

**UNIVERSITY
OF
LUSAKA**

School of Postgraduate Studies

**AN ANALYSIS ON THE IMPACT OF FDI ON MINING, MINING TAXATION
AND ECONOMIC GROWTH ON MINERAL DEPLETION OF THE
EXTRACTIVE INDUSTRY IN ZAMBIA**

BY

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A dissertation submitted to the school of Postgraduate Studies, University of Lusaka in partial fulfillment of the award of the Master of Science in Business Administration and Finance.

@2024.

DECLARATION

I, **MARTHA BWALYA CHANDA** do hereby declare that the contents of the study are my original work and that to the best of my knowledge have not been previously presented for any award in any other University. All the sources of information used in this piece of work have been dully acknowledge.

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DEDICATION

This thesis is dedicated to God Almighty, who means everything to me. To all individuals who have felt like giving up owing to completion delays caused by funds and other restraints, remember that delay is not denial; keep pressing on! To my family: my incredible husband, Eng. Lewis Mvula, who has provided constant support and encouragement in every manner conceivable. To my amazing mother, Dr. Grace Lushinga, who taught me the importance of education and hard work and has been my foundation and motivation throughout my journey. To my siblings, my brother and his wife, Mr. and Mrs. Chanda, and Musonda Mazingaliwa, who have continuously supported and encouraged me during this journey and to my friends Zammy and Tasha who provided constant encouragement and a listening ear. And to my mentors Mr. Roy and advisors, whose guidance and wisdom have been invaluable. This work is a testament to your belief in me. Thank you.

ACKNOWLEDGEMENTS

I would like to convey my heartfelt thankfulness to God, who has given me the strength, guidance, and insight to carry out this task. I am also grateful to everyone who has helped and mentored me through the completion of this dissertation.

I am extremely thankful to my supervisor, Dr. Joseph Musonda, for his helpful instruction, insightful critique, and ongoing support. Their experience and encouragement helped shape this research.

My greatest gratitude goes to the several industry professionals, government officials, and stakeholders in Zambia's extractive industry who kindly volunteered their time, knowledge, and data, which were critical to this study.

Finally, I am grateful to my family and friends for their continuous support, patience, and encouragement during this journey. Your belief in me has been a constant source of motivation.

Thank you all for your contributions to this work.

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ABSTRACT

As a country endowed with abundant mineral resources, Zambia's mining industry holds significant potential for driving economic development and fostering prosperity (Mbilima, 2021). However, the relationship between FDI inflows, taxation regimes, and overall economic growth in this sector needs a comprehensive analysis to understand their impact and implications. Therefore, this study examined trends of FDI, evaluating how these investments made an impact on mining taxation, and economic growth.

This study used a quantitative research approach for data collection meaning that quantitative data was gathered which included historic data on mineral depletion, mining taxation, mining FDI and economic indicators such as GDP per capita.

Further, the study utilized a descriptive research design to achieve its goals and adhere to the quantitative research methodology by employing econometric models to analyse the relationship between FDI, mining tax and economic growth. The study made use of E-Views statistical analysis package for the purpose of data analysis and opted to make use of a regression analysis, given the objectives of the study. Diagnostic tests were run to test for multicollinearity, heteroscedasticity, model specification and goodness of fit of the model. The key variables included FDI inflows, effective tax rates, extractive industry outputs and GDP growth.

The study found that in the short run taxation with a lag of one period had a negative effect on the mining sector, with the lack of an effect in the long run. FDI was found to have a statistically significant positive effect on the mining sector in the short run. However, in the long run FDI did not have a statistically significant effect on the mining sector.

By comparing Zambia's experience with other resource rich countries globally and in the African context, the research provides valuable insights concerning FDI in the extractive industry. By understanding these dynamics, policy makers can design effective strategies to enhance substantial mining practices, attract FDI and promote economic growth.

CHAPTER ONE

INTRODUCTION AND BACKGROUND

1.1 Introduction

This chapter provides a synopsis of the relationship between Foreign Direct Investment (FDI), taxation policies, and economic growth as pivotal factors shaping the landscape of the mining sector in Zambia. Further this chapter highlights the objectives, research questions, significance of the study, the definition of key terms and concepts.

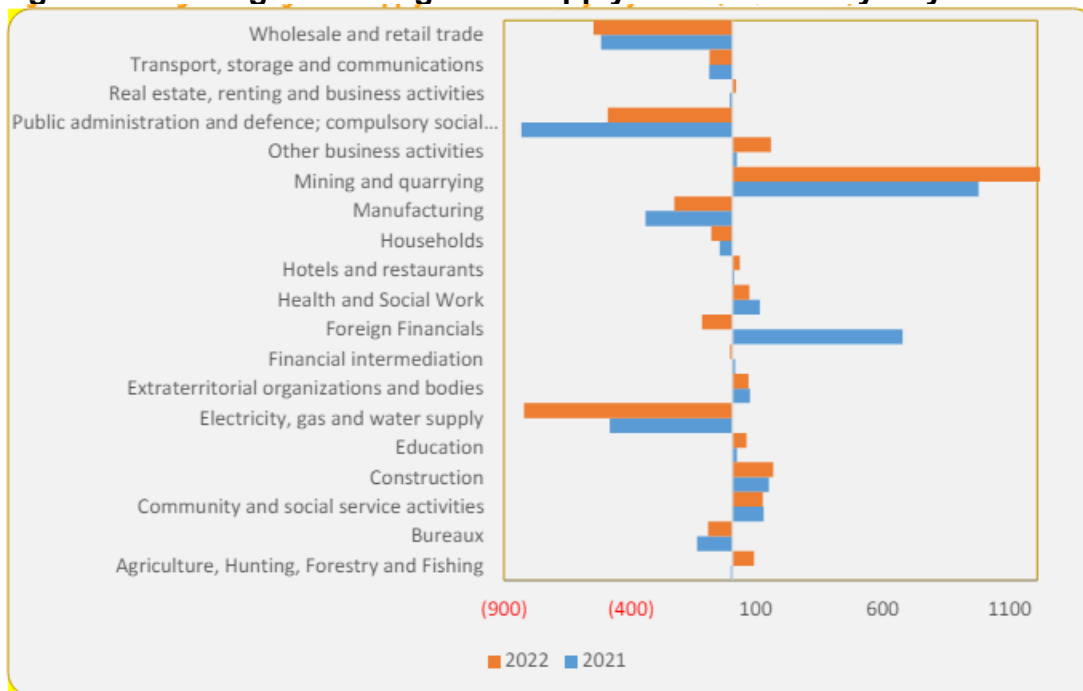
1.2 Background

Zambia's mining sector has long been a cornerstone of its economy, accounting for a substantial portion of export earnings and government revenue (Phiri, 2019). The country boasts abundant reserves of copper, cobalt, and other valuable minerals, attracting significant interest from both domestic and foreign investors (Signé & Johnson, 2021). Zambia is heavily dependent on mining, which produced 44% of government revenue and 72% of overall export earnings in 2022. Zambia is the second-largest producer of copper in Africa. Over the past few decades, Zambia's mining taxes policy have seen several modifications (Extractive Industries Transparency Initiative, 2024).

Over the years, FDI has played a crucial role in financing mining projects, facilitating technology transfer, and stimulating growth in this sector (Koyi, 2011). However, it can be added that alongside the benefits brought by FDI, challenges have emerged, particularly in the realm of taxation. Tax policies governing the mining industry have undergone revisions aimed at balancing revenue generation for the government and creating a conducive environment for investment. The effectiveness of these taxation measures in achieving their intended objectives while fostering sustainable growth remains a subject of debate and scrutiny (Unceta, 2021). Furthermore, it can be outlined that the broader macroeconomic context, including factors such as GDP growth, inflation rates, and exchange rate stability, influences the performance of the mining sector. Economic growth is both a driver and an outcome of mining activities, making it essential to examine its relationship with FDI and taxation to gauge their combined impact comprehensively (Ennin & Wiafe, 2023).

It can be outlined that despite the potential benefits, the impact of investment in the mining sector in Zambia has been marred by a range of challenges and complexities (Mbilima, 2021). Concerns have emerged regarding the equitable distribution of wealth and the extent to which local communities directly benefit from these investments. Environmental degradation, arising from the extractive activities, has also raised alarms, leading to debates around sustainable practices and the need for stringent regulatory frameworks to mitigate negative ecological consequences. Moreover, issues related to tax evasion, transfer pricing, and corporate social responsibility have underscored the importance of ensuring transparency and accountability within the sector (United Nations, 2006). These multidimensional challenges have highlighted the necessity of striking a balance between maximizing the economic advantages of investment in the mining sector and safeguarding the long-term socio-environmental well-being of Zambia and its people.

Figure 0.1: Foreign Exchange Net Supply and Demand by Key Sectors



Source: Ministry of Finance and National Planning (2023)

1.3 Statement of the problem

Despite the significance of the mining sector to Zambia's economy, several pressing issues persist, necessitating a deeper understanding of their underlying dynamics. It can be outlined that the fluctuating patterns of FDI inflows into the mining sector require closer examination to identify the factors driving investment decisions, the sectors benefiting the most, and potential barriers hindering optimal investment

(Mkonyi, Macheru, & Ayako, 2022). The factors tend to result in instability in the Zambian economy. Further, Zambia's tax regime for the mining sector has faced criticism for being complex and sometimes perceived as unfavorable to investors as outlined by Lundstøl and Isaksen (2018). This raises questions about the effectiveness of current tax policies in striking a balance between revenue generation and investment attractiveness. Especially given the importance of the mining sector to the Zambian economy which has been noted by PMRC (2021) a major driver of economic growth, contributing 12 percent to GDP. The Ministry of Finance (MOF) note that foreign exchange supply for the periods of 2021 and 2022 was largely from the mining sector as outlined in figure 1.1 above (Ministry of Finance and National Planning, 2023). Furthermore, Morisset (2001) outlined that understanding the intricate relationship between FDI, taxation, and economic growth is crucial for formulating policies that promote sustainable development in the mining sector while ensuring broader economic benefits for countries in the sub-Saharan region, such as Zambia. Therefore, addressing these challenges necessitates a holistic analysis that considers the interplay between FDI, taxation policies, and economic growth within the context of Zambia's extractive industry. This research endeavored to fill this gap by providing empirical insights and policy recommendations to guide stakeholders in navigating the complexities of this vital industry.

1.4 Research Objectives

1.4.1 Main objective

To analyze the impact of FDI on mining, mining taxation and economic growth on mineral depletion of the extractive industry in Zambia

1.4.2 Specific objectives

- i. To determine the effect of mining FDI on mineral depletion of the extractive industry in Zambia;
- ii. To establish the effect of mining taxation on mineral depletion of the extractive industry in Zambia;
- iii. To determine the effect of economic growth on mineral depletion of the extractive industry in Zambia.

1.5 Research Questions

- i. What is the effect of mining FDI on mineral depletion of the extractive industry in Zambia?

- ii. What is the effect of mining taxation on mineral depletion of the extractive industry in Zambia?
- iii. What is the effect of economic growth on mineral depletion of the extractive industry in Zambia?

1.6 Research Hypothesis

- i. Ho: There is no effect of mining FDI on mineral depletion of the extractive industry in Zambia
H₁: There is a positive effect of mining FDI on mineral depletion of the extractive industry in Zambia
- ii. Ho: There is no effect of mining taxation on mineral depletion of the extractive industry in Zambia
H₁: There is a negative effect of mining taxation on mineral depletion of the extractive industry in Zambia
- iii. Ho: There is no effect of economic growth on mineral depletion of the extractive industry in Zambia.
H₁: There is a positive effect of economic growth on mineral depletion of the extractive industry in Zambia.

1.7 Significance of the study

The significance of the study is that it considers how key economic variables have impacted the extractive industry in Zambia and therefore informs policy and adds to literature on the subject; providing a further understanding on the macroeconomic relationships in order to ensure continued growth of the economy so as to contribute to the body of knowledge.

1.8 Scope of the study

The study considered data from the extractive industry in Zambia. The data that was considered was secondary time-series data that ranged from 1990 to 2020. The variables considered in the study were mineral depletion as the dependent variable and economic growth, FDI and mineral tax as the independent variables.

1.9 Definition of key terms and concepts

Listed below is the definition of the key terms and concepts utilized throughout the study;

i. Foreign Direct Investment

Foreign direct investment (FDI) refers to the investment made by a company or individual in one country into business interests located in another country, with the objective of establishing a lasting interest and exerting a significant degree of influence on the management and operations of the foreign enterprise.

ii. Mineral Depletion

This is the reduction or gradual loss of essential minerals from the Earth's crust, soil or ecosystem as a result of human activities such as mining and agriculture as well as natural processes leading to reduced resource availability and soil fertility.

iii. Mining Sector

The cluster of process that are involved with extraction, management, and processing of naturally occurring solid minerals from the earth surface.

iv. Taxation

This is the compulsory financial charge or some other type of levy imposed upon a taxpayer (an individual or legal entity) by a governmental organization in order to fund various public expenditures.

v. Economic Growth

This is an increase in the capacity of an economy to produce goods and services, compared from one period of time to another. It can be measured in nominal or real terms, the latter of which is adjusted for inflation.

1.10 Chapter Summary

This research paper aimed to delve into the intricate relationship between FDI, taxation, economic growth, and their effects on the mining sector in Zambia. By examining these variables, the study seeks to provide insights that can inform policymakers, investors, and stakeholders on strategies for optimizing the contribution of the mining sector to Zambia's socio-economic advancement.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the literature reviewed in the study. The chapter outlines empirical literature, theoretical literature and the conceptual framework of the study. On the theoretical framework, the chapter considers theories that are centered on the research main objective and the specific research objectives. The empirical literature review considers similar studies done on the subject by different scholars to provide context.

2.2 Theoretical Framework

2.2.1 Resource Curse Theory

This study uses the Resource Curse Theory to investigate potential negative outcomes, like rent-seeking behavior and Dutch Disease (the unfavorable effects that can result from a spike in a country's currency value). The study looks at how FDI, taxes, and economic growth affect Zambia's extractive industry. The Resource Curse argument states that countries with plentiful natural resources—such as oil or minerals—generally grow and develop their economies more slowly than those with scarcer resources. This dilemma results from a number of things, such as over-reliance on erratic commodity prices, corruption, and poor resource revenue management.

Resource-rich nations may be subject to a "curse" brought on by events such as the Dutch Disease, in which an infusion of capital from resource sales causes currency appreciation and a downturn in other industries like manufacturing and agriculture. Furthermore, a wealth of natural resources can encourage political elites to engage in rent-seeking and corruption, which would undermine government and exacerbate inequality. In order to ensure that resource wealth translates into long-term economic prosperity for all citizens, countries must invest in diversification strategies, promote sustainable resource management practices, and implement transparent governance mechanisms to mitigate the negative effects of the resource curse (Badeeb, Lean, & Clark, 2017).

2.2.2 Resource-Based Development Theory

The Resource-Based Development theory was used in the study in order to evaluate solutions for sustainable resource management, with a focus on the

importance of investing in diversification and good governance. It can be outlined that according to the Resource-Based Development theory, it is possible to effectively utilize natural resources to support development and growth of the economy in a sustainable manner. In contrast to the Resource Curse Theory, this viewpoint places a strong emphasis on the necessity of transparent institutions, strategic policies, and excellent governance in order to maximize the advantages of resource extraction. Natural resource-rich nations can invest in infrastructure, education, and other productive fields with the money made from resource extraction, promoting economic diversity and lowering poverty. Responsible use of a nation's natural wealth can spur industrialization, increase employment, and raise living conditions for the populace. The Resource-Based Development Theory emphasizes the necessity of managing natural resources responsibly and making sure that the proceeds fund programs that support equitable development and long-term economic resilience (Miemczyk, Howard, & Johnsen, 2016).

2.2.3 Dependency Theory

The Dependency Theory was considered in the study as it provides an explanation on how developing countries' reliance on selling raw materials, whether minerals or agricultural products, to industrialized nations has left them fundamentally disadvantaged in the global economy. This theory contends that this reliance upholds global economic inequality and feeds a cycle of underdevelopment. Developing countries often face unequal terms of trade, where the prices of their primary exports are dictated by more powerful nations, leading to limited economic diversification and industrialization. Additionally, the need for foreign capital and technology further entrenches their dependence on developed countries. Dependency theorists advocate for policies aimed at reducing dependency, such as import substitution industrialization and promoting regional economic integration. They stress that in order to achieve self-sustaining prosperity and reduce poverty, developing countries must be given the authority to exert sovereignty over their resources and economic policies (Emmanuel, 2023).

2.2.4 Different Regional Perspectives on Mining

2.2.4.1 Global Perspective on Mining

Notwithstanding the long-lasting impacts of the COVID-19 pandemic on businesses worldwide and some volatility in metals prices in the middle of 2022, the global mining

economy started the year on the upswing and continued to make significant contributions to the global economy. Through ongoing pandemic recovery efforts, the mining industry has shown its continued resilience over the past year. Trends in the mining industry today include potential for the shift to renewable energy and an increasing emphasis on the ESG commitments made by mining corporations. It is stated that a sizeable amount of the Canadian economy is derived from the mining industry. (Cassels Brock & Blackwell LLP, 2023).

2.2.4.2 North America and Greenland

One significant contributor to Mexico's GDP (gross domestic product) is the mining sector. Furthermore, the social advantages of mining extended throughout the nation, attracting foreign investment to Mexico. Gold, basalt, quarry aggregate, silver, lead, copper, coal, zinc, and limestone are the minerals that are the objective. Molybdenum, zinc, manganese, lead, copper, cadmium, selenium, silver, bismuth, gold, barite, bentonite, celestite, fluorite, wollastonite, magnesium sulfate, coal, and gypsum are just a few of the minerals whose output has significantly increased in the last few years. Furthermore, as attention around the globe shifts to battery metals. The Mexican president declared his intention to nationalize the country's lithium reserves and signed an executive order creating LitoMX, also known as Litio para Mexico, to oversee the exploration, mining, and refining of lithium across the country's borders as well as the control of the commodity's economic value chains. The exact methods of accomplishing this task have not yet been decided. Additionally, it is unknown how this revelation will impact businesses that have lithium concessions at the time of its release (Cassels Brock & Blackwell LLP, 2023).

The production of metal mine products, primarily copper, zinc, iron ore, and gold, is a major economic driver in the United States. The US economy also heavily depends on the production of industrial minerals, namely crushed stone, cement, and construction sand and gravel. Ilmenite, molybdenum, colored corundum (ruby and pink sapphires), eudialyte (zirconium and rare-earth elements), diamonds, iron, lead, zinc, nickel, and gold are the target minerals in Greenland. As the ice melts in Greenland and exposes possible nickel and cobalt deposits, there has been a surge in interest in minerals used in battery technology or renewable energy. Just two mines have started production out of the seven exploitation licences that are already in place (Cassels Brock & Blackwell LLP, 2023).

2.2.4.3 South America

Latin American economies rely heavily on mining. Along with large potash and lithium reserves, the region has numerous reserves of gold, silver, copper, and zinc. The area has witnessed a significant increase in foreign direct investment recently due to its wealth of natural resources. In the current global economy, the region has the potential for growth that is promising. For instance, a large number of Chinese businesses have made investments in Latin America. Mining is the fifth-largest exporter in Argentina and has experienced some of the fastest growth of any industry. The primary target minerals are copper, gold, silver, and lithium; other minerals include lead, molybdenum, zinc, iron, aluminum, uranium, boron, and potash. Argentina is one of the largest producers of lithium in the world, and the increasing global trend regarding battery minerals has also taken place in Argentina (Cassels Brock & Blackwell LLP, 2023).

An important part of Brazil's economy is the mining sector. Since 2006, there has been a rise in the extraction of minerals; production peaked in 2011. Although they are still high, mining profits have recently decreased, mostly as a result of the fall in the price of mineral commodities, especially iron ore, which makes up the majority of Brazil's mineral production. Brazil is home to a wide variety of metallic and non-metallic minerals found in its geology, some of which—such as tantalite, niobium, and lithium—have become more significant due to recent advancements in technology. Iron ore, bauxite, aluminum, niobium, copper, manganese, kaolin, gold, and other minerals are the target minerals. Brazil has been actively prospecting for rare-earth reserves, and if some of the projects in the southeast of the country work out, there will probably be more interest in these minerals (Cassels Brock & Blackwell LLP, 2023).

The mining sector is the most important economic sector in Chile. The nation's regular taxes and charges, along with royalties, account for a significant amount of its revenue. Chile has ideal mining opportunities in terms of both geography and geology. Even though copper is the primary metallic target mineral, the nation also has other projects involving molybdenum, gold, silver, zinc, lead, and iron. Among the most important non-metallic minerals are lithium and nitrate. Article 27 was a proposal put up by the newly elected Chilean government in 2022 to nationalize the country's lithium and copper sectors. Nevertheless, the Chilean constitutional assembly rejected the idea (Cassels Brock & Blackwell LLP, 2023).

2.2.4.4 Asia and Australasia

Japan relies heavily on a number of minerals. For a "specified mineral," the government will designate each specified area through a tender bid process. The mining right for that particular defined region will be awarded to the most competitive bidder. Oil and combustible natural gas are among the specified minerals; gold, silver, copper, lead, bismuth, tin, antimony, mercury, zinc, iron, iron sulfide, manganese, tungsten, nickel, cobalt, uranium, thorium, and barites, which are hydrothermal deposits found subsea or beneath the sea; copper, lead, zinc, iron, manganese, tungsten, molybdenum, nickel, and cobalt ore; and asphalt (Cassels Brock & Blackwell LLP, 2023).

Given that India is one of the biggest exporters of iron ore, chromite, bauxite, mica, and manganese, mining is a significant economic activity in the nation. With a number of public-sector enterprises, the government holds the largest stake in the domestic mining sector. Since much of the nation's potential mineral resources have not yet been completely explored, the government has also started a number of reforms to permit greater private sector participation in mineral activity. India is a major producer of metallic minerals such as chromite, iron ore, zinc, bauxite, manganese, aluminum, and copper. It also produces a wide variety of non-metallic, fuel, and atomic minerals (Cassels Brock & Blackwell LLP, 2023).

2.2.4.5 Mining in Africa

With large quantities of diamonds, iron ore, phosphates, copper, gold, and manganese, among other natural resources, Angola is a resource-rich country. Angola was once a significant producer of iron ore, gold, and copper. However, after gaining independence in 1975 and lasting for over 30 years, the country's mineral growth was severely hindered (except from the diamond industry). The civil war ended in 2002. Since then, Angola has carried out substantial mining and exploration initiatives in addition to resuming mineral extraction. But the full mining potential of the nation is still untapped. Target minerals these days include copper, manganese, gold, iron ore, and diamonds. Additionally, the nation is dedicated to expanding its investment portfolio in industrial and construction mineral resources, such as quartz, granite, and marble. The primary minerals mined in the Democratic Republic of the Congo include cobalt, coltan, copper, gold, diamonds, zinc, cassiterite, and wolframite. Being the backbone of the national economy and a significant contributor to GDP, the mining

sector is significant to the nation. Cobalt, copper, zinc, diamonds, gold, tin, and manganese are the target minerals.

The mining industry contributes significantly to Ghana's domestic GDP, and the industry's overall fiscal receipts have grown recently. Additionally, the overall number of workers employed by mining enterprises has increased. Furthermore, the mining industry is essential to luring foreign capital into Ghana. Gold makes up the vast bulk of the mining sector's activity and earnings, with diamonds, bauxite, and manganese being the other significant minerals extracted. Following a prefeasibility study on the Ewoyaa lithium project in 2022, Ghana is also expected to become the first lithium producer in West Africa (Cassels Brock & Blackwell LLP, 2023).

Mining is a key economic engine in Mozambique, and its share of the country's GDP keeps rising. In an effort to replenish its low foreign exchange reserves, the nation has been creating a program to promote the export of minerals. Senior industry participants from Australia, Brazil, India, Russia, and South Africa have consequently bought stakes in a variety of mining regions throughout the nation. Investor interest has also been piqued by minerals utilized in battery technology, such as graphite, graphene, and vanadium. One of the biggest aluminum smelters in the world as well as one of the biggest producers of tantalite and beryllium is located in Mozambique. The nation also has high-grade bauxite, titanium, iron ore, copper, lead, and heavy mineral sands. Though production has declined recently, the province of Tete is recognized as having one of the greatest coal reserves in the world (Cassels Brock & Blackwell LLP, 2023).

The mining industry is a major driver of the South African economy. With abundant resources of manganese, chromium, gold, platinum group metals, and aluminosilicates, South Africa contributes significantly to global production of ferro-chromium, platinum group metals, vanadium, and aluminosilicate exports. It is also one of the world's top exporters of gold, vanadium, and platinum group metals. Large amounts of high-grade manganese ore as well as deposits of copper, zinc, iron, coal, and diamonds can be found in South Africa. The production of manganese in South Africa has expanded due to the rising global demand for this element, which is essential for the creation of lithium-ion batteries (Cassels Brock & Blackwell LLP, 2023).

Mining has a lengthy history in Zambia, mostly focused on copper and cobalt. Due to its reputation for having high-grade deposits, the Copperbelt Province has historically seen a concentration of mine development. Small-scale resources of coal, zinc, manganese, and gold are also present throughout the nation. Recently, the scope of exploration has increased to include prospecting for diamonds, uranium, and nickel. Zambia is a top producer of premium stones and is also well-known for its gemstones. Recently, significant coal-bed methane resources have been found through exploration. Base metals, platinum group metals, uranium, and gold are the principal target minerals. Nonetheless, there has been a rise in the use of exploration for manganese, lead, zinc, and cobalt mining (Cassels Brock & Blackwell LLP, 2023).

2.3 Empirical Literature

2.3.1 Mining Sector and Economic Growth

Mtiki (2022) examined natural resource management and the relationships between macroeconomic performance and copper pricing in Zambia and Chile, two copper-rich nations with different histories. It examined mining's non-fiscal benefits as well as fiscal strategies and tax regimes. The macroeconomic performance of the two nations, as well as the macroeconomic volatility that exists both inside and outside of them and may have domestic origins, were compared using eleven measures. Based on the indicators, it was discovered that the economy of Zambia is comparatively more impacted by changes in copper prices than the economy of Chile. The fact that Zambia has higher levels of macroeconomic uncertainty both internally and externally than Chile demonstrates the negative impact Zambia's populism-driven policy inconsistencies have on the country's economy.

Nasir (2020) studied the North Morowali, Central Sulawesi, Indonesia mining sector's economic potential and the creation of business-friendly regional development management, which intended to foster collaboration between the local government and mining industry entrepreneurs. The research employed a descriptive qualitative methodology, utilizing primary data from focus group discussions and secondary data observations from the North Morowali, Indonesia statistical office. The study indicated that although mining potential has not been fully utilized, all mining products have a great deal of promise as a financing unit in North Morowali. The reasons for the challenges in optimizing and gaining access to mining products exploration are the

lack of guidelines, infrastructure including roads, and efficient land and water transportation.

According to Aksoy, Konuk, and Ak (2020), the mining industry has contributed significantly to the recent and historical economic expansion of industrialized nations with abundant natural resources. They therefore made the case that it is crucial for emerging nations' economies to grow. They go on to say that because the mining industry fuels the expansion of other connected industries, it is typically backed by incentives. They point out that the most significant tool used by governments to impose economic policies and accelerate economic growth in both rich and developing nations is incentives. The report also pointed out that the incentives or supports provided by the Turkish government to boost mining investments fall into two categories: those that fall under the Investment Incentive Program and those that are based on the Turkish Mining Law. Regression analysis and the Granger Causality Test were thus used to examine the impact of investment incentives given to Turkey's mining industry between 2001 and 2017 on the mining production index (MPI) and their indirect effect on GDP. The analysis made use of information on the total amount of fixed investment as well as the number of investment incentive certificates that companies in the mining sector had obtained. The results of this study showed that, in just a single year, providing incentives to companies in the mining sector to increase their fixed investments had a considerable and favorable effect on GDP and MPI. Nevertheless, the incentives given to the mining industry did not cause the mine's production index to rise in tandem with the GDP.

According to Taušová et al. (2017), mining activities are dispersed throughout the globe. They also point out that it continues to evolve and endures for many decades in Slovakia. It should be emphasized that the mining sector is constantly growing on all continents. The growing need for raw materials is given as the explanation. The most significant aspect of the mining sector, which generates raw materials valued at hundreds of millions of euros annually in Slovakia alone, is the procurement of mineral raw materials. The study found that a wide range of state and regional variables are impacted by the mining industry, both directly and indirectly. The sector raises the value of the gross domestic product, influences wages, and encourages employment. Notwithstanding the study's many advantages, it contended that lawmakers and the general public are generally concerned about the detrimental impacts of mining

operations. The study's contribution focused on analyzing the mining industry's impact in Slovakia while taking socioeconomic indices into account. The study's comprehensive perspective on Slovakia's mining industry was created through the use of regression and correlation analysis, which made it possible to identify regional dependencies. The study came to a conclusion about the impact of mining operations in Slovakia and the surrounding areas with the aid of these assessments. The contribution's objective was to assess how mining activities affected the creation of socioeconomic indices for each region in Slovakia. We shall do correlation analysis because the reliance of the individual indicators at the level of Slovakia and the other nations is being compared. The findings at the national level for Slovakia demonstrated the strongest correlation between GDP, average salary, employment, and mining earnings.

Awolusi (2016) investigated the relationship between mineral resource endowment and economic growth in the Southern African economies, using a panel dataset of 14 countries in the Southern African Development Community (SADC) from 1990 to 2014. The empirical methodology involved the use of Ordinary Least Squares (OLS) and Generalized Method of Moments (GMM) as the estimation techniques. The study found that real growth in services, real growth of manufacturing, real growth of agriculture, real growth of mining, human capital development, infrastructural development, trade openness, and growth in foreign direct investment are important determinants of economic growth in Southern African economies during the study period.

2.3.2 Mining Sector and FDI

In a study published by Alfar, Elheddad, and Doytch (2024) examined the effects of violence on greenfield FDI in the mining industry for a period spanning 151 nations and the first quarter of 2003 to the third quarter of 2017. The paper suggested to concentrate on testing two impacts, in contrast to earlier efforts. To find the influence of conflict on FDI over the current and future yearly quarters, the study first looked for a dynamic impact. The study also looks for a spatial spillover effect. Using a special proprietary database called FDI-Markets, the study used both an event study analysis and a panel geographical technique to accomplish these goals. The primary conclusions were as follows: First, the likelihood of a dynamic impact varies with the level of conflict intensity for that specific nation group; higher levels of conflict intensity

are linked to a higher likelihood of a dynamic impact. Secondly, the research discovered a noteworthy adverse spillover effect between foreign direct investment (FDI) in greenfield mining from adjacent nations and the FDI-receiving economy. However, the study did not find that FDI in greenfield mining of the FDI-receiving economy was spatially spillover by conflict in surrounding countries.

Ennin and Wiafe (2023) in their study investigated the impact of mining foreign direct investment on economic growth in Ghana using quarterly time series data from 1996–2015. The study employed the Autoregressive Distributed Lag bounds testing approach to cointegration and the error correction model to investigate the existence of a long-run and short-run equilibrium relationship between foreign direct investment into the mining sector and economic growth. The study established that foreign direct investment into the mining sector hurts economic growth in Ghana in the long run but a positive in the short run. The study also found that private sector credit, capital stock, government spending, and labor participation rate have a statistically significant positive relationship with economic growth in the long run. Trade openness exhibited a statistically significant negative long-run relationship with economic growth, while inflation had a positive but insignificant impact on economic growth for the study period. The study recommended that government should encourage research and development in the mining sector and align mining and other environmental policies to ensure sustainable growth. It was further recommended that government tactfully provide investment incentives to ensure the development of other sectors to avoid the Dutch disease.

Yang, Xing, & Hou (2020) examined the risk factors that affect foreign direct investment (FDI) in Mongolia's mining sector. By applying the complex network approach, the study obtained the importance and ranking of each risk factor. Further, the study divided these risk factors into three levels. The first level included government stability, business regulations, and so on, while the second level included culture and religion, transportation cost, and so on. The third level included electricity supply, GDP, and so forth. The results of the analysis of the study suggested that foreign companies should focus on first and second level risk factors, while also giving due consideration to third level risk factors.

A comprehensive review of empirical literature on the impact of foreign direct investment (FDI) in Zambia's extractive industry revealed a nuanced understanding of

the sector's dynamics and the associated implications for the country's economic and social landscape. Several studies, such as those conducted by Mubanga and Simatele (2017) and Banda et al. (2019), emphasized the pivotal role of FDI in fostering technological advancement and infrastructural development within Zambia's mining sector. These studies highlighted how FDI has led to the introduction of modern mining technologies, thereby improving production efficiency and enhancing the sector's overall competitiveness in the global market. Additionally, researchers such as (Limpitlaw, 2018) have underscored the positive impact of FDI in promoting job creation and skill development, thereby contributing to the alleviation of unemployment and the enhancement of human capital within the extractive industry.

However, the empirical literature also shed light on the challenges posed by FDI in Zambia's extractive industry. Research by Mwiya and Tshuma (2016) and Ng'andu and Mulenga (2020) pointed to the persistent concerns regarding the equitable distribution of wealth and the local communities' limited access to the benefits derived from foreign investments. These studies highlighted the need for robust regulatory mechanisms and transparent governance structures to ensure that FDI translates into tangible socio-economic development and inclusive growth at the grassroots level. Furthermore, scholarly work by Mwape and Mwitwa (2018) and Tembo and Nkhata (2021) underscored the environmental consequences of FDI in the extractive industry, stressing the urgency of implementing sustainable mining practices and stringent environmental regulations to mitigate the adverse effects of mining activities on Zambia's natural ecosystems and biodiversity.

Ilboudo (2014) in their paper investigated the impact of Foreign Direct Investment (FDI) on the Total Factor Productivity (TFP) in the Mining Sector of Chile. The study made use of the Solow model and developed a Cobb-Douglas production function to estimate total output as a function of labor, capital and productivity. Hence, TFP was the portion of output that was not attributed to labor or capital and it was derived as the Solow 'residual'. The study estimated the capital variable as a function of capital stock corrected for depreciation and utilization rate. The study further derived the labor variable as a function of hours worked corrected for quality (education premium). The study found that FDI was positively correlated with TFP and it was statistically significant in most cases. The relation was more significant when the variations in the price of copper are included in the regression.

Vivoda (2011) in their paper assessed the conditions that influence foreign direct investment in the mineral industries of China and India. The paper first surveyed literature on the determinants of foreign direct investment to identify key conditions, under which host countries attract mining FDI. It then built an evaluative framework which allowed for comparative analysis. The paper then comparatively evaluated the performance of foreign investment regimes that govern mineral industries in China and India. The findings of the study showed that the overall conditions for foreign mining investment in China and India were not favorable and that substantial policy, regulatory and other changes in both countries need to be made if more investment is to flow.

2.3.3 Mining Sector and Taxation

The development of an economic mechanism for environmental management that guarantees adherence to the principles of rational resource consumption through the creation of environmental taxation tools is one of the issues with the sustainable development of mineral resource clusters, according to Tyuleneva and Moldazhanov (2020). This research paper outlines the ways in which environmental taxes are being used to implement sustainable development. These strategies include environmental taxes, encouraging the wise use of natural resources, applying environmental technologies, and supporting the use of alternative energy sources, such as by setting up trading quotas on emissions into the environment. The applicability of these strategies in the Russian Federation and the mining region is also assessed. Furthermore, the study conducted in the Kemerovo region included a comparative analysis of the dynamics of relative indicators of production activity, the costs associated with mitigating its negative effects on the environment, and it supported the need for environmental taxation tools to ensure the region's sustainable development. In their article, Hilson (2019) critically evaluated the situation of development driven by the mining sector in sub-Saharan Africa. It stated that policies are "biased" in favor of large-scale extraction in the majority of the region's governments. Officials from the World Bank have long argued that the large-scale mines in sub-Saharan Africa that are funded and run by multinational corporations based outside have the potential to develop into "growth poles" that significantly boost economic growth. The article points out that in order for this to occur, though, drastically different policy approaches will be

required—changes that the governments in the region have not demonstrated much interest in pursuing thus far.

According to Laporte, De Quatrebarbes, and Bouterige (2017), it is simple to claim that Africa lacks knowledge regarding the distribution of mining resource rent between investors and governments. According to the study, the academic and operational approaches have been limited since the available statistics are frequently insufficient for a thorough analysis of African tax legislation as it relates to the natural resource sectors. The first legal and tax database, which details the tax laws that apply to industrial gold mining enterprises in 14 gold-producing African nations between 1980 and 2015, was outlined in the study. Notably, the databases had three significant innovations: (i) a list of all taxes and duties (rate, base, and exemptions) that must be paid for a gold project's prospecting and mining phases; (ii) a fresh, comprehensive history record spanning the years 1980 to 2015; (iii) the connection between every tax record and its official source. A preliminary examination of rent sharing and mining tax regimes in the major gold-producing nations was conducted using this database. The first set of findings emphasized how different tax laws are between nations that speak English and those that speak French. The study observes that most nations have experienced a convergence of their average effective tax rates, with an increase in effective tax rates in the majority of these countries as a result of tax reforms implemented since 2010.

The purpose of the Kulczycka et al. (2017) study was to examine how taxes affect resource appraisal in Polish copper mines that are currently in operation and to evaluate the medium- to long-term implications for investors and the government. According to the report, new taxes and royalties included in the total tax burden have a positive effect on municipal and state budgets. However, they contended further that mining corporations' incentives to invest are likely to be diminished by increased taxation levels. According to the study, one of the most important things for investors to consider at different stages of a project is the possibility of taxes. As a result, the report contended that taxes have a major impact on both ongoing operations and the discovery of new natural resources in Poland. They also mention that it has brought about new difficulties because of the non-linear nature of the new tax, which is only applied to copper and silver extraction and is significantly greater than other taxes.

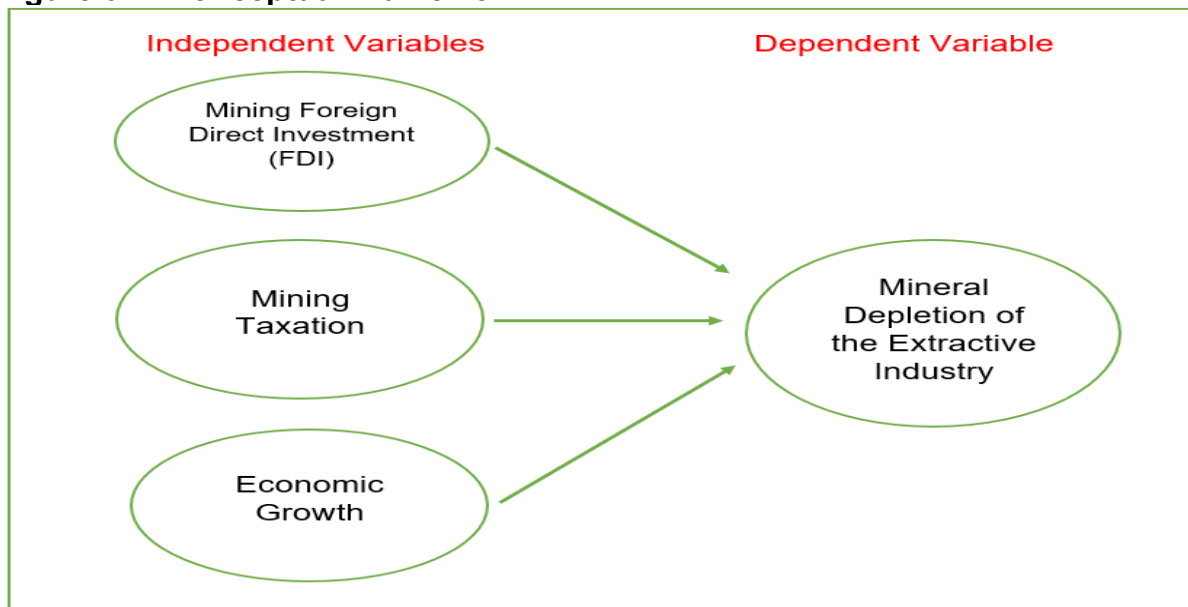
Reducing the profits ceiling can lead to a decline in exploratory efforts as well as the cancellation of some new investments in Poland.

According to Besa and Banda (2016), mineral taxes is an important revenue-raising exercise for all governments. According to the study, the established tax structure must find a balance between serving the revenue needs of both the government and mining companies. Therefore, before implementing a tax system, it's important to consider the benefits and drawbacks for both the government and mining companies with a goal to get both sides into a win-win position. Using Lumwana and Kansanshi Mines as case studies, their article examined the effects of adopting or raising the royalty-based tax on the mining industry in Zambia. The paper concludes that establishing or increasing these fees on the mining industry raises the cutoff grade, encouraging the use of high grading mining techniques. This method has disastrous technological and economic implications on the government and mining sector. The conclusion reached was that because orebodies exhibit varying degrees of mineralization, mineral royalty is not a fair tax system.

2.4 Conceptual Framework

The figure 2.1 below outlines the conceptual framework of the study:

Figure 0.1: Conceptual Framework



Source: Author (2024)

Figure 2.1 above highlights the conceptual framework of the study. The study outlines that the growth of the mineral extractive industry in Zambia is important as it drives GDP and the foreign exchange rate. The study therefore seeks to establish how three factors, mining FDI, mining taxation and economic growth, impact the growth in the mining sector through the variable mineral depletion.

One may argue that the relationship between taxation, economic growth, and foreign direct investment (FDI) in the mineral extraction sector is intricate and complicated. FDI is essential to this industry because it supplies the money, know-how, and technology needed for massive mineral extraction projects. These expenditures frequently result in the advancement of the local workforce's skills, the creation of jobs, and the construction of infrastructure, all of which support economic expansion (Phiri, 2019).

Contrarily, it is claimed that taxes play a dual role in this dynamic as a tool for regulation and as an incentive. Tax policies are used by governments to entice foreign investment by providing advantageous tax rates, exemptions, and incentives. The necessity to extract cash from mineral resources, which are frequently a sizable source of national income, must be balanced with these incentives. Good tax laws sustain a competitive investment climate while guaranteeing that the host nation profits from its natural riches (Banda & Besa, 2016).

Increased government revenue from taxes and royalties, better infrastructure, and greater living standards are just a few of the wider economic benefits that can result from the economic expansion in the mineral extraction sector brought about by foreign direct investment. The partnership does not, however, come without difficulties. Excessively generous tax incentives can result in a loss of potential revenue for the host country, while high tax rates can discourage foreign direct investment. Furthermore, to promote sustainable growth, the social and environmental effects of mineral extraction must be properly regulated (Extractive Industries Transparency Initiative, 2024).

2.5 Chapter Summary

This chapter shows a review of theoretical and empirical literature concerning the subject matter on the relationship between FDI, mining tax and economic growth on the extractive industry. The chapter considered various theories including the Resource cursed theory, resource based dependency theory and the dependency theory to lay out the foundation of how FDI, mining taxation and economic growth have an impact of the mining sector. The chapter further provides a highlight of different perspectives on mining at a global level, and various regions including the African region. The chapter also explores the relationships between economic growth and the mining sector, FDI and mining sector and tax and the mining sector on the extractive industry and how it affects economic growth. Based on the theories reviewed, the chapter presented a conceptual framework for the study incorporating, mediating and dependent variables and their relationships in accordance with this study. The next chapter will focus on the methodologies utilized in the research.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The chapter outlines the methods and procedures that were used to meet the study objectives through the use of statistical tools. The chapter outlines the research approach, research design and the data used in the study. Further, the chapter further guides on the data analysis method and the ethical considerations of the study.

3.2 Research Approach

Three primary research techniques are provided as options for adoption. A mixed techniques approach, a quantitative approach, and a qualitative approach are described. Based on the research objectives, a quantitative research approach was used in this study.

3.3 Research Design

The study used a descriptive research design to achieve its goals and adhere to the quantitative research methodology. It can be concluded that in order to provide a thorough understanding of a certain population or phenomenon, a descriptive research design is essential (Siedlecki, 2020). It enables researchers to see, characterize, and evaluate traits, actions, or trends in a particular setting. Forming hypotheses is made easier and more informed by descriptive research, which records and summarizes data without changing factors. This study helps guide future exploratory or explanatory research projects.

3.4 Study Population and Sample Size

The study considered all available time series data on the extractive industry in Zambia on mineral extraction, mining taxation, mining FDI and GDP per capita which are stored by the World Bank (2024) who currently have the largest time-series on the data of on interest on Zambia. For the sample size, quantitative data analysis requires a minimum of 30 observations. Therefore, 30 observations was established as the minimum number of observations, hence the minimum sample size. The study considered time-series annual data from 1990 to 2020, therefore representing 31 observations.

3.5 Data Collection

The study collected secondary time series data from the World bank (2024) World Development indicators on Zambia. This is an online source that provides for credible

data that is open-source and can therefore be used in research and statistics for analysis.

3.6 Data Sources

The study made use of the entire population on the data of the variables available on Zambia obtained from the world development indicators (WDI) dataset. This dataset that was used in the study was obtained from the World Bank (2024) and made use of annual quantitative time-series secondary data that ranged from 1990 to 2020, accounting for 31 observations. This was within the minimum required number of observations of 30 to perform a regression analysis.

3.7 Data Analysis

The study made use of E-Views statistical analysis package for the purpose of data analysis. The study opted to make use of a regression analysis, given the objectives of the study. The regression analysis used involved the use of an Error correction model (Scheiblecker, 2013). It is noted that an Error Correction Model (ECM) is the standard way to model time series equations. The study made use of a stationarity test to check the stationarity of the variables. The findings of the stationarity test was used to determine which econometric model was to be adopted for analysis. The study then ran the econometric model through regression analysis. After establishing this, diagnostic tests were run to test for multicollinearity, heteroscedasticity, model specification and goodness of fit of the model.

The model that was employed is outlined below:

$$MIN = ECG + TAX + FDI \quad (1)$$

This model is interpreted in the econometric form as:

$$MIN = \beta_0 + \beta_1 ECG_t + \beta_2 TAX_t + \beta_3 FDI_t + \mu_t \quad (2)$$

Where A priori

$$\beta_1 > 0; \beta_2 < 0; \beta_3 > 0; \beta_4 > 0; \beta_5 > 0$$

The variables outline:

MIN = Mineral Depletion; ECG = Economic Growth; TAX = Taxation; FDI = Foreign Direct Investment; μ = error correction term.

The study made will use Inflation rate and Exchange rate as control variables.

The study further considered diagnostic/post-estimation tests to ensure that the model was according to statistical expectation. The research applied the use of the following post estimation tests:

- i. Heteroscedasticity Test: The Breusch-Pagan-Godfrey test was used to test if the variance of the errors was constant;
- ii. Autocorrelation Test: The Breusch-Godfrey Serial Correlation Test was used to check if there is correlation between errors;
- iii. Omitted Variables: The Ramsey RESET test was used to test if the model was stable and did not have omitted variables.
- v. Normality test: The Jarque-Bera test was used to test if the errors were normally distributed.
- vi. Goodness of fit: The R-Squared and Adjusted R-Squared values were used to test how well the model fits the data.

3.8 Validity of the Study

It can be outlined that a method's validity in research is determined by how well it assesses the targeted outcome. High validity research yields findings that accurately reflect the traits, qualities, and variances seen in the real world, whether it be social or physical. In order to ensure the validity of the research, the study made use of data that was obtained from a credible source and analyzed the data using statistical procedures and provided for diagnostic tests to validate the findings of the regression analysis.

3.9 Ethical Considerations

It is maintained that ethical issues in research are essential to maintaining the validity, reliability, and social significance of scientific investigations. Notably, these elements safeguard participants' rights and welfare, encourage integrity and openness, and guard against wrongdoing like fabrication, falsification, or plagiarism. It should be highlighted that ethical norms also guarantee responsible research practices, confidentiality preservation, informed consent acquisition, and harm minimization. Respecting moral principles fosters public confidence, promotes knowledge growth, and guarantees that research results can be used for good. The oversight and

enforcement of ethical compliance in research operations is a crucial responsibility of institutional review boards (IRBs) and ethics committees.

The ethical considerations adopted in the study ensured to make use of secondary data from a credible source with permission for use as it is a public database. The study considered and made use of correct statistical methods and principles in analysis. The study further made use of peer reviewed literature and ensured to correctly cite these sources to avoid plagiarism.

3.10 Limitations of the study

Note that limitations of studies are those restrictions or flaws that affect the validity, dependability, or generalizability of research findings. It is argued that sample size limitations, measurement mistakes, selection bias, and outside influences on the outcomes are some of these perceived flaws. Thus, it is contended that methodological decisions like data collection strategies, experimental layouts, or analytical approaches can result in limitations. Transparency requires acceptance of these limits, which also gives context for interpreting the findings. It also assists in directing future study by pointing out areas that require more analysis and development. Resolving study limits improves the research's robustness and reliability, leading to more accurate and trustworthy findings.

The study sought to ensure a comprehensive analysis of data through the use of a large number of observations above the prescribed minimum of 30 observations. However, the study obtained 31 observations which were sufficient for the data analysis.

3.11 Chapter Summary

This chapter outlined the appropriate research approach and research design utilized to implement the research. The chapter also defined the study population and sample size, the type of data utilized and its sources and the methods used to analyse the data. Finally the chapter described the validity of the data, ethical considerations taken during the study and the limitations faced during the study.

CHAPTER FOUR

PRESENTATION OF RESULTS

4.1 Introduction

This chapter highlights the results of the data analysis conducted in the study. The chapter outlines the results based on the methods and procedures used and outlines the guidance that was used to reach a conclusion on the tests and results contained. The chapter also highlights the post-estimation tests that were conducted to ensure correct estimation of the regression model.

4.2 Descriptive Statistics

The study's descriptive statistics primarily serve as a proxy for the central tendency measurements. The center point or typical value of a dataset is represented by the summary statistics known as measures of central tendency. The three most widely used metrics of central tendency in statistics are the mean, median, and mode. Each uses a different formula to determine the central point. Selecting the most appropriate central tendency measure is contingent upon the nature of the data being analyzed. It should be made clear that the central tendency is just one feature of a distribution, regardless of whether the researcher is using the mean, median, or mode.

The center of a symmetric distribution is precisely located by the mean. The midway value is called the median. It is a natural measure of central tendency because it is the number that divides the dataset in half. As a measure of central tendency, outliers and skewed data have less of an impact on the median than the mean. The value that appears the most frequently in your data collection is the mode, which is a different kind of central tendency metric than the mean or median. In order to get the mode, there is need to sort the values in the dataset by categories or by numerical values. Next, determine which value appears the most frequently. The variability surrounding the core value is another way to comprehend the data distribution. The variability surrounding the core value is another way to comprehend the data distribution. It should be noted that this characteristic indicates the average distance between the data points and the center.

The study considered the parameters of the data based on measures of central tendency as outlined in table 4.1 below. This was done to observe and have a general understanding to the data that was used for analysis.

Table 0.1: Measures of central tendency

| Measure | MIN | AID | EXC | FDI | INF | TAX |
|---------------------|----------|----------|----------|----------|----------|----------|
| Mean | 5.142869 | 1.80E+08 | 3.240849 | 3.462210 | 27.55310 | 15.54261 |
| Median | 3.400310 | 1.38E+08 | 1.036010 | 2.986572 | 15.92739 | 15.56476 |
| Maximum | 21.72319 | 4.95E+08 | 20.01849 | 9.604383 | 165.5340 | 19.48288 |
| Minimum | 0.002715 | 12000000 | 0.000643 | - | - | 11.68752 |
| Std. Dev. | 5.541957 | 1.56E+08 | 4.577453 | 2.560781 | 35.93759 | 1.660464 |
| Observations | 52 | 32 | 52 | 52 | 52 | 32 |

Source: Author (2024)

Table 4.1 above outlines the measures of central tendency that include the mean, median and standard deviation of the data. Further, it also highlights the minimum value, maximum value and total number of observations of each variable considered.

4.2.1 Test for Stationarity

According to the stationarity test, a time series' stationarity indicates that a variable's value remains constant throughout time, meaning that variations in time do not contribute to changes in a variable's value. In order to obtain knowledge about the actual state of the relationship between the variables, a true analysis of the nature of the variables, and accurate forecasting and prediction, it is necessary for the data to be devoid of seasonality and trends. The study made use of time-series quantitative annual data in its analysis. In order to correctly estimate the model to use, the study made use of a stationarity test.

The study made use of the Augmented Dickey-Fuller (ADF) test of stationarity and table 4.2 below outlines the findings from the exercise. A statistical test called the Augmented Dickey Fuller test is used to determine if time series are stationary. This kind of unit root test allows us to determine whether the time series has a unit root at all. The Unit root is described as a time series feature that shows whether the time series exhibits any stochastic trends that deviate from its mean value. When a time series has a unit root, it becomes non-stationary, which makes it more difficult to draw statistical conclusions from it and make forecasts for the future.

Table 0.2: Findings from the ADF test

| Variable | t-statistic | 5% critical statistic | t-P-value | Stationarity |
|----------|-------------|-----------------------|-----------|------------------|
| MIN | -2.541902 | -2.921175 | 0.1120 | - |
| | -6.445409 | -2.922449 | 0.0000 | First Difference |
| AID | -1.002821 | -2.960411 | 0.7398 | - |
| | -7.238699 | -2.963972 | 0.0000 | First Difference |
| ECG | -6.348578 | -2.919952 | 0.0000 | Level |
| | - | - | - | - |
| EXC | 5.245887 | -2.919952 | 1.0000 | - |
| | -3.903044 | -2.921175 | 0.0039 | First Difference |
| FDI | -1.592389 | -2.922449 | 0.4788 | - |
| | -10.18345 | -2.922449 | 0.0000 | First Difference |
| INF | -2.26671 | -2.919952 | 0.1864 | - |
| | -6.388386 | -2.921175 | 0.0000 | First Difference |
| TAX | -3.063497 | -2.960411 | 0.0400 | Level |
| | - | - | - | - |

Source: Author (2024)

The Augmented Dickey Fuller (ADF) test was used to test for stationarity of the variables to determine the order of cointegration at 5% level of significance. Based on the presence of variables stationary both at level and at first difference, the research made use of the Autoregressive Distributed Lag (ARDL) model.

4.2.2 Long-run Cointegration

In summary, a statistical relationship between two or more time series variables that moves together over an extended length of time, notwithstanding short-term variances, is known as long-run cointegration. Furthermore, it is stated that cointegrated variables may suggest a stable equilibrium relationship, which means that any divergence from the equilibrium will only last a short while before the variables re-converge. In order to ensure that models capture underlying stable relationships rather of being misled by short-term fluctuations, it is consequently believed that cointegration is essential to economic and financial modeling. Cointegration aids in the identification and understanding of the long-term equilibrium among variables. To find cointegration, methods such as the Engle-Granger or Johansen tests are frequently employed.

To test for the long-run cointegration, the study made use of the ARDL bounds test. It can be noted that ARDL bounds testing approach is a cointegration method developed by Pesaran et al. (2001) to test the presence of the long run relationship between the variables. The results of the test are outlined in table 4.3 below.

Table 0.3: Results of the ARDL Test

| Test-Statistic | Value | K |
|------------------------------|--------------------|--------------------|
| F-Statistic | 5.121157 | 6 |
| Critical Value Bounds | | |
| Significance | Lower bound | Upper bound |
| 1% | 3.15 | 4.43 |
| 5% | 2.45 | 3.61 |

Source: Author (2024)

The null hypothesis is that there is no long-run relationship. The study made use of the F-statistic as the test statistic (5.121157). If the calculated F-statistic exceeds the upper critical bounds value, then the H_0 is rejected. If the F-statistic falls within the bounds then the test is inconclusive. Lastly, if the F-statistic falls below the lower critical bounds value, it implies that there is no co-integration. Therefore, the study concludes the presence of a long-run cointegration at both 1 percent ($5.121157 > 4.43$) and 5 percent ($5.121157 > 3.61$) levels of significance.

4.3 Model Estimation

4.3.1 Model Statistics

Table 4.4 below outlines the model statistics used to establish the characteristics of the model. The model considers the R-squared, adjusted R-squared and the observed p-value of the F-statistic of the model

Table 0.4: Results for Model Statistics

| Measure | Value |
|--------------------|----------|
| R-Squared | 0.922023 |
| Adjusted R-Squared | 0.844046 |
| F-statistic | 11.82428 |
| Prob | 0.000020 |

Source: Author (2024)

The findings on the model statistics on the R-squared show that 92.20 percent of the variations are explained by the model and the adjusted R-squared which is an even better measures shows that 84.40 percent of the variations are explained by the model. The prob outlines that the model is observed to be statistically significant ($p\text{-value} = 0.000020 < 0.05$) at 5 percent level of significance.

4.3.2 Short Run model

The research then estimated the cointegrating form of the model which outlines the short run coefficients of the model. The results of this analysis is outlined in table 4.5 below. In order to test for the significance of the variables, all the conclusions were made at 0.05 level of significance. The null hypothesis indicates that the variables are insignificant, therefore a value greater than 0.05 will lead to failure to reject null hypothesis.

The study considered the short-run relationship between mineral rent and the aspects of human capital development, namely education, health and income. The study sought to establish the existing relationship between the dependent and independent variables in the short-run. The error correction term (CointEq(-1)) outlines the speed of adjustment given a disequilibrium in the model in a previous period.

Table 0.5: Short run model results

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|------------|-------------|--------|
| ECG | -0.263967 | 0.162491 | -1.624509 | 0.1266 |
| FDI | 0.698558 | 0.326532 | 2.139326 | 0.0505 |
| TAX | 0.337425 | 0.510743 | 0.660655 | 0.5196 |
| TAX | -2.132153 | 0.561227 | -3.799092 | 0.0020 |
| TAX | 1.247515 | 0.754195 | 1.654102 | 0.1203 |
| CointEq(-1) | -0.576094 | 0.114689 | -5.023108 | 0.0002 |

Source: Author (2024)

The results show the presence of the equilibrium given the negative value of the CointEq(-1). To test for the statistical significance of the variables, the probability was used at a 5% level of significance. The null hypothesis indicates that the variables are significant, therefore a value greater than 0.05 will lead to rejecting the null hypothesis. Therefore, the CointEq(-1) is found to be statistically significant given an observed probability of 0.0002. Further, the results show that the speed of adjustment on average to the equilibrium in the current period is 57.61 percent for a deviation in the previous period in the short run.

The study considered the short run effects of FDI on MIN. The study found the presence of a positive effect given the coefficient of 0.698558. This relationship was found to be statistically significant at 5 percent level of significance and at 10 percent level of significance. Therefore, a one unit increase in FDI will result into a 0.699 unit change in MIN.

The study further considered the effect of TAX on MIN in the short run. The study finds that TAX with a lag of one period is statistically significant at 5 percent level of significance, with an observed negative effect given the coefficient -2.132153, ceteris paribus. Therefore, a unit increase in one period lag of TAX will have an inverse effect on MIN in its current period of - 2.132153, ceteris paribus.

The study did not make inference in ECG and TAX in the current period and TAX with a lag of 2 periods as it was statistically not significant.

4.3.3 Long Run model

The research then estimated the long run coefficients of the model. The results of this analysis are outlined in table 4.6 below. In order to test for the significance of the variables, all the conclusions were made at 0.05 level of significance. The null hypothesis indicates that the variables are insignificant, therefore a value greater than 0.05 will lead to failure to reject null hypothesis.

Table 0.6: Long run model results

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|--------|
| ECG | -0.458202 | 0.316387 | -1.448231 | 0.1696 |
| FDI | 1.212577 | 0.603961 | 2.007708 | 0.0644 |
| TAX | 1.064305 | 1.487953 | 0.715281 | 0.4862 |

Source: Author (2024)

The study considered the long relationship between MIN and ECG, FDI and TAX. The study sought to establish the existing relationship between the dependent and independent variables in the long run. The study found that ECG, FDI and TAX were found to be statistically not significant as the observed probabilities were found to be greater than the 5 percent level of significance.

4.4 Post Estimation Tests

The study performed post estimation tests to establish the correct estimation of the model. These are outlined in the table 4.8 below and the figures below. Column three provides for the observed

prob while the conclusion arising from the results is indicating in the last column of the table. This important in order to test the assumptions earlier made and be able to make predictions afterwards.

Table 0.7: Findings and Conclusions of Post Estimation tests

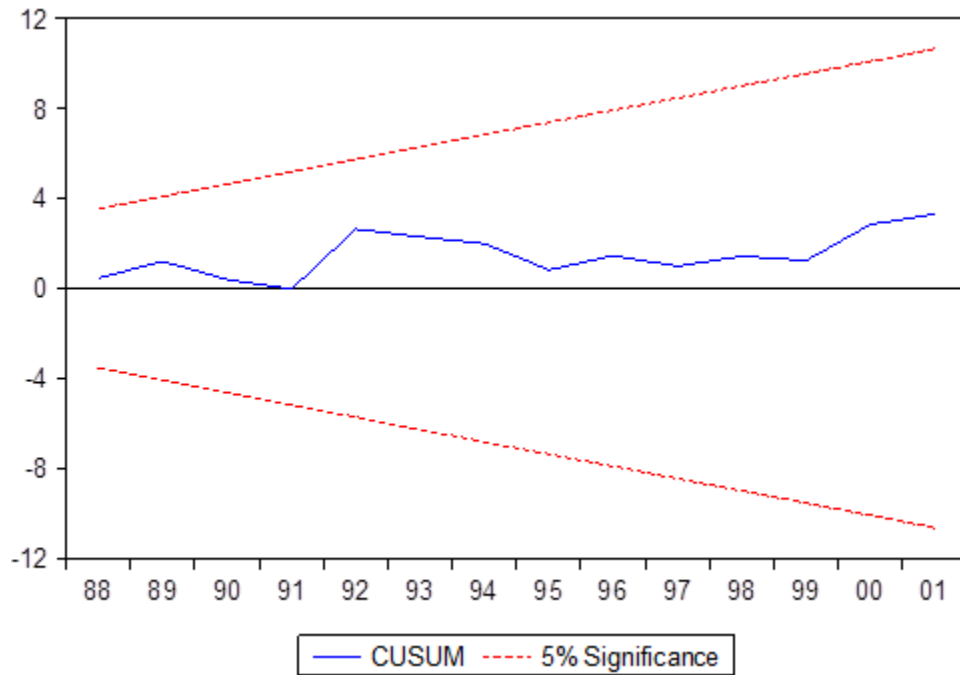
| Test | Name of Test | Observed Prob. | Conclusion |
|---|--|----------------|---|
| Normality Test | Jarque-Bera normality test | 0.687992 | The null hypothesis states that the errors are normally distributed. The study therefore fails to rejects the null hypothesis, and conclude that the errors are normally distributed. |
| Test for Serial Correlation | Breusch-Godfrey Serial Correlation LM Test | 0.3335 | The null hypothesis states that the errors are not serially correlated in the model. The study therefore fails to reject the null hypothesis. |
| Heteroskedasticity Test | Breusch-Pagan-Godfrey Test | 0.9487 | The null hypothesis states that the variance of the error term is homoscedastic. The study therefore fails to reject the null hypothesis. |
| Test for Correct Model Specification | Ramsey RESET Test | 0.8993 | The null hypothesis states that the model is correctly specified. The study therefore fails to reject the null hypothesis. |

Source: Author (2024)

4.5 CUSUM Tests

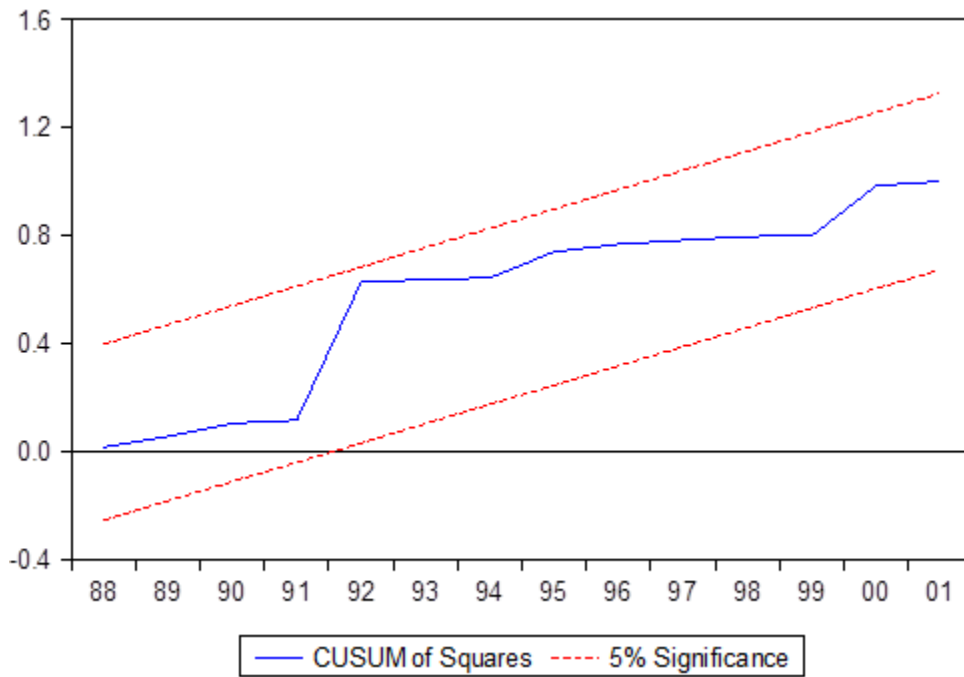
The result in the figure 4.1 and figure 4.2 below are from the CUSUM test and CUSUM of Squares test, respectively, used to indicate the stability of the model and show that the model is stable at a 0.05 level of significance since the variation was within the stability bound for the time under consideration.

Figure 0.1: CUSUM Test



Source: Author (2024)

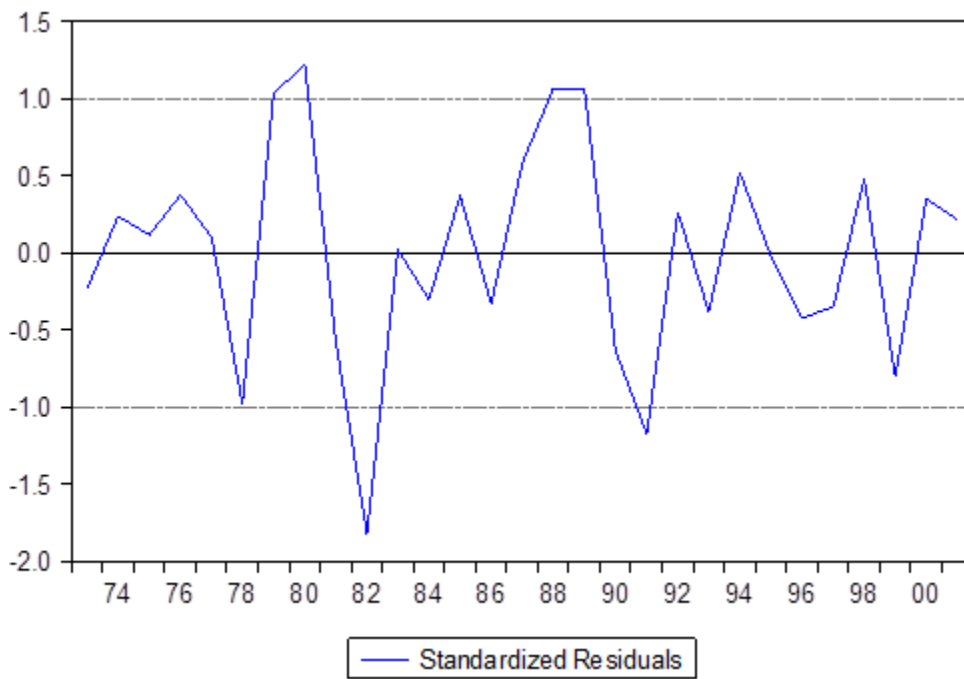
Figure 0.2: CUSUM Test of Squares



Source: Author (2024)

The Figure 4.3 below shows that the errors are randomly distributed.

Figure 0.3: Standardized errors



Source: Author (2024)

4.6 Chapter Summary

This chapter provides a presentation and analysis of the results obtained from the data analysis conducted in the study. The first part outlined how the study utilized descriptive research by finding the central tendency measurements for the data sets used. This was done to observe and have a general understanding to the data that was used for analysis. The second part of the chapter presented the results from the post-estimation tests that were conducted to ensure correct estimation of the regression model.

The following chapter outlines the findings based on the results obtained from the data analysis conducted.

CHAPTER FIVE

DISCUSSION

5.1 Introduction

The chapter considers the results of the data analysis and presents the findings of the study. The chapter presents the discussion based on the study objectives.

5.2 The effect of FDI on mineral depletion of the extractive industry in Zambia

The study considered the short run effects of mining FDI on the extractive industry in Zambia. The study found the presence of a positive effect given the coefficient of 0.698558. This relationship was found to be statistically significant at 5 percent level of significance and at 10 percent level of significance. Therefore, a one unit increase in FDI will result into a 0.699 unit change in mining sector. The study finds the lack of a long run relationship between the variables given the statistically not significant effect of FDI on mining sector. Therefore, based on these findings, the study concludes that in the short run there is a positive effect of mining FDI on the extractive industry while in the long run there is no effect.

It can be argued that the short-term benefits of foreign direct investment (FDI) include increased production, capital infusion, and the ability to purchase cutting-edge equipment. This flood helps mining ventures grow and flourish quickly, boosting employment and local economies. Furthermore, FDI improves environmental management and operational efficiency by bringing experience and managerial abilities (Limpitlaw, 2018). On the other hand, the benefits can fade over time as argued by Mwiya and Tshuma (2016) and Ng'andu and Mulenga (2020). They argued that when resources are depleted as a result of heavy mining, the economy may begin to suffer. Due to its reliance on foreign direct investment, the industry is susceptible to changes in investor tactics and political unrest. Furthermore, the damage that extensive mining does to the ecosystem may not be remedied. So, even while foreign direct investment (FDI) boosts growth at first, its long-term advantages are limited unless they are combined with sustainable practices and economic diversity.

5.3 The effect of mining taxation on mineral depletion of the extractive industry in Zambia

The study further considered the effect of taxation on the mining sector in the short run. The study finds that TAX with a lag of one period is statistically significant at 5

percent level of significance, with an observed negative effect given the coefficient -2.132153, *ceteris paribus*. Therefore, a unit increase in one period lag of taxation will have an inverse effect on mining sector in its current period of -2.132153, *ceteris paribus*. High taxes in the mining industry can have a short-term detrimental effect on profitability by lowering the amount of money available for reinvesting right away in operations and exploration. Hilson (2019) argues that this might cause businesses to suffer with greater financial obligations and possible investor withdrawal owing to lower returns, which can result in decreased production, job losses, and a halt in sector growth. Kulczycka, et al (2017) and Besa and Banda (2016) argue that over time, taxation may have less of an impact on the mining industry as businesses reduce costs and boost productivity in order to adjust to the new tax landscape. Furthermore, predictable operating costs can eventually result from stable tax laws, enabling businesses to make appropriate plans and investments. Furthermore, international agreements and long-term contracts have the ability to lessen the effects of taxation over time. Thus, while taxation can hinder short-term growth, its long-term impact is often neutralized by sector adaptation.

5.4 The effect of economic growth on mineral depletion of the extractive industry in Zambia

The study found that economic growth was statistically not significant in both the short run and the long run based on the research analysis. Economic growth may not significantly impact the mining sector in both the short run and the long run due to several factors. In the short run, the mining sector's performance is largely driven by commodity prices, which are influenced by global demand and supply dynamics rather than domestic economic growth. Even with robust economic growth, if global commodity prices are low, the mining sector may not experience significant benefits (Awolusi, 2016). In the long run, the structural characteristics of the mining sector limit its responsiveness to economic growth. The sector's capital-intensive nature means that investments and project developments are lengthy and not immediately influenced by short-term economic fluctuations. Additionally, resource depletion and environmental regulations can constrain long-term growth, irrespective of broader economic conditions. Furthermore, economic growth often drives diversification, reducing the relative importance of mining within the overall economy as argued by

Mtiki (2022). Therefore, while economic growth brings broad benefits, its direct impact on the mining sector is often muted and indirect.

5.5 Chapter Summary

This chapter provided the discussion and analysis of the findings based on the three (3) specific objectives of the research and considered the findings of the study presented in the previous chapter four (4). The next chapter provides the conclusions and recommendations for the research findings

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The chapter considers the discussion from the previous chapter and endeavors to summarize these arguments through a conclusion and recommendations.

6.2 Conclusion

The main aim of this study was to establish the impact mining FDI, economic growth and taxation on mineral depletion on the extractive industry in Zambia. The study adopted a quantitative approach through a descriptive research design. The study made use of a regression analysis to establish the existent relationship between the dependent and independent variables. The study found that in the short run taxation with a lag of one period had a negative effect on the mining sector, with the lack of an effect in the long run. FDI was found to have a statistically significant positive effect on the mining sector in the short run. However, the study was found to lack a statistically significant effect on the mining sector in the long run.

6.3 Recommendations

The study therefore makes the following recommendations based on the discussion:

- i. There is need to ensure that investments in the mining sector encourage long term sustainable economic growth as opposed to the findings that FDI only results in short term growth.
- ii. There is need for a more comprehensive study to establish the ways on which FDI can be more effective in ensuring long term economic growth in Zambia.

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| | MIN | AID | EXC | FDI | INF | TAX |
|--------------|----------|----------|----------|-----------|-----------|----------|
| Mean | 5.142869 | 1.80E+08 | 3.240849 | 3.462210 | 27.55310 | 15.54261 |
| Median | 3.400310 | 1.38E+08 | 1.036010 | 2.986572 | 15.92739 | 15.56476 |
| Maximum | 21.72319 | 4.95E+08 | 20.01849 | 9.604383 | 165.5340 | 19.48288 |
| Minimum | 0.002715 | 1200000 | 0.000643 | -0.958513 | -14.16990 | 11.68752 |
| Std. Dev. | 5.541957 | 1.56E+08 | 4.577453 | 2.560781 | 35.93759 | 1.660464 |
| Skewness | 1.441614 | 0.448627 | 1.952319 | 0.661494 | 2.193182 | 0.020482 |
| Kurtosis | 4.721583 | 1.843634 | 6.840386 | 2.548209 | 7.632172 | 3.168874 |
| Jarque-Bera | 24.43319 | 2.856331 | 64.98867 | 4.234558 | 88.17730 | 0.040262 |
| Probability | 0.000005 | 0.239748 | 0.000000 | 0.120359 | 0.000000 | 0.980070 |
| Sum Sq. Dev. | 267.4292 | 5.75E+09 | 168.5241 | 180.0349 | 1432.761 | 497.3635 |
| Observations | 52 | 32 | 52 | 52 | 52 | 32 |

Null Hypothesis: MIN has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

| | t-Statistic | Prob.* |
|--|-------------|--------|
| Augmented Dickey-Fuller test statistic | 2.541902 | 0.1120 |
| Test critical values: | | |
| 1% level | -3.568308 | |
| 5% level | -2.921175 | |
| 10% level | -2.598551 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MIN)
Method: Least Squares
Date: 05/01/24 Time: 18:08
Sample (adjusted): 1972 2021
Included observations: 50 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|------------|-------------|------------|-------------|--------|
| MIN(-1) | -0.305942 | 0.120360 | -2.541902 | 0.0144 |
| D(MIN(-1)) | 0.189012 | 0.160746 | 1.175844 | 0.2456 |

| | | | | | |
|--------------------|----|---------------|--------------|-----------------------|--------------|
| | C | 1.6118 96 | 0.78034 3 | 2.06562 3 | 0.044 4 |
| R-squared | | 0.1264 93 | | Mean dependent var | 0.171 101 |
| Adjusted squared | R- | 0.0893 23 | | S.D. dependent var | 4.038 756 |
| S.E. of regression | | 3.8541 61 | | Akaike info criterion | 5.594 308 |
| Sum squared resid | | 698.16 42 | | Schwarz criterion | 5.709 030 |
| Log likelihood | | - 136.8577 | | Hannan-Quinn | 5.637 995 |
| F-statistic | | 3.4030 48 | | Durbin-Watson stat | 1.537 470 |
| Prob(F-statistic) | | 0.0416 64 | | | |

Null Hypothesis: D(MIN) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

| | t-Statistic | Prob. * |
|--|-------------|------------|
| Augmented Dickey-Fuller test statistic | - | 0.000 |
| Test critical values: | 6.445409 | 0 |
| 1% level | - | |
| 5% level | 3.571310 | |
| 10% level | - | |
| | 2.922449 | |
| | - | |
| | 2.599224 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MIN,2)
Method: Least Squares
Date: 05/01/24 Time: 18:08
Sample (adjusted): 1973 2021
Included observations: 49 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------|-------------|------------|-------------|-------|
| D(MIN(-1)) | - | 0.22348 | - | 0.000 |
| D(MIN(-1),2) | 1.440480 | 9 | 6.445409 | 0 |
| | 0.5050 | 0.15418 | 3.27562 | 0.002 |
| | 41 | 1 | 4 | 0 |
| C | 0.0268 | 0.53766 | 0.04992 | 0.960 |
| | 41 | 1 | 1 | 4 |

| | | | |
|--------------------|----------|-----------------------|-------|
| R-squared | 0.4938 | Mean dependent var | 0.346 |
| Adjusted squared | 0.4718 | S.D. dependent var | 0.73 |
| S.E. of regression | 0.79 | Akaike info criterion | 451 |
| Sum squared resid | 642.87 | Schwarz criterion | 277 |
| Log likelihood | 132.5941 | Hannan-Quinn | 5.578 |
| F-statistic | 22.442 | Durbin-Watson stat | 1.442 |
| Prob(F-statistic) | 0.0000 | | 179 |

Null Hypothesis: AID has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | t-Statistic | Prob.* |
|--|-------------|--------|
| Augmented Dickey-Fuller test statistic | 1.002821 | 0.7398 |
| Test critical values: | | |
| 1% level | -3.661661 | |
| 5% level | -2.960411 | |
| 10% level | -2.619160 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(AID)
Method: Least Squares
Date: 05/01/24 Time: 18:09
Sample (adjusted): 1971 2001
Included observations: 31 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|--------|
| AID(-1) | -0.079675 | 0.079451 | -1.002821 | 0.3242 |
| C | 262658.01 | 181861.54 | 1.444275 | 0.1594 |

| | | | |
|--------------------|--------|-----------------------|-------|
| R-squared | 0.0335 | Mean dependent var | 12515 |
| Adjusted squared | 0.0001 | S.D. dependent var | 484 |
| S.E. of regression | 0.88 | Akaike info criterion | 66523 |
| | 665172 | | 522 |
| | 58 | | 38.92 |
| | | | 616 |

| | | | |
|-------------------|----------|--------------------|-------|
| Sum squared resid | 1.28E+17 | Schwarz criterion | 39.01 |
| Log likelihood | 601.3555 | Hannan-Quinn | 868 |
| F-statistic | 1.0056 | Durbin-Watson stat | 38.95 |
| Prob(F-statistic) | 50 | | 632 |
| | 0.3242 | | 2.489 |
| | 42 | | 043 |

Null Hypothesis: D(AID) has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | t-Statistic | Prob.* |
|--|-------------|--------|
| Augmented Dickey-Fuller test statistic | -7.238699 | 0.0000 |
| Test critical values: | | |
| 1% level | -3.670170 | |
| 5% level | -2.963972 | |
| 10% level | -2.621007 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(AID,2)
 Method: Least Squares
 Date: 05/01/24 Time: 18:09
 Sample (adjusted): 1972 2001
 Included observations: 30 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|------------|-------------|------------|-------------|--------|
| D(AID(-1)) | -1.303520 | 0.180077 | -7.238699 | 0.0000 |
| C | 164417.97 | 1219346.0 | 1.348411 | 0.1883 |

| | | | |
|--------------------|-----------|-----------------------|----------|
| R-squared | 0.6517 | Mean dependent var | 60333.25 |
| Adjusted R-squared | 0.6392 | S.D. dependent var | 1.09E+08 |
| S.E. of regression | 656087.00 | Akaike info criterion | 38.90 |
| Sum squared resid | 1.21E+17 | Schwarz criterion | 407 |
| Log likelihood | 581.5098 | Hannan-Quinn | 38.93 |
| F-statistic | 52.398 | Durbin-Watson stat | 054 |
| | 77 | | 2.168 |
| | | | 358 |

0.0000
 Prob(F-statistic) 00

Null Hypothesis: ECG has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=10)

| | t-Statistic | Prob.* |
|--|-------------|--------|
| Augmented Dickey-Fuller test statistic | 6.348578 | 0.0000 |
| Test critical values: | | |
| 1% level | -3.565430 | |
| 5% level | -2.919952 | |
| 10% level | -2.597905 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(ECG)
 Method: Least Squares
 Date: 05/01/24 Time: 18:10
 Sample (adjusted): 1971 2021
 Included observations: 51 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|-----------------------|-------------|----------|
| ECG(-1) | -0.907377 | 0.142926 | -6.348578 | 0.0000 |
| C | 0.097906 | 0.547438 | 0.178845 | 0.8588 |
| R-squared | 0.451315 | Mean dependent var | | 0.028718 |
| Adjusted R-squared | 0.440117 | S.D. dependent var | | 5.223787 |
| S.E. of regression | 3.908715 | Akaike info criterion | | 5.602720 |
| Sum squared resid | 748.6244 | Schwarz criterion | | 5.678478 |
| Log likelihood | -140.8694 | Hannan-Quinn | | 5.631670 |
| F-statistic | 40.3044 | Durbin-Watson stat | | 2.029678 |
| Prob(F-statistic) | 0.0000 | | | |

Null Hypothesis: EXC has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=0)

| | | t-Statistic | Prob. * |
|--|-----------|--------------|------------|
| Augmented Dickey-Fuller test statistic | | 5.24588 7 | 1.000 0 |
| Test | critical | | |
| values: | 1% level | - | |
| | 5% level | 3.565430 | |
| | 10% level | - | |
| | level | 2.919952 | |
| | level | - | |
| | level | 2.597905 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(EXC)
 Method: Least Squares
 Date: 05/01/24 Time: 18:13
 Sample (adjusted): 1971 2021
 Included observations: 51 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|-----------------------|-------------|----------|
| EXC(-1) | 0.148699 | 0.028346 | 5.245887 | 0.0000 |
| C | -0.054479 | 0.138299 | -0.393922 | 0.6953 |
| R-squared | 0.359639 | Mean dependent var | | 0.378514 |
| Adjusted squared | 0.346570 | S.D. dependent var | | 0.980350 |
| S.E. of regression | 0.792466 | Akaike info criterion | | 2.411091 |
| Sum squared resid | 30.77210 | Schwarz criterion | | 2.486849 |
| Log likelihood | -59.48282 | Hannan-Quinn | | 2.440040 |
| F-statistic | 27.51934 | Durbin-Watson stat | | 1.808365 |
| Prob(F-statistic) | 0.000003 | | | |

Null Hypothesis: D(EXC) has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=0)

| | t-Statistic | Prob. * |
|--|-------------|------------|
| Augmented Dickey-Fuller test statistic | -3.903044 | 0.0039 |
| Test critical values: | | |
| 1% level | -3.568308 | |
| 5% level | -2.921175 | |
| 10% level | -2.598551 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(EXC,2)
 Method: Least Squares
 Date: 05/01/24 Time: 18:13
 Sample (adjusted): 1972 2021
 Included observations: 50 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|-----------------------|-------------|----------|
| D(EXC(-1)) | -0.498173 | 0.127637 | -3.903044 | 0.0003 |
| C | 0.209142 | 0.130861 | 1.598200 | 0.1166 |
| R-squared | 0.240912 | Mean dependent var | | 0.033488 |
| Adjusted R-squared | 0.225097 | S.D. dependent var | | 0.987047 |
| S.E. of regression | 0.868883 | Akaike info criterion | | 2.595962 |
| Sum squared resid | 36.23799 | Schwarz criterion | | 2.672443 |
| Log likelihood | -62.89905 | Hannan-Quinn | | 2.625086 |
| F-statistic | 15.23375 | Durbin-Watson stat | | 1.897639 |
| Prob(F-statistic) | 0.000296 | | | |

Null Hypothesis: FDI has a unit root
 Exogenous: Constant
 Lag Length: 2 (Automatic - based on SIC, maxlag=10)

| | t-Statistic | Prob. * |
|--|-------------|------------|
| Augmented Dickey-Fuller test statistic | -1.592389 | 0.4788 |

| | | | |
|--------------|----------------|-----|----------|
| Test values: | critical level | 1% | - |
| | | 5% | 3.571310 |
| | critical level | 10% | - |
| | | | 2.922449 |
| | | | 2.599224 |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(FDI)
 Method: Least Squares
 Date: 05/01/24 Time: 18:18
 Sample (adjusted): 1973 2021
 Included observations: 49 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|-----------------------|-------------|-------|
| | - | 0.13674 | - | 0.118 |
| FDI(-1) | 0.217743 | 0 | 1.592389 | 3 |
| | - | 0.15322 | - | 0.000 |
| D(FDI(-1)) | 0.593899 | 9 | 3.875888 | 3 |
| | - | 0.13252 | - | 0.002 |
| D(FDI(-2)) | 0.433851 | 3 | 3.273776 | 0 |
| | 0.8189 | 0.56673 | 1.44500 | 0.155 |
| C | 36 | 6 | 4 | 4 |
| R-squared | 0.4624 | | | 0.004 |
| Adjusted R-squared | 0.4266 | Mean dependent var | | 816 |
| S.E. of regression | 1.9755 | S.D. dependent var | | 000 |
| Sum squared resid | 175.63 | Akaike info criterion | | 4.277 |
| Log likelihood | 100.8039 | Schwarz criterion | | 709 |
| F-statistic | 12.904 | Hannan-Quinn | | 4.432 |
| Prob(F-statistic) | 0.0000 | Durbin-Watson stat | | 143 |
| | 03 | | | 4.336 |
| | | | | 301 |
| | | | | 2.090 |
| | | | | 788 |

Null Hypothesis: D(FDI) has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic - based on SIC, maxlag=10)

| | t-Statistic | Prob.* |
|--|-------------|--------|
| Augmented Dickey-Fuller test statistic | - | 0.000 |
| Test values: | 10.18345 | 0 |
| | - | |
| | 3.571310 | |

| | |
|-------|----------|
| 5% | - |
| level | 2.922449 |
| 10% | - |
| level | 2.599224 |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(FDI,2)
 Method: Least Squares
 Date: 05/01/24 Time: 18:18
 Sample (adjusted): 1973 2021
 Included observations: 49 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|-----------------------|-------------|--------|
| D(FDI(-1)) | -0.2237169 | 0.219687 | -10.18345 | 0.0000 |
| D(FDI(-1),2) | 0.0502435 | 0.127404 | 3.943641 | 0.0003 |
| C | 0.036391 | 0.286964 | 0.126814 | 0.8996 |
| R-squared | 0.809726 | Mean dependent var | 0.012630 | - |
| Adjusted R-squared | 0.801453 | S.D. dependent var | 0.072 | 4.507 |
| S.E. of regression | 2.008287 | Akaike info criterion | 711 | 4.291 |
| Sum squared resid | 185.5279 | Schwarz criterion | 537 | 4.407 |
| Log likelihood | -102.1469 | Hannan-Quinn | 4.335 | 655 |
| F-statistic | 97.87843 | Durbin-Watson stat | 712 | 2.145 |
| Prob(F-statistic) | 0.000000 | | | |

Null Hypothesis: INF has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=10)

| | t-Statistic | Prob.* |
|--|-------------|--------|
| Augmented Dickey-Fuller test statistic | -2.266771 | 0.1864 |
| Test critical values: | | |
| 1% level | -3.565430 | |
| 5% level | -2.919952 | |
| 10% level | -2.597905 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(INF)
 Method: Least Squares
 Date: 05/01/24 Time: 18:18
 Sample (adjusted): 1971 2021
 Included observations: 51 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|-----------------------|-------------|-------|
| | - | 0.07821 | - | 0.027 |
| INF(-1) | 0.177289 | 2 | 2.266771 | 9 |
| C | 5.6126 | 3.54378 | 1.58380 | 0.119 |
| | 80 | 6 | 9 | 7 |
| R-squared | 0.0949 | | | 0.720 |
| Adjusted R-squared | 0.0764 | Mean dependent var | | 091 |
| S.E. of regression | 20.072 | S.D. dependent var | | 617 |
| Sum squared resid | 19741. | Akaike info criterion | | 8.874 |
| Log likelihood | 224.3115 | Schwarz criterion | | 959 |
| F-statistic | 5.1382 | Hannan-Quinn | | 8.950 |
| Prob(F-statistic) | 0.0278 | Durbin-Watson stat | | 717 |
| | 53 | | | 8.903 |
| | | | | 909 |
| | | | | 1.706 |
| | | | | 432 |

Null Hypothesis: D(INF) has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=10)

| | t-Statistic | Prob.* |
|--|-------------|--------|
| Augmented Dickey-Fuller test statistic | - | 0.000 |
| Test critical values: | 6.388386 | 0 |
| 1% level | - | |
| 5% level | 3.568308 | |
| 10% level | - | |
| | 2.921175 | |
| | - | |
| | 2.598551 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(INF,2)
 Method: Least Squares

Date: 05/01/24 Time: 18:18
 Sample (adjusted): 1972 2021
 Included observations: 50 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------------------|-------------|-----------------------|-------------|-------|
| | - | 0.14426 | - | 0.000 |
| D(INF(-1)) | 0.921591 | 0 | 6.388386 | 0 |
| | 0.6171 | 3.00559 | 0.20532 | 0.838 |
| C | 14 | 0 | 2 | 2 |
| R-squared | 0.4595 | | | 0.153 |
| Adjusted R-squared | 0.4482 | Mean dependent var | | 777 |
| S.E. of regression | 21.246 | S.D. dependent var | | 387 |
| Sum of squared resid | 54 | Akaike info criterion | | 443 |
| Log likelihood | 222.7361 | Schwarz criterion | | 924 |
| F-statistic | 40.811 | Hannan-Quinn | | 9.018 |
| Prob(F-statistic) | 0.0000 | Durbin-Watson stat | | 026 |

Null Hypothesis: TAX has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=7)

| | t-Statistic | Prob.* |
|--|-------------|--------|
| Augmented Dickey-Fuller test statistic | 3.063497 | 0.0400 |
| Test critical values: | | |
| 1% level | -3.661661 | |
| 5% level | -2.960411 | |
| 10% level | -2.619160 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(TAX)
 Method: Least Squares
 Date: 05/01/24 Time: 18:19
 Sample (adjusted): 1971 2001
 Included observations: 31 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
|----------|-------------|------------|-------------|-------|

| | | | | |
|--------------------|----------|-----------------------|----------|----------|
| | - | 0.12321 | - | 0.004 |
| TAX(-1) | 0.377458 | 1 | 3.063497 | 7 |
| | 5.7644 | 1.92083 | 3.00100 | 0.005 |
| C | 33 | 2 | 9 | 5 |
| <hr/> | | | | |
| R-squared | 0.2444 | | | - |
| Adjusted R-squared | 0.2184 | Mean dependent var | | 0.087177 |
| | 45 | S.D. dependent var | | 1.276 |
| S.E. of regression | 1.1285 | | | 515 |
| Sum squared resid | 11 | Akaike info criterion | | 3.142 |
| | 36.932 | Schwarz criterion | | 0.16 |
| Log likelihood | 56 | Hannan-Quinn | | 3.234 |
| | - | Durbin-Watson stat | | 5.31 |
| F-statistic | 46.70124 | | | 3.172 |
| Prob(F-statistic) | 9.3850 | | | 1.73 |
| | 13 | | | 2.327 |
| | 0.0046 | | | 797 |
| | 90 | | | |

Dependent Variable: MIN

Method: ARDL

Date: 05/01/24 Time: 18:21

Sample (adjusted): 1973 2001

Included observations: 29 after adjustments

Maximum dependent lags: 1 (Automatic selection)

Model selection method: Akaike info criterion (AIC)

Dynamic regressors (3 lags, automatic): AID ECG EXC FDI INF TAX

Fixed regressors: C

Number of models evaluated: 4096

Selected Model: ARDL(1, 2, 0, 2, 0, 0, 3)

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|----------|-------------|------------|-------------|--------|
| MIN(-1) | 0.423906 | 0.114689 | 3.696141 | 0.0024 |
| AID | -1.36E-08 | 8.25E-09 | -1.647983 | 0.1216 |
| AID(-1) | -3.18E-09 | 8.80E-09 | 0.361841 | 0.7229 |
| AID(-2) | 3.35E-08 | 9.59E-09 | 3.494568 | 0.0036 |
| ECG | -0.16249 | 0.16249 | -1.624509 | 0.1266 |
| EXC | 28.13153 | 8.26868 | 3.402179 | 0.0043 |
| EXC(-1) | 10.705 | 8.73863 | 1.22507 | 0.240 |
| EXC(-2) | 52 | 9 | 8 | 0.000 |
| FDI | 25.320 | 4.25104 | 5.95635 | 0.000 |
| INF | 0.6985 | 0.32653 | 2.13932 | 0.050 |
| | 58 | 2 | 6 | 0.531 |
| | - | 0.01924 | - | 0.531 |
| | 0.012363 | 3 | 0.642432 | 0 |

| | | | | |
|--------------------|----------|-----------------------|----------|-------|
| | 0.3374 | 0.51074 | 0.66065 | 0.519 |
| TAX | 25 | 3 | 5 | 6 |
| | - | 0.58639 | - | 0.316 |
| TAX(-1) | 0.608923 | 8 | 1.038412 | 7 |
| | 2.1321 | 0.56122 | 3.79909 | 0.002 |
| TAX(-2) | 53 | 7 | 2 | 0 |
| | - | 0.75419 | - | 0.120 |
| TAX(-3) | 1.247515 | 5 | 1.654102 | 3 |
| | - | 14.3760 | - | 0.547 |
| C | 8.863782 | 6 | 0.616565 | 4 |
| <hr/> | | | | |
| R-squared | 0.9220 | | | 4.218 |
| Adjusted R-squared | 0.8440 | Mean dependent var | | 023 |
| S.E. of regression | 2.1651 | S.D. dependent var | | 522 |
| Sum squared resid | 65.627 | Akaike info criterion | | 059 |
| Log likelihood | 52.99135 | Schwarz criterion | | 281 |
| F-statistic | 28 | Hannan-Quinn | | 4.910 |
| Prob(F-statistic) | 0.0000 | Log likelihood | 52.99135 | crit. |
| | 20 | | 11.824 | 1.894 |
| | | Durbin-Watson stat | | 564 |

*Note: p-values and any subsequent tests do not account for model selection.

ARDL Bounds Test

Date: 05/01/24 Time: 18:22

Sample: 1973 2001

Included observations: 29

Null Hypothesis: No long-run relationships exist

| Test Statistic | Value | k |
|----------------|---------|---|
| F-statistic | 5.12115 | 6 |

Critical Value Bounds

| Significance | I0 Bound | I1 Bound |
|--------------|----------|----------|
| 10% | 2.12 | 3.23 |
| 5% | 2.45 | 3.61 |
| 2.5% | 2.75 | 3.99 |
| 1% | 3.15 | 4.43 |

Test Equation:

Dependent Variable: D(MIN)

Method: Least Squares

Date: 05/01/24 Time: 18:22

Sample: 1973 2001

Included observations: 29

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|-----------------------|-------------|------------|-------------|----------|
| D(AID) | -1.77E-08 | 1.02E-08 | 1.739906 | 0.1038 |
| D(AID(-1)) | -2.73E-08 | 1.15E-08 | 2.370467 | 0.0327 |
| D(EXC) | 18.55295 | 8.210646 | 2.259621 | 0.0403 |
| D(EXC(-1)) | 22.88211 | 4.800730 | 4.766380 | 0.0003 |
| D(TAX) | 0.111376 | 0.623811 | 0.178542 | 0.8609 |
| D(TAX(-1)) | 1.152806 | 0.823845 | 1.399300 | 0.1835 |
| D(TAX(-2)) | 0.563180 | 0.751500 | 0.749407 | 0.4660 |
| C | 4.533579 | 17.35134 | 0.261281 | 0.7977 |
| AID(-1) | 1.35E-08 | 1.33E-08 | 1.014702 | 0.3275 |
| ECG(-1) | 0.075439 | 0.165862 | 0.454827 | 0.6562 |
| EXC(-1) | 6.221011 | 2.256776 | 2.756593 | 0.0154 |
| FDI(-1) | 0.007118 | 0.370873 | 0.019194 | 0.9850 |
| INF | 0.004126 | 0.020037 | 0.205904 | 0.8398 |
| TAX(-1) | 0.427708 | 1.028218 | 0.415970 | 0.6837 |
| MIN(-1) | 0.599156 | 0.129130 | 4.639962 | 0.0004 |
| R-squared | 0.809965 | | | |
| Adjusted R-squared | 0.619930 | | | |
| S.E. of regression | 2.515201 | | | |
| Sum squared resid | 88.56733 | | | |
| Log likelihood | 57.33799 | | | |
| F-statistic | 4.262193 | | | |
| Prob(F-statistic) | 0.005209 | | | |
| Mean dependent var | | | | 0.376302 |
| S.D. dependent var | | | | 4.079821 |
| Akaike info criterion | | | | 4.988827 |
| Schwarz criterion | | | | 5.696049 |
| Hannan-Quinn | | | | 5.210320 |
| Durbin-Watson stat | | | | 1.772855 |

ARDL Cointegrating And Long Run Form
 Dependent Variable: MIN
 Selected Model: ARDL(1, 2, 0, 2, 0, 0, 3)
 Date: 05/01/24 Time: 18:23
 Sample: 1970 2021
 Included observations: 29

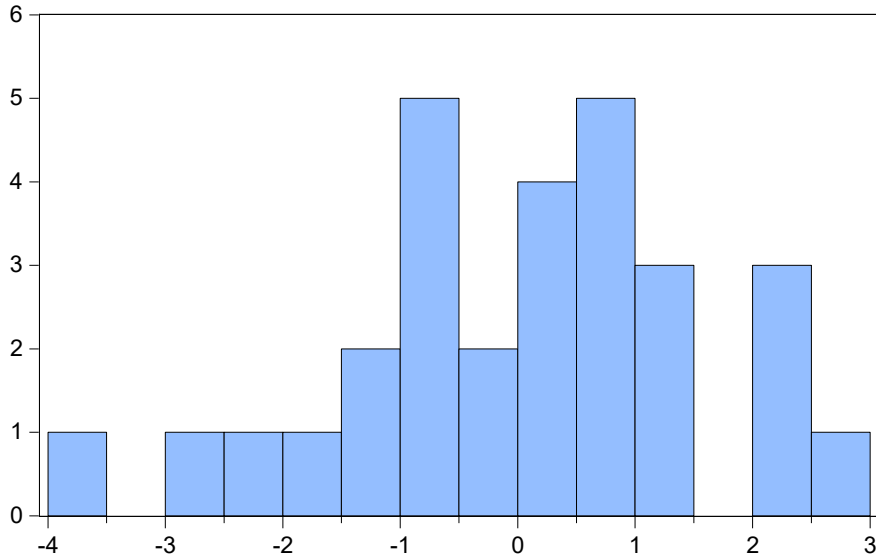
| Cointegrating Form | | | | |
|--------------------|-------------|------------|-------------|-------|
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| | - | 0.00000 | - | 0.121 |
| D(AID) | 0.000000 | 0 | 1.647983 | 6 |
| | - | 0.00000 | - | 0.003 |
| D(AID(-1)) | 0.000000 | 0 | 3.494568 | 6 |
| | - | 0.16249 | - | 0.126 |
| D(ECG) | 0.263967 | 1 | 1.624509 | 6 |
| | - | 8.26868 | - | 0.004 |
| D(EXC) | 28.131534 | 1 | 3.402179 | 3 |
| | - | 4.25104 | - | 0.000 |
| D(EXC(-1)) | 25.320722 | 2 | 5.956357 | 0 |
| | 0.6985 | 0.32653 | 2.13932 | 0.050 |
| D(FDI) | 58 | 2 | 6 | 5 |
| | - | 0.01924 | - | 0.531 |
| D(INF) | 0.012363 | 3 | 0.642432 | 0 |
| | 0.3374 | 0.51074 | 0.66065 | 0.519 |
| D(TAX) | 25 | 3 | 5 | 6 |
| | - | 0.56122 | - | 0.002 |
| D(TAX(-1)) | 2.132153 | 7 | 3.799092 | 0 |
| | 1.2475 | 0.75419 | 1.65410 | 0.120 |
| D(TAX(-2)) | 15 | 5 | 2 | 3 |

| | | | | |
|-------------|----------|---------|----------|-------|
| | - | 0.11468 | - | 0.000 |
| CointEq(-1) | 0.576094 | 9 | 5.023108 | 2 |

$$\text{Cointeq} = \text{MIN} - (0.0000 \cdot \text{AID} - 0.4582 \cdot \text{ECG} + 13.7038 \cdot \text{EXC} + 1.2126 \cdot \text{FDI} - 0.0215 \cdot \text{INF} + 1.0643 \cdot \text{TAX} - 15.3860)$$

Long Run Coefficients

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| | 0.0000 | 0.00000 | 1.38839 | 0.186 |
| AID | 00 | 0 | 4 | 7 |
| | - | 0.31638 | - | 0.169 |
| ECG | 0.458202 | 7 | 1.448231 | 6 |
| | 13.703 | 4.45585 | 3.07547 | 0.008 |
| EXC | 845 | 4 | 0 | 2 |
| | 1.2125 | 0.60396 | 2.00770 | 0.064 |
| FDI | 77 | 1 | 8 | 4 |
| | - | 0.03466 | - | 0.545 |
| INF | 0.021459 | 3 | 0.619091 | 8 |
| | 1.0643 | 1.48795 | 0.71528 | 0.486 |
| TAX | 05 | 3 | 1 | 2 |
| | - | 24.9439 | - | 0.547 |
| C | 15.385996 | 77 | 0.616822 | 3 |



| | |
|-------------------|-----------|
| Series: Residuals | |
| Sample 1973 2001 | |
| Observations 29 | |
| Mean | 5.02e-15 |
| Median | 0.218403 |
| Maximum | 2.647422 |
| Minimum | -3.940153 |
| Std. Dev. | 1.530960 |
| Skewness | -0.391155 |
| Kurtosis | 3.083596 |
| Jarque-Bera | 0.747957 |
| Probability | 0.687992 |

Breusch-Godfrey Serial Correlation LM Test:

| | | | |
|---------------|--------|---------------------|-------|
| F-statistic | 1.2049 | Prob. F(2,12) | 0.333 |
| | 25 | | 5 |
| Obs*R-squared | 4.8498 | Prob. Chi-Square(2) | 0.088 |
| | 51 | | 5 |

Test Equation:

Dependent Variable: RESID

Method: ARDL

Date: 05/01/24 Time: 18:24

Sample: 1973 2001

Included observations: 29

Presample missing value lagged residuals set to zero.

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|--------|
| MIN(-1) | 0.027527 | 0.131488 | 0.209350 | 0.8377 |
| AID | -1.01E-09 | 8.16E-09 | 0.123936 | 0.9034 |
| AID(-1) | -3.54E-10 | 8.79E-09 | 0.040248 | 0.9686 |
| AID(-2) | 1.59E-09 | 9.53E-09 | 0.166679 | 0.8704 |
| ECG | -0.16631 | 0.166315 | -0.999372 | 0.6935 |
| EXC | 0.067145 | 8.346528 | 0.403720 | 0.9905 |
| EXC(-1) | 0.104648 | 9.025426 | 0.012538 | 0.9062 |
| EXC(-2) | 1.080680 | 4.338564 | 0.119737 | 0.9067 |
| | 1.420705 | | 0.327460 | 0.7490 |

| | | | | |
|--------------------|----------|-----------------------|----------|--------|
| | - | 0.33516 | - | 0.773 |
| FDI | 0.098515 | 7 | 0.293928 | 8 |
| | - | 0.02033 | - | 0.788 |
| INF | 0.005585 | 5 | 0.274640 | 3 |
| | - | 0.55175 | - | 0.898 |
| TAX | 0.071835 | 6 | 0.130194 | 6 |
| | - | 0.64395 | - | 0.685 |
| TAX(-1) | 0.267286 | 4 | 0.415070 | 4 |
| | 0.1837 | 0.56622 | 0.32455 | 0.751 |
| TAX(-2) | 69 | 8 | 0 | 1 |
| | - | 0.79210 | - | 0.773 |
| TAX(-3) | 0.233269 | 7 | 0.294491 | 4 |
| | 6.1122 | 14.9726 | 0.40822 | 0.690 |
| C | 43 | 9 | 6 | 3 |
| | 0.0969 | 0.36072 | 0.26869 | 0.792 |
| RESID(-1) | 26 | 8 | 5 | 7 |
| | - | 0.31474 | - | 0.151 |
| RESID(-2) | 0.481932 | 3 | 1.531191 | 6 |
| <hr/> | | | | |
| R-squared | 0.1672 | | | 5.02E- |
| Adjusted R-squared | 36 | Mean dependent var | | 15 |
| | - | | | 1.530 |
| S.E. of regression | 0.943115 | S.D. dependent var | | 960 |
| Sum squared resid | 2.1340 | | | 4.643 |
| | 92 | Akaike info criterion | | 984 |
| Log likelihood | 54.652 | Schwarz criterion | | 5.445 |
| | 19 | Hannan-Quinn | | 503 |
| F-statistic | - | | | 4.895 |
| Prob(F-statistic) | 50.33777 | crit. | | 010 |
| | 0.1506 | | | 2.104 |
| | 16 | Durbin-Watson stat | | 105 |
| | 0.9996 | | | |
| | 46 | | | |

Heteroskedasticity Test: Breusch-Pagan-Godfrey

| | | | | |
|---------------------|--------|----------------------|--|-------|
| F-statistic | 0.4055 | | | 0.948 |
| | 58 | Prob. F(14,14) | | 7 |
| Obs*R-squared | 8.3676 | Prob. Chi-Square(14) | | 0.869 |
| Scaled explained SS | 2.0316 | Prob. Chi-Square(14) | | 3 |
| | 37 | | | 0.999 |
| | | | | 9 |

Test Equation:
 Dependent Variable: RESID^2
 Method: Least Squares
 Date: 05/01/24 Time: 18:24
 Sample: 1973 2001
 Included observations: 29

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
|----------|-------------|------------|-------------|-------|

| | | | | |
|--------------------|----------|-----------------------|----------|-------|
| | 21.337 | 26.3309 | 0.81036 | 0.431 |
| C | 60 | 4 | 3 | 3 |
| | - | 0.21006 | - | 0.994 |
| MIN(-1) | 0.001434 | 2 | 0.006826 | 6 |
| | -2.37E- | 1.51E- | - | 0.877 |
| AID | 09 | 08 | 0.156811 | 6 |
| | -1.22E- | 1.61E- | - | 0.461 |
| AID(-1) | 08 | 08 | 0.757751 | 2 |
| | 1.65E- | 1.76E- | 0.94071 | 0.362 |
| AID(-2) | 08 | 08 | 7 | 8 |
| | - | 0.29761 | - | 0.206 |
| ECG | 0.394164 | 5 | 1.324409 | 6 |
| | - | 15.1447 | - | 0.229 |
| EXC | 19.02844 | 6 | 1.256437 | 5 |
| | 18.222 | 16.0055 | 1.13848 | 0.274 |
| EXC(-1) | 06 | 3 | 5 | 0 |
| | 3.9384 | 7.78613 | 0.50582 | 0.620 |
| EXC(-2) | 12 | 0 | 4 | 9 |
| | 0.4970 | 0.59807 | 0.83107 | 0.419 |
| FDI | 38 | 0 | 0 | 9 |
| | - | 0.03524 | - | 0.191 |
| INF | 0.048360 | 6 | 1.372058 | 6 |
| | 0.0860 | 0.93546 | 0.09201 | 0.928 |
| TAX | 79 | 7 | 7 | 0 |
| | 0.4577 | 1.07403 | 0.42620 | 0.676 |
| TAX(-1) | 61 | 5 | 7 | 4 |
| | 0.3681 | 1.02793 | 0.35813 | 0.725 |
| TAX(-2) | 42 | 3 | 8 | 6 |
| | - | 1.38136 | - | 0.160 |
| TAX(-3) | 2.048545 | 9 | 1.482981 | 2 |
| <hr/> | | | | |
| R-squared | 0.2885 | | | 2.263 |
| Adjusted R-squared | 39 | Mean dependent var | | 017 |
| | - | | | 3.324 |
| S.E. of regression | 0.422922 | S.D. dependent var | | 410 |
| | 3.9655 | | | 5.899 |
| Sum squared resid | 66 | Akaike info criterion | | 418 |
| | 220.15 | | | 6.606 |
| Log likelihood | 99 | Schwarz criterion | | 640 |
| | - | Hannan-Quinn | | 6.120 |
| F-statistic | 70.54157 | crit. | | 911 |
| | 0.4055 | | | 2.125 |
| Prob(F-statistic) | 58 | Durbin-Watson stat | | 813 |
| | 0.9486 | | | |
| | 73 | | | |

Ramsey RESET Test
Equation: UNTITLED
Specification: MIN MIN(-1) AID AID(-1) AID(-2) ECG EXC EXC(-1)
EXC(-2) FDI INF TAX TAX(-1) TAX(-2) TAX(-3) C
Omitted Variables: Squares of fitted values

| | Value | Df | Probability |
|--|-------|----|-------------|
|--|-------|----|-------------|

| | | | |
|-------------|--------------|---------|--------|
| t-statistic | 0.128 986 | 13 | 0.8993 |
| F-statistic | 0.016 637 | (1, 13) | 0.8993 |

F-test summary:

| | Sum of Sq. | Df | Mean Squares |
|------------------|---------------|----|-----------------|
| Test SSR | 0.083 883 | 1 | 0.0838 83 |
| Restricted SSR | 65.62 749 | 14 | 4.6876 78 |
| Unrestricted SSR | 65.54 361 | 13 | 5.0418 16 |

Unrestricted Test Equation:

Dependent Variable: MIN

Method: ARDL

Date: 05/01/24 Time: 18:24

Sample: 1973 2001

Included observations: 29

Maximum dependent lags: 1 (Automatic selection)

Model selection method: Akaike info criterion (AIC)

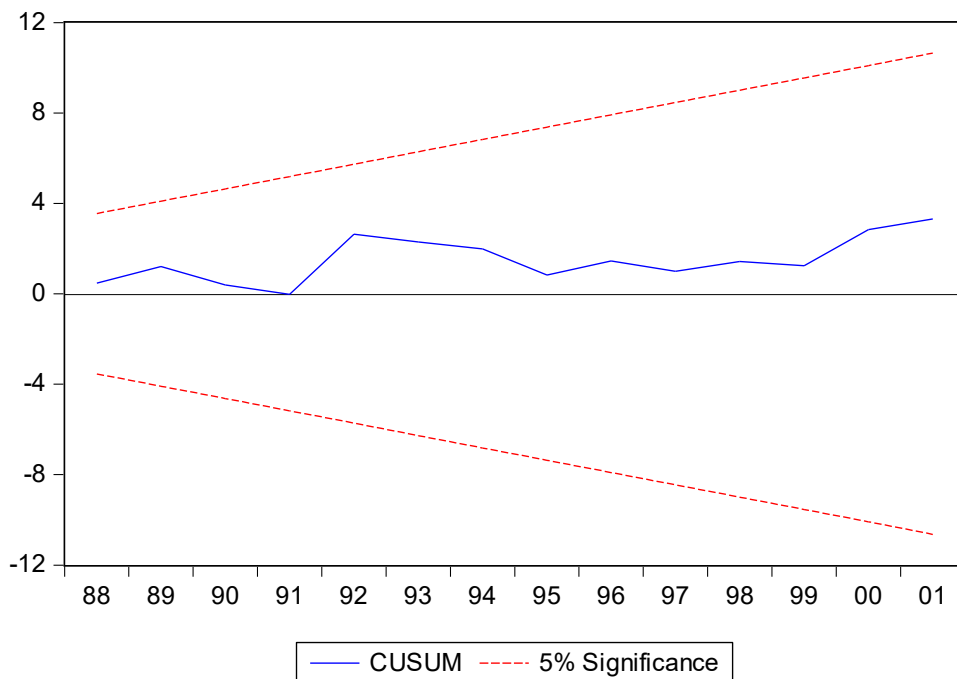
Dynamic regressors (3 lags, automatic):

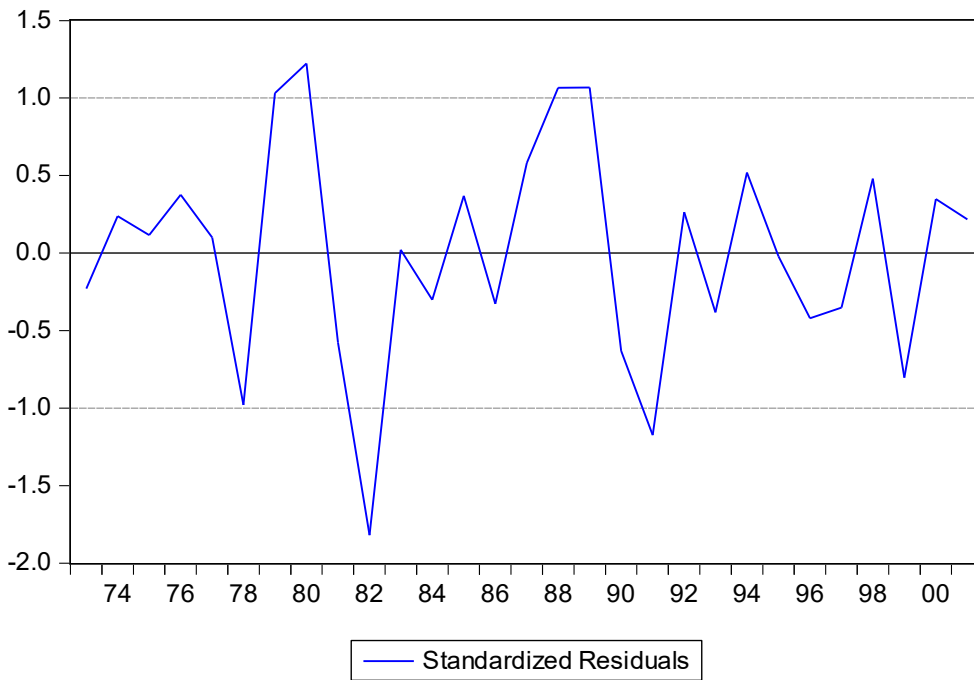
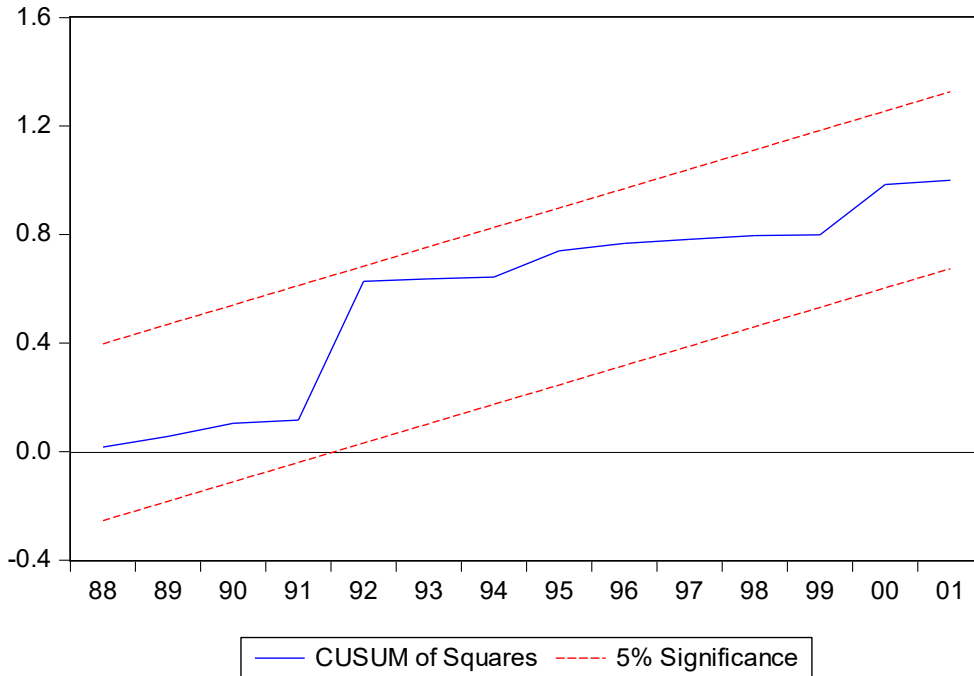
Fixed regressors: C

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|----------|--------------------|---------------|---------------------|------------|
| MIN(-1) | 0.4536 87 | 0.25972 2 | 1.74681 5 | 0.104 2 |
| AID | - | 9.06E-09 | - | 0.146 |
| AID(-1) | 1.40E-08 - | 09 1.02E- | 1.542982 - | 8 0.804 |
| AID(-2) | 2.59E-09 3.63E- | 08 2.42E- | 0.253308 1.50216 | 0 0.157 |
| ECG | 08 - | 08 0.21007 | 6 - | 0 0.205 |
| EXC | 0.280147 - | 4 17.6480 | 1.333560 - | 2 0.111 |
| EXC(-1) | 30.12109 10.820 | 5 9.10623 | 1.706766 1.18822 | 6 0.256 |
| EXC(-2) | 21 27.769 | 7 19.4909 | 0 1.42474 | 0 0.177 |
| FDI | 63 0.7204 | 6 0.37866 | 4 1.90249 | 8 0.079 |
| INF | 15 - | 9 0.02495 | 2 - | 5 0.682 |
| TAX | 0.010430 0.3882 | 7 0.66039 | 0.417895 0.58797 | 8 0.566 |
| TAX(-1) | 97 - | 3 0.64387 | 9 - | 6 0.341 |
| TAX(-2) | 0.636203 2.3389 | 2 1.70588 | 0.988089 1.37113 | 1 0.193 |
| TAX(-3) | 84 - | 0 0.79224 | 1 - | 5 0.134 |
| C | 1.263762 - | 1 32.2428 | 1.595172 - | 7 0.703 |
| FITTED^2 | 12.55134 - | 6 0.03434 | 0.389275 - | 4 0.899 |
| | 0.004430 | 5 | 0.128986 | 3 |

| | | | |
|--------------------|------------------|--------------------|-------|
| | 0.9221 | Mean dependent | 4.218 |
| R-squared | 23var | | 023 |
| Adjusted squared | R- 0.8322 | | 5.482 |
| | 64 | S.D. dependent var | 522 |
| | 2.2453 | Akaike info | 4.756 |
| S.E. of regression | 99criterion | | 745 |
| | 65.543 | | 5.511 |
| Sum squared resid | 61 | Schwarz criterion | 115 |
| | - | Hannan-Quinn | 4.993 |
| Log likelihood | 52.97281 criter. | | 004 |
| | 10.261 | | 1.898 |
| F-statistic | 93 | Durbin-Watson stat | 822 |
| | 0.0000 | | |
| Prob(F-statistic) | 70 | | |

*Note: p-values and any subsequent tests do not account for model selection.





Pairwise Granger Causality Tests
 Date: 05/01/24 Time: 17:49
 Sample: 1970 2021
 Lags: 2

| Null Hypothesis: | Obs | F-Statistic | Prob. |
|--------------------------------|-----|-------------|------------|
| AID does not Granger Cause MIN | 30 | 0.501 13 | 0.61 18 |
| MIN does not Granger Cause AID | | 0.660 38 | 0.52 54 |
| EXC does not Granger Cause MIN | 50 | 4.193 58 | 0.02 14 |
| MIN does not Granger Cause EXC | | 0.792 98 | 0.45 87 |
| FDI does not Granger Cause MIN | 50 | 0.932 69 | 0.40 10 |
| MIN does not Granger Cause FDI | | 0.782 97 | 0.46 32 |
| INF does not Granger Cause MIN | 50 | 1.127 73 | 0.33 27 |
| MIN does not Granger Cause INF | | 1.841 05 | 0.17 04 |
| TAX does not Granger Cause MIN | 30 | 1.551 96 | 0.23 16 |
| MIN does not Granger Cause TAX | | 0.136 05 | 0.87 34 |
| EXC does not Granger Cause AID | 30 | 0.087 14 | 0.91 68 |
| AID does not Granger Cause EXC | | 5.802 76 | 0.00 85 |
| FDI does not Granger Cause AID | 30 | 0.610 07 | 0.55 12 |
| AID does not Granger Cause FDI | | 17.43 61 | 2.E- 05 |
| INF does not Granger Cause AID | 30 | 0.047 06 | 0.95 41 |
| AID does not Granger Cause INF | | 0.103 62 | 0.90 20 |
| TAX does not Granger Cause AID | 30 | 1.269 68 | 0.29 84 |
| AID does not Granger Cause TAX | | 0.564 49 | 0.57 57 |
| FDI does not Granger Cause EXC | 50 | 0.585 87 | 0.56 08 |
| EXC does not Granger Cause FDI | | 0.115 75 | 0.89 10 |
| INF does not Granger Cause EXC | 50 | 0.144 94 | 0.86 55 |
| EXC does not Granger Cause INF | | 0.657 60 | 0.52 30 |
| TAX does not Granger Cause EXC | 30 | 4.000 51 | 0.03 11 |
| EXC does not Granger Cause TAX | | 2.544 95 | 0.09 86 |

| | | | |
|--------------------------------|----|-------|------|
| INF does not Granger Cause FDI | 50 | 2.423 | 0.10 |
| | | 53 | 01 |
| FDI does not Granger Cause INF | | 1.188 | 0.31 |
| | | 36 | 41 |
| TAX does not Granger Cause FDI | 30 | 1.397 | 0.26 |
| | | 11 | 60 |
| FDI does not Granger Cause TAX | | 2.162 | 0.13 |
| | | 75 | 60 |
| TAX does not Granger Cause INF | 30 | 1.658 | 0.21 |
| | | 93 | 06 |
| INF does not Granger Cause TAX | | 0.403 | 0.67 |
| | | 33 | 24 |