Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Economics

Master's Thesis

Analysis and Comparison of the Fiscal Sustainability of Germany, Norway, the Netherlands

Joseph Bassit

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

DIPLOMA THESIS ASSIGNMENT

Bc. Joseph Bassit

Economics and Management

Thesis title

Analysis and Comparison of the Fiscal Sustainability of Germany, Norway, and the Netherlands

---

Objectives of thesis

The diploma thesis will focus on the fiscal sustainability of Germany, Norway and the Netherlands.
The research question is:
What is the impact on Germany's fiscal sustainability after the reliance on Russian gas stopped?

Methodology

The preparation of the thesis can be divided into several sub-steps. The titles of the chapters may be different, but they must meet their objectives in terms of content.

In the introduction, the author briefly introduces the topic and explains why the topic is relevant for processing.

In the following chapter, entitled "Objectives", the author specifies the research question, the aim of the work and the hypotheses associated with the processing of the work. At the same time, he explains the potential contribution of his work to the current research or practical application.

The creation of a literary search will follow. This section will provide a detailed overview of the literature and the current state of knowledge, focusing on fiscal sustainability connected with gas reliance. It will include a critical analysis of the most important studies, including the methods used, the results found and, where appropriate, the problematic points. Methodically, this part of the work will be the analysis of documents.

The literary search will provide a basis for the author to specify the methods used for the analytical part of the work. The chapter entitled "Methodology" will present in detail all the methods used; it will also include the source of the data, their description and the process of their preparation for the analysis.

In the next step (analytical part), the author applies the knowledge gained during the literature study to analyse the obtained data using the methods specified in the methodology. This part is a core component of the thesis. This part of the thesis will contain the analysis results and a comparison of the results with other authors focused on the same topic (discussion). This part may also contain recommendations for policymakers or other interested parties.

In the final part (Conclusion), the author will summarise his findings, mention the limitations of the research and indicate possible possibilities for further research.

The proposed extent of the thesis

60 – 80 pages

Keywords

Fiscal sustainability, gas, Germany, green finance, Russia

Recommended information sources

Adedoyin, F. F. et al. (2023) 'Energy policy simulation in times of crisis: Revisiting the impact of renewable and non-renewable energy production on environmental quality in Germany', Energy Reports. Elsevier Ltd, 9, pp. 4749–4762. doi: 10.1016/j.egyr.2023.03.120

Artelys, Does Phasing-Out Russian Gas Require New Gas Infrastructure? (2022): Brief. Pap, https://www.artelys.com/wp-content/uploads/2022/05/Artelys-Russian-gas-phase-out-Briefing-note.pdf. (Accessed 23 May 2023).

European Commission DG Energy (2023) Quarterly report On European gas markets. Bruxelles. Available at: https://energy.ec.europa.eu/system/files/2023-01/Quarterly report on European gas markets Q3_FINAL.pdf (Accessed: 23 May 2023)

Sun, Y., Gao, P. and Razzaq, A. (2023) 'How does fiscal decentralization lead to renewable energy transition and a sustainable environment? Evidence from highly decentralized economies', Renewable Energy. Elsevier Ltd, 206, pp. 1064–1074. doi: 10.1016/j.renene.2023.02.069

Wiertz, T., Kuhn, L. and Mattissek, A. (2023) 'A turn to geopolitics: Shifts in the German energy transition discourse in light of Russia's war against Ukraine', Energy Research & Social Science, 98, p. 103036. doi: 10.1016/j.erss.2023.103036

Expected date of thesis defence

2023/24 SS – PEF

The Diploma Thesis Supervisor

doc. Ing. Irena Benešová, Ph.D.

Supervising department

Department of Economics

Electronic approval: 05. 09. 2023

prof. Ing. Lukáš Čechura, Ph.D.

Head of department

Electronic approval: 03. 11. 2023

doc. Ing. Tomáš Šubrt, Ph.D.

Dean

Prague on 27. 11. 2024

Declaration

I hereby declare that the diploma thesis titled “Analysis and Comparison of the Fiscal Sustainability of Germany, Norway, Italy, the Netherlands, and The Czech Republic” was carried out by me under the guidance and supervision of my supervisor, Doc. Ing. Irena Benešová, Ph.D. I further declare that the information derived from the reviewed works of literature, governments’ budgets, and other resources has been duly acknowledged in the text and the list of references provided.

In Prague 29rd of November 2024 Signature.....

Acknowledgment

To begin with, I would like to dedicate this achievement to the souls of my grandfather and father. Their memories have been a constant source of strength, inspiration, and ambition throughout my journey.

To my mother, grandmother, sister, and entire family—thank you for your unwavering support, encouragement, and belief in me. I am forever grateful for your presence in my life.

A special gratitude goes to Professor Irena Benešová, for granting me the invaluable opportunity to work under her supervision. Her guidance, profound knowledge, and insightful feedback were fundamental to successfully completing my thesis.

My deep appreciation is also extended to my professors for their invaluable support and contributions throughout my master's program.

Last but not least, I extend my heartfelt thanks to the Czech Republic for welcoming me and providing me with the opportunity to pursue my Master's degree here.

Analysis and Comparison of the Fiscal Sustainability of Germany, Norway, and the Netherlands

Abstract

This thesis examines the fiscal sustainability of public finances in selected European countries—Germany, the Czech Republic, the Netherlands, Italy, and Norway—within the context of the Russia-Ukraine conflict, volatile natural gas prices, and shifting demographics. These nations face distinct fiscal challenges, shaped by their roles in the global energy market, their reliance on imported energy, and demographic pressures such as ageing populations and migration flows.

The research focuses on the fiscal responses of these countries to recent economic shocks, including measures such as energy subsidies, structural reforms, and adjustments to public spending and taxation. Using econometric models, the study evaluates the impact of energy price fluctuations on government expenditures. It explores how fiscal adjustments influence deficit-to-GDP ratios, providing insights into the sustainability of public finances under economic stress.

Demographic changes, such as the ageing population and the overflow of refugees resulting from the conflict, are also analyzed for their long-term implications on fiscal policies and economic stability. Special attention is given to the selected countries coordinated fiscal responses and their strategic efforts to reduce dependency on Russian gas, assessing how these shifts affect national budgets and fiscal sustainability.

Through a comparative analysis of the selected countries, the thesis underscores the complex interplay between fiscal policy, external economic shocks, and structural challenges. The findings provide evidence-based policy recommendations to strengthen fiscal sustainability while addressing immediate economic needs and long-term fiscal risks. This research contributes to a deeper understanding of public finance management during geopolitical uncertainty and economic transformation.

Keywords: Fiscal Sustainability, Budget Balance, Public Finances, Energy Sources, Demography.

Analýza a srovnání fiskální udržitelnosti Německa, Norska, a Nizozemska

Abstrakt

Tato diplomová práce zkoumá fiskální udržitelnost veřejných financí ve vybraných evropských zemích – Německu, České republice, Nizozemsku, Itálii a Norsku – v kontextu konfliktu mezi Ruskem a Ukrajinou, nestabilních cen zemního plynu a demografických změn. Tyto státy čelí různým fiskálním výzvám, které jsou ovlivněny jejich rolemi na globálním energetickém trhu, závislostí na dovozu energií, jakož i demografickými tlaky, jako je stárnutí populace a migrační toky.

Výzkum se zaměřuje na fiskální reakce těchto zemí na nedávné ekonomické šoky, včetně opatření, jako jsou energetické dotace, strukturální reformy a úpravy veřejných výdajů a daňových politik. Pomocí ekonometrických modelů studie hodnotí dopad výkyvů cen energií na vládní výdaje a zkoumá, jak fiskální úpravy ovlivňují poměr deficitu k HDP, čímž poskytuje náhled na udržitelnost veřejných financí pod ekonomickým tlakem.

Demografické změny, jako je stárnutí populace a příliv uprchlíků v důsledku konfliktu, jsou rovněž analyzovány z hlediska jejich dlouhodobých dopadů na fiskální politiku a ekonomickou stabilitu. Zvláštní pozornost je věnována koordinovaným fiskálním reakcím vybraných zemí a jejich strategickým snahám o snížení závislosti na ruském plynu, přičemž je hodnocen dopad těchto změn na státní rozpočty a fiskální udržitelnost.

Prostřednictvím komparativní analýzy vybraných zemí diplomová práce zdůrazňuje složitou provázanost mezi fiskální politikou, vnějšími ekonomickými šoky a strukturálními výzvami. Závěry poskytují na důkazech založená doporučení pro politiku zaměřenou na posílení fiskální udržitelnosti při současném řešení naléhavých ekonomických potřeb a dlouhodobých fiskálních rizik. Tento výzkum přispívá k hlubšímu pochopení správy veřejných financí v době geopolitické nejistoty a ekonomických transformací.

Klíčová slova: Fiskální udržitelnost, rozpočtová bilance, veřejné finance, energetické zdroje, demografie.

Table of Contents

Table of Figures

Table of Tables

Abbreviations

GDP	Gross Domestic Product
NFT	Net Financial Transactions
MCM	Million cubic meters
OADR	Old age dependency ratio
CZK	Czech koruna
EUR	Euro
EU	European Union
OLS	Ordinary Least Square
OCED	Organization for Economic Co-operation and Development

1 INTRODUCTION

Fiscal sustainability is defined as the ability of a government to maintain public finances at a credible and serviceable position over the long term. (OECD, 2013)

The sustainability of public finances also referred to as fiscal sustainability, is the ability of a government to sustain its current spending, tax and other-related policies in the long run without threatening its solvency or defaulting on some of its liabilities or promised expenditures. (European Commission, 2017)

The sustainability of public finances is fundamental to ensuring economic stability and enabling governments to fulfil their financial commitments without compromising future fiscal health. It involves balancing between revenues and expenditures over the long term, keeping debt levels manageable, and adapting to economic, demographic, and external challenges. Fiscal sustainability is critical for fostering economic growth, maintaining market confidence, and ensuring fairness across generations.

In recent years, the issue of fiscal sustainability has gained prominence due to rising public debt, global economic crises, and structural pressures such as ageing populations and climate-related risks. Governments face increasing demands to balance the provision of public services, economic development, and responses to unexpected events, such as the COVID-19 pandemic and volatile energy prices caused by geopolitical tensions. These pressures underscore sound fiscal management's importance in preventing excessive debt accumulation and economic instability.

Indicators such as the debt-to-GDP ratio, budget deficits, and primary fiscal balances are commonly used to assess a government’s fiscal position. However, fiscal sustainability is shaped by complex factors, including economic growth, interest rates, policy decisions, and external circumstances. For example, while high debt levels may be manageable during periods of low borrowing costs and robust economic growth, they can become unsustainable during economic downturns or rising interest rates.

This study explores the sustainability of public finances amid changing economic and fiscal challenges. By examining the relationships between fiscal policies, economic conditions, and external shocks like energy price fluctuations, it seeks to provide insights into the drivers of

sustainable fiscal practices. The analysis aims to guide policymakers in building fiscal resilience while pursuing long-term economic and social goals.

2 LITERARY SEARCH

This thesis focuses on the sustainability of public finances and fiscal policies in several European countries, including Norway, Germany, the Czech Republic, Italy, and the Netherlands, in the context of economic shocks arising from the Russia-Ukraine conflict. This geopolitical crisis triggered significant volatility in energy prices. It prompted a reassessment of political and economic relationships between the European Union and Russia. The EU's high dependence on Russian gas intensified geopolitical risks, amplifying the impact on member states.

The selection of these specific countries is based on factors such as their dependence on gas imports, domestic gas production capacity, economic growth trajectories, levels of public debt, and fiscal policy responses. Additionally, the thesis examines demographic shifts within these nations, including those influenced by immigration and asylum flows resulting from the war. These considerations provide a comprehensive framework to evaluate how internal and external pressures influence fiscal sustainability.

2.1 Countries' Fiscal Sustainability

The member states of the European Union commit to maintaining stable public finances following the fiscal rules of the Maastricht Treaty. The Maastricht Treaty (1992) established the European Union and laid the groundwork for the euro, and introduced strict fiscal regulations to promote economic stability and convergence among member states. Known as the ***Stability and Growth Pact (SGP)*** criteria, these rules set clear limits: annual government budget deficits must not exceed 3% of GDP, and public debt should remain below 60% of GDP, with countries exceeding this threshold required to demonstrate consistent progress toward reduction. The objectives of these rules are to ensure fiscal discipline, prevent excessive borrowing that could destabilize the eurozone, and support long-term economic stability and integration. Member states must submit Stability or Convergence Programs to the European Commission for review. If thresholds are breached, countries may face the ***Excessive Deficit Procedure (EDP),*** which demands corrective measures and can include sanctions. These rules were temporarily relaxed during the COVID-19 pandemic under the general escape clause to allow flexibility for crisis management. However, discussions about reforming the framework are ongoing, addressing

challenges such as high debt levels, climate investment needs, and economic recovery. Nevertheless, the framework can be adapted or differentiated among member states to account for their specific economic conditions and fiscal challenges. (*Consolidated version of the Treaty on European Union - PROTOCOLS - Protocol (No 12) on the excessive deficit procedure*, 2008)

2.1.1 Germany

Germany's recent fiscal policy in 2024 is focused on achieving fiscal normalcy while driving economic sustainability and growth. It prioritizes efficient public spending, structural reforms, and investments in future-oriented sectors. Therefore, the federal government introduced in its Stability Program 2024 new acts to secure both future economy and sustainability as the following:

- **Fiscal Normalization**:

  Adherence to the constitutional ***debt brake*** ensures prudent spending and deficit reduction.

  Structural consolidation is expected to reduce the deficit and the debt-to-GDP ratio, projected to decline to 62% by the end of the forecast period.

- **Legislative and Structural Reforms**:

  Financing for the Future Act (*Zukunftsfinanzierungsgesetz*): Enhances private and venture capital access for high-growth and innovative companies.

  Growth Opportunities Act (*Wachstumschancengesetz*): Introduces targeted tax incentives for investment, simplifies the tax system, and reduces bureaucratic burdens.

  Bureaucracy Relief Act IV (*Bürokratieentlastungsgesetz IV*): Reduces administrative barriers for businesses and citizens, enhancing productivity.

  Act on the Further Development of Skilled Immigration (*Gesetz zur Weiterentwicklung der Fachkräfteeinwanderung*): Simplifies immigration for skilled workers from non-EU countries.

Initial and Continuing Education and Training Act (*Gesetz zur Stärkung der Aus- und Weiterbildungsförderung*): Focuses on preventing unemployment due to structural changes and bolstering workforce skills.

- **Investment in Climate and Innovation**:

  €49.1 billion is allocated through the **Climate and Transformation Fund** to promote climate-neutral transformation.

  Temporary expansion of reduced electricity duty for manufacturing, agriculture, and forestry under the **Electricity Price Package** boosts competitiveness.

- **Labor Market and Education Policies**:

  Targeted improvements in childcare under the **Child Daycare Quality Act (*KiTa-Qualitätsgesetz*)**, with €4 billion in funding for 2024.

  Enhanced labor market participation through reforms supporting employment incentives, refugee integration, and skill development.

- **Addressing Demographic Challenges**:

  Creation of a pension stabilization fund to invest in capital markets, ensuring long-term viability of the statutory pension system.

  Measures aim to boost productivity, increase private investment, and modernize public administration to mitigate labor shortages.

Germany's fiscal approach combines careful consolidation with transformative investments to secure long-term economic strength and sustainability. (*German Stability Programme 2024 - Federal Ministry of Finance - Resources*, 2024)

2.1.2 The Czech Republic

The Czech Republic's fiscal policy, as outlined in the **November 2023 Fiscal Outlook**, focuses on addressing immediate challenges while ensuring long-term sustainability. The country, impacted by the COVID-19 pandemic, the war in Ukraine, and rising energy prices, has seen an increase in public debt. However, it remains below the EU's 60% debt-to-GDP threshold. The government introduced several measures to restore fiscal balance, including subsidies to households and businesses during the energy crisis, which were phased out as energy prices stabilized. Despite increasing debt temporarily, these measures were crucial in mitigating the economic impact of rising energy costs.

The **Czech pension system** faces significant challenges due to an aging population, with nearly 47% of the population expected to be 65 or older by 2070. In response, the government has implemented reforms such as raising the retirement age, tightening early retirement conditions, and adjusting pension indexation to better align with inflation and wage growth. These changes aim to stabilize the pension system, with projections indicating a reduction in pension expenditures by up to 0.5% of GDP by 2060.

The **one-off measure** for the energy crisis included subsidies totaling CZK 46 billion in 2023, with additional support for energy operators and regional distribution systems. These subsidies are set to end by 2024, leading to fiscal savings. (*Fiscal Outlook of the Czech Republic* 2023)

Fiscal Consolidation Measures

- To improve fiscal health, the government launched a **consolidation package** in 2023, targeting both **expenditure reductions** and **revenue enhancements** to bring notable improvements to the state budget, Also, additional measures were implemented to reduce the risk of long-term financial instability, particularly to address structural issues in the pension, healthcare, and long-term care systems, considering the aging population of the Czech Republic. Therefore, to sustain the public finances the consolidation package introduced the following policies:

- **Expenditure Reductions**:
    - CZK 49 billion in savings for 2024, with cuts to subsidies, public sector salaries, and operational costs.
    - Reforms include the closure of underused administrative offices and reduced welfare benefits.
- **Revenue Enhancements**:
    - Corporate income tax raised by 2 percentage points to 21%, adding CZK 22 billion in revenue.
    - Real estate taxes increased by 1.8 times, contributing CZK 10 billion.
    - Introduction of a 0.6% sickness insurance contribution for employees, raising CZK 13 billion.
    - Simplification of VAT rates and higher excise duties on tobacco, alcohol, and gambling.

2.1.3 The Netherlands

The Netherlands adopted the so-called Recovery Resilience Plan (RRP), which outlines a comprehensive set of reforms and investments to address structural challenges across various sectors, including green transition, digital transformation, workforce development, pension reform, healthcare resilience, housing, and labor market segmentation. These initiatives support the country's long-term economic growth, competitiveness, and sustainability. The RRP provides a cohesion policy and solid framework that governs several key aspects as the following:

- **Green Transition:** The plan emphasizes the deployment of renewable energy sources, grid connection investments, and hydrogen infrastructure development. It also promotes energy efficiency in buildings, sustainable agriculture, and the transition to renewable transport.
- **Digital Transformation:** Investments are directed towards quantum technology, digital skills, and the development of digital solutions for safe, smart, and sustainable transport systems.

- **Workforce Development:** The plan addresses gaps in education caused by the COVID-19 pandemic, encourages continuous learning, and supports career advice and skill development, particularly in high-productivity sectors.
- **Pension System Reform:** Reforms aim to improve the fairness, transparency, and shock resilience of the second pillar of the pension system.
- **Healthcare Resilience:** The plan seeks to enhance the resilience of the healthcare sector, ensuring its ability to cope with future crises.
- **Housing Market:** The plan includes measures to reform planning and permitting procedures, set regional construction targets, and unlock private construction projects to address the housing shortage and improve affordability.
- **Self-Employment and Labor Market Reform:** The plan introduces mandatory disability insurance for the self-employed and tackles issues such as bogus self-employment.

Moreover, The Dutch government has introduced several fiscal policies designed to ensure structural reforms and provide additional investments to enhance economic performance and ensure a more sustainable future for the country. These reforms cover the following economy's aspects:

- **Taxation and Wealth:** Aligning taxation of different types of income from wealth could help curb the accumulation of illiquid forms of wealth and reduce tax arbitrage, thus promoting fairer wealth distribution.
- **Labor Market and Skills:** Tackling labor market segmentation, improving students' basic skills, addressing structural labor and skills shortages, and encouraging mobility to high-productivity sectors are key areas for enhancing social resilience and inclusive growth.
- **Housing and Construction:** Measures to remove obstacles to housing construction and ensure affordable rental housing are crucial to meet housing demand and support economic mobility.
- **Long-Term Care Sustainability:** Ensuring the budgetary sustainability of the long-term care system is vital as expenditures in this area are expected to rise significantly.

- **Electricity Grid and Renewable Energy:** Tackling grid congestion through further investments and regulatory reforms will enable the acceleration of renewable energy deployment, which is essential for achieving sustainability goals.
- **Agriculture Sustainability:** Making agriculture more sustainable by reducing nitrogen emissions and improving water quality will help mitigate environmental impacts and support the green transition. (*2024 European Semester: Country Reports - European Commission*, 2024)

2.1.4 Italy

Italy's fiscal sustainability and debt situation are marked by several challenges and ongoing adjustments, particularly following the impacts of the COVID-19 pandemic and the global economic conditions. The Italian economy is facing a medium-term fiscal risk, with the government debt-to-GDP ratio projected to remain high at around 148% by 2029 and potentially increase further in the following years. This is one of the main concerns for Italy's fiscal sustainability, as high debt levels are coupled with a slowing economy.

The Italian government has implemented fiscal policies to support economic recovery and sustainability. This includes leveraging EU recovery funds, improving the efficiency of public spending, and investing in key sectors such as digital transformation, energy, and green infrastructure. (*Draft budgetary plans - European Commission*, 2024)

The Italian government has worked to stabilize its finances by relying on a mix of strategies, including increasing fixed-rate securities and reducing reliance on foreign debt holders. Despite these measures, higher-than-expected interest rates could still lead to rising debt burdens, particularly in the medium and long term. For example, the average interest rates for Italy's government bonds have been rising, pushing yields higher and increasing the cost of servicing the debt.

Fiscal risks are relatively low in the short term, but the medium to long-term outlook remains more uncertain. Additionally, the country is facing slow productivity growth, which has long constrained economic expansion and competitiveness. Structural reforms and investments in innovation are seen as essential to improving productivity, which is critical for reducing Italy's debt burden. (*In-depth reviews - European Commission*, 2024)

2.1.5 Norway

Norway’s economy and public finances are generally robust due to the so-called Norwegian Sovereign Wealth Funds, established after the great discovery of oil in the North Sea to protect Norway's economy from fluctuations in oil revenues. It functions as both a financial safety net and a long-term savings fund, ensuring that the wealth from oil is shared with both current and future generations of Norwegians. The fund helps secure the country’s fiscal stability. It provides the sustainable management of oil resources for the benefit of all citizens. (*Norges Bank Investment Management*, 2010)

However, the country faces ongoing challenges related to inflation, global economic conditions, and the long-term sustainability of its fiscal policies. The country’s fiscal sustainability is closely linked to the management of its Government Pension Fund Global (GPFG), which finances a substantial portion of public expenditure, especially in times of economic downturn. However, the increasing reliance on the Fund to cover a growing share of government spending raises concerns about its long-term stability, particularly in light of projected reductions in petroleum revenues and the ageing population. (Government.no, 2023)

In 2024, Norway’s fiscal policy will focus on maintaining economic stability while managing high inflation. The projected structural non-oil fiscal deficit for 2024 is NOK 409.8 billion, and Fund spending will represent 10.3% of mainland GDP. This follows the fiscal guideline of limiting spending from the Fund to a sustainable level, typically around 3% of its value. However, higher oil revenues and inflationary pressures have increased Fund spending. The government's fiscal impulse, which indicates the change in underlying Fund spending, will be moderate but could be further adjusted depending on economic conditions. (Government.no, 2023)

The key challenge for fiscal policy remains balancing the need to stimulate the economy while curbing inflation. The coordination between fiscal and monetary policy is crucial, as an overly expansive fiscal policy could necessitate higher interest rates, putting pressure on households and businesses. The Ministry of Finance projects that public expenditure in 2024 will continue to be high, amounting to 61.7% of mainland GDP, with social spending and infrastructure investments

driving much of the increase. Despite this, the fiscal stance for 2024 is expected to have a neutral impact on economic activity. (Government.no, 2023)

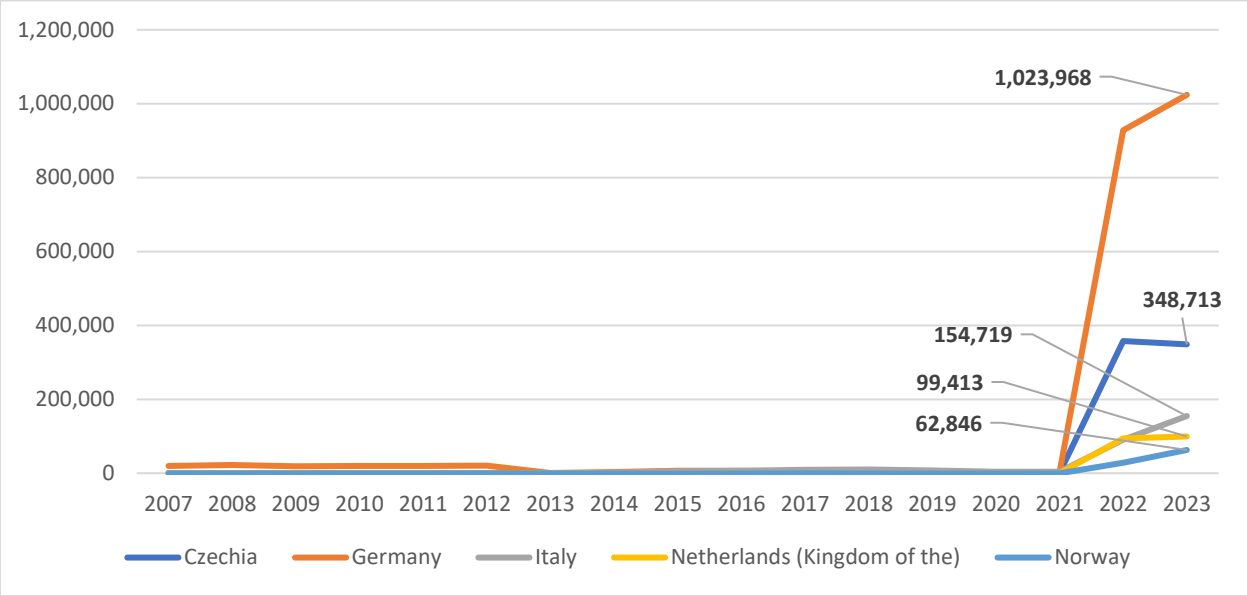
Looking forward, Norway faces potential fiscal pressure due to demographic changes, especially the ageing population, which will increase demand for public services like pensions and healthcare. The country must also adjust its fiscal policies to respond to unforeseen global events, such as geopolitical tensions or climate-related challenges. These pressures and uncertainty surrounding the Fund's future performance will require careful planning and prioritization to ensure Norway's fiscal sustainability.

2.2 Fiscal Sustainability Challenges

The fiscal sustainability challenges faced by the selected countries did not begin with the COVID-19 pandemic but have been exacerbated by the ongoing Russia-Ukraine conflict. This conflict has significantly impacted global energy prices, particularly in the EU, and continues to affect economies worldwide. Additionally, the conflict has caused a large displacement of Ukrainian citizens, many of whom have sought asylum in the countries under study, contributing to changes in their demographic composition. The responses from governments in these countries have involved policy adjustments and increased spending, largely as a reaction to the economic disturbances caused by the conflict. These changes have influenced key macroeconomic variables, such as inflation, interest rates, public spending, and economic growth. This study will examine how this crisis has affected the fiscal sustainability of the selected nations. The recent surge in energy prices, demographic shifts, and corresponding increases in government expenditures have placed considerable strain on public finances, leading to larger fiscal deficits across these countries.

The EU has experienced a significant influx of refugees over the past decade, initially driven by tensions in the Middle East and continuing due to the Russian-Ukrainian conflict. Figure (1) below shows the total number of refugees relocated to the selected countries.

Figure 1 Number of Ukrainian Refugees Total Number per year between 2007 - 2023



Source UNHCR: https://www.unhcr.org/refugee-statistics/download

3 RESEARCH QUESTION AND METHODOLOGY

Based on the previous text, the following research question arises:

How will the fiscal sustainability of EU countries be affected by the surge in gas prices, demographic shifts stemming from the Russian-Ukrainian conflict, and the EU's policy to reduce reliance on Russian gas?

Following the research question, the research hypothesis was developed to examine how the geopolitical risks arising from the Russian-Ukrainian conflict impact the fiscal sustainability of select EU countries. Several factors were considered in shaping the hypothesis, including the EU's decision to reduce reliance on Russian gas, which has led to an economic burden from surging gas prices, and the demographic challenges resulting from the influx of refugees.

Based on these considerations, the following hypothesis for this study was formulated:
H_0: ***There is no correlation between the surge in gas prices, demographic changes, and fiscal sustainability.***

The methodology of this study is designed to encompass two main components: a theoretical framework in the form of a literature review and a practical component comprising econometric analyses.

The initial stage of the study will involve a comprehensive review of the selected countries' natural gas sectors, focusing on their gas production, import and export levels, and degree of reliance on Russian gas. This analysis will provide an understanding of how much these economies are exposed to external energy shocks.

A further review will examine historical instances of energy crises to determine how such events have influenced key macroeconomic indicators (e.g., inflation, GDP growth, interest rate). The review will explore whether these crises have triggered a ***Domino effect***—a chain reaction through various sectors of the economy—leading governments to adopt new fiscal policies, with specific attention to adjustments in government expenditures, tax policies, or debt management strategies. (Bação, Domingues, Duarte, 2012)

The stage of the analytical section employs a combination of econometric and statistical methods to gain a detailed understanding of public finances and the fiscal policies implemented in selected countries during a period marked by conflicts and energy crises. These crises pose significant threats to government fiscal balances and GDP growth.

The chosen methods are essential for accurately interpreting data from reputable institutions such as the OECD and Eurostat. The study focuses on evaluating fiscal sustainability, represented by the Deficit/Surplus-GDP ratio, and examines how it is influenced by factors such as government spending, demographic challenges, and economic shocks caused by gas price surges during the period 2007 to 2023.

4 RESEARCH LIMITATION

- The diversity in energy sources and the correlation and fluctuation in their prices thanks to the demand per season led to eliminating the gas price variable from the estimated model.
- forecasting the long-term effects of energy price fluctuations was challenging, as the full impact on GDP has yet to be observed but is expected to emerge in the future, due to persistently high energy prices and the reduction of government subsidies which their influence remains hard to measure at the time of performing this analysis.
- Net Financial Transactions (NFT) was used in its aggregate form rather than as NFT per capita, as the focus is on national-level fiscal sustainability and the direct impact of government financial flows on the deficit-to-GDP ratio. While NFT per capita could provide insights into individual-level fiscal impacts, it was deemed less relevant to the study's objectives, which prioritize the analysis of aggregate fiscal policies and macroeconomic dynamics.
- The analysis was expanded to include additional countries, such as the Czech Republic and Italy. These countries were selected based on their significant reliance on Russian natural gas, the degree to which inflation was affected by the surge in gas prices, and their levels of indebtedness. Including these countries enhances the efficiency of this study by providing a broader perspective and allowing for a more comprehensive observation of the impacts on fiscal sustainability.

5 LITERATURE REVIEW

5.1 Natural Gas in Europe

Historically, Russia has been the EU's major natural gas supplier. Following the 2006 and 2009 Russia-Ukraine-Europe gas conflicts, and tensions in the aftermath of the 2013-14 Ukrainian crisis, the EU has sought to reduce its reliance on Russian natural gas supplies. However, Russia continues to contribute approximately 40% of the EU's gas demand (McWilliams, Sgaravatti, Tagliapietra, Zachmann, 2022)

In 2020, the consumption of natural gas by Europe was 512 BCM (billion cubic meters), however, 36% of this quantity came from Russia (Poljak (6104031aa470a), 2022). Two years later in 2022, Russia possessed on 45% of Europe natural gas imports, earning $900 million per day (CBC News ·, 2022)

The situation of Russia being Russia's major natural gas supplier to the European Union has ended due to the Russia-EU dispute, which flared up after the conflict between Russia and Ukraine began in February 2022. Most EU countries, along with the United States and other countries like Great Britain and Canada, agreed to impose sanctions on Russia in response to the aforementioned conflict (Collins, Mattingly, Liptak, Judd, 2022).

These sanctions aimed to cut off selected Russian banks from SWIFT, including Gazprom Bank, in addition to preventing the Central Bank of Russia from accessing its assets held abroad by freezing $400 billion in foreign exchange reserves (Horsley, 2022) (Cohen and Smialek, 2022).

On the contrary, Gazprom, the largest joint-stock company in Russia and the largest exporter of natural gas in the world, was obliged to cut the gas flow to Germany by more than half as a result of sanctions that prevented the company from receiving its turbine from Canada.

Moreover, Russian President Vladimir Putin signed the so-called “Decree 172” which obligated the purchasers of Russian pipeline gas from the countries that were designated as “Unfriendly”, as per Russia’s Unfriendly Country List (Davies and Elliott, 2022), to perform the payments of Russian gas in the ruble currency (CIS LEGISLATION, 2022).

Consequently, to President Putin’s decision, the German Minister of Economic Affairs and Climate Action, Robert Habeck, announced that G7 countries had refused the Russian President’s

demand to pay for gas in the ruble, which led directly one day after this announcement to decrease the gas flow through the "Yamal-Europe pipeline" at Germany's Mallnow point to zero (Reuters, 2022).

Therefore, Minister Habeck declared the so-called "early warning level" due to the limitation of gas flow. Moreover, he urged Germans to voluntarily reduce the consumption of energy to be the initial stage of ending Germany's dependency on Russian gas (Germany calls for people to cut energy use as a response to the Russian threat, 2022).

Several European countries undertook a similar step until, eventually, the European Union revealed plans to suspend its reliance on Russian oil, gas, and coal by 2027 (REPowerEU, 2022).

To continue with, the dependency level on natural gas as a source of energy has been always significantly high among the European countries, thus, the gas dispute between the EU and Russia will influence the economic sectors in the EU countries. However, the impact may vary from country to country because some countries have comparative advantages in possessing and producing natural gas in their natural resources.

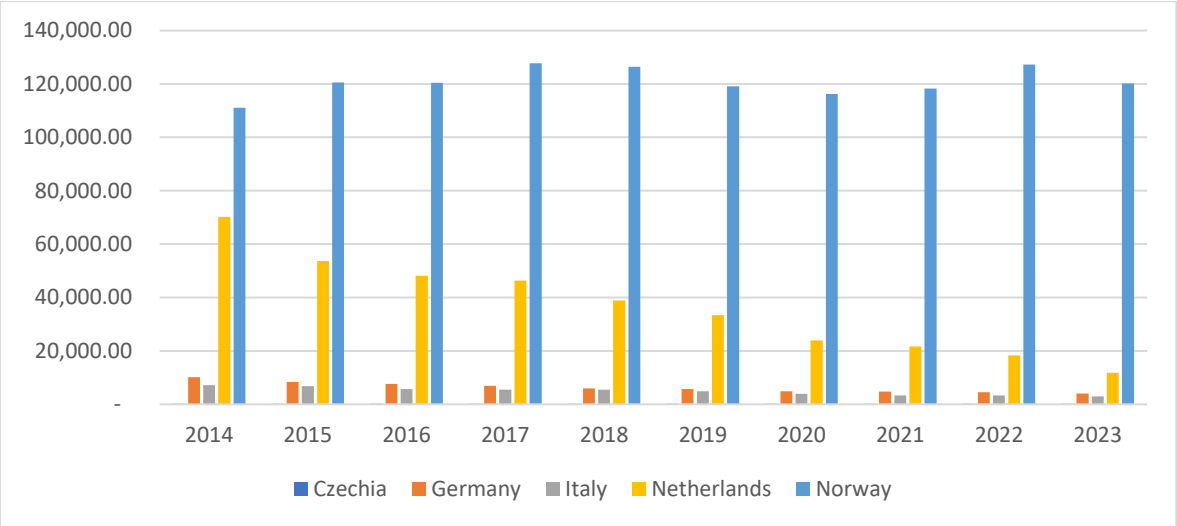
In comparison between the selected countries in terms of natural gas possessing and production, Norway and the Netherlands stand as the leaders among the others according to their discovery of natural resources. The story began when the Netherlands announced the gas discovery in the so-called Groningen field in 1959 by the Dutch Petroleum Company, however, the gas production took place after four years in 1963 ('The Dutch Groningen Gas Field | European Gas Hub', 2018).

On the contrary, the Groningen field discovery enthused the world in general and Norway in particular, to start its quest of discovering the natural resources in the North Sea until 1969, in which Norway proclaimed the discovery of the Ekofisk field and production began in 1971 (Government. No, 2021).

The aforementioned discoveries gave Norway and the Netherlands a comparative advantage in natural gas production, creating a disparity among the selected countries. Figure (2) depicts the natural gas production (measured in million cubic meters) by the selected countries for the last decade between 2014 and 2023. It is distinguishable that Norway and the Netherlands possess a higher level of gas production, followed by Germany and Italy with slight difference, and the

Czech Republic with the lowest level. Moreover, Norway maintains a stable production level compared to the other countries, and the production level declined over the period. (Eurostat, 2024)

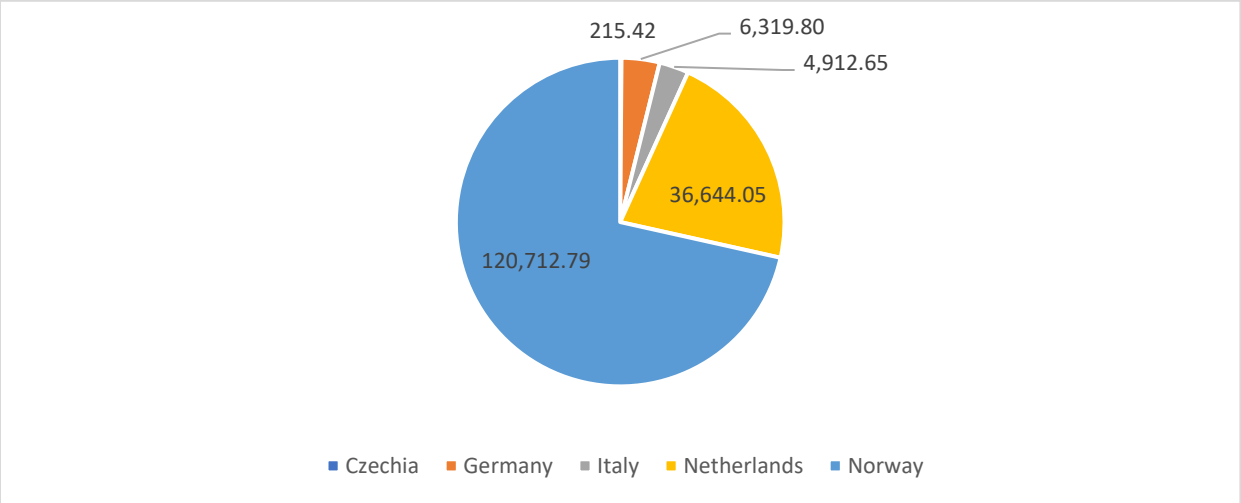
Figure 2 Natural Gas Production between 2014 and 2023 (in million cubic meters)



Source: Eurostat (monthly data, own calculation by the author to adjust it to annual data).
https://ec.europa.eu/eurostat/databrowser/view/nrg_cb_gasm__custom_10238547/default/table?lang=en

Furthermore, Figure (3) illustrates the average gas production between the selected countries for the last decade. Norway has the highest average production of 120,712.79 (mcm), followed by the Netherlands with an average of 36,644.05 (mcm), Germany at 6,319.8 (mcm), Italy at 4,912.65 (mcm) and the Czech Republic at 215.42 (mcm). (Eurostat, 2024)

Figure 3 Average Natural Gas Production between 2014 and 2023 (in million cubic meters)



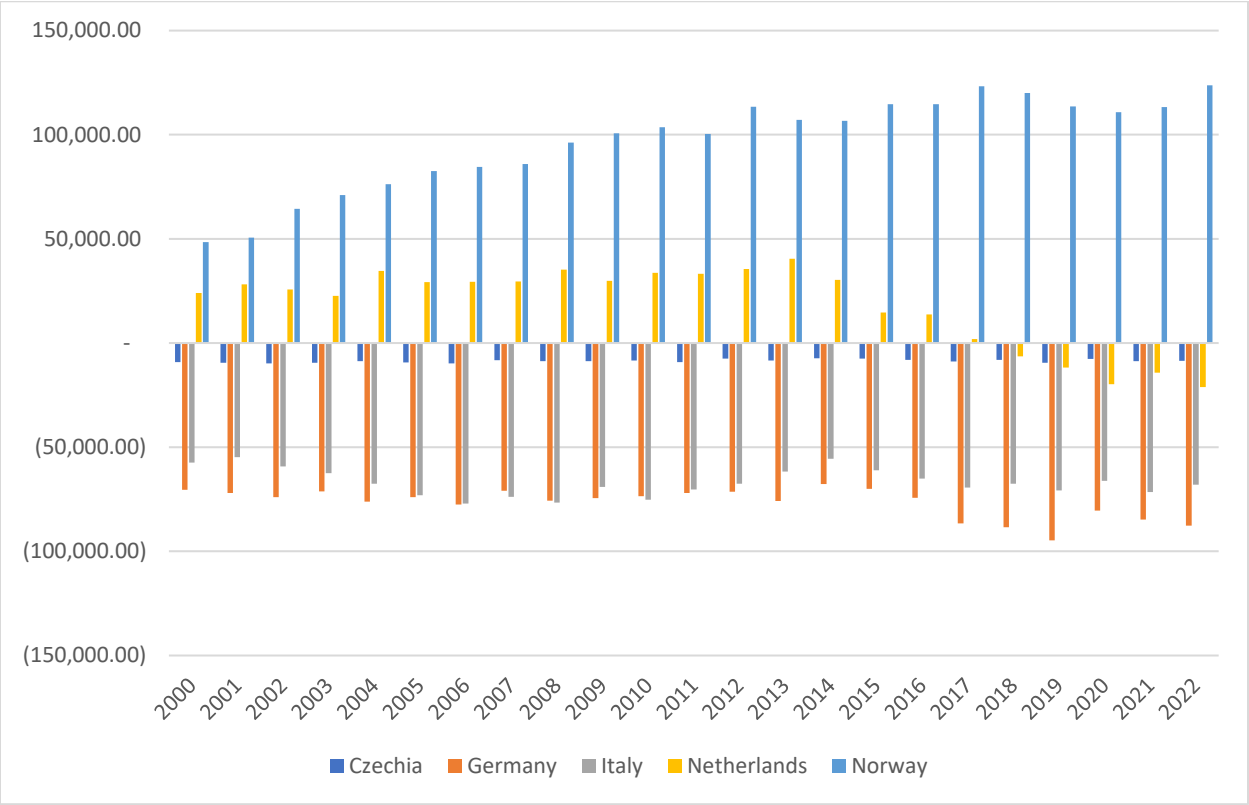
Source: Eurostat (monthly data, own calculation by the author to adjust it to annual average data).
https://ec.europa.eu/eurostat/databrowser/view/nrg_cb_gasm__custom_10238547/default/table?lang=en

The possession and production of natural gas play a significant role in determining a country's imports and exports of the abovementioned commodity. Although some countries are listed as one of the highest natural gas producers, they may simultaneously import the commodity due to several geopolitical or financial crisis consequences. For instance, the so-called EU Green Deal in EU was introduced to overcome climate change and environmental degradation challenges to make the European Union climate-neutral by 2050. Therefore, the EU set many targets accordingly, including reducing net greenhouse gas and carbon emissions (*The European Green Deal - European Commission*, 2021).

The EU Green Deal targets obliged the member states in general and the gas-producing countries in particular to fulfil the deal goals which led to phasing out some gas production fields like the Groningen field in the Netherlands in which the gas production was diminishing before the Green Deal due increase the dependency on imported natural gas (*Dutch Gas Production from the Small Fields: Why extending their life contributes to the energy transition*, 2021).

Figure (4) illustrates the selected countries imports and exports of natural gas between 2000 to 2022. The discrepancy between a country's exports and imports can determine the classification as either a net exporter or a net importer. Deceptively, Norway was always sufficient for natural gas resources, which led the country to abandon importing gas and be only an exporter. However, the Netherlands classification changed slightly from net exporter to net importer by 2018. The remaining countries lacked the sufficiency in gas production, which made them a net importer.

Figure 4 Total Imports & Exports of Natural Gas by Country between 2000 to 2022 (in million cubic meters)

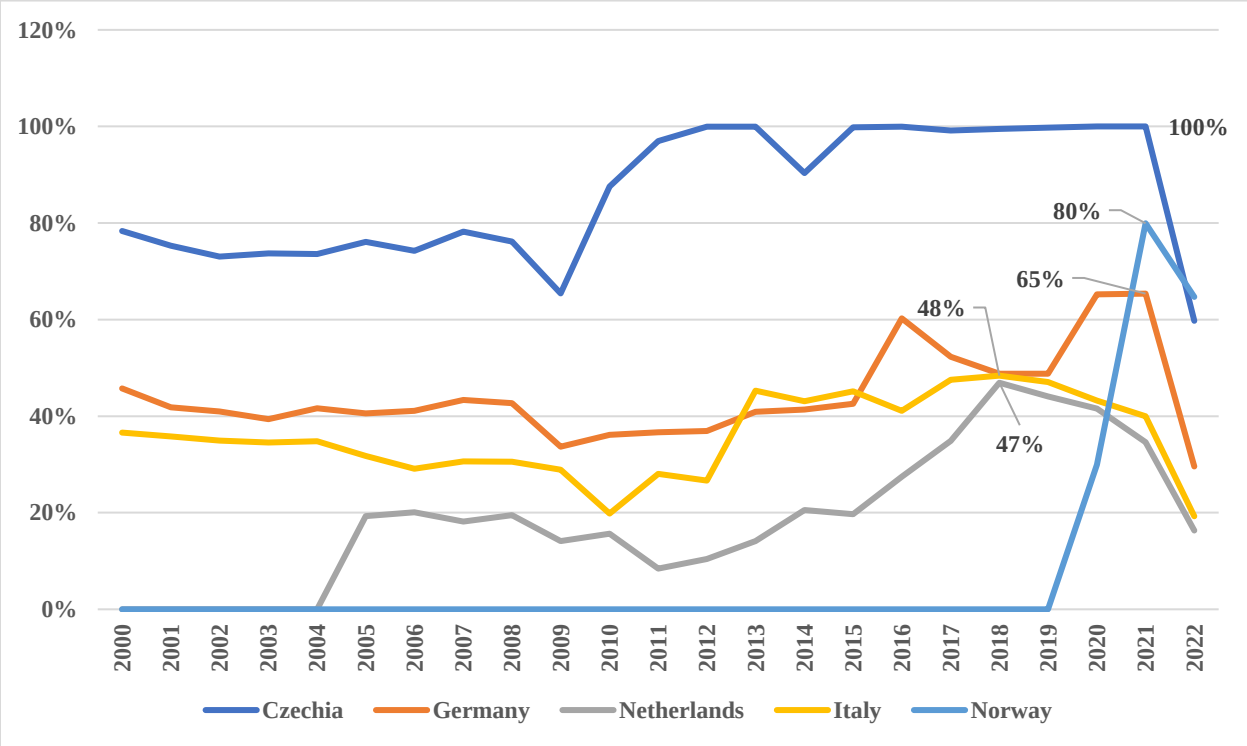


Source: Eurostat (Author's calculation) https://doi.org/10.2908/NRG_TE_GAS & https://doi.org/10.2908/NRG_TI_GAS

The previous graph depicts a high dependency on importing natural gas by most European countries since gas is mainly used for power generation, household heating, and industrial processes. Thus, to cover the high demand and consumption in the EU, the member states depended on Russian gas as one of the biggest suppliers. However, due to the international trade theory, ***Hecksher-Ohlin Theory*** developed by the Swedish economists Eli Heckscher and Bertil Ohlin, the abundance of resources is the driving force of international trade between countries. Therefore, according to Heckscher-Ohlin Theory, the higher the abundance of natural gas, the lower the commodity imports from a foreign country (Leamer, 1995). The following figures from (5) to (7) illustrate the level of dependency on Russian gas imports as a share of total natural gas imports by the selected countries between 2000 and 2022. Moreover, it is clear that Norway and the Netherlands have been less importers of natural gas due to the factor of production. On the other hand, the Czech Republic, Germany, and Italy respectively have been the higher importers as they produced and possessed fewer natural gas resources.

Figure 5 illustrates the yearly share of Russian natural gas imports as a proportion of total natural gas imports for the selected countries. The Czech Republic was the most dependent, reaching 100% reliance on Russian gas between 2015 and 2021. Germany followed, with dependency peaking at 65% in 2021. Italy's dependency ranged from 40%, reaching its highest level of 48% in 2018. The Netherlands was among the least dependent countries; however, its overall reliance on imports increased as its domestic natural gas production declined. Notably, the Netherlands recorded its highest share of Russian gas imports at 47% in 2018. On the other hand, Norway has no significant imports of natural gas due to its high domestic production levels. However, a slight level of imports from Russia was recorded in 2020, although the value remains minimal, as illustrated in Figure 5.

Figure 5 Yearly Share of Russian Natural Gas Imports to Total Gas Imports between 2000 to 2022

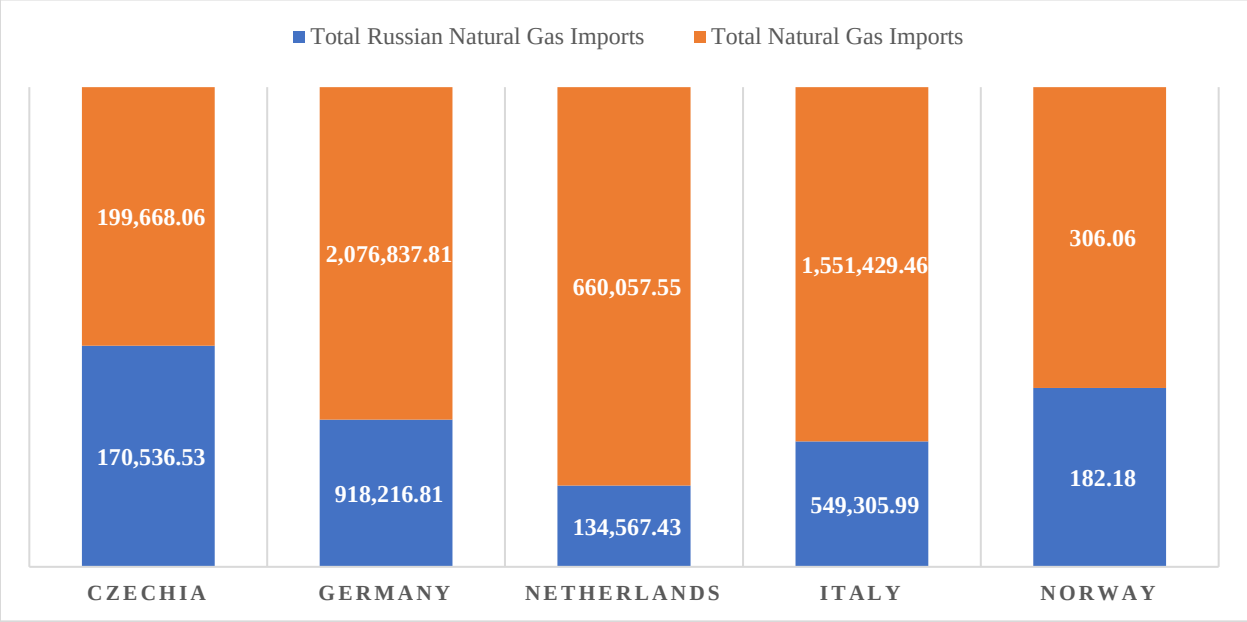


Source: Eurostat (Author's calculation) https://doi.org/10.2908/NRG_TI_GAS

Figures 6 and 7 present the total and average share of Russian natural gas imports compared to total gas imports from 2000 to 2022. The Czech Republic imported approximately 170,000 MCM, with an average import of 85%. Germany followed with a total of around 919,000 MCM, averaging 44%. Italy imported 550,000 MCM, with an average of 35%. Meanwhile, the

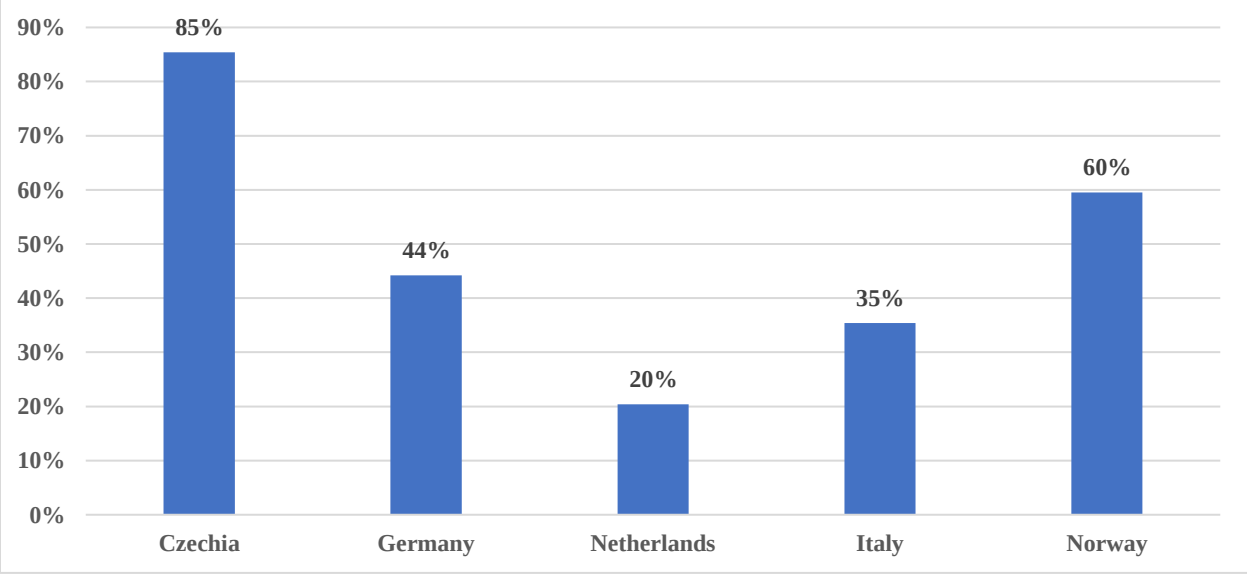
Netherlands recorded approximately 135,000 MCM, with an average of 20%. Although Norway's average import of Russian gas appears higher at 60%, the total volume of imports was minimal at 182 MCM, limited to the period between 2020 and 2022.

Figure 6 The Values of Total Russian Natural Gas Imports Compared to Total Gas Imports from 2000 to 2022



Source: Eurostat (Author's calculation) https://doi.org/10.2908/NRG_TI_GAS

Figure 7 The Average of Total Russian Natural Gas Imports Comparing to Total Gas Imports from 2000 to 2022



Source: Eurostat (Author's calculation) https://doi.org/10.2908/NRG_TI_GAS

How the EU-Ukraine-Russian conflict might influence the energy sector and gas prices?

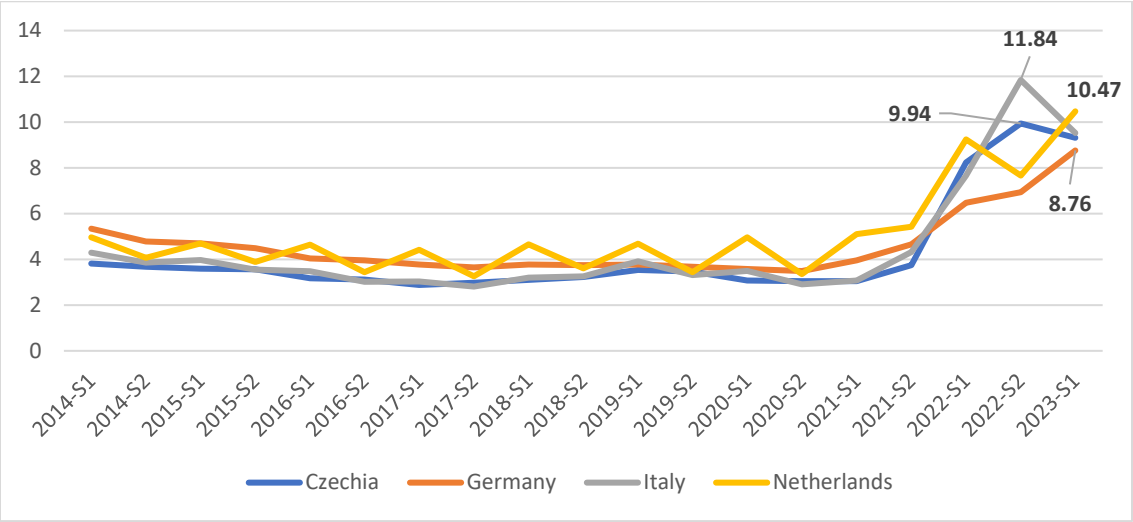
The impact on the energy sector and gas prices dates back to before the conflict began. In 2021, prices surged due to supply and demand considerations in the global LNG and European regional gas markets. The winter of 2020-2021 has been recorded as the coldest winter in Europe, Russia, and northeast Asia over the last four decades; therefore, a rally of gas stocking up began among the buyers mentioned above, triggering an increase in demand for gas to replenish supplies (Fazelianov, 2022).

Although the higher demand was the starpoint to influence gas prices, however, other drives contributed to a sharp jump in prices by the end of 2021. For instance, in the EU gas production was lower than the previous year as the Norwegian gas flow diminished in addition to the continuous declining in the Groningen Dutch field output. Furthermore, piped imports from Russia decreased due to lower flows on the Yamal Europe route, and despite increasing pipeline imports from Algeria, Iran, and Azerbaijan, they were insufficient to offset the decrease in pipeline imports from Russia. Notably, the decline in Russian flow was attributed to geopolitical considerations putting pressure on the European Commission to approve Nordstream 2 (Fulwood, 2021).

The following figures from 8 to 11 depict the changes in gas prices per first semester between 2014-S1 and 2023-S1. The prices remained slightly stable over the last decade, however, the situation changed in the second season of 2021 when a sharp jump took place leading the prices to an extraordinarily high record. Although, the prices among the selected countries increased overall, nonetheless, this increment was uneven between the countries. Furthermore, the figures differentiate between prices for Household and Non-household consumers whether the tax and levies are included or not. (*Statistics | Eurostat*, 2023)

Italy possessed the highest increment in gas prices for non-household consumers as depicted in Figures 8 and 9. The gas prices for non-households with tax and levies reached 11.84 Euro cents per kilowatt-hour semi-annually. The Czech Republic followed with 9.94, the Netherlands with 10.47, and Germany with 8.76

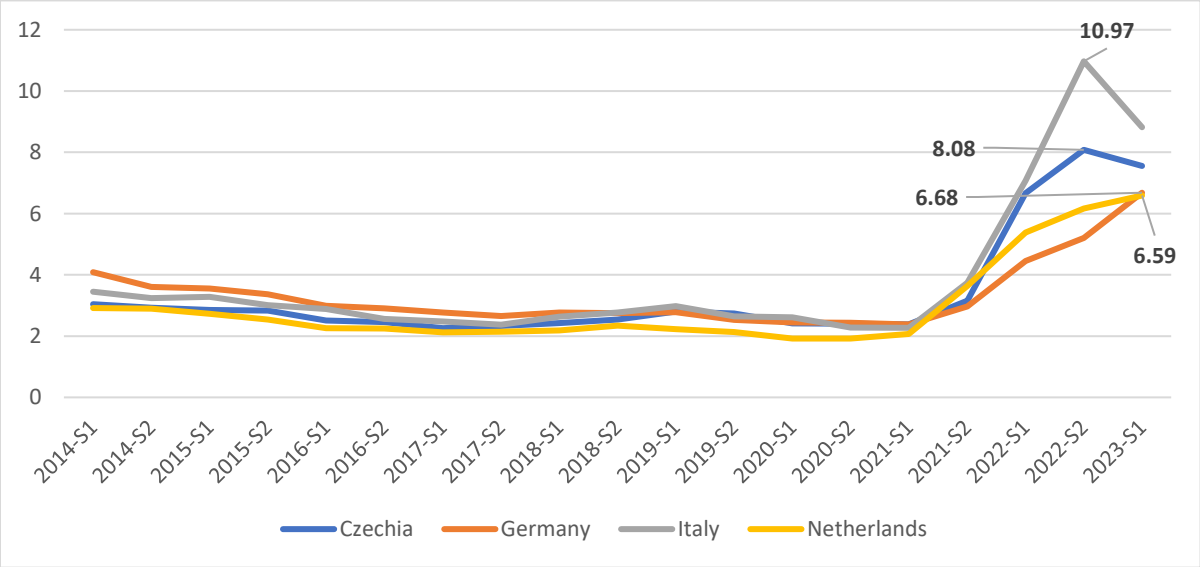
Figure 8 Gas Prices for Non-household with Tax Euro Cent per Kilowatt-Hour Semi-annual between 2014-Semester 1 to 2023- Semester 1



Source: Eurostat (Author's calculation)
https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_203$defaultview/default/table?lang=en

Considering natural gas prices for non-households, excluding taxes and levies, Italy recorded the highest price at 10.97 Euro cents per kilowatt-hour, followed by the Czech Republic at 8.08 Euro cents, Germany at 6.68 Euro cents, and the Netherlands at 6.59 Euro cents.

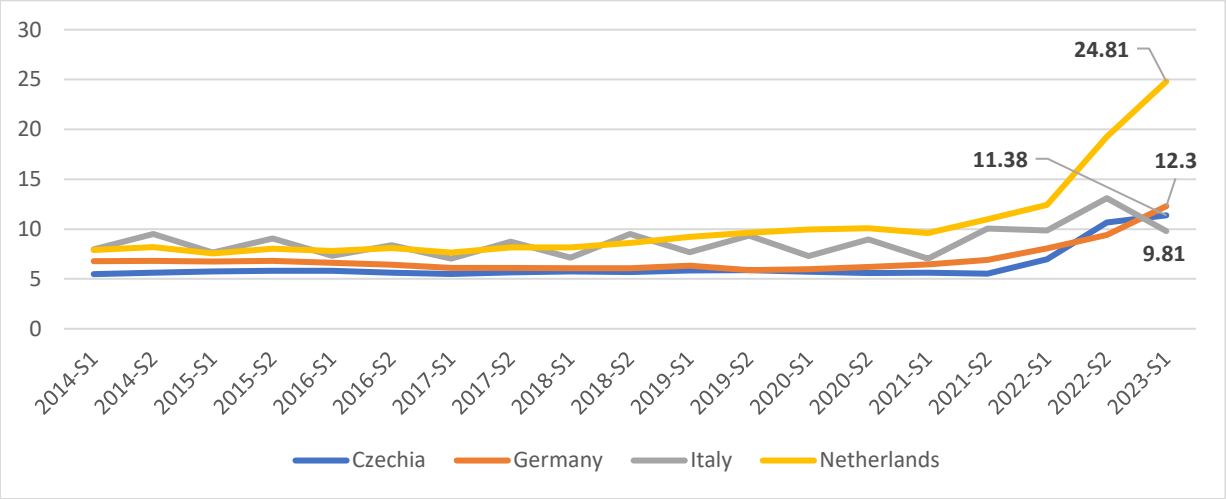
Figure 9 Gas Prices for Non-household without Tax Euro Cent per Kilowatt-Hour Semi-annual between 2014- Semester 1 to 2023- Semester 1



Source: Eurostat (Author's calculation)
https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_203__custom_9836727/default/table

In contrast, the largest price increase for household consumers with tax was observed in the Netherlands, as shown in Figures 10 and 11, where prices surged to 24.81 Euro cents per kilowatt-hour. In Germany, prices rose to 12.3 Euro cents, followed by 11.38 Euro cents in the Czech Republic and 9.81 Euro cents in Italy.

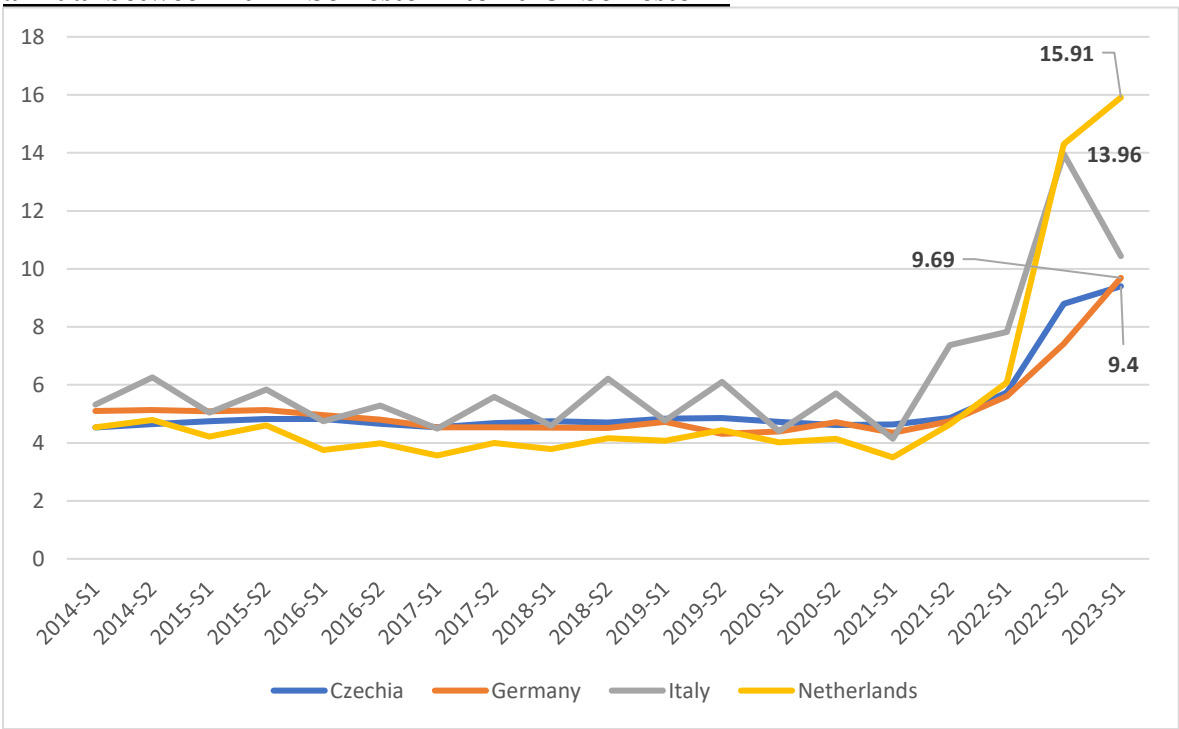
Figure 10 Gas Prices for Household with Tax Euro Cent per Kilowatt-Hour Semi-annual between 2014- Semester 1 to 2023- Semester 1



Source: Eurostat (Author's calculation)
https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_202__custom_9836773/default/table

On the other hand, household gas prices excluding taxes remained at their highest levels in the Netherlands, reaching 15.91 Euro cents per kilowatt-hour. Italy followed with 13.96 Euro cents, while Germany recorded 9.69 Euro cents and the Czech Republic 9.4 Euro cents.

Figure 11 Gas Prices for Household without Tax Euro Cent per Kilowatt-Hour Semi-annual between 2014- Semester 1 to 2023- Semester 1



Source: Eurostat (Author's calculation)
https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_202__custom_9836773/default/table

5.2 Impact of Gas Crisis on Macroeconomic

The volatility of gas prices has long been a significant factor influencing economic dynamics on both national and global scales. As a vital component of transportation, manufacturing, and energy production, fluctuations in gas prices can trigger widespread repercussions across various sectors of the economy in general and government fiscal health in particular by affecting revenue and expenditure patterns. The complex relationship between gas prices and fiscal sustainability extends beyond direct government finances to affect broader economic dynamics such as inflation, consumer spending, investment decisions, and geopolitical tensions, which will exert considerable pressure on the national budget and create challenges for maintaining long-term economic stability.

In the following chapter, the thesis focuses on the impact of gas price volatility on some economic indicators.

5.2.1 Inflation

Several studies have stated that with the Russian gas shutoff to Europe, gas prices would rise substantially, which can be recognized in the previous figures. However, the studies observed that the increase in gas prices would impact the inflation in a country. According to Chen (2009), as with oil and gas prices in the past, such rises would pass through domestic consumer price inflation. Although the degree of oil and gas prices pass-through varies across countries, it has always been positively correlated with energy imports. Historically, international energy prices have been significant drivers of consumer price inflation in several countries. International oil and gas prices influence inflation directly, through the prices that households pay for refined oil and gas products, and indirectly, by raising the costs of manufacturing other goods and services.

A study in Germany was introduced by the International Monetary Fund in order to observe the economic impacts of a potential Russian gas shutoff. The study estimated the historical relationship between international gas prices and domestic inflation in order to assess the impact of the Russian gas shutoff on Germany's inflation. Eventually, the study concluded a positive correlation between international gas prices and German inflation due to two scenarios of price increments in 2022, and 2023 respectively. However, the study emphasized the role of governments in such gas emergencies, in which governments may use their enacted powers to allow corporations to pass on price rises to consumers regardless of current contracts and that could result in a contemporaneous passthrough rather than the lagged pass-throughs observed in historical data,

resulting in higher front-loaded consequences on inflation. Moreover, the study revealed that the passthrough and resulting consumer price inflation rates may be higher than the estimation since the international gas price rises discussed in this study are exceptional before 2021 (Lan, Sher, and Zhou,2022).

The Czech National Bank introduced another study to observe the effect of oil price shocks on the Czech economy. The study stated that domestic oil importers are among the first to be affected by the oil price shock. Simultaneously, all other domestic importers face increased pricing due to the increase in global oil prices. Both categories of importers pass on the increased expenses to their prices, which raises their customers' costs (and prices) and finished goods prices. In conclusion, the study observed both long- and short-run impacts over the Czech economic growth and inflation, respectively. Based on the study's estimations, a 20% increase in oil prices in Czech koruna would reduce economic growth by around 0.4 percentage points per year in the first few years after the shock. The shock would reduce the long-run GDP level by around 0.7%. In the short term, inflation is expected to rise by 0.4 percentage points per year (Dybczak, Voňka, van der Windt, 2008).

5.2.2 Interest Rate

Central banks adopt restrictive monetary policies to combat inflation, primarily through increasing interest rates. This approach aims to stabilize the economy by reducing borrowing and spending, thus lowering demand-driven price pressures. Higher interest rates make loans more expensive for both individuals and businesses, leading to a decline in consumption and investment. Simultaneously, they incentivize saving by offering better returns on deposits and bonds. Recent global inflation spikes, driven partly by rising energy costs, prompted central banks like the Federal Reserve and the European Central Bank to raise rates aggressively, aiming to control inflation and stabilize expectations. However, such policies can pose challenges, including slower economic growth and higher debt servicing costs for households and governments, requiring careful calibration by policymakers. (Mathai, 2009)

David Turner and Francesca Spinelli conducted a study examining the relationship between the interest-rate growth differential and government debt dynamics. They discovered that higher interest rates lead to increased interest payments, as the net government debt-to-GDP ratio is

determined by the primary deficit ratio combined with the net interest payments on the previous period's debt. Based on this analysis, they concluded that the growth rate of the debt-to-GDP ratio is positively correlated with the interest-rate growth differential (Turner and Spinelli, 2013).

Consequently, countries with high debt-to-GDP ratios, such as Italy, are particularly vulnerable to rising inflation and interest rates, as these factors intensify budget deficits and exacerbate indebtedness.

5.2.3 Economic Growth

The relationship between energy sources and economic growth is fundamental and sophisticated, as energy serves as a cornerstone for industrial production in an economy. Energy is a critical input for industrial production processes that power machinery, equipment, and transportation systems. Therefore, any energy availability and affordability changes will be reflected in industrial production outputs. Since industrial production is considered a key contributor to a country's gross domestic product as well as one of the main indicators of the GDP, thus, GDP levels in terms of production might be typically correlated with energy sources and will respond accordingly while the value of energy supply and prices are being fluctuated.

A study was introduced by Bayar and Kilic (2014) to examine the effects of oil and natural gas prices on industrial production in the eurozone member countries. The study found that oil and natural gas prices were significant in determining industrial production growth, however, the authors inferred a negative relationship between prices and production growth due to their empirical findings that state a 1% increase in oil price and natural gas prices will respectively lead to 19% and 18% decrease in industrial production.

The dependency on energy sources like oil and natural gas in terms of either consumption or production can play a significant role in shaping a country’s economic growth, as consumption and production are the primary elements of Gross Domestic Product. Thus, in terms of the natural gas-producing countries, the increase in prices might have a positive correlation with their GDP. On the other hand, in countries that depend on natural gas imports as a source of energy in the production process and lack the production of natural gas, any shock in natural gas prices might

negatively influence their household consumption and industrial production respectively, which eventually lead to making the countries' GDP endures the shocks burdens.

Research was performed by Salisu, Gupta, and Olaniran (2023) to measure the effect of oil uncertainty shock on the real GDP of several developed and emerging countries. the authors found an adverse relationship between an unexpected shock in oil prices and the economy's output of the majority of observed countries. however, the so-called high oil-reliant economies like Norway, the Philippines, and Saudi Arabia were positively correlated to the increase in oil prices.

5.3 Impact of Gas Crisis on Budget Deficit

A study by Zerife Yildirim and Ayşe Atilgan Yaşa (2014) was performed to observe the correlation between energy demand and budget deficit in Turkey and other selected European countries. the authors concentrated on some countries that are heavily reliant on energy imports such as Germany, Italy, France, and Spain in addition to Turkey. The outcomes of this study indicate to the absence of a direct link between energy demand and public deficit since many developing countries opt for privatization as a solution instead of making public investments. Nonetheless, the study concluded the energy imports are not explicitly included in the performance budgets of central administrations. Instead, the causal relationship is more prominently reflected in the current account balance. This outcome may differ for net energy-exporting countries though, so that the broader economic effects of energy imports can indirectly lead to budget deficits. (Yildirim and Yaşa, 2014)

6 ANALYTICAL PART

An econometric model is constructed for each examined country separately in the analytical part. Where, the dependent variable is presented as Deficit/Surplus-GDP ratio to address fiscal sustainability, in addition to the independent variables to determine the indirect impact of gas price surges which are associated with the Net Financial Transactions (NFT) and Event Shocks as a dummy variable, while adding the Old Age Dependency ratio (OARD) into each regression model. Gretl software was used for the econometric analysis due to its comprehensive data analysis tools. The data was collected from the OECD and EUROSTAT databases between 2007 and 2023.

The **Net Financial Transactions (NFT)** reflects the net difference between a government's financial inflows and outflows, considering account investments and financial transactions. In the context of a gas crisis, governments typically introduce subsidies, financial aid packages, or investments in alternative energy, which directly impact their fiscal balance and are captured through NFT.

The **Old Age Dependency Ratio (OADR)** is a demographic measure that represents the proportion of older individuals, typically aged 65 and above, compared to the working-age population, usually defined as those aged 15-64. It is expressed as a percentage so that the increase in this percentage refers to either an increase in the number of the aged population (pensioners) or a decrease in the number of the working-age population or a combination of both factors simultaneously. The OADR reflects not only the demographic composition of each country’s population but also includes Ukrainian refugees, who are accounted for within the population figures. This can impact both the numerator and denominator of the ratio, depending on the age distribution of the refugees.

A dummy variable for **Event Shocks** was introduced to capture the surge in gas prices caused by the Russian-Ukrainian conflict, assigning a value of 1 during the crisis and 0 in its absence for the examined period. The study also accounts for other past crises that negatively impacted economies and pressured governments’ fiscal stability, such as the 2008 Global Financial Crisis and the COVID-19 pandemic. Due to Italy's high level of indebtedness, the EU Debt Crisis is specifically included in the regression model, with a value of 1 assigned to the years 2011 and 2012 to reflect its significant influence.

The following hypothesis will be tested in each regression model for the selected countries of Germany, the Czech Republic, the Netherlands, and Italy:

- H1: NFT is positively correlated with the Deficit/Surplus-GDP ratio.
- H2: Old Age Dependency ratio positively correlates with the Deficit/Surplus-GDP ratio.
- H3: The dummy variable Event Shocks positively correlates with the Deficit/Surplus-GDP ratio.

However, for the Norway regression model, the following hypothesis will be tested:

- H1: NFT is positively correlated with the Deficit/Surplus-GDP ratio.
- H2: Old Age Dependency ratio negatively correlates with the Deficit/Surplus-GDP ratio.
- H3: The dummy variable Event Shocks positively correlates with the Deficit/Surplus-GDP ratio.

6.1 Econometric Modeling

This chapter addresses a practical analysis of the selected countries by developing an econometric model for each country individually. To begin with, the dependent variable (Endogenous), independent variable (Exogenous), and a unit vector used to create a constant are used to formulate the following economic model:

$y_{1t} = f(x_1, x_2, x_3, x_4)$

where:

- y_{1t}: Deficit/Surplus-GDP ratio.
- x_1: Constant.
- x_2: Net Financial Transactions NFT.
- x_3: Old Age Dependency ratio.
- x_4: Event Shocks as a dummy variable.

Considering the assumptions derived from the economic model and economic theory, a regression model using the Ordinary Least Squares method (OLS) will be formulated for each country as follows:

$$\beta 1 y1 = \gamma 11 x1 + \gamma 12 x2 + \gamma 13 x3 + \gamma 14 x4 + u1$$

in which:

- $\beta 1$: dependent variable parameter.
- $\gamma 11 ... \gamma 14$: parameters of independent variables.
- $u1$: random variable or residuals.

Furthermore, the OLS method will be used to verify the model, so that all aspects such as economic, statistical, and econometric verification will be performed. A table of datasets for a selected country will be presented to formulate the country's econometric model. The dataset contains the model's dependent and all independent variables and their values for the examined period between 2007 and 2023.

6.2 Formulation of Germany Econometric Model

Table 1 The Dataset of Germany Econometric Model

Year	Deficit/Surplus-GDP ratio	Net Financial Transactions	Old age dependency ratio	Event Shocks
	%	million EUR	%	dummy
	Yt	X2t	X3t	X4t
2007	0.26	3937	29.9	0
2008	-0.12	-6809	30.4	1
2009	-3.15	-79207	30.9	0
2010	-4.38	-115620	31.4	0
2011	-0.88	-23074	31.4	0
2012	0.01	-1521	31.4	0
2013	0.04	3512	31.5	0
2014	0.58	21832	31.6	0
2015	0.96	28239	32	0
2016	1.16	36237	32	0
2017	1.34	44571	32.4	0
2018	1.95	63416	32.8	0
2019	1.53	45171	33.2	0
2020	-4.34	-146025	33.7	0
2021	-3.59	-108501	34.2	1
2022	-2.50	-83562	34.7	1
2023	-2.6	-100229	34.7	1

Source: Eurostat-Database https://ec.europa.eu/eurostat/databrowser/view/demo_pjanind__custom_13652375/default/table https://doi.org/10.2908/GOV_10A_MAIN https://doi.org/10.2908/DEMO_PJANIND

Referring to the literature review and economic theory, the relationship between dependent variable and independent variables is expected to be as follows:

- The Deficit/Surplus-GDP ratio will increase with the increase in Net Financial Transactions.
- The Deficit/Surplus-GDP ratio will increase with the increase in the Old Dependency ratio.

- The Deficit/Surplus-GDP ratio will increase if the event shock driven by the surge in gas prices takes place.

Before verifying the model, it is essential to observe the multicollinearity between the independent variables. The multicollinearity means that two or more independent variables in a regression model are highly correlated, meaning that one can be predicted from another. With a high degree of multicollinearity, the results can be misled due to non-separate influences of individual independent variables on the dependent one. Moreover, the high multicollinearity can be observed when the correlation coefficient is equal to or higher than 0.8 in absolute value.

Table 2 The Correlation Matrix of the Independent Variables of Germany's Model

Net Financial Transactions	**Old age dependency ratio**	**Event Shocks**	
X_{2t}	**X_{3t}**	**X_{4t}**	
1	-0.3876	-0.4317	**X_{2t}**
	1	0.4975	**X_{3t}**
		1	**X_{4t}**

Source: Gretl Software – Own Calculation, 2024

Referring to Table2 of the correlation matrix of the Germany econometric model, the absence of high multicollinearity can be observed as all values are less than (0.8). Therefore, there is no need to adjust the data and the analysis of the Linear Regression Model can be pursued.

6.2.1 The Model Quantification

The main aim of econometric model quantification is to estimate the value of its parameters since the parameters are essential to provide insights into the strength and characteristics of the relationships among the variables within the model.

Table 3 The Outcomes of Germany's Regression Model

Variable	Coefficient	Std. Error	t-ratio	p-value	Significance
const	−2.96944	1.77224	−1.676	0.1177	
X_{2t}	3.34E-05	1.16E-06	28.86	<0.0001	***
X_{3t}	0.0908742	0.0556453	1.633	0.1264	
X_{4t}	0.225357	0.187305	1.203	0.2504	

Source: Gretl Software – Own Calculation, 2024

Mean dependent var	−0.807622	**S.D. dependent var**	2.151935
Sum squared resid	0.956128	**S.E. of regression**	0.271198
R-squared	0.987096	**Adjusted R-squared**	0.984118
F (3, 13)	331.4695	**P-value(F)**	1.59E-12
Log-likelihood	0.341701	**Akaike criterion**	7.316598
Schwarz criterion	10.64945	**Hannan-Quinn**	7.64789
rho	0.004066	**Durbin-Watson**	1.717653

Source: Gretl Software – Own Calculation, 2024

Referring to the outcomes in the table 3, the Germany's econometric model can be formulated as the following:

$$y_{1t} = -0.296944 + 3.34e^{-05}\, x_{2t} + 0.0908742\, x_{3t} + 0.225357\, x_{4t} + u_{1t}$$

6.2.2 The Model Verification

Verification validates the model's validity and suitability for use in real-world circumstances. The verification process in econometric modeling typically breaks down into three phases, economic, statistical, and econometric verification. Each verification's phase addresses different aspects to ensure that a model is theoretically solid, statistically reliable, and methodologically adequate. To ascertain the model's theoretical coherence and consistency with accepted economic principles, it is first checked against economic theory. This phase ensures that the model's basis is well-rooted in economic theory.

The first phase is followed by the next one of model's statistical verification to assess the statistical significance of model's variables in order to ensure that they significantly enhance its predictive ability and general dependability. This phase is eseential for the model to be empirically credible and for its results to be interpretable with confidence, this statistical analysis is essential.

The last phase in the verification process is to assess whether the model meets the assumptions of classical linear regression analysis. This involves evaluating the model for linearity, homoscedasticity (constant error term variance), and normally distributed residuals. Adherence to these assumptions is essential to ensure the reliability of the regression outcomes.

A 95% confidence interval is used to conduct the test, so that eventually, variable significance, model validity, and the conditions for testing methods are met.

- **The Economic Verification**

In the economic verification, the parameters are observed whether they align with the established theory, hypotheses, and expected values according to the model's specifications.

In terms of ceteris paribus and due to the model's quantification, the estimated parameters can be interpreted as the following:

- If Germany's NFT increased by 1 million EUR, the deficit-to-GDP ratio will increase by 0.0000334 P.P.
- If Germany's Old Age Dependency ratio increases by 1%, the deficit-to-GDP ratio will increase by 0.0908742 P.P.
- If a shock event such as a gas price surge occurs, the deficit-to-GDP ratio will increase by 0.225357 P.P.

According to the afore-mentioned verification, the hypotheses are failed to be rejected. This conculeds that the variables influence the short-term fiscal sustainability represented by the deficit-to-GDP ratio in Germany. Nevertheless, the impact of NFT on Germany's deficit-to-GDP ratio is slightly small in comparison to the impact of the remaining variables.

- **The Statistical Verification**

This verification addresses the statistical evaluation of the parameters as well as the econometric model. To begin with, the coefficient of determination (R^2) stands for the measurement of the regression model's quality. It indicates the proportion of the variance in the dependent variable explained by the independent variables in a regression model. The coefficient range falls at 0 and 1, where the higher the R^2, the more variability of the dependent variable is explained by the independent variables.

The adjusted R^2 in Germany model in Table 3 equals 0.984118, meaning the aforementioned selected variables explain 98% of Germany's fiscal sustainability. This concludes that the variables are significant in this model, and the estimated equation linear model can be considered statistically significant.

Statistical Significance of the Parameters

Although the coefficient of determination provides a reliable estimation of the strength of the relationship between the independent variable and the estimated model, it does not involve the estimation of the parameters' statistical significance. Therefore, an additional verification shall be conducted to observe the parameters' statistical significance.

The statistical significance of the estimated parameters, which is denoted as (α), is evaluated by the calculation of the so-called P-value, which is presented in Table 4 for 0.05 as the level of significance, and that corresponds to a 95% confidence level, so that the lower the significance level, the higher the level of confidence. The null hypothesis states that each parameter is statistically insignificant at the chosen significance level. Therefore, the null hypothesis is rejected if the P-value is less or equal to the selected significance level of 0.05. Otherwise, it will be accepted if the P-value exceeds the significance level of 0.05, making the parameter not considered statistically significant.

Table 4 Statistical Significance of Germany Model's Parameters

	Net Financial Transactions	**Old age dependency ratio**	**Event Shocks**
	X_{2t}	**X_{3t}**	**X_{4t}**
P-value	$3.57e^{-13}$	0.1264	0.2504
Significance Level	0.05	0.05	0.05
Null hypothesis	Rejected	Accepted	Accepted

Source: Gretl Software – Own Calculation, 2024

From Table 4, the P-value of NFT indicates $3.57e^{-13}$, which is significantly lower than the significance level (α). This result leads to the rejection of the null hypothesis, confirming the statistical significance of the NFT variable. This indicates that the NFT variable strongly influences fiscal sustainability.

On the other hand, the P-values of the Old Age Dependency ratio and Event Shocks as of 0.1264 and 0.2504 respectively, exceed the significance level of 0.05, leading to failure to reject the null hypothesis concerning these variables, which indicates the statistical insignificance of both

variables. Thus, changes in the aforementioned variables do not have a statistically significant impact on the dependent one.

The insignificance of the Old Age Dependency Ratio in the model may be attributed to proactive policies implemented under Germany's Stability Program. The Federal Government has introduced the ***Act on the Further Development of Skilled Immigration***, which simplifies immigration processes for skilled labor from non-EU countries. These measures aim to enhance Germany's economic competitiveness, boost productivity growth, and create favorable conditions for sustained economic expansion by strengthening the factors of production.

Additionally, the Federal Government has made significant strides in integrating refugees into the labor market. For instance, Ukrainian refugees have been granted full access to employment opportunities and all employment promotion measures under ***Book II of the Social Code (Sozialgesetzbuch II)*** from their arrival in Germany. The ***"job turbo"*** plan of action further accelerates their integration, ensuring their swift and sustainable inclusion in the workforce. These initiatives likely mitigate the economic pressures associated with an ageing population, reducing the measurable impact of the dependency ratio on fiscal sustainability.

The insignificance of the Event Shock (gas price surge) variable may be attributed to the German Federal Government's proactive measures to mitigate the economic repercussions of Russia's invasion of Ukraine and the subsequent energy price increases. Specifically, the government implemented three major relief packages in 2022 and 2023, with a total value of approximately €100 billion.

Furthermore, establishing ***the Economic Stabilisation Fund (Energy),*** equipped with up to €200 billion, served as a "protective shield" for the economy. This fund provided loans and support aimed at cushioning the effects of the energy crisis. These substantial fiscal measures likely absorbed much of the potential impact of the gas price surge, neutralizing its direct impact on the Deficit/Surplus-GDP ratio within the model.

- **The Econometric Verification**

Econometric verification ensures that the necessary conditions are met for the proper application of an econometric model, by testing several aspects of the model as the following:

- Heteroskedasticity
- Normality of Residuals
- Autocorrelation

The aforementioned tests were performed and their results are presented in Table 5.

Table 5 Econometric Verification Results of Germany's Model

	Heteroskedasticity	**Normality of Residuals**	**Autocorrelation**
	Breusch-Pagan	**Jarque-Bera Test**	**Breusch-Godfrey Test**
P-value	0.051034	0.89032	0.988198
Significance Level	0.05	0.05	0.05
Null hypothesis	Accepted	Accepted	Accepted

Source: Gretl Software – Own Calculation, 2024

Heteroskedasticity

One of the econometric verifications requires testing the variance of the residuals in an OLS model to ensure that the model provides reliable and unbiased estimates, otherwise, it leads to inefficient estimates causing incorrect conclusions about significance. This test is conducted through a set of two assumptions. The first assumption denotes that residuals have the same but unknown variance. This is known as a constant variance of homoscedasticity. Nevertheless, when this assumption is violated, this leads to the second assumption of the non-constant residual variance or the so-called heteroskedasticity.

The Breusch-Pagan test was used to observe the heteroskedasticity, where the null hypothesis assumes the homoscedasticity of residuals. As depicted in Table 5, the P-value of 0.051034 is

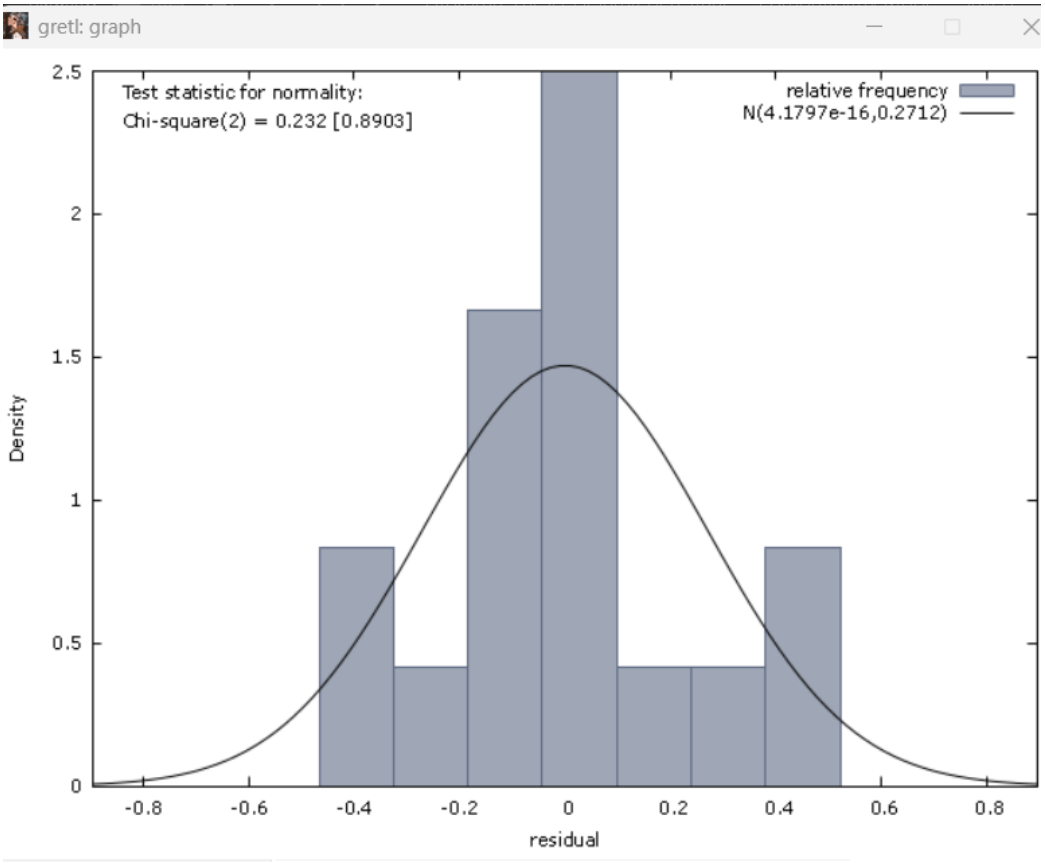
slightly higher than the significance level α = 0.05 leading to failure to reject the null hypothesis and to confirm the homoscedasticity of residuals and unbiased estimates of the model.

Normality of Residuals

Ensuring that the residuals follow a normal distribution in the OLS model is critical for a statistically valid conclusion. Thus, the Jarque-Bera test was used to check the normality, for which the null hypothesis of this test states that the residuals are normally distributed. Referring to Table 5, the P-value of the Jarque-Bera test equal to 0.89032 is higher than the significance level α = 0.05 which leads to the failure in rejecting the null hypothesis and to confirms the normality of residuals and the robustness and reliability OLS model's outcomes.

Additionally, the normality of residuals was also observed in the residuals' histogram, which illustrates their distribution. However, the histogram should reveal the Gaussian curve if the normality is met. Gaussian curve represents the probability density function of normal distribution around the central mean.

Figure 12 Residuals' Histogram of Germany's Model



Source: Gretl Software – Own Calculation, 2024

Figure 12, illustrates the histogram of the residuals, where the histogram shape resembles the Gaussian curve. This leads to further evidence about the normality of residuals.

Autocorrelation in the Residuals

This test is conducted to check whether the residuals of an econometric model are correlated with each other over time, meaning that the errors can influence errors in subsequent years in previous ones. To conduct this test, the so-called Breusch-Godfrey test was used to check either the absence or the presence of autocorrelation among the residuals. The results can be observed in Table 5 for the P-value of 0. 988198. As the P-value is higher than the significance level $\alpha = 0.05$, the null hypothesis which assumes the absence of autocorrelation, is failed to be rejected meaning that the residuals are not autocorrelated.

6.3 Formulation of the Czech Republic Econometric Model

Table 6 The Dataset of the Czech Republic Econometric Model

Year	Deficit/Surplus-GDP ratio	Net Financial Transactions	Old Age Dependency ratio	Event Shocks
	%	million EUR	%	dummy
	Yt	**X2t**	**X3t**	**X4t**
2007	-0.70	-1165	20.3	0
2008	-2.00	-2799.1	20.6	1
2009	-5.50	-8072.6	21.1	0
2010	-4.10	-6785.3	21.7	0
2011	-2.70	-4243.4	22.3	0
2012	-3.90	-6228.8	23.4	0
2013	-1.30	-1805.8	24.6	0
2014	-2.10	-3282.6	25.7	0
2015	-0.70	-1134.2	26.6	0
2016	0.70	1095.5	27.6	0
2017	1.50	2978.2	28.6	0
2018	0.90	1701.1	29.6	0
2019	0.30	784.8	30.4	0
2020	-5.60	-12558.1	31.1	0
2021	-5.00	-12235.3	32.3	1
2022	-3.10	-8671.8	32.6	1
2023	-3.8	-11779.7	32.1	1

Source: Eurostat-Database https://ec.europa.eu/eurostat/databrowser/view/demo_pjanind__custom_13652375/default/table https://doi.org/10.2908/GOV_10A_MAIN https://doi.org/10.2908/DEMO_PJANIND

Referring to the literature review and economic theory, the relationship between dependent variable and independent variables is expected to be as follows:

- The Deficit/surplus-GDP ratio will increase with the increase in Net Financial Transactions.
- The Deficit/surplus-GDP ratio will increase with the increase in the Old Dependency ratio.
- The Deficit/surplus-GDP ratio will increase if the event shock driven by the surge in gas prices takes place.

Before verifying the model, the multicollinearity was observed and the matrix is presented in the following table 7:

Table 7 The Correlation Matrix of Independent Variables of Czechia's Model

Net Financial Transactions	Old age dependency ratio	Event Shocks	
X_{2t}	X_{3t}	X_{4t}	
1	-0.2496	-0.5131	X_{2t}
	1	0.3755	X_{3t}
		1	X_{4t}

Source: Gretl Software – Own Calculation, 2024

From Table 7, the absence of multicollinearity among the independent variables can be confirmed as all values are less than (0.8). Therefore, there is no need to adjust the data, thus, the analysis of the Linear Regression Model can be pursued.

6.3.1 The Model Quantification

Table 8 The Outcomes of Czechia's Regression Model

Variable	Coefficient	Std. Error	t-ratio	P-value	Significance
const	−3.74709	0.671323	−5.582	8.90E-05	***
X_{2t}	0.0004871	2.45E-05	19.88	4.09E-11	***
X_{3t}	0.133246	0.0258547	5.154	0.0002	***
X_{4t}	0.675983	0.294	2.299	0.0387	**

Mean dependent var	−2.182353	**S.D. dependent var**	2.28753
Sum squared resid	2.307987	**S.E. of regression**	0.421352
R-squared	0.972434	**Adjusted R-squared**	0.966072
F (3, 13)	152.863	**P-value(F)**	2.19E-10
Log-likelihood	−7.148835	**Akaike criterion**	22.29767
Schwarz criterion	25.63052	**Hannan-Quinn**	22.62896
rho	−0.150815	**Durbin-Watson**	1.641035

Source: Gretl Software – Own Calculation, 2024

Referring to the outcomes in the Table 8, the Czech Republic's econometric model can be formulated as the following:

$$y_{2t} = -3.74709 + 0.0004871\ x_{2t} + 0.133246\ x_{3t} + 0.675983\ x_{4t} + u_{2t}$$

6.3.2 The Model Verification

Economic, statistical, and econometric verification will be conducted, where a 95% confidence interval will be used to conduct the test, so that variable significance, model validity, and the conditions for testing methods will be met eventually.

- **The Economic Verification**

In the economic verification, the parameters are observed whether they align with the established theory, hypotheses, and expected values according to the model's specifications.

In terms of ceteris paribus and due to the model's quantification, the estimated parameters can be interpreted as the following:

- If Czechia's NFT increases by 1 million EUR, the deficit-to-GDP ratio will increase by 0.0004871 P.P.
- If Czechia's Old Age Dependency ratio increases by 1%, the deficit-to-GDP ratio will increase by 0.133246 P.P.
- If a shock event such as a gas price surge occurs, the deficit-to-GDP ratio will increase by 0.675983 P.P.

According to the aforementioned verification, the hypotheses failed to be rejected. This concludes that the independent variables influence the short-term fiscal sustainability represented by the deficit-to-GDP ratio in Czechia. Nevertheless, the impact of NFT on Czechia's deficit-to-GDP ratio is slightly low in comparison to the impact of the remaining variables.

- **The Statistical Verification**

This verification addresses the statistical evaluation of the parameters and the econometric model. The adjusted R^2 in the Czechia model in Table 8 equals 0.966072, meaning that the aforementioned selected variables explain 96% of Czechia's fiscal sustainability. This concludes that the variables are significant in this model, and the estimated equation linear model can be considered statistically significant.

Statistical Significance of the Parameters

The statistical significance of the estimated parameters, which is denoted as (α), is evaluated by the calculation of the so-called P-value, which is presented in Table 9 as the level of significance of α = 0.05, and which corresponds to a 95% of confidence level, so that the lower the significance level, the higher the level of confidence. The null hypothesis states that each parameter is statistically insignificant at the chosen significance level. Therefore, if the P-value is less or equal to the selected significance level of 0.05, then the null hypothesis is rejected. Otherwise, it will be accepted if the P-value exceeds the significance level of 0.05 which will lead to not considering the parameter as statistically significant.

Table 9 Statistical Significance of Czechia Model's Parameters

	Net Financial Transactions	Old Age Dependency ratio	Event Shocks
	X_{2t}	X_{3t}	X_{4t}
p-value	4.09E-11	0.0002	0.0387
Significance Level	0.05	0.05	0.05
Null hypothesis	Rejected	Rejected	Rejected

Source: Gretl Software – Own Calculation, 2024

From Table 9, the P-value of NFT, old-age dependency ratio, and event shocks indicate ($4.09e^{-11}$, 0.0002, and 0.0387) respectively. Since each P-value of the estimated parameters is significantly lower than the significance level α = 0.05, this leads to the rejection of the null hypothesis, confirming the statistical significance of the NFT, old-age dependency ratio, and event shocks variables and indicating that fiscal sustainability is strongly influenced by the NFT variable.

- **The Econometric Verification**

The following tests were performed and their results are presented in Table 9.

- Heteroskedasticity
- Normality of Residuals
- Autocorrelation

Table 10 Econometric Verification Results of Czechia's Model

	Heteroskedasticity	Normality of Residuals	Autocorrelation
	Breusch-Pagan	**Jarque-Bera Test**	**Breusch-Godfrey Test**
P-value	0.449203	0.16359	0.500545
Significance Level	0.05	0.05	0.05
Null hypothesis	Accepted	Accepted	Accepted

Source: Gretl Software – Own Calculation, 2024

Heteroskedasticity

This test is conducted through a set of two assumptions. The first assumption denotes that residuals have the same but unknown variance. This is known as the constant variance of homoscedasticity. Nevertheless, when this assumption is violated, this leads to the second assumption of the non-constant residual variance or the so-called heteroskedasticity.

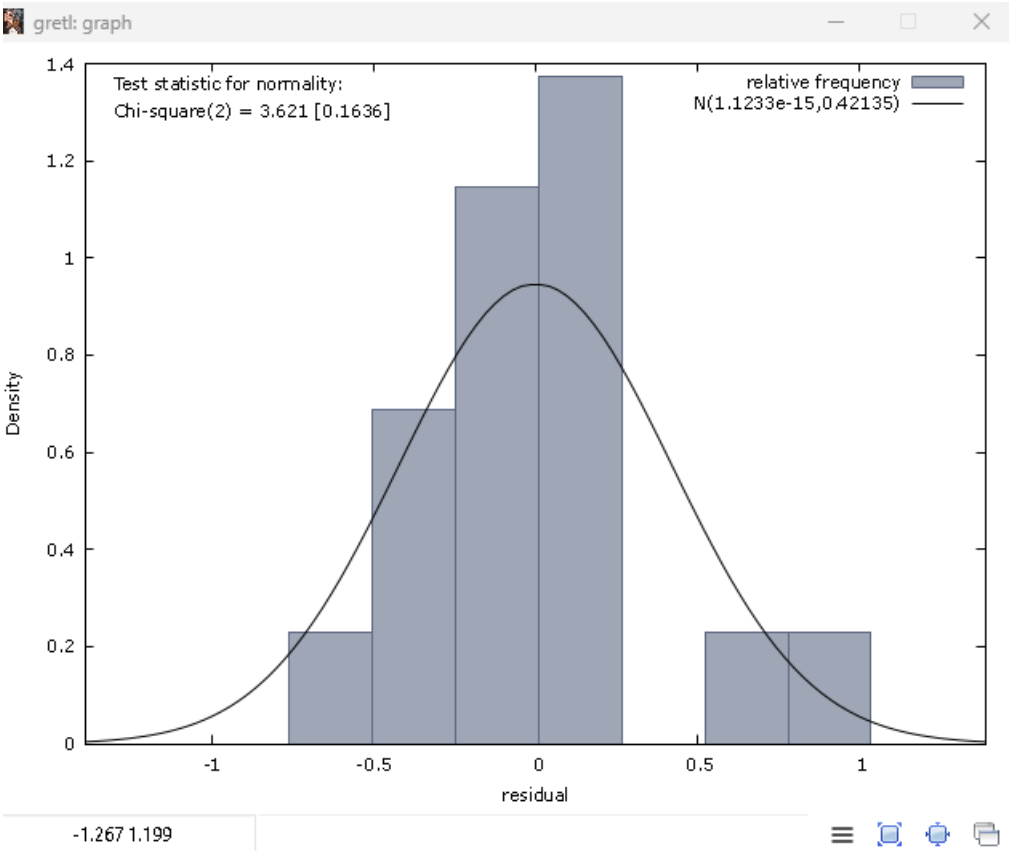
The Breusch-Pagan test was used to observe the heteroskedasticity, where the null hypothesis assumes the homoscedasticity of residuals. As depicted in Table 10, the P-value of 0.449203 is higher than the significance level $\alpha = 0.05$ leading to the failure to reject the null hypothesis, and confirming the homoscedasticity of residuals and unbiased estimates of the model.

Normality of Residuals

The Jarque-Bera test was used to check the normality, for which the null hypothesis of this test states that the residuals are normally distributed. Referring to Table 10, the P-value of the Jarque-Bera test is equal to 0.16359 and higher than the significance level $\alpha = 0.05$ which leads to the failure to reject the null hypothesis and confirms the normality of residuals and the robustness and reliability of the OLS model's outcomes.

Additionally, the normality of residuals was also observed in the residuals' histogram, which illustrates their distribution. However, the histogram should reveal the Gaussian curve if the normality is met. Gaussian curve represents the probability density function of normal distribution around the central mean.

Figure 13 Residuals' Histogram of Czechia's Model



Source: Gretl Software – Own Calculation, 2024

Figure 13, illustrates the histogram of the residuals, where the histogram shape resembles the Gaussian curve. This leads to further evidence about the normality of residuals.

Autocorrelation in the Residuals

The Breusch-Godfrey test was used to check either the absence or the presence of autocorrelation among the residuals. The results can be observed in Table 10 for the P-value of 0.500545. As the P-value is higher than the significance level $\alpha = 0.05$, then the null hypothesis which assumes the absence of autocorrelation is failed to be rejected, meaning that the residuals are not autocorrelated.

6.4 Formulation of the Netherlands Econometric Model

Table 11 The Dataset of the Netherlands Econometric Model

Year	Deficit/Surplus-GDP ratio	Net Financial Transactions	Old Age Dependency ratio	Economic Shocks
	%	million EUR	%	dummy
	Y_t	X_{2t}	X_{3t}	X_{4t}
2007	-0.30	-1035	21.5	0
2008	0.00	352	21.8	1
2009	-5.10	-31425	22.3	0
2010	-5.30	-34272	22.8	0
2011	-4.40	-30469	23.3	0
2012	-3.80	-24681	24.4	0
2013	-2.90	-19392	25.5	0
2014	-2.20	-15377	26.4	0
2015	-1.80	-12250	27.2	0
2016	0.20	2583	27.8	0
2017	1.30	9964	28.4	0
2018	1.50	11848	29	0
2019	1.80	14687	29.5	0
2020	-3.60	-29350	30.1	0
2021	-2.20	-19643	30.6	1
2022	0.00	53	31.1	1
2023	-0.4	-3827	31.4	1

Source: Eurostat-Database https://ec.europa.eu/eurostat/databrowser/view/demo_pjanind__custom_13652375/default/table https://doi.org/10.2908/GOV_10A_MAIN https://doi.org/10.2908/DEMO_PJANIND

Referring to the literature review and economic theory, the relationship between dependent variable and independent variables is expected to be as follows:

- The Deficit/surplus-GDP ratio will increase with the increase in Net Financial Transactions.
- The Deficit/surplus-GDP ratio will increase with the increase in the Old Dependency ratio.
- The Deficit/surplus-GDP ratio will increase if the event shock driven by the surge in gas prices takes place.

Before verifying the model, the multicollinearity was observed and the matrix is presented in the following table 12:

Table 12 The Correlation Matrix of Independent Variables of Netherlands' Model

Net Financial Transactions	Old age dependency ratio	Event Shocks	
X_{2t}	X_{3t}	X_{4t}	
1	0.3829	0.1741	X_{2t}
	1	0.3441	X_{3t}
		1	X_{4t}

Source: Gretl Software – Own Calculation, 2024

From Table 12, the absence of multicollinearity among the independent variables can be confirmed as all values are less than (0.8). Therefore, there is no need to adjust the data, thus, the analysis of the Linear Regression Model can be pursued.

6.4.1 The Model Quantification

Table 13 The Outcomes of Netherlands' Regression Model

Variable	Coefficient	Std. Error	t-ratio	P-value	Significance
const	−1.60463	0.532335	−3.014	1.00E-02	***
X_{2t}	0.0001361	3.95E-06	34.44	3.69E-14	***
X_{3t}	0.0529937	0.0195808	2.706	0.018	**
X_{4t}	0.217149	0.144643	1.501	0.1572	

Mean dependent var	−1.600000	**S.D. dependent var**	2.320291
Sum squared resid	0.731684	**S.E. of regression**	0.237241
R-squared	0.991506	**Adjusted R-squared**	0.989546
F (3, 13)	505.8232	**P-value(F)**	1.05E-13
Log-likelihood	2.615816	**Akaike criterion**	2.768369
Schwarz criterion	6.101222	**Hannan-Quinn**	3.099661
rho	0.074776	**Durbin-Watson**	1.694201

Source: Gretl Software – Own Calculation, 2024

Referring to the outcomes in the Table 13, the Netherlands' econometric model can be formulated as the following:

$$y_{3t} = -1.60463 + 0.0001361x_{2t} + 0.0529937\ x_{3t} + 0.217149\ x_{4t} + u_{3t}$$

6.4.2 The Model Verification

Economic, statistical, and econometric verification will be conducted, where a 95% confidence interval will be used to conduct the test, so that variable significance, model validity, and the conditions for testing methods will be met eventually.

- **The Economic Verification**

In the economic verification, the parameters are observed whether they align with the established theory, hypotheses, and expected values according to the model's specifications.

In terms of ceteris paribus and due to the model's quantification, the estimated parameters can be interpreted as the following:

- If the Netherlands' NFT increases by 1 million EUR, the deficit-to-GDP ratio will increase by 0.0001361 P.P.
- If the Netherlands' Old Age Dependency ratio increases by 1%, the deficit-to-GDP ratio will increase by 0.0529937 P.P.
- If a shock event such as a gas price surge occurs, the deficit-to-GDP ratio will increase by 0.217149 P.P.

According to the aforementioned verification, the hypotheses failed to be rejected. This concludes that the variables influence the short-term fiscal sustainability represented by the deficit-to-GDP ratio in the Netherlands. Nevertheless, the impact of NFT on the Netherlands' deficit-to-GDP ratio is slightly low in comparison to the impact of the remaining variables.

- **The Statistical Verification**

This verification addresses the statistical evaluation of the parameters as well as the econometric model. The adjusted R2 in the Netherlands' model in Table 13 is equal to 0.989546, meaning that 98% of the Netherlands' fiscal sustainability is explained by the aforementioned selected variables. This concludes that the variables are significant in this model, and so on the estimated equation linear model can be considered statistically significant.

Statistical Significance of the Parameters

The statistical significance of the estimated parameters, which is denoted as (α), is evaluated by the calculation of the so-called P-value, which is presented in Table 14 as the significance level of α = 0.05, and which corresponds to a 95% confidence level, so that the lower the significance level, the higher the level of confidence. The null hypothesis states that each parameter is statistically insignificant at the chosen level of significance. Therefore, if the P-value is less or equal to the selected significance level of 0.05, then the null hypothesis is rejected. Otherwise, it will be accepted if the P-value exceeds the significance level of 0.05 which will lead to not considering the parameter as statistically significant.

Table 14 Statistical Significance of Netherlands Model's Parameters

	Net Financial Transactions	Old age dependency ratio	Event Shocks
	X_{2t}	X_{3t}	X_{4t}
p-value	3.69E-14	0.018	0.1572
Significance Level	0.05	0.05	0.05
Null hypothesis	Rejected	Rejected	Accepted

Source: Gretl Software – Own Calculation, 2024

From Table 14, the P-value of NFT and the old age dependency ratio indicate ($3.69e^{-14}$ and 0.018) respectively. Since each P-value of the afore-mentioned estimated parameters is significantly lower than the significance level α = 0.05, this leads to the rejection of the null hypothesis, confirming the statistical significance of the NFT and old age dependency ratio variables and indicating that the NFT variable strongly influences fiscal sustainability.

On the other hand, the P-value of Event Shocks as of 0.1572 exceeds the significance level α 0.05, leading to the failure to reject the null hypothesis concerning this variable and to consider the Event Shocks as statistically insignificant. Thus, changes in the aforementioned variables do not have a statistically significant impact on the dependent one.

The insignificance of the surge in gas prices that is represented by the Event Shocks variable may be attributed to the country's robust transition to renewable energy, diversified energy mix, and proactive policies aimed at reducing reliance on natural gas. The rapid increase in installed

renewable energy capacity (wind, solar, biomass, and geothermal) has significantly reduced the country's reliance on imported gas or volatile fossil fuel prices. With renewables contributing a growing share to electricity production, the economic impact of gas price surges may have been mitigated, rendering the shock less statistically significant. Moreover, adopting of the new technology of heat pumps reduces dependency on natural gas for heating, further weakening the link between gas price surges and broader economic repercussions.

- **The Econometric Verification**

The following tests were performed and their results are presented in Table 15.

- Heteroskedasticity
- Normality of Residuals
- Autocorrelation

Table 15 Econometric Verification Results of Netherlands' Model

	Heteroskedasticity	Normality of Residuals	Autocorrelation
	Breusch-Pagan	**Jarque-Bera Test**	**Breusch-Godfrey Test**
P-value	0.50763	0.94915	0.773762
Significance Level	0.05	0.05	0.05
Null hypothesis	Accepted	Accepted	Accepted

Source: Gretl Software – Own Calculation, 2024

Heteroskedasticity

This test is conducted through a set of two assumptions. The first assumption denotes that residuals have the same but unknown variance. This is known as a constant variance of homoscedasticity. Nevertheless, when this assumption is violated, this leads to the second assumption of the non-constant residual variance or the so-called heteroskedasticity.

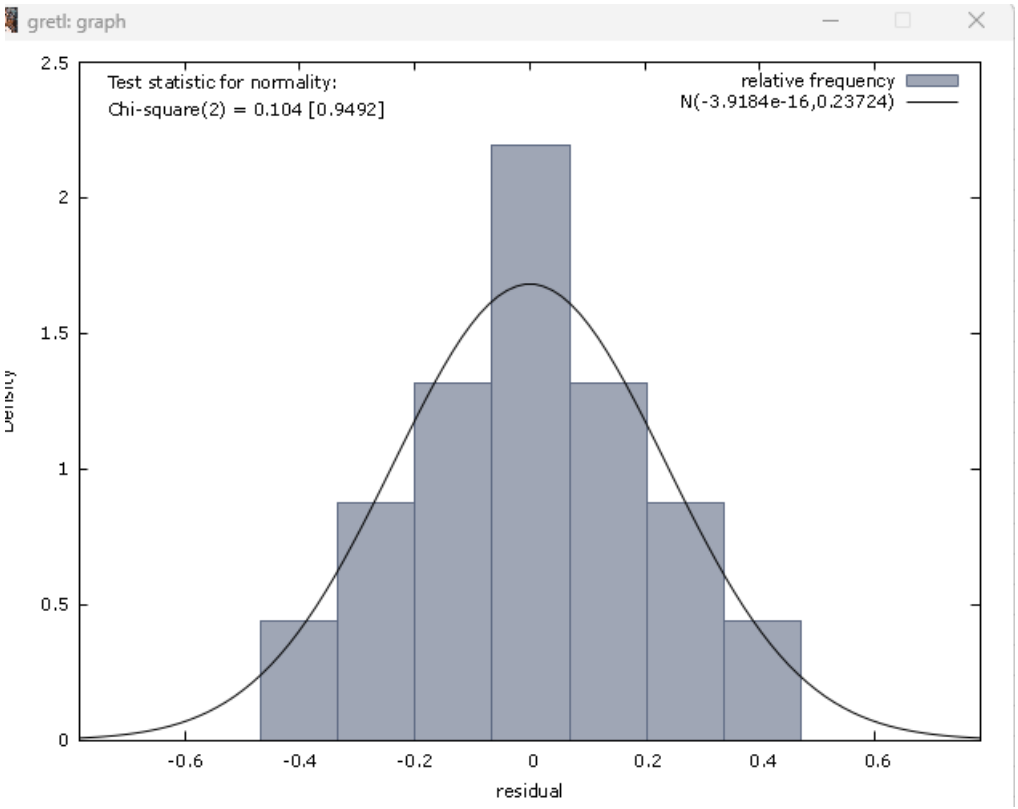
The Breusch-Pagan test was used to observe the heteroskedasticity, where the null hypothesis assumes the homoscedasticity of residuals. As depicted in Table 15, the P-value of 0.50763 is higher than the significance level $\alpha = 0.05$ leading to the failure to reject the null hypothesis and to confirm the homoscedasticity of residuals and unbiased estimates of the model.

Normality of Residuals

The Jarque-Bera test was used to check the normality, for which the null hypothesis of this test states that the residuals are normally distributed. Referring to Table 15, the P-value of the Jarque-Bera test is equal to 0.94915 and higher than the significance level $\alpha = 0.05$ which leads to the failure to reject the null hypothesis and confirms the normality of residuals and the robustness and reliability of the OLS model's outcomes.

Additionally, the normality of residuals was also observed in the residuals' histogram, which illustrates their distribution. However, the histogram should reveal the Gaussian curve if the normality is met. Gaussian curve represents the probability density function of normal distribution around the central mean.

Figure 14 Residuals' Histogram of Netherlands' Model



Source: Gretl Software – Own Calculation, 2024

Figure 14, illustrates the residuals histogram, where the histogram shape resembles the Gaussian curve. This leads to further evidence about the normality of residuals.

Autocorrelation in the Residuals

The Breusch-Godfrey test was used to check either the absence or the presence of autocorrelation among the residuals. The results can be observed in Table 15 for the P-value of 0.773762. As the P-value is higher than the significance level $\alpha = 0.05$, then the null hypothesis which assumes the absence of autocorrelation failed to be rejected, meaning that the residuals are not autocorrelated.

6.5 Formulation of Italy Econometric Model

Table 16 The Dataset of Italy Econometric Model

Year	Deficit/Surplus-GDP ratio	Net Financial Transactions	Old age dependency ratio	Economic Shocks
	%	million EUR	%	dummy
	Y_t	X_{2t}	X_{3t}	X_{4t}
2007	-1.30	-23444	30.5	0
2008	-2.60	-44068	30.6	1
2009	-5.10	-82972	30.8	0
2010	-4.20	-66175	31.1	0
2011	-3.50	-58581	31.2	1
2012	-3.00	-48690	32	1
2013	-2.90	-50610	32.6	0
2014	-2.80	-46940	33.3	0
2015	-2.50	-42064	34	0
2016	-2.40	-38598	34.5	0
2017	-2.50	-40607	35	0
2018	-2.20	-38842	35.4	0
2019	-1.50	-28313	35.8	0
2020	-9.40	-153963	36.4	0
2021	-8.90	-160254	37	1
2022	-8.10	-159757	37.5	1
2023	-7.2	-152012	37.8	1

Source: Eurostat-Database https://ec.europa.eu/eurostat/databrowser/view/demo_pjanind__custom_13652375/default/table https://doi.org/10.2908/GOV_10A_MAIN https://doi.org/10.2908/DEMO_PJANIND

An extraordinary adjustment was made to the dummy variable of Italy's regression model, by giving the value 1 to the years of 2011 and 2012 due to the Eurozone Debt crisis and its impact on Italy’s indebtedness.

Referring to the literature review and economic theory, the relationship between dependent variable and independent variables is expected to be as follows:

- The Deficit/surplus-GDP ratio will increase with the increase in Net Financial Transactions.
- The Deficit/surplus-GDP ratio will increase with the increase in the Old Dependency ratio.
- The Deficit/surplus-GDP ratio will increase if the event shock takes place driven by the surges in gas prices takes place and the Debt crisis in the Eurozone.

Before verifying the model, the multicollinearity was observed and the matrix is presented in Table 17:

Table 17 The Correlation Matrix of Independent Variables of Italy's Model

Net Financial Transactions	Old Age Dependency Ratio	Event Shocks	
X_{2t}	X_{3t}	X_{4t}	
1	-0.6288	-0.4767	X_{2t}
	1	0.1482	X_{3t}
		1	X_{4t}

Source: Gretl Software – Own Calculation, 2024

From Table 17, the absence of multicollinearity among the independent variables can be confirmed as all values are less than (0.8). Therefore, there is no need to adjust the data, thus, the analysis of the Linear Regression Model can be pursued.

6.5.1 The Model Quantification

Table 18 The Outcomes of Italy‘s Regression Model

Variable	Coefficient	Std. Error	t-ratio	P-value	Significance
const	−3.92731	1.56922	−2.503	2.65E-02	**
X_{2t}	5.8176E-05	2.85E-06	20.39	2.98E-11	***
X_{3t}	0.113792	0.0494983	2.299	0.0387	**
X_{4t}	0.512655	0.226904	2.259	0.0417	**

Mean dependent var	−4.123529	**S.D. dependent var**	2.632852
Sum squared resid	1.909316	**S.E. of regression**	0.383237
R-squared	0.982785	**Adjusted R-squared**	0.978812
F (3, 13)	247.3864	**P-value(F)**	1.03E-11
Log-likelihood	−5.536977	**Akaike criterion**	19.07395
Schwarz criterion	22.40681	**Hannan-Quinn**	19.40525
rho	0.258043	**Durbin-Watson**	1.196864

Source: Gretl Software – Own Calculation, 2024

Referring to the outcomes in the Table 18, the Italy‘s econometric model can be formulated as the following:

$$y_{4t} = -3.92731 + 0.0000582\ x_{2t} + 0.113792\ x_{3t} + 0.512655\ x_{4t} + u_{4t}$$

6.5.2 The Model Verification

Economic, statistical, and econometric verification will be conducted, where a 95% confidence interval will be used to conduct the test, so that variable significance, model validity, and the conditions for testing methods will be met eventually.

- **The Economic Verification**

In the economic verification, the parameters are observed whether they are in line with the established theory, hypotheses, and expected values according to the specifications of the model.

In terms of ceteris paribus and due to the model's quantification, the estimated parameters can be interpreted as the following:

- If Italy's NFT increases by 1 million EUR, the deficit-to-GDP ratio will increase by 0.0000582 P.P.
- If Italy's Old Age Dependency ratio increases by 1%, the deficit-to-GDP ratio will increase by 0.113792 P.P.
- If a shock event such as the gas prices surge and/or Debt crisis takes place, the deficit-to-GDP ratio will increase by 0.512655 P.P.

According to the aforementioned verification, the hypotheses are failed to be rejected. This concludes that these variables influence the short-term fiscal sustainability represented by the deficit-to-GDP ratio in Italy. Nevertheless, the impact of NFT on Italy's deficit-to-GDP ratio is slightly low in comparison to the impact of the remaining variables.

- **The Statistical Verification**

This verification addresses the statistical evaluation of the parameters as well as the econometric model. The Adjusted R^2 in Italy's model in Table 18 is equal to 0.978812, meaning that 97% of Italy's fiscal sustainability is explained by the aforementioned selected variables. This concludes that the variables are significant in this model, and the estimated equation of the linear model can be considered statistically significant.

Statistical Significance of the Parameters

The statistical significance of the estimated parameters, which is denoted as (α), is evaluated by the calculation of the so-called P-value, which is presented in Table 19 as the level of significance α = 0.05, and which corresponds to a 95% confidence level, so that the lower the significance level, the higher the level of confidence. The null hypothesis states that each parameter is statistically insignificant at the chosen significance level. Therefore, if the P-value is less or equal to the selected significance level of 0.05, the null hypothesis is rejected. Otherwise, it will be accepted if the P-value exceeds the significance level of 0.05 which will lead to not considering the parameter as statistically significant.

Table 19 Statistical Significance of Italy Model's Parameters

	Net Financial Transactions	Old age dependency ratio	Event Shocks
	X_{2t}	X_{3t}	X_{4t}
p-value	2.98E-11	0.0387	0.0417
Significance Level	0.05	0.05	0.05
Null hypothesis	Rejected	Rejected	Rejected

Source: Gretl Software – Own Calculation, 2024

From Table 19, the P-value of NFT, the old age dependency ratio, and Event Shocks indicate ($2.98e^{-11}$, 0.0387, and 0.0417) respectively. Since each P-value of the aforementioned estimated parameters is significantly lower than the significance level α = 0.05, this leads to the rejection of the null hypothesis, confirming the statistical significance of all independent variables and to the conclusion that fiscal sustainability is strongly influenced by the NFT variable.

- **The Econometric Verification**

The following tests were performed and their results are presented in Table 20.

- Heteroskedasticity
- Normality of Residuals
- Autocorrelation

Table 20 Econometric Verification Results of Italy's Model

	Heteroskedasticity	Normality of Residuals	Autocorrelation
	Breusch-Pagan	**Jarque-Bera Test**	**Breusch-Godfrey Test**
P-value	0.085372	0.417396	0.423909
Significance Level	0.05	0.05	0.05
Null hypothesis	Accepted	Accepted	Accepted

Source: Gretl Software – Own Calculation, 2024

Heteroskedasticity

This test is conducted through a set of two assumptions. The first assumption denotes that residuals have the same but unknown variance. This is known as a constant variance of homoscedasticity. Nevertheless, when this assumption is violated, this leads to the second assumption of the non-constant residual variance or the so-called heteroskedasticity.

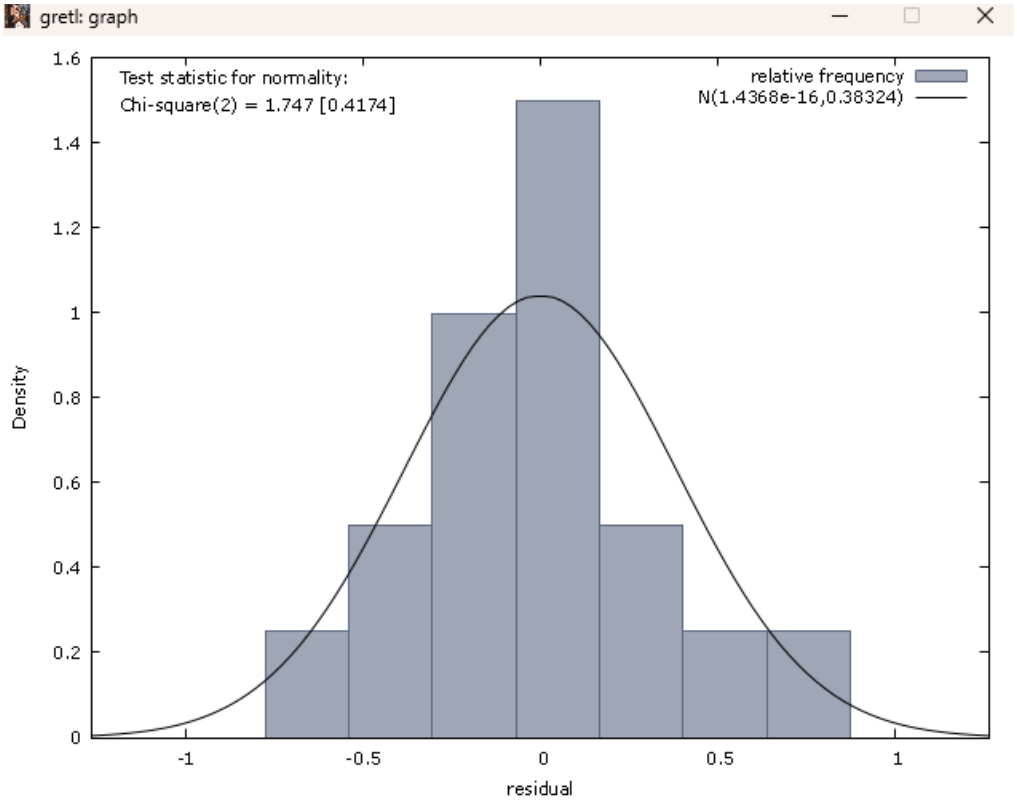
The Breusch-Pagan test was used to observe the heteroskedasticity, where the null hypothesis assumes the homoscedasticity of residuals. As depicted in Table 20, the P-value of 0.085372 is higher than the significance level $\alpha = 0.05$ leading to the failure to reject the null hypothesis and to confirm the homoscedasticity of residuals and unbiased estimates of the model.

Normality of Residuals

The Jarque-Bera test was used to check the normality, for which the null hypothesis of this test states that the residuals are normally distributed. Referring to Table 20, the P-value of the Jarque-Bera test is equal to 0.417396 and higher than the significance level $\alpha = 0.05$ which leads to the failure to reject the null hypothesis and confirms the normality of residuals and the robustness and reliability of OLS model's outcomes.

Additionally, the normality of residuals was also observed in the residuals' histogram, which illustrates their distribution. However, the histogram should reveal the Gaussian curve if the normality is met. Gaussian curve represents the probability density function of normal distribution around the central mean.

Figure 15 Residuals' Histogram of Italy's Model



Source: Gretl Software – Own Calculation, 2024

Figure 15, illustrates the residuals histogram, where the histogram shape resembles the Gaussian curve. This leads to further evidence about the normality of residuals.

Autocorrelation in the Residuals

The Breusch-Godfrey test was used to check either the absence or the presence of autocorrelation among the residuals. The results can be observed in Table .20, for the P-value of 0.423909. As the P-value is higher than the significance level $\alpha = 0.05$, then the null hypothesis which assumes the absence of autocorrelation failed to be rejected, meaning that the residuals are not autocorrelated.

6.6 Formulation of Norway Econometric Model

Table 21 The Dataset of Norway Econometric Model

Year	Deficit-GDP ratio	Net Financial Transactions	Old age dependency ratio	Economic Shocks
	%	million EUR	%	dummy
	Y_t	X_{2t}	X_{3t}	X_{4t}
2007	17	50747.1	22.2	0
2008	18.5	57801.1	22.1	1
2009	10.2	28184.5	22.1	0
2010	10.9	35482.3	22.5	0
2011	13.3	45998.9	22.8	0
2012	13.7	55137.3	23.3	0
2013	10.6	42900.7	23.7	0
2014	8.6	31937.2	24.1	0
2015	6	21410.8	24.5	0
2016	4	13180	25	0
2017	5	17074.9	25.4	0
2018	7.8	28732.1	25.9	0
2019	6.5	23810	26.4	0
2020	-2.6	-7981.6	26.9	0
2021	10.3	43697	27.6	1
2022	25.6	143457.2	28.1	1
2023	16.5	73626.2	28.4	1

Source: Eurostat-Database https://ec.europa.eu/eurostat/databrowser/view/demo_pjanind__custom_13652375/default/table https://doi.org/10.2908/GOV_10A_MAIN https://doi.org/10.2908/DEMO_PJANIND

As per the set of data, it's distinguishable that Norway has maintained consistent budget surpluses over a long period, supported by significant revenues from its oil and gas sector. These revenues are managed prudently through the Norwegian Sovereign Wealth Fund, which helps ensure fiscal sustainability and positively influences Norway's financial indicators, including Net Financial Transactions.

Referring to the literature review and economic theory, the relationship between dependent variable and independent variables is expected to be as follows:

- The Deficit/surplus-GDP ratio (resulting in surplus) will increase with the increase in Net Financial Transactions.
- The Deficit/surplus-GDP (resulting in surplus) ratio will decrease with the increase in the Old Dependency ratio.
- The Deficit/surplus-GDP (resulting in surplus) ratio will increase if the event shock takes place driven by the surges in gas prices.

Before verifying the model, the multicollinearity was observed and the matrix is presented in Table No. 22:

Table 22 The Correlation Matrix of Independent Variables of Norway's Model

Net Financial Transactions	Old age dependency ratio	Event Shocks	
X_{2t}	X_{3t}	X_{4t}	
1	0.2259	0.669	X_{2t}
	1	0.4717	X_{3t}
		1	X_{4t}

Source: Gretl Software – Own Calculation, 2024

From Table 22, the absence of multicollinearity among the independent variables can be confirmed as all values are less than (0.8). Therefore, there is no need to adjust the data, thus, the analysis of the Linear Regression Model can be pursued.

6.6.1 The Model Quantification

Table 23 The Outcomes of Norway's Regression Model

Variable	Coefficient	Std. Error	t-ratio	P-value	Significance
const	30.2799	4.20816	7.196	6.99E-06	***
X2t	0.000175	1.34E-05	13.07	7.45E-09	***
X3t	−1.11275	0.170138	−6.540	1.88E-05	***
X4t	3.051	1.10353	2.765	0.0161	**

Mean dependent var	10.7	**S.D. dependent var**	6.515462
Sum squared resid	21.50864	**S.E. of regression**	1.286278
R-squared	0.968333	**Adjusted R-squared**	0.961026
F (3, 13)	132.5087	**P-value(F)**	5.38E-10
Log-likelihood	−26.12151	**Akaike criterion**	60.24301
Schwarz criterion	63.57586	**Hannan-Quinn**	60.5743
rho	−0.148834	**Durbin-Watson**	1.782274

Source: Gretl Software – Own Calculation, 2024

Referring to the outcomes in the Table 23, Norway's econometric model can be formulated as the following:

$$y5t = 30.2799 + 0.000175\ x2t - 1.11275\ x3t + 3.051\ x4t + u5t$$

6.6.2 The Model Verification

Economic, statistical, and econometric verification will be conducted, where a 95% confidence interval will be used to conduct the test, so that variable significance, model validity, and the conditions for testing methods will be met eventually.

- **The Economic Verification**

In the economic verification, the parameters are observed whether they are in line with the established theory, hypotheses, and expected values according to the specifications of the model.

In terms of ceteris paribus and due to the model's quantification, the estimated parameters can be interpreted as the following:

- If Norway‘s NFT increases by 1 million EUR, the deficit-to-GDP (resulting in surplus) ratio will increase by 0.000175 P.P.
- If Norway‘s Old Age Dependency ratio increases by 1%, the deficit-to-GDP ratio (resulting in surplus) will decrease by 1.11275 P.P.
- If a shock event such as a gas price surge occurs, the deficit-to-GDP (resulting in surplus) ratio will increase by 3.051 P.P.

According to the aforementioned verification, the hypotheses are failed to be rejected. This concludes that these variables influence the short-term fiscal sustainability represented by the deficit-to-GDP ratio in Norway. Nevertheless, the impact of NFT on Norway‘s deficit-to-GDP ratio is slightly low in comparison to the impact of the remaining variables.

- **The Statistical Verification**

This verification addresses the statistical evaluation of the parameters as well as the econometric model. The adjusted R^2 in the Norway‘s model in Table 23 is equal to 0.961026, meaning that 96% of the Norway‘s fiscal sustainabilty is explained by the afore-mentioned selected variables. Which concluds that the variables are significant in this model, and so on the estimated equation of linear model can be considered as statistically significance.

Statistical Significance of the Parameters

The statistical significance of the estimated parameters, which is denoted as (α), is evaluated by the calculation of the so-called P-value, which is presented in Table 24 as a significance level of α = 0.05, and which corresponds to a 95% confidence level, so that the lower the significance level, the higher the level of confidence. The null hypothesis states that each parameter is statistically insignificant at the chosen significance level. Therefore, if the P-value is less or equal to the selected significance level of 0.05, then the null hypothesis is rejected. Otherwise, it will be accepted if the P-value exceeds the significance level of 0.05 which will lead to not considering the parameter as statistically significant.

Table 24 Statistical Significance of Norway Model's Parameters

	Net Financial Transactions	Old age dependency ratio	Event Shocks
	X_{2t}	X_{3t}	X_{4t}
p-value	7.45E-09	1.88E-05	0.0161
Significance Level	0.05	0.05	0.05
Null hypothesis	Rejected	Rejected	Rejected

Source: Gretl Software – Own Calculation, 2024

From Table 24, the P-value of NFT, the old age dependency ratio, and Event Shocks indicate ($7.45e^{-09}$, $1.88e^{-05}$, and 0.0161) respectively. Since each P-value of the aforementioned estimated parameters is significantly lower than the significance level α = 0.05, this leads to the rejection of the null hypothesis, confirming the statistical significance of all independent variables and the conclusion that fiscal sustainability is strongly influenced by the NFT variable and old-age dependency ratio.

- **The Econometric Verification**

The following tests were performed and their results are presented in Table 25.

- Heteroskedasticity
- Normality of Residuals
- Autocorrelation

Table 25 Econometric Verification Results of Norway's Model

	Heteroskedasticity	Normality of Residuals	Autocorrelation
	Breusch-Pagan	Jarque-Bera Test	Breusch-Godfrey Test
P-value	0.628549	0.216443	0.626042
Significance Level	0.05	0.05	0.05
Null hypothesis	Accepted	Accepted	Accepted

Source: Gretl Software – Own Calculation, 2024

Heteroskedasticity

This test is conducted through a set of two assumptions. The first assumption denotes that residuals have the same but unknown variance. This is known as a constant variance of homoscedasticity. Nevertheless, when this assumption is violated, this leads to the second assumption of the non-constant residual variance or the so-called heteroskedasticity.

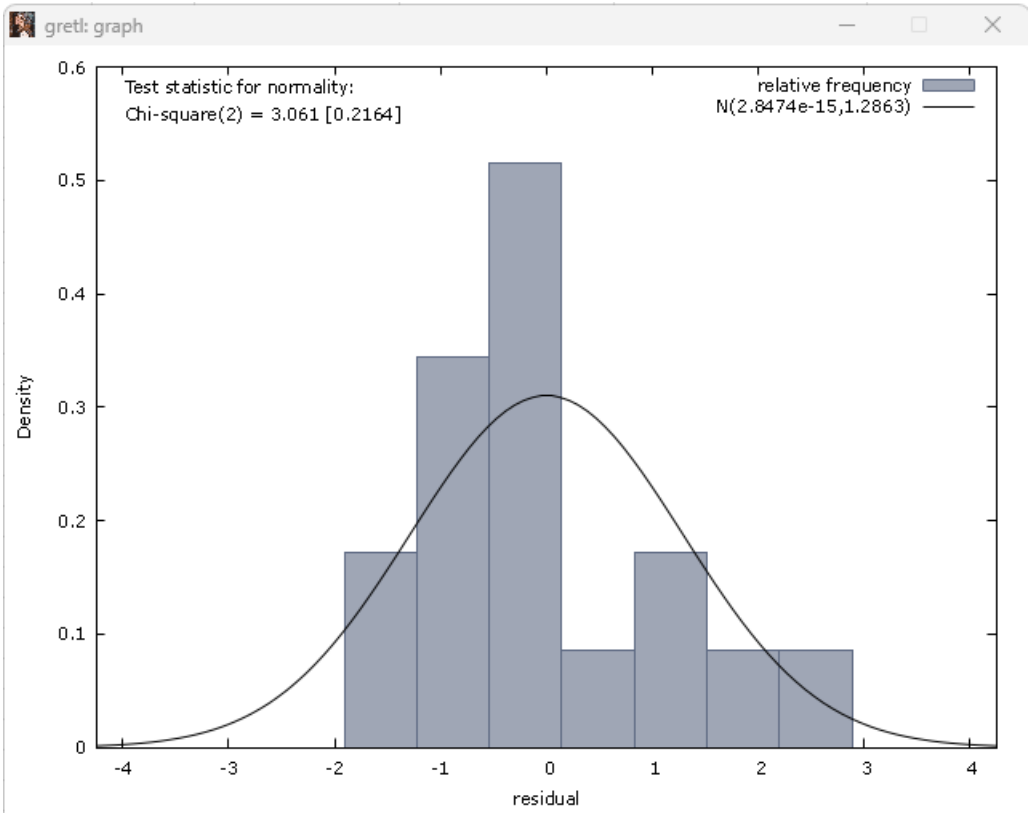
The Breusch-Pagan test was used to observe the heteroskedasticity, where the null hypothesis assumes the homoscedasticity of residuals. As depicted in Table 25, the P-value of 0.628549 is higher than the significance level $\alpha = 0.05$ leading to the failure to reject the null hypothesis and to confirm the homoscedasticity of residuals and unbiased estimates of the model.

Normality of Residuals

The Jarque-Bera test was used to check the normality, for which the null hypothesis of this test states that the residuals are normally distributed. Referring to Table 25, the P-value of the Jarque-Bera test is equal to 0.216443 and higher than the significance level $\alpha = 0.05$ which leads to the failure to reject the null hypothesis and confirms the normality of residuals and the robustness and reliability of OLS model's outcomes.

Additionally, the normality of residuals was also observed in the residuals' histogram, which illustrates their distribution. However, the histogram should reveal the Gaussian curve if the normality is met. Gaussian curve represents the probability density function of normal distribution around the central mean.

Figure 16 Residuals' Histogram of Norway's Model



Source: Gretl Software – Own Calculation, 2024

Figure 16, illustrates the residuals histogram, where the histogram shape resembles the Gaussian curve. This leads to further evidence about the normality of residuals.

Autocorrelation in the Residuals

The Breusch-Godfrey test was used to check either the absence or the presence of autocorrelation among the residuals. The results can be observed in Table 25, for the P-value of 0.626042. As the P-value is higher than the significance level $\alpha = 0.05$, the null hypothesis which assumes the absence of autocorrelation failed to be rejected, meaning that the residuals are not autocorrelated.

7 RESULTS AND DISCUSSION

The econometric models developed for the selected countries, alongside an extensive review of relevant literature and an analysis of their budget balances, were utilized to address the research question. The aim was to evaluate the impact of fiscal sustainability during periods of economic crisis and geopolitical risks stemming from the Russian-Ukrainian conflict. Following Russia's invasion of Ukraine, the EU made the strategic decision to suspend its reliance on Russian natural gas, a move that coincided with a dramatic surge in energy prices, exacerbated by the conflict. This study examined the fiscal policies implemented by the selected countries to address the repercussions of the conflict and the resulting energy price surge.

The focus of this study was not on analyzing macroeconomic variables but rather on observing the impact of various macroeconomic events on countries' budget deficits, starting with the conflict and extending to the fiscal policies implemented in response. This approach highlights the presence of the ***domino effect*** across the economy, where one event triggers cascading impacts. The Russian-Ukrainian conflict elevated geopolitical risks, prompting the EU to suspend reliance on Russian gas, which in turn led to a severe gas crisis marked by a sharp surge in gas and other energy prices. This crisis fueled extreme inflation, as both domestic producers and energy importers passed the increased costs onto consumers, driving domestic price inflation to extraordinary levels. These findings align with previous research by **Shiu-Sheng Chen (2009)**, **Ting Lan, Galen Sher, and Jing Zhou (2022)**, and **Kamil Dybczak, David Voňka, and Nico van der Windt (2008)**, which similarly emphasize the interplay between energy price shocks, inflation, and economic ripple effects.

To combat inflation, central banks adopted restrictive monetary policies, primarily through continuous interest rate hikes. While effective in addressing inflation, these policies imposed additional burdens on businesses and governments with high debt levels, as rising interest rates increased debt servicing costs. This impact is consistent with the work of **Koshy Mathai (2009)** and **David Turner and Francesca Spinelli (2013)**, which highlight the trade-offs of monetary tightening in managing inflation and its consequences on fiscal balance.

Governments have implemented a wide range of fiscal and demographic policies to address the challenges stemming from the conflict and its accompanying domino effect on macroeconomic

variables. These measures have placed significant pressure on government budgets, driven by increased spending to support households, businesses, domestic markets, and the broader economy. This thesis aimed to examine the impact of the crisis on fiscal sustainability in selected countries, focusing on the deficit/surplus-to-GDP ratio. This metric was analyzed in relation to three key variables representing the outcomes of the implemented policies, demographic challenges, and economic shocks during the crisis.

The analysis revealed that these variables significantly influence fiscal sustainability, leading to the conclusion that the gas crisis indirectly affects fiscal sustainability through its direct impact on macroeconomic variables and fiscal policies. However, the degree of this impact varies across countries, depending on whether a country is an energy importer or exporter, its level of indebtedness, and the extent of its investment in renewable energy. While investments in renewables contribute to long-term sustainability, they can still exert short-term pressure on budget balances due to increased public spending. These findings align with the conclusions of **Zerife Yildirim and Ayşe Atilgan Yaşa (2014)**, who highlighted the indirect effects of energy imports on public deficits through their direct connection to current account balances.

Analyzing fiscal sustainability in the selected countries during periods of fiscal pressure resulting from the surge in gas prices and the fiscal policies implemented to mitigate associated risks has led to the following insights:

Countries like **Norway** stand to benefit from such crises, not only due to the country's possession of natural gas but also because of the sustainable development of its natural resource revenues. This has allowed Norway to maintain fiscal stability, enabling it to address challenges arising from demographic shifts and other factors that could threaten public spending.

In contrast, **Germany**'s diversified economy and large industrial sector can manage the short-term risks of rising gas prices. However, the long-term effects of the crisis on its industries remain uncertain, as the ongoing high energy costs for local producers are expected to impact GDP and macroeconomic variables negatively. This, in turn, will likely have a detrimental effect on fiscal sustainability in the long run.

For the **Czech Republic**, a significant challenge emerged due to its high and undiversified dependence on natural gas imports from Russia. This dependency created substantial pressure on the government's public finances, leading to lower fiscal sustainability in the short term.

Meanwhile, the **Netherlands** experienced a less significant impact from the gas crisis due to its diversified energy resources, thanks to the government's investment in renewable energy. However, while the immediate effects of the crisis were minimal, ongoing pressure on government spending remains due to substantial investments in developing renewable energy sources.

Italy, however, was the most impacted country, given its high level of indebtedness. The crisis placed additional strain on Italy's fiscal stability, leading to higher government expenditures aimed at subsidizing the economy. At the same time, Italy was required to maintain a restrictive fiscal policy to adhere to EU recommendations for reducing its debt in line with the Maastricht Treaty.

Eventually, demographic challenges must be considered in all countries' fiscal policies, as they often require increased government spending. Addressing these challenges could involve policies to attract skilled workers and improve immigration laws.

Based on these findings, the hypothesis of this study is rejected, and a positive correlation between the surge in gas prices and fiscal sustainability is confirmed.

8 RECOMMENDATIONS

Accelerate Energy Diversification

- **Reduce Reliance on Single Energy Sources**

Countries like the Czech Republic and Italy, which are heavily dependent on imported natural gas, must prioritize diversifying their energy supply chains. This includes increasing imports from alternative suppliers to reduce vulnerability to geopolitical risks and exploring opportunities for local energy production, such as untapped renewable or fossil fuel resources. By expanding the diversity of energy sources, these countries can enhance energy security and reduce exposure to price volatility in global markets.

- **Enhance Renewable Energy Investments**

The Netherlands' effective mitigation of gas price surges underscores the critical role of renewable energy investments. Scaling up capacities in wind, solar, and geothermal energy can help countries significantly reduce dependency on volatile gas markets. Renewable energy not only provides a sustainable alternative but also strengthens long-term fiscal stability by reducing energy import costs and stabilizing domestic energy prices. Governments should encourage private sector involvement and public-private partnerships to accelerate the transition while minimizing fiscal pressures.

Strengthen Fiscal Policy Frameworks

Countries with high debt levels, such as Italy, should implement restrictive fiscal policies to control deficits and manage public debt effectively. However, this approach must be carefully balanced to avoid stifling economic growth. Governments should ensure adequate spending on growth-promoting sectors such as infrastructure, renewable energy, and technological innovation. Investments in these areas can stimulate economic activity, increase productivity, and generate long-term fiscal benefits, helping to offset the pressures of high debt levels. A dual focus on fiscal discipline and strategic growth is essential for achieving sustainable fiscal stability.

Address Demographic Challenges

- **Integrate Refugees and Migrants into Labor Markets**

Countries facing demographic challenges should adopt policies similar to those implemented in Germany, focusing on the integration of refugees and migrants into the labor market. Providing training, language programs, and support for job placement can help these groups contribute to the workforce, alleviate labor shortages, and mitigate the fiscal pressures caused by aging populations. By investing in the economic integration of migrants, countries can enhance productivity and reduce dependency on social services.

- **Encourage Workforce Participation**

Expanding workforce participation among underrepresented groups, such as women, older workers, and people with disabilities, can help offset the negative economic impacts of ageing populations. Policymakers should introduce flexible working arrangements, better access to childcare, and retraining programs to increase employment among these groups. Higher participation rates can boost labor supply, increase productivity, and contribute to long-term fiscal sustainability.

- **Promote Skilled Immigration**

Countries facing demographic challenges and labor shortages, should streamline immigration policies to attract skilled workers. By easing visa processes and recognizing foreign qualifications, these countries can address labor market gaps and enhance economic productivity. Skilled immigration is an essential tool for boosting innovation, maintaining a competitive workforce, and ensuring the sustainability of social security systems.

Align Monetary and Fiscal Policies

- **Coordinate Inflation Management**

While restrictive monetary policies, such as interest rate hikes, are crucial for controlling inflation, it is essential for these policies to be coordinated with fiscal measures to minimize their negative

impact on public debt servicing costs and business borrowing. A joint approach between monetary and fiscal authorities can ensure that inflation is kept in check without excessively burdening public finances or disrupting economic activity. Governments should aim for a balanced fiscal stance that supports growth while managing inflationary pressures, ensuring that monetary tightening does not unduly strain debt sustainability.

- **Prepare for Rising Interest Costs**

Governments should proactively build fiscal buffers during periods of economic stability to absorb the potential impact of rising debt servicing costs during cycles of monetary tightening. By setting aside reserves or reducing budget deficits when economic conditions are favorable, governments can ensure they have the financial flexibility to manage higher interest payments during periods of higher interest rates. This foresight can protect fiscal sustainability and provide a cushion against the economic shocks caused by fluctuating interest rates.

9 CONCLUSION

This study analyzed the fiscal sustainability of five European countries—Germany, Italy, the Netherlands, the Czech Republic, and Norway—during the period 2007–2023, focusing on the impacts of geopolitical risks arising from the Russian-Ukrainian conflict, gas price surges, demographic shifts, and the EU's policy to reduce reliance on Russian gas.

The selection of these countries was determined by their reliance on energy resources and their roles in the natural gas market. Among the selected countries, some are net importers while others are net exporters. Notably, the Netherlands is unique as the only country that transitioned from being a net exporter to a net importer of natural gas. Additionally, the level of indebtedness was a key consideration, with Italy included due to its significantly high debt-to-GDP ratio.

The thesis highlighted the presence of a domino effect, where the conflict triggered significant economic and fiscal repercussions. The sharp rise in gas prices fueled extreme inflation, as increased costs from domestic producers and energy importers were passed onto consumers, escalating domestic price inflation to extraordinary levels. To combat this inflation, central banks adopted restrictive monetary policies, including interest rate hikes, which while effective in controlling inflation, added pressure on governments and businesses with high debt levels due to rising interest payments.

Governments also implemented various fiscal and demographic policies to address the crisis, which further strained budgets due to increased spending to support households, businesses, and the economy. The findings indicate that fiscal sustainability is indirectly affected by the gas crisis through its direct influence on macroeconomic variables and fiscal policies. The degree of impact varies across countries based on their energy dependency, indebtedness levels, and investment in renewable energy. While investments in renewable energy contribute to long-term sustainability, they often impose short-term fiscal pressures due to increased public spending.

The policies implemented by these countries were aimed at mitigating short-term economic shocks caused by the gas price surge and at ensuring long-term fiscal sustainability. The creation of energy funds, energy subsidies, and investments in renewable energy were central to managing the fiscal pressures from rising energy prices. Additionally, changes to labor market policies to include refugees were vital for addressing demographic challenges, providing

necessary workforce support, and ensuring that countries could maintain economic growth despite external shocks.

The research employed a mixed methodology, combining a theoretical review of fiscal dynamics with econometric modeling, utilizing data from OECD and Eurostat. The deficit-to-GDP ratio served as the primary indicator of fiscal sustainability, with explanatory variables including Net Financial Transactions (NFT), the Old Age Dependency Ratio (OADR), and Event Shocks to capture gas price surges.

Each country exhibited unique fiscal responses shaped by its economic structure, energy policies, and government interventions. Germany's model highlighted the significant role of NFT in influencing its deficit-to-GDP ratio, while variables such as OADR and Event Shocks were insignificant, likely due to robust fiscal measures, including subsidies in energy relief packages and policies to integrate skilled labor and refugees.

Italy faced significant fiscal constraints, with all dependent variables substantially impacting on its fiscal sustainability. This was primarily driven by the surge in gas prices, which exerted additional pressure on Italy's fiscal stability. On one hand, the government provided subsidies to support the economy, while on the other hand, it implemented restrictive fiscal policies to control the rising levels of indebtedness resulting from previous accumulated deficit.

The Netherlands benefited from an aggressive transition to renewable energy, with rapid wind and solar capacity growth, making Event Shocks insignificant while NFT and OADR emerged as significant factors influencing fiscal outcomes.

The Czech Republic was the most affected by gas price surges, with all variables, including Event Shocks and demographic challenges, showing significant impacts, reflecting its heightened vulnerability to energy and fiscal shocks.

In contrast, Norway maintained fiscal stability due to its Sovereign Wealth Fund and its position as a leading gas exporter. Both Net Financial Transactions (NFT) and event shocks played a positive role in strengthening its fiscal metrics. However, similar to other countries, the influence of the Old Age Dependency Ratio (OADR) had a negative impact on fiscal sustainability.

These findings underline the critical role of energy diversification, renewable investments, effective fiscal policies, and demographic adjustments in mitigating the impacts of crises. The study demonstrates the importance of proactive governance, structural reforms, and fiscal buffers in ensuring economic resilience and long-term fiscal sustainability, particularly during periods of geopolitical and economic instability.

10 REFERENCES

1. ‘The Dutch Groningen Gas Field | European Gas Hub’ (2018), 21 August. Available at: https://www.europeangashub.com/the-rise-and-fall-of-the-dutch-groningen-gas-field.html (Accessed: 5 March 2024).
2. *2024 European Semester: Country Reports - European Commission* (2024). Available at: https://economy-finance.ec.europa.eu/publications/2024-european-semester-country-reports_en (Accessed: 01 November 2024).
3. *About the fund* (2010) *Norges Bank Investment Management*. Available at: https://www.nbim.no/en/the-fund/about-the-fund/ (Accessed: 12 September 2024).
4. Bayar, Y. and Kilic, C. (2014) ‘*Effects of Oil and Natural Gas Prices on Industrial Production In the Eurozone Member Countries’*, International Journal of Energy Economics and Policy, 4(2), pp. 238–247. Available at https://dergipark.org.tr/en/pub/ijeeep/issue/31909/350803?publisher=http-www-cag-edu-tr-ilhan-ozturk (Accessed: 17 March 2024).
5. Chen, S.-S. (2009) ‘Oil price pass-through into inflation’, *Energy Economics*, 31(1), pp. 126–133. Available at: https://doi.org/10.1016/j.eneco.2008.08.006.
6. Cohen, P. and Smialek, J. (2022) ‘The West’s Plan to Isolate Putin: Undermine the Ruble’, *The New York Times*, 28 February. Available at: https://www.nytimes.com/2022/02/28/business/russia-sanctions-central-bank-ruble.html (Accessed: 3 March 2024).
7. *Consolidated version of the Treaty on European Union - PROTOCOLS - Protocol (No 12) on the excessive deficit procedure* (2008) *OJ C*. Available at: http://data.europa.eu/eli/treaty/teu_2008/pro_12/oj/eng (Accessed: 20 November 2024).
8. Davies, R. and Elliott, L. (2022) ‘How EU energy firms plan to pay for Russian gas without breaking the law’, *The Guardian*, 28 April. Available at: https://www.theguardian.com/world/2022/apr/28/why-are-eu-energy-firms-agreeing-to-pay-for-russias-gas-in-roubles (Accessed: 3 March 2024).
9. *Draft budgetary plans 2024 - European Commission* (2024). Available at: https://economy-finance.ec.europa.eu/economic-and-fiscal-governance/stability-and-growth-pact/preventive-arm/annual-draft-budgetary-plans-dbps-euro-area-countries/draft-budgetary-plans-2024_en (Accessed: 07 November 2024).

10. Dutch Gas Production from the Small Fields: Why extending their life contributes to the energy transition (July 2021) Oxford Institute for Energy Studies. Available at: https://www.oxfordenergy.org/publications/dutch-gas-production-from-the-small-fields-why-extending-their-life-contributes-to-the-energy-transition/ (Accessed: 6 March 2024).
11. Energy, M. of P. and (2021) *Norway's oil history in 5 minutes*, *Government.no*. regjeringen.no. Available at: https://www.regjeringen.no/en/topics/energy/oil-and-gas/norways-oil-history-in-5-minutes/id440538/ (Accessed: 5 March 2024).
12. *European Commission (2017) SUSTAINABILITY OF PUBLIC FINANCES. pp. 1. Available at:* https://commission.europa.eu/system/files/2020-06/european-semester_thematic-factsheet_public-finance-sustainability_en_0.pdf
13. Eurostat (2024) *Exports of natural gas by partner country*. Available at: https://doi.org/10.2908/NRG_TE_GAS.
14. Eurostat (2024) *Imports of natural gas by partner country.* Available at: https://doi.org/10.2908/NRG_TI_GAS.
15. Eurostat (2024) *Supply, transformation and consumption of gas - monthly data*. Available at: https://doi.org/10.2908/NRG_CB_GASM (Accessed: 5 March 2024).
16. Fazelianov, E.M. (2022) 'The Energy Crisis in Europe and Russian Gas Supplies', *Herald of the Russian Academy of Sciences*, 92(Suppl 9), pp. S902–S907. Available at: https://doi.org/10.1134/S1019331622150035.
17. *Fiscal Outlook of the Czech Republic (November 2023)* (2023) *Ministry of Finance CR*. Available at: https://www.mfcr.cz/en/fiscal-policy/macroeconomic-analysis/fiscal-outlook/2023/fiscal-outlook-of-the-czech-republic-nov-53587 (Accessed: 10 September 2024).
18. Fulwood, M. (2021) 'Surging gas prices likely to reverse course', *Financial Times*, 1 October. Available at: https://www.ft.com/content/f2ca6690-0390-4374-a9d5-29caf2d651dd (Accessed: 10 March 2024).
19. *German Stability Programme 2024 - Federal Ministry of Finance - Resources* (2024) *Bundesministerium der Finanzen*. Available at: https://www.bundesfinanzministerium.de/Content/EN/Standardartikel/Press_Room/Publications/Brochures/german-stability-programme-2024.html (Accessed: 20 November 2024).

20. *Germany calls for people to cut energy use as response to Russian threat* (2022) *POLITICO*. Available at: https://www.politico.eu/article/germany-raises-early-alarm-over-gas-supply-after-putins-ruble-threat/ (Accessed: 3 March 2024).
21. Government.no (2023) *The National Budget 2024*, *Government.no*. regjeringen.no. Available at: https://www.regjeringen.no/en/national-budget/2024/id2994174/ (Accessed: 20 October 2024).
22. Horsley, S. (2022) 'In an effort to choke Russian economy, new sanctions target Russia's central bank', *NPR*, 28 February. Available at: https://www.npr.org/2022/02/28/1083580974/in-an-effort-to-choke-russian-economy-new-sanctions-target-russias-central-bank (Accessed: 3 March 2024).
23. *In-depth reviews - European Commission* (2024). Available at: https://economy-finance.ec.europa.eu/economic-and-fiscal-governance/macroeconomic-imbalance-procedure/depth-reviews_en (Accessed: 08 November 2024).
24. Kaitlan Collins, Phil Mattingly, Kevin Liptak and Donald Judd (2022) *White House and EU nations announce expulsion of 'selected Russian banks' from SWIFT | CNN Politics*, *CNN*. Available at: https://www.cnn.com/2022/02/26/politics/biden-ukraine-russia-swift/index.html (Accessed: 3 March 2024).
25. Kamil Dybczak, David Voňka, Nico van der Windt (2008) '*The effect of oil price shocks on the Czech economy - Czech National Bank'.* Available at: https://www.cnb.cz/en/economic-research/research-publications/cnb-working-paper-series/The-effect-of-oil-price-shocks-on-the-Czech-economy-00001 (Accessed: 17 March 2024).
26. Leamer, E.E. (1995) *The Heckscher-Ohlin Model in theory and practice.* Princeton, NJ: International Finance Section, Department of Economic, Princeton Univ (Princeton studies in international finance, 77). Available at https://ies.princeton.edu/pdf/S77.pdf.
27. Mathai, K. (2009) 'Back to Basics: What Is Monetary Policy?', *Finance & Development*, 46(003). Available at: https://doi.org/10.5089/9781451953756.022.A014.
28. McWilliams, B., Sgaravatti, G., Tagliapietra, S. and Zachmann, G. (2022) 'Can Europe survive painlessly without Russian gas?', *Bruegel-Blogs*, 27 Jan, NA, available: https://link.gale.com/apps/doc/A691416106/AONE?u=anon~c40cff93&sid=googleScholar&xid=83a268eb [accessed 02 Mar 2024].

29. OECD (2013) *Fiscal sustainability*. Paris: OECD, pp. 48–49. Available at: https://doi.org/10.1787/gov_glance-2013-11-en.
30. Pedro Bação, João Maia Domingues, António Portugal Duarte, 2012. Financial crisis and domino effect. *Managing Structural Changes-Trends and Requirements. Belgrado: Institute of Economic Sciences*, pp.199-213. Available at: https://www.researchgate.net/publication/317097887_Financial_Crisis_and_Domino_Effect
31. Poljak (6104031aa470a), J. (2022) *'Could Europe replace Russian gas with green hydrogen? Let's look at the numbers'*, *Recharge | Latest renewable energy news*. Available at: https://www.rechargenews.com/energy-transition/could-europe-replace-russian-gas-with-green-hydrogen-lets-look-at-the-numbers/2-1-1212798 (Accessed: 3 March 2024).
32. Presidential decree of the Russian Federation 'About special procedure for execution by foreign buyers of obligations to the Russian suppliers...' (2022) CIS. LEGISLATION. Available at: https://cis-legislation.com/document.fwx?rgn=138826 (Accessed: 3 March 2024).
33. *REPowerEU* (18 May, 2022) *European Commission - European Commission*. Available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3131 (Accessed: 3 March 2024).
34. *Reuters* (2022) 'Gas flows via Yamal-Europe pipeline fall to zero, other flows steady', 29 March. Available at: https://www.reuters.com/business/energy/russian-gas-flows-europe-remain-steady-2022-03-29/ (Accessed: 3 March 2024).
35. Salisu, A.A., Gupta, R. and Olaniran, A. (2023) 'The effect of oil uncertainty shock on real GDP of 33 countries: a global VAR approach', *Applied Economics Letters*, 30(3), pp. 269–274. Available at: https://doi.org/10.1080/13504851.2021.1983134.
36. Stastna, Kazi. (2022) 'Missiles fly, but Ukraine's pipeline network keeps Russian gas flowing to Europe', *CBC News*, 12 April. Available at: https://www.cbc.ca/news/business/russian-gas-europe-1.6415652 (Accessed: 03 March 2024).

37. *Statistics | Eurostat* (2023). *Gas prices for household consumers - bi-annual data (from 2007 onwards)* Available at: https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_202__custom_9836773/default/table (Accessed: 11 March 2024).
38. *Statistics | Eurostat* (2023). *Gas prices for non-household consumers - bi-annual data (from 2007 onwards)* Available at: https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_203__custom_9836727/default/table (Accessed: 11 March 2024).
39. *The European Green Deal - European Commission* (2021). Available at: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en (Accessed: 6 March 2024).
40. Ting Lan, Galen Sher and Jing Zhou (2022) *The Economic Impacts on Germany of a Potential Russian Gas Shutoff*, *IMF*. Available at: https://www.imf.org/en/Publications/WP/Issues/2022/07/18/The-Economic-Impacts-on-Germany-of-a-Potential-Russian-Gas-Shutoff-520931 (Accessed: 1 January 2024).
41. Turner, D. and Spinelli, F. (2013) 'Interest-rate-growth differentials and government debt dynamics', *OECD Journal: Economic Studies*, 2012(1), pp. 103–122. Available at: https://doi.org/10.1787/eco_studies-2012-5k912k0zkhf8.
42. Yildirim, Z. and Yaşa, A.A. (2014) 'The Relation between the Budget Deficit and Energy Demand in the Selected European Countries and Turkey: Panel Cointegration Analysis', *International Journal of Trade, Economics and Finance*, 5(6), pp. 482–489. Available at: https://doi.org/10.7763/IJTEF.2014.V5.420.