Economic Growth Effects of the Interaction of Natural Resources and Institutional Quality by Source: Empirical Evidence from Africa

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ABSTRACT: *The purpose of this study was to investigate the relationship between natural resources by source, institutional quality by source, and economic growth in Africa using multiple co-integration analysis, the ARDL technique, and VECM granger causality. The findings show that various resources contribute to economic growth in different ways. Mineral rents (MR) have a negative impact on growth, while forest rents (FR) have a beneficial impact. The findings also show that forest rents contribute more to growth in the rule-of-law (ROL) model than in the market openness (MO) model. Among the institutional quality (IQ) variables, the rule of law has the most significant impact on the continent's economic growth. Furthermore, when IQ was added as an interaction variable in the models, both resources (MR and FR) ended up contributing favourably to development. The study recommends that resource-rich countries must specifically concentrate on improving the rule of law since robust outcomes are generated when interacted with natural resources.*

KEY WORDS: Economic growth, mineral rents, forest rents, rule of law, market openness, interaction.

INTRODUCTION

Natural resources are significant factors in economic development and have the ability to raise the living standards of the population. Natural resources, when administered correctly by both the public and private sectors, can assist in easing poverty around the world, mostly in developing countries.

The influence of resources on economic growth is a subject that has been discussed for a long time (Ross, 2015 and Van der Ploeg, 2011). Thus far, there seems to be no agreement on whether natural resources are improving economic growth or not. Nevertheless, starting with the study performed by Sachs and Warner (1995), they showed that natural resources have a negative influence on growth and this is branded as the "resource curse." Sachs and Warner (1997) confirmed this hypothesis with a huge number of cross-section studies employing samples from numerous countries and a long time span, and it has, therefore, turned out to be an established view (Gylfason et al., 1999; Auty and Mikesell, 1998; Sachs and Warner, 1999).

The validation of a natural-resource curse is puzzling since, like human and physical capital, traditional economic theory proposes that natural resources ought to stimulate economic growth, hence economic development. Given the theoretical literature, natural resources are associated with decreased economic growth for four main reasons. Firstly, natural resources have the tendency to produce high rents, which might promote corruption. The institutional influence of natural resources will be used to explain this consequence more comprehensively (Sala-i-Martin and Subramanian, 2003)**.** Secondly, natural resource abundance can trigger volatility in countries, especially in commodity prices, which could be damaging to economic growth. Third, nations rich in natural resources are more vulnerable to the Dutch disease. Finally, it has been established that huge natural resource endowments have the potential to damage longstanding growth by decreasing educational opportunities.

Studies debunking the natural-resource curse, on the other hand, are resurfacing with systematic evidence on how natural resources are a cause of economic growth and development (Alexeev and Conrad, 2011; Brunnschweiler and Bulte, 2008; Brunnschweiler, 2008). Before the 20th century, natural resources that were typically made up of main commodities contributed greatly to world trade and economic expansion. The availability of natural resources has induced preliminary economic development in the Norway, United States, Australia, New Zealand, Iceland, Canada, and other countries (Mehlum et al., 2006). Ecuador has recently seen a large gain in revenue as a result of progress in its resources, and Norway has utilized its natural resources to ensure future generations' economic prosperity (Papyrakis, 2016; Papyrakis and Gerlagh, 2003).

The deceptive resilience of institutional quality (IQ) is another reason to be uncertain about the validity of the resource curse and the impossibility of establishing reliable comparisons between rich and developing countries (Bennett et al., 2017; Alexeev and Conrad, 2011). As a result, the institutional quality in Africa and other developing economies is deemed inferior to that of industrialized countries. Unfortunately, in comparison to resource-poor African countries, resource-rich African countries have weaker institutions (Gueye and Lee, 2015). Economic growth and human well-being are typically higher in countries with abundant natural resources and improved institutional quality and governance, such as good democratic practices and accountability, improved institutional quality, a low level of corruption, and greater interconnection among government entities (Mehlum et al., 2006; Bulte et al., 2005).

The significance of institutional quality in transforming natural resources into economic success or failure is confirmed by both dynamic panel and cross-country analyses (Bakwena et al., 2009). Our present study reveals that different resources contribute differently to economic growth. Mineral rents (MR) contribute negatively to growth while forest rents (FR) contribute positively to growth in both models (model with rule of law as institutional quality and model with market openness as institutional quality), both in the short run and long run. The result also reveals that forest rents contribute more to growth in the model with the rule of law (ROL) as an institutional quality than in the model with market openness (MO) as an institutional quality. Among the institutional quality variables, the ROL has the largest significant contribution to economic growth in the region. The result also reveals that when institutional qualities were included in the models as interacting terms, the interactions with both resources (MR and FR) ended up contributing positively to economic growth. However, it was observed that the interactions with resources contribute more to growth in the model with ROL as an institutional quality than in the model with market openness as an institutional quality. This suggests that the rule of law plays a more critical role in enabling natural resources to contribute positively to growth than market openness. As the current study has shown, raising IQ can improve the economy by mitigating numerous problems in developing countries, ranging from corruption and an increasing crime rate to low FDI and slow growth. Notwithstanding this, policymakers and proponents of economic growth in Africa have limited awareness and knowledge of which types of natural resources contribute the most to growth and prosperity and which are less prone to growth disruption. Improving IQ also improves economic development and democratization, according to the twin rationales (Carothers, 2003). Bakwena et al. (2009) and Karabegovi (2009) argue that IQ is essential for resource-rich countries to gain better regulation over their fates by implementing policies that are most likely to promote economic progress. When an economy is dominated by low institutional quality, resource rents do not improve the economic status of the country, but instead result in a curse (Antonakakis et al., 2017).

As a result, how the abundance of natural resources influences long-term growth is an important subject in growth and development research. The debate is ongoing, with around 40% of the empirical submissions indicating a negative consequence, 40% showing no consequence, and 20% indicating a beneficial effect (Havranek et al., 2016). This current research goes beyond the progressive and retrogressive consequences of aggregate resource rents and tries to ascertain which of the resource rents contribute positively to growth and which one does not. Also, we attempt to identify which of the institutional qualities plays a more critical role in turning natural resource rents into contributing more to growth and prosperity, hence economic development.

The continent of Africa was chosen for this study since it is largely dependent on natural resources to drive its growth (Bah, C. M., 2016). The continent is endowed with different types of natural resources. The economic significance of natural resources cannot be overemphasized in the economic development of Africa. This is because they play a very noteworthy function in the total exports of the continent, hence its GDP. Because of the full reliance on natural resources, the governments in Africa usually put plans in place to make sure that natural resources contribute positively to long-term growth in their countries. This, however, brings us to the issue of policies and institutional frameworks that governments in Africa have put in place to improve the standard of the natural resources sector to achieve sustainable development.

The region of Africa is renowned for having a substantial quantity of natural resource endowment. According to the UNECA (United Nations Economic Commission for Africa), the African region has more than 40% of the world's platinum group minerals (PGMs) reserves: diamonds, gold, phosphate, vermiculite, cobalt, chromite, vanadium, and manganese. The region has also been rated first in producing diamonds, platinum, chromite, gold, cobalt, and vanadium. The significance of Africa as a source of gas and oil, as well as other energy resources, is growing. In

2006, Africa's oil and gas reserves remained at 7.9 and 8.6 percent of global production, respectively. Also, Africa is known for producing approximately 16 percent of the world's uranium.

Despite the huge endowment of natural resources, Africa remains one of the world's regions that has a very low United Nations HDI; its GDP per capita is, on average, around $2,623 per year. There are only a few countries, such as Seychelles, Botswana, Libya, Equatorial Guinea, Mauritius, South Africa, and Gabon, that have a GDP per capita of between $6,000 and $17,000 per year. It is against this backdrop that this present study tends to choose African countries as a sample.

The question that we desire to pose at this moment is why are countries rich in natural resources susceptible to weak economic growth? Various explanations advanced by some economists include the Dutch disease phenomenon, increased rent-seeking activities, bribery and unwarranted bureaucracies, a preference for a closed economic policy, and, at times, a lack of labor-based knowledge and education. In order to produce empirical evidence on the effect of natural resources in the African economies, the following questions for policy are significant from the perspective of African states: First, do different natural resources contribute differently to economic growth? Second, does different IQ contribute differently to economic growth? Third, what are the natural resources' impacts on economic growth by source? Fourth, what are the contributions of IQ by source to economic growth? Fifth, what are the contributions of institutional qualities by source to making natural resources a benefit instead of a curse to economic growth, hence economic development? In order to address these concerns, the study examines whether natural resources contribute positively or negatively to economic growth. It also evaluates the influence of natural resources by source on economic growth. The study also looks at the influence of IQ by source on economic growth. Finally, it tries to establish whether institutional quality by source plays a role in turning natural resources into a blessing and which type of IQ contributes more.

However, our current study focuses on the disaggregation of natural resource rents by source and the disaggregation of institutional quality by source, not only relating to growth but also to sustainable development. In short, the study adds to the existing body of natural resource-institutions-growth literature.

Firstly, the majority of previous research relied on aggregated natural resource rents to investigate the impact of natural resources on growth in the economy. Using the combined natural resource rents does not permit the disaggregation of the effects of natural resource rents by source. As a result, the current study aims to look at the effects of natural resource rents by source as they pertain to growth in the natural resource-institutions-growth nexus. This means that the goal of this current study is to divide the relative effects of natural resource rents by source on economic growth in the same regression.

Secondly, the extant literature concentrates on the combined institutional quality measures and, consequently, they cannot distinguish which of the institutional quality indicators does better in terms of improving economic growth. This current research disaggregated the institutional quality measures into two classifications in the same regression: the model with ROL as institutional quality and the model with MO as institutional quality. This distinction reveals the contribution of each institutional quality indicator and, as a result, presents policy implications on the type of institutional quality that a country must prioritise in order to improve economic growth.

Thirdly, the major contribution of this study is the simultaneous inclusion, in the analysis of the natural-resource curse, of disaggregated institutions as a means through which disaggregated natural resources influence economic growth. In contrast to a good number of previous studies, which only take into account the aggregated interactive impacts, this study brings together the interactive effects between mineral rents and the rule of law on the one hand and mineral rents and market openness on the other hand in the same model. Similarly, this study also combines the interactive impacts between forest rents and the rule of law on the one hand and forest rents and market openness on the other hand in the same model. This will definitely distinguish which of the institutional quality indicators perform well in turning natural resource rents into contributing positively to growth and prosperity.

Fourthly, as the estimation of this study includes panel data that creates a more homogeneous sample in terms of region, one of the contributions of this paper is to use this sample to investigate the existence of the transmission channel (institutions) at play. However, existing literature has not explored the disaggregated transmission mechanisms of the resource curse in Africa through disaggregated institutions on the basis of employing panel data. By performing our analysis successively on this sample, we hope to release the constraint of a homogeneous natural resource curse effect in all African countries. This way, we could acknowledge that a marginal increase in natural resource rent could have a more adverse or positive impact on growth through institutions. Similarly, as indicated by Horvath and Zeynalov (2016), the majority of prior studies concentrated on cross-sectional data. On the other hand, Van der Ploeg (2011) and Rajan and Subramanian (2011) underline the need for panel data since cross-sectional data suffers from omitted variable bias caused by the link between starting income and the excluded initial productivity level. We will take this advice and use panel data for the African continent. Some articles have concentrated on the connection between institutional quality and natural resources (Sala-i-Martin and Subramanian, 2008; Mehlum et al., 2006a; Mehlum et al., 2006b; etc.). To the best of our knowledge, this paper will provide the first empirical analysis of the impact of resource rents by source on economic growth in the entire African context through disaggregated institutions since previous studies have only focused on Sub-Saharan Africa (SSA) and specific-country studies.

The research is structured as follows: Section two comprises a review of the literature. Section three covers methodology and data. Section four looks at the empirical analysis and discussion, and Section five includes the conclusion and policy suggestions.

LITERATURE REVIEW

The evidence for the empirical work of the resource curse, whether taken as a whole or in connection to specific causal pathways, is rather diverse. Case studies by Gelb (1988) and Auty (1983) were the first to empirically test the natural resource hypothesis. However, Sachs and Warner's (1995) cross-sectional research is recognised as the original empirical assessment of the natural resource curse idea. Sachs and Warner (1995) compiled an extensive cross-section panel of countries rich in natural resources for the period between 1970 and 1989, and found that economic growth is adversely connected to dependence on natural resources. As a result of the publication of these landmark works, a huge volume of successful research has been prompted to investigate the direct and indirect links between natural resource dependency and economic growth. Natural resource-based economies, according to Mehlum et al. (2006) and Gylfason (1999, 2001), have tended to be failures in development since 1970. According to Nili and Rastad (2007), the mean GDP per capita of oil-exporting countries fell by 29% between 1975 and 2000. During the same time period, the average per capita income in the rest of the world climbed by 34%.

Research by Arezki and Nabli (2012) focuses on the Middle East and North Africa (MENA) over the course of more than four decades (1960–2008). They conclude that while several nations achieved high per capita income levels using standard income level metrics, others did badly when a larger range of outcome metrics was used to analyse them. Furthermore, these nations have witnessed low and non-inclusive economic development as well as severe macroeconomic instability. Similarly, Arezki and Nabli's results corroborate Karl's (2005) observation that "countries dependent on oil export money not only did worse than their resource-poor rivals but also much worse than they should have, given their income sources." (Page 23).

A recent reexamination of heterogeneous panel co-integration approaches in a sample of developing nations by Kim and Lin (2015) follows in a similar vein. Kim and Lin discover that nations with plentiful natural resources have slower economic growth than those with limited resources, resulting in natural resources remaining a curse.

Apergis and Payne (2014) explore the impact of oil abundance on economic growth in a host of countries from 1990 to 2013, concentrating on abundance instead of dependency. Between 1990 and 2003, they discover negative effects on economic growth. After 2003, the influence of abundant oil on growth turned favourable. The researchers attributed the positive growth to improvements in institutional quality and economic transformation in MENA nations.

Some, including Mehrara (2009), have discovered a non-linear correlation between oil revenue growth (dependency) and total economic growth. Mehrara discovered that there is a threshold of increase in oil revenue over which it has a negative effect on production in a panel study of thirteen oil-exporting nations conducted in five-year intervals between 1965 and 2005. The threshold is approximately 18–19% growth.

Additionally, resource curse linkages have been examined in a number of single-country investigations. Prior to Sachs and Warner (1993), descriptive studies like Gelb (1988) and Auty (1991) were common. Several studies in Africa have linked the resource curse to a lack of progress in huge resource-rich countries like Nigeria, the Democratic Republic of the Congo, Ghana, and Angola. Some people also draw comparisons between countries with and without abundant natural resources, frequently using Botswana as a counter-example. Some examples are Fosu and Gyapong (2012), Hammond (2011), Dartey-Baah et al. (2003), Sala-i-Martin and Subramanian (2003), and Bevan et al. (1999). When it comes to the instance of Venezuela in Latin America, Rodrigues and Sachs (1999) give their thoughts. These publications sometimes offer heterodox macroeconomic advice to mitigate the consequences of the resource curse because low growth is often linked to the interaction between the resource curse and inappropriate fiscal and industrial policies. Examples include regulating the real exchange rate and rejecting an inflation-targeting monetary system, as well as supplementing such a policy posture with tighter capital account controls (see also Satti et al., 2014).

Numerous single-country studies have also attempted to acquire lessons for escaping the resource curse by concentrating on resource-rich countries that have escaped it, such as Pegg (2010) for Botswana; Su et al. (2016) and Liu (2014) for China; Parlee (2015) for Canada; Loayza et al. (2013) for Peru; De Gregorio and Labbé (2011) for Chile; James and Aadland (2011) for Mauritius, Botswana and the United States; Papyrakis and Gerlagh (2007) for the United States; Badeeb and Lean (2017) for Yemen, and Gylfason (2011) for Norway. For instance, Norway's government's success may be attributed to the country's powerful state agencies, effective public policy, prudent resource management, and the formation of a petroleum savings fund. African and Middle Eastern nations show a very different image in relation to the distribution of earnings from natural resources and the implementation of policies to diversify output.

In relation to institutional quality, natural resources literature and the role of institutions can be split down into three broad classifications. Natural resources, according to the first school of thought, diminish the quality of institutions, resulting in dismal economic outcomes. When natural resources are abundant, they have a tendency to stifle economic progress by making it difficult to build good institutions or implement reforms. According to these studies, natural resources diminish the quality of institutions by impeding democracy, decreasing civil rights, and undermining the rule of law (Sala-i-Martin and Subramanian, 2008; Isham et al., 2005; Leite and Weidmann, 1999). The highest levels of corruption can be found in nations rich in natural resources, as demonstrated by Leite and Weidmann (1999). According to Isham et al. (2005), the best-endowed countries in terms of being conveniently accessible to cash crops (coffee, cocoa) and natural resources (gold, diamonds) are those that have lower institutional quality.

Natural resources can impair institutional growth since governments utilise income from natural resources to soothe opposition, shift public accountability, and oppose efforts for institutional reforms (Sala-i-Martin and Subramanian, 2008; Isham et al., 2005). According to a study by Sachs and Warner (1997), those countries with the greatest abundance of natural resources tend to be those with the weakest institutions. This is due to the fact that the availability of natural resources, in general, contributes to the growth of corrupt activities and, as a result, the inefficiency of institutions. As a result, civil conflicts are more likely to break out in countries with plenty of natural resources due to the institutional curse (Collier and Hoeffler, 2005a). Consequently, natural resources can damage the state by causing civil conflicts and institutional upheavals. Conflicts over the collection and distribution of rent exacerbate political unrest and heighten the danger of violent conflict (Carbonnier, 2013). Carbonnier asserts that in order to maintain power, leaders prefer to transfer extractive rents to powerful groups rather than economic activities that can lead to growth. As a result, and in line with the concept of the rentier state, oil rent functions as a limitation on democracy. According to Jensen and Wantchekon (2004), natural resource wealth and democratic governments in Africa have a negative relationship. They contend that a country's democratic transition and subsequent democratic consolidation in Africa are both influenced by the availability of resources. Furthermore, because citizens pay less into the public purse, leaders are hesitant to report on rent distribution to them, strengthening the propensity to see the creation of opaque and anti-democratic institutions (Ross, 1999; Leite and Weidmann, 1999).

Karl (1997) stated that the rent is inversely proportional to the quality of the institutions in question. For instance, countries that depend heavily on exports of minerals, fuels, and agriculture have notably poor measures of institutional quality. The availability of natural resources has also been proven to have a negative impact on democracy by Collier and Hoeffler (2005b) and Auty (2000). In fact, countries' economic growth has been strongly impacted by the mix of democracy and resource rent. According to Acemoglu et al. (2001), the types of institutions established in colonies are dependent on the resources available and the ease with which rent may be appropriated.

The second type of literature says that natural resources interact with institutional quality, and that the quality of these institutions determines how natural resource revenues are spent, and thus whether natural resources are a blessing or a curse (Mehlum et al., 2006a).When it comes to whether natural resources are used to generate economic growth, an institution's quality is the determining factor. According to Norman (2009), natural resource initial stockpiles are connected to having extremely little institutional capacity in respect of the rule of law, yet they have no direct impact on economic growth. Even when resource stocks are taken into account, total exports of resources have little impact on the rule of law, but they do have an effect on the average growth rate.

According to Sala-i-Martin and Subramanian (2008), when institutional quality is adjusted for, resources are no longer harmful to economic growth. As Mehlum and colleagues (2006b) have shown, if institutions are of high quality, natural resources can aid in economic development. Institutional presence, on the other hand, that encourages predatory behaviours, adds to the transformation of natural resources into a curse. From this standpoint, there is a critical point at which natural resource depletion ceases to have a negative impact. The curse can be explained in terms of the relationship between institutions and economic growth. Poorly run institutions are a prerequisite for the curse to manifest itself.

In the third type of work, institutions are shown to be neutral (Mehlum et al., 2006b). As a result, the link between natural resources and growth is not affected by institutions. As a result, Sachs and Warner (1997) contend that institutional quality perform no particular function in the resource curse. As stated by these authors, the fundamental way in which the resource curse manifests itself is not through the impact of abundant natural resources on institutions. Furthermore, Arezki and van der Ploeg (2007) reach the conclusion that natural resources have little influence on economic growth.

Nonetheless, the outcomes of this study would thus add to the findings of other scholars and governments in policy formulation with respect to economic growth and natural resources. The findings will give more practical evidence on the effectiveness of domestic institutional quality in augmenting natural resources towards economic growth in African countries and will proffer recommendations to governments of other underdeveloped-natural resource countries.

METHODOLOGY AND DATA

Specification of research model

We model the economic growth sensitivity to mineral rents, forest rents, physical capital, human capital development, and institutional quality in Africa from 1995 to 2020, following the work of Balsalobre-Lorente et al. (2018) and Hasson and Masih (2017). The log-log form of the growth function for Africa is characterized by the following equation 1:

$$lnY_{it} = \beta_0 + \beta_1 lnMR_{it} + \beta_2 lnFR_{it} + \beta_3 lnPK_{it} + \beta_4 lnHC_{it} + \beta_5 lnROL_{it} + \beta_6 lnMO_{it} + \varepsilon_{it} \quad (1)$$

Where:

Y_{it} = Real GDP per capita at market prices. Aggregates are based on constant 2010 U.S. dollars.
MR_{it} = Mineral rents (% of GDP)
FR_{it} = Forest rents (% of GDP)
PK_{it} = Gross fixed capital formation as a proxy for physical capital
HC_{it} = Tertiary School enrolment is used as a proxy for human capital.
ROL_{it} = Rule of Law (used as a proxy for institutional quality)
MO_{it} = Market Openness (used as a proxy for institutional quality)
ε_{it} = the error term, assumed to be normally distributed
$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 > 0$

According to Usman et al. (2020a, b), the log-log specification assists in stabilizing the variance and therefore explains the estimated results in elasticities.

The effects of the independent variables on the dependent variable, for both the short and long run, are obtained by estimating a dynamic unrestricted error correction model (UECM) via the approach of an Autoregressive Distributed Lag (ARDL) model specified by equation 2.

$$lnY_t = \beta_0 + \sum_{i=1}^{q} \beta_1 lnY_{t-1} + \sum_{i=1}^{P} \beta_{2,i} lnMR_{t-1} + \sum_{i=1}^{P} \beta_{3,i} lnFR_{t-1} + \sum_{i=1}^{P} \beta_{4,i} lnPK_{t-1} + \sum_{i=1}^{P} \beta_{5,i} lnHC_{t-1} + \sum_{i=1}^{P} \beta_{6,i} lnROL_{t-1} + \sum_{i=1}^{P} \beta_{7i} lnMO_{t-1} + \varepsilon_{it}$$

(2)

Where p and q are the optimal lag lengths, and the others remain as previously defined. If lnY, lnMR, lnFR, lnPK, lnHC, lnROL, and lnMO are co-integrated, it consistently implies that they will continue to have level relationships as stated through long-run coefficients. Therefore, these variables can be shown via an error correction model (ECM), whereas Equation 3 yields the long-run coefficients.

$$lnY_{it} = \gamma_0 + \mu_1 lnMR_{it} + \mu_2 lnFR_{it} + \mu_3 lnPK_{it} + \mu_4 lnHC_{it} + \mu_5 lnROL_{it} + \mu_6 lnMO_{t-k} + \sum_{k=1}^{q} \vartheta_k \, \Delta lnY_{t-k} + \sum_{k-1}^{P1} \theta_{1,k} \, \Delta lnMR_{t-k} + \sum_{k-1}^{P2} \theta_{2,k} \, \Delta lnFR_{t-k} + \sum_{k-1}^{P3} \theta_{3,k} \, \Delta lnPK_{t-k} + \sum_{k-1}^{P4} \theta_{4,k} \, \Delta lnHC_{t-k} + \sum_{k-1}^{P5} \theta_{5,k} \, \Delta lnROL_{t-k} + \sum_{k-1}^{P6} \theta_{6,k} \Delta lnMO_{t-k} + \varepsilon_{it}$$

(3)

where Δ is the first differenced operator, which is usually described as $\Delta y_t = y_t - y_{t-1}$. We find the long-run coefficients of the variables as $\beta_i = \mu_i / (1 - \sum_{j=1}^{q} \vartheta_j)$; i = 1, 2, 3, 4, 5, 6. Because the variables are already in their natural logarithms, the long-run coefficients are presented in elasticities, whereas the ECT is defined as $ec_t = lnY_{it} - \beta_1 lnmr_{it} - \beta_2 lnfr_{it} - \beta_3 lnpk_{it} - \beta_4 lnhc_{it} - \beta_5 lnrol_{it} - \beta_6 lnmo_{it}$ where the coefficients of β_1, β_2, β_3, β_4, β_5 and β_6 represent the long-run estimates of the mineral rents, forest rents, physical capital, human capital development, rule of law and market openness. If there is a disequilibrium in the short-run, the ECM measures the rate of adjustment to the long-run equilibrium level trajectory. Thus, Equation 4 presents the ECM equation as follows:

$$lnY_t = \rho + \sum_{k-1}^{q} \lambda_{i,k} \, \Delta lnY_{t-k} + \sum_{k-1}^{P1} \partial_{1,k} \, \Delta lnMR_{t-k} + \sum_{k-1}^{P2} \partial_{2,k} \, \Delta lnFR_{t-k} + \sum_{k-1}^{P3} \partial_{3,k} \, \Delta lnPK_{t-k} + \sum_{k-1}^{P4} \partial_{4,k} \, \Delta lnHC_{t-k} + \sum_{k-1}^{P5} \partial_{5,k} \, \Delta lnROL_{t-k} + \sum_{k-1}^{P6} \partial_6 \Delta lnMO_{t-k} + \omega EC_t + \varepsilon_{it}$$

(4)

where the coefficients λi , $\partial 1$, $\partial 2$, $\partial 3$, $\partial 4$, $\partial 5$, and $\partial 6$ signify the short-run effects of economic growth, mineral rents, forest rents, physical capital, human capital development, rule of law and market openness, respectively. This modelling technique is appropriate in circumstances where the variables' integrating properties are I(1), I(0), or jointly co-integrated. The model is adaptable and can be utilized in a variety of situations, such as ours. Another advantage of adopting the ARDL model is that it assesses both long-run and short-run effects at the same time. The integrating qualities of the variables are evaluated before estimating the model to avoid integrating orders above 1, as suggested by Pesaran et al. (2001). We use Panel Unit root test results to do this.

Data

The section of this paper applies to a yearly panel data set for 30 African countries for the period covering from 1995 to 2020. The benchmark used in choosing countries to be encompassed in the study was purely anchored on complete data accessibility on the pertinent variables needed to fulfil the assessment of the precise model. The benefit of employing panel data is that it controls for individual heterogeneity, limits collinearity variables and checks for trends in the data, a situation that ordinary cross-sectional and time-series data cannot provide (Baltagi, 2005). We compiled data on real GDP per capita, which represents economic growth, mineral rents, forest rents, physical capital and human capital development for Africa. We further collected variables of institutional quality, such as the rule of law (ROL) and market openness (MO). In this research, the bulk of the data sets used were sourced from issues such as World Bank (WB) national accounts, World Development Indicators (WDI) and the "Index of Economic Freedom", published every year by Gwartney, Lawson and Hall. Appendix 1 contains a list of the 15 nations represented in the panel data.

Panel Unit Root Test Estimation

Like time-series data, it is feasible that the cross-section time-series characteristics will have a substantial impact on the econometric model specification. Therefore, a test for stationarity on the panel data is essential. Due to the intricate process of dealing with the panel data, the normal ADF and PP tests for unit root could lead to estimators that are unreliable. As a result, we ran the first-generation and second-generation panel unit root tests for stationarity in panel data.

This study used two first-generation alternative unit root test methods to analyze the presence of nit root in the panel data and to remove inconsistency and erroneous test statistics in the estimation. These encompassed the Levin–Lin–Chu (LLC) approach by Levin et al. (2002) and the Im-Pesaran-Shin (IPS) test by Im et al. (2003). The general model of one of the two-first generation panel unit root tests, the LLC approach, is specified by Equation 5.

$$y_{it} = \delta_i y_{i,t-I} + z_{it}^{'} k + \varepsilon_{it}, \quad I = 1, 2, \ldots\ldots, N: t = 1, 2, \ldots\ldots, T, \tag{5}$$

Where ε_{it} represents the error term; Z signifies the deterministic part that could be 0, 1, the fixed effects, μ_i, or fixed effects plus a time trend t; and $\delta = 1$ shows the existence of unit root. Levine et al. (2002) presume that $\delta_i = \delta, \forall_i$ signifying common-persistent parameters throughout the cross-section or all panels share equal autoregressive parameters. As a result of this assumption, a new equation is rewritten as described by Equation 6.

$$\Delta y_{it} = \rho y_{i,t-I} + z_{it}^{'} k + \varepsilon_{it,} \; \mathrm{I} = 1, 2, \ldots\ldots, \mathrm{N}: \mathrm{t} = 1, 2, \ldots\ldots, \mathrm{T} \tag{6}$$

Where $\rho = \delta - I$. At this point the null hypothesis of $\delta = I$ is the same as $\rho = 0$ and Δ is the first difference operator. Alongside the added lags of the dependent variable, the improved model of Levine et al. (2002) can be specified by Equation 7:

$$\Delta Y_{it} = \rho y_{i,t-I} + z'_{it}k + \sum_{j=1}^{p} \beta_{ij}\, \Delta Y_{it-j} + \varepsilon_{it} \tag{7}$$

Where P denotes the maximum number of lags. The test of LLC is centered on testing the null hypothesis that H_0: $\rho = 0$, against the alternative hypothesis that H_1: $\rho < 0$. The null hypothesis of non-stationarity is tested via an adjusted t-statistic for ρ that is biased. Bildirici and Kayıkçı (2012) show that the LLC test offers enhanced estimates relative to some earlier methods of stationarity tests. However, this test presumes that the different techniques are cross-sectionally independent. The weakness of the panel unit root test of LLC is that it takes the ρ to be static throughout the panel. Nevertheless, in reality, this assumption is debatable. Im et al. (2003) instead relax this assumption by considering the null hypothesis that all cross-sectional entities are non-stationary as against the alternative hypothesis that some (but not all) entities are stationary. The Im et al. (2003) panel unit root test is stated by Equation 8.

$$\Delta Y_{it} = \rho_i y_{i,t-I} + Z'_{it}k + \sum_{j=1}^{p_i} \beta_{ij} \Delta Y_{it-j} + \varepsilon_{it} \tag{8}$$

At this point, contrasting the LLC test, the null hypothesis is specified as H_0: $\rho_i = 0\ \forall_i$ against the alternative hypothesis that $H_1 : \rho_i < 0$ for i = 1, 2,…, N_1 and $\rho_i = 0$ for i = N_1 + 1, 2,…, N with $0 < N_1 \leq N$. The IPS test is centered on the ADF statistics, considering the simple average throughout the groups. The unit root null hypothesis of country i is confirmed through Equation 9.

$$\overline{t_{NT}} = \frac{1}{N}\sum_{i=1}^{N} t_{iT}\,(p_i, \beta_i) \tag{9}$$

Where t_{iT} (p_i, β_i) with β_i equal to (β_i,1,…. β_i, p_i) signifies the ADF t-statistic. They, therefore, normalized the statistics and indicate that the normalized t-bar statistics converge to a normal distribution as N and T tend to infinity. Im et al. (2003) state that the t-bar test performs well when we have a small sample.

Cross-Sectional Dependence Test

The stationarity tests of both LLC and IPS assume that the panel time series are cross-sectionally independent. Nonetheless, it is debated that this hypothesis is somewhat limited in the framework of regressions that deal with cross-country data and cause severe distortion of size (Pesaran, 2007). In order to fix this difficulty, we employ a second-generation panel unit root test specified by Pesaran (2007) that considers the relationship between cross-sections. The unit-root test of Pesaran (2007) considers the ADF regressions of cross-sectional data as analogous to the Im et al. (2003) and is expressed by Equation 10 (see Pesaran, 2007, p. 283):

$$\Delta\gamma_{it} = \alpha_i + \beta_i\gamma_{it-1} + c_i\bar{y}_{t-1} + \sum_{j=0}^{p} d_{ij}\Delta\bar{y}_{i-j} + \sum_{j=1}^{p} \delta_{ij}\Delta\gamma_{it-1} + \varepsilon_{it} \tag{10}$$

Were $\bar{y}_t$ and $\Delta\bar{y}_t$ are the proxies for unobserved common factor(s) including $\bar{y}_t = N^{-1}\sum_{i=1}^{N}\gamma_{it}$; $\Delta\bar{y}_t = N^{-1}\sum_{i=1}^{N}\Delta\gamma_{it}$ and ε_{it}, i =1,…., N, t =1,….,T are presumed to be iid throughout i and t taking zero mean, variance σ_i^2 and a fourth-order finite moment. The stationarity test is centered on the null hypothesis that H_0: $b_i = 0\ \forall_1$, against the alternative hypothesis that H_1: $b_i < 0$ for i = 1,…., N_1, $b_i = 0$ for $N_1 + 1$,…., N and be capable of tested via the OLS estimate t-ratio of b_i specified by t_1 (N, T). The testable t-ratio considers the specification of cross-sectionally augmented version of IPS test CIPS (N, T) = $N^{-1}\ \Sigma^{N}_{i=1} t_i$ (N, T). Therefore, the null hypothesis that all-time series in the panel have unit root is tested as against the alternative hypothesis that at least one of the time series has no unit root. To remove size distortions in models with residual serial correlations and liner trends, he enhances the basic ADF regression with the cross-sectional mean of lagged levels and first differences of the various series (CADF statistics).

Panel Co-integration Test

In the literature, there are numerous tests of co-integration, and the occurrence of a panel co-integration test from the examination of time series is a new episode. Therefore, we employed seven different test statistics for investigating the co-integration nexus in the various panels defined by Pedroni (1999). This test was further categorized into two groups: the "inner dimension" and "between dimension" statistics, generally defined as the panel co-integration test and grouped mean panel co-integration statistics, respectively. Nevertheless, this testing was structured in order to reduce the possible bias produced by the likely endogenous series in the model. When using the Pedroni (1999) co-integration test, first, we estimate the panel co-integration regression model (Equation 11) and set aside the residual:

$$X_{it} = \delta_{oi} + \alpha_{it} + \beta_{1i}Y_{1it} + \beta_{ni}Y_{nit}\,\pi_{it} \tag{11}$$

Secondly, we find the first difference in our dataset for the 30 countries included in the study and estimate the residuals of the differentiated regression as stated by Equation 12:

$$\Delta X_{it} = \theta_{1i}\Delta Y_{1it} + \theta_{ni}\Delta Y_{nit} + \varepsilon_{it} \tag{12}$$

The third series of the test is the residual and the long-run variance are estimated employing the regression equation established after estimating our first difference. Next, we estimate the correct autoregressive model employing the residuals from the panel co-integration regression equation. The last stage is the calculation of the seven-panel statistics created by Pedroni (1999), applying the averages and variance modification.

VECM Granger Causality Test

With the existence of a long-run relationship among the variables, a VECM can be estimated so as to determine a cause-effect evaluation (Pesaran et al., 1999). Furthermore, a two-step procedure can be started by first evaluating co-integrating regression in order to get the error terms (Granger, 1987). The F-statistic signifies the short-run causality for the short-run explanatory variables, while λ_i, the coefficient of ECT_{t-1}, captures the causality of the long-run. If λ_i, the ECT_{t-1} coefficients is statistically significant, it thus recommends a long-run causal association between the variables. Once validated, the ECT discovered by the long run VECM is used to identify the causality direction. To accomplish this goal, we follow Iorember et al. (2020) by defining the VECM framework as follows:

$$\begin{bmatrix} \Delta\ln Y_{it} \\ \Delta\ln MR_{it} \\ \Delta\ln FR_{it} \\ \Delta\ln PK_{it} \\ \Delta\ln HC_{it} \\ \Delta\ln ROL_{it} \\ \Delta\ln MO_{it} \end{bmatrix} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \\ \beta_5 \\ \beta_6 \\ \beta_7 \end{bmatrix} + \begin{bmatrix} \mu_{11i}\mu_{12i}\mu_{13i}\mu_{14i}\mu_{15i}\mu_{16i}\mu_{17i} \\ \mu_{21i}\mu_{22i}\mu_{23i}\mu_{24i}\mu_{25i}\mu_{26i}\mu_{27i} \\ \mu_{31i}\mu_{32i}\mu_{33i}\mu_{34i}\mu_{35i}\mu_{36i}\mu_{37i} \\ \mu_{41i}\mu_{42i}\mu_{43i}\mu_{44i}\mu_{45i}\mu_{46i}\mu_{47i} \\ \mu_{51i}\mu_{52i}\mu_{53i}\mu_{54i}\mu_{55i}\mu_{56i}\mu_{57i} \\ \mu_{61i}\mu_{62i}\mu_{63i}\mu_{64i}\mu_{65i}\mu_{66i}\mu_{67i} \\ \mu_{71i}\mu_{72i}\mu_{73i}\mu_{74i}\mu_{5i}\mu_{76i}\mu_{77i} \end{bmatrix} \times \begin{bmatrix} \Delta\ln Y_{t-1} \\ \Delta\ln MR_{t-1} \\ \Delta\ln FR_{t-1} \\ \Delta\ln PK_{t-1} \\ \Delta\ln HUMC_{t-1} \\ \Delta lnROL_{t-1} \\ \Delta\ln MO_{t-1} \end{bmatrix} + \ldots + \begin{bmatrix} \mu_{11i}\mu_{12i}\mu_{13i}\mu_{14i}\mu_{15i}\mu_{16i}\mu_{17i} \\ \mu_{21i}\mu_{22i}\mu_{23i}\mu_{24i}\mu_{25i}\mu_{26i}\mu_{27i} \\ \mu_{31i}\mu_{32i}\mu_{33i}\mu_{34i}\mu_{35i}\mu_{36i}\mu_{37i} \\ \mu_{41i}\mu_{42i}\mu_{43i}\mu_{44i}\mu_{45i}\mu_{46i}\mu_{47i} \\ \mu_{51i}\mu_{52i}\mu_{53i}\mu_{54i}\mu_{55i}\mu_{56i}\mu_{57i} \\ \mu_{61i}\mu_{62i}\mu_{63i}\mu_{64i}\mu_{65i}\mu_{66i}\mu_{67i} \\ \mu_{71i}\mu_{72i}\mu_{73i}\mu_{74i}\mu_{5i}\mu_{76i}\mu_{77i} \end{bmatrix} \times \left[\begin{bmatrix} \Delta\ln Y_{t-1} \\ \Delta\ln MR_{t-1} \\ \Delta\ln FR_{t-1} \\ \Delta\ln PK_{t-1} \\ \Delta\ln HUMC_{t-1} \\ \Delta lnROL_{t-1} \\ \Delta\ln MO_{t-1} \end{bmatrix}\right] + \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \\ \lambda_4 \\ \lambda_5 \\ \lambda_6 \\ \lambda_7 \end{bmatrix} ECT_{t-1} + \begin{bmatrix} e_{1,t} \\ e_{2,t} \\ e_{3,t} \\ e_{4,t} \\ e_{5,t} \\ e_{6,t} \\ e_{7,t} \end{bmatrix}$$

(13)

where $e_{1,t}$ $e_{2,t}$ $e_{3,t}$ $e_{4,t}$ $\varepsilon_{5,t}$, $\varepsilon_{6,t}$ and $\varepsilon_{7,t}$ represent the residual terms, assumed to have zero means and distributed normally; and μ_i represent the short-run elasticity parameters (Equation 13).

Diagnostic Tests

Diagnostic tests were used to show the strength of the model. For the diagnostic test, serial correlation and heteroscedasticity are used.

RESULTS AND DISCUSSION

Summary Statistics

The descriptive statistics of the series are reported in Table 1. The mineral sector has the highest mean, maximum, and minimum values, followed by the forest sector. This highlights many African nations' reliance on minerals, and more focus is being paid to this sector at the expense of other sectors that might drive endogenous growth funding.

The pair-wise correlation matrix as stated in the lower section of table1 shows a positive correlation between the independent variables and growth, with the exception of mineral rents. With physical capital (PK), calculated as the gross fixed capital formation, recorded as 0.39, which is fairly strong. Though most of the series display a positive correlation with growth, the mineral sector exhibits a negative correlation. Many economies in Africa rely mostly on the mineral sector as their main revenue source. Though correlation is not causation, these findings further suggest that minerals could affect economic growth unfavourably. There is no evidence of multi-collinearity as the correlations among the explanatory variables are fairly low.

Table 1: Summary Statistics

Variables	Y	MR	FR	PK	HC	ROL	MO
Mean	3.5	80.3	61.7	20.7	15.4	0.4	0.6
Maximum	228.8	545.6	289.8	122.6	101.7	1.4	1.2
Minimum	65.3	122.3	79.9	2.4	4.1	2.0	2.3
Std. Dev	2.9	44.1	23.3	19.5	22.8	0.9	0.8
Y	1.00						
MR	-0.27	1.00					
FR	0.17	-0.14	1.00				
PK	0.39	0.59	0.04	1.00			
HC	0.28	-0.22	0.17	0.60	1.00		
ROL	0.19	-0.35	0.08	0.61	0.10	1.00	
MO	0.14	-0.31	-.0.11	0.6	0.21	0.59	1.00

Source: Researchers' computation

Panel Unit Root Test Results

The stationarity assumption in the data applied is essential in the study of panel data. The significance of data stationarity in the study of panel data rests on the fact that conditions of constant mean, variance, and covariance must be satisfied in order to approve the flawlessness of the suggested parameters and models. Hence, it is important to take into account whether or not the data is unit root free before evaluating the correlation between economic growth and the explanatory variables. Phillips and Perron (1988) indicated that performing regressions with variables that are not stationary could lead to misrepresentative outcomes, displaying seemingly meaningful associations even where the variables are created independently. A test for stationarity can be used to establish whether or not the variables of interest have unit roots, and this test is also required here since the regression estimation is established on the assumption that the panel data is stationary. Table 2 shows the panel unit root test summary of the results obtained.

Table 2: Panel Unit root test results

Variable	LLC	IPS	ADF	PP
lnY	-27.9 (0.0)	-27.9 (0.0)	633.6 (0.0)	640.1 (0.0)
lnMR	-21.7 (0.0)	-25.6 (0.0)	559.9 (0.0)	636.3 (0.0)
lnFR	-21.3 (0.0)	-19.6 (0.0)	448.4 (0.0)	485.1 (0.0)
lnPK	-24.2 (0.0)	-23.6 (0.0)	542.3 (0.0)	611.8 (0.0)
lnHC	-31.1 (0.0)	-32.4 (0.0)	714.3 (0.0)	823.5 (0.0)
lnROL	-23.1 (0.0)	-21.2 (0.0)	478.2 (0.0)	516.6 (0.0)
lnMO	-30.7 (0.0)	-32.1 (0.0)	712.7 (0.0)	710.1 (0.0)

Note: probabilities for Fisher tests are calculated using asymptotic Chi-square distribution. All other tests assume asymptotic normality. The probability values for the tests are in parentheses.

Panel Co-Integration Test Results

The outcomes of the Predoni co-integration test results are reported in Table 3.

Table 3: Pedroni co-integration test result

Model	Statistics	P-Value
Within-Dimension		
Panel v-Statistic	-1.9267	0.9730
Panel rho-Statistic	2.6624	0.9961
Panel PP-Statistic	-4.5629	0.0000*
Panel ADF-Statistic	-4.4998	0.0000*
Between-Dimension		
Group rho-Statistic	3.4931	0.9998
Group PP-Statistic	-6.9606	0.0000*
Group ADF-Statistic	-6.4431	0.0000*

Note: * indicate significance at 1% level

The results of the investigation in Table 3 demonstrate that the null hypothesis of no co-integration is rejected at the levels of 1% and 5% significance since the majority of the test statistics substantiate the rejection of the null hypothesis.

Thus, the entire proof from the co-integration tests of Pedroni (1999, 2004) indicates that a long-run relationship occurs between the dependent and the independent variables in the panel of African countries used in the study.

Furthermore, we test for co-integration using the ARDL bounds test to investigate the robustness of the co-integration tests by Pedroni co-integration. When the variables are considered as forcing variables, the estimated F-statistics are greater than the upper critical limits at the 1% and 5% levels, as shown in Table 4. This suggests that there are six co-integrating vectors for Africa (see table 4), substantiating the existence of co-integration throughout the sample period and among the series.

Table 4: ARDL Bounds test for co-integration

		Significance Levels			
Variables	F-Statistic Value	Levels	Lower Bound I (0)	Upper Bound I (1)	Co-integrated
lnY	81.4982	10% 5% 1%	2.12 2.45 3.15	3.23 3.61 4.43	Yes
lnMR	2.9571	10% 5% 1%	2.12 2.45 3.15	3.23 3.61 4.43	No
lnFR	4.2823	10% 5% 1%	2.12 2.45 3.15	3.23 3.61 4.43	Yes
lnPK	30.6429	10% 5% 1%	2.12 2.45 3.15	3.23 3.61 4.43	Yes
lnHC	4.4132	10% 5% 1%	2.12 2.45 3.15	3.23 3.61 4.43	Yes
lnROL	80.1584	10% 5% 1%	2.12 2.45 3.15	3.23 3.61 4.43	Yes
lnMO	3.9631	10% 5% 1%	2.12 2.45 3.15	3.23 3.61 4.43	Yes

Source: Researchers' computation

Presentation of Panel Regression Results

Sample Analysis without Interaction Terms

The findings of the panel regressions of the whole sample of 30 African countries are presented in table 5. We start our main analysis by assessing the evidence premised on the baseline model evaluation using the ARDL model, which in fact takes the relative effect of the independent variables on the dependent variable. Model 1 of Table 5 denotes the base model of the ARDL panel without any institutional variables.

Table 5: Estimation Results without interaction terms

VARIABLES	Estimators (Dependent Variable = d(lnY)/lnY		
	Autoregressive Distributed Lag (ARDL) model		
	Model 1	Model 2	Model 3
Short-run parameters			
$dlnMR_t$	-0.5199 (-21.50)*	-0.5262 (-22.30)*	-0.5244 (-22.81)*
$dlnFR_t$	1.3055 (3.42)*	1.3587 (12.01)*	1.3441 (8.27)*
$dlnPK_t$	0.0299 (3.27)*	0.0438 (2.10)**	0.0355 (3.52)*
$dlnHC_t$	1.0226 (2.41)*	1.1708 (1.93)***	1.1596 (3.42)*
$dlnROL_t$	----------	1.0112 (16.56)*	----------
$dlnMO_t$	----------	----------	1.1349 (2.84)*
$ECM_{(-1)}$	-0.0638 (-2.53)**	-0.0656 (-2.07)**	-0.0853 (-4.80)*
C	6.5398 (12.27)*	6.1917 (12.06)*	3.9294 (9.11)*
Diagnostic checking			
R^2	81.4939	0.8848	0.8767
LM	4.5173 [0.1045]	4.5836 [0.1011]	4.5150 [0.1046]
HET	10.5415 [0.1599]	10.9356 [0.1415]	10.5341 [0.1039]
Long-run parameters			
$lnMR_t$	-0.5203 (21.86)*	-0.5257 (21.79)*	-0.5213 (21.91)*
$lnFR_t$	1.2664 (1.8069)***	1.3575 (1.95)***	1.3064 (8.15)*
$lnPK_t$	0.0285 (2.86)*	0.0426 (3.96)*	0.0369 (1.65)***
$lnHC_t$	1.0402 (7.55)*	1.2442 (3.31)*	1.0509 (7.61)*
$lnROL_t$	----------	1.0082 (16.48)*	----------
$lnMO_t$		-----------	1.1029 (7.53)*
C	6.6698 (10.68)*	6.9475 (37.29)*	3.7029 (6.65)*
Diagnostic checking			

R^2	81.3065	0.6831	80.2839
LM	4.4042 [0.1106]	2.5345 [0.2816]	1.2947 [0.5234]
HET	10.5739 [0.1025]	3.6469 [0.7243]	8.3667 [0.2124]

***, ** and *** represent 1%, 5% and 10% respectively. t-statistic values are reported in parenthesis while probability values are represented by [ ]. LM is the Lagrange multiplier test for serial correlation. HET is White's heteroscedasticity test.**

Starting with the short run, the findings indicate that mineral rents are negatively associated with economic growth. The coefficient of mineral rents is -0.5199, implying that a 1% increase in mineral rents reduces economic growth by approximately 0.5%. Given Africa's abundance of natural resources, this study adds credence to the resource curse theory. A large number of scholars have come to the same conclusion that economies with an abundance of natural resources expand at a slower rate than those with fewer resources (Jalloh, 2013; Boschini et al., 2007; Auty, 2001; Sachs and Warner, 1995, 2001, 1997; Rainis, 1991). Concerning the effect of forest rents on economic growth, the coefficient of forest rents is 1.3055, suggesting that a 1% increase in forest rents increases economic growth by 1.31% in the short run. This finding did not validate the resource curse phenomenon. This result agrees with the findings of Bah, C. M., 2016; Adu, 2012; Nunn, 2008; Sala-i-Martin et al., 2004; Manzano and Rigobon, 2001, 2006; in relation to natural resources and economic growth. The policy implication of this finding lies with the encouragement of raising forest rent revenues by supporting the enactment and re-enforcement of more regulatory frameworks in order to encourage more revenue mobilization.

Models 2 and 3 present the outcomes when institutional variables are sequentially included in the base model. The effects of mineral rents in all the estimations are largely the same. There is overwhelming evidence of a negative and significant correlation between mineral rents and economic growth. Also, the effects of forest rents in all the estimations are largely the same. There is some suggestion that there is a positive and significant association between forest rents and economic growth.

In relation to the institutional quality variables, the ARDL estimates reveal that the coefficients of the two measures of institutional quality (ROL and MO) have positive signs and are statistically significant at the 1% level (see table 5). It indicates that the enhancement of institutional quality has a strong and positive effect on growth in Africa. This outcome is consistent with the results of numerous findings on the role of institutions in improving growth performance (see e.g. Bah, C. M., 2021; Ghazanchyan, M. and Stotsky, J. G., 2013; Mijiyawa, A., 2013; Du, J., 2010). This result also supports the conclusions of Doucouliagos and Ulubasoglu (2006), De Haan and Sturm (2000), Dawson (1998), and Easton and Walker (1997) that sound economic institutions are necessary for economic growth. They claim that economic freedom boosts growth directly by enhancing the efficiency with which inputs are converted into outputs, as well as indirectly by boosting and attracting investment. Gwartney et al. (2006) established similar outcomes. Regarding the control variables, the outcomes in Table 5 show that they are mostly satisfactory in their individual coefficients. For instance, the findings show that physical capital investment has a positive and statistically significant impact on growth as anticipated. This is coherent with the traditional theory of growth that physical capital investment is essential for the enhancement of growth. Ghazanchyan, M., and Stotsky, J. G. (2013) also confirm such an outcome. The conclusion of this statement also agrees with the findings of Chow and Li (2002), as can be recognized by the impact of physical capital on China's economy. It was established by Chow and Li (2002) that the major influence on the growth of the Chinese economy after the reform period of 1978-1998 was the accumulation of capital instead of increases in TFP in productivity. According to their findings, capital accumulation accounted for 54% of economic growth. According to Li et al. (2005), capital accumulation accounted for 63 percent of post-reform growth between 1978 and 2003.

Also, human capital investment is reported to be positive and strongly significant to growth, consistent with the endogenous growth theory. Considering these two together, the findings suggest that investments in both human and physical capital are important for improving economic growth. Nevertheless, it is important to note that the effect of human capital development on growth (1.0226) is greater than that of investment in physical capital (0.0299), underscoring the significance of the former over the latter on economic growth.

Considering the long-run effects, the outcomes in table 5 establish that mineral rents have negative and statistically significant effects on economic growth in all the models (see models 1 to 3 of table 5). This suggests that a 1% increase in mineral rents reduces economic growth by the different sizes of the mineral rent coefficients, holding the other explanatory variables constant. Similar to the short run, the coefficients of the long-run estimates reveal that a 1% increase in forest rents, physical capital, human capital, rule of law, and market openness improves economic growth by the various magnitudes of their coefficients (see models 1 to 3 of table 5), keeping the other explanatory variables constant.

Sample Analysis with Interaction Terms

Starting with the short run, the introduction of the interaction terms (see table 6) does not change the outcomes with respect to the statistical significance and signs of the control variables. Mineral rents have a negative and statistically significant influence on growth. This is consistent with the results in table 6.

Table 6: Estimation Results with interaction terms

Variables	Estimators (Dependent Variable = d(lnY)/lnY				
	Autoregressive Distributed Lag (ARDL) model				
	Model 1	Model 2	Model 3	Model 4	Model 5
Short-run parameters					
$dlnMR_t$	-0.5199 (-21.50)*	- 0.5009 (-9.06)*	-0.4979 (-5.31)*	-0.0789 (-2.17)**	-0.0665 (-3.96)*
$dlnFR_t$	1.3055 (3.42)*	0.9253 (63.22)*	0.8171 (6.99)*	0.6927 (2.77)*	0.7200 (17.80)*
$dlnPK_t$	0.0299 (3.27)*	0.0418 (3.89)*	0.0606 (1.99)**	0.0409 (3.84)*	0.0839 (3.31)*
$dlnHC_t$	1.0226 (2.41)*	1.0338 (14.43)*	0.9497 (23.59)*	0.8829 (9.93)*	0.9046 (13.76)*
$dln(ROL*MR)_t$	-----------	0.0213 (2.07)**	----------	----------	-----------
$dln(ROL*FR)_t$	-----------	-----------	1.7513 (3.63)*	-----------	-----------
$dln(MO*MR)_t$	-----------	-----------	-----------	0.0068 (2.29)**	-----------
$dln(MO*FR)_t$	-----------	-----------	-----------	-----------	1.7408 (3.57)*
$ECM_{(-1)}$	-0.0668 (2.68)*	-0.0665 (3.96)*	-0.0412 (3.83)*	-0.0404 (3.82)*	-0.0703 (2.04)**
C	4.4474 (2.37)**	3.8364 (3.75)*	4.3342 (2.24)**	4.0592 (3.88)*	2.0558 (7.97)*

Diagnostic checking					
R^2	0.8847	0.8623	0.6771	0.6813	0.6732
LM	2.6679 [0.2634]	4.0552 [0.1317]	4.5363 [0.1035]	4.4574 [0.1077]	4.7561 [0.0927]
HET	9.6085 [0.1421]	10.3306 [0.1114]	10.2697 [0.1137]	6.6095 [0.3585]	9.3570 [0.1545]
Long-run parameters					
$lnMR_t$	-0.5203 (-21.86)*	- 0.5162 (5.15)*	-0.5532 (-2.90)*	-0.0671 (-2.85)*	-0.0726 (3.27)*
$lnFR_t$	1.2664 (1.81)***	0.6923 (2.97)*	0.4845 (9.18)*	0.4389 (3.10)*	0.8753 (1.88)***
$lnPK_t$	0.0285 (2.86)*	0.0417 (3.87)*	0.0416 (3.87)*	0.0406 (3.78)*	0.0855 (3.28)*
$lnHC_t$	1.0402 (7.55)*	1.0039 (6.58)*	0.9739 (15.40)*	0.8648 (2.04)**	0.8607 (3.29)*
$ln(ROL*MR)_t$	-----------	0.0229 (2.62)*	-----------	-----------	-----------
$ln(ROL*FR)_t$	-----------	-----------	1.5555 (2.12)**	-----------	-----------
$ln(MO*MR)_t$	-----------	-----------	-----------	0.0216 (2.46)**	-----------
$ln(MO*FR)_t$	-----------	-----------	-----------	-----------	1.3536 (1.75)***
C	5.4153 (12.62)*	6.0088 (10.18)*	5.8594 (18.76)*	4.8372 (11.57)*	6.2494 (11.95)*
Diagnostic checking					
R^2	0.6727	0.6694	0.6714	0.6707	0.6708
LM	5.5863 [0.0612]	2.8803 [0.2369]	4.1781 [0.1238]	4.7231 [0.0943]	4.9576 [0.0838]
HET	9.1823 [0.1636]	10.1835 [0.1784]	6.7629 [0.3433]	12.3919 [0.0538]	11.1505 [0.0838]

***, ** and *** represent 1%, 5% and 10% respectively. t-statistic values are reported in parenthesis while probability values are represented by [ ]. LM is the Lagrange multiplier test for serial correlation. HET is White's heteroscedasticity test.**

Interestingly, the interactions of mineral rents with the rule of law and market openness were able to generate positive influences on growth. This basically implies that these institutional factors are associated with the usefulness of mineral rents on growth in Africa. Basically, the results confirm that the lack of good institutions means mineral rents alone would have negative effects on growth. Similarly, the interactions of forest rents with the rule of law and market openness generate robust and positive effects on growth. Basically, institutional quality improvement, particularly when it has to do with the trustworthiness of the government's dedication to trade policy, as well as contract enforcement quality and property rights protection, is crucial. Corruption, for example, decreases private investment by increasing expenses and increasing investor uncertainty. According to these findings, institutional quality and natural resources are complimentary in Africa's economic process. Moreover, we discovered that the effects of the interactions between mineral rents and the variables of institutional quality (models 2 and 4 of table 6) are relatively small, which may reflect the fact that African institutions are of poor quality.

In similar fashion to the short run, the coefficients of the long-run estimates reveal that a 1% increase in the interaction between mineral rents and the rule of law, the interaction between forest rents and the rule of law, the interaction between mineral rents and market openness, the interaction between forest rents and market openness, forest rents, human capital development, and physical capital improves economic growth by the various magnitudes of their coefficients (see models 1 to 5 of table 6), keeping the other explanatory variables constant. The outcomes in table 6 also establish that mineral rents have negative and statistically significant effects on economic growth in all the models (see models 1 to 5 of table 6). This implies that a 1% rise in mineral rents slows growth by the different sizes of the mineral rent coefficients, keeping the other explanatory variables constant.

Diagnostic tests

Overall, the short and long run panel ARDL regressions go well with the diagnostic analyses. Considering the ARCH test, the models are devoid of heteroscedasticity. Furthermore, because the null hypotheses of the Breush-Godfrey Serial Correlation LM Tests are accepted, the specified panel ARDL models do not experience serially correlated errors. As a result, the carefully selected panel ARDL models are appropriate for estimating.

VECM Granger Causality Results

The understanding of the route of causation amongst the given variables gives a better vision for policymakers in the formulation of natural resources, economic growth, and institutional quality policies. Hence, it is of great importance to the researcher to run tests of Granger causality as soon as co-integration presence is observed. The Granger Causality test was used in the study to examine the direction of influence among the variables, and the results are explained below.

Table 7 shows the results of the VECM Granger causality for the overall sample of Africa, for both long-run and short-run causality. Concerning the short-run causality, the results reveal that mineral rents Granger cause economic growth and human capital development. This finding is anticipated because of the fact that a large number of African countries are driven largely by natural resources (minerals), which bring huge rents and which are also a major source of conflict, instability of commodity prices, and corruption (which reduce economic growth). It also has the potential to affect human capital development negatively by reducing educational opportunities and harming long-term growth. Therefore, there is a need to increase the share of forest rents in the natural resource mix to improve economic growth, hence economic development, since our research has proven that forest rents affect economic growth positively. This outcome is in agreement with Bah, C. M. (2016), who found a causal relationship between growth and natural resources. We also discover an indication of a one-way causal relationship running from institutional quality to economic growth. Additionally, we find evidence to substantiate a unidirectional causal relationship running from economic growth and mineral rents to human capital development. Our research further demonstrates a bidirectional causal relationship between forest rents and economic growth; physical capital and economic growth; mineral rents and physical capital; forest rents and physical capital; institutional quality and human capital development.

Table 7: Results of VECM Granger -causality test

	Short-run causal relationship						Long run
Dep. variable	ΔLnY_{t-1}	$\Delta lnMR_{t-1}$	$\Delta lnFR_{t-1}$	$\Delta lnPK_{t-1}$	$\Delta lnHC_{t-1}$	$\Delta lnIQ_{t-1}$	$ECT_{(t-1)}$
ΔLnY_t	-	1.3073** (0.0140)	8.7067* (0.0000)	8.5292* (0.0000)	0.7384 (0.3571)	8.6500* (0.0000)	-0.1138* [16.28]
$\Delta lnMR_t$	5.1066* (0.0000)	-	1.1364 (0.3731)	6.5014* (0.0000)	5.1958* (0.0000)	8.1898* (0.0000)	-0.0158** [2.49]
$\Delta lnFR_t$	5.1067* (0.0000)	2.2387 (0.1075)	-	5.2473* (0.0000)	0.1019 (0.2243)	6.4956* (0.0000)	-0.1074* [16.33]
$\Delta lnPK_t$	8.0749* (0.0000)	1.4062*** (0.0665)	1.5631** (0.0436)	-	1.5121 (0.1601)	6.4713* (0.0000)	-0.0872* [16.29]
$\Delta lnHC_t$	6.5582* (0.0000)	1.2905*** (0.0855)	0.0129 (0.8355)	2.2719 (0.1040)	-	0.0203 (0.4596)	-0.0817**[2.21]
$\Delta lnIQ_t$	1.5696 (0.1415)	0.0953(0.1156)	2.2413 (0.1072)	0.1919 (0.1219)	13.8443* (0.0000)	-	-0.0321** [2.39]

Note: *, **, and * denote rejection of the null hypothesis at 1%, 5%, and 10% significant levels, respectively, P-values are listed in parentheses, t –values are reported in [].**

The causal relationship for the long-run parameters of the overall sample of African countries illustrates that the ECT_{t-1} coefficients have negative signs and shows statistical consistency in all VECMs. Furthermore, the statistical reliability of the ECT_{t-1} displays that if there are deviations in the short term, the system corrects itself to long-term balance at a relative speed for economic growth (-0.1138), forest rents (-0.1074), physical capital (-0.0872), and human capital development (-0.0817) VECMs compared to the adjustment speed of institutional quality (-0.0321) and mineral rents (-0.0158) VECMS.

CONCLUSIONS AND POLICY IMPLICATIONS

According to economic theory, an abundance of natural resources boosts economic growth by increasing the availability of "natural capital." Several studies, including those of Papyrakis and Gerlagh (2007) and Sachs and Warner (1995, 1999, 2001), discovered an inverse relationship between the rate of economic growth and the availability of natural resources. However, other scholars and international organisations, such as the ICMM (International Council on Mining and Metals) assert that, contrary to popular belief, mining may contribute significantly to economic growth and poverty alleviation. However, does this point resonate with African growth in relation to natural resources? The goal **o**f this study was to look into the correlation between natural resources, institutional quality, and economic growth in Africa, a continent that is richly endowed with a plethora of natural resources, using multiple co-integration analysis, the ARDL approach, and VECM granger causality between 1995 and 2020 based on data availability. Two major measures of institutional quality were used, namely the rule of law (ROL) and market openness (MO). Similarly, two natural resource indicators (mineral rents and forest rents) were employed. Consequently, the main hypothesis that was established is connected to the influence of institutional quality in Africa on the resource-economic growth relationship. Panel unit root tests are carried out in the research to test for stationarity. The outputs show that all the variables are integrated of the same order I(1), signifying that there are unit roots at level in all the variables but they are stationary at first difference. In addition, the study's findings from the Pedroni co-integration test results disclose the presence of long-run association among the variables in the models. Additionally, the results of the bounds test via ARDL endorse the existence of a long-run relationship among the variables.

This paper has a number of significant results. OLS results based on ARDL estimators indicate that investment in physical capital and human capital are significant factors for growth performance in Africa. Most significantly, the empirical results reveal that different resources contribute differently to economic growth. First, mineral rents (MR) contribute negatively to growth while forest rents (FR) contribute positively to growth in both models (model with rule of law as institutional quality and model with market openness as institutional quality), both in the short run and long run. The policy implication of the negative effect of mineral rents on economic growth is that the continent could not channel the huge earnings from mineral rents properly into accomplishments that improve growth and development, implying a resource curse rather than a blessing. This negative impact of mineral rents has led to general disturbances in the economic and political lives of the people of the African continent. As indicated, forest rents as an indicator of natural resources exhibited a positive contribution to economic growth. This implies that forest rents represent an important factor that can transform the growth of the economies of Africa.

Second, the results also reveal that forest rents contribute more to growth in the model with rule of law (ROL) as IQ than in the model with market openness (MO) as IQ. Among the institutional quality variables, the rule of law has the most substantial contribution to economic growth on the continent. Third, the result further reveals that when institutional qualities were included in the models as interacting terms, both resources (MR and FR) ended up contributing positively to growth. However, it was observed that resources contribute more to growth in the model with the rule of law as an institutional quality than in the model with market openness as an institutional quality. This suggests that the rule of law plays a more critical role in making natural resources contribute positively to growth than market openness. Further evaluations confirm that for mineral rents to have a substantial positive influence on growth, domestic institutional quality is required. Specifically, we established that the positive influence of mineral rents on economic growth is dependent on institutional quality, particularly when it has to do with regulatory quality, the effectiveness with which trade policy is developed and implemented, control of corruption, the trustworthiness of the government‘s obligation to trade and financial policies, including the quality of contract implementation and protection of property rights. Moreover, the results of the VECM causality output showed that, in the long run, mineral rents, forest rents, and institutional quality granger-cause economic growth. Similarly, economic growth granger-causes mineral rents and forest rents. In addition, we find a two-way causality between forest rents and economic growth; mineral rents and economic growth in the short run. Additionally, the results confirm the existence of a one-way causal relationship running from IQ to economic growth; IQ to mineral rents; and IQ to forest rents. However, there was no causal relationship between forest rents and mineral rents.

One major policy implication of our findings is that resource-rich countries must first improve and strengthen the quality of their domestic institutions. This research suggests that institutional quality is vital for a country's economic growth. The effect is that an enhancement in institutional quality improves economic growth performance. Also, this implies that these specific institutional factors (ROL and MO) are associated with natural resources to improve Africa’s economic growth. The result confirms that natural resources could have a significant and positive effect on economic growth in the presence of institutions. In essence, enhancing the quality of institutions, particularly as it relates to judicial effectiveness, over and above the quality of contract execution and safeguarding property rights, fighting corruption, the quality of formulating and implementing trade policy, and the trustworthiness of government commitment policies to trade is vital.

Another very important policy implication of our study is that resource-rich countries must specifically concentrate on improving the rule of law since robust outcomes are generated when interacting with natural resources, both in the short run and the long run. This could be attributed to the idea that the effectiveness of the judiciary, particularly for underdeveloped nations, may be the most crucial aspect of economic liberty in setting the groundwork for economic growth (Miller et al., 2019). Judicial effectiveness is a vital and robust tool for fighting corruption. This finding buttresses the traditional understanding that confronting the existence of corruption is significant for realizing strong economic growth, particularly in developing countries. But this could only be achieved through an effective and efficient judicial system. The rule of law—enforcement of contracts and property rights protection; a court system that is not partial; and an independent judicial system—is vital for protecting property and safeguarding contracts, which are the basics of a market economy. Without the presence and trust of the rule of law, economic growth and prosperity will be challenging to achieve. Based on those mentioned above, resource-rich countries' governments should develop policies that would considerably enhance economic freedom, thus benefiting from exporting natural resources.

Our control variables' policy implications are explicit. One of the most significant input factors, human capital, has been thought to be an essential growth factor. By employing the gross enrolment ratio of tertiary education in Africa as a human capital proxy, human capital and economic growth are established to be significantly and positively related. This suggests that an enhancement of human capital will complement natural resources in improving the growth of the economies of resource-rich countries and, therefore, probably the living standards and economic development of the citizens of those countries. From the policy standpoint, the governments of such countries must improve and devise policies that will increase tertiary education enrolment through more educational institutions and continue to give financial support to students. The focus must be to enhance the quality of tertiary education. Aghion and Howitt (1998) stated that education at the tertiary level is more significant for innovation and technology diffusion. It is also essential to encourage a favourable atmosphere and develop the necessary infrastructure for national investment and FDI to boom. This could be achieved through investment in physical capital.

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Appendix

Table 1: Sample of African Countries

No.	Country	Abbreviation	Panel data id
1	Algeria	DZA	1
2	Benin	BEN	2
3	Botswana	BWA	3
4	Burkina Faso	BFA	4
5	Burundi	BDI	5
6	Cameroon	CMR	6
7	Central African Republic	CAF	7
8	Chad	TCD	8
9	Congo Dem. Republic	COD	9
10	Congo Republic	COG	10
11	Cote D'Ivoire	CIV	11
12	Egypt Arab Rep	EGY	12
13	Ethiopia	ETH	13
14	Equatorial Guinea	GNQ	14
15	Gabon	GAB	15
16	Ghana	GHA	16
17	Kenya	KEN	17
18	Malawi	MWI	18
19	Mozambique	MOZ	19
20	Namibia	NAM	20
21	Niger	NER	21
22	Nigeria	NGA	22

23	Rwanda	RWA	23
24	Senegal	SEN	24
25	Sierra Leone	SLE	25
26	Tanzania	TZA	26
27	Togo	TGO	27
28	Tunisia	TUN	28
29	Uganda	UGA	29
30	South Africa	ZAF	30