I Z A Institute of Labor Economics
Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 13586

The Extractive Industry's Impact on Economic Growth in SADC Countries

Simeão Nhabinde
Almas Heshmati

AUGUST 2020

DISCUSSION PAPER SERIES

IZA DP No. 13586

The Extractive Industry's Impact on Economic Growth in SADC Countries

Simeão Nhabinde
Eduardo Mondlane University

Almas Heshmati
Jönköping University and IZA

AUGUST 2020

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

The Extractive Industry's Impact on Economic Growth in SADC Countries

The Southern African Development Community (SADC) countries are rich in natural resources and in most of them their extractive industries extract and export natural resources with little industrial processing. This study analyzes the direct and indirect impacts that the extractive industries in the SADC countries have on their economic growth. The study also examines the hypothesis of economic convergence. Its empirical results are based on data from the 11 founding SADC countries covering the period 2004-17. The results show that despite the process of integration, the SADC economies do not converge in terms of per capita incomes. The extractive industries have direct negative impacts on the countries' economic growth thus providing evidence of a resource curse. Extractive industries in South Africa, Botswana, and Namibia have positive direct impacts on their economic growth. However, in terms of indirect impacts, the extractive industries do not have any impact on GDP because their impact on manufacturing, human capital, public expenditure, economic openness, exchange rate, and inflation is insignificant. The study also shows that GDP, the colonial path followed by these countries, and inflation have a negative but insignificant impact on extractive industries, while manufacturing, government expenditure, and economic openness have positive but insignificant impacts in all SADC countries. Human capital and exchange rate are the only factors that have both significant positive and negative impacts on economic growth, respectively.

JEL Classification: N57, Q13, P48

Keywords: SADC, extractive industry, growth impact, natural resources, resource curse, Africa

Corresponding author:
Almas Heshmati
Jönköping International Business School
Jönköping University
P.O. Box 1026
SE-551 11 Jönköping
Sweden
E-mail: almas.heshmati@ju.se

1. Introduction

In general, all Southern African countries are rich in natural resources. Since their European colonization in the 19th century their economies have been shaped as extractive economies. The single goal was the extraction of these resources with the objective of feeding industries in their respective metropolises with raw materials. Growth happened because of the growth and progress in these metropolises. The only exception was South Africa. In the post-independence period and at present, this structure of the colonial economy has not undergone any transformation. The countries still have economies based on industries that extract their natural resources and export these to the old metropolises and other international markets without any transformation and/or processing. Therefore, their income gains from natural resources are the incomes that the extractive industries get from the extraction and marketing of raw materials without any industrial processing, that is, the extractive industries' do not lead to any positive spill-over effects on other local industries.

After the Second World War (WWII), authors like Rostow (1961) who were aligned with the classical worldview, argued that having natural resources was a necessary foundation, if not the reason, for growth taking-off. However, in the 1980s studies paradoxically showed that countries rich in natural resources or which had abundant natural resources were not witnessing sustainable economic growth. Such studies developed a hypothesis which they called a 'resource curse'. The term shows the negative relationship between abundance of natural resources and poor growth of the economy. This hypothesis is still under scrutiny as it shows that the growth effect not only reduces convergence but also contributes to divergence and increased inequalities in development.

This study analyzes the direct and indirect impacts of extractive industries on economic growth in SADC countries. Its aim is to verify the resource curse hypothesis and its transmission channels. Its objective is verifying the Solow convergence hypothesis in SADC countries. For this, we developed an econometric model based on panel data on the 11 founding SADC countries which shows that the resource curse has a direct impact of extractive industries' incomes and that this is negative and statistically significant. The study covers the period 2004 -17. We chose 2004 as the starting point because one of the SADC countries, Mozambique, had just started experiencing major developments in its extractive industries after the discovery and extraction of natural gas in Pande in the Inhambane province.

This study is organized in five sections. The first section gives the introduction. The second section gives a literature review on the impact that natural resources have on an economy and the resource curse hypothesis. Section 3 outlines the models and discusses the data and estimation methods. Section 4 analyzes the direct and indirect impacts of extractive industries in SADC. Section 5 gives the conclusion and some recommendations.

2. Literature Review

2.1 The precursors of the economic modeling of the Dutch Disease

Badeeb et al. (2017), argue that there are two divergent perspectives on the role that natural resources play in an economy. A more positive perspective of the classical school argues that natural resources play a beneficial role in the process of economic development. This vision was revisited by economists in the post WWII period, especially by Rostow (1961) who argued that natural resources enabled developing countries to take-off. This thinking prevailed till the early 1980s. However, a pessimistic wave also emerged after the Dutch manufacturing industry's poor economic performance and so emerged the concept of the Dutch Disease. Dutch Disease is considered a predecessor of the resource curse hypothesis in economics literature. According to Badeeb et al. (2017), Cordon and Neary (1982), and Corden (1984) are the pioneers of the economic modeling of the Dutch Disease hypothesis.

Gelb and associates (1988), provided the first proof of the existence of a paradox between the sustainability of economic growth and the abundance of natural resources based on a study in oil-producing countries. This paradox was later called the resource curse by Auty (1993). Sachs and Warner (1995), gave the first empirical evidence of the phenomenon. Gylfanson (2001), empirically demonstrated the links between the resource curse and some of the determinants of economic growth, in what we can consider the indirect effects of natural resources in an economy. Since then, studies on the economic impacts of natural resources have multiplied; these studies focus on various aspects and try to prove the existence of the resource curse whose transmission mechanisms overlap between political, economic, and social rationalities. From an economic point of view, the main issues that block the growth of rich economies dependent on natural resources are Dutch Disease; the volatility of commodity prices; economic policy failures; and neglecting education, while the political economy rationalities are linked to rent-seeking, fragility of the institutions, and corruption (Badeeb et al., 2017; Auty, 1997, 1998, 2001, 2003; Gylfanson, 2001).

Frankel (2010), gives six arguments to show that the abundance of hydrocarbons, other minerals, and agricultural products is a curse. First, the secular decline of commodity prices in the international market; second, investments crowding-out in manufacturing, a sector which should offer benefits and spill-overs necessary for dynamic growth; third, the volatility of international prices of fuels and other mining and agricultural commodities; fourth, fragility of the institutions where the physical infrastructure of oil deposits or other resources are controlled by the government or by a hierarchical elite; fifth, tendency for armed conflicts that are hostile to economic growth; and sixth, fluctuations in commodity prices which produce macroeconomic instability via real exchange rate and government spending that imposes unnecessary costs.

Doing an empirical cross-country analysis taking into account the notion of dependency, Sachs and Warner (2001), found that between 1970 and 1990 natural resources had a statistically negative impact in resource-rich countries, which they see as evidence of the resource curse. They also found that these countries had high prices and weak growth led by exports. Income from exports of natural resources measured as a percentage of GDP decreased growth. Institutions measured in terms of the rule of law had a negligible impact. Sachs and Warner's (1995, 1997, 2001), findings led to several empirical reconstructions and deconstructions. Studies placed special focus on institutions which they argued did not matter for the growth paths of the countries that they studied.

Among the studies on the construction and deconstruction of Sachs and Warner's studies, is Gylfanson's (2001) study that turned to the indirect economic impacts of natural resources via human capital. Gylfason found that an increase in natural capital was associated with a decrease in school enrolments and years of schooling. On the other hand, an increase in enrolments in secondary education raised the annual growth rate of per capita GDP. Gylfanson (2001), concludes that the production of human capital through education was inversely related to the abundance of natural resources, and economic growth varied directly because of education.

In a later study using other types of variables and using the average per capita growth between 1960 and 2000 as the dependent variable, Gylfanson (2011), tested the conditional convergence hypothesis. He found that initial income had a negative impact and was significant in the current income of the countries studied. He further noted that while the abundance of resources, measured in terms of the proportion of natural capital being high, the rate of economic growth was relatively low, and dependency measured in terms of natural capital per capita, had a positive effect on growth. The remaining variables like the quality of institutions, investments, and the production of human capital, had a positive and significant impact on growth (Gylfanson, 2011).

2.2 The direct and indirect impacts of resource extraction

Following the reconstructive and deconstructive aspects and also an economic and institutional analysis through the direct and indirect effects of the abundance of natural resources on economic growth, Papyrakis and Gerlagh (2004), found that natural resources had a negative impact on growth if considered in isolation. However, they had a direct positive impact when the model included other explanatory variables, such as corruption, investments, economic openness, trade, and education. Analyzing the direct effects of these variables on growth, the authors found that corruption had a negative effect. Investments, trade liberalization, and schooling had a significant positive impact whereas, the terms of trade had a significant negative impact. A variation of the ratio between the price of exports and the price of imports led growth to drop. According to the authors, the signs of the coefficients went against intuition found in the literature.

An economy characterized by a high ratio of investments, high rate of per capita income, less opening, declining terms of trade, and higher educational standards can experience a relatively high growth rate. In an analysis of the indirect impacts of natural resources, Papyrakis and Gerlagh (2004), found that natural resources had a significant positive impact on corruption, terms of trade, and investments, but a negative impact on schooling. So, as transmission channels of the resource curse, corruption had an indirect impact while natural resources had a direct positive effect on economic growth. Investments had a negative indirect impact. The international channels of transmission which impact the effects of natural resources are the degree of openness of the economy and its terms of trade; all these were indirectly negatively impacted by natural resources. An abundance of resources reduced economic openings and effected the terms of trade. The education channel resulted in almost twice the effect of corruption, contrasting Sachs and Warner's (1995, 1999), findings that corruption had a greater negative effect on economic growth.

In their initial review, Brunnschweiler and Bulte (2008), identified three alternative measures of abundance of resources (hydrocarbons reserves' per capita in 1993; estimates of the per capita value of stocks in 1970; and the main fuel and non-fuel mineral resources). The World Bank came up with abundance indicators for 2000. On the basis of three equations, these authors took institutions, resource dependence, and growth per capita as the exogenous variables and found that the resource curse vanished when they included dependence on resources and that abundance was positively related to the dependency.

Alexeev and Conrad (2006), found that oil endowments were positively and significantly related to the resource curse. The equation of the ratio of the value of oil production and GDP was also statistically significant. In all instrumental equations, the coefficients of oil wealth were significant. They concluded that their results were less likely to show that oil was a curse. Countries with oil resources tend to have relatively higher levels of GDP. In estimating the impact of global mineral wealth in terms of GDP per capita levels they found that both the variables had positive and significant coefficients. Testing the hypothesis of institutional quality, they showed that countries with weaker institutions benefitted more from natural resources. On the basis of these results, Alexeev and Conrad (2006), concluded that countries with good institutions and which were rich, tended to benefit less from the positive effects of natural resources, while countries with weak institutions that tended to be poor in the absence of substantial natural resources earned relatively large benefits from their natural resources. The authors concluded that Norway will be fine with or without oil, but Kuwait would be poor without oil. This result contradicts Mehlum et al.'s (2006), results.

Rodrik et al. (2004), discuss the primacy of institutions over geography and integration in economic development while Easterly and Levine (2003) emphasize how endowments influence economic development. Sala-i-Martin and Subramanian (2012), argue that institutional quality, in general, will be subject to measurement errors and endogeneity problems. According to them, their results are not consistent with those obtained in a previous study. The impact of natural resources is negative and significant. The overall picture suggests that natural resources have a negative impact on growth through their effect on institutions and once the institutions are controlled for the resources do not have any impact on growth. On the measurement of this indirect effect of natural resources, Sala-i-Martin and Subramanian (2012) noted that an increase in the proportion of natural resources to total exports led to a deterioration in institutional quality resulting in a decline in the growth rate. Fossil fuels and minerals had different institutional effects in relation to other types of resources. Conclusively Sala-i-Martin and Subramanian (2012), argue that in total, some natural resources had a strong, robust, and negative effect on growth, thus undermining institutional quality. Once the effect of institutions was controlled, natural resources had a small and positive effect on growth.

Calculating the estimated effects of the point-source index -- the index for coffee and cocoa -- in the growth equation through best institutions, Isham et al. (2003), found that the effects increased in annual per capita growth and per capita GDP was higher 25 years after the oil crisis in the countries that had better institutions as compared to those countries which had poor institutions. For Mehlum et al. (2006), natural resources lowered aggregate incomes when institutions encouraged thievery and increased incomes when the institutions were friendly with the producers. Using the same data as Sachs and Warner (1995, 1997), Mehlum et al. (2006), found that there was Solow convergence among the countries studied and economic openings had a positive and significant impact on GDP.

2.3 The resource curse in a global context

Variations in openness increase the GDP gap and resource abundance has a negative impact on GDP. With a change in the abundance of resources, the GDP falls; an abundance of minerals has a negative impact on growth; the quality of institutions has a positive and in some cases a negative impact on GDP. Mehlum et al. (2006), found that human capital had a positive though insignificant effect on growth in these countries. Investments had a significant impact, while the type of colonization had a negative and significant impact on growth. Two other aspects discussed by Mehlum et al. (2006), have to do with the idea that the resource curse is purely an African phenomenon. They found that when African countries were excluded from the sample, the coefficients of the variables kept their signs, albeit with some reduction in their values. Hence, they concluded that the phenomenon is not merely African but that there is also no evidence of systematic differences that distinguish African and non-African countries.

In the context of Portuguese speaking African countries like Mozambique and Angola, Vicente (2010), analyzed the impact of natural resources on institutions in Cape Verde, São Tomé, and Príncipe, in the two countries that share many common geographical, institutional, and political characteristics. Vicente (2010) did the research because of announcements of oil discoveries in St. Tomé and Principe between 1997 and 1999. Based on household data, his study shows that the discovery of oil in these two places increased corruption among customs' authorities, in the political process, and in access to educational scholarships abroad.

When it comes to the economic deconstruction of Sachs and Warner's (1995, 1997, 1999, 2001) studies we can also refer to studies by Ding and Field (2004), James (2015), and Mavrotas et al. (2011). Using the same data as Sachs and Warner but introducing capital stock data to estimate the natural capital in the world, Ding and Field (2004), estimated a 3-equation model. The explained variable was GDP. They found that in the initial model, resource endowments had a significant and positive impact on GDP while dependency had a negative and significant impact. In Model II and the growth equation, they found the same results with the difference that the coefficient of resource endowments increased and dependency fell. In the dependence equation, resource endowments had a significant and positive impact. In Model III, the authors found that a growth in resource endowments continued to have a positive and significant impact and dependency had a negative but insignificant impact.

Mavrotas et al. (2011), did a study using panel data from 56 countries between 1970 and 2000. In terms of relations between growth and natural resources, they found that both types of resources (point-sources and diffuse-sources) had a negative but insignificant impact on growth while the exchange rate had a positive effect which was small in magnitude. The terms of trade had a significant negative impact. These results show that dependence of any kind was bad for growth in developing countries. These results are not consistent with those of Isham et al. (2003), who also differentiated point-sources and diffuse-sources.

Ji et al. (2010), used panel data for 28 Chinese provinces using both dependency and abundance of resources though they distinguished between resource abundance and resource income. They measured income in the resource model in terms of production of coal, oil, and natural gas. They obtained a measure of resource abundance by multiplying the resources extracted by their average market prices. Resource dependence was measured by the ratio of investments in fixed assets in the mining industry over investments in all the fixed assets. Using different models, the authors found that provinces with low production of resources showed a weak dependency on resources. However, not all the provinces with a high degree of resource dependence were associated with a large production of resources. The effects of the abundance of resources and resource dependence were the opposite. An abundance of resources contributed to economic development, but excessive dependence on resources inhibited growth.

James (2015), estimated the relationship between GDP per capita and resource dependence between 1970 and 1980 (increasing oil prices) contrasting this with an estimation between 1980 and 1990 (decreasing oil prices). The results showed that there was a strong positive relationship between per capita GDP and prices. For growth between 1980 and 2010 the relationship was negative while the inverse was valid for 1970. Thus, unlike Sachs and Warner (2001), who found a negative relationship between the two, James' (2015), results show a significant positive relationship between growth and dependence between 1970 and 1990.

For resource dependence in specific sectors, James (2015), found that a boom in a resource sector generated positive economic spill-overs increasing growth in the sectors that were not natural resource dependent. When Brunei, Kuwait, and Saudi Arabia were removed from the sample, the results remained positive, but insignificant. So, according to James (2015), the highly resource-rich countries tended to grow rapidly in non-natural resources sectors between 1970 and 1990. Considering the period between 1980 and 1990 (falling oil prices), while growth in the non-resources sectors had an insignificant correlation with resource dependence, the relationship between dependence and a resource sector's growth was negative. After removing the three countries, the magnitude of the resource relationship fell. The resource sector's performance in resource-dependent countries was weak when the prices fell, but this effect was different from the resource curse. A resource curse exists when the production of natural resources today produces a lower level of income in the future and it can inhibit the growth in the corresponding sector of natural resources.

In sum, all we can do is to take into account van der Ploeg's (2011), warning that when empirical evidence is used for an analysis of the impact of natural resources it can lead to any result. Therefore, we must reflect on these conflicting results and work with factors closely associated with growth in developing countries by improving the approach to the endogeneity of the dependency. We do this in our study on Southern Africa using the idea of an extractive industry that provides an income to a country when it exploits natural resources without making any primary changes.

3. Economic Impacts of the Extractive Industry in SADC

According to Badeeb et al. (2017), empirical studies on the role of natural resources in an economy have focused on the problem of the curse using general or specific causal channels. Three main groups can be distinguished. The first follows Sachs and Warner's (1995, 1997, 1999, 2001), specifications where various measures are used for capturing resource abundance or resource dependence. The second group focuses on various economic factors related to growth that may be affected by the wealth of natural resources. The third group casts doubt on the validity of the resource curse.

To clarify the two fundamental concepts used alternately in the studies mentioned earlier, we discuss the extractive industry and not abundance and/or dependency on natural resources. According to Badeeb et al. (2017), resource dependency refers to the degree to which a country depends on natural resources. But these authors do not define the percentage level of this dependency in exact terms. Resource abundance refers to finite wealth allocated from underground or mineral deposits, oil, and gas in a country. So, a country having abundant resources may not be dependent on resources if it diversifies its production structure. The abundance of natural resources is measured by estimated natural resources per capita, while dependence on natural resources is measured by the ratio of exports of natural resources in relation to GDP. For countries that rely on income from natural resources, resource dependence varies between 4.9 percent and 86.0 percent. Dependency can also be captured by examining the composition of exports by a country, where natural resources contribute 60.0-95.0 percent of the total exports. IMF takes the average share of a country's revenue from natural resources over several years (Badeeb et al., 2017).

Taking into account these aspects we determined if the SADC countries were resource dependent over the period of this study (2004-17) and found that, on average, the country that offered the higher yields as a percentage of GDP was Angola with 37.4, followed by Namibia with 17.4; Zimbabwe with 10.6; Mozambique with 10.6; Malawi with 7.8; Tanzania with 7.3; South Africa with 6.7; Lesotho with 4.6; Botswana with 4.5; Swaziland with 3.0; and Namibia with an average of 2.8. Hence, we had countries which we could consider being resource dependent because they did not reach the 4.9 percent of GDP referred to by Badeeb et al. (2017), suggesting that these economies had diversified.

Developing countries with abundant resources cannot extract such resources because they do not have capacity and appropriate technologies. In addition, these countries have no control over the market that allows them to establish an appropriate level of extraction that will meet their real needs for growth. On the contrary, technology developers are keen to limit and control the transfer of these technologies to maintain the economic dependence of developing countries rich in natural resources in such a way that the exploration will meet their interests in terms of the behavior of the market and prices. Thus, we consider revenue from the extractive industry because possessing natural resources is not synonymous with large incomes. In practice, the exploitation of natural resources involves what Collier and Hoeffler (2004), refer to as greed and grievances. Measuring the dependency on natural resources is also a controversial concept. The question is: What is the percentage of income from mineral resources as a share of GDP which classifies a country as dependent on natural resources?

3.1 Methods and procedures

To analyze the economic impacts of the extractive industry in SADC countries we developed an econometric model in three equations accounting for endogeneity. Equation (1) evaluates the direct impacts of the extractive industry via GDP. Equation (2) evaluates the indirect impacts of the extractive industry on the main economic variables affecting the economy; these are also used as control variables in equation (1). Equation (3) evaluates the extent to which these same variables can conversely affect the extractive industry itself. Hence, equations (2) and (3) assess the possible transmission channels of the resource curse which negatively affect the extractive industry. The three equations are:

$$\ln GDP_{it} = \beta_1 EXIND_{it} + \sum \beta_j X_{jit} + \mu_i + \varepsilon_{it} \quad (1)$$

where lnGDP is the logarithm of GDP per capita; EXIND is the extractive industry; X is a vector of variables that explain the variations in GDP; β are the coefficients to be estimated; *i* is the unit of analysis; t is period of time; μ is country specific effects; and ε is the random error term. The vector X is composed of the variables: manufacturing industry (MANU), human capital (HCAP), colonial past (COLON), government expenditure (GOV), economic openness (OPEN), exchange rate (EXRATE), and the inflation rate (INF).

$$X_{it} = \alpha_1 EXIND + \sum \alpha_j Z_{jit} + \mu_i + \varepsilon_{it} \quad (2)$$

where X is the vector of variables that may be affected by the extractive industry; Z is the set of variables that affect growth and that can affect variables X; α is a vector of unknown coefficients to be estimated. The vectors X and Z are composed of variables X in equation (1) minus the variable COLON.

$$EXIND_{it} = \delta_1 \ln GDP_{it} + \sum \delta_j X_{jit} + \mu_i + \varepsilon_{it} \quad (3)$$

where δ is a vector of the unknown coefficients to be estimated; the term ε and the subscripts *i* and *t* are defined as earlier. For equations (1, 2, 3) *i* = 1… N*;* *t* = 1...T. N=11 countries; and T=14 years. Thus, the total number of observations in the model is: 11x14=154. The coefficients α, β, δ were estimated using fixed effects and random effects models and we also performed the Hausman test to check which of the models fit better with the data.

3.2 The data and definition of variables

The data is obtained from the World Development Indicators (WDI). The variable GDP is measured in per capita. The variable extractive industry (EXIND) is measured in terms of income from minerals as a percentage of GDP. WDI defines mineral income as the difference between the value of production and the total cost of production. The minerals included in the calculation are tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate. We exclude income from fossil fuels (oil, gas, and coal). The variable human capital (HCP) is measured in terms of enrolments at the third level as percentage of gross enrolments. We include a dummy variable (COLON) for the colonial past defined as a Portuguese colony (0) or an English colony (1). This variable captures the idea that the colonial past influences economic growth and the performance of the mining industry. It is argued that countries that were colonies of countries with democratic institutions, inclusivists like England, might have sustainable growth and the extractive industry may perform well. On the other hand, countries that were colonies of extractivists like Portugal and Spain are unlikely to witness sustainable growth and good performance by the extractive industry (Acemoglu et al., 2001).

The variable public expenditure (GOV) is measured in terms of the government's final consumption expenditure. It includes defense and security and excludes military expenses. The variable economic openness (OPEN) is measured by the ratio of the sum of external trade by GDP. The EXRATE variable is the real exchange rate against the US dollar calculated as an annual average. Inflation (INFL) is measured by the annual growth rate of the implicit GDP deflector showing the rate of price change in the economy as a whole. All monetary variables are measured in constant 2010 prices.

Insert Table 1 about here

Table 1 gives the summary statistics of the data. It also shows that the panel is balanced and consists of 154 observations. Most of the variables show large dispersions across countries and over time. In terms of normality, all the variables present kurtosis zero (0) and non-zero skewness (0) indicating that the series does not have a normal distribution. In terms of kurtosis, all variables are leptokurtic with the exception of GDP which is pleticurtic. In terms of skewness, with the exception of the COLON variable which features a long tail to the left, all the other variables have a tail to the right. In terms of measures of central tendency and dispersion, GDP presents the highest average, because other variables are all expressed as percentages of GDP and the COLON variable is a dummy. The values of the exchange rate are particularly influenced by the exchange rate of the Zimbabwean dollar from 2006. Due to hyperinflation, in 2009 the Zimbabwean dollar was officially suspended and replaced by the US dollar and officially demonetized on 30 September 2015. However, from 2008 there is no international data on Zimbabwe's exchange rate and so we use the most influential exchange rate in the region, the South African Rand, as since 2008 Zimbabwe has adopted the South African Rand, the Botswana Pula, the Pound Sterling, and the Euro as official currencies.

Insert Table 2 about here

Table 2 gives the correlation matrix, which shows that the regressors do not have a perfect relationship. It suggests that there is no indication of serious collinearity between the explanatory variables and the subsequent risks of confounded effects.

Insert Table 3 about here

Table 3 shows that the variables lnGDP, EXIND, and GOV are stationary at level. The variables MANU, HCAP EXRATE, and INF have unitary root, but are first difference stationary. The OPEN variable is the only variable that is stationary at the second difference.

The existence of a variable with unit root that is stationary only in the second difference makes it impractical to develop a dynamic model in terms of autoregressive (AR), vector error correction (VECM), or an autoregressive distributed lag (ARDL). So, we assume the static panel data model as a suitable estimation method.

4. Analysis of the Estimation Results

Table 4 gives the estimation results of Model 1 which are estimated using fixed effects and random effects models.

Insert Table 4 about here

Table 4 shows that there is a certain patterns of the results using both the methods. The F-test statistics for the fixed effects model and the Wald test statistics for the random effects model are statistically significant at the 5 percent level of significance. This demonstrates how good the two models' specifications are. To determine which model is better we did the Hausman's test. The results are given in Table 5.

Insert Table 5 about here

Table 5 shows that the χ^2 test statistics are statistically insignificant at the 5 percent significance level. So, we do not reject the null hypothesis that the random effects method is appropriate for estimating the model. The individual effects and explanatory variables are not correlated. The results of the test to decide between the pooled OLS method and the random effects method are given in Table 6.

Insert Table 6 about here

The results in Table 6 show that we can reject the null hypothesis that the pooled model is appropriate in favor of the alternative hypothesis that the random effects model is the most appropriate. Hence, our analysis is based on the random effects model at the detriment of the pooled and fixed effects models.

4.1 Random effects model corrected for autocorrelation

The Pesaran serial autocorrelation test shows the existence of autocorrelation. The corrected estimation results are given in Table 7. The table also includes the estimation of the Solow convergence test.

Insert Table 7 about here

In the regression model RM1, Table 7 shows that the lagged lnGDP per capita has a positive and statistically significant effect on current lnGDP. This means that there is no economic Solow convergence between SADC countries despite the economic integration process. These results are not consistent with van der Ploeg and Poelhekke (2017) and Gylfanson's (2011), results who found a convergence between countries rich in natural resources in their samples. The results are also not consistent with Barro (1996) and Sachs and Warner's (1997) studies who found conditional convergence.

The regression model RM2 measures the economic impact of the extractive industry (EXIND) conditional on controlling for all other explanatory variables in the model. The results show that the mining industry had a negative and statistically significant impact on economic growth. This negative effect was consistent with the resource curse hypothesis raised initially by Gelb and associates (1988), coined by Auty (1993), and empirically tested by Sachs and Warner (1995, 1997, 2001), because these authors found that income from exports of natural resources decreased growth in countries between 1960 and 1970. This result is also consistent with Papyrakis and Gerlagh's (2004), study which found a negative impact of the direct and indirect effects of the abundance of natural resources (mining) on economic growth.

The regression models RM3 through RM9 estimate the impact of the extractive industry along with other variables which may explain variations in economic growth, included in a sequential manner according to equation (1). Table 7 also shows that in all the regressions the effect of the extractive industry is negative. These results remain consistent with the results of subsequent regressions by Sachs and Warner (1995, 1997, 2001), Papyrakis and Gerlagh (2004), and Gylfanson (2011). Gylfanson (2011), analyzed the resource curse in terms of resource abundance measured as a proportion of natural capital and found that resource abundance lowered economic growth. These results are not consistent with some results obtained by Ding and Field (2004), Alexeev and Conrad (2006), Brunnschweiler and Bult (2008), Gylfanson (2011), James (2015), Ji et al. (2010), and Sala-i-Martin and Subramanian (2012).

For example, Ding and Field (2004), found that resource endowments increased growth. According to Alexeev and Conrad (2006), oil-related regressions indicated that the effects of oil endowments were positive and significant for growth. This finding is not confirmed by our results because the data from WDI excludes income from fossil fuels. Using three alternative measures of abundance of resources Brunnschweiler and Bult (2008), found that the resource curse vanished when resource dependence was instrumented and that abundance was positively related to dependency.

James (2015), found that countries that were dependent on natural resources in 1970 had a larger per capita GDP growth over the 10 subsequent years reflecting an annual increase in oil prices. Ji et al. (2010), found that the effects of the abundance of resources, income, and resource dependence were opposites. Abundance of resources contributed to economic development in different magnitudes. Gylfanson (2011), found that natural resources measured in terms of natural capital per capita had a statistically positive effect on GDP growth. Finally, Sala-i-Martin and Subramanian (2012), show that once the institutions were controlled for, natural resources had a positive effect on growth and thereby they were a blessing rather than a curse.

In relation to other variables, Table 7 shows that the manufacturing industry (DMANU), human capital (DHCP), and institutions, seen in terms of the colonial past (DCOLON) and the level of prices (DINF) had a positive and weakly significant effect. These results convey the idea that through manufacturing, human capital, and price levels there is no resource curse using the Dutch Disease hypothesis in these economies. We clarify this evidence in equation (2) related to the indirect impacts when analyzing whether the extractive industries affected economic growth.

Table 7 focuses specifically on the variables DCOLON and GOV. The DCOLON variable is a dummy proxy of institutional, Portuguese or English colonization. Literature considers Portugal as a part of those Iberian settlers who developed absolutists, extractivists, and vicious institutions, while England exported inclusive and virtuous institutions (Acemoglu and Robinson, 2012). Thus, one can conclude that overall the economies of the SADC region were not affected by being Portuguese or English colonies.

The GOV expenditure variable had a significant impact on growth. These results contradict the Barguellil et al.'s (2018), findings as they showed that public spending lowered economic growth. In practice, these results are in agreement with Boldeau and Constantinescu (2015), who stated that there are many conflicting points of view in relation to the effects of public expenditure. In this line, Ghosh and Gregoriou (2008) obtained different results using the same methodology. Ghosh and Gregoriou (2008), showed that public expenditure in a sample of 15 LDC had a positive and significant effect. Discussing the ambiguous role of public expenditure, Barguellil et al. (2018, p. 1315) state, "public spending is likely to have a negative effect on growth through crowding-out effects on private investment. On the other hand, an increase in public spending may improve infrastructure and positively affect economic growth. Thus, the associated coefficient may be positive or negative."

Openness economic variables (DOPEN) and the exchange rate (DEXRATE) show a statistically significant impact on growth. The magnitude of the exchange rate (DEXRATE), though positive is close to zero. This is consistent with Mavrotas et al.'s (2011), findings but contrary to Barguellil et al.'s (2018), results who found a negative and significant effect of the real exchange rate on growth in developing countries.

The variable economic openness (DOPEN) had a negative and significant effect on the SADC economies' per capita GDP. These results show that trade liberalization did not develop the terms of trade in SADC countries, counteracting the validity of the hypothesis that international trade acts as an engine of economic growth. The results are not consistent with Barguellil et al.'s (2018), findings as they found a statistically significant and positive impact between the two but are consistent with the Prebisch-Singer hypothesis which states that international trade inhibits economic growth in developing countries. It is also consistent with Udeaja and Obi's (2015), findings from a study conducted in Nigeria and some estimates of Ji et al. (2010), in China who measured the opening up of the economy measure as FDI's proportion of gross investments in fixed assets in Chinese provinces.

4.2 The extractive industry's impacts on GDP at the country level

The results in Table 7 show aggregate results of SADC countries; these results are not country-specific. We try to find out the direct impacts of the extractive industries from the perspective of each country controlling for all other variables. Table 8 reports the results of this estimation. Angola serves as the reference. The table shows that with the exception of Swaziland, extractive industries in SADC countries had a statistically significant impact on economic growth, but the effects were mixed. Among the countries where the impact was positive are Botswana, Namibia, and South Africa. These results, in part, are consistent with reality.

Insert Table 8 about here

Among the developing African countries, Botswana is seen as being rich in natural resources and is considered an example of a good management of national income resulting from the extraction of these resources (Acemuglu and Robinson, 2012). However, this view can be questioned from the point of view of well-being. The rural population in Botswana has not benefited from the income from resource extraction showing inequalities in the distribution of wealth, social stratifications, and exclusion. South Africa is a SADC country where the extractive industry emerged after the discovery of mines in Kimberley in 1856. The management process followed a trend towards investments and diversification in the face of the internal political process. The old Dutch settlers (Boers) achieved independence from England and declared South Africa as their territory. They structured the extractive industry sector such that their net income was for internal development and not for the metropolises. In practice, South Africa is an outlier in the framework of SADC countries. Its mining industry is not limited to extraction. There is internal industry processing, and the use and exports of some final goods from the extractive industry. The extractive industry had the potential to lead to industrialization and creating spill-overs to other industrial sectors. The model was transported to Namibia because post WWI, Namibia was under the South African domain.

The largest negative direct impact of the extractive industry on growth which validates the hypothesis of the resource curse, is in Malawi and Mozambique followed by Lesotho, Tanzania, Zimbabwe, and Zambia respectively. In Mozambique this high magnitude can be justified by the fact that the extractive industry as a source of economic growth is very recent in the country. Its local settlement strategy never bet on this sector. Local labor was exported as cheap labor to the developed South African mines. In the post-independence period, the extractive sector remained dormant due to internal conflicts and so income from it never reverted to the national economy due to illegal and disadvantageous terms of concession contracts.

Zambia's extractive industry is based primarily on copper which has lost importance in modern industry thus leading to great volatility in prices. The situation in Zimbabwe can be associated with constant economic crises accompanied by international sanctions applied initially in 1970 and enforced more vigorously very recently.

4.3 Indirect impacts of the extractive industry

Studies on the curse of natural resources seek to explain this phenomenon through indirect impacts by regressing dependence or the abundance of natural resources on variables which can explain variations in growth. We measure the indirect impacts of the extractive industry (EXIND) on economic growth according to equation (2). The Hausman test shows that the random effects model is the accepted model specification. The estimation results are given in Table 9. With the exception of the regression model (RM1), where the endogenous variable is DMANU, the Wald statistic is significant at the 5 percent significance level, showing a good fit of the model to the data. It shows that the extractive industry (EXIND) did not affect the manufacturing industry and was also not producing the necessary spill-overs to other industrial sectors in the SADC area.

Insert Table 9 about here

The regressions models (RM1), RM2), (RM4), (RM5), and (RM6) present unexpected signals in accordance with the hypothesis of the resource curse, whereby an abundance of the resources or dependence on resource investments leads to a crowding-out of investments in manufacturing (RM1), low production, and stock of human capital (RM2). Resource-rich countries tend to be closed (RM4); natural resources tend to be an overvaluation of the exchange rate (RM5); and there are high internal prices (RM6). The regression model (RM3) is the only one that presents a signal consistent with the theory of the resource curse, whereby governments in rich countries and/or those dependent on natural resources tend to raise public spending. But in all the regression models the impact of the extractive industry is statistically insignificant. This means that the extractive industry has no indirect impacts on the economy via crowding-out, human capital, public expenditure, economic openness, exchange rate, and inflation.

Looking at the other regression results, we note that in the regression model (RM2) inflation rate (DINF) has a negative impact on human capital (DHCP). In the case of (RM4) the exchange rate (DEXRATE) has a negative and significant impact on the economy's opening (DOPEN), but with magnitude zero as in equation (1). In model (RM5), inflation has a positive and significant impact on the exchange rate. In (RM6), government spending (GOV) has a positive and significant impact on inflation (DINF).

Some studies argue that the resource curse is a negative impact on the economy which is also caused by other factors affected by dependency and/or abundance of resources. These factors are the same as those which explain economic growth. So, the logic is reverse causation. We verify which of the variables that explain economic growth can affect the extractive industry, including GDP, regressing them over the variable EXIND according to equation (3). In this equation the Hausman test shows random effects as the preferred model. The estimation results are presented in Table 10.

Insert Table 10 about here

Focusing on the regression models (RM7) and (RM8) whose Wald statistics are statistically significant shows an adjustment of the model. First of all, we can see that the level of development in the countries (GDP), their colonial paths (COLON), and inflation affect the extractive industry negatively but the impact is insignificant. Second, the exchange rate has a negative and significant impact on the extractive industry, but its magnitude is close to zero. This result is consistent with the results in equations (1) and (2). Human capital has a positive and significant impact on the extractive industry. This is consistent with the theory of human capital, which suggests that high levels of education increase production and productivity (Hall and Jones, 1999).

This may also be consistent with the idea that the extractive industry can absorb much of the human capital to the detriment of other sectors because of higher returns. But it also warns that for the extractive sector's good performance, it is better not to overlook human capital. The remaining variables of manufacture (MANU), government spending (GOV), and the economy opening (DOPEN) have a positive but insignificant impact on the mining industry in SADC. It is worth mentioning here that the variable DOPEN has a positive sign. It is revealing that the manufacturing industry is dependent on external markets which limits its transformation. It is important to also mention that it was verified in equation (2) that the extractive industry does not lead to spill-overs to other industrial sectors.

5. Summary and Conclusion

SADC is an economic region of sub-Saharan Africa consisting of countries rich in natural resources. Like most developing countries, most of the SADC countries are limited to extracting and exporting these natural resources with little or no industrial processing. Hence, the income from mineral resources is income resulting from the difference between the value of the extracted product in international prices and the cost of the extraction. Taking into account the empirical evidence on natural resources being a curse, this study analyzed the direct and indirect impacts of the extractive industry in SADC countries. The study also examined the Solow convergence hypothesis. It estimated three models. The first model measured the direct impacts of the extractive industry on growth using GDP per capita. The second model measured the indirect impacts of the extractive industry on growth using indicators serving as a source of the resource curse. The third model evaluated the effects of the variables that affect the extractive industry and growth. To do this analysis, an econometric panel data model was estimated using data from the 11 founding SADC countries. The study covered the period 2004 to 2017.

The study found that despite the region's economic integration, SADC countries do not converge at the level of development and the extractive industry which has a direct negative impact on their economic growth. This result gives evidence of the resource curse hypothesis. The study also found that certain countries like South Africa, Botswana, and Namibia had positive direct impacts of the extractive industry. In case of the indirect impacts measured in terms of factors which can affect economic growth, the study found that the extractive industry did not have any impact on GDP because its impact on manufacturing, human capital, public expenditure, economic openness, exchange rate, and inflation was insignificant. The study also showed that GDP, colonial path, and inflation had a negative but insignificant impact on the extractive industry, while manufacturing, government expenditure, and economic openness had a positive but insignificant impact. Human capital and the exchange rate were the only factors which had a significant impact on the extractive industry and growth. Although human capital had a positive effect, exchange rate had a negative effect though of a small magnitude.

The estimation results show that the extractive industry had a negative impact on economic growth in SADC. This result validates the hypothesis of the resource curse. However, a country level analysis showed heterogeneity in the effects. In some countries including Botswana, South Africa, and Namibia the impact was positive, while Malawi and Mozambique experienced a negative impact. Contrary to theory, the economy opening had a negative impact on SADC countries' growth. The study also highlighted that SADC economies, despite their ongoing integration process, did not converge in development. In relation to indirect impacts, the results showed that the extractive industry did not affect any variables which explained economic growth. For this reason, one can say that the manufacturing sector's crowding-out, human capital, government expenditure, exchange rate, and price levels are not transmission channels of the resource curse. But the study found that the level of prices adversely affected human capital and the manufacturing sector induced greater openness in the economy, while the exchange rate negatively affected this opening-up. Inflation raised the currency exchange rate and government spending raised inflation.

The study also found that human capital had a positive and significant impact on the extractive industries in SADC countries corroborating the idea that the quality of the workforce is important for production and productivity in the extractive industry or in any other economic sector. The other interesting findings are the negative effects of the level of economic growth and inflation which though having a negligible impact warns about some factors that may contribute to the poor performance of the extractive industries in SADC countries, in particular the problem of colonial institutions and prices. This is why some of the policy recommendations are improving institutions and following a prudent fiscal policy for controlling inflation. The same can be said about the monetary policy and the exchange rate, although their effects were negative but of small magnitudes, influencing the extractive industry, human capital, and economic openness.

References

Acemoglu, D., Johnson, S., and Robinson, J.A. (2001). The Colonial Origins of Comparative Development: An Empirical Investigation, *American Economic Review*, 91(5), 1369–1401.

Acemoglu, D., and Robinson, J.A. (2012). *Why nations fail: The origin of power, prosperity and poverty*, first ed. New York: Crown Publishers.

Alexeev, M., and Conrad, R. (2006). The Elusive Curse of Oil. *The Review of Economics and Statistics*, 91(3), 586–598.

Auty, R.M. (1993). *Sustaining Development in mineral economies: the resource curse thesis*. London: Rutledge.

Auty, R. (1997). Natural resource endowment, the state and development strategy, *Journal of International Development*, 9(4), 651-663.

Auty, R. (1998). *Resource abundance and economic development: improving the performance of resource-rich countries*. Research for Action 44. Helsinki: UNU/WIDER.

Auty, R. (2001). The political economy of resource-driven growth, *European Economic Review*, 45(4-6), 839-846.

Auty, R. (2003). *Natural resources, development models and sustainable development*. International Institute for Environment and Development, Discussion Paper, 03-01.

Badeeb, R., Lean, H., and Clark, J. (2017). The evolution of the natural resource curse thesis: a critical literature survey, *Resources Policy*, 51, 123-134.

Barguellil, A., Ben-Salha, O., and Zmami, M. (2018). Exchange rate volatility and economic growth, *Journal of Economic Integration*, 33(2), 1302-1336.

Barro, R.J. (1996). Democracy and growth, *Journal of Economic Growth*, 1(1), 1-27.

Boldeau, F., and Constantinescu, L. (2015). The main determinants affecting economic growth, *Bulletin of the Transilvania University of Braşov Series V: Economic Sciences*, 8(57), 329-338.

Brunnschweiler, C., and Bulte, E. (2008). The resource curse revisited and revised: A tale of paradoxes and red herrings, *Journal of Environmental Economics and Management*, 55, 248–264.

Collier, P., and Hoeffler, A. (2004). Greed and Grievance in Civil War, *Oxford Economic Papers*, 56, 563-595.

Corden, W. (1984). Booming sector and Dutch disease economics: survey and consolidation, *Oxford Economic Papers*, 36(3), 359–380.

Corden, W., and Neary, P. (1982). Booming sector and deindustrialization in a small open economy, *Economic Journal*, 92(568), 825–848.

Ding, N., and Field, B. (2004). Natural resource abundance and economic growth, *Land Economics*, 81, 496–502.

Easterly, W., and Levine, R. (2003). Tropics, germs, and crops: how endowments influence economic development, *Journal of Monetary Economics* 50(1), 3–39.

Frankel, J. (2010). *The natural resource: a survey*. National Bureau of Economic Research, 15836: 2-47.

Gelb, A. and Associates (1988). *Oil windfalls: blessing or curse?* Washington DC: The World Bank.

Ghosh, S., and Gregoriou, A. (2008). The composition of government spending and growth: Is current or capital spending better? *Oxford Economic Papers*, 60(3), 484-516.

Gylfanson, T. (2001). Natural resources, education, and economic development, *European Economic Review*, 45(4–6), 847– 859.

Gylfanson, T. (2011). *Natural resource endowment: a mixed blessing*? CESIFO Working Paper, No. 3353.

Hall, R., and Jones, C. (1999). Why do some countries produce so much more Output per worker than others? *Journal of Economics*, 114(1), 83–116.

Isham, J., Woolcock, M., Pritchett, L., and Busby, G. (2003). *The Variety of resource experience: how natural resource export structures affect the political economy of economic growth*. Rothay Center for International Affairs Working Paper Series 12.

James, A. (2015). The resource curse: a statistical mirage? *Journal of Development Economics*, 114, 55-63.

Ji, K., Magnus, J., and Wang, W. (2010). Resource abundance and resource dependence in China. *CentER Discussion Paper*, Vol. 2010-109. Tilburg: Econometrics.

Mavrotas. G., Murshed, S., and Torres, S. (2011). Natural resource dependence and economic performance in the 1970-2000 Period, *Review of Development Economics*, 15(1), 124–138, 2011.

Mehlum, H., Moene, K., and Torvik, R. (2006). Institutions and the resource curse, *Economic Journal*, 116, 1–20.

Papyrakis, E., and Gerlagh, R. (2004). The resource curse hypothesis and its transmission channels, *Journal of Comparative Economics*, 32(1), 181–193.

Rodrik, D., Subramanian, S., and Trebbi, F. (2004) Institutions ruler: the primacy of institutions over geography and integration in economic development, *Journal of Economic Growth,* 9(2), 131–165.

Rostow (1961). Take-off into economic growth, *Challenge*, 8(8), 29-37.

Sachs, J., and Warner, A. (1995). *Natural resources abundance and economic growth*. National Bureau Research Working Paper, 5398.

Sachs, J., and Warner, A. (1997) Sources of slow growth in African economies, *Journal of African Economies*, 6(3), 335–376.

Sachs, J., and Warner, A. (1999). The big push, natural resource booms and growth, *Journal of Development Economic*s, 59, 43-76.

Sachs, J., and Warner, A. (2001). Natural resources and economic development: The curse of natural resources, *European Economic Review*, 45, 827-838.

Sala-i-Martin, X., and Subramanian, A. (2012). Addressing a natural resource curse: an illustration from Nigeria, *Journal of African Economies*, 22(4), 570–615.

The World Bank (1997). *Expanding the measure of wealth: indicators of environmentally Sustainable development*. Washington, DC: The World Bank.

Udeaja, E.A., and Obi, K.O. (2015). Determinants of economic growth in Nigeria: evidence from error correction model approach. International Knowledge Sharing Platform, *Developing Country Studies*, 5(9), 27-42.

van der Ploeg, F. (2011). Natural resources: curse or blessing, *Journal of Economic*, 2(49), 366-420.

van der Ploeg, F., and Poelhekke, S. (2017). The impact of natural resources: survey of recent quantitative evidence, *The Journal of Development Studies,* 53(2), 205-216.

Vicente, P. (2010). Does oil corrupt? Evidence from a natural experiment in West Africa, *Journal of Development Economics,* 92, 28–38.

Table 1. Summary statistics of the data, N=154

Variable	Mean	STD	MIN	Max	Skewness	Kurtosis
GDP	2887.949	2474.185	321.30	7582.50	0.680	1.980
EXIND	10.245	10.851	0.55	59.94	2.763	11.017
MANU	11.876	7.221	4.52	35.22	1.820	6.010
HCAP	7.457	6.309	0.47	28.22	1.359	3.969
COLON	0.818	0.386	0.00	1.00	-1.649	3.722
GOV	22.810	15.591	2.05	88.89	2.779	11.300
OPEN	0.879	0.410	0.07	2.43	0.405	3.876
EXRATE	295.000	970.484	2.55	9686.77	6.643	59.490
INFL	109.748	43.784	43.67	342.18	2.229	10.898

Table 2. Correlation matrix of the data, N=154

	EXIND	MANU	HCAP	COLON	GOV	OPEN	EXRATE	INFL
EXIND	1.0000							
MANU	-0.3776	1.0000						
HCAP	-0.2363	-0.1284	1.0000					
COLON	-0.5993	0.2472	0.1847	1.0000				
GOV	-0.1501	0.0055	-0.1412	0.0975	1.0000			
OPEN	0.0161	0.1529	0.0725	-0.2209	0.5053	1.000		
EXRATE	0.0109	-0.1039	-0.1763	0.1032	0.0199	-0.0952	1.0000	
INFL	-0.0888	-0.1822	0.0590	-0.0156	0.4767	0.3152	0.2380	1.0000

Table 3. Stationarity analysis of the data

	P(t)	P-Value	P(t)-1	P-value	P(t)-2	P-value	Order of integration 5%)
lnGDP	34.275	0.0460	-	-	-	-	I(0)
EXIND	47.059	0.0014	-	-	-	-	I(0)
MANU	22.679	0.4200	55.280	0.0001	-	-	I(1)
HCAP	7.567	0.9981	75.243	0.0000	-	-	I(1)
GOV	45.129	0.0026	-	-	-	-	I(0)
OPEN	22.499	0.4304	28.367	0.1638	74.094	0.000	I(2)
EXRATE	5.432	0.9999	37.817	0.0192	-	-	I(1)
INFL	4.718	1.0000	43.283	0.0044	-	-	I(1)

Table 4. Fixed and random effects estimation results, dependent variable: lnGDP

Exogenous Variable	Fixed Effects	Random Effects
EXIND	-0.005*	-0.005*
	[0.002]	[0.002]
DMANU	0.006	0.006
	[0 005]	[0.005]
DHCP	-0.002	-.0002
	[0.006]	[0.006]
COLON	0.000	0.380
	[omitted]	[1.088]
GOV	0.004*	0.004*
	[0.001]	[0.001]
DOPEN	-0.080**	-0.080**
	[0.041]	[0.041]
DEXRATE	0.000	0.000
	[0.000]	[0.000]
DINFL	-0.001	-0.001
	[0.001]	[0.001]
	F(t) 5.56	W(t) 38.41
	(0.000)	(0.000)

Note: The numbers in square brackets are standard errors. The numbers in parentheses are the p-values. * Significant at the 5% level of significance and ** significant at the 10% level of significance. D indicate the variable is measured as changes.

Table 5. The Hausman test's results

Exógenos Variable	Fixed Effect (b)	Random Effect (B)	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
EXIND	-0.005	-0.0004	-0.000	0.000
DMAN	0.006	0.006	0.000	0.001
DHCP	-0.002	-0.002	-0.000	0.001
COLON				
GOV	0.004	0.004	0.000	0.000
DDOPEN	-0.080	-0.080	0.000	0.007
DEXRATE	0.000	0.000	$3.24e^{-09}$	$1.08e^{-06}$
DINFL	-0.001	-0.001	$-7.34e^{-06}$	0.000
χ^2				0.030
				(1.000)

Note: The values in parentheses are p-values. D indicate the variable is measured as changes.

Table 6. Pooled OLS and random effects test results

Exogeneous Variable	Variable		Sd = sqrt(Var)
lnGDP	1.057		1.028139
e	0.008		0.091789
u	1.985		1.408873
χ^2		608.31	
		(0.000)	

Table 7. Random effects model corrected for autocorrelation, dependent variable lnGDP

EXOG VARS	RM1	RM2	RM3	RM4	RM5	RM6	RM7	RM8	RM9
lnGDP(-1)	0.694* [0.101]								
EXIND		-0.005* [0.002]	-0.005* [0.002]	-0.005* [0.002]	-0.005* [0.002]	-0.005* [0.002]	-0.004* [0.002]	-0.004* [0.002]	-0.004* [0.002]
DMANU			0.0067 [0.006]	0.0067 [0.006]	0.0067 [0.006]	0.0069 [0.007]	0.006 [0.005]	0.006 (0.005]	0.006 [0.006]
DHCP				0.003 [0.005]	0.0028 [0.005]	0.0014 [0.004]	-0.002 [0.003]	-0.002 [0.004]	-0.002 [0.004]
COLON					0.404 [0.900]	0.004 [0.910]	0.339 [0.895]	0.390 [0.900]	0.380 [0.917]
GOV						0.004* [0.002]	0.004* [0.002]	0.004* [0.002]	0.004* [0.002]
DOPEN							-0.083* [0.040]	-0.081* [0.040]	-0.080* [0.040]
DEXRATE								0.000* [0.000]	0.000* [0.000]
DINFL									0.001 [0.001]
W(t)	40.02*	8.00*	12.85*	12.95*	16.22*	27.35*	11.00**	333.45*	625.28*

Note: The values in brackets are robust standard errors. * Significant at the 5% level of significance and ** at the 10% level of significance. D indicate the variable is measured as changes.

Table 8: The Impact of the extractive industry on lnGDP at the country level

Independent variable: EXIND	Coefficient [StdError]
Country	
Angola	
Botswana	0.538* [0.060]
Lesotho	-1.182* [0.060]
Malawi	-2.149* [0.532]
Mozambique	-2.171* [0.050]
Namibia	0.040* [0.062]
South Africa	0.645* [0.055]
Swaziland	-0.034 [0.062]
Tanzania	-1.658* [0.054]
Zambia	-1.517* [0.048]
Zimbabwe	-0.943* [0.034]

Note: The values in brackets are robust standard errors. * 5% significance level.

Table 9. Indirect impacts of the extractive industry

Dependent Variable	DMANU	DHCP	GOV	DOPEN	DEXRATE	DINFL
Indep.Variable	RM1	RM2	RM3	RM4	RM5	RM6
EXIND	0.009 [0.008]	0.008 [0.007]	0.150 [0.183]	0.001 [0.001]	-2.897 [2.506]	-0.081 [0.162]
DMANU	..	0.004 [0.044]	-0.026 [0.181]	0.010 [0.016]	2.724 [4.181]	0.206 [0.251]
DHCP	0.007 [0.071]	..	0.286 [0.215]	-0.006 [0.012]	..	..
COLON	-0.035 [0.150]	-0.192 [0.237]	..	..	..	..
GOV	-0.005 [0.005]	0.004 [0.004]	..	-0.000 [0.000]	..	0.289* [0.087]
DOPEN	0.703 [1.170]	-0.293 [0.692]	0.357 [1.144]	..	-186.39 [279.92]	0.972 [1.149]
DEXRATE	0.000 [0.000]	-0.000 [0.000]	0.000 [0.000]	-0.000* [0.000]	..	0.000 [0.001]
DINFL	0.012 [0.007]	-0.008* [0.003]	0.536 [0.456]	0.000 [0.000]	6.642* [3.043]	..
W(t)	8.96 (0.256)	117.13 (0.000)	15.73 (0.015)	63.08 (0.000)	22.12 (0.000)	50.73 (0.000)

Note: The values in brackets are robust standard errors. The values in parentheses are p-values.

Table 10. The impacts on the extractive industry, dependent variable: EXIND

Independent Variable		RM1	RM2	RM3	RM4	RM5	RM6	RM7	RM8
lnGDP	..	-3.915 [3.339]	-4.269 [2.981]	-4.660 [3.361]	-2.322 [2.411]	-2.860 [2.757]	-2.249 [2.142]	-2.812 [2.405]	-2.451 [2.450]
DMANU	..	..	0.100 [0.099]	0.111 [0.105]	0.100 [0.093]	0.100 [0.095]	0.075 [0.088]	0.077 [0.091]	0.100 [0.116]
DHCP	..	..	..	0.581 [0.353]	0.570 [0.344]	0.567 [1.67]	0.560 [0.347]	0.590 [0.348]	0.517** [0.265]
COLON	..	..	..	..	-15.173 [10.661]	-14.970 [11.02]	-14.240 [10.326]	-13.100 [10.70]	-15.847 [12.54]
GOV	..	..	..	..	..	0.013 [0.023]	0.001 [0.023]	0.004 [0.024]	0.0752 [0.062]
DOPEN	..	..	..	..	..	..	0.672 [0.100]	0.592 [0.100]	0.741 [1.163]
DEXRATE	..	..	..	..	..	..	..	-0.000* [0.000]	-0.000 [0.000]
DINFL	..	..	..	..	..	..	..	..	-0.236 [0.192]
W(t)	0.88 (0.349)	1.37 (0.241)	2.39 0.302)	3.26 (0.353)	4.11 (0.392)	5.78 (0.328)	9.04 (0.172)	32.67 (0.000)	73.70 (0.000)

Note: The values in brackets are robust standard errors. The numbers in parentheses are p-values. * significant at the 5% level of significance and ** at the 10% level of significance.