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The Role Of Export Sophistication On The Income Levels Of Emerging Economies In Africa

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Abstract
This study examines the role of export sophistication in shaping income levels in emerging African economies over the period 2000 to 2024. Motivated by persistent income disparities and limited structural transformation across the continent, the study investigates whether upgrading export structures contributes directly to income growth and identifies the conditions under which such upgrading becomes economically meaningful. Drawing on the Hausman–Rodrik framework of export sophistication, the analysis covers 44 African countries and employs a panel data approach.
Methodologically, the study applies a comprehensive set of econometric techniques, including pooled ordinary least squares, fixed effects, random effects, and dynamic system generalized method of moments estimations to address unobserved heterogeneity and endogeneity. To deepen understanding of transmission mechanisms, mediation and interaction analyses are conducted, with particular attention to the role of human capital.
The empirical findings reveal that export sophistication does not exert a statistically significant direct effect on income levels across most model specifications. This result remains robust even after accounting for dynamic effects and potential endogeneity. In contrast, human capital and institutional quality consistently emerge as strong and significant determinants of income, highlighting their central role in economic performance. Mediation analysis indicates that export sophistication does not significantly raise income through human capital accumulation. However, interaction results demonstrate that export sophistication becomes income-enhancing when combined with higher levels of human capital, confirming the presence of important complementarities.
Overall, the study concludes that export sophistication alone is insufficient to drive income growth in emerging African economies. Its effectiveness depends critically on complementary investments in human capital and institutional development. These findings contribute to the literature on structural transformation and endogenous growth by emphasizing that the gains from export upgrading are conditional rather than automatic. From a policy perspective, the study underscores the need for integrated development strategies that simultaneously promote export upgrading, skill formation, and institutional strengthening to achieve sustained income growth in Africa.

Keywords: *Export Sophistication; GDP per capita; Structural Transformation; Africa; Emerging Economies*

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I. Introduction

Research Background

The importance of export sophistication in driving export growth and enhancing economic performance has been widely discussed in various literatures (Hausman et al., 2007; Lin et al., 2017; Zhang and Xing, 2019; Abdmoulah, 2023). These studies also emphasize that export upgrading not only raises the value and diversity of a country's export basket but also positively improves economic development. Moreover, numerous studies also identify the determinants of the sophistication of exports (Zhu and Fu, 2013; Zapata et al., 2024). The determinants include: aid for trade (Gnangnon and Robers, 2015), environmental regulation (Wang et al., 2022), foreign direct investment (Wacker et al., 2016; Zhang and Chen, 2020; Yan et al., 2023), and income level (Poghosyan, 2016).

The role of export sophistication in influencing income level is of particular interest. The nexus between income and export sophistication remains complex and multifaceted. Poghosyan (2016) argues that GDP per capita plays a crucial role in upgrading the export structure, which facilitates the advanced technological capabilities and the ability to import high-tech inputs. The host countries' ability to apply this technology is crucial for enhancing export sophistication. The relationship between income and export sophistication in emerging economies is positive; however, this transition involves major challenges, such as escaping the middle-income trap by building complex capabilities, facing global competition, avoiding reliance on simple goods, and requiring deliberate policies for structural transformation.

Historically, income levels in African countries have varied significantly over time, characterized by growth periods, long stretches of stagnation or decline, and extreme internal and between-country inequality rooted in colonial history. Today, there is significant variation in income levels across the continent. Africa

contains some of the poorest countries in the world (South Sudan), but also middle-income countries and nations with high GDP per capita (Seychelles, South Africa). Inequality within countries is a major concern, often greater than the inequality between countries, with the top 10% of the population holding a disproportionate share of the total income.

Over the past decade, African economies have experienced only moderate improvements in income levels, with GDP per capita remaining comparatively low by global standards. Recent macroeconomic indicators show that average income in Sub-Saharan Africa increased gradually from approximately USD 1,540 in 2020 to slightly above USD 1,600 by 2023-2024 as per data reported by the Federal Reserve Economic Data (FRED). Furthermore, complementary estimates from Statista place the broader continental average between USD $1,900 and USD $2,000 in the early 2020s. Despite this upward trajectory, the overall pace of income growth has been slow and uneven, marked by substantial disparities between countries. Economies such as Seychelles and Mauritius consistently perform at higher-income levels, while many low-income nations continue to lag, reflecting the heterogeneity that characterizes the region's developmental landscape.

Furthermore, trends in export sophistication across Africa over the last ten years reveal minimal structural transformation. According to the evidence from UNCTAD, the continent's export complexity has remained largely stagnant, with some indicators showing a slight decline in the breadth of exported product categories during the 2010s compared to the 2000s. The export structure continues to be dominated by low-complexity primary commodities such as crude oil, natural gas, minerals, and precious metals. Even though some countries have expanded into mildly processed goods such as refined petroleum products and value-added mineral derivatives, the shift has been insufficient to generate a robust diversification pathway.

A critical insight emerging from empirical literature is that higher export sophistication is positively associated with accelerated income growth, particularly in developing and emerging economies. More sophisticated export baskets often reflect stronger productive capabilities, technological upgrading, and knowledge diffusion factors that contribute directly to long-term economic development. However, Africa's persistent dependence on resource-based exports has limited its ability to tackle this growth channel. The slow pace of diversification and the continued focus on primary commodities underscore a missed opportunity for the region to leverage export upgrading as a mechanism for raising income levels and achieving sustained economic progress.

Research Purpose

This research aims to contribute to the existing literature by analyzing the role of income level in export sophistication, mainly focusing on the unique context of African countries, where limited studies exist on this topic. First, the study seeks to examine how export sophistication affects income levels in Africa by exploring the composite and multifaceted relationship between them. In addition, the study also determines the role of human capital, FDI, trade openness, and institutional quality in shaping this relationship. This is particularly important that much of the existing literature, such as Ndu et al. (2007) and Fosu (2013), has concentrated on a broader relationship between export sophistication and income in Sub-Saharan Africa without delving deeply into the majority of African countries.

Second, this study makes a novel contribution by highlighting the moderating roles of FDI, human capital, trade openness, and institutional quality in this relationship. It shows that export sophistication is insufficient to improve income levels in Africa; therefore, its success in improving income levels is contingent upon the strength of institutional frameworks and the absorptive capacity of the workforce. This builds on Hwang and Rodrik (2007), who argued that the nexus between export sophistication and income operates through both direct and indirect channels.

This research contribution has important implications for both the academic literature and policy. For the literature, this study provides an upgraded understanding of how export sophistication influences income, specifically in Africa, where the existing evidence is sparse. For policymakers, the study underscores the importance of not only focusing on export sophistication but also investing in human capital development, technological adoption, and infrastructure that supports export diversification. The study also suggests that interventions of policy aimed at improving those areas could significantly enhance overall economic growth and the region's export performance.

Research Significance

The role of export sophistication is critically important in shaping the income levels of emerging economies in Africa, which seek to achieve sustainable and inclusive economic transformation. This proposed study provides significant contributions at the empirical, theoretical, and policy levels. The existing literature highlights the strong relationship between export structure upgrading and economic growth; however limited focus on the African contexts. This study also aims to cover up the gap in the literature beyond traditional determinants of income, such as human capital, FDI, trade openness, institutional quality, and infrastructure.

Moreover, this study, therefore, advances a deeper insight into how structural transformation in exports interacts with macroeconomic fundamentals to analyze cross-country differences in income performance.

Second, this proposed study also provides methodological value as it employs advanced estimation techniques such as fixed effects, Hausman tests, and the Hausman-Taylor instrumental variable approach to address endogeneity and produce robust results. A rigorously constructed export sophistication measure (EXPY) is incorporated together with key control variables, as it enriches the analytical toolkit available to the development of economists and trade scholars working on African data, where measurement challenges and structural heterogeneity are common.

This proposed study also holds substantive policy significance for African governments, regional bodies, and international development partners. An understanding of how export sophistication drives income growth provides a clear roadmap for implementing industrial policies that go beyond traditional commodity dependence. In addition, this research offers evidence-based guidance for promoting higher-value manufacturing, strengthening global value chain participation, and improving the region's competitiveness as it identifies the transmission mechanism, such as technological upgrading, productivity spillover, and learning effects. Additionally, the results can support policymakers in tailoring human-capital investments, improving institutional frameworks, and fostering an enabling environment for innovation and value addition.

Furthermore, this study contributes to Africa's long-term development agenda by supporting the pursuit of economic diversification, resilience, and improved living standards. As the continent continues to face challenges related to volatility in commodity markets, limited structural transformation, and uneven income growth, the insights derived from this research provide a critical foundation for rethinking export strategies and designing coherent policies that effectively link trade upgrading with improved welfare outcomes. The significance of this work, therefore, lies not only in advancing scholarly debates but also in offering practical and timely solutions to some of Africa's most persistent developmental constraints.

Research Objectives

This study is designed to investigate the fundamental role that export sophistication plays in shaping the income levels of emerging economies in Africa. Its primary objective is to evaluate the causal linkage between the sophistication of a country's export basket and its overall income performance, measured through GDP per capita. By doing so, the research seeks to determine whether African economies that diversify into more complex and technologically advanced export products experience higher and more sustained income growth than those that remain concentrated in low-value primary commodities. Beyond establishing this relationship, the study also aims to explore the specific channels through which export sophistication influences economic performance. These channels may include productivity gains arising from technological upgrading, the acquisition of higher-level skills, enhanced learning-by-doing, and deeper integration into global value chains that facilitate the transfer of knowledge and innovation.

Additionally, the study aims to identify the factors that enable emerging African economies to achieve higher levels of export sophistication. Particular attention is given to factors such as human capital development, institutional quality, foreign direct investment inflows, infrastructural improvement, and macroeconomic stability, as these elements are widely recognized in the literature as essential drivers of structural transformation. The study further investigates whether the impact of export sophistication on income levels varies across different African economies, acknowledging that structural characteristics such as whether a country is resource-dependent or more diversified may shape the magnitude or direction of this effect. Moreover, the study examines the role of policy frameworks, including trade liberalization, exchange rate management, and regional initiatives such as the African Continental Free Trade Area (AfCFTA), in either strengthening or constraining the positive effects of export sophistication on income growth.

Ultimately, the purpose of the study is to generate robust, data-driven insights that can inform policy design and implementation across the continent. The study aims to provide actionable recommendations to African policymakers by assessing the interplay between export complexity and income levels, and by identifying the policy and structural conditions that support this relationship. These recommendations are intended to support long-term structural transformation, promote productive upgrading, and contribute to sustained improvements in income levels across emerging economies in Africa.

II. Literature Review

Literature on Export Sophistication

Measuring Export Sophistication

Hausman, Hwang, and Rodrik (2007) measure the productivity of the country's export basket by comparing it with the income level of countries with similar export structures. According to the authors, this measure assures that each good *k* that a country can potentially produce and export has a basic level of productivity associated with it. *Prodyk,* that is the weighted average of the income levels of this good *k 's* exporters, where the weights correspond to the revealed comparative advantage of each country j in good *k:5*

$$Prody_k = \sum_j \left(\frac{\frac{xjk}{\sum_j x_{jk}}}{\frac{x_{jk}}{\sum_i \sum_j x_{jk}}} \right) Y_j \quad (1)$$

where *xjk* is the value of exports of good k by country *j, Xj* is the total value of country *j's* Exports, and *Yj* is the per capita level of income of country j, measured as the real GDP in PPP, per capita. The bigger share a given good *k* weighs in the exports of rich countries, the more sophisticated it will be. The sophistication level associated with a country *j's* export bundle, noted *EXPYj,* is the overall level of productivity of its export basket. It is the weighted sum of the productivity levels associated with each exported good *k, Prodyk*, with the weights being the share of each good in the country's total exports.

$$EXPY_J = \sum_K \left(\frac{x_{JK}}{Xj}\right) PRODY_k \quad (2)$$

According to Hausman et al. (2007), this measure is not directly determined; rather, it is based on the basic features that make a product sophisticated. However, it is inferred from observed trade patterns that certain products require a high level of development to export.

Lall (2000) suggests an alternative indicator of sophistication as a robustness test that classifies products by technological levels. Existing literature (Lall, 2000) claims that this indicator of high technology is more precise since it is focused on the top of quality. Additionally, it is strictly related to technology, contrary to EXPY, which cannot be held as strictly measuring technology because it accounts for other aspects that make a given product likely to be exported by advanced, technology-rich countries.

Driving Factors of Export Sophistication

Foreign direct investment (FDI) has been widely examined in the literature as a potential catalyst for export upgrading and structural transformation in developing economies. Export sophistication, commonly measured using the EXPY index developed by Hausmann, Hwang, and Rodrik (2007), captures the income and knowledge content embedded in a country's export basket. Based on this framework, FDI is theorized to influence export sophistication by transferring advanced technologies, managerial expertise, and access to global markets from multinational enterprises (MNEs) to host economies. However, the empirical evidence on the FDI and export sophistication nexus remains mixed, particularly in Sub-Saharan Africa (SSA), where structural constraints persist.

The theoretical literature identifies both direct and indirect channels through which foreign direct investment can influence the sophistication of exports. According to Weldemicael (2012), direct effects arise when foreign firms engage in export-oriented production within host countries, thereby immediately altering the composition of exports toward more sophisticated goods. In such cases, the presence of MNEs raises export sophistication by introducing products associated with higher income levels and technological intensity.

Indirect effects, by contrast, operate through spillover mechanisms. Harding and Javorcik (2012) argue that FDI enhances export upgrading by generating productivity spillovers to domestic firms through labor mobility, supplier-to-buyer linkages, and demonstration effects. Similarly, Zhang and Xing (2019) emphasize that foreign firms often possess superior production technologies and quality control standards, which, when diffused to local firms, can support the production of higher-quality exports. However, these indirect effects are not automatic and depend critically on host-country absorptive capacity.

Moreover, a substantial strand of empirical literature supports the view that foreign direct investment positively contributes to export sophistication. Using firm-level data, Anwar and Sun (2018) show that FDI promotes export quality upgrading in China's manufacturing sector by improving productivity and innovation capacity. At the cross-country level, Ozsoy, Fazlioglu, and Esen (2021) find that FDI inflows are positively associated with export sophistication, particularly when accompanied by strong patent activity, suggesting that technological spillovers are central to the upgrading process. More recently, Yan et al. (2023) provide evidence that outward FDI enhances product quality and export performance through learning and reverse technology spillovers. According to the existing studies, it can be argued that FDI serves as an important channel for integrating developing economies into global value chains, thereby facilitating the transition from low-complexity exports to more knowledge-intensive goods.

Despite these positive findings, another strand of literature questions the effectiveness of FDI in promoting export sophistication. Lenaerts and Merlevede (2015) contend that FDI spillovers are not guaranteed, particularly for small or less productive domestic firms. Similarly, Zhang and Chen (2020) find that outward FDI does not significantly improve China's export sophistication at the national level, although regional heterogeneity exists. These findings suggest that the impact of foreign direct investment (FDI) may be uneven and contingent on local conditions.

In the context of SSA, a study by Masunda, Chiweshe, and Mhonyera (2025) provides compelling evidence that FDI, in isolation, does not have a statistically significant effect on export sophistication. The authors

argue that this result reflects the sectoral composition of FDI in SSA, which is heavily concentrated in extractive industries that generate limited technological spillovers and weak linkages with domestic firms.

Finally, a third strand of the literature underlines the possibility that foreign direct investment may even hinder export sophistication under certain conditions. Godart and Gorg (2013) show that foreign firm dominance can crowd out domestic suppliers and limit learning opportunities. Likewise, Suyanto and Salim (2013) argue that while foreign direct investment may increase export participation, it does not necessarily improve export quality if domestic firms cannot absorb foreign technologies. In addition, Anwar and Sun (2018) further note that FDI spillovers may allow low-capability firms to enter export markets while remaining locked into low-quality production. These studies caution against assuming a uniformly positive relationship between FDI and export sophistication, particularly in economies with weak domestic capabilities.

Recent empirical studies argue that export sophistication depends critically on the accumulation of human capital that allows countries to exploit and recombine existing productive knowledge. According to Zhu and Fu (2021), higher levels of education significantly enhance countries' ability to export technologically sophisticated products by strengthening firms' absorptive capacity and innovation potential. The authors' cross-country panel analysis shows that economies with higher human capital stocks exhibit faster upgrading of their export baskets, particularly in manufacturing sectors with high skill intensity.

Furthermore, Nouira, Plane, and Sekkat (2022) find that human capital is a key explanatory variable in export upgrading processes across developing and emerging economies. Their findings suggest that education improves export sophistication not only directly, by raising productivity, but also indirectly by facilitating technology diffusion and inter-sectoral linkages. These results reinforce the view that human capital is a foundational input for building complex production structures. Other recent studies emphasize the close interaction between human capital and innovation in driving export sophistication. Lee and Yi (2022) show that human capital significantly strengthens the impact of Research and development expenditure on export complexity, indicating strong complementarity effects. Countries with higher levels of skilled labor are better able to transform innovation efforts into commercially viable and exportable high-value products.

At the firm and sectoral levels, Canh, Schinckus, and Thanh (2023) provide evidence that workforce skills enhance firms' capacity to adopt advanced technologies, thereby enabling product upgrading and entry into more sophisticated export markets. Their findings suggest that without sufficient human capital, investments in technology and innovation yield limited export upgrading outcomes.

Another strand of recent literature links human capital to participation and upgrading within global value chains (GVCs). Ignatenko, Raei, and Mircheva (2020) argue that countries with higher human capital levels are more likely to specialize in higher value-added segments of GVCs, such as design, engineering, and knowledge-intensive manufacturing, rather than low-skill assembly activities. This positioning within GVCs is strongly associated with higher export sophistication.

In addition, Del Prete and Rungi (2023) show that skilled labor enables domestic firms to absorb knowledge spillovers from multinational enterprises and upgrade their export portfolios. Their firm-level evidence indicates that labor mobility and supplier linkages transmit tacit knowledge only when the local workforce possesses sufficient technical and managerial skills.

Likewise, recent work also highlights the role of human capital in leveraging digital transformation for export upgrading. Zhang, Liu, and Qamruzzaman (2022) find that the digital economy contributes positively to export sophistication, but only in regions with adequate human capital endowments. The authors suggest a threshold effect where digital infrastructure alone does not enhance export complexity unless supported by skilled labor capable of utilizing digital technologies. Similarly, Li and Wang (2024) demonstrate that human capital intensifies the positive impact of digital trade and e-commerce on export upgrading, particularly in emerging economies. These findings reinforce the idea that human capital acts as a catalyst that transforms technological opportunities into sophisticated export outcomes.

An important contribution of the post-2020 literature is the identification of nonlinear and threshold effects. Rivera-Batiz (2023) shows that the effect of human capital on export sophistication becomes stronger once a minimum level of institutional quality and economic development is achieved. According to the authors, human capital is a necessary but not sufficient condition for export upgrading, and complementary factors such as governance and infrastructure matter. Moreover, UNCTAD (2021) and IMF (2022) policy-oriented studies emphasize that the quality and relevance of skills are decisive for export sophistication. These reports argue that mismatches between education systems and industrial needs can limit the effectiveness of human capital accumulation in driving export upgrading.

Recent empirical evidence underscores the importance of targeted human capital development, particularly in developing regions. Signe and Johnson (2021) argue that low export sophistication in African economies is partly explained by weak technical and vocational skills, which constrain industrial diversification. Asongu, Nnanna, and Tchamyou (2024) further show that improvements in human capital significantly enhance export complexity in African countries when combined with industrial and innovation policies.

Literature on Income

Structural and Institutional Drivers of Income Levels

This section reviews literature on income levels, focusing on human capital accumulation, income distribution, and governance as key mechanisms through which export sophistication influences income outcomes.

The discourse on income inequality (IE) and income levels is closely connected to the literature on export sophistication, particularly through the unified theory of inequality and growth. This framework posits that the relative importance of physical and human capital accumulation evolves over the development process (Galor and Moav, 2004). In the early stages of development, growth is largely driven by physical capital accumulation, and income inequality may facilitate growth by concentrating savings among capital owners. However, as economies progress, human capital becomes the primary engine of growth due to the increasing complementarity between skills, technology, and production complexity.

This theoretical transition is central to the concept of export sophistication. Sophisticated exports characterized by higher technological content, knowledge intensity, and productivity require a skilled labor force capable of adopting, adapting, and innovating within complex production processes. Unlike physical capital, which can generate output regardless of its distribution, human capital is embedded in individuals, implying that the aggregate level of productive capacity and export sophistication increases when skills and education are broadly distributed across the population.

Income inequality plays a dual role within this framework. High inequality may initially support physical capital accumulation, but can hinder human capital formation when credit constraints limit access to education and skills development for lower-income groups. This, in turn, constrains a country's ability to diversify into sophisticated exports and limits the potential income gains arising from structural transformation. Conversely, according to Engelbrecht (2003), Hendricks (2002), investments in education, skills training, and healthcare enhance labor productivity, support export upgrading, and promote more inclusive income growth by enabling wider participation in high-value export sectors. Institutional theories further reinforce this linkage by emphasizing that good governance creates an enabling environment for both human capital accumulation and export sophistication. Strong institutions ensure that public and private investments in skills and innovation are efficiently allocated, thereby facilitating structural transformation and more equitable income distribution (Faria et al., 2016; O'Neill and Bagchi-Sen, 2023; Uddin et al., 2021).

Empirical evidence on human capital, income inequality, and implications for export sophistication

Although much of the empirical literature on human capital focuses on economic growth rather than inequality, its implications for export sophistication and income levels are substantial. Studies linking human capital to aggregate income growth (Okunade et al., 2022) implicitly assume that growth will transform into poverty reduction and improved income distribution. However, evidence shows that high growth can coexist with persistent income inequality, particularly in economies undergoing structural transformation without sufficient skill diffusion (Domhoff, 2012).

Empirical studies that directly examine human capital and income inequality provide insights into how export sophistication may affect income levels. Savvides (1998) found that human capital reduces income inequality across countries, suggesting that broader access to skills enhances the distributional gains from economic openness and export upgrading. Similarly, Acemoglu and Dell (2010) showed that a substantial share of income differences across regions and countries is attributable to variations in human capital, which is a key determinant of productivity and the capacity to produce sophisticated goods. Comparable findings have been reported in regional analyses (López-Bazo and Motellón, 2012; Shahpari and Davoudi, 2014; Sheikh et al., 2016).

Education inequality has also been shown to exacerbate income inequality, thereby weakening the inclusive effects of export sophistication. Coady and Dizioli (2018) demonstrated that schooling inequality significantly increases income inequality, implying that export upgrading may benefit only a narrow segment of the workforce when access to education is uneven. Evidence from Brazil confirms that reductions in educational inequality contributed to declining income inequality, partly by enabling broader participation in higher-productivity sectors (Lam et al., 2015). In addition, cross-country studies further show that educational expansion improves both income distribution and the ability of economies to move into more sophisticated export structures (Lee and Lee, 2018).

Furthermore, Burzynski et al. (2020) showed that skill misallocation and limited access to education significantly constrain income growth in poorer economies. These findings are particularly relevant for emerging African economies, where export baskets remain dominated by primary commodities and low-skill manufactures. In such contexts, insufficient human capital limits the transition toward sophisticated exports, while existing income gains are unevenly distributed.

However, some studies observe a nonlinear relationship between human capital and income inequality (Checchi, 2004; Menezes Filho and Kirschbaum, 2019; Castelló-Climent and Domenech, 2021). These findings suggest that skill-biased technological change can initially increase inequality if demand for skilled labor outpaces

supply. This reinforces the argument that export sophistication alone is insufficient to guarantee inclusive income growth without complementary investments in human capital and inclusive institutions.

On the other hand, governance quality plays a crucial mediating role in determining whether export sophistication translates into higher and more equitable income levels. Empirical evidence shows that good governance reduces income inequality by ensuring fair access to opportunities and efficient resource allocation (Zhuang et al., 2010; Huang et al., 2018). According to studies by Njangang et al. (2022), governance thresholds must be met for these effects to materialize in resource-rich and developing economies.

Corruption undermines the income-enhancing effects of export sophistication by distorting investment decisions and concentrating gains among elites. While some forms of corruption may have ambiguous short-term distributional effects (Wong, 2017), the dominant empirical evidence indicates that corruption increases income inequality over the long run (Apergis et al., 2010). In the context of export sophistication, weak institutions may allow rents from high-value exports to be captured by a small segment of firms or individuals, thereby limiting broad-based income gains.

Summary of Literature Review and Research Gap

Summary of Literature

The literature reviewed in this study provides a comprehensive understanding of the theoretical and empirical foundations linking export sophistication to income levels, particularly within the context of emerging and developing economies. A central consensus across the literature is that income growth is not solely determined by the volume of exports but critically by the composition and complexity of exported goods and services. Export sophistication reflects the level of knowledge, skills, and productive capabilities embedded in a country's export basket and has emerged as a key indicator of structural transformation and long-term income potential.

The export sophistication literature builds on the premise that countries exporting more complex products tend to exhibit higher income levels because such products embody advanced technologies, require skilled labor, and generate stronger learning and productivity spillovers. Empirical evidence consistently shows a positive association between export sophistication and per capita income, suggesting that upgrading export structures can serve as a pathway to sustained income growth. For emerging African economies, this insight is particularly relevant given their historical dependence on primary commodity exports characterized by low value addition and limited income-generating capacity.

However, the literature also emphasizes that export sophistication does not operate in isolation. Its income-enhancing effects are conditional on complementary factors such as human capital accumulation, institutional quality, productive investment, and macroeconomic stability. Among these, human capital emerges as a pivotal factor that enables countries to move into sophisticated export activities and to translate export upgrading into higher productivity and wages. Recent studies highlight that education quality, skill relevance, and health outcomes significantly influence both export performance and income outcomes.

At the same time, the income levels literature underscores that growth outcomes must be examined alongside income distribution dynamics. Evidence from emerging African economies indicates that improvements in human capital and export upgrading may raise average income levels while simultaneously exacerbating income inequality, particularly when access to education and productive employment is uneven. This has led to a growing recognition that income levels reflect not only aggregate growth but also the distribution of economic gains across the population.

The reviewed studies further demonstrate that institutional quality plays a critical mediating role. Strong institutions enhance the effectiveness of human capital investments, facilitate export diversification, and ensure that income gains from sophisticated exports are more broadly shared. Conversely, weak governance, limited absorptive capacity, and structural constraints can weaken or distort the income effects of export sophistication.

Overall, the literature suggests a complex, multi-channel relationship in which export sophistication influences income levels directly through productivity gains and indirectly through human capital development, structural transformation, and institutional interactions. For African economies undergoing economic transition, these relationships are particularly salient as policymakers seek to move beyond commodity dependence toward inclusive and sustainable income growth.

Research Gap

Several important gaps remain, particularly in relation to emerging African economies, despite the growing body of literature on export sophistication and income levels. First, much of the empirical literature is dominated by cross-country global samples, with limited Africa-specific analyses that account for the continent's unique structural characteristics, such as high informality, commodity dependence, and uneven human capital distribution. As a result, existing findings may not fully capture the mechanisms through which export sophistication affects income levels in African contexts.

Second, while numerous studies establish a positive relationship between export sophistication and per capita income, there is limited empirical work that explicitly integrates human capital as a mediating or complementary factor in this relationship. Many studies treat human capital and export sophistication as separate determinants of income, rather than examining how human capital conditions the income effects of export upgrading.

Third, the distributional dimension of income levels remains underexplored in the export sophistication literature. Although recent research acknowledges that export upgrading may generate skill-biased income gains, few studies systematically analyze how income inequality interacts with export sophistication to shape overall income outcomes in emerging African economies. This represents a significant omission, given persistent inequality and unequal access to education and skills across the continent. Moreover, existing studies often rely on static or short-term analyses, which limit understanding of the dynamic relationship between export sophistication and income levels over time. There is a need for longitudinal analyses that capture how sustained export upgrading influences income trajectories as economies undergo structural transformation.

Finally, from a policy perspective, there is insufficient evidence on how export sophistication strategies can be designed to promote inclusive income growth rather than merely raising average income levels. This limits the usefulness of existing research for policymakers seeking to align export upgrading with broader development objectives.

III. The Current State Of Export Sophistication And Income Levels In Emerging African Economies

Current State of Export Sophistication in Africa

Overview of African Export Structure

Africa's export earnings have increased in recent years. According to estimates, in 2023, the total merchandise exports in Africa reached approximately $665.4 billion, growing about 16.8% from the previous year. However, Africa's share of global exports remains modest, at under 3% of world merchandise exports. This underscores both growth and structural limitations in African trade performance.

Table 1: Estimated Export Revenues of Top African Exporters (2025)

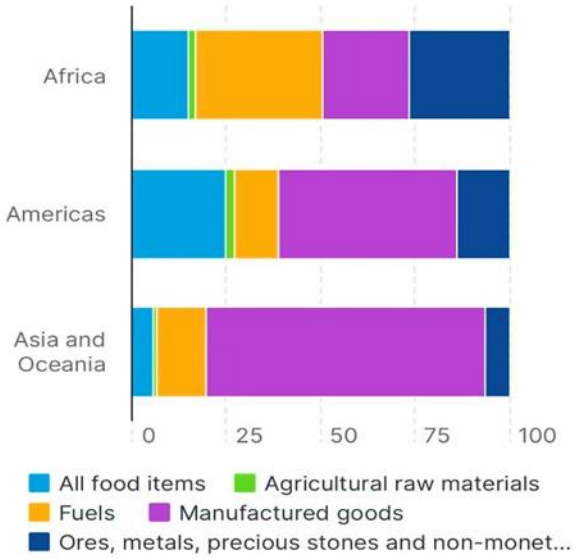
Country	Estimated Export Revenue ($ Billion)	Main Export Category
South Africa	88.3	Minerals, vehicles, coal, platinum
Nigeria	45.6	Oil and Gas, Agricultural products
Egypt	41.9	Petroleum products, Chemicals, Textiles
Algeria	35.2	Petroleum, natural gas
Angola	32.3	Oil, diamonds, LNG
Morocco	32.1	Automobiles, Machinery, fertilizers
Tunisia	20+	Textiles, electrical equipment
DRC	28.5	Copper, cobalt, gold
Ivory Coast	18.4	Cocoa, petroleum products
Others	Variable	Diverse raw materials and goods

Table 1 above highlights that export revenues are heavily tied to mining, petroleum, and extractive industries, with relatively limited manufacturing output among export leaders, thus, a key sign of low export sophistication.

Present Realities and Emerging Patterns in Africa

In the current decade, Africa's export landscape exhibits modest improvements in export volume yet persistent challenges in sophistication. According to recent UNCTAD data, primary goods, defined to include raw materials such as fuels, minerals, and agricultural commodities, accounted for approximately 76.8 % of Africa's merchandise exports in 2024, with fuels alone constituting close to one-third of the total. This dominant share of primary goods underscores the continuing reliance on natural resources rather than value-added manufactured products.

Fig 1. Export Structure of developing economies by product group, percentage, value basis, (2024)



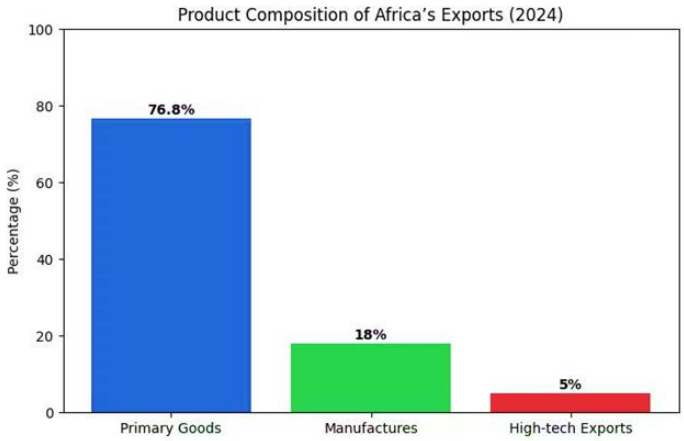
Source: UN Trade and Development, UNCTADstat (2025)

In Africa, primary goods, defined as everything except manufactured products, accounted for 76.8% of merchandise exports in 2024, with fuels making up 33.7% of this. Developing Americas relied less on primary goods exports (52.6%), and Developing Asia and Oceania even less (26.0%). Among these three developing regions, developing Asia and Oceania recorded the lowest proportion of food exports (5.7%), far behind developing Americas (24.7%) and developing Africa (14.8%).

This structural pattern reflects deep-seated constraints. Across numerous African economies, export baskets are highly concentrated in commodities whose production depends more on natural resource endowments than on industrial and technological capabilities. A substantial share of countries in the region derives over 60 % of their export earnings from oil, gas, or mineral products, thus, a concentration that exposes economies to price volatility and dampens incentives for industrial upgrading.

Graph 1 below illustrates this segmentation by product category share in total exports. The left panel depicts the 76.8 % share of primary products, while the right panel shows the much smaller combined share of manufactured and technology-intensive goods.

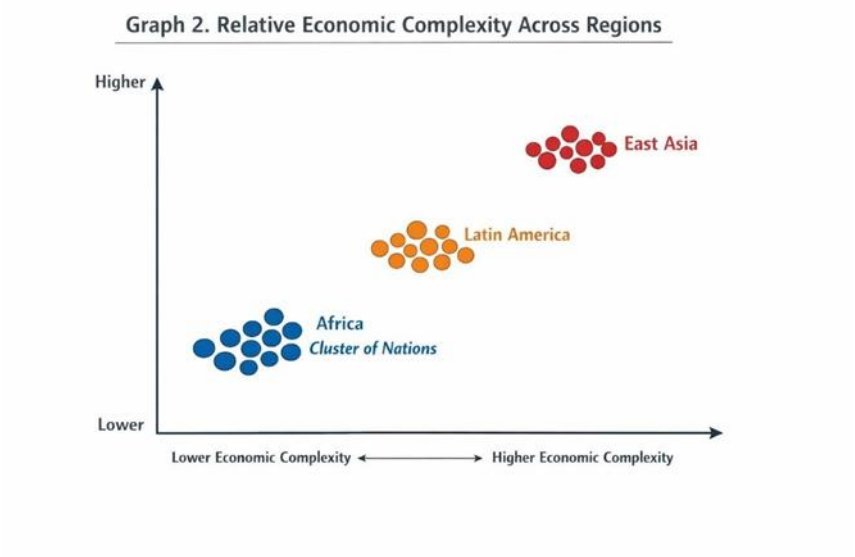
Fig 2: Product Composition of Africa's Exports (2024)



Moreover, the Economic Complexity Index (ECI) further reinforces this narrative. Countries with higher export sophistication typically export a diverse range of products that few other countries produce. Within Africa, only a handful of countries, such as South Africa, Egypt, and to a lesser degree Kenya, score above very low absolute positions on the ECI ranking, but most African countries cluster toward the bottom of global complexity rankings, with scores far lower than those of East Asian or European economies.

The graph below captures Africa's ECI distribution compared with Asia and Latin America

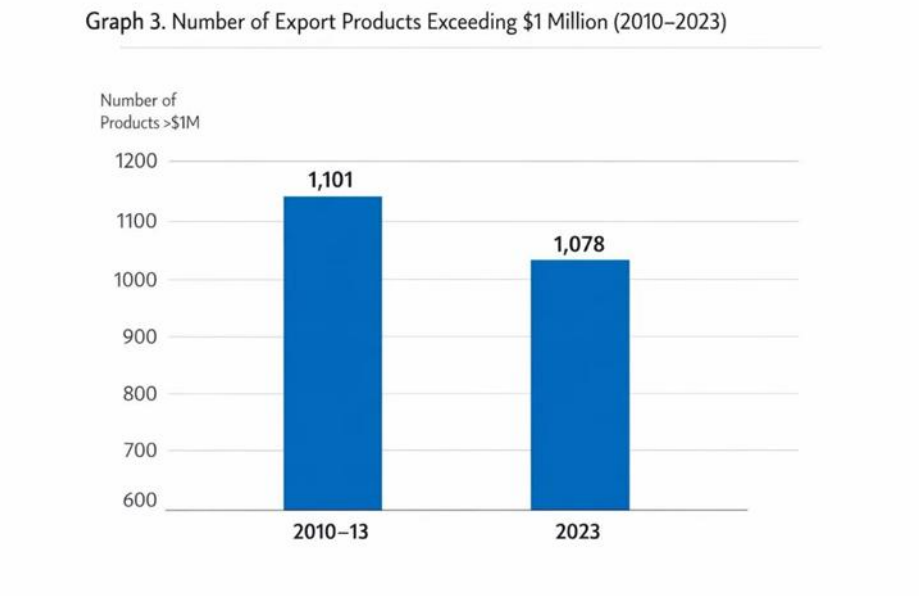
Fig 3: Relative Economic Complexity Across Regions



The dispersion above means that while a few African economies have relatively more complex export baskets, the continental average remains low, inhibited by structural barriers such as limited industrial capacity, infrastructure deficits, and weak integration into global value chains.

Despite these challenges, there are gradual signs of diversification and structural transformation, although it is uneven across countries and regions. For instance, export diversification metrics indicate that over the past decade, the number of distinct products exported by African economies with values above US $1 million at the HS4 level has slipped only slightly, moving from around 1,101 products (2010 to 2013 average) to about 1,078 by 2023. There has also been a modest broadening of export categories; for instance, non-crude petroleum products, copper, gold, and iron ores have increased their shares compared to a decade ago, even if most remain of low complexity.

Fig 4: Number of Export Products Exceeding $1 million (2010-2023)



This slight contraction in export diversity indicates that although African exporters have maintained a broad base of products, the shift toward higher complexity products remains limited. Emerging patterns in intra-African trade also point to opportunities for sophistication. The implementation of the African Continental Free Trade Area (AfCFTA) is designed to reduce tariff and non-tariff barriers, potentially creating regional value chains and encouraging the production of intermediate and manufactured goods.

Despite these positive trajectories, there are considerable policy and structural constraints to enhancing export sophistication. High trade costs driven by infrastructure gaps, where transport and logistics costs remain significantly above global averages, reduce competitiveness in manufactured goods. Similarly, limited access to reliable energy and technological infrastructure hinders firms' ability to absorb and use advanced technologies.

If Africa is to diversify its export base and climb the global complexity ladder, policy priorities will need to address these constraints directly. Investments in infrastructure, especially logistics and energy, education and skills development, industrial policy targeting higher-value manufacturing sectors, and regional integration mechanisms are critical. The AfCFTA presents a platform to deepen intra-African trade and build regional value chains, but realizing its potential requires substantive regulatory harmonization and investment in productive capacities.

In conclusion, Africa's current export sophistication remains low by global standards, with exports heavily concentrated in primary and low complexity goods. Although there are pockets of diversification and early signs of richer export structures, especially in larger economies, the overall continental pattern underscores the persistent challenge of transforming export baskets into more complex, value-added products. Strategic reforms and targeted investments remain essential for Africa to transition toward a more diverse and sophisticated export profile, which is foundational for long-term sustainable economic growth.

IV. Research Methodology

Research Design

This study adopts a quantitative, explanatory panel research design to empirically examine the effect of export sophistication on income levels in emerging African economies. The explanatory design is appropriate because the study seeks to identify and estimate causal relationships between export sophistication and economic outcomes. The study also contributes to the broader development economics literature on structural transformation and export-led growth by focusing on causality rather than mere correlation. We use panel data to enable the analysis to exploit both cross-sectional variation across countries and time series variation within countries, thereby improving the precision and robustness of the estimated coefficients. This design is particularly well-suited to the African context, where countries differ significantly in export composition, institutional quality, and development trajectories.

Justification for Panel Data Approach

Panel data analysis is preferred over pure cross-sectional or time-series approaches for several reasons. First, it allows the study to control for unobserved, time-invariant country-specific characteristics, such as geography, colonial legacy, cultural factors, and natural resource endowments, which may otherwise bias the estimated relationship between export sophistication and income levels. Second, panel data improves estimation efficiency by increasing the number of observations, which is crucial given the long-time horizon of the study (2000 to 2024).

Furthermore, panel data makes it possible to examine dynamic processes of structural transformation, capturing how gradual changes in export sophistication translate into income gains over time. This is particularly relevant for African economies, where export upgrading is typically slow and path-dependent.

Moreover, the sample consists of 52 African countries observed annually over the period 2000 to 2024, yielding a balanced panel. The choice of this period is motivated by several factors. First, it captures major global and regional economic developments, including trade liberalization, the commodity super-cycle, the expansion of global value chains, and the rise of emerging markets. Furthermore, it reflects a period during which many African countries implemented export diversification and industrialization strategies, making it particularly relevant for analyzing export sophistication and income dynamics. The broad country coverage enhances the external validity of the findings and allows for generalization across different African sub-regions and income groups.

Theoretical Foundation of the Research Design

The research design is grounded in structural transformation theory and endogenous growth theory. Structural transformation theory emphasizes the shift of economic activity from low-productivity sectors to higher-productivity, more technologically advanced activities, particularly in manufacturing and modern services. Endogenous growth theory highlights the role of knowledge accumulation, human capital, and technological innovation in driving long-run income growth. Export sophistication serves as a measurable proxy for these theoretical mechanisms. By exporting more sophisticated products, countries are assumed to accumulate productive capabilities, benefit from learning-by-doing, and integrate into higher value-added segments of global value chains. The research design, therefore, explicitly models export sophistication as a key explanatory variable influencing income levels, while controlling for other growth-relevant factors.

On the other hand, within the research design, GDP per capita is specified as the dependent variable, representing income levels and overall economic performance. Export sophistication, measured using the EXPY index, is the main independent variable of interest. The inclusion of human capital, foreign direct investment, trade openness, and institutional quality as control variables reflects the multidimensional nature of economic development and ensures that the estimated impact of export sophistication is not confounded by other key determinants of income. In addition, the design recognizes that export sophistication does not operate in isolation; rather, its income-enhancing effect depends on complementary factors that shape a country's absorptive capacity. This conceptualization strengthens the analytical framework and aligns the empirical model with contemporary development theory.

Addressing Endogeneity

A central feature of the research design is the explicit treatment of endogeneity. Export sophistication may be endogenous due to reverse causality; thus, higher income levels enable more sophisticated exports. omitted variables, or measurement error. In this study, ignoring these issues would lead to biased and inconsistent estimates. The study adopts the Hausman and Rodrik proxy variable method, which provides a robust identification strategy in situations where valid external instruments are difficult to obtain. This method uses a proxy variable that is correlated with export sophistication but uncorrelated with the error term in the income equation, allowing the study to isolate the exogenous component of export sophistication. Incorporating this approach directly into the research design enhances the credibility of the causal interpretation of the results.

Data Sources and Sample Selection

Data Sources

Variable Category	Data Source	Specific Indicators
Exports (product-level)	UN Comtrade / UNCTADstat	Export values by HS 4-digit classification
Income levels	World Bank WDI	GDP per capita, PPP (constant 2017 international $)
Human capital	Penn World Tables (PWT 11.0)	Human Capital Index
FDI	World Bank WDI	Foreign Direct Investment inflows (% of GDP)
Institutions	World Governance Indicators (WGI)	Rule of Law, Government Effectiveness, Control of Corruption
Trade openness	World Bank WDI	(Exports + Imports)/GDP (%)

Sample Selection

The study employs a dynamic panel data regression model using the Generalized Method of Moments (GMM) approach to address potential endogeneity issues. This is a way of estimating the impact of export sophistication on income levels in this research. The baseline equation is specified as follows:

$$InGDP_{pcit} = \alpha + \beta_1 InEXPY_{it} + \beta_2 InInv_{it} + \beta_3 InHC_{it} + \beta_4 Infra_{it} + \beta_5 TradeOp_{it} + \epsilon_{it}$$

Where:

$InGDP_{pcit}$ = Log of real GDP per capita for the country i at time t

$InEXPY_{it}$ = Log of export sophistication index

$InInv_{it}$= Log of investment as % of GDP

$InHC_{it}$ = Log of human capital index

$Infra_{it}$ = Log of electricity consumption per capita

$TradeOp_{it}$ = Trade openness as % of GDP

ϵ_{it} = Error term

The GMM estimator is used to account for potential reverse causality (higher income levels may lead to export sophistication). It also corrects for heteroskedasticity and autocorrelation present in panel data. The cointegration tests will also be carried out to determine if long-run relationships exist between income levels and export sophistication. The present research will also include the baseline estimation (fixed and random effects) to provide insights before addressing endogeneity. Furthermore, to obtain robust estimates and account for lagged income effects, dynamic panel estimation (GMM system) is employed. Lastly, the robust checks will be carried out using alternative measures of export sophistication and additional control variables.

Variables and Measurement

Dependent Variable

Income level (lnGDPpc): Natural logarithm of GDP per capita, PPP, constant 2017 international dollars.

Independent Variable of Interest

Export sophistication (EXPY) is constructed in two stages: PRODY (product sophistication) and EXPY (country sophistication). Mathematically:

$$PRODY_j = \sum_i \left(\frac{\frac{x_{ij}}{\sum_j x_{ij}}}{\frac{x_{ij}}{\sum_i \sum_j x_{ij}}} \right) \quad (3)$$

$$EXPY_i = \sum_j \left(\frac{x_{ij}}{\sum_j x_{ij}} \right) PRODY_j \quad (4)$$

Control Variables

FDI (% of GDP) captures foreign capital inflows and technology transfer. Human Capital Index (HCI) is a proxy for labor quality and productivity. The Infrastructure Index involves the availability of transport, energy, and ICT infrastructure, and institutional Quality (INST) is a composite index of governance indicators. Trade Openness (OPEN) proxy for integration into global markets.

Estimation Strategy

Baseline estimation: Fixed Effects (FE) with robust SEs.
Robustness checks: lagged EXPY, alternative dependent variables, different aggregation levels, and exclusion of outliers.
Endogeneity: IV estimation with lagged world PRODY and commodity shocks; estimation with 2SLS and GMM.
Transmission channels: mediation and interaction analysis (EXPY × HCI, EXPY × INFRA).

Diagnostic and Specification Tests

Heteroskedasticity: Breusch–Pagan and White tests.
Multicollinearity: Variance Inflation Factor (VIF).
Endogeneity: Hausman test; instrument relevance via first-stage F-statistics; Hansen J-test.

Ethical Considerations

This study uses only secondary macroeconomic data from internationally recognized sources. No personal or sensitive data is involved. Data will be handled transparently, cited properly, and stored securely. The methodology combines robust data collection, rigorous econometric techniques, and careful diagnostic testing to ensure the validity and reliability of results. By applying both baseline and advanced estimators, the study aims to provide credible evidence on the impact of export sophistication on income levels in African emerging economies.

V. Empirical Results And Analysis

Table 5.1. Descriptive Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
GDP per capita	1100	5749.321	5359.592	711.976	28011.158
Export Sophistication	872	10.277	.183	7.946	10.942
Infrastructure	1047	45.098	29.802	1.3	100
FDI	1085	3.789	7.173	-17.292	103.337
Human Capital Index	888	1.878	.481	1	3.054
Institutional Quality	1011	-1.361	1.151	-3.742	2.099
Trade Openness	1000	64.105	28.356	2.462	165.049

Sources: Author calculations, 2026

The descriptive statistics for the panel dataset of 44 emerging African economies, covering the period 2000–2024, are summarized in Table 5.1. The average GDP per capita is USD 5,749, with a standard deviation of 5,360, ranging from USD 712 to USD 28,011, indicating substantial disparities in income levels across countries. Export sophistication averages 10.28 (SD = 0.18), suggesting moderate variation in the complexity of exports across economies. Infrastructure development exhibits a mean value of 45.10, with considerable variation between countries (SD = 29.80) and extreme values ranging from 1.3 to 100, highlighting wide disparities in physical and technological infrastructure. Foreign direct investment inflows average 3.79% of GDP, with high variability (SD = 7.17) and notable extremes, including occasional negative inflows (-17.29%) and peaks of 103.34%, reflecting the volatile nature of investment flows in the region. The human capital index averages 1.88 (SD = 0.48), indicating moderate levels of human capital development, while institutional quality shows a mean of -1.36 (SD = 1.15), reflecting generally weak governance across the sample. Trade openness averages 64.11% of GDP, with significant variation (SD = 28.36) and an extensive range from 2.46% to 165.05%, suggesting both structural and temporal differences in integration into the global economy. Overall, these statistics indicate that

structural factors such as income, infrastructure, and human capital differ substantially across countries, whereas investment flows and trade openness exhibit more dynamic changes over time within individual economies.

Correlation Analysis

Table 5.2.1. Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) income	1.000						
(2) sophistication	0.195**	1.000					
	(0.000)						
(3) infrastructure	0.754**	0.131**	1.000				
	(0.000)	(0.000)					
(4) FDI	-0.092**	0.037**	-0.114**	1.000			
	(0.002)	(0.282)	(0.000)				
(5) human capital index	0.607**	0.225**	0.574**	-0.017**	1.000		
	(0.000)	(0.000)	(0.000)	(0.621)			
(6) trade openness	0.369**	0.112**	0.277**	0.287**	0.378**	1.000	
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)		
(7) Institutional Quality	0.464**	0.174**	0.424**	-0.021**	0.416**	0.306**	1.000
	(0.000)	(0.000)	(0.000)	(0.499)	(0.000)	(0.000)	

Source: Authors' calculation, 2026

The correlation analysis among the key variables is presented in Table 2. GDP per capita (income) exhibits a strong positive and statistically significant relationship with infrastructure ($r = 0.754$, $p < 0.001$) and human capital index ($r = 0.607$, $p < 0.001$), indicating that countries with higher income levels tend to have better infrastructure and more developed human capital. Income is also moderately positively correlated with trade openness ($r = 0.369$, $p < 0.001$) and institutional quality ($r = 0.464$, $p < 0.001$), suggesting that wealthier economies are generally more integrated into the global market and exhibit stronger governance structures. Export sophistication shows a small but significant positive correlation with income ($r = 0.195$, $p < 0.001$) and human capital ($r = 0.225$, $p < 0.001$), and a weak positive correlation with infrastructure ($r = 0.131$, $p < 0.001$) and institutional quality ($r = 0.174$, $p < 0.001$), implying that countries with more complex export structures tend to have slightly higher income, better human capital, and stronger institutions, though the relationships are less pronounced than for income. Export sophistication has no significant correlation with FDI ($r = 0.037$, $p = 0.282$), suggesting that sophistication is not strongly associated with foreign direct investment inflows in this sample.

Infrastructure is positively associated with income, human capital ($r = 0.574$, $p < 0.001$), trade openness ($r = 0.277$, $p < 0.001$), and institutional quality ($r = 0.424$, $p < 0.001$), indicating that well-developed infrastructure coexists with higher income, better human capital, greater trade integration, and stronger institutions. FDI shows weak and mostly non-significant correlations with human capital ($r = -0.017$, $p = 0.621$) and institutional quality ($r = -0.021$, $p = 0.499$), but it is moderately correlated with trade openness ($r = 0.287$, $p < 0.001$), reflecting that investment flows are more strongly associated with openness to international markets than with structural economic characteristics. Trade openness is significantly correlated with all variables except FDI (the positive correlation with FDI is also significant, $r = 0.287$, $p < 0.001$), demonstrating that countries more integrated into global trade tend to have higher income, infrastructure, human capital, and stronger institutional quality. Institutional quality is positively correlated with income, human capital, infrastructure, trade openness, and export sophistication, further confirming the role of governance in shaping economic and structural outcomes.

Overall, the correlation analysis indicates that structural variables such as income, human capital, infrastructure, and institutional quality are strongly interrelated, whereas FDI shows weaker associations with these factors. Export sophistication is positively associated with income and structural variables, but the correlations are modest, suggesting that while sophistication aligns with development indicators, it is not strongly tied to FDI or trade openness in this dataset.

Panel Regression Analysis

Pooled OLS (Baseline Model)

Income	Coefficient	St. Err.	t-value	p-value	[95% Conf	Interval	Sig
Export Sophistication	48.015	808.004	0.06	.953	-1538.553	1634.582	
Infrastructure	96.143	5.639	17.05	0	85.071	107.214	***
FDI	-77.221	29.258	-2.64	.009	-134.67	-19.771	***
Human Capital Index	2630.363	340.111	7.73	0	1962.533	3298.193	***
Trade Openness	29.63	5.311	5.58	0	19.202	40.058	***
Institutional Quality	739.583	136.166	5.43	0	472.212	1006.954	***
Constant	-4550.699	8259.608	-0.55	.582	-20768.975	11667.577	

*** $p<.01$, ** $p<.05$, * $p<.1$

The results of the pooled OLS regression examining the determinants of GDP per capita across 44 emerging African economies from 2000 to 2024 are presented in Table 5.3.1. The analysis indicates that infrastructure, human capital, trade openness, and institutional quality are all positively and significantly associated with income, highlighting their critical role in economic development. Specifically, a one-unit increase in the infrastructure index is associated with an increase of approximately USD 96 in GDP per capita, while improvements in the human capital index correspond to an increase of over USD 2,630. Similarly, higher trade openness and stronger institutional quality are linked to higher income, with coefficients of USD 29.63 and USD 739.58, respectively. In contrast, foreign direct investment exhibits a negative and significant coefficient, suggesting that higher FDI inflows are associated with lower income in this baseline model, which may reflect short-term volatility or heterogeneity across countries. Export sophistication, while positively signed, is statistically insignificant, indicating that its effect on income is not captured in the pooled specification.

Overall, these findings underscore the importance of structural factors, particularly infrastructure, human capital, trade integration, and governance in driving income levels, while also suggesting that pooled OLS may be insufficient to fully capture the role of export sophistication, necessitating the use of more advanced panel models that account for country-specific effects.

Fixed Effects (FE) Model

Income	Coefficient	St. Err.	t-value	p-value	[95% Conf	Interval	Sig
Export Sophistication	-69.933	277.98	-0.25	.801	-615.813	475.948	
Infrastructure	-4.521	5.165	-0.88	.382	-14.664	5.621	
FDI	12.8	11.981	1.07	.286	-10.728	36.327	
Human Capital Index	3442.4	316.977	10.86	0	2819.942	4064.859	***
Trade Openness	-3.604	3.596	-1.00	.317	-10.665	3.457	
Institutional Quality	359.491	124.034	2.90	.004	115.921	603.061	***
Constant	1453.482	2875.404	0.51	.613	-4193.054	7100.017	

*Significance level *** p<.01, ** p<.05, * p<.1*

Random Effects (RE) Model

Income	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval	Sig
Export Sophistication	-58.366	283.584	-0.21	.837	-614.18	497.447	
infrastructure	-.648	5.18	-0.13	.9	-10.799	9.504	
FDI	9.748	12.199	0.80	.424	-14.16	33.657	
Human Capital Index	3449.291	316.863	10.89	0	2828.251	4070.332	***
Trade Openness	-1.661	3.62	-0.46	.646	-8.757	5.434	
Institutional Quality	449.388	123.33	3.64	0	207.665	691.111	***
Constant	1058.597	2991.638	0.35	.723	-4804.906	6922.1	

*Significance level *** p<.01, ** p<.05, * p<.1*

The results of the fixed effects (FE) and random effects (RE) regressions (Tables 5.3.2 and 5.3.3) indicate that export sophistication is not statistically significant in either model, with coefficients of -69.93 (FE, $p = 0.801$) and -58.37 (RE, $p = 0.837$). This suggests that, within the panel of 44 African countries from 2000 to 2024, changes in export sophistication over time do not have a measurable direct impact on GDP per capita, when controlling for other structural variables.

Infrastructure and trade openness also remain insignificant in both models, indicating that within-country variations over time in these variables are insufficient to explain short-term changes in income. In contrast, human capital is highly significant and positively associated with income in both FE (3442.4, $p < 0.01$) and RE (3449.29, $p < 0.01$) models, highlighting the crucial role of education, skills, and knowledge accumulation in driving economic growth. Institutional quality is also positive and significant in both FE (359.49, $p = 0.004$) and RE (449.39, $p < 0.01$), suggesting that stronger governance structures contribute meaningfully to higher income levels. FDI is positive but remains statistically insignificant in both specifications.

G.M.M Estimation Results

Income	Coef.	St. Err.	t-value	p-value	95% Conf	Interval	Sig
Lagged Income	.896	.096	9.31	0	.707	1.084	***
Export Sophistication	-13.513	115.257	-0.12	.907	-239.413	212.386	
infrastructure	11.121	8.607	1.29	.196	-5.749	27.99	
FDI	-3.272	7.398	-0.44	.658	-17.771	11.228	
Human Capital Index	247.435	367.325	0.67	.501	-472.509	967.38	
Institutional Quality	141.02	111.554	1.26	.206	-77.621	359.662	
Trade Openness	3.714	3.709	1.00	.317	-3.556	10.985	
Constant	-199.321	1534.214	-0.13	.897	-3206.325	2807.682	

*Significance level *** p<.01, ** p<.05, * p<.1*

The System GMM estimation was conducted to account for the dynamic nature of GDP per capita and potential endogeneity between income and explanatory variables. The results indicate that lagged income is highly significant (coefficient = 0.896, $p < 0.01$), confirming that past income strongly predicts current economic performance, and highlighting the persistence of GDP in emerging African economies. In contrast, export sophistication remains statistically insignificant (coefficient = -13.513, $p = 0.907$), suggesting that, within the observed time frame and sample, changes in the complexity of exports do not have a measurable short-term effect on income. Similarly, infrastructure, FDI, human capital, institutional quality, and trade openness are all statistically insignificant in this dynamic specification, indicating that most short-term variations in GDP are captured by past income rather than contemporaneous changes in these structural variables.

The insignificance of export sophistication in this model does not imply that it is economically irrelevant. Instead, it likely reflects a combination of factors: slow evolution of export structures, the indirect nature of their impact through channels such as human capital or institutional quality, and the dominance of income persistence in explaining short-term variation. These results underscore that while export sophistication may be a key driver of long-term development, its immediate effect on GDP per capita is difficult to detect in panel regressions, even when using advanced dynamic techniques such as System GMM. This finding aligns with previous empirical studies that suggest the benefits of export sophistication manifest over longer horizons and through structural improvements rather than direct contemporaneous effects.

Robustness Checks
Multicollinearity
Variance inflation factor

	VIF	1/VIF
	1.918	.521
infrastructure	1.837	.544
Institutional Quality	1.524	.656
Trade Openness	1.392	.719
FDI	1.111	.9
Export Sophistication	1.083	.923
Mean VIF	1.478	.

Variance inflation factors (VIF) were computed to assess the presence of multicollinearity among the independent variables in the baseline regression model. As shown in the results, all VIF values are well below the conventional threshold of 10, with the highest being 1.918 for human capital and the lowest 1.083 for export sophistication. The mean VIF across all regressors is 1.478, indicating that, on average, less than 1.5 times the variance of each estimated coefficient is inflated due to correlation with other independent variables. These findings suggest that multicollinearity is not a concern in the model, and the estimated coefficients can be interpreted with confidence without concern for distortion caused by highly correlated regressors. Consequently, the results of the pooled OLS, FE, RE, and GMM regressions are unlikely to be biased by multicollinearity among the explanatory variables.

Heteroskedasticity

Income	Coefficient	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
Export Sophistication	-69.933	365.228	-0.19	.849	-815.827	675.961	
infrastructure	-4.521	16.709	-0.27	.789	-38.645	29.602	
FDI	12.8	20.312	0.63	.533	-28.684	54.283	
Human capital index	3442.4	1439.943	2.39	.023	501.644	6383.157	**
Institutional Quality	359.491	194.43	1.85	.074	-37.588	756.569	*
Trade openness	-3.604	9.611	-0.37	.71	-23.233	16.025	
Constant	1453.482	4571.23	0.32	.753	-7882.215	10789.178	

**** p<.01, ** p<.05, * p<.1*

The regression results reported above incorporate heteroskedasticity-robust standard errors, ensuring that the estimated standard errors and corresponding t-values are valid even if the variance of the error term is not constant across observations. Using robust standard errors allows for more reliable inference and avoids the risk of underestimating standard errors, which can lead to false statistical significance in the presence of heteroskedasticity. The results indicate that export sophistication remains negative (-69.933) but statistically insignificant ($p = 0.849$), implying that variations in export complexity do not have a discernible effect on income in this specification. Infrastructure and trade openness also have statistically insignificant coefficients, suggesting that short-term variations in these variables are not strongly associated with income once heteroskedasticity is accounted for.

In contrast, human capital has a positive and statistically significant effect on GDP per capita (coefficient = 3442.4, $p = 0.023$), indicating that improvements in education and skills are important drivers of income in

emerging African economies. Institutional quality (Inst) is marginally significant at the 10% level (coefficient = 359.491, p = 0.074), suggesting that stronger governance and institutions may positively contribute to income, although the evidence is less strong than for human capital. The use of robust standard errors confirms that these estimates are resistant to heteroskedasticity, enhancing the credibility of the inference. Overall, the findings highlight the dominant role of human capital, while the direct effects of export sophistication, infrastructure, trade openness, and FDI are not statistically significant in the presence of heteroskedasticity.

Trend Analysis

Fig 5.5.1 Export Sophistication Trends over time by country

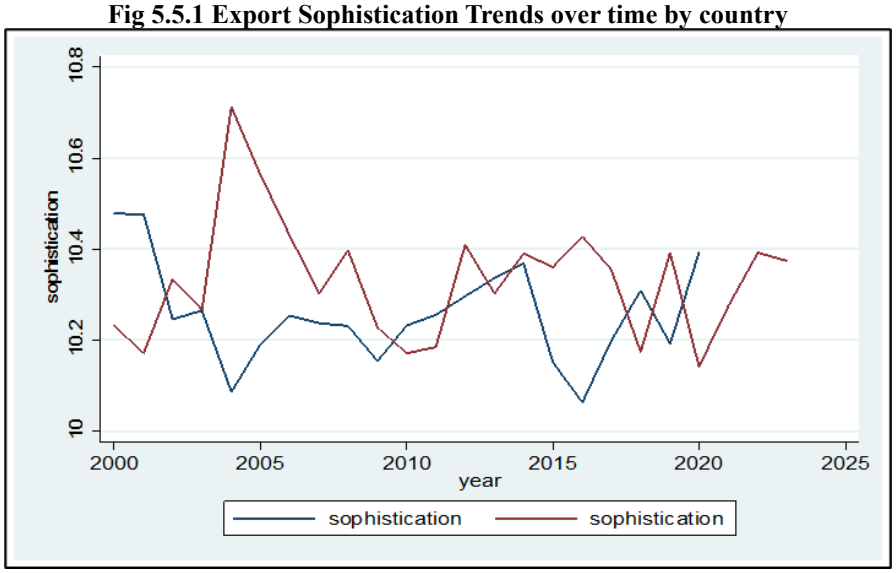


Fig 5.5.2. Scatter Plot: Income vs sophistication

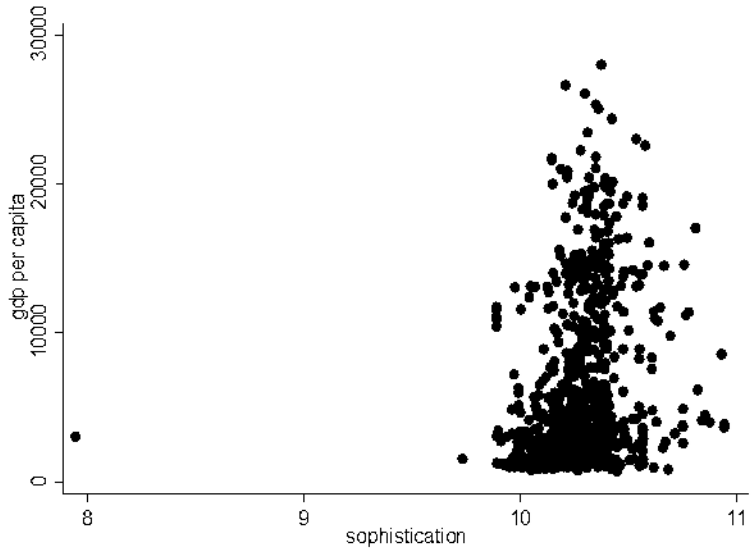


Figure 5.5.1 illustrates the evolution of export sophistication across selected African economies over the period 2000 to 2024. The figure shows that export sophistication exhibits moderate fluctuations over time, with no clear sustained upward trend across countries. While some countries experience short-term improvements, particularly in the early to mid-2000s, these gains are often followed by stagnation or reversals. The overall pattern suggests that export sophistication in African economies evolves slowly and unevenly, reflecting structural rigidities, limited industrial upgrading, and dependence on primary commodity exports. The relatively narrow range of variation over time indicates that most changes in export sophistication occur gradually, which helps explain why its effect on income may be difficult to capture in short-run panel regressions. This slow-moving nature reinforces the view that export sophistication is a long-term structural transformation variable rather than a short-term growth driver.

Figure 5.5.2 presents a scatter plot depicting the relationship between GDP per capita and export sophistication. The distribution of observations reveals a weak positive association, with higher levels of income generally corresponding to higher export sophistication. However, the relationship is highly dispersed, particularly at mid to high levels of sophistication, indicating substantial heterogeneity across countries. Several observations with relatively high export sophistication remain associated with low- or moderate-income levels, suggesting that export complexity alone is insufficient to guarantee higher income without complementary factors such as strong institutions, human capital, and infrastructure. The absence of a clear linear pattern supports the regression results, which show that export sophistication does not exert a strong direct effect on income in the short run. Instead, the scatter plot suggests that the income benefits of export sophistication are conditional and indirect, materializing only when supported by broader structural and institutional development.

Together, these two figures visually reinforce the empirical findings from the pooled OLS, FE, RE, and System GMM estimations. The slow temporal evolution of export sophistication and the weak unconditional correlation with income help explain why export sophistication remains statistically insignificant across most model specifications. The figures, therefore, provide descriptive evidence that supports the econometric conclusion that export sophistication influences income primarily through long-term and indirect channels, rather than through immediate short-run effects.

Mechanism Analysis

In this section, we test how infrastructure, human capital, or institutions mediate the relationship between export sophistication and income.

Total Effect

The researcher tests the overall effect of export sophistication on income before accounting for the mediator, thus human capital. It captures all possible channels through which export sophistication may influence income, both directly and indirectly.

income	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
sophistication	166.124	237.202	0.70	.484	-299.56	631.809	
infrastructure	35.294	3.641	9.69	0	28.146	42.442	***
FDI	10.294	12.021	0.86	.392	-13.306	33.895	
Institutional	328.818	114.608	2.87	.004	103.815	553.82	***
Trade openness	-3.669	3.496	-1.05	.294	-10.532	3.195	
Constant	3320.156	2437.393	1.36	.174	-1465.034	8105.347	

Effect of Export Sophistication on Human Capital

Human Capital	Coefficient	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
sophistication	.052	.035	1.49	.138	-.017	.12	
infrastructure	.011	0	22.58	0	.01	.012	***
FDI	-.001	.002	-0.48	.628	-.004	.002	
Institutional Quality	-.043	.015	-2.81	.005	-.074	-.013	***
Trade openness	0	0	-0.09	.926	-.001	.001	
Constant	.797	.36	2.22	.027	.091	1.504	**

**** p<.01, ** p<.05, * p<.1*

Direct Effect

income	Coefficient	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
sophistication	-69.933	277.98	-0.25	.801	-615.813	475.948	
Human capital index	3442.4	316.977	10.86	0	2819.942	4064.859	***
infrastructure	-4.521	5.165	-0.88	.382	-14.664	5.621	
FDI	12.8	11.981	1.07	.286	-10.728	36.327	
Institutional Quality	359.491	124.034	2.90	.004	115.921	603.061	***
Trade openness	-3.604	3.596	-1.00	.317	-10.665	3.457	
Constant	1453.482	2875.404	0.51	.613	-4193.054	7100.017	

**** p<.01, ** p<.05, * p<.1*

Table 5.6.1 presents the results of the baseline income regression assessing the total effect of export sophistication on GDP per capita. The coefficient on export sophistication is positive (166.124) but statistically insignificant ($p = 0.484$), indicating that export sophistication does not exert a significant overall effect on income in the absence of the mediator. In contrast, infrastructure has a strong positive and highly significant effect on income (coefficient = 35.294, $p < 0.01$), underscoring the importance of physical capital and productive capacity in driving economic performance. Institutional quality is also positive and statistically significant (coefficient = 328.818, $p = 0.004$), highlighting the role of governance and institutional effectiveness in promoting higher income levels. Foreign direct investment and trade openness remain statistically insignificant, suggesting limited short-run effects on income once structural factors are controlled for.

Table 5.6.2 examines the effect of export sophistication on human capital, which serves as the potential mediator. The coefficient on export sophistication is positive (0.052) but statistically insignificant ($p = 0.138$), indicating that improvements in export sophistication do not significantly enhance human capital accumulation in the short run. Infrastructure exhibits a strong and highly significant positive effect on human capital ($p < 0.01$), reflecting its role in improving access to education and skills development. Institutional quality, however, is negatively and significantly associated with human capital ($p = 0.005$), suggesting that institutional weaknesses may constrain effective human capital formation despite improvements in other areas. Foreign direct investment and trade openness do not display statistically significant effects.

Table 5.6.3 reports the direct effect of export sophistication on income after controlling for human capital and other covariates. The coefficient on export sophistication becomes negative and remains statistically insignificant (–69.933, $p = 0.801$), confirming the absence of a direct short-run impact on income. In contrast, human capital exhibits a large, positive, and highly significant effect on income (coefficient = 3442.4, $p < 0.01$), emphasizing its central role as a key driver of economic development. Institutional quality remains positive and statistically significant, while infrastructure, FDI, and trade openness continue to be insignificant in this specification.

Overall, the mediation analysis provides no empirical support for human capital as a mediating channel through which export sophistication influences income in the short run. Export sophistication is insignificant in both the total and direct effect models and does not significantly affect the mediator. These findings suggest that export sophistication operates primarily as a long-term structural transformation variable, whose income effects materialize gradually and indirectly rather than through immediate improvements in human capital or short-run income growth. This result is consistent with structural development theory and aligns with the broader econometric evidence presented earlier in the chapter.

Interaction Effects

Does the impact of export sophistication depend on human capital or institutional quality?

Table 5.7.1

Income	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
sophistication	-697.054	355.719	-1.96	.059	-1423.53	29.422	*
soph_hci	335.338	140.488	2.39	.023	48.424	622.252	**
infrastructure	-4.592	16.67	-0.28	.785	-38.638	29.453	
FDI	12.841	20.367	0.63	.533	-28.753	54.435	
Institutional Quality	358.371	194.331	1.84	.075	-38.505	755.247	*
Trade openness	-3.749	9.647	-0.39	.7	-23.451	15.953	
Constant	7895.45	3355.085	2.35	.025	1043.452	14747.448	**

**** p<.01, ** p<.05, * p<.1*

The results reported in Table 5.7.1 show the interactive effect of export sophistication and human capital on income by incorporating an interaction term between export sophistication and the human capital index. The coefficient on export sophistication is negative and marginally statistically significant at the 10 percent level (coefficient = –697.054, $p = 0.059$), indicating that, in isolation, increases in export sophistication are associated with lower income levels when human capital is at its baseline level. This suggests that export upgrading alone may not generate immediate income gains in the absence of complementary human capital.

However, the interaction term between export sophistication and human capital (soph_hci) is positive and statistically significant at the 5 percent level (coefficient = 335.338, $p = 0.023$). This finding implies that the income effect of export sophistication becomes positive and stronger as human capital improves. In other words, human capital significantly moderates the relationship between export sophistication and income, transforming export sophistication into a growth-enhancing factor when sufficient skills and knowledge are present in the economy.

Among the control variables, institutional quality remains positive and weakly significant at the 10 percent level, reaffirming the importance of governance and institutional effectiveness in supporting income growth. Infrastructure, foreign direct investment, and trade openness are statistically insignificant, suggesting that their short-run effects on income are limited once structural interactions are accounted for. The constant term is positive and statistically significant, reflecting a positive baseline level of income across countries.

Overall, these results provide strong empirical evidence that export sophistication contributes to income growth only when accompanied by adequate human capital, highlighting the complementarity between productive knowledge embedded in exports and domestic skill accumulation. This finding supports endogenous growth and structural transformation theories, which emphasize that the gains from export upgrading are conditional on a country's absorptive capacity.

Summary of Empirical Analysis

This study empirically investigated the relationship between export sophistication and income levels in emerging African economies using panel data techniques over the study period. A range of estimation methods, including pooled OLS, fixed effects, random effects, and dynamic system GMM, were employed, alongside robustness and diagnostic tests, to ensure the credibility and consistency of the findings.

The pooled OLS estimates indicated that income levels are strongly influenced by infrastructure development, human capital accumulation, institutional quality, and trade openness. In contrast, export sophistication was not statistically significant in the baseline specification. When unobserved country-specific characteristics were controlled for using fixed and random effects models, export sophistication remained statistically insignificant, suggesting that income variations across African economies are driven primarily by structural, institutional, and human capital factors rather than export sophistication alone.

Diagnostic tests revealed the presence of heteroskedasticity and serial correlation, as well as potential endogeneity concerns, particularly due to income persistence and reverse causality between income and export sophistication. Consequently, a dynamic system GMM estimator was employed to address these issues. The GMM results confirmed strong persistence in income levels, as evidenced by the positive and highly significant lagged income term. However, even after controlling for endogeneity and dynamic effects, export sophistication remained statistically insignificant, reinforcing the conclusion that export upgrading by itself does not automatically translate into higher income levels in African economies.

To further explore the underlying transmission mechanisms, mediation and interaction analyses were conducted. The mediation results indicated that export sophistication does not exert a statistically significant indirect effect on income through human capital accumulation. In contrast, the interaction analysis revealed a more nuanced relationship. While export sophistication exhibited a weakly negative direct effect on income, its interaction with human capital was positive and statistically significant, indicating that higher levels of human capital enhance the income-generating effects of export sophistication. This finding highlights the importance of absorptive capacity in transforming complex exports into economic gains.

Across all model specifications, human capital and institutional quality consistently emerged as robust and significant determinants of income, underscoring their central role in long-term economic performance. Infrastructure showed strong positive effects in static models, while foreign direct investment and trade openness displayed mixed and generally insignificant effects once structural and institutional variables were controlled for. Multicollinearity diagnostics confirmed that the estimated models were stable and not affected by excessive correlation among regressors.

Overall, the empirical results demonstrate that export sophistication alone is insufficient to drive income growth in emerging African economies. Its effectiveness is conditional on complementary factors, particularly human capital development and institutional quality. These findings align with structural transformation and endogenous growth theories, which emphasize that the benefits of export upgrading materialize only when economies possess the necessary skills, institutions, and absorptive capacities to utilize complex productive knowledge. Accordingly, policies aimed at promoting export sophistication should be accompanied by sustained investments in education, skills development, and institutional strengthening to achieve durable income growth.

VI. Discussions, Policy Implications, And Conclusion

Introduction

This chapter synthesizes and interprets the empirical findings presented in Chapter Five, situating them within the broader theoretical and empirical literature on export sophistication and economic development. It discusses the key results, draws out their policy implications for emerging African economies, outlines the study's contributions, acknowledges limitations, and proposes directions for future research. The central objective of this chapter is to explain why export sophistication has not yielded direct income gains in the sample economies and under what conditions it can become income-enhancing

Discussion of Key Empirical Findings

A central finding of this study is that export sophistication does not exert a statistically significant direct effect on income levels across most model specifications. This result holds consistently across pooled OLS, fixed effects, random effects, and dynamic GMM estimations. Even after addressing endogeneity, income persistence, heteroskedasticity, and serial correlation, export sophistication remains insignificant. This finding challenges the simplified assumption that upgrading the export basket automatically leads to higher income levels. Instead, it supports the view that export sophistication is a necessary but not sufficient condition for income growth. In the context of many African economies, export upgrading may occur in enclaves, rely heavily on foreign firms, or lack strong backward linkages to the domestic economy. As a result, the knowledge and productivity embedded in sophisticated exports may not diffuse widely enough to raise average income levels.

These results align with recent empirical studies suggesting that the income benefits of export sophistication depend heavily on domestic absorptive capacity, production structures, and institutional quality rather than export composition alone. Human capital emerges as one of the most robust and consistent determinants of income across all estimation techniques. In both static and dynamic models, the human capital index is positive and highly statistically significant, indicating that improvements in education, skills, and workforce quality directly raise income levels.

However, mediation analysis shows that export sophistication does not significantly increase income through human capital accumulation. This suggests that export upgrading has not yet translated into systematic skill development in the sampled economies. In many cases, sophisticated production processes may be imported, capital-intensive, or externally managed, limiting their contribution to domestic human capital formation.

Nonetheless, the interaction analysis provides a crucial insight: human capital significantly moderates the effect of export sophistication on income. The positive and significant interaction term indicates that export sophistication becomes income-enhancing only when human capital levels are sufficiently high. This finding confirms the importance of complementary capabilities and supports endogenous growth theory, which emphasizes the role of skills in transforming productive knowledge into economic gains.

In addition, infrastructure displays a strong positive effect on income in pooled OLS models but becomes statistically insignificant in fixed effects, random effects, and GMM estimations. This pattern suggests that while infrastructure differences explain income variation across countries, changes in infrastructure within countries over time have a weaker short-run impact on income growth. This result may reflect long gestation periods associated with infrastructure investments or inefficiencies in project implementation. It also highlights that infrastructure alone cannot compensate for weaknesses in human capital or institutional frameworks.

Institutional quality consistently shows a positive and statistically significant effect on income across most specifications. This finding underscores the role of governance, regulatory quality, and political stability in facilitating productive investment, efficient resource allocation, and income growth. Moreover, institutional quality complements export sophistication by shaping the environment in which firms operate. Weak institutions may prevent firms from upgrading production processes, forming linkages, or reinvesting export revenues domestically. The results, therefore, reinforce the argument that institutional reform is a critical precondition for successful structural transformation.

Foreign direct investment and trade openness exhibit mixed and generally insignificant effects once structural and institutional variables are controlled for. While openness and FDI can facilitate technology transfer and market access, their benefits appear conditional rather than automatic. In the African context, FDI may be concentrated in extractive sectors with limited spillovers, while trade openness may expose domestic firms to competition without adequate capacity to upgrade. These findings suggest that openness-oriented policies must be complemented by targeted industrial and human capital strategies.

The dynamic GMM results reveal strong income persistence, as evidenced by the highly significant lagged income term. This indicates that income levels are path-dependent, with historical conditions exerting a lasting influence on current outcomes. Such persistence makes structural transformation more challenging and reinforces the need for long-term, coordinated policy interventions.

Policy Implications

The empirical findings of this study carry several important policy implications for emerging African economies. First, policies aimed solely at increasing export sophistication are unlikely to generate sustained income growth unless accompanied by investments in human capital. Governments should prioritize education systems, technical training, and skill development aligned with the requirements of more complex production structures.

Second, strengthening institutional quality is essential. Transparent governance, effective regulation, and contract enforcement enhance the capacity of firms to innovate, form linkages, and benefit from export upgrading. Institutional reforms should therefore be integrated into broader industrial and trade strategies.

Third, infrastructure investment should be strategically targeted to support productive sectors rather than pursued as an isolated objective. Infrastructure that improves connectivity between firms, workers, and markets is more likely to enhance the income effects of export sophistication. Fourth, trade and FDI policies should be designed to maximize spillovers. This includes encouraging joint ventures, local sourcing, and technology transfer, as well as supporting domestic firms' participation in global value chains. Finally, the presence of income persistence highlights the importance of policy consistency and long-term commitment. Short-term reforms are unlikely to overcome entrenched structural constraints without sustained implementation.

Future research could extend this analysis by using firm-level or sectoral data to examine micro-level transmission mechanisms. Further work could also explore nonlinear effects of export sophistication, regional heterogeneity within Africa, or the role of digitalization and innovation systems in shaping export upgrading outcomes

Chapter Summary and Final Conclusion

In summary, this chapter has shown that the income effects of export sophistication in emerging African economies are conditional rather than automatic. While export upgrading alone does not significantly raise income levels, its interaction with human capital and institutional quality plays a decisive role. The findings underscore the importance of complementary investments and structural reforms in achieving inclusive and sustained income growth. Ultimately, export sophistication should be viewed not as an end in itself, but as part of a broader development strategy centered on skills, institutions, and productive transformation.

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