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Does agricultural development improve the structure of exports in sub-Saharan Africa?

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Abstract

Purpose – While structuralist theory on international trade advocates refocusing development efforts on the industrial sector for optimal structural change in the economy, sub-Saharan African countries seem to be relying more on the agricultural sector for their development. This raises the question of the relevance of such a development strategy. This article examines how agricultural development affects the structural dynamics of exports from sub-Saharan African countries.

Design/methodology/approach – Based on panel data from 44 sub-Saharan African countries over the period 1995–2014, this study examines the effects of agricultural development on the structural dynamics of these countries' exports. To do so, three indicators of agricultural development (agricultural value added, agricultural employment and agricultural productivity) and two structural indicators of exports (diversification and export quality) are used. The Panel-Corrected Standard Errors (PCSE) estimator and the System Generalized Moment Method (Sys-GMM) were used to estimate our dynamic panel regression models.

Findings – The results show that each of the three agricultural development indicators has a significant influence on the diversification and quality of exports of the sample countries but that only the improvement of agricultural productivity has a positive effect.

Practical implications – In order to improve the export structure of sub-Saharan African countries, this document recommends that governments focus agricultural development on improving labour productivity, among other things, through training in modern agricultural techniques that incorporate cutting-edge technology. We also recommend that they strengthen the synergy between the three sectors of the economy by promoting the final and intermediate consumption of locally produced goods.

Originality/value – Unlike other studies, our article assesses the transformative power of agricultural development in sub-Saharan Africa by taking into account the quality of exports and agricultural productivity.

Keywords Agricultural development, Structural change, Export diversification, Export quality, Sub-Saharan Africa

Paper type Research article

1. Introduction

The nations of sub-Saharan Africa (SSA) are currently grappling with significant external shocks, including the aftermath of the Covid-19 pandemic, the Russia–Ukraine war and escalating conflicts in the Middle East. These successive crises have exacerbated the vulnerability of productive structures already weakened by internal constraints and historical policy choices. Consequently, strengthening economic resilience has become a critical priority, with the export structure serving as a vital diagnostic tool. As established by Hidalgo

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et al. (2007), export data acts as a window into a country's economic complexity, reflecting the diversification and ubiquity of its goods. For SSA, the transition from primary raw products to a high-value-added basket is a fundamental requirement for inclusive growth and global integration (Cadot *et al.*, 2011; Hesse, 2008), representing the long-term process of structural change (Chenery *et al.*, 1986; Syrquin, 1988).

The debate over the optimal path to this transformation remains polarised. The dominant structuralist paradigm, supported by influential works such as Rodrik (2013) and Cadot *et al.* (2016), identifies manufacturing as the main catalyst for export sophistication. Forero and Tena-Junguito (2024) reinforce this by highlighting a long-term positive correlation between industrialisation and diversification. However, in practice, many resource-dependent SSA economies struggle to move beyond extractive industries (Calzada Olvera and Spinola, 2025). Guided by the principle of the comparative advantage, several nations continue to prioritise the agricultural sector, leveraging their abundant endowments of arable land and labour.

This strategic reliance on agriculture presents an empirical paradox. Between 1995 and 2019, agriculture in SSA accounted for 16% of GDP and 59% of total employment, yet it remains characterised by low productivity, estimated at USD 20,000 per worker (WB, 2022). During this period, export diversification indices rose only marginally from 0.58 to 0.60, while the share of agricultural raw materials in total exports actually fell from 7% to 3% (UNCTAD, 2022). This suggests that while diversification efforts exist, they have not yet induced a deep transformation in economies that remain heavily dependent on agriculture for livelihoods. This divergence raises a critical research question regarding whether agricultural development truly improves the export structure in the region.

Theoretical frameworks offer conflicting perspectives on this issue. On one hand, Ricardo's (1817) theory of comparative advantage suggests that specialising in natural advantages could trap SSA in a concentration of primary products, hindering sophistication. On the other hand, Lewis's (1954) theory of labour transfer, central to neo-structuralist approaches (Lin, 2012, 2013), posits that rising agricultural productivity frees up labour for the industrial sector. This transition enables the production of manufactured exports, leading to diversification and a move upmarket (Rodrik, 1998). Despite these theories, there is a notable gap in the literature; most studies focus on the industrial sector (Rodrik, 2013), and rare exceptions like Fonchamnyo and Akame (2016) often overlook export quality, use limited indicators, or fail to account for endogeneity bias.

This article addresses these academic shortcomings by offering a threefold contribution. First, it examines the impact of agricultural development on both export diversification and quality. Second, it employs three distinct indicators: agricultural value added as a percentage of GDP, agricultural employment, and agricultural labour productivity. Third, it utilises a robust System Generalized Method of Moments (Sys-GMM) econometric methodology to control for endogeneity. The study provides essential insights for policymakers, suggesting that efforts must focus specifically on agricultural labour productivity to positively influence export structures. Academically, it reaffirms the role of agriculture in structural change and invites a reconsideration of intersectoral synergies in development models.

The rest of the article is organised as follows. Section 2 presents a brief review of the literature. Section 3 describes the data and methodology. Section 4 discusses the results. Section 5 concludes with policy recommendations.

2. Literature review

Our study is anchored in the emerging and growing literature on the determinants of export structure dynamics. We will first outline the foundational works in this field, then examine the studies that incorporate agricultural performance among the factors modifying the structure of exports and finally analyse the core theories underpinning the causal relationship under investigation.

The analysis of structural change originates from approaches focussing on stylised facts, where the agricultural sector is clearly demonstrated to be the root of structural transformation (Gollin, 2010). Over the last two decades, this body of economic literature has witnessed the emergence of new, more dynamic approaches based on seminal work. McMillan and Rodrik (2011) identified a 'structural effect' by decomposing the total labour productivity growth function, capturing the impact of intersectoral labour mobility and changes in sectoral output shares. This paved the way for a growing field of research on the structural dynamics of exports, which refers to changes over time in the composition, quantity, and quality of an economy's export basket (Anand *et al.*, 2012; Hausmann *et al.*, 2007; Henn *et al.*, 2020; Hidalgo and Hausmann, 2009; Imbs and Wacziarg, 2003). These authors draw on neoclassical (Ricardo, 1817) and neo-structuralist theories [1] (Lin, 2012, 2013) as well as international trade models (Melitz, 2003) to define new metrics for diversification, sophistication and quality focused on exports.

To quantify export structure, Imbs and Wacziarg (2003) developed a measure of production and export diversification based on the Gini index, subsequently adapted in recent literature using indices such as the Theil index (Cadot *et al.*, 2013; Mania and Rieber, 2019). Parteka *et al.* (2025) further refined this by providing a technology-based interpretation of diversification stages. Hausmann *et al.* (2007) constructed a product sophistication index to quantify the level of technology embodied in an export product. Anand *et al.* (2012) extended this to include service sophistication. More recently, Henn *et al.* (2020) developed an EQI, defining quality as the relative price of a country's varieties within their respective product range. These complexity indicators are deemed crucial, as a lack of structural transformation, often mapped through them, is considered a precursor to the resource curse, especially in resource-rich economies (Timbe *et al.*, 2024; Valverde-Carbonell, 2025).

Despite the growing literature on the determinants of export structural dynamics (e.g. Cabral and Veiga, 2010; Cadot *et al.*, 2016; Elhiraika and Mbate, 2014; Henn *et al.*, 2020; Lectard and Rougier, 2018; Lefgoum, 2017; Mania and Rieber, 2019; Nguyen and Su, 2021; Osakwe and Kilolo, 2018; Swathi and Sridharan, 2022), there is a notable gap concerning the role of agricultural development in structuring exports, despite the sector's major economic importance in sub-Saharan African (SSA) countries. Fonchamnyo and Akame (2016) are among the few who have examined this link. Using a fractional Logit model on a panel of 32 SSA countries (1995–2013), they highlighted the significant contribution of agricultural value added to export diversification, finding a beneficial effect from its increase. However, their estimates suffered from three main limitations: they did not account for differences in countries' economic size (agricultural value added was not relative to GDP); they considered only one dimension of export structure (diversification), neglecting sophistication or quality; and they omitted other agricultural performance indicators (e.g., productivity or contribution to employment). More recent empirical studies have begun to fill this gap. Nofiu *et al.* (2025) investigated the effect of the relative size of agricultural exports on sustainable development in SSA, finding a positive influence. Furthermore, analyses of factors impacting the sector's export capacity, such as Foreign Direct Investment (FDI), show that while FDI can enhance domestic agricultural production and strengthen export capacity in sub-regions like SADC (Mabeta *et al.*, 2025), its overall impact on broader export diversification across the continent remains non-significant (Isah, 2025).

The theoretical frameworks explaining the link between agricultural development and export structure dynamics are rooted in the comparative advantage and structuralist theories of international trade. According to Ricardo (1817), countries specialise in the production and export of goods they can produce at a relatively low cost, stemming from factor endowments (natural resources, unskilled labour) and/or productivity differences (Lectard, 2016). Most SSA countries, rich in natural resources, tend to concentrate their exports on primary sector products (Ngangoué, 2016). An increase in agricultural labour productivity reduces the production cost of agricultural products, conferring a comparative advantage in these exports, which inevitably affects the export structure. While an improvement in agricultural productivity may allow for product differentiation in terms of price and quality, the resulting comparative advantage leads to a concentration of exports in less complex agricultural products. However, the increased volume of agricultural exports may facilitate the diversification of trading partners. Thus, through the channel of comparative advantages, agricultural development can have a significant impact on SSA countries' export structure, generally leading to a product-type concentration but potential trading-partner diversification.

In contrast, the structuralist model developed by Lewis (1954), highlighting the transfer of productive resources from the traditional (agricultural) to the modern (non-agricultural) sector of a dual economy (Berthelier and Lipchitz, 2005), provides an alternative framework. This model postulates that surplus agricultural labour migrates to the expanding manufacturing sector, stimulating economic growth and manufacturing exports. An increase in agricultural productivity, catalysed by technical progress and human capital improvements, can release labour for the manufacturing sector. This mechanism could encourage the diversification and sophistication of exports, as seen in the growth of the textile industry in Ethiopia. Based on Lewis's model, structuralists suggest that developing countries should focus their exports on products that involve all productive sectors of the economy to achieve overall economic change. They favour the development of the manufacturing sector, which mobilises upstream raw materials from the primary sector and downstream logistics and marketing services from the tertiary sector. However, neo-structuralists like Lin (2012) and Lin and Monga (2010) believe industrialisation should target industries with genuine development potential, identified based on a country's actual and latent comparative advantages. Lin argues that deviation from comparative advantages risks poor economic performance (Lin, 2013), hence, the failure of import substitution strategies. Rodrik (1998) disagrees, citing the effectiveness of these strategies for two decades in Latin American and East Asian countries. Lin's neo-structuralist approach (2012) positions itself as a reconciler between neoclassical comparative advantage theories and pure structuralist thinking, which favours industrialisation driven by new priority sectors unrelated to comparative advantage (Lectard, 2016; Rodrik, 2012). Ultimately, the structuralist theory of surplus labour establishes a theoretical link between agricultural development and the export structure of SSA countries, a relationship that must now be verified empirically. We therefore tested the following hypotheses:

H1. Agricultural development positively impacts export diversification in SSA.

H2. Agricultural development positively impacts export quality in SSA.

3. Methodology

3.1 Variables

We utilise an unbalanced panel of 44 Sub-Saharan African countries (see Table A1) over the period 1995–2014. The sample and timeframe are dictated by data availability. Data sources, descriptive statistics, and the correlation matrix are provided in Tables A2, A3, and A4, respectively.

3.1.1 Dependent variables. To examine shifts in export structure, we employ two distinct dependent variables: the level of export concentration and the quality of exports.

The level of export concentration is captured by the Theil Index (1972). This is a standard measure of the degree to which a country's exports are concentrated within a restricted set of products. Widely applied in the economic diversification literature (Cadot *et al.*, 2013; Mania and Rieber, 2019), the index is proportional to concentration but inversely proportional to diversification. Higher values indicate greater concentration (lower diversification). Unlike the Herfindahl-Hirschman or Gini indices, the Theil Index (*TI*) allows for a decomposable analysis into intensive and extensive margins, providing a more granular understanding of diversification dynamics (Gnidchenko, 2021). The index is calculated as follows:

$$TI^c = \frac{1}{n}\sum_i \frac{X_i^c}{\frac{1}{n}\sum_i X_i^c} \, ln\left(\frac{X_i^c}{\frac{1}{n}\sum_i X_i^c}\right) = \sum_i \frac{X_i^c}{\sum_i X_i^c} \, ln\left(\frac{X_i^c}{\sum_i X_i^c} \Big/ \frac{1}{n}\right) \quad (1)$$

where X_i^c is the value of exports for product i and country c, and n is the total number of products exported (export lines) by all countries. Cadot *et al.* (2011) break down this index into extensive margin ($TI^c_{(B)}$) and intensive margin ($TI^c_{(W)}$) as follows:

$$TI^c = TI^c_{(B)} + TI^c_{(W)} = \sum_g \frac{X_g^c}{\sum_i X_i^c} \, ln\left(\frac{\frac{1}{n_g}X_g^c}{\frac{1}{n}\sum_i X_i^c}\right) + \sum_g \frac{X_g^c}{\sum_i X_i^c} T_g^c \quad (2)$$

where X_g^c is the total value of exports for product group g and country c, n (or n_g) is the total number of potential export lines for all products (or specific product group g for country c) and T_g^c is the standard Theil index for group g calculated according to the formula in Equation (1).

Export quality is captured by the index developed by Henn *et al.* (2020), which measures the average quality within each product category. While some authors use the terms 'quality' and 'sophistication' interchangeably (Hallak, 2006; Hummels and Klenow, 2005), others distinguish between them (Anand *et al.*, 2012; Hausmann *et al.*, 2007). For this study, we use the term quality, recognising its link to export sophistication. At the country level, a high index value reflects the superior quality of product varieties within the export basket.

Applied in recent literature (Nguyen and Su, 2021, 2022), the Henn *et al.* (2020) index estimates quality using a modified version of the Hallak (2006) model. The authors assume that, for any given product, the exchange price (unit value) is determined by three factors: the unobservable quality of the product θ_{mxt}, the per capita income of the exporting country y_{xt} (a proxy for the technological gap and production costs) and the geographical distance between the importer and exporter $Dist_{mx}$. By defining an augmented gravity equation, export quality (*EQI*) is estimated as follows:

$$Quality_{mxt} = \delta ln\,\theta_{mxt} = \zeta_1' ln\,P_{mxt} + \zeta_2' ln\,y_{xt} + \zeta_3' ln\,Dist_{mx} \quad (3)$$

The subscripts m, x and t denote the importer, exporter and time period, respectively.

3.1.2 Explanatory and control variables. Our empirical analysis focuses on measuring the impact of agricultural development on the structure of exports in Sub-Saharan Africa. We employ a set of explanatory variables of interest and standard control variables to mitigate omitted variable bias.

The key explanatory variables chosen to capture both agricultural development and structural change, in line with recent literature (Grabowski and Self, 2022a; Mc.Millan *et al.*, 2014; Moussir and Chatri, 2020; Swathi and Sridharan, 2022; Zhang and Diao, 2020), are:

Agricultural Value Added (AVA) as a percentage of GDP (%GDP): This variable quantifies the economic weight of the agricultural sector relative to the overall economy, thus accounting for cross-country differences in economic size. A continuous decrease in this ratio over time is typically observed during structural transformation (Fei and Ranis, 1975; Kuznets, 1973; McMillan *et al.*, 2014). An increase in this indicator over time might symmetrically reflect de-industrialisation, which could negatively impact export diversification and quality.

Agricultural Employment (% total employment): Denoted as *Agr_Emp*, this indicator measures the proportion of the workforce engaged in agricultural activities (CEA, 1984). Like the AVA ratio, its decline in favour of other sectors (Fei and Ranis, 1975; McMillan *et al.*,

2014) is a macroeconomic indicator of structural transformation, reflecting the shift of unskilled labour and wealth creation opportunities out of the agricultural sector.

Agricultural Labour Productivity (Agr_Prod, constant 2015 USD): This is considered the most comprehensive indicator of agricultural development, representing the average wealth created per worker annually. It captures the impact of physical capital, human capital, and technology invested in the sector (Diao *et al.*, 2018; Grabowski and Self, 2022a; McMillan and Zeufack, 2022; Swathi and Sridharan, 2022). High *Agr_Prod* is indicative of advanced development within the sector and is theorised to be the starting point for structural transformation (Cadot *et al.*, 2016), leading to the intersectoral migration of surplus labour and, consequently, a change in the economy's sectoral and export structures (McMillan *et al.*, 2014). We use constant values to adjust for inflation.

To reduce omitted variable bias, nine control variables were included, reflecting established determinants of export structure (e.g. Carrère *et al.*, 2011; Elhiraika and Mbate, 2014; Nguyen and Su, 2021; Osakwe and Kilolo, 2018). These are Value Added of the Manufacturing Sector (*MVA*) and the Services Sector (*SVA*), population size (*Pop*) used as a proxy for the size of the economy, trade openness (*Openness*), domestic investment (*Invest*), foreign direct investment (*FDI*), natural resource endowment (*Resources*); the country's geographical distance from its trading partners (*Dist*), and institutional quality (*Inst*). The literature shows that *MVA* share and *Openness* positively correlate with export diversification, while *Resources* favour concentration (Osakwe and Kilolo, 2018). *FDI* showed mixed effects on diversification in some studies, while Carrère *et al.* (2011) found that both *FDI* and *Dist* contribute to export concentration, whereas *Pop* (market size) and good *Inst* promote diversification. Invest was also found to positively affect diversification (Elhiraika and Mbate, 2014). Furthermore, *Openness*, *FDI* and *Inst* collectively enhance export quality (Nguyen and Su, 2021). Key controls like education and infrastructure were excluded due to the high risk of multicollinearity and the potential for over-identifying the model's instruments.

3.2 Data and sources

The variables studied in this paper are drawn from several authoritative sources (see Table A2). Export concentration and quality indices are obtained from the IMF Diversification Toolkit, calculated from SITC 4-digit (Rev.1) COMTRADE data covering 851 products across ten categories. Indicators for agricultural value added, employment and labour productivity, along with control variables (MVA, SVA, openness, population, investment, FDI and resources), are sourced from the World Bank's World Development Indicators. Institutional quality data is retrieved from the World Governance Indicators, while average geographical distance data originates from the CEPII DistGeo dataset.

Although the panel is unbalanced, descriptive statistics in Table A3 reveal that exports in the sample are generally concentrated (mean 1.42) and of lower quality (mean −0.48), with relatively low variability (Std dev. of 0.24 and 0.31, respectively). Despite signs of structural change in SSA economies, evidenced by the agricultural sector's lower weight in GDP (mean 2.78) and employment (mean 3.85) relative to the services sector (mean 3.77), agricultural labour productivity remains low (mean 7.05) and volatile (Std dev. 0.95).

Preliminary analysis through Figure A1 and pairwise correlations (Table A4) indicates that the agricultural sector's share of GDP and employment correlates positively with export concentration and negatively with quality. Conversely, agricultural productivity exhibits an inverse relationship, correlating negatively with export concentration and positively with quality. Given that these correlations do not imply causality, these relationships are further examined through formal econometric estimations.

3.3 Models and estimation strategies

To analyse the relationship between agricultural development and export structure, this study employs a panel data framework. Drawing on established empirical literature (Hodey *et al.*, 2015; Mania and Rieber, 2019; Osakwe and Kilolo, 2018), we assume that export dynamics in Sub-Saharan Africa are driven by various determinants, including unobserved country- and time-specific effects. The relationship is formalised as follows:

$$LogY_{i,t} = \alpha + \beta_1 Log\,X_{i,t} + Z'_{i,t}\beta_k + \mu_i + \lambda_t + v_{i,t} \tag{4}$$

$$\text{With}: Y_{i,t} = \begin{cases} TI_{i,t} \\ EQI_{i,t} \end{cases}; X_{i,t} = \begin{cases} AVA_{i,t} \\ Agr\_Emp_{i,t} \\ Agr\_Prod_{i,t} \end{cases}; i = 1, \ldots, 44;\ t = 1995, \ldots\ldots, 2014$$

$$\frac{\partial log\ Y}{\partial log\ X} = \beta_1;\ \frac{\partial log\ Y}{\partial log\ z_k} = \beta_k;\ k > 1$$

where $Y_{i,t}$ represents the export structure of country i in year t, captured by either the Theil index (TI) for concentration or the Export Quality Index (EQI). $X_{i,t}$ denotes agricultural development, measured alternatively by agricultural value added (AVA), employment (Agr_Emp), or productivity (Agr_Prod). Z' represents the transpose of the vector of time-varying and time-invariant control variables. The terms μ_i and λ_t represent country- and time-specific effects, respectively, while $v_{i,t}$ is the idiosyncratic error.

Because of the high correlation between agricultural development indicators and variance inflation factor (VIF) scores exceeding 10, these variables are included individually to avoid multicollinearity. Consequently, each export structure indicator is subject to three distinct specifications based on Equation (4). All variables were log-transformed to mitigate the impact of outliers and ensure estimation stability. The resulting coefficients are interpreted as elasticities, representing the percentage change in the dependent variable for a 1% increase in the independent variable. For regressions involving the Theil Index, a negative coefficient signifies a reduction in concentration (increased diversification), while a positive coefficient indicates a rising concentration.

The parameters of Equation (4) are estimated using the Panel Corrected Standard Error (PCSE) estimator proposed by Beck and Katz (1995), implemented via STATA 13. This estimator is selected for two main reasons. First, it effectively addresses heteroscedasticity, cross-sectional correlation, and first-order autocorrelation (issues identified in our dataset by the modified Wald (Greene, 2000), Wooldridge (2002) and Pesaran (2004) tests). Second, unlike the fixed-effect estimator, PCSE permits the inclusion and assessment of time-invariant factors.

However, the PCSE estimator does not inherently account for endogeneity, which may arise from measurement errors, omitted variable bias or reverse causality. Measurement error is a potential concern given the lack of a universal consensus on quantifying export diversification and quality. Omitted variable bias may occur if critical determinants are excluded to avoid multicollinearity; for instance, trade policy variables often correlate strongly with openness and investment. Furthermore, reverse causality may exist if improvements in export structure drive changes in trade openness or investment levels.

Finally, since shifts in export structure are path-dependent, contemporary structures are likely influenced by historical trends. Following Agosin *et al.* (2012) and Nguyen and Su (2021), we introduce a lagged dependent variable ($Y_{i,t-1}$) to capture this persistence or "memory effect" of comparative advantages. These considerations lead to the formalisation of the relationship through the following dynamic panel model:

$$LogY_{i,t} = \alpha + \beta_1 Log\,Y_{i,t-1} + \beta_2 Log\,X_{i,t} + Z'_{i,t}\beta_k + \mu_i + \lambda_t + v_{i,t} \tag{5}$$

The parameters of the dynamic model are estimated using the System Generalized Method of Moments (Sys-GMM) developed by Blundell and Bond (1998). This approach combines equations in first differences with equations in levels, allowing lagged level variables to serve as internal instruments.

The selection of the Sys-GMM estimator is justified by three main factors. First, it is specifically designed for "small-T, large-N" panels (where the number of cross sections exceeds the number of time periods) and is robust to unbalanced datasets (Roodman, 2009). Second, it effectively addresses endogeneity, autocorrelation and heteroscedasticity (Arellano and Bond, 1991; Blundell and Bond, 1998). Third, as demonstrated by Bond *et al.* (2001), Sys-GMM is more efficient than the Difference GMM (Diff-GMM) estimator, particularly when the series are highly persistent.

For the Sys-GMM results to be considered valid, four diagnostic criteria must be satisfied: (1) The Arellano-Bond test must indicate the absence of second-order serial correlation (AR(2)) in the error terms; (2) The Hansen (1982) or Sargan (1958) over-identification tests must confirm the validity of the instruments; (3) To avoid overfitting and bias, the number of instruments must not exceed the number of countries in the sample; (4) The coefficient of the lagged dependent variable must be statistically significant and possess a magnitude of less than 1.

3.4 Instrumentation strategy and validity

To ensure the consistency of the Sys-GMM estimator, the instrumentation strategy follows the classification framework established by Roodman (2009). This approach effectively addresses the endogeneity inherent in the lagged-dependent variable and key explanatory factors. To mitigate potential reverse causality (where export structure might simultaneously influence manufacturing [MVA], services [SVA] or agricultural development), the endogenous variables, including *AVA*, *Agr_Emp*, *Agr_Prod*, *Openness* and *Resources*, are instrumented using their own deeper lags (from $t-2$ to $t-10$). This technique ensures that these instruments remain uncorrelated with the current idiosyncratic error term.

Furthermore, investment metrics such as Invest and FDI are treated as predetermined and instrumented with shorter lags ($t-1$ to $t-2$), reflecting the fact that current investment decisions are typically shaped by past shocks rather than contemporaneous ones. Conversely, demographic (*Pop*), geographical (*Dist*) and institutional (*Inst*) factors are assumed to be strictly exogenous, as they are unlikely to be influenced by short-term fluctuations in export structure. Consequently, these variables serve as external instruments within the model.

The robustness of this configuration is verified through the Hansen over-identification test and the Arellano-Bond test for second-order autocorrelation (AR(2)). Additionally, to address the risk of weak instruments, a Kleibergen-Paap under-identification test is performed via an auxiliary IV-2SLS estimation. The resulting *p*-values, which are consistently below 10%, allow for the rejection of the null hypothesis of weak instruments. This confirms that the selected instruments are statistically relevant and strongly correlated with the endogenous regressors, ensuring the reliability of the subsequent empirical findings.

4. Results and discussion

This section comments on the empirical results derived from the estimation of our main models. Tables 1 and 2 present the PCSE and Sys-GMM estimates for export concentration, while Table 3 addresses export quality. Robustness checks are summarised in Tables 4–6. Diagnostic tests confirm the validity of the Sys-GMM estimations; specifically, the Hansen and Sargan statistics fail to reject the null hypothesis of valid over-identifying restrictions, and Arellano-Bond tests confirm the absence of second-order serial correlation (AR 2). Furthermore, the instrument count remains below the number of countries, and the lagged dependent variable coefficients are significant and less than unity, satisfying all requirements for dynamic panel consistency.

Table 1. PCSE and Sys-GMM estimates of simple model

	LogTi (Theil index: proxy of export concentration)					
	PCSE			Sys-GMM		
	(1)	(2)	(3)	(4)	(5)	(6)
LogAVA	0.033**			0.047**		
	(0.016)			(0.021)		
LogAgr_Emp		0.121***			0.077**	
		(0.024)			(0.036)	
LogAgr_prod			−0.058***			−0.081**
			(0.01)			(0.038)
LlogTi				0.664***	0.542***	0.613***
				(0.109)	(0.097)	(0.117)
_cons	1.356***	0.978***	1.839***	0.348*	0.359**	1.112***
	(0.048)	(0.098)	(0.071)	(0.195)	(0.164)	(0.305)
Observations	824	840	756	784	797	722
R-squared	0.919	0.943	0.945			
Countries				44	43	43
Instruments				10	10	8
AR(1)				0.00	0.00	0.00
AR(2)				0.475	0.406	0.571
Sargan				0.702	0.957	0.922
Hansen				0.765	0.925	0.830

Note(s): Robust standard errors are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Source(s): Authors' own work

4.1 Agricultural development and export diversification

Initial estimates in Table 1 suggest that the economic and social weight of agriculture significantly heightens export concentration, thereby hindering diversification. A 1% increase in agricultural value added as a share of GDP and agricultural employment as a share of total employment increases concentration by 0.03% and 0.12%, respectively. Conversely, a 1% rise in agricultural productivity reduces concentration by 0.05%. Consistent with structuralist theory, these results imply that while specialisation in primary goods−often reinforced by comparative advantages in SSA−concentrates the export portfolio, productivity gains facilitate the transfer of surplus labour to manufacturing and services (Grabowski and Self, 2022a). This suggests that free-trade policies promoting international specialisation may offer limited structural benefits to African economies if they trap them in primary production.

To mitigate endogeneity and omission bias, the model was re-estimated using the Sys-GMM estimator, with the results in Table 2 mirroring the initial PCSE findings. As highlighted by Swathi and Sridharan (2022), the economic weight of agriculture appears to crowd out the manufacturing sector, which is detrimental to the export structure. A 1% increase in the agricultural share of GDP raises the concentration index by 0.017%, a result consistent with Lewis's (1954) dual economy model. Since structural change typically involves a declining agricultural share in favour of broader economic diversification, an inverse trend logically reinforces concentration. This aligns with Prebisch (1950), who noted the vulnerability of developing countries dependent on agricultural exports and the stabilising role of diversification against deteriorating terms of trade. Notably, these findings contrast with Fonchamnyo and Akame (2016), likely because their study measured agricultural value added in absolute terms rather than relative to GDP, failing to account for varying economic sizes across the region.

Regarding labour, a 1% increase in agricultural employment increases concentration by 0.024%, suggesting that labour polarisation in the primary sector reduces the workforce available for manufactured goods. This abundance of agricultural labour provides a

Table 2. Sys-GMM estimates with control variables

	LogTi (1)	(2)	(3)
LlogTi	0.616***	0.639***	0.705***
	(0.029)	(0.028)	(0.028)
LogAVA	0.017*		
	(0.01)		
LogAgr_Emp		0.024*	
		(0.013)	
LogAgr_prod			−0.024**
			(0.012)
LogMVA	−0.027***	−0.023**	−0.023**
	(0.01)	(0.01)	(0.009)
LogSVA	−0.042	−0.051	−0.067
	(0.042)	(0.059)	(0.078)
LogPop	−0.033***	−0.028***	−0.026**
	(0.007)	(0.006)	(0.01)
LogOpen	0.006	−0.039	−0.014
	(0.035)	(0.023)	(0.033)
LogInvest	0.015	0.034***	0.031**
	(0.013)	(0.01)	(0.014)
LogFDI	0.003	0.005**	0.003
	(0.003)	(0.002)	(0.003)
LogDist	−0.178*	−0.07	−0.051
	(0.098)	(0.091)	(0.103)
LogRes	0.011**	0.011	0.007
	(0.005)	(0.007)	(0.008)
LogInst	−0.03***	−0.034***	−0.011
	(0.011)	(0.011)	(0.017)
_cons	2.737***	1.768**	1.711**
	(0.707)	(0.686)	(0.674)
Observations	499	487	462
Countries	39	38	38
Instruments	38	38	37
AR(1)	0.008	0.008	0.008
AR(2)	0.304	0.300	0.304
Sargan	0.493	0.511	0.238
Hansen	0.471	0.448	0.466

Note(s): Standard errors are in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): Authors' own work

comparative advantage in production costs, consistent with Ricardo's (1817) theoretical framework. However, as Parteka (2010) argues, effective diversification is unlikely when the workforce remains concentrated in the agricultural sector, as this contradicts the standard process of structural transformation. Conversely, improved agricultural productivity demonstrates a statistically significant positive impact on diversification, corroborating Grabowski and Self (2022b). Following Lewis (1954), productivity growth (often driven by technological change) releases surplus labour into high-potential sectors like manufacturing. This mechanism works through two channels: an increase in agricultural surplus that expands export volumes (intensive margin) and the reallocation of labour to produce complex exportable goods (extensive margin).

The control variables align with the findings of Cadot *et al.* (2016) and Lederman and Maloney (2007). Manufacturing value added (LogMVA) significantly promotes diversification, whereas natural resource wealth (LogRes) worsens concentration. Similarly,

Table 3. Sys-GMM regression on export quality index

	LogEQi (1)	(2)	(3)
LlogEQi	0.814***	0.92***	0.812***
	(0.029)	(0.018)	(0.048)
LogAVA	−0.029**		
	(0.014)		
LogAgr_Emp		−0.015*	
		(0.009)	
LogAgr_prod			0.037**
			(0.018)
LogMVA	0.045***	0.026***	0.021**
	(0.008)	(0.008)	(0.01)
LogSVA	0.054**	0.019**	0.02
	(0.023)	(0.009)	(0.032)
LogPop	−0.011	−0.017***	−0.008
	(0.008)	(0.005)	(0.008)
LogOpen	−0.104**	−0.099***	−0.11**
	(0.048)	(0.028)	(0.053)
LogInvest	0.117***	0.054***	0.057***
	(0.021)	(0.009)	(0.018)
LogFDI	0.003	0.001	0.004
	(0.004)	(0.003)	(0.003)
LogDist	0.12	0.128	0.268**
	(0.113)	(0.102)	(0.129)
LogRes	−0.005	−0.001	−0.001
	(0.003)	(0.002)	(0.005)
LogInst	−0.053**	−0.036***	−0.04
	(0.022)	(0.011)	(0.024)
_cons	−1.112	−0.718	−2.438**
	(0.827)	(0.791)	(1.025)
Observations	499	487	462
Countries	39	38	38
Instruments	34	34	32
AR(1)	0.005	0.005	0.006
AR(2)	0.261	0.242	0.240
Sargan	0.678	0.228	0.605
Hansen	0.753	0.483	0.564

Note(s): Standard errors are in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): Authors' own work

the services sector (LogSVA), population size (LogPop), trade openness (LogOpen), geographical distance (LogDist) and institutional quality (LogInst) contribute positively to diversification, echoing Swathi and Sridharan (2022) and Osakwe and Kilolo (2018). However, contrary to the former, domestic investment (LogInvest) and foreign direct investment (LogFDI) appear to reinforce concentration in SSA. This likely reflects the primary-sector orientation of such investments, which strengthens existing specialisation patterns.

Finally, the analysis of diversification margins (Table A5) clarifies that while agricultural development may reduce concentration on the extensive margin (new products), it increases it on the intensive margin (volumes of existing products). Given that export growth in this context is primarily driven by the intensive margin (Mania and Rieber, 2019; Lectard, 2017; Cadot *et al.*, 2013), the observed negative effect of agricultural weight and the positive effect of productivity on overall diversification are well justified.

Table 4. Alternative measure of structural change

	LogECi Log AVA (1)	(2)	LogAgr_Emp (3)	(4)	LogAgr_prod (5)	(6)
LlogECi	0.262*** (0.06)	0.205*** (0.054)	0.12** (0.049)	0.15*** (0.045)	0.168** (0.066)	0.149*** (0.05)
LogAVA	−0.23*** (0.074)	−0.205** (0.085)				
LogAgr_Emp			−0.247*** (0.087)	−0.117** (0.056)		
LogAgr_prod					0.257* (0.134)	0.162** (0.07)
_cons	0.665*** (0.229)	−2.864*** (0.845)	0.982*** (0.312)	−2.029*** (0.674)	−1.799* (0.981)	−4.502*** (0.785)
Control variables	No	Yes	No	Yes	No	Yes
Observations	498	465	498	465	473	440
Countries	28	28	28	28	28	28
Instruments	14	17	14	18	14	18
AR(1)	0.003	0.004	0.008	0.004	0.004	0.007
AR(2)	0.330	0.257	0.107	0.149	0.148	0.112
Hansen	0.327	0.280	0.101	0.515	0.777	0.443

Note(s): Standard errors are in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): Authors' own work

4.2 Agricultural development and export quality

Beyond diversification, the structural dynamics of exports are reflected in their quality and sophistication. Although these concepts are conceptually distinct (Henn *et al.*, 2020), they are intrinsically linked: a more sophisticated export basket typically indicates higher product quality. While the literature on export sophistication is expanding (Anand *et al.*, 2012; Lectard and Rougier, 2018), empirical evidence specifically addressing export quality – as defined by Henn *et al.* (2020) – remains scarce, with notable exceptions being the work of Nguyen and Su (2021, 2022). This section investigates how agricultural development influences the quality of exports in SSA.

The results presented in Table 3 indicate that the export quality of SSA countries declines as the share of agriculture in GDP and employment rises yet increases significantly alongside agricultural productivity. Specifically, columns (1) and (2) show that a 1% increase in agricultural value added relative to GDP and in agricultural employment reduces export quality by 0.03% and 0.015%, respectively. Conversely, column (3) reveals that a 1% increase in agricultural productivity yields a 0.037% improvement in the export quality index. These findings corroborate Lewis's (1954) structuralist theory, whereby enhanced agricultural productivity releases surplus labour for reallocation into more capital-intensive and technologically advanced manufacturing and service sectors. Furthermore, the agricultural surplus generated by productivity gains necessitates the development of agribusiness and processing industries. This transition into agri-food manufacturing positively impacts both the extensive margin of diversification and the overall quality of the export basket.

Table 3 further demonstrates that the services sector, which currently exhibits greater dynamism than the manufacturing sector in SSA (Cadot *et al.*, 2016), exerts a significant positive impact on export quality, despite the region's low volume of service exports (Anand *et al.*, 2012). The high statistical significance of the manufacturing sector underscores its potential to substantially upgrade export quality, even from its current underdeveloped base. This reinforces the necessity for SSA countries to revitalise their manufacturing sectors, beginning with the agro-industrial value chain.

Regarding trade openness, our results indicate a significant negative relationship with export quality, diverging from the findings of Nguyen and Su (2021). This negative association likely stems from persistent trade deficits and an export basket heavily concentrated on primary commodities, which inherently limits quality upgrading. Consequently, these results suggest that SSA countries may need to consider selective protectionist measures and import-substitution policies to foster the domestic industrial capabilities required for high-quality exports.

4.3 Robustness checks

4.3.1 Alternative measure of export structure. To verify the consistency of our findings, we employ the Economic Complexity Index (ECI) developed by Hidalgo *et al.* (2007) as an alternative dependent variable. Sourced from the Atlas of Economic Complexity, the ECI synthesises diversification and ubiquity, effectively capturing both the sophistication and quality of an economy's export basket. The results, reported in Table 4, demonstrate that the estimated effects of agricultural development remain stable and statistically significant at the 10% level, even with the inclusion of control variables. Consistent with our previous findings, increasing the share of agriculture in GDP and total employment negatively impacts economic complexity, whereas improvements in agricultural productivity exert a positive influence.

Table 5. Regional heterogeneity (dep. Var: export concentration)

LogTi	CRNR (1)	(2)	(3)	CPNR (4)	(5)	(6)
LogAVA	−0.072***			0.033*		
	(0.023)			(0.018)		
LogAgr_Emp		0.093**			0.146***	
		(0.039)			(0.045)	
LogAgr_prod			−0.041*			−0.155***
			(0.025)			(0.013)
LogMVA	−0.099***	−0.042*	−0.059***	−0.108***	−0.081***	−0.049*
	(0.024)	(0.022)	(0.019)	(0.03)	(0.029)	(0.025)
LogSVA	−0.061	−0.132*	−0.051	−0.282***	−0.409***	−0.408***
	(0.058)	(0.074)	(0.062)	(0.067)	(0.068)	(0.07)
LogPop	−0.024*	−0.036***	−0.088***	−0.092***	−0.097***	−0.093***
	(0.014)	(0.013)	(0.018)	(0.011)	(0.013)	(0.01)
LogOpen	0.106**	0.119**	0.127***	−0.097**	0.012	0.068
	(0.05)	(0.058)	(0.043)	(0.038)	(0.047)	(0.042)
LogInvest	0.069**	0.151***	0.085***	−0.012	−0.067**	−0.084***
	(0.034)	(0.042)	(0.03)	(0.021)	(0.033)	(0.03)
LogFDI	−0.002	−0.009	0.004	0.003	−0.002	−0.004
	(0.006)	(0.01)	(0.005)	(0.007)	(0.009)	(0.007)
LogDist	−3.003***	−1.32***	−2.398***	0.868***	−0.129	−0.477**
	(0.461)	(0.431)	(0.351)	(0.261)	(0.253)	(0.228)
LogRes	0.014	0.027	0.013	0.047***	0.001	0.017***
	(0.022)	(0.022)	(0.018)	(0.009)	(0.012)	(0.006)
LogInst	−0.143***	−0.123***	−0.013	−0.032	−0.115***	−0.157***
	(0.044)	(0.039)	(0.047)	(0.047)	(0.04)	(0.036)
_cons	28.232***	12.099***	24.015***	−3.162	2.995	9.738***
	(4.122)	(3.81)	(2.992)	(2.201)	(2.054)	(1.94)
Observations	223	223	207	279	267	258
R-squared	0.881	0.566	0.978	0.969	0.3	0.468

Note(s): Standard errors are in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. CRNR: Countries rich in natural resources, CPNR: Countries poor in natural resources

4.3.2 Sensitivity to regional heterogeneity. We further examine the sensitivity of our results to country heterogeneity, specifically regarding natural resource dependence. Following the criteria used by the World Bank and Cadot *et al.* (2016), the sample is bifurcated into two subgroups: "resource-rich" countries, where hydrocarbon and mining rents average at least 10% of GDP, and "resource-poor" countries, where this ratio falls below 10% (see Table A1). While a standard heterogeneity test involves assessing coefficient equality via Seemingly Unrelated Estimation (SUEST) and a Chow test, the PCSE estimator's heteroscedasticity-corrected standard errors are incompatible with SUEST. Consequently, we rely on subgroup regressions using the PCSE estimator, as the restricted sample sizes do not meet the conditions established by Roodman (2009) for GMM application.

The results in Tables 5 and 6 show that the variables of interest generally maintain their sign and significance across both subgroups, with one notable exception for resource-rich nations. In these countries, the coefficient for agricultural value added (Log*AVA*) is negative, suggesting that an increasing agricultural share in GDP actually promotes export diversification. This suggests that expanding the agricultural sector in resource-dependent economies reduces their over-reliance on extractive industries, thereby mitigating the 'natural resource curse' in the short to medium term – a finding aligned with Fonchamnyo and Akame (2016). Conversely, in resource-poor countries already dependent on primary products, an increase in agriculture's economic weight further concentrates the export basket, reinforcing the baseline results.

Table 6. Regional heterogeneity (dep. Var: export quality)

LogEQi	CRNR (1)	(2)	(3)	CPNR (4)	(5)	(6)
LogAVA	−0.065***			−0.054**		
	(0.024)			(0.027)		
LogAgr_Emp		−0.132***			−0.157**	
		(0.047)			(0.064)	
LogAgr_prod			0.076***			0.086**
			(0.028)			(0.035)
LogMVA	0.075**	0.066**	0.147***	0.21***	0.179***	0.165***
	(0.029)	(0.03)	(0.027)	(0.043)	(0.045)	(0.049)
LogSVA	0.23***	0.222***	0.104	0.022	0.09	0.129
	(0.078)	(0.079)	(0.087)	(0.099)	(0.078)	(0.081)
LogPop	0.024*	0.009	0.051***	0.051***	0.05*	0.021
	(0.013)	(0.014)	(0.019)	(0.015)	(0.027)	(0.024)
LogOpen	−0.101*	−0.06	−0.212***	0.384***	0.27***	0.277***
	(0.058)	(0.061)	(0.061)	(0.059)	(0.056)	(0.048)
LogInvest	−0.041	−0.023	0.002	0.084	0.085**	0.081**
	(0.045)	(0.042)	(0.037)	(0.052)	(0.035)	(0.032)
LogFDI	0.031**	0.027**	0.03**	−0.007	−0.004	−0.001
	(0.013)	(0.013)	(0.013)	(0.018)	(0.009)	(0.008)
LogDist	0.625	0.896*	0.127	2.653***	1.921***	2.629***
	(0.429)	(0.528)	(0.305)	(0.428)	(0.478)	(0.66)
LogRes	−0.163***	−0.164***	−0.129***	−0.063***	−0.029*	−0.047**
	(0.025)	(0.025)	(0.025)	(0.014)	(0.016)	(0.022)
LogInst	0.311***	0.273***	0.192***	−0.127**	−0.083	−0.029
	(0.044)	(0.047)	(0.058)	(0.064)	(0.07)	(0.068)
_cons	6.758*	9.475*	−1.144	20.328***	14.486***	19.9***
	(3.848)	(4.848)	(2.521)	(3.596)	(4.15)	(5.874)
Observations	221	221	152	278	266	257
R-squared	0.567	0.568	0.677	0.356	0.506	0.646

Note(s): Standard errors are in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. CRNR: Countries rich in natural resources, CPNR: Countries poor in natural resources

5. Conclusion and policy recommendations

This study contributes to the literature on structural economic change by examining the impact of agricultural development on the diversification and quality of exports across 44 SSA countries between 1995 and 2014. Using both PCSE and Sys-GMM estimators, the empirical evidence reveals that while all three indicators of agricultural development – value added, employment, and productivity – significantly influence export dynamics, only improvements in agricultural labour productivity foster positive structural shifts. These findings align with Lewis's (1954) structuralist theory, suggesting that productivity gains are essential to release surplus labour and capital for the manufacturing and services sectors. However, the results also highlight a persistent lack of synergy between these sectors, indicating that merely increasing the economic weight of agriculture without efficiency gains reinforces primary-commodity dependence and the 'natural resource curse' in resource-rich nations.

From a social and developmental perspective, the study implies that enhancing agricultural productivity is a vital catalyst for rural poverty reduction and food security, as demonstrated by successful cooperatives in Ethiopia and farming households in Sudan. Nevertheless, these advancements must be inclusive to prevent widening inequalities between large-scale producers and smallholders. In terms of research, the findings underscore the continued relevance of Lin's (2012) neo-structuralist framework in the SSA context while identifying a critical need for updated datasets beyond 2014 to reflect the contemporary post-pandemic economic landscape. Future research should therefore focus on country-specific case studies and the integration of agricultural productivity within global value chains.

To foster structural transformation, it is recommended that SSA governments prioritise inter-sectoral integration by developing agricultural value chains that link primary production to domestic agribusiness. Practical policy measures should include the implementation of agricultural entrepreneurship training, the simplification of access to credit and the promotion of technological innovation. Furthermore, the effective operation of the African Continental Free Trade Area is crucial for rebalancing trade balances and supporting import-substitution processes. Simultaneously, producers should be encouraged to form cooperatives and invest in human capital to master modern production techniques. By combining sustainable mechanisation with more aggressive trade policies, SSA countries can transition from a reliance on low-complexity primary goods toward a more sophisticated and high-quality export basket.

Note

1. The principle of comparative advantage is often seen as detrimental to SSA countries as it confines them to low value-added, volatile-priced goods. The new structuralist economy, conversely, suggests selective protectionism as a potential path out of the underdevelopment trap.

Supplementary material

The supplementary material for this article can be found online.

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