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Investigating the impact of financial liberalization on mining productivity in Zimbabwe from 1980 to 2021

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Dissertation accepted in fulfillment of the requirements of the Masters of Commerce Degree in Financial economics at Great Zimbabwe University

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Graduation ceremony: 2023

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DECLARATION FORM

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DEDICATION

I dedicate this successful project to my father and mother, Mr and Mrs Mapingure, for all the love, encouragement; having faith in me and passion they gave me to accomplish this research project.

May God Almighty, bless them abundantly.

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To, God Almighty, l bless your name and give you honour, for all things are possible in your name.

Abstract

Financial liberalization emphasizes on the leading role of market forces in the financial sector of the economy and it is one of the debatable issues in the world economy. However, it is far from clear how financial liberalization actually affects productivity growth in general. This study aims to investigate the impact of financial liberalization on mining productivity over the period of 1980 to 2021. The ARDL approach to co-integration and error correction model were employed to assess the long run relationships. The empirical results obtained from the study indicate that financial liberalization has contributed significantly to the increase in mining productivity. The variables used are as follows the dependent variable, mineral rent representing the mining productivity and the independent variables interest rate, exchange rate, inflation, foreign direct investment, trade openness and mineral depletion. The empirical findings revealed that interest rate, foreign direct investment and mineral depletion had a positive impact on mining productivity (mineral rent) and was statistically significant. While, exchange rate, inflation and trade openness had a negative impact on mining productivity and was statistically significant. The main policy recommendations were that government needs to continually implement policies that allow investors to enter and exit the mining sector without any barriers since this would attract new participants to the mining industry and foster competition among the major firms. Government support is required for the small-scale sector to increase its capability for mining and quality control.

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LIST OF ACRONYMS

AIC : Akaike Information Criterion

ARDL : Autoregressive Distributed Lag

ECM : Error Correction Model

EC : Error Correction

FDI : Foreign Direct Investment

GDP : Gross Domestic Product

LR : Long Run

MD : Mineral Depletion

MMCZ : Mineral Marketing Corporation of Zimbabwe

MR : Mineral Rent

PGM : Platinum Group Metals

SR : Short Run

TDO : Trade Openness

ZMDC : Zimbabwe Mining Development Corporation

CHAPTER 1: INTRODUCTION

1.0 Introduction

McKinnon and Shaw in 1973 highlighted the pervasive "financial repression" in developing nations when examining the effects of financial regulations on growth, referring to a wide range of governmental laws that limit the operations of financial intermediaries. They made the argument that nations that practice financial repression typically pay astronomical consequences. Rigid administrative controls on financial operations, such as credit allocation, interest rates, and capital flows, because the financial sector to go out of balance, cause economic losses due to inefficiency, and inhibit economic progress. According to a recent study by Jafarov et al. (2019), growth was considerably harmed by financial repression. In particular, they discovered that restrictions on interest rates slowed economic development by 0.4 to 0.7 percentage points, with greater effects in countries with more developed financial systems. Since mining is a key contributor to the nation's GDP, the slower growth has led to a decline in mining productivity.

The groundbreaking work of McKinnon and Shaw, who argued that financial liberalization will increase savings, promote investments, and spur economic growth, also contributed to the prominence of financial liberalization in the early 1970s. A rising number of economists, such as Durusu-Ciftci et al. (2017), have advocated in support of financial and economic deregulation. The word "liberalization" literally means "removal of controls." When we speak of financial liberalization, what we really mean is the lifting of restrictions and limitations placed on the financial sector by a governing body. Because of this, a lot of countries, especially emerging ones, have decided that financial liberalization is the way to go for their economy. Financial liberalization evolved into a valuable and important monetary policy in many nations that boosts production, particularly in the mining industry. Financial liberalization encourages savings and investment, and it also gives many mining businesses access to credit markets where they can obtain capital to finance their operations. These factors all contribute to productivity growth in the mining industry. The World Bank and the International Monetary Fund began to promote the structural adjustment programs in the 1980s. Governments in some developing nations have implemented the idea of financial liberalization.

Traditional relationships between mining companies, local people, and the government are changing as a result of the financial sector's deregulation in Zimbabwe, which promoted both domestic and international investment in the mining sector, Chigumira and Makochekanwa (2014). This change calls for a reevaluation of the best policy strategies to increase the economic and social benefits of mineral production. The capacity of emerging and transitioning nations to maximize the economic and social benefits of mineral extraction is improved in this article through the consideration of efficient mechanisms.

Below is an overview of typical issues with mineral economies. The potential for leveraging foreign direct investment and the potential to forge new alliances between regional communities, business, the government, and international development organizations through social investment initiatives are also taken into account Chigumira and Makochekanwa (2014). Following the liberalization of the financial sector, the article will concludes with a series of recommendations for the creation and execution of policy approaches toward leveraging mineral production for economic and social benefit. Since mining requires financing from the financial institutions, these recommendations address both policy design and implementation. According to the World Bank (2012), Zimbabwe is a country with a wealth of natural resources, which made this study necessary in light of the aforementioned scholarly discussion. In this study, I examine whether the series of financial liberalization from 1980 to 2022 has had significant effects on the productivity of Zimbabwe’s mining sector and thus contributed to Zimbabwe’s phenomenal economic growth.

1.1 Background

Given the comparative advantage in mineral resources Zimbabwe has, in comparison with other Southern African countries and other developed countries, it is therefore imperative to study the role these mineral resources play on the overall performance of the economy. Since independence (1980) mining sector has contributed an average of about 40% of total exports, Hawkins (2009); the major share coming from gold and other minerals such as ferrochrome, nickel and platinum. There is a geologically created feature known as the Great Dyke which has several types of metals and minerals. This phenomenal feature contains large quantities of chrome and platinum as well as chromites. In the uppermost layers various ores of other metals are found as gold, nickel, copper, and cobalt. Most of these metals occur in company with iron where they are disseminated as metal sulfides. The specific question to be addressed in the study is that, since the country has been exploiting around 40 different minerals and metals in Zimbabwe for the past 42 years the period covered by this research,have these resources contributed to economic growth and development or not.

The mining industry benefited from the deregulation of fiscal and monetary reforms, investment regulations, and trade liberalization during the Economic Structural Adjustment Plan (ESAP) (1991-1996) period. Import-permit formalities were eliminated, making it simple to obtain inputs for the mining industry (Kanyeze et al, 2011). Small-scale miners who were illegally panning for gold in most of the nation's rivers sprang up like mushrooms in the 1990s. The Zimbabwe Mining Development Corporation Act (Chapter 21:08), which formed the Zimbabwe Mining Development Corporation (ZMDC), the government investment vehicle in the mining sector, was also founded during this time. ZMDC is tasked with and required to carry out development the mining industry and perhaps start own business. The Mineral Marketing Corporation of Zimbabwe (MMCZ), a second government-owned corporation in charge of marketing minerals, was likewise made possible by the Mineral Marketing Corporation of Zimbabwe Act: Chapter 21:04. MMCZ is the only authorized marketing and sales representative for all minerals in Zimbabwe.

According to Mugumbate (2010), there hasn't been much exploration in Zimbabwe (for the majority of the minerals) outside of rediscovering discoveries among the more than 6,000 that were already recognized from earlier workings. The majority of minerals have been mined by small-scale miners who lack the capacity and willingness to conduct extensive exploration, even near their deposits. It has been speculated that more of these little mines are located on enormous deposits that demand exploration. Exploration in Zimbabwe has been greatly impacted by sanctions, the guerrilla war of the 1960s and 1970s, and the general and progressive isolation from the international community since the late 1990s (Mugumbate, 2010; Hawkins, 2009). This was particularly true in the earlier eras (1960s and 1970s), when new technologies and exploration methods were being created and successfully used elsewhere.

According to the Chamber of Mines of Zimbabwe (2012), the mining sector increased from 3.6% of GDP in 2006 to 13% in 2011.This was as a result of liberalization policies put in place in 2009, which helped to rebuild mining sector confidence and lead to the reopening of previously closed mines, mostly in the gold mining industry. Positive growth tendencies were evident in the output from month to month and year to year. The use of many currencies also helped to stabilize the economic environment, which supported the expansion. As an illustration, the historical evolution of the gold sector from 1980 to 2014 typically exhibits three phases: (i) increased growth from 1980 to 1999; (ii) a declining tendency from 2000 to 2008; and (iii) a general rebound from 2008 to 2014 (Mlambo, 2018).

Mining is Zimbabwe's main draw, with more than 60 minerals that are traded internationally, claims Mhishi (2020). Despite the abundance of mineral resources for Greenfield ventures in Zimbabwe, only ten of those are fully mined. The 800 mines in Zimbabwe have an annual revenue potential of US$18 billion, but since 2009, they have only produced roughly US$2 billion. This amounts to a tremendous opportunity for Australian and foreign investors as it represents around a tenth of the sector's total potential. In order to increase foreign direct investments, the Zimbabwean government has continued to adopt and put into action investor-friendly measures aimed at calming and regaining investor confidence. The government also liberalizes the financial sector as the away to promote savings and investment from local investors in the mining industry.

As of October 2018, 60% of Zimbabwe's export revenue came from the sale of minerals, while the country's mining industry generated roughly 16% of the country's GDP. In an effort to capitalize on the nation's abundant natural resources, such as the Great Dyke, the second-largest platinum deposit in the world with roughly 2.8 billion tonnes of ore containing the platinum group metals, the government has also laid out ambitious plans to quadruple the sector's total value to $12 billion by 2023. This potential has been hindered by an ineffective industry, which has failed to realize its aim of 40 tons of gold production for 2019 and has only grown to be worth an estimated $3 billion. The nation's lenient licensing laws, which allow foreign firms to own 100% of a mine license for any commodity, save from platinum and diamonds, in perpetuity, are a major contributing factor. This has caused numerous businesses to hold cheaply bought licenses for years without being compelled to turn them into operating mines, reducing

Zimbabwe's potential production and denying smaller and local businesses the chance to pursue projects.

The mining industry in Zimbabwe is highly varied, with around to 40 distinct minerals, claims the Zimbabwe Chamber of Mines (2021). Platinum group metals (PGM), chrome, gold, coal, and diamonds are the main minerals. With over 2.8 billion tons of PGM and 10 billion tons of chromium ore, the nation has the second-largest platinum deposit and high-grade chromium ores in the world. The sector makes up about 12% of the nation's GDP, and the minister of mines asserts that it has the potential to produce US$12 billion annually if the government addresses issues like ongoing power shortages, liquidity crisis, a lack of foreign currency, and policy uncertainty. Low foreign exchange retention requirements have presented difficulties for mineral exporters and affected the mining productivity, especially when the black market exchange rate significantly deviated from the official rate and encouraged smuggling. COVID-19 hampered the government's hopes that the sector would spur economic growth in 2020, but early signs of recovery emerged in 2021, supported by higher global commodities prices. According to the Zimbabwe Chamber of Mines (2022), the government plans to alter the Mines and Minerals Act to make it more progressive and investor-friendly.

1.2 Statement of the Problem

Despite the presence of financial liberalization policy, and the positive improvements in the economy after deregulation of the financial sector, most mining companies and small mines are still faced with liquidity challenges which affect mining productivity in Zimbabwe. Opinions of economists about the role of financial liberalization on mining productivity are still polarized. Since independence (1980) mining sector has contributed an average of about 40% of total exports, Hawkins (2009); the major share coming from gold and other minerals such as ferrochrome, nickel and platinum. There is a geologically created feature known as the Great Dyke which has several types of metals and minerals. The specific question to be addressed in the study is that, since the country has been exploiting around 40 different minerals and metals in Zimbabwe for the past 42 years the period covered by this research, have these resources contributed to economic growth and how financial liberalization affect its productivity . On the other hand there are several economists who are convinced not only that financial liberalization is very important for productivity growth, but also that finance causes growth. Therefore the need to find out the impact of the financial liberalization on economic growth, if the finance sector causes growth or they have no influence on the level of GDP, currently there is stilled mixed economic opinions on the impact of financial liberalization on productivity growth in Zimbabwe, as the available studies had different conclusions towards the topic.

The total contributions of financial liberalization to major economic indicators as well as the bidirectional effect between the variables remain unknown despite the government of Zimbabwe's efforts to liberalize the financial sector. On the other hand, prior research, as noted in the literature review, mostly focused on examining the impact of its constituent parts, such as the liberalization of interest rates, loan disbursement, and total deposit. This study aims to shed light on the effects of total financial liberalization on financial sector expansion, savings and investment, efficient resource allocation, financial stability on mining productivity, which is a major driver of economic growth.

1.3 Objectives of the Study

a) The main objective of this study is to assess the impact of financial liberalization on mining productivity in Zimbabwe.

b) Is there a short-run effect of financial liberalization on mining productivity?

c) Is there a long-run effect of financial liberalization on mining productivity?

1.4 Statement of Hypothesis

Ho: financial liberalization has no effect on mining productivity in Zimbabwe
H_1: financial liberalization has an effect on mining productivity in Zimbabwe

1.5 Significance of the Study

Future research, according to Bakwena and Bodman (2010), should look at how financial sector liberalization affects the way that natural resources affect economic growth in developing nations. By examining the impact of mining and financial liberalization on economic growth in Zimbabwe, this study aims to respond to their suggestion. The author is not aware of any earlier empirical studies that examined how financial liberalization affected mining production, much less those that used Zimbabwe as a focus country. To put it another way, this study is the first of its type to look into a phenomenon like that, especially in the setting of Zimbabwe. The endogeneity issue and the dynamic character of the productivity growth data are also addressed in this work, something totally ignored in previous similar empirical research on the subject matter

This study serves great importance to policies regarding finance and mining productivity in Zimbabwe, it also aim to assist all stakeholders in the mining sector; these could include mining companies, its owners and shareholders, its clients to understand more on what's happening in the mining sector and what could be done. The results of this study are important in implementing economic policies aimed at rejuvenating the Zimbabwean mining sector which was facing difficulties for the last decades. The study results are important to monetary authorities especially when formulating new policies aimed at promoting mining activities which could result in positive impact on mining in Zimbabwe.

1.6 Delimitations of the Study

The study is limited to the period from 1980-2013. Limited time could be controlled by organizing due dates on each chapter of the study and try to meet each in time, so as to have adequate time to come up with a good study at the end. The best way to delimit this problem of unreliable information is to use of reliable records like World Bank records as data sources. If the data on some variables has some missing figures or values, this could force the researcher to try look for other variables with full data or figures before regressing.

1.7 Limitations of the Study

Since the research is country-specific, cross-country panel data will not be collected. Time series data will be used because it is solely focused on Zimbabwe; nonetheless, the data being used has its own limitations and was gathered for other reasons. Yet, it is helpful in this research and adequate to accomplish the desired goal. Although the quality and reliability of secondary data may be in doubt, reliable and trustworthy sources were used to gather it.

Financial resources are likely to have a negative impact on the execution of a solid and thorough research project since they are insufficient for the researcher to access the internet and collect data from data sources. The majority of the data is publicly accessible online and on source websites thanks to the internet.

1.8Organization of the study

The research will employ the following framework or structure: The research on the impact of financial liberalization on mining production is examined in Chapter 2 both theoretically and empirically. In Chapter 3, the technique and an explanation of the variables are offered. While Chapter Five compiles all of the study's findings and policymakers' suggestions on the effect of financial liberalization on mining production, Chapter Four chronicles and presents the findings and their interpretation.

1.9 Conclusion

This Chapter has provided a synopsis of the study by highlighting the introduction, background and problem statement. The Chapter also reflected on justification of the study and the benefits it will bring to the policy makers so as to achieve their goal ensuring stability and high performance of the mining sector. The following chapter aims to review the major theories and empirical literature in the context of the impact of financial liberalization on mining productivity.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

The topic of the study was introduced in the chapter before, along with its background, justification, and significance. The main theories and empirical research in the context of financial liberalization, mining productivity, and growth will be reviewed in this chapter. The Solow-Swan model of economic growth, the Harrod-Domar model, the Endogenous growth theory, and the theory of Financial Liberalization are among the theories. Research from the United States, China, Asia, Ghana, Nigeria, Zimbabwe, and other nations is included in the empirical review.

2.1. Theoratical Literature Review

2.1.1. The neoclassical growth model (Solow–Swan model of economic growth)

The Solow and Swan (1957) neoclassical growth model offers a common framework for understanding economic growth as it aims to comprehend the factors that determine long-term economic growth rate through accumulation of material inputs like physical capital and labor. This model contends that the impact of technological advancement is vital, perhaps even more so than the growth of capital. The neo-classical model of economic growth makes the following assumptions: an aggregate production function with constant returns to scale in labor, reproducible capital, the production of one composite good, net output after depreciation of capital, the payment of labor and capital according to their marginal physical productivities, flexibility of prices and wages, full employment of the available stock of capital, and diminishing returns as capital and labor age. It suggests that when economies experience the same rates of savings, depreciation, labor force expansion, and productivity growth, they will eventually conditionally converge to the same level of income.

The model demonstrates the propensity for the capital-labor ratio to change over time in the direction of the equilibrium ratio when the technical coefficient is changeable. It asserts that a long-term growth rate in per capita depends solely on the external rate of technological advancement. An increase in savings will momentarily increase per capita and per capital K/L output. But, at a higher level of per capita output, both would resume a constant state of growth. An increase in savings will momentarily increase per capita and per capital K/L output. Savings have an impact on the long-term level of per capita output but have no effect on the long-term growth rate of per capita output.

The methods used to assess growth show how diverse the roles played by capital formation and technology advancement in economic growth. Although the Neoclassical model views technology as a driver of economic growth, the rate of technical progress is exogenously determined, this is a clear flaw in the model's explanation of how technology advances.

2.1.2. Harrod–Domar model

Development was seen as a byproduct of real sector development by Harrod and Domar in 1939 and 1946, respectively. Their model is used to analyze economic growth rates in terms of capital productivity and savings rates, particularly in countries with large and expanding populations. According to the Harrod-Domar model, the main development strategy is to mobilize savings and generate investments to hasten economic expansion. According to this concept, the capital-output ratio and the savings ratio are both inversely related to the rate of economic growth. According to the concept, consistent growth rates and full employment are not things that an economy naturally experiences. It comes to the conclusion that while saving and investing is a necessary but not sufficient condition for increased economic expansion. While savings are the engine of the economy, the neo classical model also fails to explain how savings are determined because it treats savings as an external quantity.

2.1.3 Endogenous Growth Theory

The study's analysis of productivity growth is theoretically underpinned by endogenous growth theory. According to Kaldor, the introduction of endogenous growth theory was a considerable improvement over the Neoclassical Growth and the Harrod-Domar Growth Models in 1957. The major technological developments that drive long-lasting productivity rise are clearly identified by the endogenous growth theory. The relationship between input growth and transformation process effectiveness is heavily stressed in the hypothesis as a means of explaining productivity growth (Koushik, 2017). According to the endogenous growth theory, economic activity connected to the advancement of new technological knowledge drives long-term growth. Total factor productivity (TFP), which affects long-term economic growth, is said to be influenced by the pace of technological development.

The measure that provides a thorough measurement of productivity is determined to be total factor productivity (TFP). TFP is the ratio of output (or value added) to a weighted total of the inputs used in the production process, according to Kathuria et al. (2011). Since it is inclusive by nature, it is unaffected by the problem of shifting factor intensities in manufacturing. Both intermediate inputs and capital intensity are taken into account throughout the TFP measurement process. Despite the objections made of the TFP as a notion for gauging company or industry level productivity, numerous authors have used it as a gauge of firm or industry level productivity (Harris & Li, 2012; Ackah et al., 2012; Levine & Warusawitharana, 2014).

2.1.4 Theory of Financial Liberalization

After (Bumann et al., 2013)), published his key paper on the relationship between finance and growth, a number of additional investigations, such as those by Durusu-Ciftci et al., (2017), and Alagidede, (2018), came to support his idea. These studies are acknowledged as serving as the theoretical cornerstone for examining how financial liberalization affects productivity growth in both developed and developing economies. The studies by Schumpeter (1911), widely regarded as the first framework that clarifies the connection between finance and growth hypothesis, emphasize that having a sound financial system in place in an economy is a crucial first step toward producing technological innovation, which results from the wise distribution of economic resources in such a way that resources move from unproductive to productive sectors. Patrick's supply-leading hypothesis, which also claimed that when a well-functioning financial market and the supporting services are made accessible in advance of the time they are needed, they are able to drive the real sectors on the road of expansion, confirms the argument put forward by Schumpeter. This is accomplished by effectively transferring limited economic resources from surplus to deficit spending units while maintaining the highest rates of return on investment (Varela 2018).

2.1.5 Nexus between Financial liberalization and Productivity Growth

No country in the global economy can disregard the crucial functions that the financial systems in both developed and developing nations carry out. Mobilizing financial resources from surplus spending units for productive purposes is one of these tasks. Another crucial function is that the financial system makes risk management easier. The capacity of a nation to shift resources from those seen to be less productive to the more productive sectors is important for economic progress. The entire intermediation process is made possible by the financial system (Restuccia and Rogerson, 2013). The connection between a strong financial system and increased productivity development was first theorized by Schumpeter in 1912. Further investigations have supported and strengthened this claim (Prati et al., 2013). Financial distortions are more likely to be eliminated when sound economic policies are effectively implemented inside an economy. Several research, such those by Dabla-Norris et al. (2013) and Aghion et al. (2005), have found that capital market development has a closer and bigger impact on productivity growth independent of these policies. Due to their capacity to allocate the resources required to increase productive capacity, structural reforms have been found to be one of the economic interventions that have contributed to productivity growth in both developed and developing economies, according to data from Dabla-Norris et al. (2013). The idea that trade openness, effective and well-developed financial systems, and national institutions with the capacity to foster competition and facilitate entry and exit, facilitate productivity growth at the cross-country, sector, industry, and firm levels, is supported by a wealth of evidence that is present in other related studies and literature (Christiansen et al., 2013).

2.2 Empirical Literature

Several types of findings are shown by empirical research on the impact of financial liberalization on productivity growth. Literature has provided explanations for the factors that led to these various results. They include estimating techniques (Krishnan et al., 2014; Nandy&Puri, 2014), the economy's stage of development (Chauvet&Jacolin, 2015; Gatti& Love, 2008), the type of data used (primary or secondary), and the sample size used (Ali &Najman, 2015).

Obamuyi (2009) investigated the connection between Nigeria's economic expansion and the liberalization of interest rates. He demonstrated that the real loan rates have a major impact on economic growth and that there is a long-run relationship between economic growth and interest rate liberalization using annual data from 1970 to 2006 using a co-integration and error-correction model. Additionally, he confirmed a link between investment and economic growth and interest rates and investment. Thus, the findings of Fowowe (2009) that interest rates are growth-enhancing in the long run are confirmed.

The assertion that there is a substantial association between financial liberalization and productivity growth, as documented by various scholars on the topic, has been corroborated by a number of other empirical investigations on the relationship between financial liberalization and productivity growth. The relationship between the rise of financial intermediaries and sources of growth was explored by Beck et al. in 2000. The authors' report indicates that there is a strong positive relationship between financial intermediary development and real per capita GDP growth as well as total factor productivity growth. Economic variables like private credit and liquid liabilities were used as proxies for measuring financial intermediary development in 63 economies for the period 1960-1995. Further empirical research has also highlighted how effective financial systems promote investment and innovation (Levine 2005). The consequence is that there is a larger likelihood that they could benefit from technology transfer in nations where effective financial institutions have been established. Well-developed financial systems have traditionally been the driving force behind efficient capital allocation across and between businesses and industries (Rajan&Zingales, 2001; Tressel, 2008). According to Larrain and Stumpner (2013), the right distribution of resources across and within enterprises and industries resulted in a 17% increase in manufacturing productivity in 10 Eastern European nations that implemented reforms aimed at reducing financial repression.

Using the endogenous growth model, Akpan (2004) conducted a research in Nigeria to theoretically and empirically examine the impact of financial liberalization, manifested in an increase in real interest rates, and financial deepening (measured by the M2/GDP ratio), on the pace of economic growth in Nigeria. The results demonstrated that, despite the fact that interest rate liberalization has a favorable effect; it is unlikely to hasten economic growth on its own. According to Fowowe's (2008) empirical analysis of the effect of financial liberalization on Nigeria's economic growth, the liberalization had a significant positive impact on growth over the long term, supporting the idea that even though it might cause financial fragility in the short term, financial liberalization is growth-enhancing over the long term.

This debate makes use of empirical data found by Krishnan, Nandy, and Puri (2014). Nandy and Puri (2014) assert that the impacts on productivity have always been favorable in every economy where smaller, financially constrained enterprises are resourced with bank funding. Others' studies (Krishnan et al., 2014; Chauvert&Jacolin, 2015), which were based on real-world data from private and public manufacturing companies in the US after interstate banking deregulation made bank financing available to businesses, produced encouraging results. Their findings were consistent with those of Robb and Robinson (2014), who stated that access to bank financing is a crucial component in a company's productivity, particularly when small and fledgling businesses are involved. Ali and Najman discovered other intriguing evidence (2015). They pointed out that savings and lines of credit have demonstrated a substantial positive relationship with productivity growth as determined by Total Factor Productivity (TFP).

For a parallel study in Ghana, Adusei (2013) used annual time series data from 1971 to 2010. In contrast to the previous work, he used the Generalized Method of Moments (GMM), Error Correction Model (ECM), and Fully Modified Ordinary Least Square (FM-OLS) as the estimate methodologies. He pointed out that Ghana's economic growth is impeded by finance. His research showed that financial liberalization hinders growth and is hence harmful to the economy. The study also found that domestic credit to GDP ratio and the money supply to GDP ratio both work against growth in the long- and short-term (Adusei, 2013).

In a study by Cole et al. (2016), they modeled company technology adoption decisions for India, Mexico, and the United States, with the role of external financing as a key factor. It was shown that a financial structure that engages in long-term contracts and effective performance monitoring could be a significant motivator for a corporation to employ sophisticated technology for the aim of boosting improved productivity. They discovered that while the reward occurs later in the firm's development cycle, advanced production methods heavily rely on a large initial capital expenditure. For the same reason, industrialized nations like the US, which have effective financial institutions and systems in place, benefit economically and easily from implementing such cutting-edge technologies. When compared to sophisticated technology, India and Mexico operate flexible systems that enable the adoption of entry-level and intermediate-level technologies, resulting in lower finance demands and shorter pay-off horizons. The consequence is that the type of technology a country chooses can account for variances in TFP between nations. According to Cole et al(2016) analysis, India and Mexico could increase their TFP by

46% and 43%, respectively, if their financial systems were equal to those of the United States (Cole et al., 2016).

Iranian economist Banam (2010) examined the effects of financial liberalization on the country's economic expansion as well as the factors that influence it. The findings demonstrated that Iran's economic growth as measured by GDP is positively and statistically significantly impacted by financial liberalization and thereby support the theory of financial liberalization.

2.3 Conclusion

This chapter has highlighted that how financial liberalization affect growth this also affect mining productivity. In conclusion, both empirical and theoretical literature suggested that liberalization of the financial sector will lead to increase in savings, encourage investments and induce productivity growth. In the following section the researcher will look on methodology, examine Zimbabwe data to find if financial liberalization affects growth that is mining productivity.

CHAPTER 3: METHODOLOGY

3.0 Introduction

Numerous ideas and empirical data that demonstrated how financial liberalization affects mining production were covered in the chapter before. The research techniques employed in the study are now explicitly defined in this chapter. This chapter mainly focuses on research methodology which was used to investigate the impact of financial liberalization on mining productivity in Zimbabwe. The study imported the secondary data from World Bank and Zimstat Data for the period of 1980-2021. The study employed the ARDL approach due to many advantages, including, the fact that the ARDL approach is more efficient on the long run parameter estimates and is often more heterogeneous, given that it enables the estimated standard errors to be unbiased. The chapter is therefore divided into five sections. Following this introduction, model specification followed by the justification of variables which is then followed by analytic techniques and the conclusion of the chapter.

3.1 Theoratical

The model is enhanced by a number of theories. The explanatory variable is built on the foundation of the Solow-swan model and the Harrod-Domar model discussed in chapter 2. These studies are acknowledged as serving as the theoretical cornerstone for examining how financial liberalization affects productivity growth in both developed and developing economies. They widely regarded as the first framework that clarifies the connection between finance and growth hypothesis, emphasize that having a sound financial system in place in an economy is a crucial first step toward producing technological innovation, which results from the wise distribution of economic resources in such a way that resources move from unproductive to productive sectors. The supply-leading hypothesis, which also claimed that when a well-functioning financial market and the supporting services are made accessible in advance of the time they are needed, they are able to drive the real sectors on the road of expansion. This is accomplished by effectively transferring limited economic resources from surplus to deficit spending units while maintaining the highest rates of return on investment. The idea that trade openness, effective and well-developed financial systems, and national institutions with the capacity to foster competition and facilitate entry and exit, facilitate productivity growth at the cross-country, sector, industry, and firm levels, is supported by a wealth of evidence that is present in other related studies and literature.

3.2 Model Specification

The ARDL cointegration approach was developed by Pesaran et al. and Pesaran and Shin in 1999. (2001). In comparison to other earlier and more traditional cointegration techniques, it has three advantages. The ARDL can be utilized when the underlying variables are integrated in orders one, zero, or fractionally, according to the first point. The order in which the variables being analyzed are integrated does not have to match. The second advantage is that the ARDL test performs substantially better in the case of small and limited sample sizes. The third and last advantage is that the ARDL technique enables us to construct accurate long-run model estimations (Harris and Sollis, 2003).The ARDL model used in this study is specified as follows:

$$\Delta Yt = \alpha 0 + \sum_{t=1}^{n} \alpha 1i\Delta Yt - 1 + \sum_{t=1}^{n} \alpha 2i\Delta Fdi\ t - 1 + \sum_{t=1}^{n} \alpha 3i\Delta Gcf\ t - 1 + \sum_{t=1}^{n} \alpha 4i\alpha Open\ t - 1 + \sum_{t=1}^{n} \alpha 5i\Delta Xrt\ t - 1 + \beta 1Y + \beta 2Fdi + \beta 3Gcf + \beta 4Open + \beta 5Xrt\ t + \varepsilon i$$

Where: Δ: $denotes\ the\ first\ difference\ operator$; α: $is\ the\ drift\ component$;

εi: $is\ the\ white\ noise\ residuals$

Hypothesis testing

H0: α1i = α2i = α3i = α4i = α5i = 0 (No cointegration)

H1: α1i ≠ α2i ≠α3i≠ α4i ≠ α5i ≠ 0 (Cointegration), for i= 1, 2, 3, 4, 5.

Decision criteria

Reject H0: if the F-statistic > UB critical bounds value,

Do not reject H0: if the F-statistic < LB critical bounds value.

In order to empirically analyse the long-run relationships and short run dynamic interactions among the variables I am going to apply the autoregressive distributed lag (ARDL) cointegrationtechnique.My econometric investigations with time series data use a regression specification, following other prior studies such as Adusei (2013) and also on the account of the theoretical literature, the model for the study is specified as:

$$MR = \beta_0 + \beta_1 Inf + \beta_2 exr + \beta_3 Ir + \beta_4 fdi + \beta_5 tdo + \beta_6 md + \beta_7 dum + \varepsilon$$

Where: MR = mineral rent (% of GDP);

β: Estimated regression coefficient;

lnf: lnflation;

exr: exchange rate;

ir: interest rate;

fdi: foreign direct investment

tdo: trade openness

md: mineral depletion

dum: dummy

ε: Residuals in the equation

3.3Estimation Technique and and tool

3.3.1 The Autoregressive Distributive Lag (ARDL**)**

A co-integration test is used in the study to examine the impact of financial liberalization on mining produce and to determine the relationship and causality "between these variables. The study employed the ARDL approach due to many advantages, including, the fact that the ARDL approach is more efficient on the long run parameter estimates and is often more heterogeneous, given that it enables the estimated standard errors to be unbiased. More of the ARDL parameters can be freely estimated and the error correction coefficient requires restriction far less frequently than is the case with the Engle Granger approach. According to Pesaran & Pesaran (1997) the RDL also has advantages over other approaches because it fixes the endogenous regressors" and autocorrelation problem at once.

In addition, there are other advantages associated with ARDL approach, relative to other approaches. Firstly, the ARDL approach is flexible because it can be employed even if the variables are of “different order, while other approaches, like Johansen approach, requires the variables to be of the same order (Pesaran and Pesaran, 1997). ARDL estimates and t-tests sizes are assumed to be reliable and effective, compared to other approaches. Lastly, the approach takes preference due to the exceptional estimates power, being found reliable and more efficient in small samples compared to that of the Johansen” technique.

The technique requires the estimation of an error correction model. When there is disequilibrium of variables in short-run, it will therefore be important to specify Error Correction Model (ECM). The “ECM model will describe all the dynamics of disequilibrium of variables in short run. The ARDL model can also be used to drive the ECM by using a simple linear transformation that integrates long run equilibrium and short run adjustments without” losing long run information.

3.4 Definitions and Justification of Variables

3.4.1 Mineral Rent (% of GDP)

The difference between the value of production for a stock of minerals at market prices and their entire production costs is known as a mineral rent, according to World Bank (2011). In order to construct an analytical framework for sustainable development, it is crucial to take into account the contribution of natural resources to economic output. In some nations, revenues from natural resources, particularly those derived from fossil fuels and minerals, make up a sizeable portion of GDP. A large portion of these revenues take the form of economic rents, or profits that exceed the cost of extracting the resources. Economic rents result from natural resources since they cannot be created. Natural resources in fixed supply frequently command returns substantially in excess of their cost of production, but competitive forces drive supply expansion for created commodities and services until economic profits are driven to zero. The liquidation of a nation's capital stock is shown by rents from nonrenewable resources like fossil fuels and minerals, as well as rents from overharvesting of forests. Countries effectively borrow against their future when they use such rents to finance current consumption rather than investing in new capital to replenish what is being used up.

3.4.2 Exchange rate

The rate at which one currency will be exchanged for another is known as the exchange rate. Each nation chooses the regime of exchange rates that will be used for its respective currency. A currency might be hybrid, pegged (fixed), or floating, for instance. Governments have the authority to set restrictions and limits on currency rates. A nation's currency may be strong or weak. Exchange rates in systems with floating exchange rates are set on the foreign exchange market, which is constantly active and available to a wide variety of buyers and sellers. In trying to find a relationship between mineral produce and the exchange rate one would expect mineral prices to be a significant determinant of the real exchange rate, the link probably being transmitted via the terms of trade. I also expect to find evidence that point to the existence of co-movements between the exchange rate and mineral prices. Furthermore, I expect to find evidence that point to the conclusion that exchange rate movements induced by commodity prices have an impact on manufacturing output. There should also be evidence that shows a link between the exchange rate and export performance, with appreciations negatively impacting on the latter.

3.4.3 Interest Rate

An interest rate is the amount of interest that is charged on a loan, deposit, or borrowing as a percentage of the principal amount. The total interest on a loaned or borrowed sum is determined by the principal amount, the interest rate, the frequency of compounding, and the period of time the loan, deposit, or borrowing took place. The lower the interest rate the lower the cost of borrowing, this will boost productivity in the mining sector since the small scale miners are able to access loans from banks to fund their operations and boost production. On the other hand, a country's currency will rise in value when interest rates are high because higher rates will attract more foreign capital and that will boost the mining sector. This will lead to an increase in exchange rates and a strong currency. As a general rule, the higher the interest rates, the more foreign investment a country is likely to attract this will have a positive impact on mining productivity.

3.4.4 Inflation

According to some baseline of buying power in an economy, inflation is the steady increase in the average price of goods and services, Oner (2017). A collection of products and services are measured for inflation during a given time period, often a year in an economy. A currency or unit of account within an economy may lose some or all of its buying power as a result of ongoing price increases for goods and services. Both positive and bad outcomes may result from this impact. Increased general prices lead to an increase in the opportunity cost of holding money, limited resources, and limited goods and services. Employees may seek salary increases as a result of inflation if they believe that rising commodity prices will cause their income to decline and negatively impact their welfare. In addition to growing inequality, inflation can result in "bracket creep" in income tax rate schedules.

The rising inflation sent shockwaves across the mining industry's balance sheets, raising questions about how far cost increases will go given congested supply chains and tightening labor markets. Rising labor costs also put pressure on the industry, mining executives said during earnings calls and in response to questions from S&P Global Market Intelligence. Key items that drove inflation in the third quarter included fuel prices that went through the roof and crucial items like steel, used in construction and mine processing. Inflation has a negative impact on mining productivity because it increases the cost of production.

3.4.5 Foreign Direct Investment

An ownership stake in a foreign company or project is known as a foreign direct investment (FDI) and is made by a foreign investor, business, or government. Typically, the phrase refers to a corporate decision to buy a sizable portion of a foreign company or to buy it altogether in order to expand operations to a new area. The phrase is typically not used to refer to a stock purchase in a single overseas firm. FDI is a crucial component of global economic integration since it forges strong, lasting ties between nations' economies. Foreign investors enable the host nation to improve mining productivity since it brings foreign currency and help to develop infrastructure. Foreign direct investment also promotes mining productivity and has positive impact on mining in the country.

3.4.6 Trade openness

According to Haile (2017), trade openness is measured as the sum of a nation's exports and imports (trade volumes) represented as a percentage of GDP. Trade openness can be advantageous in a number of ways, including a better utilization of countries' resources due to better production conditions, achieving comparative advantage, and utilizing the economics of scale to raise income levels and improve resource allocation effectiveness. Increased development, job reallocation to new pursuits requiring more human capital, and improved cross-border knowledge transfer are all advantages of trade openness. Openness to trade, however, may result in less tax revenue for governments in developing nations. Therefore, trade openness must be accompanied with policies and initiatives that promote macroeconomic stability and a positive investment climate. Finally, trade openness encourages investment as well as economic growth. Furthermore, as trade openness encourages economic growth and investment, it will have a beneficial effect on mining productivity. Trade policies such as average weighted tariff rate and real effective exchange rate improve economic performance through trade.

3.4.6 Mineral Depletion

The value of the stock of mineral resources divided by the lifetime (limited to 25 years) of the remaining reserves is known as the mineral depletion ratio. It includes bauxite, phosphate, iron, copper, nickel, lead, zinc, tin, gold, lead, and lead. Mineral depletion could eventually cause humanity serious problems, due to lower productivity in the mining industry. When the nation uses up the majority of its mineral reserves, mining output will likely to decline.

3.4.7 Dummy Variable

Dummy variable is used to explain some shocks within the time period of this study like cyclones and droughts. In the data collected, one represents the presence of a shock while zero represents there is no shock during that year. The performance of mining sector affected as compared years where there is mild cyclones or no cyclones. However, the presents of natural disasters like cyclones proved to be one of the strong negative effects on mining sector performance. Mining is the back bone of Zimbabwe`s economy, so during cyclones season the performance of mining sector reduced because mining activities is difficult to carryout due to flooding. Small scale miners are more vulnerable due to lack of adequate equipment like compressors and heavy machineries to boost their mining production.

3.5 Data Sources

Table 3.1 Data sources, measurements and value

Variable	**Measured by**	**Value**	**Source**
Mineral rent	The difference between the value of production for a stock of minerals at market prices and their entire production costs, as a % of GDP	US dollar	World Bank
Exchange rate	LCU per US$, Period average	Us dollar	World bank
Interest rate	Lending interest rate	Local currency	World Bank
Inflation	Gdp deflator annual %	Local currency	World Bank
Foreign Direct Investment	Net Inflows (BoP, Current US$)	Us dollar	World Bank
Trade openness	measured as the sum of a nation's exports and imports (trade volumes) represented as a percentage of GDP	Local currency	World Bank and Zimstat
Mineral depletion	value of the stock of mineral resources divided by the lifetime of the remaining reserves	Us dollar	World bank

3.6 Diagnostic Test

I will run some diagnostic checks to make sure the parameters are reliable. The researcher will test for autocorrelation, multicollinearity, heteroscedasticity, and stationarity using maximum likelihood procedures.

3.6.1 Testing for Stationary

A stochastic process is deemed stable if its mean and variance remain constant throughout time since the covariance between two time periods only depends on the lag between the two time periods, not the actual moment at which the covariance is estimated (Gujarati, 2004). To prevent erroneous regression in time series, stationarity testing is crucial. In this inquiry, the unit root test was applied. The unit root has grown in popularity as a stationarity (or non-stationarity) test during the past few years (Gujarati, 2004).

In statistical regression analysis, it is more common practice to avoid working with non-stationary data in order to prevent spurious regression. Numerous time series in the economic and financial sectors exhibit trending or non-stationarity in the mean. The typical assumptions for asymptotic analysis will be incorrect if the variables in the regression model are not stable, and the study will not be able to do useful hypothesis testing on the regression parameters. Two often used unit root tests are the Augmented Dickey-Fuller test and the Phillips-Perron test.

This study uses the Phillips-Perron test Phillips-Perron (PP) test takes care "of the autocorrelation in residual without adding the lagged difference terms. This test is similar to the Augmented Dickey-Fuller test however, the major difference is how each of those tests handles the autocorrelation. The ADF uses a parametric auto-regression to approximate the structure of errors when the" Phillips-Perron test ignores the serial correlation (Gujarati, 2003).

3.6.2 Descriptive Statistics

By presenting several summarized statistics on a variable, such as the mean, median, standard deviation, and, in many cases, the lowest and highest observation, descriptive statistics give a first indication of the variables used in regression analysis. The variables are expected to be regularly distributed if the means and medians are close together. The degree of variance from the mean is measured by the standard deviation, and lower deviations produce more reliable results.A set of data that deviates from the symmetrical bell curve, or normal distribution, is said to be skewn when it exhibits distortion or asymmetry. If the curve is stretched to the left or right, it is referred to as being skewed. A value of zero indicates a symmetrical distribution, a positive value indicates rightward skewness, a negative value indicates leftward skewness, and a value between -3 and +3 indicates typical values for samples from a normal distribution. Positive kurtosis denotes that there are not enough cases in the tails, whereas negative kurtosis denotes that there are too many cases in the tails. Kurtosis measures the heaviness of a distribution's tails.

3.6.3 Optimal Lag Length Test

Cointegration must be tested when the data is non-stationary at level form. Since selecting a higher order lag length than the actual lag length increases the model's mean squared prediction errors and underfitting the lag length commonly results in associated errors, the ideal lag length must first be tested before testing for cointegration. The selection order criteria are used to perform the optimal lag length test. The general rule is to choose the lag length with the least value, regardless of the criterion you choose.

3.6.4 Testing for Normality

The Classical Linear Regression Model's normality assumption specifies that each i is normally distributed, with a mean of 0, variance of 2, and constant covariance, or $\mu i_{\sim} N(0.5^2)$. The ʒderivation of probability or sampling distributions of estimation parameters and variance is made possible by the normalcy assumption. The Jarque-Bera test, the normal probability plot, the graphical tool, and the results histogram are a few examples of normality tests. The Jarque-Bera test is shown in the example below.

Test Jarque-Bera (JB).

The JB test computes the skewness and kurtosis measures of OLS residuals. It is an asymptotic test based on Ordinary Least Squares (OLS) (Gujarati 2004). Here is the test statistic:

$$JB = n[\frac{s^2}{6} + (k-3)^2/24$$

Where: n= sample size

S= skewness coefficient

K= kurtosis coefficient

The above test indicates that for a normally distributed variable, s=0 and k=3. As a result, the JB test is a joint hypothesis where s and k are each 0 and 3, and this statistic asymptotically follows the Chi-square distribution with two degrees of freedom. The hypothesis that the residuals are normally distributed is rejected if the estimated p value of the JB statistic is low, that is, the value of the statistic is different from zero, but accepted if it is high, that is, the statistic is closer to zero.

3.6.5 Testing for Cointegration

Cointegration tests can identify instances where two or more non-stationary time series are combined in such a way that they are unable to drift away from equilibrium. The tests' purpose is to establish the degree to which two variables are affected by the same average price during a certain time period. After determining that the variables are stationary, cointegration experiments "are used to check whether there is impact between them. The aim of using cointegration in this analysis is to look at the long-run equilibrium or relationship between mining productivity represented by mineral rent and the explanatory variables (exchange rate, inflation, interest rate, trade openness and foreign direct investment), as well as to derive the practical economic assumptions based on the findings. This research used Engle-Granger Two- Step approach to search for cointegration. The Engle-Granger method starts by creating residuals based on the static regression and then testing the residuals for the presence of unit roots. It uses other tests to test for stationarity units in time series. If the time series is cointegrated, the Engle-Granger" method will show the stationarity of the residuals.

3.6.6 Testing for Correlation

Finding out if there is a relationship between two or more variables, as well as identifying its strength and direction, is what correlation is all about (Kiganda, 2014). This study evaluated correlation coefficients from the correlation matrix to see if there was a link between the mineral rent and each of the independent variables: interest rates, exchange rate, inflation, Gross Domestic Product and trade openness.

The hypothesis is as follows;

H_0: r =0; correlation does not exist

H_1: r ≠1: correlation exist

The study also involved testing for the statistical significance of the correlation coefficient (r) by obtaining t statistic.

3.6.7 Testing for Autocorrelation

Mankiw (1990) defined autocorrelation as the correlation between individuals within a group of observations that are ordered chronologically (as time series data) or spatially (as space series data) (as in cross-sectional data). The traditional linear regression model in regression makes the assumption that the disturbances have no autocorrelation. The Durbin Watson (D-W) test is used to determine whether there is any autocorrelation. In more formal terms, the D-W test statistic evaluates the linear link between adjacent regression model residuals. Whenever there is no serial association, the D-W statistic will be close to 2. In the worst case, if there is a positive serial correlation, it will be near to zero and less than two. If there is a negative association, the D-W statistic will be in the range of 2 and 4.

Positive serial correlation is the sort of dependence that is most common. When there are 50 or more observations and only a few independent variables, a D-W statistic of less than 1.5 is a strong indicator of positive first order serial correlation. In order to believe that there is no autocorrelation across variables, Chen (2016) claims that the Durbin Watson statistic must be 1.7 to 3.

3.6.8 Testing for Heteroscedasticity

According to Gujarati (2004), heteroscedasticity describes a scenario in which the variance of the disturbance term does not have a constant variance. Furthermore, because the error term includes the omission, model misspecification or variable omission may lead to heteroscedasticity. When the estimator is no longer efficient but nevertheless remains unbiased, heteroscedasticity is present. They lack minimum variance in the class of the unbiased estimator, in other words. Therefore, heteroscedasticity develops when the homoscedasticity assumption is broken, which results in the variances of disturbance terms conditional on explanatory factors no longer being constant. This is symbolically represented as: $E(\mu i) = Si^2$. Outliers, specification errors, changes in data collection methods, changes in discretionary income, heteroskedasticity, and skewness in the distribution of one or more repressors in the model are some of the causes of heteroskedasticity (Gujarati, 2004). To check for heteroscedasticity in this study, the researcher employs the Breusch-Pagan-Godfrey method.

H_0: There is no Heteroscedasticity

H_1: There is Heteroscedasticity

Decision Rule: Accept H_0 if the $Chi^2 > 0.05$ and conclude that the model does not suffer from heteroscedasticity.

3.7 Conclusion

The study's methodology was described in the chapter that came before it. Prior to interpretation, diagnostic tests must be run, which will guarantee the researcher gets accurate estimations. The study will present and interpret the findings in the next chapter.

CHAPTER 4: RESULTS PRESENTATION AND INTERPRETATION

4.0 Introduction

This chapter aims to present the Estimating a time series model using the Autoregressive Distributed Lag (ARDL) for testing the relationship between financial liberalization and mining productivity in Zimbabwe from 1980 to 2021. This chapter presents the empirical results from the estimations done as stated in the preceding chapter. Descriptive statistics will be presented first, while stationarity, cointegration test and regression results in that order. In addition, this chapter will also give an interpretation of the results obtained.

4.1 Descriptive statistics

Descriptive statistic summary is provided below for all the variables presented individually in tables beginning with mineral rent, inflation, exchange rate, interest rate, trade openness and foreign direct investment respectively. The sample consists of 41 observations (1980 to 2021). These descriptive statistics were obtained using the following STATA command:

. summarize logmr loginfl logexch logintr logtdo logfd logmd , detail: the following results were obtained.

Table 4.1: Descriptive Statistics

Variables	Mean	Standard deviation	skewness	kurtosis
Mineral rent	0.68	0.67	0.15	2.1
inflation	3.89	3.27	2.49	13.23
Exchange rate	3.93	12.02	0.69	1.71
Interest rate	3.48	1.49	1.9	7.06
Trade openness	18.04	1.203	-2.87	11.35
Foreign direct investment	16.41	8.22	-1.36	2.91
Mineral depletion	18.31	0.91	0.29	2.1

Source: Student's STATA Computation

The table 4.1 above shows descriptive statistics gives a first indication of the variables used in regression analysis. The variables are expected to be regularly distributed if the means and medians are close together. The degree of variance from the mean is measured by the standard deviation, and lower deviations produce more reliable results. A set of data that deviates from the symmetrical bell curve, or normal distribution, is said to be skewness when it exhibits distortion or asymmetry. If the curve is stretched to the left or right, it is referred to as being skewed. A value of zero indicates a symmetrical distribution, a positive value indicates rightward skewness, a negative value indicates leftward skewness,so from the table 4.1 above mineral rent, inflation, exchange rate, interest rate and mineral rent their positive value indicates rightward skewness, while trade openness and foreign direct investment negative value indicates leftward skewness. and a value between -3 and +3 indicates typical values for samples from a normal distribution. Positive kurtosis denotes that there are not enough cases in the tails, whereas negative kurtosis denotes that there are too many cases in the tails. Kurtosis measures the heaviness of a distribution's tails.

4.2 Diagnostic tests

4.2.1 Stationarity Tests

Before running the model, data should be stationary at least at 5% level of significance. The stationarity test of variables was performed using the Phillips-Perron and Augunted Dickey-Fuller unit-root test. The test is essential since running regressions with non-stationary data may lead to spurious regressions. After performing the tests, mineral rent and inflation were stationary in level but after the first difference, exchange rate, interest rate, trade openness and foreign direct investment became stationary that is they are integrated of order 1.

H_0: Variable has a unit root

H_1: Variable is stationary

Below is a table which summarize the results of the stationarity for all variables

Table 4.2: Unit root test for all variables (Augmented Dickey-Fuller unit-root test)

Variable	Test statistic	1% Critical value	5% Critical value	10% Critical value	P-value
Mineral rent	-2.868	-3.641	-2.955	-2.611	0.0419
Inflation	-4.550	-3.641	-2.955	-2.611	0.0002
Exchange rate	-2.636	-3.655	-2.961	-2.613	0.0413
Interest rate	-2.924	-3.641	-2.955	-2.955	0.0426
Trade openness	-3.492	-3.648	-2.958	-2.612	0.0082
Foreign direct investment	-6.265	-3.648	-2.958	-2612	0.000
Mineral depletion	-7.053	-3.648	-2.958	-2.612	0.000

Source: Student's STATA Computation

Table 4.3: Unit root test for all variables (Phillips-Perron unit-root test)

Variable	Test statistic	1% Critical value	5% Critical value	10% Critical value	P-value
Mineral rent	-3.024	-3.641	-2.955	-2.611	0.0327
Inflation	-4.573	-3.641	-2.955	-2.661	0.0069
Exchange rate	-5.304	-3.648	-2.958	-2.612	0.00
Interest rate	-2.885	-3.641	-2.955	-2.611	0.0472
Trade openness	-3.54	-3.648	-2.968	2.612	0.0070
Foreign direct investment	-6.266	-3.648	-2.958	-2.6112	0.00
Mineral depletion	-7.529	-3.648	-2.958	-2.612	0.00

Source: Student's STATA Computation

From the tables 4.2 and 4.3 above, the p-value is below 5% level of significant for all variables meaning that we reject the null hypothesis and conclude that the data was stationary at first difference. In statistical regression analysis, it is more common practice to avoid working with non-stationary data in order to prevent spurious regression. Numerous time series in the economic and financial sectors exhibit trending or non-stationarity in the mean. The typical assumptions for asymptotic analysis will be incorrect if the variables in the regression model are not stable, and the study will not be able to do useful hypothesis testing on the regression parameters.

Before testing for cointegration, the researcher test for optimal lag length as shown in the table 4.3 below.

Table 4.3: Optimal Lag Test

Lag	FPE	AIC	HQIC	SBIC
0	0.32	1.68	1.79	1.98
1	0.19	1.2	1.33	1.56
2	0.2	1.25	1.39	1.64
3	0.21	1.31	1.46	1.74
4	0.22	1.29	1.47	1.77

Source: Student's STATA computation

The researcher used the Akaike Information Criterion (AIC) and the lag with the smallest AIC figure was 1, therefore, the optimal lag length is 1 lags. In this study lag selection was done in order to select the criterion with the lowest value which is the AIC, this is because the lower the value, the better the model. The importance of lag selection is that when selecting a higher order lag length than the true lag length causes an increase in the mean-square forecast errors of the regression and that under fit-ting the lag length often generates autocorrelated errors.

4.2.2 Testing for Correlation

Correlation shows the relationship between two or more variables, as well as identifying its strength and direction. This study evaluated correlation coefficients from the correlation matrix to see if there was a link between the mineral rent and each of the independent variables: interest rates, exchange rate, inflation, Gross Domestic Product, trade openness and mineral depletion.

Table 4.8: Correlation results

	mr	infil	exch	intr	fdi	tdo	md
mr	1.000						
infil	0.2965	1.000					
exch	-0.0544	-0.0138	1.000				
intr	0.2205	0.8466	0.0225	1.000			
fdi	0.0365	0.1351	-0.6011	0.2465	1.000		
tdo	-0.1907	-0.0055	-0.2183	0.2023	0.6312	1.000	
md	0.4378	0.0692	0.6724	0.0039	-0.6551	-0.5815	1.000

Source: Student's STATA Computation

The table 4.9 above shows that the correlation coefficient between mineral rent and inflation is 0.2965. As the sign of the correlation coefficient is positive, the study concluded that there is a positive correlation between these two variables, that is, as inflation increases as mineral rent also increases.

The correlation coefficient between mineral rent and exchange rate is -0.0544. As the sign of the correlation coefficient is negative, the study concluded that there is a negative correlation between these two variables, that is, as exchange rate increases as mineral rent also decreases.

The correlation coefficient between mineral rent and interest rate is 0.2205. As the sign of the correlation coefficient is positive, the study concluded that there is a positive correlation between these two variables, that is, as interest rate increases as mineral rent also increases.

The correlation coefficient between mineral rent and foreign direct investment is 0.0365. As the sign of the correlation coefficient is positive, the study concluded that there is a positive correlation between these two variables, that is, as foreign direct investment increases as mineral rent also increases.

The correlation coefficient between mineral rent and trade openness is -0.1907. As the sign of the correlation coefficient is negative, the study concluded that there is a negative correlation between these two variables, that is, as trade openness increases as mineral rent also decreases.

The correlation coefficient between mineral rent and mineral depletion is 0.4378. As the sign of the correlation coefficient is positive, the study concluded that there is a positive correlation between these two variables, that is, as mineral depletion increases as mineral rent also increases.

4.2.3 Johansen Cointegration Test

Cointegration test was carried out using the trace statistic and max statistic.

$$H_0: There\ is\ no\ cointegration$$

$$H_1: There\ is\ cointegration$$

Reject null hypothesis when the Trace or Max statistics is greater than 5% critical value.

Table 4.4: Cointegration Test

Maximum Rank	Max Statistic	5% Critical value
0	522.07	124.24
1	264.58	94.15
2	132.52	68.52
3	66.23	47.21
4	36.54	29.68
5	12.46	15.41
6	4.54	3.76
7	0	

Source: Student's STATA computation

As shown in Table 4.4 above, using the Max statistics, we reject the null hypothesis of no cointegration since from rank zero to four the Max statistics is higher than the 5% critical value. For a maximum rank of five cointegration equation, we do not reject the null hypothesis since the max statistics (12.46) is less than the 5% critical value (15.41) and conclude that there is at most five cointegrated equation in the model.

4.3 ARDL Bound Test

Bound testing as an extension of ARDL modeling uses F and t-statistics to test the significance of the lagged levels of the variables in a univariate equilibrium correction system when it is unclear if the data generating process underlying a time series is trend of first difference stationary, the ARDL Bound Test results are shown below.

Table 4.7: ARDL Bound Test

F-statistics		
F-stat	Lower Bound (L.05)	Upper Bound (L.05)
4.966	2.32	3.50
t-statistics		
t-stat	Lower Bound (L.05)	Upper Bound
-4.641	-2.86	-4.57

Source: Student's STATA Computation

If F-statistic is greater than upper bound, there is a long run relationship. In this case, F-statistic is 4.966; it is greater than the upper bound (3.50) and lower bound (2.32), indicating there is long run relationship between the dependent and independent variable. Therefore we reject if F > critical value for I(1) regressors and conclude that there is long run relationship between the mineral rent and independent variables that is interest rate, inflation, exchange rate, FDI and trade openness.

Using the T-statistic, the lower bound is -2.86 and upper bound is -4.57 compared to the t-statistic which is -4.641. If the t-statistic is below the lower bound there is long run relationship between the dependent variable and the independent variable, in this case -4.641> 2.86 in absolute terms. The upper bound is -4.57, compare to -4.641 t-stat, hence there is no long run relationship. Therefore we reject if t > critical value for I(0) regressors and conclude that there is no long run relationship between dependent variable and the independent variable. Therefore, we have to run the ARDL model with the error correction.

4.4 Autoregressive Distributed Lag (ARDL) Results

In a single-equation framework, the autoregressive distributed lag (ARDL) model is used to analyze dynamic relationships with time series data. The distributed lag element of the model allows the dependent variable's current value to depend on both its own historical realizations, and the autoregressive part, and the present and historical values of other explanatory variables. It is possible for the variables to be stationary, nonstationary, or a combination of the two. The ARDL model used to distinguish between long-run and short-run effects, as well as to test for cointegration or, more generally, for the presence of a long-run relationship among the variables of interest. This is done using its equilibrium correction (EC) representation. The ARDL results are shown on the table below.

Table 4.5: ARDL Long-Run Results

Dependent Variable : MR			R-squared	0.9341
Method: ARDL			ADJ R-squared	0.7967
Sample: 1980-2021				
Included Observations : 38				
Variable	Coefficient	Std-Error	t-stat	Prob
ADJ MR	-0.6504943	0.1401761	-4.64	0.001
LR INFIL	-1.109296	0.3976096	-2.79	0.016
EXCH	-0.974219	0.0264433	-3.68	0.003
INTR	1.630504	0.4931943	3.31	0.006
FDI	0.1378391	0.292683	4.71	0.001
TDO	-3.305743	0.725159	-4.39	0.001
MD	1.916424	0.2467559	7.77	0.000

Source: Student's STATA Computation

4.4.1 Mineral Rent

On the table 4.5 above, the Adjustment -0.6504943 is statistically significant at 5% holding other things constant. -0.6504943 is the adjustment time/ the speed of adjustment of error correction of previous period in current period. The error correction term represents the long-run relationship. The error correction coefficient play a crucial role in this error correction estimation as the greater co-efficient indicates higher speed of adjustment of the model from the short-run to the long-run. A negative and significant coefficient of the error correction term indicates the presence of long-run causal relationship.

4.4.2 Inflation

A 1% change in inflation will result in a 1.109296 % decrease in mineral rent as shown on the table 4.5 above, ceteris paribus. Inflation is statistically significant at 5% level. The results show there is negative long-run relationship between inflation and mining productivity. This finding supports the results of Mahadevan and Adjaye (2005) who concluded that the results indicate negative unidirectional causality running from both price series to mining productivity growth. The results show that domestic inflation has a small but adverse effect on mining productivity growth. Inflation in mineral price has a greater negative effect on mining productivity growth. The rising costs for labor, energy and equipment and continued supply chain constraints created a snowball effect of complications for the mining companies.

4.4.3 Exchange Rate

A 1% change in exchange rate will result in a 0.0974219% decrease in mineral rent holding other things constant. Exchange rate is statistically significant at 5% level, as shown on the table 4.5 above. The study shows that exchange rate affect the mining productivity negatively that is there is long run negative relationship between these two variables, and theory also support that Ngandu (2005) in the goods market, a positive shock to the exchange rate of the domestic currency that is an unexpected appreciation will make exports more expensive and imports less expensive. As a result, the competition from foreign markets will decrease the demand for domestic products, decreasing domestic output and price.

4.4.4 Interest Rate

A 1% change in interest rate will result in 1.630504% increase in mineral rent, ceteris peribus. Exchange rate is statistically significant at 5% level as shown on the table 4.5 above. The study showed that there is positive long-run relationship between interest rate and mineral rent. This finding supports the results Obamuyi (2009) who concluded that the real lending interest rates have a significant effect on productivity growth and there exists a long-run relationship. Akpan (2004) also concluded that interest rate liberalization has a positive impact on productivity growth. The study's results show that the lower the interest rate the lower the cost of borrowing, this will boost productivity in the mining sector since the small scale miners are able to access loans from banks to fund their operations and boost production. On the other hand, a country's currency will rise in value when interest rates are high because higher rates will attract more foreign capital and that will boost the mining sector. This will lead to an increase in exchange rates and a strong currency. As a general rule, the higher the interest rates, the more foreign investment a country is likely to attract this will have a positive impact on mining.

4.4.5 Foreign Direct Investment

A 1% change in foreign direct investment will result in increase in mineral rent by 0.1378391% holding other things constant as shown on the table 4.5 above. Foreign direct investment is statistically significant at 5% level. This finding supports the results of Masunda and Choga (2021) who concluded that a one unit increase in FDI would increase productivity in the mining sector. Iddrisu et al (2015); Tondl and Fornero (2008) cited in Masunda and Choga (2021) also concluded that in Africa, FDI to extractive minerals has been positively correlated to productivity in the mining sector. According to the literature, FDI is a pure input component that can increase domestic capital through technology transfer and knowledge spillovers, as predicted by the Neoclassicals and from the standpoint of endogenous growth. Foreign investors enable Zimbabwe to improve mining productivity since it brings foreign currency and help to develop infrastructure. Foreign direct investment also promotes mining productivity and has positive impact on mining in the country.

4.4.6 Trade Openness

The table 4.5 above shows that a 1% change in trade openness will result in a decrease in mineral rent by 3.563449% holding other things constant. Trade openness is statistically significant at 5% level. The study show that trade openness has negative impact on mining productivity. This finding support the results of Menyah, Nazlioglu and Wolde-Rufael (2014) who concluded that trade openness pose a threat to developing nations because they are forced to compete in the same market with stronger nations. This challenge can stifle established local industries or result in the failure of newly developed industries. The study makes the case that the majority of the exports from the mining industry in Zimbabwe are unprocessed raw minerals, which sell for very little money on the global market. Other related findings by Masunda and Choga (2021) who concluded that technical efficiency in the mining sector cannot be improved by trade liberalizing in the mining industry but probably by adopting the best mining methods and sustainable technical capacity.

4.4.7 Mineral Depletion

A 1% change in Mineral depletion will result in increase in mineral rent by 1.916424% holding other things constant. Mineral depletion is statistically insignificant at 5% level. The results supported by Rodriquez and Arias (2008) who concluded that decreasing reserve levels are likely to increase the cost of extraction while technical change contributes to decrease extraction costs, since both effects occur simultaneously it might be difficult to determine the relative magnitude of each effect. Other related studies (Filippou and King 2011 cited in Mitra 2018) concluded that due to technological changes impacts surpassed the detrimental impacts of depletion within a specific range of transition in ores, for a given type of ore set in a specific technological regime. The direct positive impacts of some of the geologic traits for example larger size of ore bodies have helped too. The performance of technology, in terms of balancing the negative effects of depletion on productivity growth, is largely situation-specific, meaning that it varies greatly depending on the type and stage of depletion of the chosen metal, the type of deposits, including the characteristics of the geological zone.

4.5 Post Estimation Test

4.5.1 Autocorrelation Test

The Durbin Watson (D-W) test is used to determine whether there is any autocorrelation. In more formal terms, the D-W test statistic evaluates the linear link between adjacent regression model residuals. Whenever there is no serial association, the D-W statistic will be close to 2. In the worst case, if there is a positive serial correlation, it will be near to zero and less than two. If there is a negative association, the D-W statistic will be in the range of 2 and 4. Positive serial correlation is the sort of dependence that is most common. When there are 50 or more observations and only a few independent variables, a D-W statistic of less than 1.5 is a strong indicator of positive first order serial correlation. In order to believe that there is no autocorrelation across variables, the Durbin Watson statistic must be 1.7 to 3 as shown on the table below, the dw-statistic is 2.13 which are no autocorrelation across variables as shown on the table below.

Table 4.6 Breusch-Godfrey LM test for AUTOCORRELATION

Dw-statistic = 2.13

Lag	Chi2	DF	Pro>chi	
1	19.245	1	0.000	
2	19.819	2	0.000	
3	21.439	3	0.001	
4	33.840	4	0.000	

Source: Student's STATA Computation

4.5.2 Heteroscedasticity test

Table 4.7 Heteroscedasticity results

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity	
Chi2	Prob>chi2
4.33	0.5032

Source: Student's STATA Computation

The p-value = 0.5032, this shows that it is insignificant, we do not reject H0 if the chi2>0.05 and conclude that there is no heteroscedasticity this implies that there is no presence of outlier in the data.

4.6 Conclusion

This chapter has presented and interpreted the results from the ARDL Model Regression. The study shows that inflation, exchange rate and trade openness has negative impact on mineral rent and they are statistically significant, while interest rate, foreign direct investment and mineral depletion has positive impact on mineral rent and they are statistically significant. The next chapter gives the conclusion of the study and the policy recommendations gathering results obtained in this chapter as well as highlight areas for further study.

Chapter 5: Summary, Conclusion and Policy Recommendation

5.0 Introduction

The chapter before explained the Autoregressive Distributed Lag (ARDL) results and demonstrated that, over the long term, the interest rate, inflation, foreign direct investment, and trade openness have a positive impact on the productivity of Zimbabwe's mining industry, which is represented by the mineral rent, except exchange rate which have a negative impact. This chapter includes a part on policy advice and recommendations as well as a summary, conclusion, and results of the study. Finally, this Chapter also highlights topics that need more research. This study's major goal was to look into how financial liberalization affected mining productivity between 1980 and 2021. The results show that there is evidence to reject the null hypothesis that financial liberalization has no impact on Zimbabwe mining productivity. In addition, the study's findings indicate that interest rates, foreign direct investment, inflation, and trade openness all have a long-term impact on mining productivity.

5.1 Summary and Conclusion

These conclusions are made based on the estimation results shown in the previous section. Additionally, depending on the econometric technique used, this section offers policy implications that can be used to ensure that both the present and future generations benefit economically from the mineral resources. The study began with the early on section, taking a look at the foundation of the investigation. The background of the study was attempting to find out what has been occurring in the past concerning mining productivity to where it is now as well as how financial liberalization affects productivity growth and less complex terms what has been the significant inspiration of the study. This introductory chapter went on to discuss the problem statement, research objective and question.

The study in chapter two provides literature review of the study, which is theoretical literature and empirical literature review which discusses how other studies that were conducted found the results between financial liberalization and productivity growth in Zimbabwe and other developing countries. Then chapter three indicated the research methodology dealing with the impact of financial liberalization on mining productivity in Zimbabwe. Statistical techniques were conducted in this study, these statistical techniques include: formulating economic models, unit root test, determining the co-integration using the time series techniques, also the study analyzed the Autoregressive Distributing Lag model and diagnostic tests. The data used in the study determined the impact of financial liberalization on mining productivity in Zimbabwe for the period of 1980-2021. And then chapter four estimated and analyzed the results by utilizing the time series cointegration estimation technique and Autoregressive Distributing Lag model to check the cointegrated relationships between the dependent variable and independent variables. This technique allows prediction of active error correction specification, which gives an estimation of both the long run dynamics and short run of dynamics.

5.2 Policy Recommendations

The results of this study provide strong evidence in favor of the main premise of the study, which is that changes in interest rates have a significant positive impact on mining production. Interest rates will be determined by market forces if the government liberalizes the banking industry. The supply and demand for loans will affect the lending interest rates. Borrowing will be encouraged by low interest rates, which will enable investors in the mining sector to fund their operations at a cheaper cost and increase mining output. Many local miners in Zimbabwe are struggling financially to expand their operations. Therefore, the government is urged by this study to ensure that lending rates are reasonable and that all miners have access to funds when they need to finance their operations.

The study advised the policy makers to implement legislation collectively and progressively requiring new investments in the extraction of minerals to build processing facilities in host countries' mining value addition as this might re-direct economies onto a development path. The focus is on large investors, multinational mining firms that are innovators and have well-established supply networks in global markets to drive mining processing in host nations.

The study also advises the government of Zimbabwe to allow investors to enter and exit the mining sector without any barriers since this would attract new participants to the mining industry and foster competition among the major firms. Free entry and exit of firms create competition which promote efficiency and full utilization of resources and therefore increases productivity in the mining sector.

The government must provide suitable incentives, such as tax breaks and money spend on Research and Development, this will promote research and technology growth. The department of Research and development will assist to come up with all pressing issues that demand immediate attention such as treatment of refractory gold, the decrease of beneficiation electrical power needs and therefore energy costs, high productivity mining methods, techniques for enhancing rock stability during mining. In addition, the government must promote value addition on all mineral produce so that they fetch higher prices on the international markets.

Government support is required for the small-scale sector to increase its capability for mining and quality control. Despite being a crucial part of the Zimbabwean economy, small-scale mining is mostly avoided by service providers. Loan and service providers, including financial institutions and fuel suppliers, may contribute by encouraging this industry while also fostering long-lasting commercial ties. It was acknowledged that the risk involved in this industry worried service providers and financial institutions. A model might be created to reduce this risk and increase productivity.

In Zimbabwe's mining sector, gold panning has become a concern, costing the government a significant amount of foreign money. The focus of efforts should be on determining the root cause of this behavior and finding workable solutions that take into account the societal structure that depends on the illicit but lucrative trade for existence.

Small-scale miners play a crucial role in the socioeconomic structure of Zimbabwe, and their success undoubtedly secures good living conditions for many mining workforce. Therefore, further efforts should be made, including more financial aid, to maintain this sector's maximal output capability. In order to persuade banks (particularly the Zimbabwe Development Bank) to relax their regulations and lend money to small scale miners for the purchase of equipment and replacement parts, more emphasis should be paid to the financing of this mining industry. Clearly, additional resources are required for this sector, just as they have been successfully poured into small-scale agriculture.

5.3 Areas for further study

There are areas that the current research has not been able to cover due to time constraints and other exogenous factors. The study focused on the relationship between financial liberalization on mining productivity using the ARDL Analysis. This study observed that a lot more needs to be researched on the impact of financial repression on mining productivity in Zimbabwe. In addition, there is need to extend the study to assess the impact of government intervention in the financial sector on mining productivity growth. The study use the secondary time series data from 1980 to 2021 but the use of panel data for different countries might give more reliable results that can be used for comparison. Areas of further study may also include using a different methodology for example Vector Error Correction Model (VECM) analysis is foreseeable in the future.

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Appendix

Appendix 1: Research Data

Year	Mr	infil	exch	intr	tdo	fdi	md
1980	3.211776	18.25358	0.000645291	7.5	47941831	1131198500	76170689.57
1981	1.641102	21.6	0.000690976	13	47886776	1667639400	48857037.43
1982	1.026467	25.42958	0.000759946	13	47933888	1627132000	27625837.35
1983	1.485639	22.3928	0.001014234	13	55634400	1110662000	35204673.13
1984	1.394715	20.38532	0.001258937	13	69108193	1082116700	29287202.62
1985	1.291791	23.56851	0.001615516	13	86174501	1004558300	26971364.9
1986	0.993888	22.58587	0.001668476	13	95803580	1122658400	16748470.46
1987	1.326149	20.05234	0.001663462	13	88789405	1006879000	27341409.27
1988	2.390138	14.95382	0.001807734	13	85896286	1461499300	117550038.8
1989	2.059322	19.0238	0.00212134	13	87068878	1246095600	106115557.6
1990	1.229287	23.62543	0.002454518	13	85079083	1526358800	53205750.52
1991	6.556822	31.3	0.003625489	36.7	93773885	1650816800	84904695.91
1992	7.009879	50.09246	0.005104267	39.3	121585601	1366313300	52540492.88
1993	5.66061	35.62557	0.006490494	31.8	135587377	1494901100	32696456.62
1994	5.961453	30.26011	0.008160799	30.3	144337367	1635092100	106741391.2
1995	3.694206	30.58137	0.008675219	34.7	145686450	1398089100	72805956.3
1996	3.990079	29.42459	0.010013713	33.6	135133733	1585919300	90810251.6
1997	3.10029	26.84984	0.012125047	34.7	156183303	1546744200	66493651.23
1998	0.804858	39.69975	0.023706013	49.3	200558865	1328437900	40100259.53
1999	0.7036	66.51782	0.038344711	68	165341485	987298800	34540660.9
2000	0.801847	63.86371	0.044468377	68.5	161325617	907788700	38330457.33
2001	0.564823	79.94713	0.05511466	31.3	162378826	695798400	25484610.75
2002	1.320306	141.2148	0.055098291	45.8	155876527	317105800	79526198.71
2003	1.215036	373.0364	0.698216081	346	139972223	458207300	51573287.31
2004	2.064641	357.9906	5.074419498	202.5	132965489	261781100	91065077.76
2005	1.945654	245.8153	22.38903999	415	123913182	87777200	77811097.94
2006	4.45015	1289.1	164.5473633	500	121603720	85532400	198369033.7
2007	5.529277	66220.3	9686.771484	775	112363008	376244600	251437997.6
2008	2.405775	2.31E+08	6723052032	10600	126168820	226433100	74062375.41
2009	0.912793	0.093318	6162797700	13.12	72767943	1232079529	62412499.33
2010	2.284566	11.059	5602543369	18.63	77082516	2259412007	203901214.4
2011	3.025829	11.47348	5042289037	19	64891943	2453419093	324535821.3
2012	1.961655	11.72493	4482034705	22.5	59590251	1687006841	255978094.4
2013	1.511742	9.633369	3921780373	20.5	43956862	2.95406008	220247623.2
2014	1.484881	0.624975	3361526042	9.47	44847316	3.4251726	223680591.2
2015	0.804563	0.36742	2801271710	8.54	74394816	2.99968736	123099152.1
2016	0.903846	2.014095	2241017378	7.11	78496502	2.66927436	141096284
2017	1.712349	3.056905	1680763046	6.91	77645292	2.74688453	229415756.4
2018	3.09237	200.7696	1120508715	7.13	23060067	3.10172108	445598362.3

2019	2.72964	225.3946	560254383.1	16.18	8089969.8	2.14280558	419713798.8
2020	3.882433	604.9459	51.32901382	33.008	831509.07	1.69903351	520628032.8
2021	3.306037	113.295	88.55244446	45.48	544059.48	1.58509959	470170916

Appendix 2: Stationarity Tests

Mineral Rent

```
. pperron logmr

Phillips-Perron test for unit root                 Number of obs   =        41
                                                   Newey-West lags =         3

                              ───────── Interpolated Dickey-Fuller ─────────
                  Test        1% Critical      5% Critical      10% Critical
               Statistic         Value            Value             Value
──────────────────────────────────────────────────────────────────────────────
 Z(rho)         -16.199          -18.288          -13.012           -10.520
 Z(t)            -3.024           -3.641           -2.955            -2.611
──────────────────────────────────────────────────────────────────────────────
MacKinnon approximate p-value for Z(t) = 0.0327
```

Inflation

```
. pperron loginfl

Phillips-Perron test for unit root                 Number of obs   =        41
                                                   Newey-West lags =         3

                              ───────── Interpolated Dickey-Fuller ─────────
                  Test        1% Critical      5% Critical      10% Critical
               Statistic         Value            Value             Value
──────────────────────────────────────────────────────────────────────────────
 Z(rho)         -21.344          -18.288          -13.012           -10.520
 Z(t)            -3.547           -3.641           -2.955            -2.611
──────────────────────────────────────────────────────────────────────────────
MacKinnon approximate p-value for Z(t) = 0.0069
```

Interest rate

```
. pperron logintr

Phillips-Perron test for unit root               Number of obs   =        41
                                                 Newey-West lags =         3
```

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(rho)	-13.774	-18.288	-13.012	-10.520
Z(t)	-2.885	-3.641	-2.955	-2.611

MacKinnon approximate p-value for Z(t) = 0.0471

Exchange rate

```
. pperron dlogexch

Phillips-Perron test for unit root               Number of obs   =        40
                                                 Newey-West lags =         3
```

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(rho)	-34.929	-18.220	-12.980	-10.500
Z(t)	-5.304	-3.648	-2.958	-2.612

MacKinnon approximate p-value for Z(t) = 0.0000

Trade Openness

```
. pperron dlogtdo

Phillips-Perron test for unit root               Number of obs   =        40
                                                 Newey-West lags =         3
```

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(rho)	-20.366	-18.220	-12.980	-10.500
Z(t)	-3.540	-3.648	-2.958	-2.612

MacKinnon approximate p-value for Z(t) = 0.0070

Foreign Direct Investment

```
. pperron dlogfd

Phillips-Perron test for unit root                Number of obs   =        40
                                                  Newey-West lags =         3

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)         -47.804           -18.220           -12.980           -10.500
 Z(t)            -8.565            -3.648            -2.958            -2.612
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

Appendix 3: Descriptive Statistics

```
. summarize logmr loginfil logexch logintr logtdo logfd logmd, detail

                            logmr
-------------------------------------------------------------
      Percentiles      Smallest
 1%    -.5712429      -.5712429
 5%    -.2208369      -.3515455
10%     -.217089      -.2208369       Obs                  42
25%     .2064345      -.2174557       Sum of Wgt.          42

50%     .6696934                      Mean           .6840574
                        Largest       Std. Dev.      .6674481
75%     1.166824       1.733532
90%     1.710057       1.785314       Variance       .4454869
95%     1.785314       1.880506       Skewness       .1537376
99%      1.94732        1.94732       Kurtosis       2.098685

                          loginfil
-------------------------------------------------------------
      Percentiles      Smallest
 1%    -2.371742      -2.371742
 5%    -.4700441      -1.001251
10%     1.117403      -.4700441       Obs                  42
25%     2.904361       .7001697       Sum of Wgt.          42

50%     3.336045                      Mean           3.891719
                        Largest       Std. Dev.      3.279894
75%     4.729995       6.405139
90%     5.921676         7.1617       Variance        10.7577
95%       7.1617       11.10074       Skewness       2.491446
99%     19.25793       19.25793       Kurtosis       13.23944

                           logexch
-------------------------------------------------------------
      Percentiles      Smallest
 1%    -7.345809      -7.345809
 5%    -7.182263      -7.277405
10%    -6.677487      -7.182263       Obs                  42
25%    -6.009825      -6.893621       Sum of Wgt.          42

50%    -3.005807                      Mean            3.93549
                        Largest       Std. Dev.      12.02834
75%     20.83705       22.34113
90%     22.22334       22.44649       Variance        144.681
95%     22.44649        22.5418       Skewness       .6964843
99%     22.62881       22.62881       Kurtosis       1.711208

                           logintr
-------------------------------------------------------------
      Percentiles      Smallest
 1%      1.93297        1.93297
 5%     1.964311       1.961502
10%     2.144761       1.964311       Obs                  42
25%     2.564949       2.014903       Sum of Wgt.          42

50%      3.06697                      Mean           3.482797
                        Largest       Std. Dev.      1.490954
75%     3.817273       6.028278
90%     5.846439       6.214608       Variance       2.222944
95%     6.214608       6.652863       Skewness        1.90091
99%     9.268609       9.268609       Kurtosis       7.064504
```

logtdo

	Percentiles	Smallest		
1%	13.20681	13.20681		
5%	15.90614	13.631		
10%	17.59872	15.90614	Obs	42
25%	17.903	16.95361	Sum of Wgt.	42
50%	18.27705		Mean	18.04111
		Largest	Std. Dev.	1.203221
75%	18.72178	18.89894		
90%	18.86654	18.90544	Variance	1.44774
95%	18.90544	18.92352	Skewness	-2.870029
99%	19.11662	19.11662	Kurtosis	11.35825

logfdi

	Percentiles	Smallest		
1%	.4606472	.4606472		
5%	.762116	.5300596		
10%	1.010467	.762116	Obs	42
25%	18.29031	.9818066	Sum of Wgt.	42
50%	20.76615		Mean	16.40915
		Largest	Std. Dev.	8.221163
75%	21.12533	21.23467		
90%	21.22454	21.24622	Variance	67.58752
95%	21.24622	21.53837	Skewness	-1.364763
99%	21.62075	21.62075	Kurtosis	2.905797

logmd

	Percentiles	Smallest		
1%	16.63382	16.63382		
5%	17.11029	17.05359		
10%	17.13426	17.11029	Obs	42
25%	17.50689	17.12391	Sum of Wgt.	42
50%	18.1807		Mean	18.30633
		Largest	Std. Dev.	.9178139
75%	19.13315	19.85508		
90%	19.59791	19.91493	Variance	.8423823
95%	19.91493	19.96861	Skewness	.2699304
99%	20.07055	20.07055	Kurtosis	2.100682

Appendix 4: Optimal Lag Test

. varsoc logmr, exog(loginfil logexch logintr logtdo logfd logmd)

Selection-order criteria

Sample: 1984 - 2021   Number of obs = 38

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-24.9634				.316213	1.68228	1.78961	1.98394
1	-14.8446	20.238*	1	0.000	.196098*	1.20235*	1.32501*	1.5471*
2	-14.8427	.00383	1	0.951	.207249	1.25488	1.39287	1.64273
3	-14.8367	.0119	1	0.913	.21915	1.3072	1.46052	1.73814
4	-13.6568	2.3599	1	0.124	.218032	1.29773	1.46638	1.77176

Endogenous: logmr

Exogenous: loginfil logexch logintr logtdo logfdi logmd _cons

Appendix 5: ARDL Bound Test

```
. estat btest

note: estat btest has been superseded by estat ectest
      as the prime procedure to test for a levels relationship.
      (click to run)
```

Pesaran/Shin/Smith (2001) ARDL Bounds Test

```
H0: no levels relationship             F =  4.966
                                       t = -4.641
```

Critical Values (0.1-0.01), **F-statistic**, Case 3

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_7	2.03	3.13	2.32	3.50	2.60	3.84	2.96	4.26

accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors

Critical Values (0.1-0.01), **t-statistic**, Case 3

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_7	-2.57	-4.23	-2.86	-4.57	-3.13	-4.85	-3.43	-5.19

accept if t > critical value for I(0) regressors
reject if t < critical value for I(1) regressors

k: # of non-deterministic regressors in long-run relationship
Critical values from Pesaran/Shin/Smith (2001)

Appendix 6: ARDL Results

```
. ardl logmr loginfil logexch logintr logfd logtdo dum logmd, lags(1 2 2 2 2 4 3 2)ec

ARDL(1,2,2,2,2,4,3,2) regression

Sample: 1984 - 2021                              Number of obs     =         38
                                                 R-squared         =     0.9341
                                                 Adj R-squared     =     0.7967
Log likelihood =  20.001569                      Root MSE          =     0.2544
```

D.logmr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ADJ						
logmr						
L1.	-.6504943	.1401761	-4.64	0.001	-.9559118	-.3450767
LR						
loginfil	-1.109296	.3976096	-2.79	0.016	-1.975613	-.2429795
logexch	-.0974219	.0264433	-3.68	0.003	-.155037	-.0398068
logintr	1.630504	.4931943	3.31	0.006	.5559256	2.705082
logfdi	.1378391	.0292683	4.71	0.001	.074069	.2016092
logtdo	-3.181018	.725159	-4.39	0.001	-4.761004	-1.601032
dum	3.305743	.7877348	4.20	0.001	1.589416	5.02207
logmd	1.916424	.2467559	7.77	0.000	1.378789	2.454059
SR						
loginfil						
D1.	.4088062	.1641018	2.49	0.028	.0512592	.7663533
LD.	.1228065	.0768474	1.60	0.136	-.0446295	.2902425
logexch						
D1.	.1147699	.061776	1.86	0.088	-.0198285	.2493684
LD.	.126081	.0764229	1.65	0.125	-.0404301	.2925922
logintr						
D1.	-.344368	.2391729	-1.44	0.175	-.8654811	.1767451
LD.	-.1550097	.1751721	-0.88	0.394	-.5366769	.2266576
logfdi						
D1.	.0053168	.0155518	0.34	0.738	-.0285677	.0392014
LD.	.0036626	.0149597	0.24	0.811	-.0289319	.036257
logtdo						
D1.	.9976204	.4305919	2.32	0.039	.0594413	1.9358
LD.	.7264043	.3860973	1.88	0.084	-.1148295	1.567638
L2D.	2.172159	.4560484	4.76	0.000	1.178514	3.165803
L3D.	2.461663	.5846026	4.21	0.001	1.187923	3.735403
dum						
D1.	-1.07935	.3565219	-3.03	0.011	-1.856144	-.3025554
LD.	-.1728114	.2607497	-0.66	0.520	-.7409362	.3953133
L2D.	-.2418543	.188768	-1.28	0.224	-.6531445	.1694358
logmd						
D1.	-.4210269	.2557261	-1.65	0.126	-.9782062	.1361523
LD.	-.6774031	.1539329	-4.40	0.001	-1.012794	-.3420121
_cons	12.97034	6.929619	1.87	0.086	-2.128007	28.06868

Appendix7: Correlation Test

```
. corr logmr loginfil logexch logintr logfd logtdo logmd
(obs=42)
```

	logmr	loginfil	logexch	logintr	logfdi	logtdo	logmd
logmr	1.0000						
loginfil	0.2965	1.0000					
logexch	-0.0544	-0.0138	1.0000				
logintr	0.2205	0.8466	0.0225	1.0000			
logfdi	0.0365	0.1351	-0.6011	0.2465	1.0000		
logtdo	-0.1907	-0.0055	-0.2183	0.2023	0.6312	1.0000	
logmd	0.4378	0.0692	0.6724	0.0039	-0.6551	-0.5815	1.0000

Appendix 8: Autocorrelation

```
. estat bgodfrey, lag(1)
```

Breusch-Godfrey LM test for autocorrelation

lags(*p*)	chi2	df	Prob > chi2
1	19.245	1	0.0000

H0: no serial correlation

```
. estat bgodfrey, lag(2)
```

Breusch-Godfrey LM test for autocorrelation

lags(*p*)	chi2	df	Prob > chi2
2	19.819	2	0.0000

H0: no serial correlation

```
. estat bgodfrey, lag(3)
```

Breusch-Godfrey LM test for autocorrelation

lags(*p*)	chi2	df	Prob > chi2
3	21.439	3	0.0001

H0: no serial correlation

```
. estat bgodfrey, lag(4)
```

Breusch-Godfrey LM test for autocorrelation

lags(*p*)	chi2	df	Prob > chi2
4	33.840	4	0.0000

H0: no serial correlation