

DRIVERS OF ECONOMIC COMPLEXITY: NEW EVIDENCE FROM DEVELOPING COUNTRIES*

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This paper examines the drivers of economic complexity in developing countries, using a balanced panel data on 102 countries from 2000-2018. The two-step system Generalized Method of Moments estimation technique was employed. The results show that while economic growth, institutional quality, population density and education are important in promoting the level of economic complexity in developing countries, terms of trade has a negative effect on economic complexity. The heterogeneous analysis reveals that, in the context of Africa, natural resource rents and education are positive drivers of economic complexity but exchange rate affects economic complexity negatively. Conversely, in non-African settings, economic growth and population density positively drive economic complexity but institutional quality, terms of trade and financial development negatively drive economic complexity. These distinctions point to the fact that a one-size-fits-all approach may not be appropriate, and policies should be designed to account for the unique economic, institutional, and developmental characteristics of African and non-African developing countries.

Keywords: Economic Complexity; Developing Countries; GMM

JEL Classification: O16; O11; C13

1. INTRODUCTION

The current complex and globalized economic system create both opportunities and challenges for many countries, some have been able to adjust to the changing conditions and seize the opportunities, while others have not. Innovation in value creation and

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production has become essential for developing nations to catch up to developed ones in today's more complex and globalized economic system (Hidalgo, 2023).

Quite recently, a new innovative method of production called 'economic complexity', which refers to the knowledge stock applied to production activities (Hidalgo and Hausmann, 2009), has emerged. Economic complexity emphasizes the significance of product sophistication and variety for a country's economic success by embodying product distinctiveness and diversification (ubiquity). The benefits that economic complexity presents include but not limited to improvement in economic growth (Hidalgo, 2021; Zhu and Li, 2017; Hausmann et al., 2014), reduction in output volatility (Hvidt, 2013), and a bridge of the income inequalities gap between countries (Hartmann et al., 2017). These benefits highlight the importance of introducing innovative policies that support the development and improvement of economic complexity.

Despite the growing importance of economic complexity in explaining economic development, knowledge of its determinants remains relatively underexplored. Understanding the factors that influence economic complexity is crucial for guiding policy decisions, encouraging innovation, boosting global competitiveness, and advancing sustainable economic growth, as discussed above. This is important because, in an increasingly interconnected world, economic complexity acts as a road map for countries looking to develop robust, diverse, and advanced economies (Hidalgo, 2023). Understanding the determinants of economic complexity is important for developing countries, in particular, for several reasons. First, many developing countries heavily rely on a limited number of products (mainly agricultural products) for export (Avom et al., 2021; Alimi and Aflouk, 2017), making them vulnerable to price fluctuations and market uncertainties. Understanding the determinants of economic complexity could allow these countries to identify and address factors hindering diversification, thereby reducing such vulnerabilities. Second, economic complexity is closely linked to long-term sustainable development (Hidalgo, 2023). It has implications for the stability and competitiveness of firms that participate in international trade relevant for sustainable development outcomes. Developing countries could use insights into the various determinants to create strategic policies that encourage the growth of complex products, fostering sustained economic growth. Third, given the importance of foreign direct investment (FDI) in fostering structural transformation in developing countries by providing capital, technology, employment, market access, and infrastructure, a clear understanding of the determinants of economic complexity could allow developing countries to create environments conducive to FDI inflows (Osinubi and Ajide, 2022; Yalta and Yalta, 2021). This is because investors are more likely to engage in countries where economic complexity is supported by favourable economic conditions and policies. Finally, developing countries provide an excellent setting for this study because the accumulation and creation of knowledge needed for structural transformation has been disappointing in many of these countries compared with developed ones. For example, the statistics for the period 2000-2018, revealed that the average level of

economic complexity in developing countries lag behind that of developed ones¹. This suggests that the productive structure of developing countries is lower, because higher economic complexity means better productive structure while lower ones imply weak productive structure of an economy.

The insight from the afore discussions make it important to understand the primary determinants of economic complexity in developing countries so that appropriate policy measures can be adopted to create a more advanced and diversified economic structure that can enable sustainable economic development. Therefore, the goal of this paper is to examine the determinants of economic complexity in developing countries with a particular focus on Africa. This is important because during the study period (2000 – 2018) and across 102 developing countries, the average economic complexity index for developing countries was -0.379. However, African countries exhibited a lower average economic complexity (-0.692) compared to their non-African developing counterparts (-0.115).

In analyzing the relationship between economic complexity and growth, classifying countries based on their level of development rather than solely on per capita income offers a more comprehensive and accurate understanding of their socio-economic realities. While per capita income is a useful metric, it fails to capture critical aspects such as productive capacity, education quality, life expectancy and overall living standards. A development-based classification incorporates productive capacity, human development indicators, inequality, and social well-being, providing a multidimensional view that better reflects the true progress and challenges of a country. This approach enables more targeted policy-making, fairer international comparisons, and more effective allocation of development assistance.

The remaining sections of the paper is outlined as follows: Section 2 review the literature on economic complexity. Section 3 discusses the data, methodology as well as estimations technique employed. Section 4 presents and discusses the empirical findings and their economic interpretations. The final section summaries the paper and suggest policy recommendations.

2. LITERATURE REVIEW

The theoretical literature on economic complexity emphasizes that the production of goods and services requires more than just labour, raw materials, and machinery (Hausmann et al., 2014). It also demands a deep knowledge of how to effectively

¹. According to the atlas of economic complexity data for the period 2000-2018, the average level of economic complexity in developing countries was -0.379 while that of developed countries was 1.153 (<http://atlas.media.mit.edu>).

combine these factors of production and manage the overall production processes. Higher economic complexity tends to enable greater product diversification and can be a source of competitive advantage. For these reasons, countries or regions with a diverse and complex economic structure are often more resilient to economic shocks, as they are not overly dependent on a narrow range of products (Hidalgo, 2023). Theoretically, this effect can be driven by macroeconomic, institutional and policy variables that include economic growth, institutional quality, terms of trade, education, natural resources, population density and financial development.

As an economy grows, it often becomes more diversified, that is, it engages in a broader range of economic activities (Nguyen et al., 2023). The emergence of new industries and the expansion of existing ones contribute to diversification of economic activities which broadens the range of productive activities within the economy (Erkan and Ceylan, 2021). As economies become more complex and sophisticated, they tend to specialize in the production of goods and services in which they have a comparative advantage. This specialization allows for the efficient allocation of resources, as countries focus on producing what they are relatively better at.

One of the key variables that ensures efficient diversification and complexity of production is the quality of institutions. Strong institutions, characterized by transparent governance, protection of intellectual property rights, and an effective regulatory environment, among others, are more likely to foster technological innovation and the development of new products. Conversely, weak institutions may hinder the complexity and diversity of production by creating barriers to entry. Such institutions tend to foster corruption and undermine property rights. Furthermore, as economies evolve and diversify into more complex sectors, there is typically a greater demand for institutions that can support and regulate their activities.

In addition, improvements in terms of trade, where export prices increase relative to import prices, can incentivize countries to specialize in exporting goods and services with higher relative prices (Krugman 2009). This may lead to a shift in export composition towards more sophisticated and higher value-added products, contributing to an increase in diversification and complexity of production. Conversely, deteriorations in terms of trade may lead countries to rely more heavily on exporting primary commodities or low-value-added goods, potentially reducing economic complexity and economic gains. Again, economic complexity is often associated with higher levels of productivity and efficiency in production processes. Countries with higher economic complexity may have more efficient production methods, advanced technology, and skilled labour, which can lead to higher-quality exports and lower production costs. These factors can contribute to improvements in terms of trade by increasing the competitiveness of exports and allowing countries to command higher prices in international markets. These outcomes can further be driven by human capital development (Yalta and Yalta 2021). Human capital enables individuals to specialize in specific tasks or industries where they have a comparative advantage, leading to greater efficiency, and productivity that improves the level of economic complexity. In a similar

vein, economic complexity, can create the resources such as generating tax revenues and profits that can be allocated toward investments in human capital.

The theoretical link between foreign direct investment (FDI) and economic complexity rests on the idea that FDI can transfer new technologies, knowledge, and production processes to the host country, which helps diversify and upgrade its economic capabilities (Nguyen et al., 2023). FDI brings advanced technology and managerial practices, which can be transferred to local firms and industries. This helps local economies develop more sophisticated production processes and introduce new, complex goods and services, advancing their economic complexity (Ghebrihiwet, 2018). FDI can also play a crucial role in elevating economic complexity by fostering an environment of knowledge sharing, skill enhancement, industrial diversification, and global integration.

Exchange rate dynamics and economic complexity revolves around how fluctuations in exchange rates influence a country's production structure, trade patterns, and ability to diversify into complex products. A competitive exchange rate (a depreciation) can make a country's exports cheaper and more attractive to international buyers. This can stimulate demand for exports, particularly in manufacturing and value-added sectors, encouraging industries to diversify their production base and shift toward more complex products. Conversely, an overvalued currency may make exports expensive, reducing demand and potentially limiting complexity gains. Stable and favourable exchange rates attract FDI by reducing currency risk for foreign investors (Nguyen et al., 2023).

The relationship between natural resource rents and economic complexity can be complex. While abundant natural resources, especially non-renewable ones such as oil and minerals, can provide significant income, they can also lead to a resource curse. This phenomenon occurs when countries that heavily depend on natural resource extraction experience slower economic diversification and underdevelopment in other sectors (Nguyen et al., 2020). Such reliance on natural resource rents can crowd out investment in alternative industries, inhibiting the development of a more diverse and complex economy. Conversely, as economies evolve towards greater complexity, they tend to foster a wider range of industries or sectors, including manufacturing, services, and technology sectors. This diversification reduces the economy's dependence on natural resource extraction as the primary source of income and government revenue, potentially leading to a decrease in the significance of natural resource rents (Mehlum et al., 2006; Hausmann and Hidalgo, 2014). Thus, while natural resource rents can initially drive economic growth, a focus on enhancing economic complexity may ultimately provide a more sustainable path for long-term development.

Moreover, higher population density often corresponds to larger and denser markets. Larger markets can support a wider variety of goods and services, facilitating specialization, innovation, and economies of scale. This can encourage the development of diverse industries and supply chains and contribute to complex production though it can also create a virtuous cycle of growth that attract people and businesses to areas with diverse economic opportunities and contributing to high population density (Giri et al.,

2019; Balc, 2016). Finally, financial development, including well-functioning banking systems, capital markets, and access to credit opportunities, can provide firms with the necessary funding to invest in innovation, research and development, and technology adoption (Nguyen et al., 2020). This access to capital enables firms to undertake more complex production processes, develop new products, and diversify their economic activities, thereby contributing to economic complexity. Also, economic complexity can drive demand for advanced financial infrastructure and services, such as sophisticated banking systems, capital markets, and financial technologies.

Several empirical studies have provided support to the theoretical linkages discussed above. Using the Panel Corrected Standard Errors estimator to investigate the effects of financial development on economic complexity in a panel of 52 countries over the period 1995–2017, Nguyen et al. (2020) found that financial development has more diverse effect on economic complexity than other determinants. That is, while large financial sector does not contribute to the level of economic complexity, efficiency of financial markets has a positive impact on economic complexity. Similarly, Saad et al. (2023) applied the Generalized Method of Moments on a panel of 133 high- middle -low countries during the period from 1984 to 2018. The authors found that economic growth positively affect economic complexity but there is negative relationship between natural resource potential and economic complexity. According to Chu (2023), economic growth, population density, education exert positive and significant effects on economic complexity while natural resources rent has a negative effect on economic complexity. However, there are substantial differences in the roles of these factors between high-income and middle- and low-income countries.

Again, Osinubi and Ajide (2022) who used the dynamic ordinary least square estimator to examine the relationship between foreign direct investment and economic complexity in nine emerging economies posit that, foreign direct investment has positive effect on economic complexity in Mexico, Indonesia, Nigeria and Turkey but negative impact in Brazil, Russia, India, China, and South Africa. Nguyen et al. (2023) investigated the effect of institutional quality on economic complexity using a panel of 89 developed and developing countries over the period 2002–2016. Their findings indicate a positive relationship between economic complexity and institutional quality. Finally, Yalta and Yalta (2021) examined the determinants of economic complexity in 12 Middle East and Northern Africa using the Generalized Method of Moments estimation technique. The result shows that, while education positively affects economic complexity, natural resource rents negatively affect it.

From the afore, empirical studies that focus directly on the determinants of economic complexity are relatively scarce. That is, few studies have ventured into identifying the determinants of economic complexity. For example, Yalta and Yalta (2021) and Nguyen et al. (2020) examined the drivers of economic complexity in middle East and North Africa, but these studies have some limitations. The key shortcoming of Yalta and Yalta (2021) is that it is limited to only 12 Middle East and North America countries. Again, it ignored the important role of institutional quality but strong and effective institutions

create an enabling environment that encourages innovation, investment, and entrepreneurship, thereby facilitating the emergence and growth of economic complexity. Also, Nguyen et al. (2020) only investigated how patents and financial development affect economic complexity. The authors used a sample of 52 economies, comprising 32 high-income economies (HIEs) and 20 middle-income economies (MIEs). There is therefore a limited scope for developing countries, hence the need for this current study. This underscores the need to focus specifically on developing countries and account for regional specificities, as the determinants and implications of economic complexity may differ substantially across regions and levels of development.

3. METHODOLOGY

3.1. Empirical Model and Estimation Strategy

To investigate the drivers of economic complexity in developing countries, we assumed that the level of economic complexity in an economy is driven by macroeconomic, institutional and policy variables. To achieve our objective, we specify the empirical model as follows:

$$EC_{it} = \delta + \mu EC_{it-1} + \beta_i X_{it} + \eta_i + \varphi_t + \varepsilon_{it} \quad (1)$$

for $i = 1, 2, 3, \dots, N$ and $t = 1, 2, 3, \dots, T$

where EC_{it} represent economic complexity for country i in period t ; EC_{it-1} is the lagged dependent variable which measures whether economic complexity converges to a long-term equilibrium and the speed at which adjustments occur toward that equilibrium, and X_{it} denote a vector of variables including economic growth, domestic investment, population density, natural resource rent, education, terms of trade, institutional quality, financial development, foreign direct investment, and exchange rate;. Also, η_i denotes individual country- specific effect, φ_t is the time specific effect, ε_{it} is the stochastic error term and δ , μ and β are the respective coefficients to be estimated.

To estimate equation (1), the Generalized Methods of Moments (GMM) estimator that cope with endogeneity concerns emanating from varied sources, including unobserved heterogeneity and/or simultaneity bias is employed. As the theoretical review suggest, the presence of economic complexity drivers such as economic growth, education and institutions in the model are likely to result in endogeneity problems. For instance, according to Saad et al. (2023), Chun (2023), and Yalta and Yalta (2021), there is a positive relationship between economic growth and economic complexity. This causality suggests potential endogeneity issue. Similarly, Saad and Assoumou-Ella (2019) suggest that economic complexity positively affect both the primary and

secondary levels. Therefore, making education a potential source of endogeneity in this study. Finally, foreign direct investment positively affects economic complexity by fostering technology transfer and innovation (Ajide 2024). Additionally, the paper accounted for the rate and speed of convergence to long run equilibrium of economic complexity by introducing the lagged dependent variable. However, this approach may lead to autocorrelation issues, necessitating the use of the GMM model, which effectively addresses these problems.

In identifying the determinants of economic complexity, it is important to understand both the short- and long-run effects of the variables. This distinction is important because it provides deeper insights into how different variables influence outcomes over various time horizons, which is essential for effective and balanced policymaking. The short-run results obtained from equation (1) represent the short-run effects. To obtain the long-run coefficients and their corresponding asymptotic standard errors for the right-hand side variables, we followed the procedure proposed by Papke and Wooldridge (2005). The long-run coefficient is obtained by dividing each short-run coefficient by one minus the coefficient of the lagged dependent variable.²

3.2. Data

The paper used a balanced panel data covering 102 developing countries from 2000 to 2018 for the analysis. The selection of countries and data period were determined by the availability of data. Economic complexity is measured using the Revealed Comparative Advantage (RCA). It values range from -2.8 to +2.8, where positive values mean more complex economy and negative values means less complex economy. The data on economic complexity data was sourced from the Atlas of economic complexity (<http://atlas.media.mit.edu>). Additionally, quality institution is measured in six dimensions: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. It values range from -2.5 to +2.5 where negative values indicate weaker institutions and positive values indicate strong institutions. The data was obtained from the World Bank's World governance indicators. Also, growth is measured by GDP per capita, human capital development is measured using secondary school enrolment as percentage of the gross, natural resource rent is measured total natural resources rents are the sum of oil rents, natural gas rents, coal rents, mineral rents, and forest rents. Financial development is measured using domestic credit provided by banks as (% of GDP), foreign direct investment is measured foreign direct investment, net inflows, terms of trade in measured by the net barter terms of trade index, investment is measured by Gross fixed capital formation (share of GDP) were obtained from World Bank's development indicators. The definition and data sources have been fully summarized in Table 1.

² The long run estimates are obtained by implementing the "nlcom" routine in Stata.

Table 1. Summary of Variable Description and Sources

Variable	Proxy/definition	Notation	Data source
Economic complexity	Economic Complexity Index (knowledge stock in production)	EC	The Atlas of economic complexity
Economic growth	Growth rate of real GDP per capita	GR	World Bank World Development indicators
Natural resource rent	Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.	NRR	World Bank World Development indicator
Financial development	Domestic credit provided by banks as percentage of GDP	FD	World Bank World Development indicator
Physical capital	Gross fixed capital formation (share of GDP)	DI	World Bank World Development indicator
Population density	Population density (people per sq. km of land area)	PoD	World Bank World Development indicator
Foreign direct investment	Foreign direct investment, net inflows (BoP, current US\$)	FDI	World Bank World Development indicator
Quality Institutions	Principal Component Analysis construction from government effectiveness, control of corruption, rule of law, voice and accountability, regulatory quality and political stability and absence of violence	INST	Author's construction based on World Bank World governance indicators
Terms of trade	Net barter terms of trade index	ToT	World Bank World Development indicator
Education	Secondary school enrolment as percentage of the gross.	Edu	World Bank World Development indicator

Source: Authors' construction

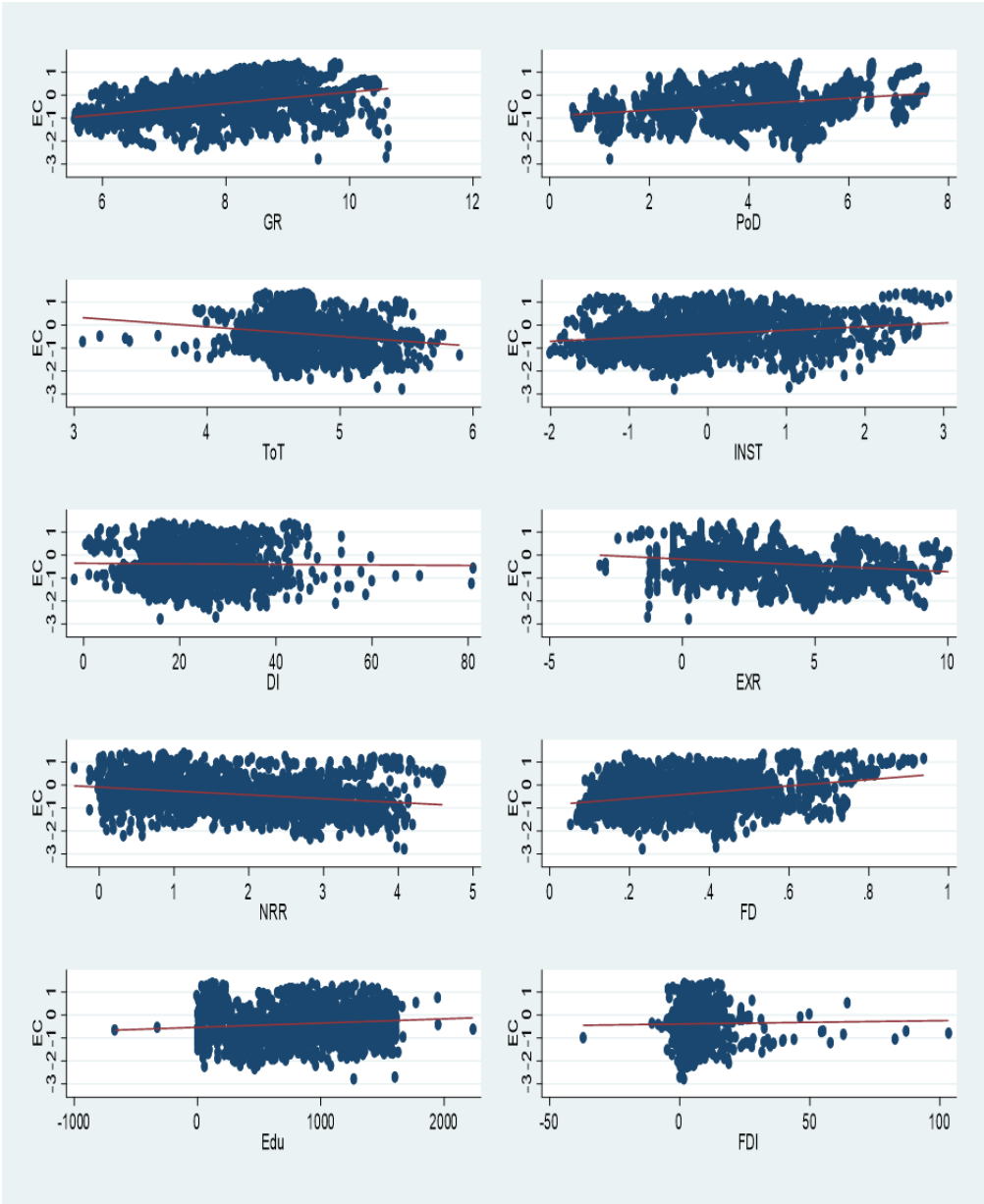
Table 2 reports the summary statistics of the variables in model. For the 102 developing countries considered, the paper found that economic complexity has average scores of -0.379, -0.692, and -0.115 in the full sample, Africa, and non-African contexts respectively. From these statistics, it is evident that African countries have the lowest average score within the sample. Again, within the period of study, economic complexity has standard deviations of 0.728, 0.605, and 0.719 for the full sample, African, and non-African countries respectively. Meaning, there is variability in the level of economic complexity across the various regions. Finally, economic complexity ranges from -2.778 to 1.393 in the full sample, -2.778 to 1.022 in Africa and -2.695 to 1.393 in non-African countries. It can be observed that non-African countries recorded the maximum value within the sample as shown in table 2 as follows:

Table 2. Descriptive Statistics

Full sample					
Variable	Obs	Mean	Std. Dev.	Min	Max
EC	1917	-0.3798	0.7286	-2.7784	1.3935
ToT	1925	120.3818	39.80621	21.3967	364.4387
EXR	1932	3.8313	2.7787	-3.1129	10.0258
GR	1929	2.5446	3.7250	-10.4592	14.7738
FDI	1931	4.6734	6.9517	-37.1726	103.3374
FD	1887	32.2778	27.1634	0.4491	157.8091
NRR	1926	11.1293	14.7483	0.0010	98.4920
DI	1912	22.6033	8.3001	0.4136	81.0210
PoD	1938	136.9358	236.1466	1.5838	196.846
Edu	1938	104.557	20.1449	46.2342	223.0346
Africa					
Variable	Obs	Mean	Std. Dev.	Min	Max
EC	878	-0.6923	0.6058	-2.7784	1.0227
ToT	892	121.8325	39.6666	21.3967	290.9305
EXR	891	4.4913	2.3327	-3.1129	9.1147
GR	890	2.0421	3.6228	-7.6573	13.9428
FDI	892	4.3194	8.2088	-10.7249	103.3374
FD	869	20.3119	19.5949	0.4491	99.9818
NRR	888	12.2605	12.1586	0.0024	88.5923
DI	878	22.2298	9.0164	1.0968	81.0210
PoD	893	90.0918	119.6315	2.2095	623.302
Edu	844	101.6435	19.36173	32.35606	149.3156
Non-Africa					
Variable	Obs	Mean	Std. Dev.	Min	Max
EC	1039	-0.1158	0.7193	-2.6958	1.3935
ToT	1033	119.1291	39.9030	50.1947	364.4387
EXR	1041	3.2665	2.9979	-2.4341	10.0258
GR	1039	2.9749	3.7590	-10.4592	14.7738
FDI	1039	4.9773	5.6402	-37.1726	55.0703
FD	1018	42.4922	28.5277	2.4711	157.8091
NRR	1035	10.1587	16.5969	0.0010	98.4920
DI	1034	22.9204	7.6294	0.4136	57.7102
PoD	1045	176.9661	296.2361	1.5838	1906.846
Edu	1821	102.9743	17.9359	20.8829	132.8169

Source: Authors' construction

To elaborate more on the association between economic complexity and its drivers, we show in Figure 1 the scatterplot of economic complexity against each of the drivers of economic complexity. The linear trend is the fitted values. The plots show economic growth (GR), populations density (PoD), foreign direct investment (FDI), physical capital (DI), education (Edu), financial development (FD), natural resource rent (NRR) and Quality of institutions (INST) have positive association with economic complexity while terms of trade (ToT) and exchange rate (EXR) have negative association with economic complexity.



Source: Authors' elaboration based on data obtained from the world Development Indicators, World Governance Indicators and atlas of economic complexity.

Figure 1. Bivariate Plots of Economic Complexity Index against Its Determinants

4. EMPIRICAL INVESTIGATIONS

Before the interpretation of the model coefficients, we present and analyze the most important System GMM diagnostics, namely the Arellano-Bond tests AR(1) and AR(2), for 1st and 2order serial correlations and the Hansen J test. The model basically relies on lagged levels and differences of endogenous and exogenous/predetermined variables as internal instruments that comply with the validity and exogeneity conditions of System GMM estimator. The statistics as presented at the bottom of Table 4 confirm - for instance: AR(1) significant, AR(2) non-significant and Hansen test insignificant, the outcomes confirm the correctness of the dynamic model formulation. Also, we check for instrument proliferation by comparing the number of instruments with the number model groups. It was found that number of groups is high than the number of instruments generated-indicating our estimates are plausible. Furthermore, to address the problem of too many instruments, we limited the instruments by a way of collapsing the instrument matrix as well as the minimum and maximum lags used was between 1-3. Ultimately, we ended up 51 instruments and this is less than/appropriate compared to the actual number of cross-sections of 102. we also checked for instruments' validity, and the statistics presented at the bottom of Table 4 indicates that the instruments used are valid, as shown by the probability-values of the Hansen J test. Based on these diagnostics test statistics, the results presented in this paper are suitable for policy recommendations.

Also, the short run results show that the coefficient of the lagged value of economic complexity is statistically significant and ranges from 0.702 to 0.857 in the full sample of developing countries, Africa and non-Africa countries. This indicates that, there economic complexity converges to a long-term equilibrium and the speed at which adjustments occur toward that equilibrium is high. This suggest that economic complexity tends to follow a cumulative process, where past levels of complexity serve as a foundation for future development. These results conform to an earlier study by Yalta and Yalta (2021) and suggests that countries with a history of higher economic complexity are more likely to continue experiencing growth in economic complexity over time. The short-run and long -run results in Tables 3 and 4 respectively.

Continuing with the analysis of the full sample of developing countries, Africa and non-African countries, it is imperative to highlight that the positive and statistically significant relationship between economic growth and economic complexity is consistently observed. This finding unequivocally demonstrates that a rise in economic growth positively enhances the countries' capacity to manufacture and export complexity. In the short run, when growth improves by a percentage point, the level of economic complexity increases by 0.96% in developing countries, while in the long run, the increase is 0.036%. In Africa, the result shows that a percentage increase in economic growth leads to an improvement in the level of economic complexity by 1.07% in the short run and 0.036% in the long run. However, in non-African developing countries, a percentage increase in economic growth results in just a 0.37% improvement in the short

Table 3. Short-run Results for the Determinants of Economic Complexity

Variable	Full Sample	Africa	Non-Africa
EC-L1	0.736 *** (0.039)	0.701*** (0.036)	0.857*** (0.030)
GR	0.009 *** (0.002)	0.010** (0.004)	0.003*** (0.001)
INST	0.098 *** (0.026)	0.039*** (0.002)	-0.024** (0.011)
NRR	0.022 (0.019)	0.009*** (0.002)	-0.001 (0.001)
EXR	-0.010 (0.012)	0.037*** (0.010)	0.004 (0.010)
ToT	-0.162 *** (0.041)	-0.277*** (0.047)	-0.186*** (0.028)
FDI	-0.004 (0.009)	-0.014** (0.007)	0.004 (0.007)
DI	-0.008 (0.016)	-0.015 (0.009)	-0.004 (0.013)
Edu	0.001 ** (0.000)	0.002** (0.001)	-0.000 (0.000)
PoD	0.076** (0.035)	0.009 (0.030)	0.066*** (0.014)
FD	0.033 (0.020)	0.093*** (0.015)	-0.024** (0.011)
Constant	0.237 (0.220)	0.511 (0.239)	0.669 (0.141)
Model Diagnostics			
No. of obs.	1834	844	990
No of groups	102	47	55
No of instruments	51	46	51
AR(2) (p-value)	0.572	0.581	0.829
Hansen test (p-value)	0.516	0.415	0.645

Note: the stochastic error terms are in parentheses. ***, and ** denotes 1%, and 5% levels of significance respectively.

Source: Authors' estimations

run and 0.026% in the long run. The results are statistically significant and suggest that, in both the short and long run, the magnitude of the impact of economic growth on the level of economic complexity is greater in Africa than in non-African developing countries. By implication, economic growth can contribute to an increase in economic complexity. This can happen through several mechanisms. For example, growing

economies tend to invest more in research and development, which leads to innovation and fosters the development of new products that are more complex and diversified. Additionally, economic growth may increase investments in education and skills development, which are crucial for the development of complex and diversified products. This outcome indicates that Africa countries can benefit greatly if measures are put in place for its growth prospects to drive their ability to produce and export more complex and diversified products to be competitive in the international market. Our finding aligns with economic complexity theory and the empirical literature, such as the works of Nguyen and Su (2021), Yalta and Yalta (2021), and Nguyen et al. (2022), on the impact of economic growth on economic complexity.

It is interesting to report that a positive and statistically significant relationship between institutional quality and economic complexity is observed in the full sample of developing countries and Africa countries. However, a negative and significant relationship between institutional quality and economic complexity is revealed in the non-Africa countries. In the full sample of developing countries and Africa countries, the findings suggest that an improvement in institutional quality positively increases countries' capacity to produce complex and diversified products. In the short run, when institutional quality improves by a percentage point, the level of economic complexity increases by 0.10% in the full sample of developing countries, while in the long run, it increases by 0.37%. In Africa, a percentage increase in institutional quality leads to an improvement in the level of economic complexity by 0.04% in the short run and 0.13% in the long run.

However, in non-African countries, a percentage increase in institutional quality reduces the level of economic complexity by 0.02% in the short run and 0.17% in the long run. These results are statistically significant and suggest that, in both the short and long run, the impact of institutional quality on economic complexity is positive in Africa but negative in non-African countries. By implication, economic complexity tends to increase in countries with well-functioning institutions. This can happen through several mechanisms. For example, institutional quality enhances economic complexity by providing a conducive environment for innovation, investment, and entrepreneurship. Effective institutions ensure the protection of property rights, enforce contracts, promote competition, and maintain political stability. These factors create a business-friendly climate where firms can thrive, leading to the development of diverse and technologically advanced and competitive products. Additionally, strong institutions facilitate knowledge transfer, encourage research and development, and attract foreign direct investment, all of which contribute to the expansion of economic complexity. Therefore, it is advised that African countries ensure institutional quality is enhanced to enable firms innovate to produce and export more complex and diversified products to ensure their competitiveness in the international marketplace. Our finding aligns with the theory and the empirical literature on institutions and economic complexity such as the works of Vu (2022) and Nguyen et al. (2023). The results related to non-African countries may occur in cases where institutions stifle innovation through excessive

bureaucracy or regulatory constraints that tend to hinder the development of complex and diversified products.

Table 4. Long-run Results for the Determinants of Economic Complexity

Variable	Full-Sample	Africa	Non-Africa
GR	0.036*** (0.010)	0.036** (0.017)	0.026** (0.010)
INST	0.373*** (0.103)	0.131*** (0.022)	-0.169** (0.084)
NRR	0.008 (0.007)	0.030*** (0.008)	-0.001 (0.006)
EXR	-0.041 (0.043)	0.125*** (0.027)	0.031 (0.073)
ToT	-0.617*** (0.156)	-0.930*** (0.202)	-1.309*** (0.194)
FDI	-0.001 (0.003)	-0.004** (0.002)	0.002 (0.005)
DI	-0.003 (0.005)	-0.004 (0.003)	-0.002 (0.008)
Edu	0.002** (0.001)	0.006** (0.003)	-0.001 (0.002)
PoD	0.292** (0.143)	0.030 (0.099)	0.469*** (0.129)
FD	0.126* (0.071)	0.313*** (0.059)	-0.170** (0.099)
Constant	0.901 (0.821)	1.714 (0.971)	4.694 (1.021)

Note: the stochastic error terms are in parentheses. *** and ** denotes 1% and 5% levels of significance respectively.

Source: Authors' estimations

Excessive regulation, corruption, or political instability in such case institutional quality could potentially hinder economic complexity. However, using political instability as a proxy for institutional quality altered the sign of the relationship between institutional quality and economic complexity. We report a negative and statistically significant relationship between political instability and economic complexity observed in full sample and non-African developing countries. However, in African the result reveals a negative but insignificant relationship between political instability and economic complexity. In models 1 and 2, the findings suggest that an increase in political instability negatively affects the countries' capacity to produce complex products.

In terms of the results regarding terms of trade, we identified a negative and statistically significant relationship between terms of trade and economic complexity. In the full sample of developing countries case, both the short-run and long-run results demonstrate that, at a 1% significance level, *ceteris paribus*, a percentage increase in

terms of trade reduces the level of economic complexity by 0.162% in the short run and 0.617% in the long run. This finding demonstrates that an increase in terms of trade (TOT) is generally unfavourable to economic complexity. For example, if increase in terms of trade arises from higher prices of low-complexity exports, like raw materials or commodities. This situation can reinforce dependence on primary exports and discourage investment in more complex, diversified industries. In Africa, our findings indicate that, *ceteris paribus*, a percentage increase in terms of trade reduces the level of economic complexity by 0.278% in the short run and 0.931% in the long run. However, in other developing countries, a percentage increase in terms of trade reduces the level of economic complexity by 0.187% in the short run and 1.309% in the long run.

By implication, terms of trade can impede the level of economic complexity. This can happen through several mechanisms. These include; first dependency on Resource Exports: Economies reliant on exporting raw materials or low-complexity goods can have unfavourable terms of trade. This reliance discourages investment in diversified industries, as resources and capital flow into established, low-complexity sectors rather than higher-complexity, knowledge-intensive sectors. Second, reduced incentives for diversification-increase in terms of trade for commodity exports can create a resource curse effect, where high export earnings from commodities reduce motivation to develop diverse, complex industries. This traps economies in low-complexity export structures. Third investment Volatility- volatile terms of trade can lead to fluctuating revenue, making it difficult for governments and businesses to commit to long-term investments in complex industries, which are often more expensive and require stable funding. This result conforms with an earlier study by Yalta and Yalta (2021), who found a negative but statistically insignificant relationship between terms of trade and the level of economic complexity in the Middle East and North Africa (MENA).

Moving on to explain the contribution of financial development, we found a positive but insignificant effect of financial development on economic complexity in the full sample case. However, in the disaggregated sample, we found a positive and statistically significant relationship between financial development and economic complexity in Africa, but a negative and statistically significant relationship between financial sector development and economic complexity in non-African developing countries. The short- and long-run results show that, at a 1% significance level, all things being equal, a percentage increase in financial development will increase the level of economic complexity by 0.093% and 0.313% respectively in Africa. This suggests that, in Africa, financial development can play a crucial role in promoting economic complexity by facilitating access to capital, fostering innovation and entrepreneurship, diversifying financial services, enhancing efficiency and productivity, and driving technological advancements. Developments in financial technology can facilitate access to financial services, improve risk assessment and management, and enhance market efficiency. These innovations can spur the growth of high-tech industries and knowledge-intensive sectors, contributing to the overall complexity of the economy.

In contrast, in non-African developing countries, the short-run result shows that at

the 5% significance level, a percentage increase in financial sector development reduces the level of economic complexity by 0.024% in the short run and 0.171% in the long run. This suggests that in non-African developing countries, financial sector development reduces product diversification and sophistication. Though this is contrary to our expectation but this outcome is impossible. For instance, when financial sectors grow rapidly, they may disproportionately allocate resources to high-return, low-complexity sectors, such as real estate or commodity-based industries. This can pull investment away from more complex, skill-intensive industries that contribute to economic complexity, slowing diversification. Again, this negative relation can be due to the fact that financial sectors where profit-making activities increasingly focus on financial markets rather than productive, diversified economic activities, financial development can limit the economy's growth in complex, high-value industries necessary for increased economic complexity.

It can therefore be concluded that the effect of financial development on economic complexity can vary depending on the specific characteristics of the financial system. In some cases, financial systems may hinder the emergence of new industries and technologies, thereby constraining economic complexity. Conversely, financial development can create opportunities for the growth of more advanced and complex industries. These results are not unfamiliar in the literature. For instance, by employing various proxy indicators for financial development, Nguyen and Su (2021) suggest that financial development indicators such as financial institutions, financial markets, financial depth, financial access, and financial efficiency consistently and positively influence economic complexity. Similarly, Nguyen et al. (2023) found a positive relationship between financial development and economic complexity in the short run and a negative relationship in the long run.

In examining the relationship between resource rent and economic complexity, an intriguing discovery is that there is a positive and statistically significant relationship between natural resource rent and economic complexity in Africa. The short and long run results show that, at a 1% significance level, *ceteris paribus*, a percentage increase in natural resource rent will increase the level of economic complexity by 0.009% and 0.031% respectively. This implies that the resource curse hypothesis does not hold in the relationship between economic complexity and resource rents. This finding suggests that natural resource depletion could prompt policy action to invest resource rents in other productive ventures, such as education, infrastructure, and strengthening institutions.

In the full sample and other non-African developing countries, the relationship between natural resource rent and economic complexity is insignificant. Despite the level of significance, it can be observed that, non-African developing countries the sign is negative, conforming the findings by Yalta and Yalta (2021).

From the afore, it is clear that the impact of natural resource rents on economic complexity is context-specific, and outcomes can vary among countries. Some resource-rich countries have successfully managed to leverage their natural resource wealth for diversified and complex economic development. Effective governance, sound

economic policies, and strategic investments in human capital and infrastructure are crucial for mitigating potential negative effects and promoting economic complexity in resource-rich economies.

Again, we found a positive and statistically significant relationship between population density and economic complexity in the full sample and non-African developing countries. These findings imply that increase in population growth can spur the level of economic complexity. In the full sample case, both the short and long-run results demonstrate that, at a 5% significance level, *ceteris paribus*, a percentage increase in population density increases the level of economic complexity by 0.077% in the short run and 0.293% in the long run. In other developing countries, a percentage increase in population density increases the level of economic complexity by 0.067% in the short run and 0.469% in the long run. The channels through which population density can increase economic complexity include expanding market size and diversity, as well as enhancing network effects. For instance, higher population density provides a larger and more diverse consumer market. This allows firms to cater to a wider range of preferences and demands, encouraging the development of diverse products and services. As firms compete to meet the needs of diverse consumer segments, they may innovate and differentiate their products, thereby contributing to economic complexity. Additionally, high population density can lead to urbanization and the clustering of economic activities in urban centres. This concentration of people and businesses where firms benefit from sharing resources, knowledge spillovers, and access to a larger pool of skilled labour. As a result, urban areas tend to have more diverse and specialized industries, fostering economic complexity. However, we could not find any significant relationship between population density and economic complexity in African.

We also highlight that there is a positive and statistically significant relationship between education and economic complexity in both the full sample and African context. This finding clearly shows that a more educated and skilled workforce is better equipped to engage in complex and technologically advanced production activities, thereby enhancing economic complexity. In the short and long run, when the level of education increases by a percentage point, the level of economic complexity increases by 0.001% and 0.002% respectively in developing countries. In Africa, a percentage increase in education leads to an improvement in the level of economic complexity by 0.002% and 0.006% in the short and long run respectively. These results are statistically significant at the 5% level. By implication, education can improve the level of economic complexity. This can happen through training and skills development, leading to increase in the knowledge and capabilities of the workforce. Highly skilled individuals are better equipped to innovate, solve problems, and adapt to changing market conditions. This fosters the creation of new technologies, products and processes, leading to the emergence of more diverse and complex industries. Our finding aligns with the economic complexity theory and previous studies in the literature, which emphasize the importance of secondary education, particularly in developing countries (see, for example, Sefa and Mustafa, 2022; Yalta and Yalta, 2021; Jetter and Hassan,

2012).

Finally, we report an important discovery regarding the relationship between exchange rates and economic complexity. The results show that exchange rates have a positive and statistically significant effect on economic complexity in Africa. In the short run and long run, at a 1% a percentage increase in the exchange rate leads to a 0.037% and 0.126% increase in the level of economic complexity respectively. This suggests that an increase in the exchange rate (depreciation of the local currency) can potentially boost economic complexity by making exports more competitive globally, encouraging industries to diversify and innovate to meet international demand. This often leads to greater investment in complex sectors as firms seek to add value to exported goods and services, driving economic diversification and complexity. Additionally, exchange rate adjustments can incentivize the development of domestic industries by making imports more expensive, thereby supporting local production and fostering skill and knowledge growth in various sectors. We found no significant relationship between exchange rate and economic complexity in the full sample or among non-African developing countries.

5. CONCLUSION AND POLICY SUGGESTIONS

This study investigated the drivers of economic complexity in 102 developing countries using a balanced panel data spanning from 2000-2018. The study examined the roles of economic growth, foreign direct investment, terms of trade, exchange rate, institutional quality, financial sector development, education, population density, and natural resource rent in determining the level of economic complexity. To determine whether the drivers of economic complexity are region specific, the analysis was also done for Africa and non-African developing countries. To achieve this, the study employed the two-step system Generalized Method of Moments technique, which cope with endogeneity concerns. Although System GMM helps address several sources of endogeneity, the estimates should not be interpreted as establishing definitive causal effects.

The findings suggest that, in the full sample of developing countries, economic growth, terms of trade, exchange rate, institutional quality, education, and population density are the key drivers of economic complexity in developing countries. While economic growth, institutional quality, education and population density positively affect economic complexity, terms of trade, exchange rate negatively affect economic complexity.

In the context of Africa, institutional quality, financial development, natural resource rent, exchange rate, and education were found to be crucial in determining the level of economic complexity, as they positively and significantly impact economic complexity.

Finally, in non-African developing countries, institutional quality and financial development negatively and significantly determine economic complexity, while population density has a strong positive effect. The reasons that could account for the divergent outcomes between African and non-African developing countries may be due to differences in economic structure, geographical location and or the degree of economic openness. These distinctions point to the fact that a one-size-fits-all approach may not be appropriate, and policies should be designed to account for the unique economic, institutional, and developmental characteristics of African and non-African developing countries. The results are basically regarded as the empirical evidence of medium- to long-term relationships among economic complexity informality economic growth. Again, the paper acknowledges that the findings are based on historical data ending in 2018 and should therefore be interpreted with appropriate caution when considering present-day conditions.

5.1. Limitation and Suggest for Future Research

Developing countries vary widely in terms of economic structure, institutional quality, and stages of development, which can make the policy implications too broad for any one country to use.

Future researchers should conduct country-specific studies to tailor policy recommendations more precisely to individual country contexts.

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