1	-0.2064	-0.0287	0.1717	-0.3088	0.0448
Unemployment Ra	-0.465	-0.2064	1	-0.7302	-0.0558	0.0937	0.1168
Population Living B	0.2483	-0.0287	-0.7302	1	-0.1853	0.293	-0.4195
Inflation	-0.0914	0.1717	-0.0558	-0.1853	1	-0.7551	0.7269
Imports (USD millic	0.0732	-0.3088	0.0937	0.293	-0.7551	1	-0.9489
Exports (USD millic	-0.0059	0.0448	0.1168	-0.4195	0.7269	-0.9489	1

Table 28 Germany correlation table

Number of Obse	30					
Number of Obse	30					
Analysis of Variance						
Source	DF	Sum of	Mean	F Value	Pr > F	
		Squares	Square			
Model	6	1.63E+13	2.72E+12	903.88	<.0001	
Error	23	6.93E+10	3.01E+09			
Corrected Total	29	1.64E+13				
Root MSE		54902	R-Square	0.9958		
Dependent Mean		3077654	Adj R-Sq	0.9947		
Coeff Var		1.78389				
Parameter Estimates						
Variable		DF	Parameter	Standard	t Value	Pr > |t|
			Estimate	Error		
Intercept		1	294329	118192	2.49	0.0204
Median Disposable Income		1	53.73804	4.46193	12.04	<.0001
Unemployment Rate (% of		1	-15151	10639	-1.42	0.1678
Population Living Below Int		1	-191121	286017	-0.67	0.5106
Inflation		1	-23179	11035	-2.1	0.0468
Imports (USD million)		1	0.48193	0.41066	1.17	0.2526
Exports (USD million)		1	0.32891	0.32058	1.03	0.3156

Source Result of Data from SAS done by me

Table 29 linear regression model analysis of Germany

In table 29 we have the linear regression model analysis of Canada; Equation of the Linear Regression is;

$$y = 294329 + 53.73804\ disp - 15151\ unemp - 191121\ pov - 23179\ inf$$
$$+\ 0.48193\ imp - 0.32891\ exp$$

Y = 294329 +53.73804 DISP -15151 X2 -191121 X3 – 23179 X4 + 0.48193 X5 0.32891 X6

Y - Real GDP (USD million)

Disp - Median disposable income per household (USD)

Unemp - Unemployment Rate (% of economically active population)

Pov - Population living below international poverty line ($1.90 a Day)

Inf - Inflation

Imp - Imports (USD million)

Exp - Exports (USD million)

Assess the fit of the function.

To assess the fit of the function we make use of Coefficient of determination (R^2) and power of dependency or correlation of coefficient (R).

R^2 here is 99.58% meaning 99.58% of the dependent variable (Real GDP (USD million)) is explained by the independent variables.

R here is 0.9978 which means there is a positive very strong dependency between the variables.

Results for testing

ANOVA

H_o: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$

H_1: at least one $\beta \neq 0$

F = 903.88

P = < 0.0001

$\alpha = 0.05$

$p > \alpha \Rightarrow$ we reject hypothesis H_o and accept H_1

Meaning at least one of the variables is statically significant.

t- Test

3.3. $H_0 = B1 = 0$	$H_0 = B2 = 0$	$H_0 = B3 = 0$
$H_1 = B1 \neq 0$	$H_1 = B2 \neq 0$	$H_1 = B3 \neq 0$
T value = 12.04	T value = -1.42	T value = -0.67
P value (0.0001) <Alpha (0.05)	P value (0.1678) > Alpha (0.05)	P value (0.5106) > Alpha (0.05)
Reject Ho	Accept Ho	Accept Ho
$H_0 = B4 = 0$	$H_0 = B5 = 0$	$H_0 = B6 = 0$
$H_1 = B4 \neq 0$	$H_1 = B5 \neq 0$	$H_1 = B6 \neq 0$
T value = - 2.1	T value = 0.42	T value = 1.73
P value (0.0468) < Alpha (0.05)	P value (0.6754) > Alpha (0.05)	P value (0.0967)> Alpha (0.05)
Reject Ho	Accept Ho	Accept Ho

Table 30 T-test table for Germany.

From Table 30 above we can see that, median disposable income per household (USD) and imports (USD million), are statistically significant while unemployment rate (% of economically active population), exports (USD Million), population living below international poverty line ($1.90 a Day) and inflation are insignificant and need to be removed from the model.

Number of Obse	30				
Number of Obse	30				
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1.59E+13	7.97E+12	452.05	<.0001
Error	27	4.76E+11	1.76E+10		
Corrected Total	29	1.64E+13			
Root MSE	132783	R-Square	0.971		
Dependent Mea	3077654	Adj R-Sq	0.9689		
Coeff Var	4.31442				
Parameter Estimates					
Variable		DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept		1	-811032	132330	-6.13	<.0001
Median Disposable Income		1	94.33261	3.16553	29.8	<.0001
Inflation		1	-12254	17347	-0.71	0.486

Source Result of Data from SAS done by me

Table 31 Adjusted linear regression model analysis of Germany.

After removing the insignificant variables from the equation, we have a new equation of the linear regression which is:

Y = -811032 +94.33261 DISP - 12254 X4

But as can be seen in the table 31 inflation is not significant and most be removed.

69

Number of Obse		30				
Number of Obse		30				
Analysis of Variance						
Source	DF	Sum of	Mean	F Value	Pr > F	
		Squares	Square			
Model	1	1.59E+13	1.59E+13	920.05	<.0001	
Error	28	4.85E+11	1.73E+10			
Corrected Total	29	1.64E+13				
Root MSE	131590	R-Square	0.9705			
Dependent Mea	3077654	Adj R-Sq	0.9694			
Coeff Var	4.27565					
Parameter Estimates						
Variable	DF	Parameter	Standard	t Value	Pr > |t|	
		Estimate	Error			
Intercept	1	-818808	130686	-6.27	<.0001	
Median Disposable Income	1	93.98263	3.09842	30.33	<.0001	

Table 32 Second adjusted linear regression model analysis of Germany.

So, the new adjusted after removing the insignificant variable inflation from the equation, we have a newer Equation of the Linear Regression which is:

$$y = -818808 + 93.98263 \, disp$$

4.7 India

India is regarded as a developing/emerging economy, it has the world's fifth-largest nominal GDP and third-largest purchasing power parity (PPP). According to the International Monetary Fund (IMF), India ranks 142nd by GDP (nominal) and 125th by GDP per capita (PPP). India is a member of WTO, BRICS, G20, South Asian Free Trade Area (SAFTA), Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), World Federation of Trade Unions (WFTU), Asian Infrastructure Investment Bank (AIIB) (IMF, 2022).

The graph 21 shows the real GDP in USD million for India from the year 1993-2022, we can notice the steep rise in the GDP from the year 2002 till it highest figure in 2022 of 3,402,271.2 million USD.

$y = 108899x - 277233$
$R^2 = 0.9413$
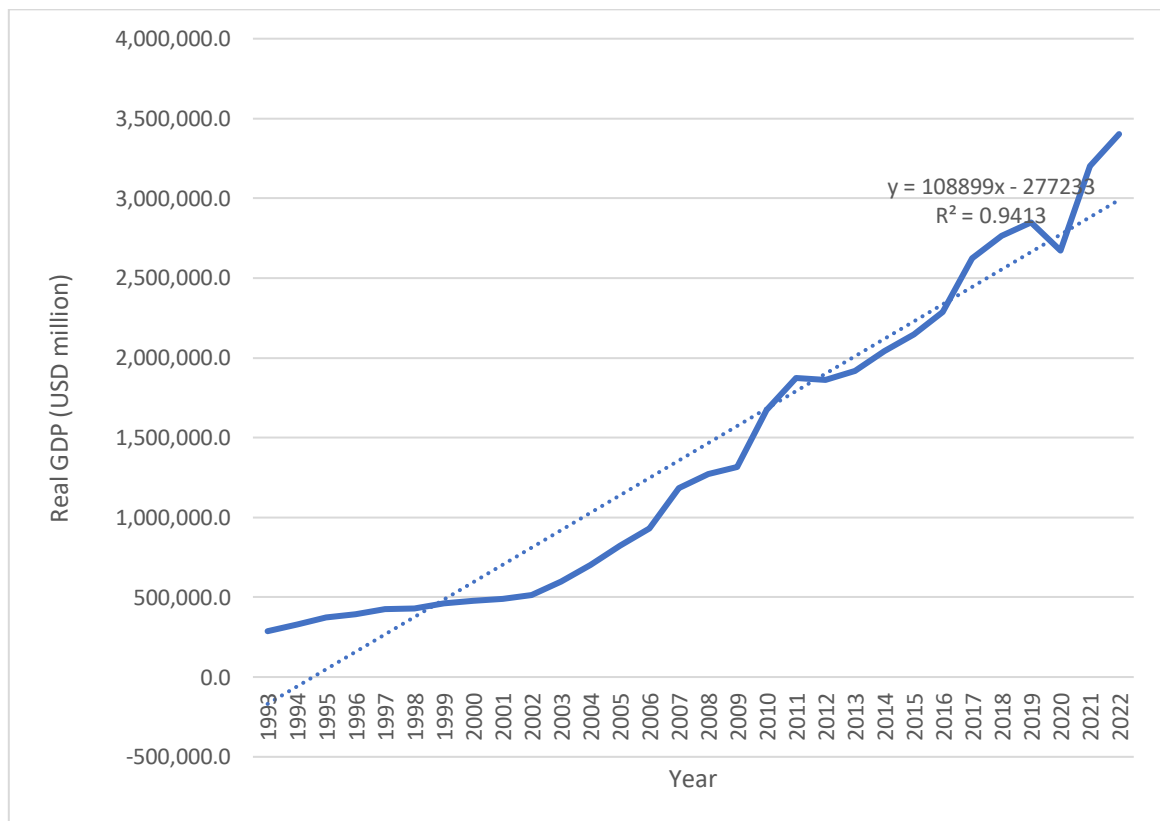
(Passport, 2023) collated by me.

Graph 22 India Real Gross Domestic Product (GDP) (USD million) for 1993-2022

The graph 22 below shows the drop in the percentage of the population living below international poverty line ($1.90 a Day), from 36.6 % in 1993 to 8.7% in 2022.

The graph shows a blue trend line with equation:

$$y = -1.2071x + 42.21$$
$$R^2 = 0.9469$$

The y-axis is labeled "Population Living Below International Poverty Line ($1.90 a Day)" ranging from 0.0 to 45.0, and the x-axis is labeled "Years" ranging from 1993 to 2022.
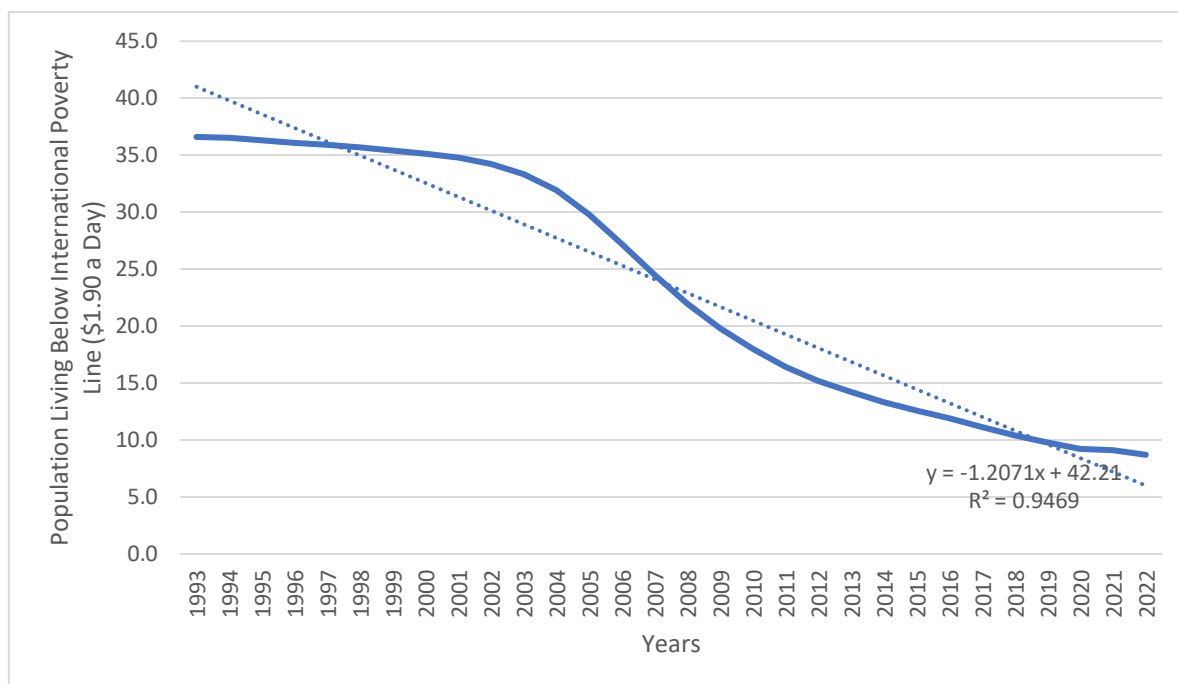
Graph 23 India Real population living below international poverty line ($1.90 a Day) for 1993-2022

In table 33 we can see the summary statistics of the population living below international poverty line ($1.90 a Day), unemployment rate (% of economically active population), inflation, median disposable income per household (USD), the real gross domestic product at purchasing power parity (GDP-PPP) as the imports and exports (USD). We have all with a coefficient of variation less than 100 meaning none has a standard deviation exceeding the mean value, with imports (USD million) being the highest.

Variable	Mean	Std Dev	Variance	Median	Coeff of Variation
Real GDP (USD million)	1410705.76	988102.4	9.76346E+11	1228276.8	70.0431232
Median Disposable Incom	3417.71	1769.62	3131560.03	3354	51.7780374
Unemployment Rate (% o	5.6330667	0.228328	0.0521337	5.6365	4.0533533
Population Living Below I	23.5	10.92053	119.257931	23.25	46.4703318
Inflation	6.8585	2.817415	7.9378296	6.1265	41.0791779
Imports (USD million)	260704.08	208490.5	43468274427	243286.05	79.9720774
Exports (USD million)	176293.01	133765.9	17893302246	157533.8	75.8769993

Table 33 Summary Statistics of India data from 1993-2022

Table 8 shows correlation between the independent variables we have some positive and negative strong correlations (0.6-0.79) and 1 negative strong correlation between import and exports (USD million), meaning normally one of them should be removed from the model, but will not be removed on the first regression model as will later be seen that exports (USD million) will be insignificant.

Correlation of Estimates								
Variable	Label	Intercept	Median Di	Unemploy	Population	Inflation	Imports (U	Exports (USD million)
Intercept	Intercept	1	-0.5995	-0.556	-0.5887	-0.2817	-0.0308	0.1001
Median Di	Median Di	-0.5995	1	-0.161	0.761	0.4156	-0.2657	0.03
Unemploy	Unemploy	-0.556	-0.161	1	-0.3295	-0.1609	0.5816	-0.5648
Population	Population	-0.5887	0.761	-0.3295	1	0.3715	-0.512	0.4591
Inflation		-0.2817	0.4156	-0.1609	0.3715	1	-0.3777	0.2704
Imports (USD million)		-0.0308	-0.2657	0.5816	-0.512	-0.3777	1	-0.9467
Exports (USD million)		0.1001	0.03	-0.5648	0.4591	0.2704	-0.9467	1

Source Result of Data from SAS done by me

Table 34 India correlation table

Below in table 35 we have the linear regression model analysis of Canada. Equation of the linear regression is;

$$y = -2817390 + 826.0397\, disp + 124045\, unemp + 35427\, pov - 3511.03\, inf - 3.0772\, imp + 3.97047\, exp$$

Y - Real GDP (USD million)

Disp - Median disposable income per household (USD)

Unemp - Unemployment Rate (% of economically active population)

Pov - Population living below international poverty line ($1.90 a Day)

Inf - Inflation

Imp - Imports (USD million)

Exp - Exports (USD million)

Number of Obs	30				
Number of Obs	30				
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	2.81E+13	4.69E+12	572.48	<.0001
Error	23	1.88E+11	8.19E+09		
Corrected Tota	29	2.83E+13			
Root MSE	90489	R-Square	0.9933		
Dependent Mea	1410706	Adj R-Sq	0.9916		
Coeff Var	6.41447				

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-2817390	609372	-4.62	0.0001
Median Disposable Income	1	826.0397	88.92949	9.29	<.0001
Unemployment Rate (% of	1	124045	91563	1.35	0.1887
Population Living Below In	1	35427	11344	3.12	0.0048
Inflation	1	-3511.03	6928.572	-0.51	0.6172
Imports (USD million)	1	-3.0772	1.30627	-2.36	0.0274
Exports (USD million)	1	3.97047	2.31603	1.71	0.0999

Source Result of Data from SAS done by me

Table 35 Linear regression model analysis of India.

Assess the fit of the function.

To assess the fit of the function we make use of Coefficient of determination (R^2) and power of dependency or correlation of coefficient (R).

R^2 here is 99.33% meaning 99.33% of the dependent variable (Real GDP (USD million)) is explained by the independent variables.

R here is 0.9966 which means there is a positive very strong dependency between the variables.

Results for testing

ANOVA

H_o: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$

H_1: at least one $\beta \neq 0$

F = 572.48

74

P= < 0.0001

α = 0.05

p > α => we reject hypothesis H_o and accept H_1

Meaning at least one of the variables is statically significant.

t- Test

$H_0 = B1 = 0$	$H_0 = B2 = 0$	$H_0 = B3 = 0$
$H_1 = B1 \neq 0$	$H_1 = B2 \neq 0$	$H_1 = B3 \neq 0$
T value = -4.62	T value = 1.35	T value = 3.12
P value (0.0001) <Alpha (0.05)	P value (0.1887) > Alpha (0.05)	P value (0.0048) < Alpha (0.05)
Reject Ho	Accept Ho	Reject Ho
$H_0 = B4 = 0$	$H_0 = B5 = 0$	$H_0 = B6 = 0$
$H_1 = B4 \neq 0$	$H_1 = B5 \neq 0$	$H_1 = B6 \neq 0$
T value = -0.51	T value = -2.36	T value = 1.71
P value (0.6172) > Alpha (0.05)	P value (0.0274) < Alpha (0.05)	P value (0.0999)> Alpha (0.05)
Accept Ho	Reject Ho	Accept Ho

Source Result of Data from SAS done by me

Table 36 T-test table for India.

Number of Obser	30					
Number of Obser	30					
Analysis of Variance						
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	
Model	3	2.80E+13	9.34E+12	851.99	<.0001	
Error	26	2.85E+11	1.1E+10			
Corrected Total	29	2.83E+13				
Root MSE	104719	R-Square	0.9899			
Dependent Mean	1410706	Adj R-Sq	0.9888			
Coeff Var	7.42317					
Parameter Estimates						
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	
Intercept	1	-2078858	506928	-4.1	0.0004	
Median Disposable Income ʄ	1	901.8346	91.53214	9.85	<.0001	
Population Living Below Inte	1	32058	11112	2.89	0.0078	
Imports (USD million)	1	-1.32719	0.43978	-3.02	0.0056	

Source Result of Data from SAS done by me

Table 37 Adjusted linear regression model analysis of India.

From Table 36 above we can see that, median disposable income per household (USD) population living below international poverty line ($1.90 a Day) and imports (USD Million), are statistically significant while unemployment rate (% of economically active population), exports (USD Million) and inflation are insignificant and need to be removed from the model. After removing the insignificant variables from the equation, we have a new equation of the linear regression which is:

$$y = -2078858 + 901.8346\, disp + 32058\, pov - 1.32719\, imp$$

4.8 Mexico

The North American country Mexico is regarded as a developing / emerging economy, according to the International Monetary Fund, it is the 15th largest in the world in terms of nominal GDP and the 13th largest in terms of purchasing power parity (PPP). It is a member if APEC, CPTPP, USMCA, OECD, G20 and WTO (IMF, 2022).

The graph 23 shows the real GDP in USD million for Mexico from the year 1993-2022, we can notice the gradual rise in the GDP from the year 1995 till it highest figure in 2022 of 1,418,543.3 million USD.

$y = 32823x + 417859$
$R^2 = 0.8806$
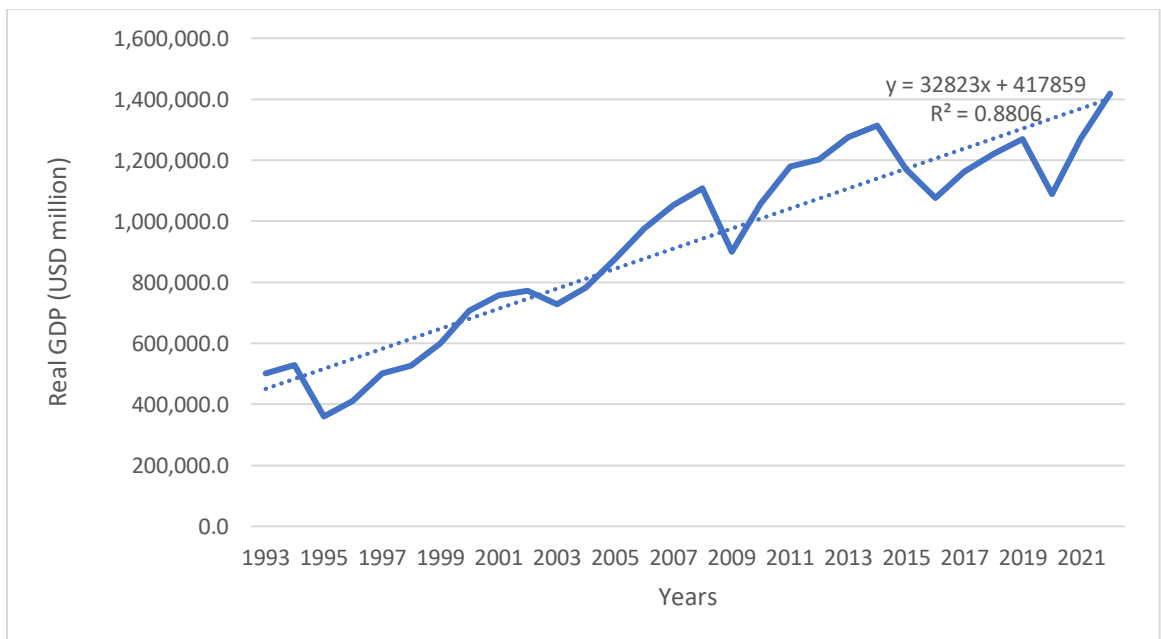
(Passport, 2023) collated by me.

Graph 24 Mexico Real Gross Domestic Product (GDP) (USD million) for 1993-2022

The graph 24 below shows a steep rise from 1994 at 7.0% to 1995 at 35.0% (the highest in the data set) to a steep drop from 1996 at 34.4% till 20.6% in 1997 and after which inflation rate down to single figures from, 2000s and has stayed in single figures.

The chart shows Mexico inflation (in %) from 1993 to 2022 with y-axis "Inflation (in %)" ranging 0.0 to 40.0 and x-axis "Years". Trendline equation: $y = 13.595e^{-0.051x}$, $R^2 = 0.4232$
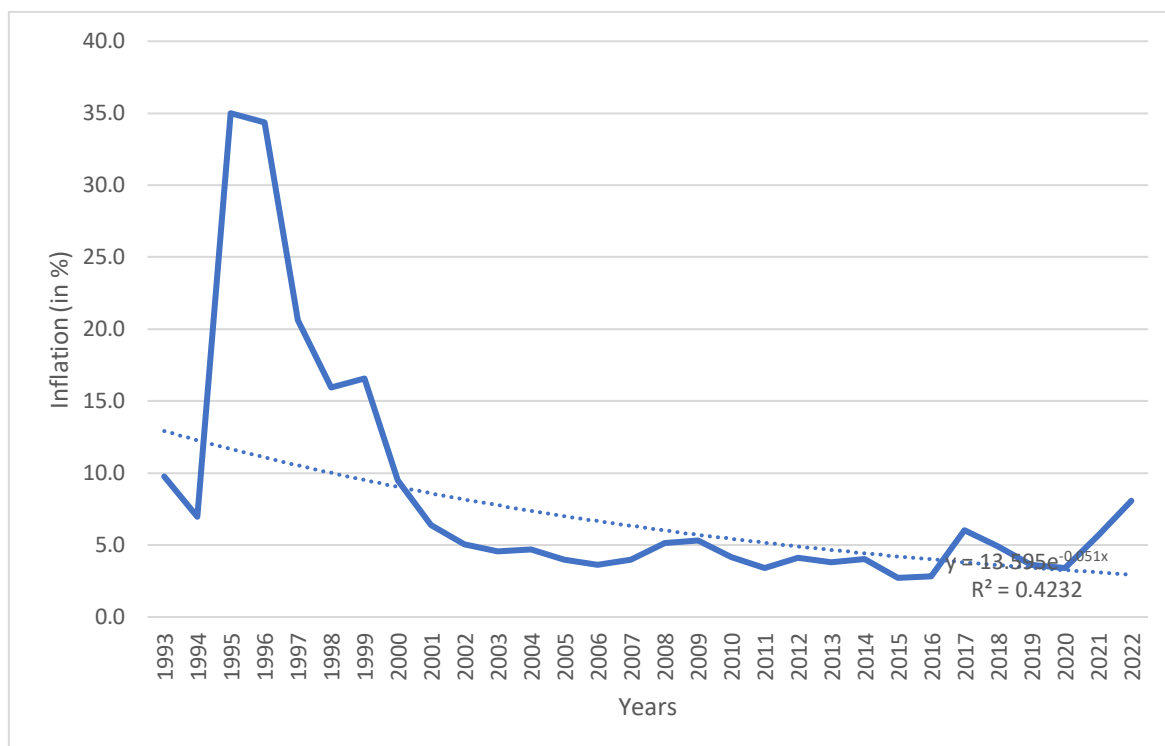
Graph 25 Mexico inflation (in %) for 1993-2022

In table 38 below we can see the summary statistics of the population living below international poverty line ($1.90 a Day), unemployment rate (% of economically active population), inflation, median disposable income per household (USD), the real gross domestic product at purchasing power parity (GDP-PPP) as the imports and exports (USD). We have all but inflation with a coefficient of variation greater than 100 meaning the standard deviation exceeds the mean value as can also be seen in the table 38 and also in graph 24 above.

Variable	Mean	Std Dev	Variance	Median	Coeff of Variation
Real GDP (USD million)	926617.02	307925.6	94818151172	1013982.5	33.2311576
Median Disposable Incom	16340.27	3981.03	15848615.22	17056.4	24.3633229
Unemployment Rate (% o	4.1549667	1.204764	1.451456	3.883	28.9957528
Population Living Below I	5.1033333	2.310021	5.3361954	4.75	45.2649376
Inflation	8.2716333	8.355173	69.8089187	4.965	101.0099557
Imports (USD million)	277318.65	144348.6	20836522082	269003.7	52.051534
Exports (USD million)	270382.9	144844.5	20979917336	260900.2	53.5701263

Table 38 Summary Statistics of Mexico data from 1993-2022

Correlation of Estimates								
Variable	Label	Intercept	Median Di:	Unemploy	Populatior	Inflation	Imports (U	Exports (USD million)
Intercept	Intercept	1	-0.4688	0.3855	-0.772	0.0358	0.4424	-0.5175
Median Di:	Median Di:	-0.4688	1	-0.0672	-0.1279	0.7046	-0.1392	-0.0154
Unemploy	Unemploy	0.3855	-0.0672	1	-0.5991	0.1857	0.4295	-0.4971
Populatior	Populatior	-0.772	-0.1279	-0.5991	1	-0.5834	-0.5215	0.691
Inflation		0.0358	0.7046	0.1857	-0.5834	1	0.2344	-0.3944
Imports (USD million)		0.4424	-0.1392	0.4295	-0.5215	0.2344	1	-0.9686
Exports (USD million)		-0.5175	-0.0154	-0.4971	0.691	-0.3944	-0.9686	1

Table 39 Mexico correlation table

Table 39 shows correlation between the independent variables we have some positive and negative strong correlations (0.6-0.79) and 1 negative strong correlation between import and exports (USD million), meaning normally one of them should be removed from the model, but will not be removed on the first regression model as will later be seen that imports and exports (USD million) will be insignificant.

Below in table 40 we have the linear regression model analysis of Canada; Equation of the Linear regression is;

$$y = -23034 + 42.39953\, disp + 4559.74259\, unemp - 2531.04878\, pov$$
$$+ 623.9086\, inf - 0.69601\, imp + 1.66053\, exp$$

y - Real GDP (USD million)

Disp - Median disposable income per household (USD)

Unemp - Unemployment Rate (% of economically active population)

Pov - Population living below international poverty line ($1.90 a Day)

Inf - Inflation

Imp - Imports (USD million)

Exp - Exports (USD million)

Number of Obse		30				
Number of Obse		30				
Analysis of Variance						
Source	DF	Sum of	Mean	F Value	Pr > F	
		Squares	Square			
Model	6	2.72E+12	4.53E+11	321.27	<.0001	
Error	23	3.24E+10	1.41E+09			
Corrected Total	29	2.75E+12				
Root MSE		37545	R-Square	0.9882		
Dependent Meaı		926617	Adj R-Sq	0.9851		
Coeff Var	4.05187					

Parameter Estimates						
Variable	Label	DF	Parameter	Standard	t Value	Pr > |t|
			Estimate	Error		
Intercept		1	-23034	126130	-0.18	0.8567
Median Disposable Income		1	42.39953	5.84985	7.25	<.0001
Unemployment Rate (% of (		1	4559.743	7721.227	0.59	0.5606
Population Living Below Int		1	-2531.05	16252	-0.16	0.8776
Inflation		1	-623.909	2013.044	-0.31	0.7594
Imports (USD million)		1	-0.69601	0.81786	-0.85	0.4035
Exports (USD million)		1	1.66053	0.93065	1.78	0.0876

Source Result of Data from SAS done by me

Table 40 linear regression model analysis of Mexico

Assess the fit of the function.

To assess the fit of the function we make use of Coefficient of determination (R^2) and power of dependency or correlation of coefficient (R).

R^2 here is 98.82 % meaning 98.82 % of the dependent variable (Real GDP (USD million)) is explained by the independent variables.

R here is 0.9990 which means there is a positive very strong dependency between the variables.

Results for testing

ANOVA

H_o: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$

H_1: at least one $\beta \neq 0$

F = 321.27

P= < 0.0001

α = 0.05

p > α => we reject hypothesis H_o and accept H_1

Meaning at least one of the variables is statically significant.

t- Test

3.4. H_0= B1 = 0	H_0= B2 = 0	H_0= B3 = 0
H_1= B1 ≠ 0	H_1= B2 ≠ 0	H_1= B3 ≠ 0
T value = 7.25	T value = 0.59	T value = -0.16
P value (0.0001) <Alpha (0.05)	P value (0.5606) > Alpha (0.05)	P value (0.8776) > Alpha (0.05)
Reject Ho	Accept Ho	Accept Ho
H_0= B4 = 0	H_0= B5 = 0	H_0= B6 = 0
H_1= B4 ≠ 0	H_1= B5 ≠ 0	H_1= B6 ≠ 0
T value = -0.31	T value = -0.85	T value = 1.78
P value (0.7594) > Alpha (0.05)	P value (0.4035) > Alpha (0.05)	P value (0.0876)> Alpha (0.05)
Accept Ho	Accept Ho	Accept Ho

Source Result of Data from SAS done by me

Table 41 T-test table for Mexico.

Number of Obse	30					
Number of Obse	30					
Analysis of Variance						
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	
Model	1	2.56E+12	2.56E+12	379.05	<.0001	
Error	28	1.89E+11	6.76E+09			
Corrected Total	29	2.75E+12				
Root MSE	82191	R-Square	0.9312			
Dependent Mea	926617	Adj R-Sq	0.9288			
Coeff Var	8.86999					
Parameter Estimates						
Variable		DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept		1	-293028	64417	-4.55	<.0001
Median Disposable Income		1	74.64045	3.83379	19.47	<.0001

Table 42 Adjusted linear regression model analysis of Mexico.

From Table 41 above we can see that, median disposable income per household (USD) is the only statistically significant variable, while unemployment rate (% of economically active population), exports and imports (USD Million) population living below international poverty line ($1.90 a Day) and inflation are insignificant and need to be removed from the model.

After removing the insignificant variables from the equation, we have a new equation of the linear regression which is:

$$y = -293028 + 74.64045 \, disp$$

4.9 South Africa

South Africa is a developing/emerging economy, South Africa's economy is the third largest in Africa and the most industrialized. It has the world's 36th largest nominal GDP and the 33rd in terms of GDP (PPP) in the world. It is a member of Southern African Customs Union (SACU), AU, AfCFTA, BRICS, WTO and the G20 (IMF, 2022).

In graph 25 we can see the real GDP in USD million for South Africa from the year 1993-2022, we can notice the steep rise in the GDP from the year 2002 till it highest figure in 2011of 458226.8 million USD, then we see slight deeps and rises after that.
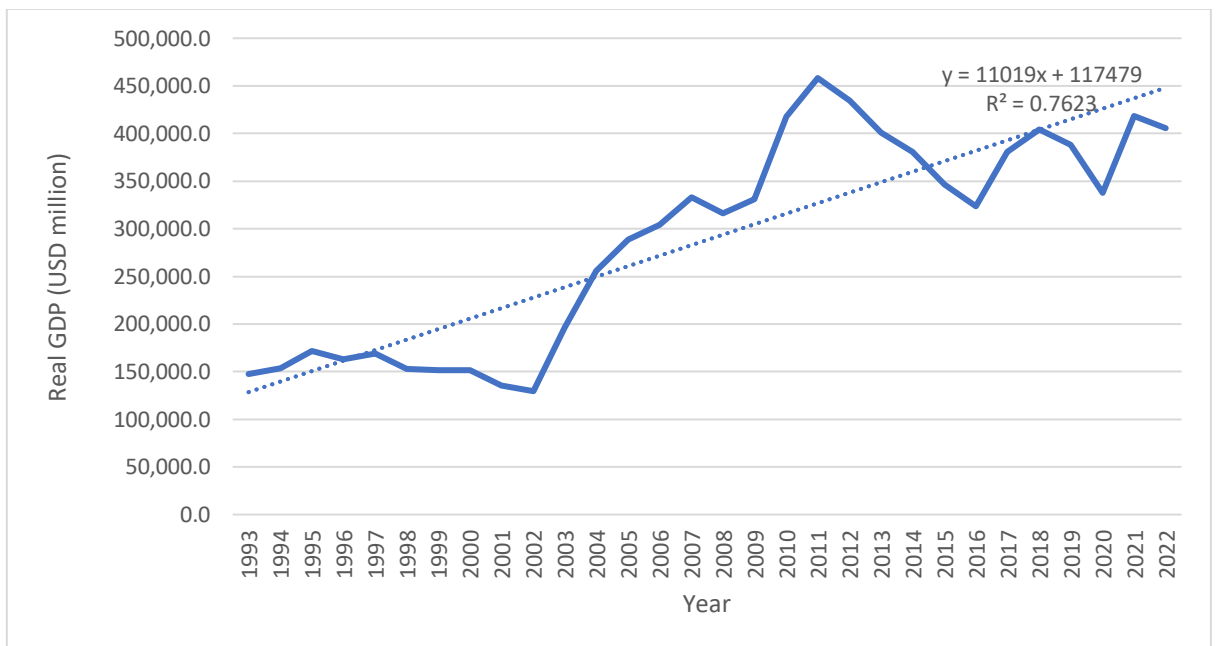
(Passport, 2023) collated by me

Graph 26 South Africa Real Gross Domestic Product (GDP) (USD million) for 1993-2022

The graph 26 below shows a steep rise and falls in the inflation (in %) of South Africa from the year 1993 till 2022, we can see the highest figure of 10.1 in 2008 and the lowest -0.7 in 2004 which is actually deflation.

The chart shows a line graph titled with y-axis "Inflation (in %)" ranging from -2.0 to 12.0, x-axis "Year" from 1993 to 2022, with trendline equation:

$$y = -1.401\ln(x) + 9.3573$$
$$R^2 = 0.2536$$
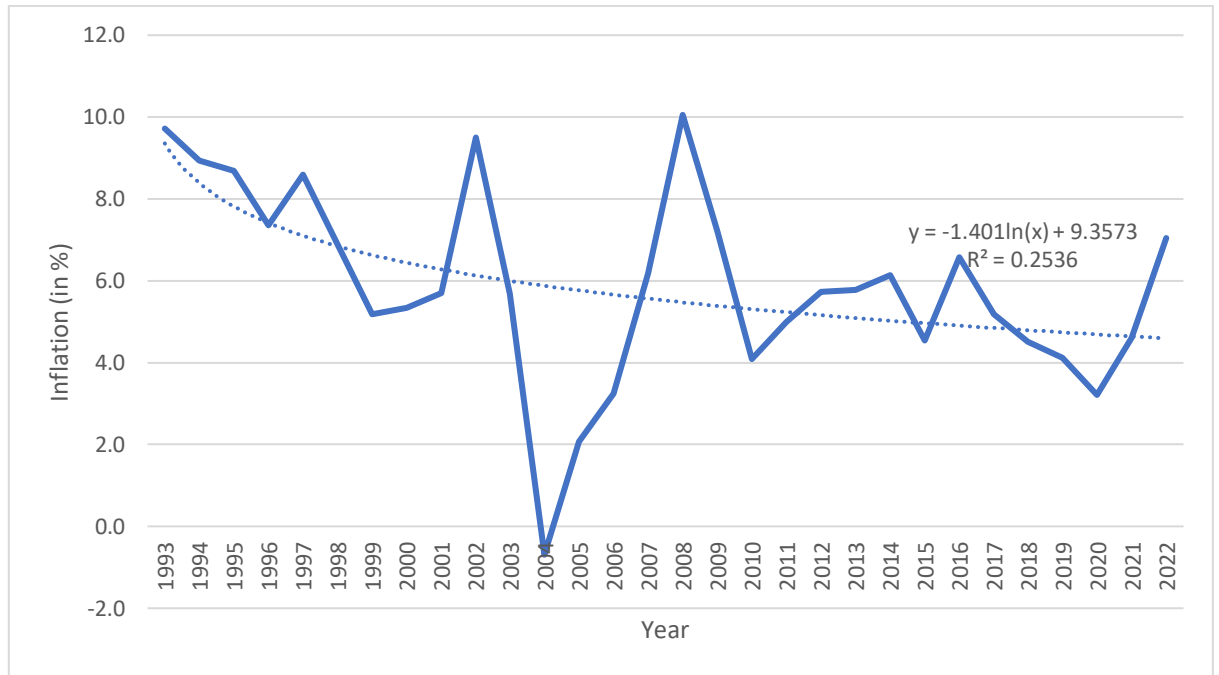
Graph 27 South Africa inflation (in %) for 1993-2022

In table 43 below we can see the summary statistics of the population living below international poverty line ($1.90 a Day), unemployment rate (% of economically active population), inflation, median disposable income per household (USD), the real gross domestic product at purchasing power parity (GDP-PPP) as the imports and exports (USD). We have all but inflation with a coefficient of variation greater than 100 meaning the standard deviation exceeds the mean value as can also be seen in the table 43 and also in graph 26 above.

Variable	Mean	Std Dev	Variance	Median	Coeff of Variation
Real GDP (USD million)	1382726.35	701053.9	4.91477E+11	1435147.3	50.7008441
Median Disposable Incom	10248.84	4465.64	19941912.38	10239.55	43.5721339
Unemployment Rate (% o	9.8145667	2.046593	4.1885428	9.752	20.8526066
Population Living Below I	5.5966667	2.123186	4.5079195	4.95	37.9366202
Inflation	146.4847333	524.5522	275155.02	6.6165	358.0934292
Imports (USD million)	127406.9	74856.08	5603433008	125719.75	58.7535526
Exports (USD million)	147980.46	86767.42	7528584908	155804.05	58.6343741

Table 43 Summary Statistics of South Africa data from 1993-2022

Table 44 shows correlation between the independent variables we have some positive and negative strong correlations(0.6-0.79), meaning we do not have to remove any of the variables from the model, .

				Correlation of Estimates				
Variable	Label	Intercept	Median Di:	Unemploy	Populatior	Inflation	Imports (U	Exports (USD million)
Intercept	Intercept	1	-0.4775	-0.7364	-0.4536	-0.1289	-0.3892	0.2798
Median Di:	Median Di:	-0.4775	1	0.6058	-0.3585	0.4001	-0.3446	-0.1726
Unemploy	Unemploy	-0.7364	0.6058	1	-0.1956	0.3655	0.2784	-0.6413
Populatior	Populatior	-0.4536	-0.3585	-0.1956	1	-0.5132	0.4251	0.2821
Inflation		-0.1289	0.4001	0.3655	-0.5132	1	-0.1745	-0.2204
Imports (USD million)		-0.3892	-0.3446	0.2784	0.4251	-0.1745	1	-0.687
Exports (USD million)		0.2798	-0.1726	-0.6413	0.2821	-0.2204	-0.687	1

Table 44 South Africa correlation table

| Number of Obse | 30 | | | | |
| Number of Obse | 30 | | | | |

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	3.55E+11	5.92E+10	500.06	<.0001
Error	23	2.72E+09	1.18E+08		
Corrected Total	29	3.58E+11			

Root MSE	10882	R-Square	0.9924
Dependent Mea	288279	Adj R-Sq	0.9904
Coeff Var	3.77477		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	107693	46374	2.32	0.0294
Median Disposable Income	1	28.65322	3.23203	8.87	<.0001
Unemployment Rate (% of	1	1217.908	1191.901	1.02	0.3175
Population Living Below Int	1	-5824.61	1168.444	-4.98	<.0001
Inflation	1	-2176.31	1101.966	-1.97	0.0604
Imports (USD million)	1	0.26267	0.35888	0.73	0.4716
Exports (USD million)	1	1.23568	0.33966	3.64	0.0014

Table 45 linear regression model analysis of South Africa

Table 45 shows the linear regression model analysis of South Africa; Equation of the Linear regression is;

$$y = 107693 + 28.65322\ disp + 1217.90785\ unemp - 5824.6118\ pov$$
$$- 2176.30949\ inf - 0.26267\ imp + 1.23568\ exp$$

Y - Real GDP (USD million)

Disp - Median disposable income per household (USD)

Unemp - Unemployment Rate (% of economically active population)

Pov - Population living below international poverty line ($1.90 a Day)

Inf - Inflation

Imp - Imports (USD million)

Exp - Exports (USD million)

Assess the fit of the function.

To assess the fit of the function we make use of Coefficient of determination (R^2) and power of dependency or correlation of coefficient (R).

R^2 here is 99.24% meaning 99.24% of the dependent variable (Real GDP (USD million)) is explained by the independent variables.

R here is 0.9961 which means there is a positive very strong dependency between the variables.

Results for testing

ANOVA

H_o: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$

H_1: at least one $\beta \neq 0$

F = 500.06

P= < 0.0001

$\alpha = 0.05$

p > α => we reject hypothesis H_o and accept H_1

Meaning at least one of the variables is statically significant.

t- Test

3.5. $H_0 = B1 = 0$	$H_0 = B2 = 0$	$H_0 = B3 = 0$
$H_1 = B1 \neq 0$	$H_1 = B2 \neq 0$	$H_1 = B3 \neq 0$
T value = 8.87	T value = 1.02	T value = -4.98
P value (0.0001) <Alpha (0.05)	P value (0.3175) > Alpha (0.05)	P value (0.0001) < Alpha (0.05)
Reject Ho	Accept Ho	Reject Ho
$H_0 = B4 = 0$	$H_0 = B5 = 0$	$H_0 = B6 = 0$
$H_1 = B4 \neq 0$	$H_1 = B5 \neq 0$	$H_1 = B6 \neq 0$
T value = -1.97	T value = 0.73	T value = 1.73
P value (0.0604) > Alpha (0.05)	P value (0.4716) > Alpha (0.05)	P value (0.0014) < Alpha (0.05)
Accept Ho	Accept Ho	Reject Ho

Source Result of Data from SAS done by me

Table 46 T-test table for South Africa.

Number of Obser	30				
Number of Obser	30				

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	3.54E+11	1.18E+11	849.93	<.0001
Error	26	3.61E+09	1.39E+08		
Corrected Total	29	3.58E+11			

Root MSE	11790	R-Square	0.9899	
Dependent Mean	288279	Adj R-Sq	0.9887	
Coeff Var	4.08962			

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	157880	32235	4.9	<.0001
Median Disposable Income	1	27.68506	2.06166	13.43	<.0001
Population Living Below Inte	1	-6847.13	979.8162	-6.99	<.0001
Exports (USD million)	1	1.40933	0.19613	7.19	<.0001

Table 47 Adjusted linear regression model analysis of South Africa

From Table 46 above we can see that, median disposable income per household (USD) exports (USD million) and population living below international poverty line ($1.90 a Day), are statistically significant while unemployment rate (% of economically active population), imports (USD Million) and inflation insignificant and need to be removed from the model. After removing the insignificant variables from the equation, we have a new equation of the linear regression which is:

$$y = 157880 + 27.68506\ disp - 6847.13115\ pov\ + 1.40933\ exp$$

4.10 Vietnam

The Southeast Asian country of Vietnam is a developing/emerging economy. In 2022 had the 36th largest in the world in terms of nominal GDP and the 26th largest in terms of purchasing power parity (PPP). It is a member of Association of Southeast Asian Nations (ASEAN), ASEAN Free Trade Area (AFTA), Regional Comprehensive Economic Partnership (RCEP), APEC, CPTPP (IMF, 2022).

In graph 27 we can see the upward slope of Real GDP, imports and exports (all in USD million). This shows that Vietnam in 30 years have improved it real GDP drastically and we can assume from the graph below that this was due to increase in trading.
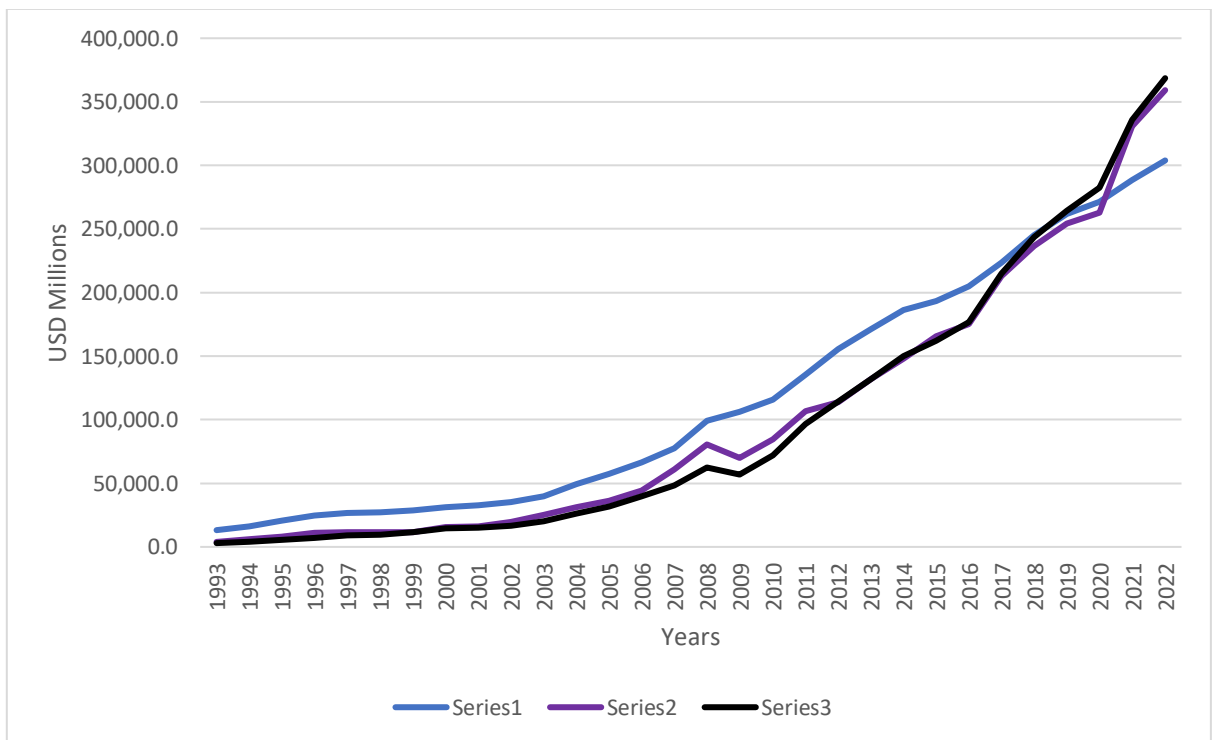
(Passport, 2023) collated by me

Graph 28 Vietnam Real Gross Domestic Product (GDP), imports and exports (USD million) for 1993-2022

Series 1 – Real GDP

Series 2 - imports

Series 3 – exports
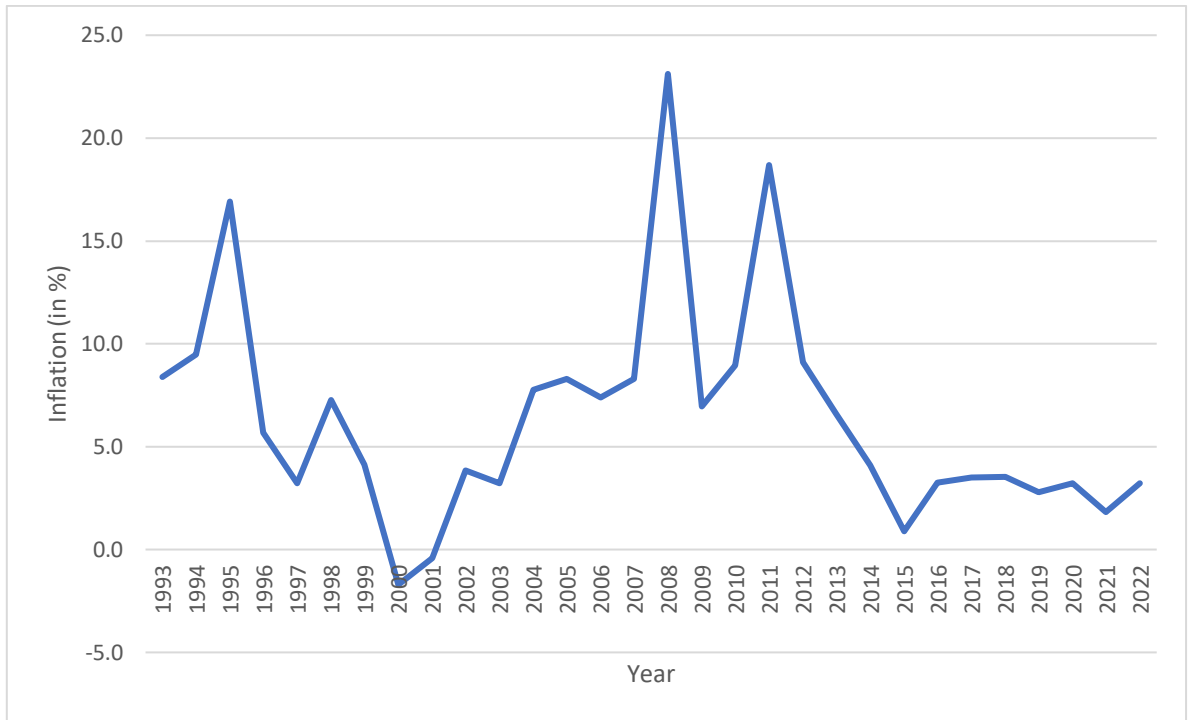
Graph 29 Vietnam inflation (in %) for 1993-2022

Graph 28 shows inflation in Vietnam (in %), we can see the fluctuations in the figures with the highest in 23.1% in 2018 and the lowest in 2000 with a valve -1.7 % which is actually deflation.

Variable	Mean	Std Dev	Variance	Median	Coeff of Variation
Real GDP (USD million)	116982.64	95151.79	9053862817	88273.05	81.3383811
Median Disposable Incom	2581.3	1674.59	2804250.65	2232.9	64.8738889
Unemployment Rate (% o	2.2557667	0.406715	0.1654172	2.2195	18.030019
Population Living Below I	13.7533333	10.49758	110.1991264	9.9	76.3275121
Inflation	6.3808667	5.384784	28.9958961	4.896	84.3895358
Imports (USD million)	101567.95	104144	10845965171	65322.9	102.5362432
Exports (USD million)	99873.15	108949.6	11870017672	52704.65	109.0879925

Table 48 Summary Statistics of Vietnam data from 1993-2022

In table 48 below we can see the summary statistics of the population living below international poverty line ($1.90 a Day), unemployment rate (% of economically active

population), inflation, median disposable income per household (USD), the real gross domestic product at purchasing power parity (GDP-PPP) as the imports and exports (USD million). We have all but the imports and exports (USD million) with a coefficient of variation greater than 100 meaning the standard deviation exceeds the mean value as can also be seen in the table 43 and also in graph 27 above.

Correlation of Estimates								
Variable	Label	Intercept	Median Di:	Unemploy	Populatior	Inflation	Imports (U	Exports (USD million)
Intercept	Intercept	1	-0.8748	-0.6304	-0.7938	0.0134	-0.2491	0.422
Median Di:	Median Di:	-0.8748	1	0.4119	0.7241	-0.1375	0.088	-0.3109
Unemploy	Unemploy	-0.6304	0.4119	1	0.0799	0.1168	-0.1277	0.0142
Populatior	Populatior	-0.7938	0.7241	0.0799	1	-0.1838	0.4784	-0.5875
Inflation		0.0134	-0.1375	0.1168	-0.1838	1	-0.4752	0.5047
Imports (USD million)		-0.2491	0.088	-0.1277	0.4784	-0.4752	1	-0.9715
Exports (USD million)		0.422	-0.3109	0.0142	-0.5875	0.5047	-0.9715	1

Source Result of Data from SAS done by me

Table 49 Vietnam correlation table

Table 49 shows correlation between the independent variables we have some positive and negative strong correlations (0.6-0.79) and 1 negative strong correlation between import and exports (USD million), meaning normally one of them should be removed from the model, but will not be removed on the first regression model as will later be seen that imports and exports (USD million) will be insignificant.

Below in table 9 we have the linear regression model analysis of Canada; Equation of the Linear regression is;

$$y = 17031 + 38.0785\,disp - 2619.14681 unemp - 816.67051\,pov - 132.19367\,inf - 0.3980\,imp + 0.60145\,exp$$

Y - Real GDP (USD million)

Disp - Median disposable income per household (USD)

Unemp - Unemployment Rate (% of economically active population)

Pov - Population living below international poverty line ($1.90 a Day)

Inf - Inflation

Imp - Imports (USD million)

Exp - Exports (USD million)

Number of Obse		30				
Number of Obse		30				
Analysis of Variance						
Source	DF	Sum of	Mean	F Value	Pr > F	
		Squares	Square			
Model	6	2.62E+11	4.37E+10	6469.14	<.0001	
Error	23	1.55E+08	6760468			
Corrected Total	29	2.63E+11				
Root MSE	2600.09	R-Square	0.9994			
Dependent Mea	116983	Adj R-Sq	0.9993			
Coeff Var	2.22263					
Parameter Estimates						
Variable		DF	Parameter	Standard	t Value	Pr > |t|
			Estimate	Error		
Intercept		1	17031	7222.647	2.36	0.0273
Median Disposable Income		1	38.0785	2.38712	15.95	<.0001
Unemployment Rate (% of		1	-2619.15	1421.402	-1.84	0.0783
Population Living Below Int		1	-816.671	156.8585	-5.21	<.0001
Inflation		1	-132.194	112.4018	-1.18	0.2516
Imports (USD million)		1	-0.39801	0.12473	-3.19	0.0041
Exports (USD million)		1	0.60145	0.12051	4.99	<.0001

Source Result of Data from SAS done by me

Table 50 linear regression model analysis of Vietnam

Assess the fit of the function.

To assess the fit of the function we make use of Coefficient of determination (R^2) and power of dependency or correlation of coefficient (R).

R^2 here is 99.94 % meaning 99.94 % of the dependent variable (Real GDP (USD million)) is explained by the independent variables.

R here is 0.9996 which means there is a positive very strong dependency between the variables.

Results for testing

ANOVA

H_o: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$

H_1:at least one $\beta \neq 0$

F = 6469.14

P= < 0.0001

α = 0.05

$p > \alpha$ => we reject hypothesis H_o and accept H_1

Meaning at least one of the variables is statistically significant.

t- Test

3.6. $H_0 = B1 = 0$	$H_0 = B2 = 0$	$H_0 = B3 = 0$
$H_1 = B1 \neq 0$	$H_1 = B2 \neq 0$	$H_1 = B3 \neq 0$
T value = 15.95	T value = -1.84	T value = -5.21
P value (0.0001) <Alpha (0.05)	P value (0.0783) > Alpha (0.05)	P value (0.0001) <Alpha (0.05)
Reject Ho	Accept Ho	Reject Ho
$H_0 = B4 = 0$	$H_0 = B5 = 0$	$H_0 = B6 = 0$
$H_1 = B4 \neq 0$	$H_1 = B5 \neq 0$	$H_1 = B6 \neq 0$
T value = 0.25	T value = -3.19	T value = 4.99
P value (0.2516) <Alpha (0.05)	P value (0.0041) > Alpha (0.05)	P value (0.0001) < Alpha (0.05)
Accept Ho	Accept Ho	Accept Ho

Source Result of Data from SAS done by me

Table 51 T-test table for Vietnam.

Number of Obse		30				
Number of Obse		30				
Analysis of Variance						
Source	DF	Sum of	Mean	F Value	Pr > F	
		Squares	Square			
Model	3	2.62E+11	8.74E+10	7174.59	<.0001	
Error	26	3.17E+08	12183983			
Corrected Total	29	2.63E+11				
Root MSE	3490.556	R-Square	0.9988			
Dependent Meaı	116983	Adj R-Sq	0.9987			
Coeff Var	2.98382					
Parameter Estimates						
Variable		DF	Parameter	Standard	t Value	Pr > |t|
			Estimate	Error		
Intercept		1	-1264.95	6762.012	-0.19	0.8531
Median Disposable Income		1	40.10819	2.85131	14.07	<.0001
Population Living Below Intı		1	-508.052	182.2743	-2.79	0.0098
Exports (USD million)		1	0.21731	0.03263	6.66	<.0001

Table 52 Adjusted linear regression model analysis of Vietnam.

From Table 52 above we can see that, median disposable income per household (USD) imports (USD million) and population living below international poverty line ($1.90 a Day), are statistically significant while unemployment rate (% of economically active population), exports (USD million) and inflation are insignificant and need to be removed from the model. After removing the insignificant variables from the equation, we have a new equation of the linear regression which is:

$$y = -1264.95483 + 40.10819 \, disp - 508.05183 \, pov + 0.21731 \, exp$$

5. Results and Discussion

The following are the adjusted equations for each of the 10 countries,

$$y_{Brazil} = 682922 + 120.5903\,disp - 99392\,pov + 137.613\,inf$$

$$y_{Canada} = -310017 + 20.734477\,disp + 2.10176\,imp$$

$$y_{Colombia} = -735577 + 36.03547\,disp + 6855.256\,unemp - 9412.9\,pov$$

$$y_{Czech\ Republic} = -1960.6 + 9.15187\,disp$$

$$y_{Egypt} = -87371 + 45.89449\,disp$$

$$y_{Germany} = -818808 + 93.98263\,disp$$

$$y_{India} = -2078858 + 901.8346\,disp + 32058\,pov - 1.32719\,imp$$

$$y_{Mexico} = -293028 + 74.64045\,disp$$

$$y_{South\ Africa} = 157880 + 27.68506\,disp - 6847.13115\,pov + 1.40933\,exp$$

$$y_{Vietnam} = -1264.95483 + 40.10819\,disp - 508.05183\,pov + 0.21731\,exp$$

The equation for Brazil shows that, the real GDP (USD million) in Brazil is affected by Median disposable income per household (USD), population living below international poverty line ($1.90 a Day) and inflation.

The equation for Canada shows that, the real GDP (USD million) in Canada is affected by Median disposable income per household (USD) and imports (USD million).

The equation for Colombia shows that, the real GDP (USD million) in Colombia is affected by Median disposable income per household (USD), Unemployment Rate (% of economically active population) and population living below international poverty line ($1.90 a Day).

The equation for India shows, the real GDP (USD million) is affected by Median disposable income per household (USD), population living below international poverty line ($1.90 a Day) and imports (USD million).

The equation for South Africa and Vietnam shows their real GDPs (USD million) by Median disposable income per household (USD), population living below international poverty line ($1.90 a Day) and exports (USD million).

GDP is the final consumption of households, non-profit institutions serving households and government; fixed assets; and exports (minus imports) (OECD, 2009). Real GDP is simply nominal GDP divided by the GDP deflator (Rashid & Antonioni, 2015).

As can be seen from the above equations, the only variable present in all 10 models is the median disposable income per household. This shows that in the 10 countries in other to increase real GDP the countries have to work on increasing the median disposable income. If real income grows more rapidly than population, we have positive economic growth including an increase in per capita income (Hess, 2016).

Also noticeable is all the developing/emerging economy except Egypt have population living below international poverty line ($1.90 a Day) as a statistically significant variable showing that poverty is contraindicated in GDP growth and in so also bad for sustainability (Hornby, 1995). Which is why the SDGs are working directly on poverty like SDG 1 (United Nations, 2021). Other SDGs like 2,3,4 and 6 are working on reducing the "symptoms" of poverty (United Nations, 2021).

It also shows that in most countries neither imports nor exports were significant to the real GDP (OECD, 2009), neither was inflation which is used to calculate the GDP deflators (Rashid & Antonioni, 2015).

What this shows at the end is that GDP is most likely affected by governmental spending and business investment, this are variables that could be looked at in later research.

Sustainability or sustainable growth is a national output growth that meets current needs without endangering future generations' ability to meet their own needs (Espinosa, et al., 2021). Growth is the important term in sustainability and if the way we measure growth is the GDP, and it has been shown that GDP is affected by the median disposable income per household. Consequently, in other to control growth economists have to make sure that the variable (median disposable income per household) that brings forth set growth are done within bounds that will not affect the sustainability of the economy and the world at large.

It is further recommended that five of the ten countries (Brazil, Colombia, India, South Africa and Vietnam) should endeavour to reduce the poverty rates among their citizens in other for their economics to grow sustainably.

6. Conclusion

In the case study 10 countries were selected randomly based on diversity as well as availability and reliability of data. This is to address the global concern of economic inequality and sustainability in a representative fashion. The data were analysed using SPSS and SAS statistical software tools.

Across the selected countries it was found out that the median disposable income per household is the most statistically significant of the other variable in the determination of the Real GDP, and in such most important in the terms of controlling growth and making sure it is sustainable.

The study also shows that the poverty rate across all 10 countries in general has been on the decline which is in line the SDGs number 1. However, it was also shown that Brazil, Colombia, India, South Africa and Vietnam which are developing or emerging economies in the case study require that poverty be worked on as it was statistically significant and was negatively affecting the growth of those nations. Egypt which is also developing or emerging economy didn't have poverty has a statistically significant variable in its regression model showing that Egypt has worked sustainably on its poverty rate and will soon be able to compete economically with the developed countries. From the study Czech Republic has a zero-poverty rate while Germany and Canada have poverty rate of 0.2 %.

It is recommended that in other to promote economic growth the median disposable income of citizens in respective countries should be enhanced using appropriate and robust economic policies.

In future, more countries in Africa and Asia should be included in similar studies in other to address the concerns of inequalities in those regions of the world.

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8. List of tables, graphs and abbreviations

8.1 List of tables

8.2 List of graphs

8.3 List of Abbreviations

AfCFTA - African Continental Free Trade Area

AFTA - ASEAN Free Trade Area

AIIB - Asian Infrastructure Investment Bank

APEC - Asia-Pacific Economic Cooperation

ASEAN - Association of Southeast Asian Nations

AU - African Union

BIMSTEC - Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation

BRICS - is an acronym for five leading emerging economies: Brazil, Russia, India, China, and South Africa.

CAEU - Council of Arab Economic Unity

CAN - Comunidad Andina (Andean Community in English)

COMESA - Common Market for Eastern and Southern Africa

CPTPP - Comprehensive and Progressive Agreement for Trans-Pacific Partnership

EAP - East Asia and Pacific

EU – European Union

IMF - International Monetary Fund

OECD - Organization for Economic Co-operation and Development

RCEP - Regional Comprehensive Economic Partnership

SACU - Southern African Customs Union

SAFTA - South Asian Free Trade Area

SSA - Sub-Saharan Africa

USA - United States of America

USMCA - United States–Mexico–Canada Agreement

WFTU - World Federation of Trade Unions

WTO - World Trade Organization