

Effect of Private Investment on Export Diversification in Sub-Saharan Africa

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Abstract

The objective of this article is to assess the effect of private investment on vertical export diversification in Sub-Saharan Africa (SSA). To achieve this, econometric estimates were made using the Moments-Multiquantile Regression (MMQR) method on the one hand. To verify the robustness of the MMQR estimates, the ordinary least squares (OLS) method grouped with Driscoll and Kraay standard errors was also used. The estimates were made using panel data for the period 2009 to 2022, covering 47 SSA countries. The results of this study show that private investment has a positive impact on the vertical diversification of exports. It is therefore important for the authorities in SSA countries to encourage a climate conducive to private investment, promote the diversification of investment sectors, and develop infrastructure.

Keywords

Private Investment, Driscoll and Kraay Method, Vertical Diversification of Exports

1. Introduction

The problem with the effect of private investment on export diversification lies in the fact that investment in the private sector is poorly targeted. Despite the potential of some countries, credit for financing the private sector is insufficient. In addition, institutional or structural constraints can also limit its effect on productive transformation and the broadening of the export base. To this end, the share of global exports in manufactured goods amounts to 70% of total exports according to UNCTAD (2019). However, raw materials, minerals, and oil constitute a negligible share. Furthermore, in Asia, manufactured goods account for more than

80% of total exports in China and South Korea (World Trade Organization, 2022)

This proves that Asia is much more dominated by manufactured goods. At the same time, in Africa, manufactured goods account for around 30% of total exports (African Union Commission, 2020). This proves that Africa is dependent on raw materials. In contrast, in sub-Saharan Africa, the share of global exports of manufactured goods is often less than 2%, with a strong dependence on raw materials (African Union Commission, 2020). In the same vein, one of the main conclusions of the study conducted by Matallah (2020) indicates that dependence on oil revenues keeps the doors closed to diversification and causes economic activity to become concentrated. This proves that there is a lack of export diversification in SSA.

Thus, the importance of diversification has been highlighted in the work of Hendrix (2017), who states that the more diversified an economy is, the more diversified its exports are, the more diversified its tax base is, and the less sensitive the economy is to the vagaries of international commodity markets. In the same vein, Hougbedji (2022) emphasised in his work in SSA that excessive dependence on natural resources exposes economies to external shocks and that diversification is essential for sustainable growth. It is therefore necessary to diversify our economy, which requires massive and heavy investment. However, African countries in general, and sub-Saharan Africa in particular, are unable to finance this, and official development assistance is also limited. Given the multiple crises observed around the world, official development assistance is no longer a source of financing that countries can rely on.

Therefore, addressing government spending and public development aid, i.e. national and international public spending, is limited. To do this, we must focus on the private sector. In the same vein, the OECD (2005) confirms that the private sector is the main driver of growth. It fuels and stimulates growth when a number of factors combine to create an environment conducive to its expansion.

Although there is a growing body of literature on the effect of private investment on export diversification, few studies offer a detailed empirical analysis of this relationship. According to the World Bank report published in 2023, export diversification is defined as a process aimed at broadening the range of exported products or accessing new markets, while rebalancing domestic production to improve overall productivity. This definition is linked to the structural transformation of economies and the improvement of economic resilience to external shocks. However, export diversification is a composite concept that can be analysed from two angles, namely horizontally and vertically, according to Ali et al. (1991), Samen (2010) and Herzer and Nowak-Lehmann (2006). These authors provide a detailed conceptual analysis, defining horizontal diversification as diversification within a single sector (primary, secondary or tertiary). This leads to a readjustment in the country's export structure through the addition of new products to the existing basket in order to reduce the risk of adverse shocks. On the other hand, vertical diversification (or sophistication) of exports allows a shift

from primary exports to manufactured goods or services. As a result, vertical diversification of exports requires more sophisticated technology and know-how, but also a larger initial capital investment than horizontal diversification. Furthermore, according to [Herzer and Nowak-Lehmann \(2006\)](#) and [Lugeiyamu \(2016\)](#), vertical diversification provides more positive externalities for the rest of the economy in terms of dynamism or spillover effects than horizontal diversification.

To this end, this study focuses on the vertical diversification of exports in SSA. The value of this study lies in the fact that it highlights how economies can transform their natural resources into higher value-added consumer goods, reduce their sensitivity to external shocks and promote sustainable and inclusive growth. In reality, the methodological approach chosen to evaluate the research hypothesis leads us to apply, on the one hand, the regression method and, on the other hand, the ordinary least squares (OLS) technique combined with Driscoll and Kraay errors. This approach is therefore the most appropriate as it allows us to capture the effect of an independent variable, such as taxation and resources, which are not constant. In addition, the Driscoll and Kraay method ensures that the confidence intervals associated with these quantile coefficients are calculated in a robust manner. Thus, for our initial estimates, we applied the quantile regression method. To ensure the robustness of our results, we used an OLS model combined with Driscoll-Kraay errors. However, to further strengthen our robustness, we examined the marginal effect of private investment on the expected values of vertical diversification, which shows a positive slope. This indicates that vertical diversification favours the variables in the model. Unlike the research conducted by [Traore and Saïm \(2025\)](#), which focused primarily on the effect of public investment on horizontal export diversification, and that of [Rogneda et al. \(2025\)](#), which adopts a macro-sectoral perspective focused on global trade flows, our research highlights the specific importance of private investment in vertical export diversification. Our contribution lies in examining the mechanisms through which private capital promotes the improvement of the quality of exported products, supports integration into global value chains and plays a role in the qualitative transformation of the export structure. This article presents a review of the literature in Section (2), followed by the methodological approach in Section (3) and the results and discussion in Section (4).

2. Review of the Literature

The theoretical discussion on the effect of private investment on export diversification focuses on classical international trade theory and the ideas of new international trade theory. Furthermore, classical models propose a theoretical framework in which countries should specialise in the production and export of commodities for which they have a comparative advantage. This theory is based on the importance of trade for growth and development ([Heckscher, 1919](#); [Ohlin, 1933](#); [Samuelson, 1948](#)). However, according to the new theory of international

trade, it opposes the phenomenon of concentration, which consists of a concentration of commodities and markets and is considered to be the main factor in the instability of export revenues (Krugman, 1980; Helpman & Krugman, 1985; Linder, 1961; Chamberlin, 1933; Lin, 2011; Lin & Treichel, 2014). Consequently, the new trade theory advocates export diversification.

From an empirical point of view, economists still disagree on the effect of private investment on vertical export diversification in developing countries, particularly in sub-Saharan Africa. Some authors have demonstrated the positive effects of private investment on vertical export diversification in sub-Saharan Africa. Others, however, have shown the negative effects of vertical export diversification in sub-Saharan Africa. Finally, another group of researchers supports the thesis that the effects of private investment on export diversification also depend heavily on the behaviour of the host country. Thus, the literature has identified several channels through which private investment influences vertical export diversification in SSA. This section outlines the issue based on empirical work. Much recent work has attempted to highlight the role of domestic private investment in export diversification. In this regard, various methods and indicators have been used by some authors to explain this relationship in the following lines. However, according to Melitz (2003), financial development, and more specifically capital market development, can have a negative impact on economic diversification. To do so, investors with listed information will direct their resources towards traditional sectors of the economy that have proven to be competitive. Thus, diversification can be affected by investors' risk-taking levels. Niass (2024) conducted a study on the effect of natural resources on the export supply portfolio of African countries using fixed-effects panel data models for the period 2000 to 2015. The results of this study show that the presence of oil resources has a negative effect on diversification, mainly through the channel of institutional degradation. However, in the presence of non-renewable resources, agricultural products negatively affect the diversification of African exports through the exchange rate channel.

However, the results of the study conducted by Yan (2024) in resource-rich countries using a cross-sectional autoregressive distributional lag model (CS-ARDL) show that financial development has a significant positive impact on the economic growth of all countries, regardless of their income level, through effective rent management. Mehlum et al. (2006) state that the natural resource curse applies to countries with weak institutions. Using data from 87 resource-rich countries with more than 10% of their GDP coming from natural resource exports, they suggest that natural resources do not contribute to economic growth in countries with institutions that favour rent-seekers. Similarly, the results of the study conducted by Asante et al. (2024) show that financial development has a significant and positive effect on economic growth. In other words, it appears that when the rule of law, political stability and the quality of regulation are highly effective, the positive effect of financial development on economic growth is greatly amplified. This study was conducted over the period 2000-2019 using panel data from 29 sub-Saharan African countries and the generalised moments method (GMM).

3. Methodological Approach to the Study

The methodology section is divided into three parts. The first part presents the models and variables used in the study. The second part defines the variables used, and the third part presents the estimation methods.

- Models and variables

Numerous estimation techniques have been used by different authors for macroeconomic analyses in order to take into account endogeneity problems. These problems arise from simultaneity, unobserved heterogeneity, measurement error and the inclusion of the delayed independent variable in the regression. Thus, in the context of this study, the methodology used is that of quantile regression developed by Machado and Silva (2019) on the one hand and by Driscoll and Kraay (1998) on the other. On the one hand, the moment quantile regression method (MMQR) was developed by Machado and Silva (2019). The main advantage of this method lies in its ability to capture structural heterogeneity in the conditional distribution of variables in a location scale framework. Indeed, this method makes it possible to assess how the effect of private investment varies between countries with different levels of diversification. Next, the model incorporates individual fixed effects throughout the distribution, allowing it to capture unobserved characteristics that may affect the results. In the context of this study, other advantages that support its use are: robustness to outliers and non-normal distributions; the ability to model non-linear relationships; and the smooth handling of issues such as endogeneity, cross-dependence and quantile crossover, ensuring consistent and reliable estimates (Sampene et al., 2024; Rehman et al., 2024). On the other hand, to verify the robustness of MMQR estimates, the grouped Ordinary Least Squares (OLS) method with standard errors from Driscoll and Kraay (1998) is used for this purpose. This method is chosen because of its many advantages, namely: it takes into account temporal and cross-sectional dependence, heteroscedasticity and autocorrelation; it is applicable to panel data, even when they have an unbalanced structure or missing values; and it is suitable when the cross-sectional dimension is greater than the temporal dimension (Sultana & Rahman, 2024; Ridwan et al., 2024; Appiah-Otoo et al., 2022).

The advantage of quantile regression is that it allows us to understand the effect of an independent variable such as taxation and natural resources, which is not uniform. To this end, studies conducted by Carrillo-Pulgar et al. (2025) have shown that fiscal decentralisation has a greater effect on the upper quantiles of CO₂ emissions. However, without appropriate correction for standard errors, these findings may be distorted by dependencies not observed in the data. To this end, the Driscoll-Kraay method ensures that the confidence intervals around these quantile coefficients are estimated in a robust manner. Previous work has been conducted on the study of the effect of private investment on economic diversification using different methodological approaches. However, in the context of this study, the model by Tadesse and Shukralla (2013), Olasehind et al. (2023), Mudayen et al. (2025), and Sachan et al. (2025) as a reference. To this end, we will introduce the

variable gross fixed capital formation, which will allow us to better assess the rate of investment in the private sector. The model is written as follows:

$$\underline{LDV}_{it} \text{ est égale à } \sigma_1 + \beta_1 \underline{LIP}_{it} + \beta_2 \underline{LIDE}_{it} + \beta_3 \underline{LIN}_{it} + \beta_4 \underline{LVA}_{it} + \beta_5 \underline{LIF}_{it} + \beta_6 \underline{LRN}_{it} + \beta_7 \underline{LOUV}_{it} + \beta_8 \underline{LPIB}_{it} + \beta_9 \underline{De}_{it} + \beta_{10} \underline{LSP}_{it} + \beta_{11} \underline{LTC}_{it} + \beta_{12} \underline{LCH}_{it} + \varepsilon_{it} \quad (1)$$

- Description of model variables

Dependent variable: vertical diversification index. The indicator used to measure export diversification is represented by the share of manufactured goods exports in the country's total exports. However, in the context of this second part of the study, vertical export diversification will be used. Vertical export diversification is defined as the shift from primary exports to manufactured exports. It can therefore be determined by the share of manufactured exports in total exports (Elbadawi, 1999; Wood & Mayer, 2001; Munemo et al., 2007; Osakwe, 2007; Aye, 2009). To do this, it is determined as follows:

$$DV \text{ is equal to } (TMX)/(TX)$$

where DV is the vertical diversification index, TMX is the share of manufactured exports and TX is the value of total exports.

Explanatory variables

Explanatory variables are divided into two categories: variables of interest and control variables.

Variables of interest

Private investment: defined as gross fixed capital formation in a country. The use of aggregate GFCF lies in the fact that, in many sub-Saharan African countries, separate data for private and public investment are often insufficient or unavailable. Consequently, aggregate GFCF constitutes a standard measure in national accounts, consistently available over long periods. Moreover, in developing economies, the private sector tends to account for the majority of GFCF, making this aggregate a relevant indicator for observing general investment trends. It is therefore the sum of local and foreign investment (Lahimer, 2009). Thus, gross fixed capital formation (GFCF) as a percentage of gross domestic product (GDP) is the indicator used to measure domestic private investment. According to Ben Hamouda et al. (2009a), GFCF is a key determinant that contributes significantly to diversification efforts. This also means that cumulative investment can have a positive effect on diversification, given that public investment can attract private investment. Therefore, the expected sign is positive. The control variables are: inward foreign direct investment (FDI), natural resources (NR), value added (VA), inflation (IN), trade openness (TO), tax incentives (TI), gross domestic product (GDP), exchange rate (ER), human capital (HC), political stability (PS) and democracy (DE).

- Data and estimation methods

To test the second hypothesis, which is to show that private investment has a positive effect on the vertical diversification of exports in SSA, we will use quantile regression and the Driscoll-Kraay method on panel data using STATA software. The data used are secondary sources from the World Bank database (World De-

velopment Indicators), UNCTAD (UNCTADstat) and Policy IV covering the period from 2009 to 2022. To this end, the estimation procedures consist of presenting descriptive statistics, variable correlation tests, cross-sectional dependence tests, stationarity tests and Lewbel's diagnostic test. The Lewbel (2012) test is based on the principle of constructing instruments from mean-centred residuals of the explanatory variables, adjusted by functions of the conditional variance. In this way, heteroscedasticity becomes a valuable tool for identifying the parameters of the model. In the context of this study, heteroscedasticity arises from structural differences between nations (income levels and natural resources), temporal fluctuations in investment and diversification, and economic and institutional shocks that affect countries in different ways.

4. Results

- Descriptive statistics

The descriptive statistics in **Table 1** show that the observed data are unevenly distributed because the values of the observations (Obs) differ between countries in sub-Saharan Africa. This means that there is missing data for certain periods in the sample. However, the average vertical diversification index in this series is -18.87376 . This negative value explains low productive sophistication. In other words, there is a high dependence on primary products, leading to vulnerability to international price shocks. As for the average level of private investment, which is 3.048207 , this suggests that the level of private sector investment is low. This weakness can be explained by an unfavorable investment climate and institutional constraints on the private sector's ability to raise capital.

Table 1. Descriptive statistics and multicollinearity test.

	Descriptive statistics					multicollinearity test	
	Obs	Means	Ecart-type	Minimum	Maximum	VIF	1/VIF
LDV	546	-18.87376	2.450707	-31.30945	-13.24653		
LIP	535	3.048207	0.3494991	1.749331	4.35672	1.57	0.637827
LIDE	590	19.62447	2.051244	10.92336	25.45166	3.54	0.282829
LPIB	612	7.462156	1.191362	5.293795	11.02149	5.53	0.180690
LTC	643	4.876627	2.101391	-0.3327384	9.165874	1.90	0.527330
LVA	624	3.140133	0.466484	1.471418	4.35754	2.24	0.446004
LIF	432	2.670129	0.4564437	1.410621	3.688535	2.52	0.396212
LOU	619	14.43311	1.504988	10.46504	17.38675	2.60	0.384652
LCH	372	3.853927	0.5301199	2.355966	4.960335	2.82	0.354985
DE	506	2.787549	0.6001841	1.5	4	2.67	0.375122
Moyen VIF						2.82	

Source: Authors.

The multicollinearity test checks whether the explanatory variables in the model, including private investment, are highly correlated with each other. This table shows that the average variance inflation factor (VIF) is 2.82, which is less than 5. This means that there is low multicollinearity. Consequently, the coefficients of the variables are stable and can be interpreted.

- **Correlation between variables**

The correlation matrix in **Table 2**, all values are below 0.75. However, a correlation of -0.0231 between private investment and vertical export diversification shows that when private investment increases, diversification tends to decrease slightly.

Table 2. Correlation matrix.

	LDV	LIP	LIDE	LPIB	LTC	LVA	LIF	LOU	LCH	DE
LDV	1	-0.0231	-0.6863	-0.6282	0.2767	-0.4074	0.2626	-0.6711	-0.374	-0.3301
LIP		1	0.316	0.3624	-0.2292	0.2748	0.2373	0.2337	0.1545	0.5263
LIDE			1	0.6406	-0.263	0.3764	-0.2277	0.634	0.4112	0.3905
LPIB				1	-0.5563	0.6954	0.1941	0.2146	0.5733	0.5875
LTC					1	-0.3622	-0.3812	-0.1312	-0.5106	-0.5739
LVA						1	0.1727	0.0571	0.2615	0.3107
LIF							1	-0.2756	0.3904	0.4177
LOU								1	0.3806	0.2423
LCH									1	0.4119
DE										1

Source: Authors.

According to **Figure 1**, private investment has a positive and significant effect on the vertical diversification of exports in the 47 countries of sub-Saharan Africa. This relationship proves that when private investment increases by one additional unit, the vertical diversification of exports increases by 2.185 units. This means that private investment can stimulate the structural transformation of exports by promoting sophisticated products or those integrated into the value chain. In addition, countries above the regression line are assumed to have greater vertical diversification of exports. This can be explained by good economic governance, efficient industrial policies, and greatly improved infrastructure. On the other hand, when countries are below this regression line, it means that there is low diversification despite growth in private investment. This shows that these countries are heavily dependent on raw materials, poor investment orientation, and institutional constraints.

The strong concentration of countries around the regression line clearly shows that the model adequately explains the variation in vertical diversification through foreign direct investment. The differences between the observed and predicted values are negligible. This means that FDI contributes to the expansion of the range of exported products through innovation, skills, and infrastructure.

Variables such as trade openness, natural resources, value added, exchange rate, GDP, and democracy have a high concentration of countries around the regression line. This shows that these variables are factors that influence vertical diversification. To this end, trade openness, for local processing, it is important to have access to technology markets. In the theoretical literature, [Grossman and Helpman \(1989\)](#), [Romer \(1990\)](#), and [Grossman and Helpman \(1991\)](#) have shown that trade openness promotes the performance and competitiveness of industrial firms, which is conducive to the development of the industrial sector. However, empirically, this is ambiguous, as the work of [Palenfo et al. \(2023\)](#) has shown that exogenous openness negatively affects manufacturing industrialization in the long term. However, the effects of endogenous openness are negative in the long term for countries dependent on natural resources. These negative effects decrease with government efficiency and financial development. Natural resources play a dual role. They can be a driver of diversification if they are processed locally, but they can also hinder diversification if they are exported in their raw form. Value added reflects the capacity for local processing linked to vertical diversification.

Thus, according to [Figure 2](#), countries are distributed along the regression line from right to left, which clearly shows that countries have strong potential for vertical export diversification. The relationship between the exchange rate and vertical export diversification explains the relevance of the model. Thus, macroeconomic stabilization is not only a short-term exchange rate policy, but also an instrument of industrial policy and long-term development. To this end, a competitive exchange rate can promote structural transformation. Even in countries dependent on natural resources, the exchange rate can be used to stimulate the manufacturing sector. From all of the above, stable and competitive exchange rate regimes tend to better diversify exports vertically. In other words, exchange rate regimes influence export margins, production costs, and incentives to invest in local processing ([Avom et al., 2020](#)). The closer countries are to the regression line, the stronger the linear relationship between the exchange rate and vertical diversification.

According to [Figure 2](#), a high concentration of countries to the left of the regression line suggests that the gross domestic product of these Sub-Saharan African countries remains low despite efforts to diversify. This weak GDP can be explained by low levels of infrastructure, skilled human capital, and technology, which can hinder local transformation. According to [Essehou and Igue \(2022\)](#), there is a threshold of economic development below which diversification has no significant effect on GDP. The relationship between the democratic variable and vertical diversification shows a positive correlation. To this end, according to [Fig-](#)

Figure 2, a high concentration of countries around the regression line shows that a democratic country tends to diversify its exports by integrating local transformation processes.

The cross-sectional dependence test assesses whether the relationship between private investment and vertical export diversification is influenced by interdependence among SSA countries. Table 3 shows that SSA countries are integrated into the global and regional economy, for example, through intraregional trade. Consequently, fluctuations in commodity prices and regional policies can simultaneously influence private investment and exports in several countries. The test result proves that private investment in the CD (Cross-Sectional Dependence) column is significant at the 5% threshold. This means that we reject the null hypothesis of no cross-sectional dependence. In other words, what is not explained by the variables included is correlated between SSA countries. For example, unobserved common shocks such as commodity price shocks. Next, Pesaran (2006) correlated common effects method allows us to take this cross-sectional dependence into account and obtain robust estimators. Subsequently, Pesaran (2006) common correlated effects method allows for the consideration of cross-sectional dependence and yields robust estimators.

Table 3. Cross-sectional dependence test.

	CD	CDw	CDw+	CD*
LDV	9.69***	0.63	722.51***	-2.4**
LIP	2.28**	-1.6*	971.69***	-2.64***
DE	-0.61	0.5	514.69***	-2.46**
LCH	16.41***	-0.39	434.86***	11.94***
LIF	7.22***	0.82	521.93***	-0.34
LOU	17.69***	-0.75	1398.26***	-2.64***
LTC	89.57***	-2.17**	3285.37***	3.55***
LIDE	5.04***	-1.52	595.2***	-2.35**
LPIB	27.98***	-0.62	1332.11***	-2.47**

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: Authors.

Estimates: FE (column 1), Instrumental variable using Lewbel's method (column 2), Quantile regression (columns 3 to 11).

In this study (Table 4), Lewbel's diagnostic test allows us to identify whether the instruments in the econometric model are valid. After validating the instruments, the test allows us to make a robust estimate of the effect of investment on vertical export diversification, despite endogeneity issues. According to Lewbel (2012), this test is used in regression models with instrumental variables to address endogeneity when external instruments are difficult to find. Thus, if private investment is endogenous, i.e. influenced by unobserved factors that also affect vertical diversification, this test allows us to correct for this bias without resorting to external instruments.

Table 4. LEWBEL diagnostic test.

VARIA	FE	IV-Lewbel	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
LIP	1.0984*** (0.368)	1.6853*** (0.617)	0.9332* (0.545)	0.9717** (0.464)	0.9986** (0.419)	1.0388*** (0.378)	1.0600*** (0.372)	1.1177*** (0.411)	1.1958** (0.558)	1.2402* (0.668)	1.3154 (0.873)
LOU	-0.5093 (0.469)	2.0010*** (0.346)	-0.5179 (0.743)	-0.5159 (0.633)	-0.5145 (0.571)	-0.5124 (0.514)	-0.5113 (0.505)	-0.5083 (0.558)	-0.5042 (0.761)	-0.5019 (0.910)	-0.4980 (1.189)
LPIB	-1.4298** (0.601)	-1.3998*** (0.191)	-1.7193** (0.731)	-1.6518*** (0.621)	-1.6046*** (0.561)	-1.5343*** (0.506)	-1.4971*** (0.498)	-1.3960** (0.550)	-1.2592* (0.748)	-1.1814 (0.894)	-1.0497 (1.170)
LIDE	-0.0159 (0.046)	-1.9210*** (0.296)	-0.0076 (0.073)	-0.0095 (0.062)	-0.0109 (0.056)	-0.0129 (0.050)	-0.0140 (0.049)	-0.0169 (0.055)	-0.0208 (0.074)	-0.0230 (0.089)	-0.0268 (0.116)
LVA	-1.3836** (0.631)	0.1573** (0.077)	-0.8228 (1.000)	-0.9536 (0.849)	-1.0450 (0.767)	-1.1812* (0.694)	-1.2533* (0.687)	-1.4490* (0.758)	-1.7141* (1.024)	-1.8648 (1.222)	-2.1200 (1.603)
LTC	-0.1860 (0.239)	-0.4699 (0.384)	-0.3749 (0.290)	-0.3308 (0.246)	-0.3000 (0.223)	-0.2541 (0.201)	-0.2299 (0.200)	-0.1639 (0.220)	-0.0747 (0.297)	-0.0239 (0.355)	0.0620 (0.465)
LCH	0.1129 (0.501)	-0.0265 (0.047)	0.5843 (0.700)	0.4744 (0.593)	0.3975 (0.536)	0.2830 (0.486)	0.2225 (0.483)	0.0579 (0.532)	-0.1648 (0.716)	-0.2915 (0.854)	-0.5059 (1.122)
DE	-0.2555 (0.318)	0.3337 (0.460)	-0.4145 (0.519)	-0.3774 (0.442)	-0.3515 (0.399)	-0.3129 (0.360)	-0.2924 (0.354)	-0.2369 (0.391)	-0.1618 (0.532)	-0.1191 (0.636)	-0.0467 (0.832)
LIF	-2.0659*** (0.735)	-0.5434** (0.229)	-2.2312** (1.091)	-2.1927** (0.929)	-2.1657*** (0.839)	-2.1256*** (0.755)	-2.1043*** (0.742)	-2.0466** (0.820)	-1.9685* (1.118)	-1.9240 (1.337)	-1.8488 (1.747)
Constant	6.4864 (6.758)	3.6860 (3.072)									
Obs	96	96	96	96	96	96	96	96	96	96	96
R-squared	0.495	0.82									

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Under identification test (Anderson canon. corr. LM statistic): 26.494. Chi-sq(8) p -val = 0.0009.

Weak identification test (Cragg-Donald Wald F statistic):	3.764
Stock-Yogo weak ID test critical values: 5% maximal IV relative bias	20.25
10% maximal IV relative bias	11.39
25% maximal IV size	10.50
Source: Stock-Yogo (2005). Reproduced by permission.	
Sargan statistic (overidentification test of all instruments):	20.294
Chi-sq(7) p -val=	0.0050

Source: Authors.

The first column (FE) of **Table 4** shows that private investment affects vertical diversification at a significance level of 1%. However, we note that there are endogeneity issues, which can be explained by the R-squared value being less than 50%, at 49.5%. This means that the model is not well explained. However, Lewbel's test allows for the correction of endogeneity in models linking private investment and vertical diversification. Consequently, the result of the model in the second column (Lewbel) shows that private investment positively influences vertical di-

verification at a significance level of 1% with an R-squared equal to 82%. This explains the reliability of the model, as the endogeneity problem is addressed.

Finally, in columns (3 to 11), quantile regression is applied to analyse how the effect of private investment on vertical diversification varies according to the level of export diversification in sub-Saharan Africa. The results in columns (6, 7 and 8) have a significant effect at a significance level of 1%. This shows that, in some SSA countries, private investment can strengthen value chains and stimulate innovation. However, in columns (4, 9, 3 and 10), private investment is significant at the 5% and 10% levels, respectively. This shows an average quantile, indicating that some SSA countries have already begun a productive transformation. The underidentification test proves that the instruments are correlated with the endogenous variables of the model, i.e. the model is identified and the instruments appear to be relevant as the p -value is 0.0009, which is less than 0.005.

Decile (or quantile) analysis (Figure 3) allows us to examine whether the effect of private investment on vertical diversification varies depending on whether the country has a low, medium or high level of vertical diversification. Figure 3 shows that all the variable curves are increasing. This proves that the effect of private investment is weak for countries with low diversification and becomes strong and positive for countries that are already diversified. To this end, countries that are already diversified can build up savings to diversify further, thanks to preconditions such as infrastructure, skilled human capital and industrial ecosystems. However, in non-diversified countries, private investment will be made in the extractive sector without generating diversification. In short, according to Hausmann et al. (2014), diversification is a path-dependent process that requires the accumulation of specific productive capacities. Private investment is a key mechanism for this accumulation.

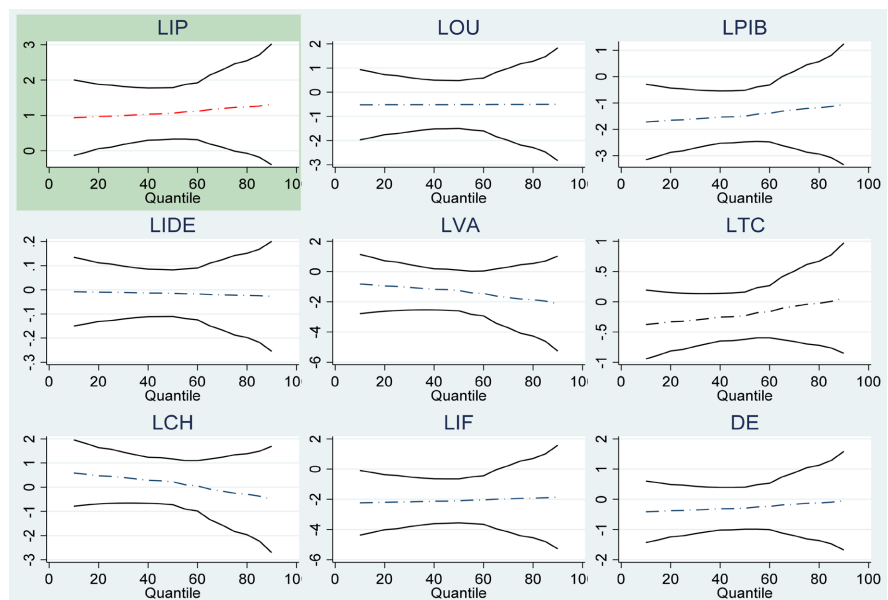


Figure 3. Graphical illustration of the effects on each decile of vertical diversification distribution. Source: Authors.

The model is generally satisfactory because **Table 5** shows that the R-square increases from 53.80% to 88.4%, which is above 50%. In columns (2), (3), (4) and (5), private investment has a positive effect on the vertical diversification of exports in SSA at a significance level of 10% respectively. This means that, in sub-Saharan African economies, this effect may be weakened by certain structural factors, which explains why significance is only observable at the 10% level. This corroborates, in theoretical terms, the work of **Hausmann et al. (2014)**, who proved that private investment is a mechanism for accumulating productive capacity that promotes diversification. Similarly, the work of **Owolabi et al. (2023)** in sub-Saharan Africa proves that financial inclusion and intra-African trade affect export diversification performance.

Table 5. Alternative estimation method: Driscoll-Kraay.

VARIABLES	(1)	(2)	(3)	(4)	(5)
LIP	-0.3176 (0.428)	0.9314* (0.540)	1.4497* (0.737)	1.4497* (0.793)	1.5332* (0.733)
LOU	-1.1476*** (0.244)	-1.3376*** (0.414)	-2.0905*** (0.487)	-2.0905*** (0.525)	-2.3596** (0.888)
LPIB	-2.7090*** (0.362)	-2.6780*** (0.572)	-2.7404** (1.103)	-2.7404** (1.187)	-3.1270** (1.240)
LIDE	-0.0244 (0.027)	0.0126 (0.051)	0.0315 (0.059)	0.0315 (0.063)	0.0241 (0.071)
LVA	-0.1305 (0.498)	-1.3528 (1.292)	-1.8196 (1.754)	-1.8196 (1.888)	-1.4433 (2.175)
LTC	0.3340*** (0.050)	0.1114 (0.221)	-0.0303 (0.291)	-0.0303 (0.313)	-0.2338 (0.742)
LCH	2.4016*** (0.490)	1.8540** (0.690)	2.1108** (0.786)	2.1108** (0.847)	2.3106** (0.864)
DE	1.3361*** (0.263)	0.1767 (0.375)	-0.1530 (0.389)	-0.1530 (0.419)	-0.2020 (0.416)
Constant	3.5335 (3.338)	12.1454** (5.004)	24.0125*** (6.175)	0.0000 (0.000)	30.0772* (14.745)
Observations	155	155	155	155	155
R-squared	0.538			0.884	
Number of groups	21	21	21	21	21
hansenp	.	.	.	.	.

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. **Source:** Authors.

Column (1): Model without any constraints

In this column (1), private investment is not significant and negatively affects the vertical diversification of exports. This proves that a decrease in PI leads to a decline in the vertical diversification of exports. This decline can be explained by the fact that private capital is concentrated in extractive or low-processing sectors, hindering the expansion of the range of exported products. This corroborates the work of [Houngbedji \(2022\)](#), who showed that dependence on natural resources hinders vertical diversification despite the fruits of investment. Thus, in the context of this study, we retain the hypothesis that private investment has a positive effect on the vertical diversification of exports. This corresponds to our second research hypothesis.

Column (2): Model with constraint: fixed effect control

The introduction of fixed effect control in this model makes it possible to measure the impact of private investment on the vertical diversification of exports, taking into account specific characteristics. Consequently, this model also allows us to control for the specific characteristics of each country, which are stable. To this end, the results of the model in column (2) show that private investment contributes favourably to the vertical diversification of exports in sub-Saharan Africa. This shows that private enterprises adopt modern processes which enhance the quality and added value of exported products.

Column (3): Fixed effects and individual dimension control

Fixed effects and individual dimension control neutralise unobserved characteristics specific to each country, such as institutions and geographical location, which remain stable over time. The individual dimension allows us to analyse the specific trajectory of each country over time. Thus, the result of model (3) shows that private investment has a positive influence on export diversification at a significance level of 10%. This leads to an improvement in exports (a shift from raw materials to manufactured or semi-processed products), thereby corresponding to vertical diversification. This growth can be explained by the model's consideration of unobserved characteristics such as institutions, geographical location and cultures. This corroborates the work of [Zakariyaou et al. \(2020\)](#), who used a fixed-effects GMM model to analyse export sophistication.

Column (4): Fixed and temporal effect control. In this column, the model results show that private investment positively affects vertical export diversification at the 10% significance level. This can be explained by an example in which, during the COVID-19 period, which led to a general decline in commodity prices, a negative temporal shock was captured by the fixed effect. Thus, countries that attracted private investment in non-traditional sectors were resilient and even managed to diversify their export basket. This corroborates the work of [Hausmann et al. \(2014\)](#), which showed that the diversification of complex products (vertical diversification) is the main driver of long-term growth.

Column (5): Control of the temporal and fixed effects

The results of the model in column (5) show that private investment has a pos-

itive effect on vertical diversification at the 10% threshold. This economically reflects that private investment fosters the creation of new production capacities, the implementation of innovative technologies, and the expansion of the export base. This means that the model took into account the specific characteristics of each country while capturing global shocks such as the pandemic and financial crises. Mastering all these different steps allows us to make a robust estimate that is more accurate and easier to interpret.

- **Robustness**

The curve (**Figure 4**) representing the marginal effect of private investment on predicted values for vertical diversification has a positive slope. This means that vertical diversification stimulates the variables in the model. This categorisation shows an average predicted value that reveals the effect of diversification at each level.

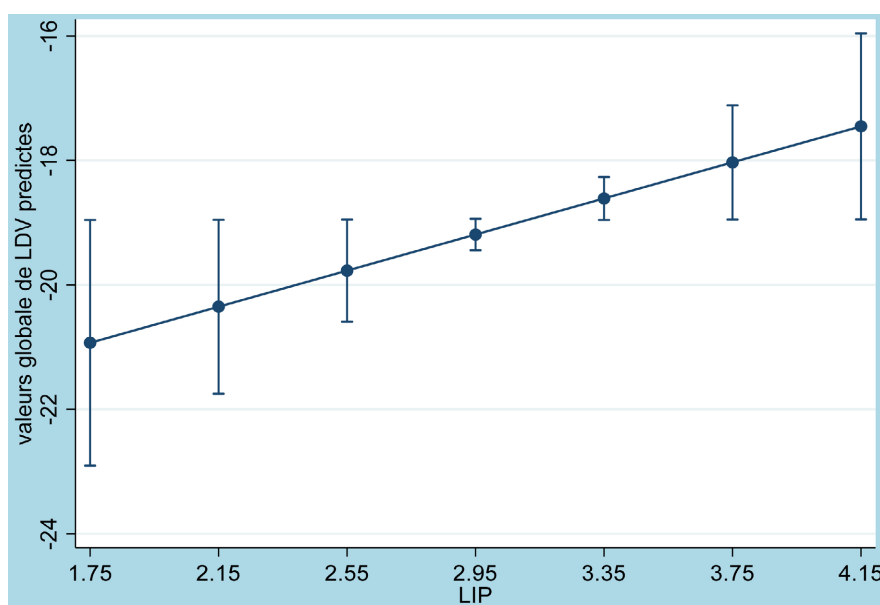


Figure 4. Marginal effect of IP on predicted values of vertical diversification. Source Authors. NB. Based on quantile regressions.

Interpretation:

These graphs (**Figure 5**) show the results of the effects of different variables on each decile of vertical diversification distribution in countries poor in natural resources. According to the figures for the LIP, LTC, LPIB and LIF variables, the curves for these variables are increasing. This suggests that the effect is weak for countries with little diversification and becomes strong and positive for those that are already diversified. On the other hand, the LOU, LCH, DE and LVA variables show decreasing curves. This decrease can be explained by the fact that private investment has decreasing returns on diversification. Factors leading to this decline in returns include, for example, a lack of skilled human capital and a lack of innovation.

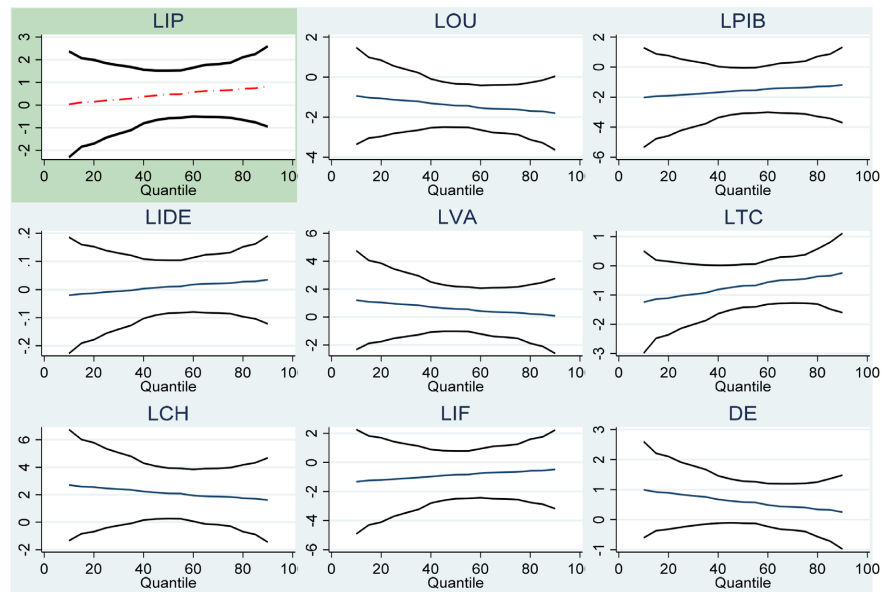


Figure 5. Graphical illustration of the effects on each decile of vertical diversification distribution: Countries poor in natural resources. **Source:** Authors.

The results of the estimation in **Table 6** show that, overall, the private investment variable has a positive effect on vertical diversification in countries poor in natural resources. This shows that growth in private investment leads to an increase in vertical diversification. However, this growth in diversification takes into account the skilled human capital of each country. Thus, in this specific case, it is noted that human capital positively affects vertical diversification at thresholds of 10%, 5%, 5%, 5%, and 10%, respectively, in columns (3), (4), (5), (6), and (7). The analyses reveal that private investment has a positive and statistically significant effect at the 5% level on the vertical diversification of exports. This validates the fact that private investment functions as a key driver of structural transformation, supporting the improvement of export quality and reducing dependence on primary commodities. This corroborates the work of **Lucas (1988)**, who states that investment in human capital promotes long-term economic growth. His theory has been used to explain why some countries manage to transform their productive structure and move upmarket in terms of products. This confirms our hypothesis that private investment has a positive effect on the vertical diversification of exports.

Table 6. Distribution table of the IP on DV in countries poor in natural resources.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	LDV	LDV	LDV	LDV	LDV	LDV	LDV	LDV	LDV
LIP	0.0366 (1.192)	0.1453 (0.941)	0.2471 (0.770)	0.3758 (0.603)	0.4732 (0.536)	0.5738 (0.550)	0.6366 (0.597)	0.7250 (0.706)	0.8205 (0.905)
LOU	-0.9405 (1.234)	-1.0594 (0.969)	-1.1708 (0.793)	-1.3117** (0.622)	-1.4184** (0.552)	-1.5284*** (0.567)	-1.5973*** (0.615)	-1.6939** (0.728)	-1.7985* (0.938)

Continued

LPIB	-2.0240 (1.694)	-1.9083 (1.361)	-1.7998 (1.114)	-1.6627* (0.869)	-1.5589** (0.773)	-1.4518* (0.793)	-1.3848 (0.863)	-1.2907 (1.021)	-1.1889 (1.280)
LIDE	-0.0208 (0.105)	-0.0131 (0.084)	-0.0060 (0.069)	0.0031 (0.054)	0.0100 (0.048)	0.0171 (0.049)	0.0215 (0.054)	0.0277 (0.063)	0.0344 (0.080)
LVA	1.1980 (1.809)	1.0420 (1.430)	0.8958 (1.172)	0.7111 (0.919)	0.5711 (0.817)	0.4267 (0.839)	0.3365 (0.908)	0.2096 (1.073)	0.0724 (1.372)
LTC	-1.2420 (0.891)	-1.1033* (0.641)	-0.9734* (0.528)	-0.8091* (0.422)	-0.6847* (0.375)	-0.5563 (0.385)	-0.4761 (0.409)	-0.3633 (0.481)	-0.2413 (0.692)
LCH	2.7001 (2.064)	2.5493 (1.652)	2.4079* (1.352)	2.2293** (1.056)	2.0939** (0.939)	1.9543** (0.964)	1.8670* (1.048)	1.7444 (1.239)	1.6117 (1.561)
LIF	-1.3258 (1.832)	-1.2080 (1.478)	-1.0976 (1.208)	-0.9581 (0.941)	-0.8523 (0.836)	-0.7433 (0.859)	-0.6751 (0.936)	-0.5794 (1.109)	-0.4757 (1.382)
DE	0.9943 (0.817)	0.8912 (0.619)	0.7945 (0.507)	0.6724* (0.401)	0.5798 (0.356)	0.4844 (0.365)	0.4247 (0.393)	0.3409 (0.464)	0.2502 (0.627)
Observations	49	49	49	49	49	49	49	49	49
Hansenp	.	.	.	.	.	.	.	.	.

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: Authors.

In terms of natural resources (Figure 6), these are classified according to their level of diversification. Private investment is low in the lower deciles because there is a high concentration in extractive products. As for trade openness, it reinforces dependence on raw materials and can also promote diversification. The GDP curve on diversification has a very high effect. This shows that it is positively correlated in the higher deciles. Foreign direct investment is on a downward trend, which shows that it is more oriented towards the extractive sector. Value added in this figure has a decreasing effect. This proves that in countries rich in natural resources, value added is driven by extractive sectors, which slows down local transformation. In this regard, Seck (2024) noted that dependence on natural resources can slow down diversification if it is not accompanied by an industrial strategy.

The exchange rate has a negative effect on vertical diversification through high exchange rate volatility, which can hinder long-term industrial projects. In addition, a very high exchange rate can encourage imports of finished products at the expense of local production. Consequently, high volatility can hinder vertical diversification and increase dependence on raw material exports. Human capital has a negative effect on diversification, which proves that some SSA countries have less skilled labour. As for the positive effect of financial incentives on vertical diversification, this proves that tax exemptions encourage companies to process raw materials locally. Finally, the curve for the democracy variable is rising, showing that it has a positive effect on vertical diversification through political stability. Political stability attracts industrial investors. Similarly, Zakariyaou et al. (2020) showed that the quality of institutions positively affects vertical diversification through democracy.

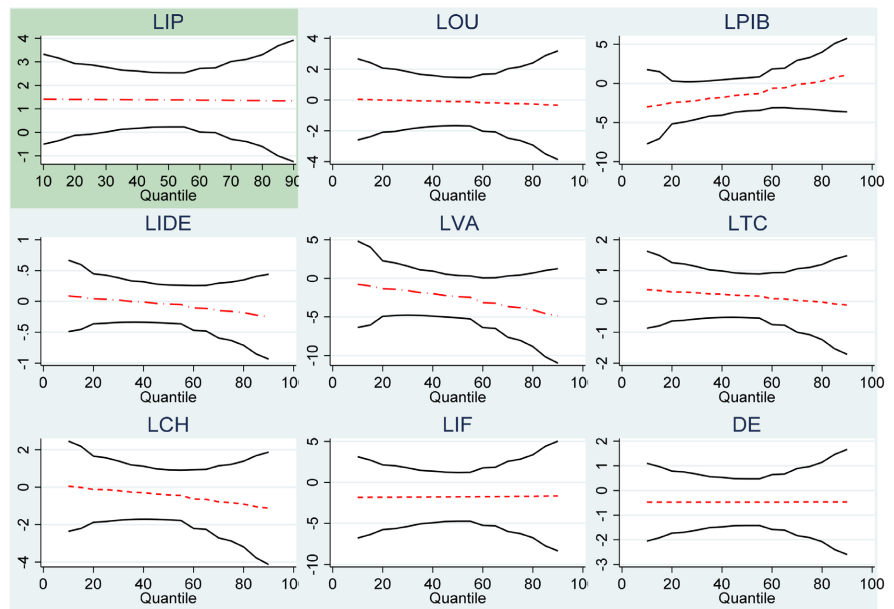


Figure 6. Graphical illustration of the effects on each decile of vertical diversification distribution: Countries rich in natural resources.

Interpretation: All models in **Table 7** show satisfactory results in that private investment has a positive effect on the vertical diversification of exports. However, the equations of models (2), (3), (4), (5), and (6) are significant at the 10%, 5%, 5%, 5%, and 5% significance levels, respectively. This means that an effect at the 5% level demonstrates that the link between private investment and vertical diversification is robust. Compared with the 10% threshold, this degree of significance indicates greater confidence that the observed effect does not result from chance. However, the results of models (1), (7), (8), and (9) are not significant due to the low quality of institutions as measured by the democracy variable.

Table 7. Distribution table of the IP on DV in resource-rich countries.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	LDV	LDV	LDV	LDV	LDV	LDV	LDV	LDV	LDV
LIP	1.4104 (0.978)	1.4007* (0.779)	1.3962** (0.703)	1.3895** (0.621)	1.3825** (0.587)	1.3689** (0.691)	1.3602 (0.843)	1.3529 (0.998)	1.3393 (1.320)
LOU	0.0424 (1.341)	-0.0092 (1.062)	-0.0330 (0.958)	-0.0683 (0.847)	-0.1051 (0.800)	-0.1770 (0.941)	-0.2231 (1.150)	-0.2617 (1.361)	-0.3335 (1.798)
LPIB	-2.9874 (2.423)	-2.4308* (1.404)	-2.1733* (1.223)	-1.7922 (1.153)	-1.3953 (1.078)	-0.6201 (1.262)	-0.1223 (1.574)	0.2944 (1.895)	1.0688 (2.396)
LIDE	0.0884 (0.295)	0.0423 (0.207)	0.0210 (0.185)	-0.0105 (0.167)	-0.0433 (0.158)	-0.1074 (0.185)	-0.1486 (0.228)	-0.1831 (0.271)	-0.2471 (0.351)
LVA	-0.7704 (2.851)	-1.3322 (1.834)	-1.5921 (1.621)	-1.9767 (1.490)	-2.3774* (1.399)	-3.1598* (1.641)	-3.6623* (2.030)	-4.0829* (2.428)	-4.8645 (3.119)

Continued

LTC	0.3780 (0.638)	0.3101 (0.482)	0.2787 (0.433)	0.2323 (0.386)	0.1839 (0.364)	0.0895 (0.428)	0.0288 (0.524)	-0.0220 (0.622)	-0.1164 (0.817)
LCH	0.0497 (1.229)	-0.1119 (0.901)	-0.1866 (0.808)	-0.2972 (0.722)	-0.4124 (0.681)	-0.6373 (0.801)	-0.7818 (0.982)	-0.9027 (1.167)	-1.1275 (1.529)
LIF	-1.8241 (2.531)	-1.8014 (2.016)	-1.7909 (1.820)	-1.7753 (1.607)	-1.7591 (1.519)	-1.7275 (1.787)	-1.7072 (2.182)	-1.6902 (2.582)	-1.6587 (3.415)
DE	-0.4752 (0.805)	-0.4741 (0.641)	-0.4736 (0.579)	-0.4729 (0.511)	-0.4721 (0.483)	-0.4707 (0.568)	-0.4697 (0.694)	-0.4689 (0.821)	-0.4675 (1.086)
Observations	47	47	47	47	47	47	47	47	47

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. **Source:** Authors.

Indeed, the significant positive effect of private investment on vertical export diversification corroborates the work of [Greene and Villanueva \(1991\)](#) and [Fielding \(1997\)](#). These authors have shown that an increase in real GDP reflects an increase in domestic wealth, leading to higher consumer and investment demand. Furthermore, the results of our work confirm this hypothesis, in that GDP negatively affects export diversification, meaning that GDP growth leads to a decrease in the concentration of exported products.

The results of the model estimation using the Driscoll-Kraay method are satisfactory ([Table 8](#)). This satisfaction is explained by the R-square, which is above 70%. Accordingly, in resource-rich countries, private investment contributes positively to vertical export diversification at the 1% significance level. This implies that a 1% increase in private investment leads respectively to a 1.23, 1.54, and 2.13 rise in vertical diversification in Sub-Saharan Africa. Furthermore, this means that private enterprises play a leading role in broadening product ranges. Their investment in the manufacturing sector also enables the local transformation of raw materials. This corroborates the work of [Lucas \(1988\)](#) and [Romer \(1990\)](#), who argue that private investment fosters the accumulation of physical and human capital, thereby stimulating innovation and productive transformation. Similarly, the studies of [Hausmann et al. \(2014\)](#) have confirmed this hypothesis. According to them, private investment enhances productive capacities, allowing the export of more complex products.

Table 8. Driscoll-Kraay method according to the level of natural resources.

	Resource-rich countries					Resource-poor countries				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
LIP	1.2348*** (0.363)	1.2348*** (0.363)	1.5440*** (0.382)	1.544*** (0.415)	2.1279*** (0.608)	-0.4527 (1.022)	0.5800 (0.967)	1.5966 (1.188)	1.5966 (1.275)	1.8168 (1.350)

Continued

LOU	-1.194*** (0.291)	-1.1944*** (0.291)	-0.8634** (0.361)	-0.863** (0.392)	-1.0605 (0.631)	-0.3391 (0.343)	-1.389*** (0.287)	-3.657*** (0.588)	-3.6573*** (0.631)	-4.8622** (1.828)
LPIB	-1.5584** (0.522)	-1.5584** (0.522)	-0.7352 (0.675)	-0.7352 (0.733)	1.5957 (1.603)	-2.6185*** (0.406)	-3.042*** (0.927)	-2.6513* (1.346)	-2.6513* (1.444)	-2.6791 (1.722)
LIDE	0.0363 (0.119)	0.0363 (0.119)	-0.0529 (0.060)	-0.0529 (0.065)	-0.0780 (0.078)	-0.3668* (0.181)	-0.0673 (0.110)	-0.0067 (0.091)	-0.0067 (0.097)	-0.1036 (0.139)
LVA	-0.8652* (0.401)	-0.8652* (0.401)	-3.5799*** (0.914)	-3.58*** (0.992)	-5.812*** (1.574)	-0.1446 (0.640)	-0.7171 (1.546)	-1.1171 (1.821)	-1.1171 (1.954)	-0.7188 (2.297)
LTC	-0.2595* (0.137)	-0.2595* (0.137)	-0.0522 (0.319)	-0.0522 (0.346)	-0.3002 (0.485)	0.5060*** (0.160)	0.2973 (0.406)	0.5854 (0.379)	0.5854 (0.407)	0.2365 (1.633)
LCH	0.4721 (0.430)	0.4721 (0.430)	0.0416 (0.366)	0.0416 (0.397)	-0.2843 (0.590)	5.6084*** (1.056)	3.3411*** (1.104)	4.0088*** (1.085)	4.0088*** (1.163)	5.0201*** (0.852)
DE	-0.9837** (0.346)	-0.9837** (0.346)	-0.0997 (0.285)	-0.0997 (0.309)	-0.2650 (0.467)	3.2006*** (0.625)	1.0296 (0.663)	0.3741 (0.734)	0.3741 (0.787)	0.0924 (0.715)
const	9.9087 (5.629)	9.9087 (5.629)	6.8108 (5.134)	6.7507 (6.532)	2.7597 (13.902)	-20.6575** (6.970)	6.6968 (6.987)	31.8610** (11.378)	37.7513*** (12.357)	49.4240 (34.263)
Obs	62	62	62	62	62	93	93	93	93	93
R ²	0.835			0.888		0.704			0.889	
PAYS	9	9	9	9	9	12	12	12	12	12

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. **Source:** Authors.

Conversely, in resource-poor countries, private investment positively affects vertical export diversification, but the effect is not statistically significant. This implies that growth in private investment may lead to an increase in vertical export diversification. Moreover, this result demonstrates that private investment can foster productive transformation, provided that other factors such as human capital and trade openness are present. This corroborates the work of [Lin \(2011\)](#) and [Rodrik \(2013\)](#), who argue that private investment can facilitate the shift towards higher value-added sectors, though this requires targeted policies such as institutions, governance, and sound economic fundamentals.

The marginal effect of private investment, according to [Figure 7](#), is positive on the predicted values of diversification in the case of resource-rich countries. This indicates that an increase in private investment leads to growth in vertical diversification through institutional and economic factors. Conversely, in both resource-rich and resource-poor countries, the marginal effect of private investment on the predicted values of vertical export diversification remains positive. This positivity is explained by the fact that private investment becomes a crucial factor in productive transformation.

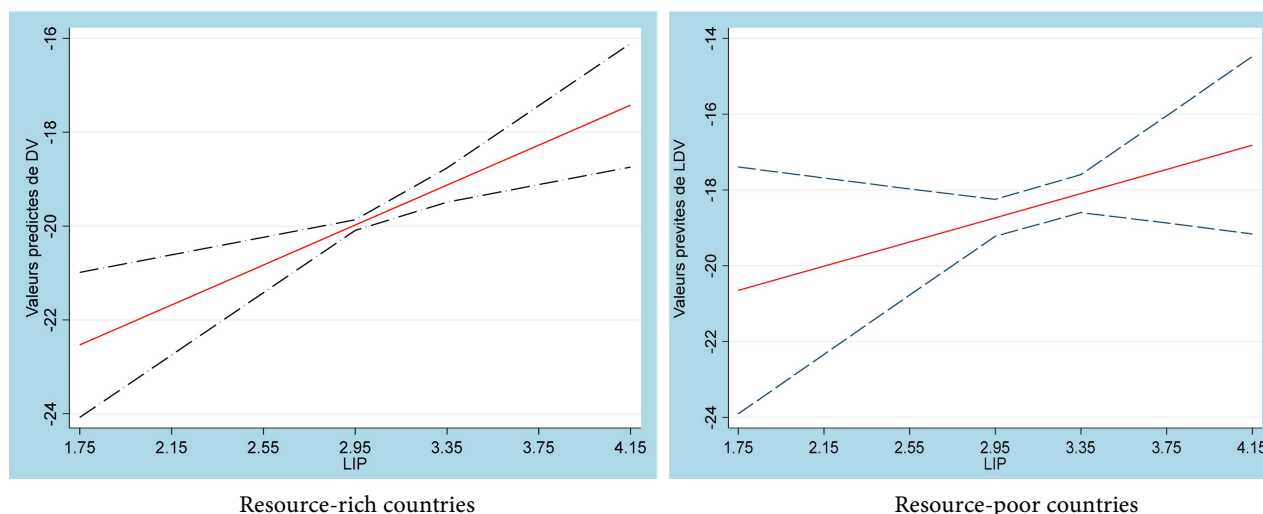


Figure 7. Marginal effect of private investment on the predicted values of vertical diversification: the case of resource-rich and resource-poor countries. **Source:** Authors.

Interpretation:

The results (Table 9) of the model estimation using the Driscoll-Kraay method according to economic development are satisfactory since the number of observations is greater than the number of instruments. For middle- and high-income countries, the number of observations is 48, which is higher than the number of instruments, seven (7). Thus, in middle- and high-income countries, private investment negatively affects the vertical diversification of exports in SSA for models (1), (2), (3), and (4). Indeed, only model (5) is positively influenced. However, models (3) and (4) are significant at the 1% level. In short, private investment negatively influences vertical diversification at the 1% significance threshold. This means that a 1% increase in PI leads to a reduction in the concentration of raw materials by 66.35% for both models (3) and (4). The GDP variable negatively affects the vertical diversification of exports at the 1% significance level. This negative effect demonstrates that there is a strong concentration of FDI in the raw materials sector. Such concentration of FDI hinders the diversification of exports into other sectors such as agriculture, livestock, transport, and health, among others. The results of models (3) and (4) also show that the FDI variable positively affects the vertical diversification of exports at the 1% significance level. This means that an increase in FDI leads to a strong concentration of exports of 26.53%. This hampers the vertical diversification of exports and confirms the findings of Fousséni (2019).

Table 9. Driscoll-Kraay method according to the level of development.

	Middle- and high-income countries					Low-income countries				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
LIP	-0.2733	-0.2733	-0.6635***	-0.6635***	0.2923	1.8367	1.9725*	2.4079**	2.4079**	2.7388***
	(0.721)	(0.721)	(0.199)	(0.216)	(0.181)	(1.406)	(1.035)	(1.024)	(1.100)	(0.804)

Continued

LOU	-1.2626*	-1.2626*	-2.3286***	-2.3286***	-2.7567***	-1.4969***	-1.7577***	-2.8587***	-2.8587***	-4.2914***
	(0.643)	(0.643)	(0.303)	(0.330)	(0.642)	(0.289)	(0.337)	(0.530)	(0.569)	(1.405)
LPIB	-2.279**	-2.2797**	-1.7897***	-1.7897***	-1.1466*	-5.1681***	-3.1251**	-2.6625*	-2.6625*	-3.9719**
	(0.766)	(0.766)	(0.403)	(0.438)	(0.600)	(0.713)	(1.356)	(1.253)	(1.345)	(1.632)
LIDE	0.1321	0.1321	0.2653***	0.2653***	0.2463***	0.0702	0.0351	0.0534	0.0534	0.0703
	(0.184)	(0.184)	(0.065)	(0.070)	(0.077)	(0.137)	(0.024)	(0.032)	(0.034)	(0.046)
LVA	-1.9452*	-1.9452*	1.5603**	1.5603**	-0.3756	1.8338***	-1.4436	-2.2526	-2.2526	-1.2032
	(1.026)	(1.026)	(0.531)	(0.578)	(0.732)	(0.361)	(1.520)	(1.819)	(1.953)	(2.090)
LTC	0.1633	0.1633	-0.6695**	-0.6695**	-0.3777	0.3283**	0.4899	1.0459**	1.0459**	-1.0393
	(0.114)	(0.114)	(0.233)	(0.253)	(0.353)	(0.122)	(0.343)	(0.404)	(0.434)	(0.991)
LCH	-0.1484	-0.1484	0.8688***	0.8688***	0.6924	3.2264***	2.2849***	2.2927**	2.2927**	2.1350**
	(0.598)	(0.598)	(0.249)	(0.271)	(0.457)	(0.538)	(0.687)	(0.832)	(0.893)	(0.905)
DE	0.804***	0.8041***	-0.1749	-0.1749	0.1782	1.2595*	0.1126	-0.1731	-0.1731	-0.4534
	(0.157)	(0.157)	(0.144)	(0.157)	(0.266)	(0.644)	(0.555)	(0.667)	(0.717)	(0.720)
Cons	17.7882*	17.7882*	20.944***	0.0000	24.6391**	7.3189*	14.062***	25.271***	0.0000	63.4344**
	(8.849)	(8.849)	(4.151)	(0.000)	(10.025)	(3.389)	(4.192)	(8.353)	(0.000)	(27.716)
Ob	48	48	48	48	48	107	107	107	107	107
R ²	0.898			0.982		0.583			0.873	
N	7	7	7	7	7	14	14	14	14	14
hansen	.									

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: Authors.

Furthermore, in the equation of model (5), private investment positively influences the vertical diversification of exports but is not significant. This implies that an increase in PI leads to an increase in vertical diversification provided that other factors such as democracy and economic conditions are present.

However, in low-income countries, private investment positively affects the vertical diversification of exports in SSA in models (6), (7), (8), (9), and (10). Only model (6) is not significant. In this regard, models (7), (8), (9), and (10) are significant at the thresholds of 10%, 5%, 5%, and 1%, respectively. This means that a 1% increase in PI results in respective increases of 1.97, 2.40, 2.40, and 2.73 in the vertical diversification of exports in SSA. This corroborates the works of Lucas (1988) and Romer (1990). This confirms the hypothesis of our study that private investment positively affects the vertical diversification of exports in Sub-Saharan Africa.

Interpretation:

According to Figure 8, the curve of the marginal effect of private investment on vertical diversification in middle- and high-income countries is initially increasing. This shows that in middle- and high-income countries, private investment stimulates diversification. Subsequently, the curve of the marginal effect tends to decline, which may be explained by the fact that as the economy diversifies, private investment generates progressively lower additional marginal gains.

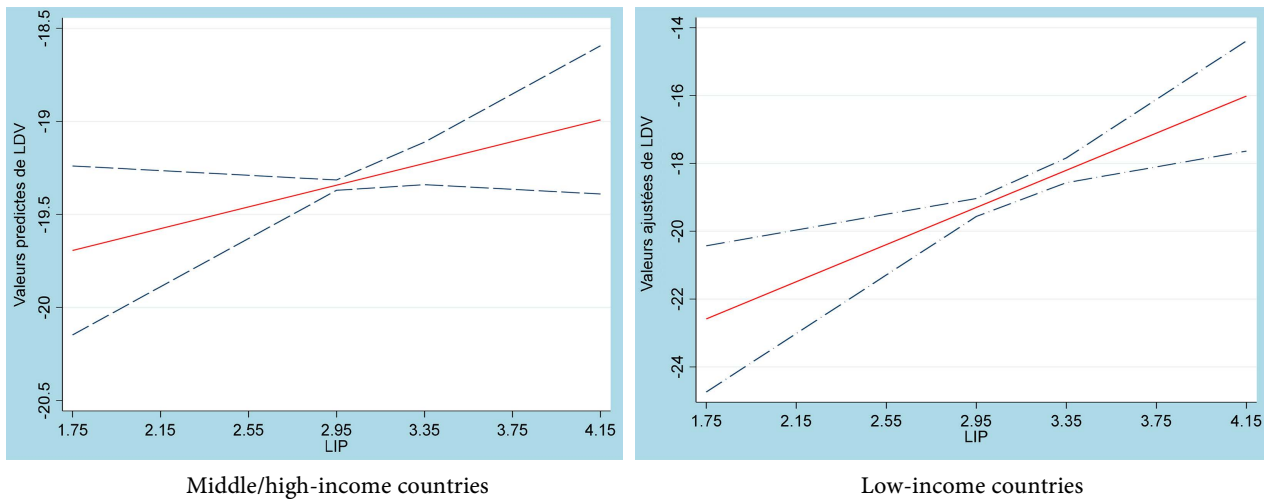


Figure 8. Marginal effect of PI on the predicted values of VD: Case of middle/high-income and low-income countries.

By contrast, according to the same figure, the curve of the marginal effect of private investment on vertical diversification in low-income countries also rises at the outset before levelling off. This indicates that private investment enhances local productivity. The subsequent stagnation may be attributed to institutional, structural, and economic constraints.

Figure 9 shows that the distributive effect of private investment on vertical diversification in less developed countries evolves in an irregular manner. This reflects an unequal distribution of the added value generated by productive transformation among the different countries of Sub-Saharan Africa. This irregularity also demonstrates that private investment may initially benefit dominant actors, followed by a slow diffusion towards other participants.

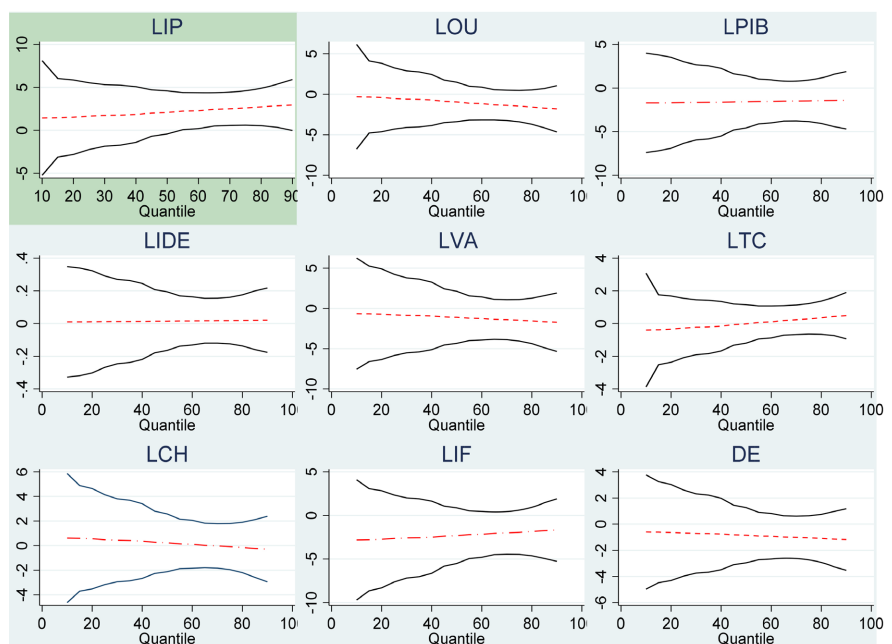


Figure 9. Distributive effect of PI on VD in less developed countries.

5. Conclusion

The objective of this second part is to analyse the effect of private investment on the vertical diversification of exports in Sub-Saharan Africa. This study has made it possible to identify the determinants of diversification, which include economic diversification and institutional diversification (Kamgna, 2007; Acemoglu et al., 2003; Kraay, 2003; North, 1990; Imbs & Wacziarg, 2003; Feng, 2004; Lahimer, 2009; Ben Hammouda et al., 2009b). These authors highlighted several factors influencing diversification, namely gross fixed capital formation, financial development (credit granted to the private sector/GDP), human capital, inflation, institutional quality, GDP per capita, and democracy.

In this respect, empirical studies on the effect of financial development on export diversification have been conducted by authors such as Fosu and Abass (2018) and Akoto (2020). The results of the analysis of the effect of private investment on vertical diversification show that private investment positively influences the vertical diversification of exports through gross fixed capital formation. Accordingly, a 1% increase in private investment leads to growth in vertical diversification in different ways depending on the countries of Sub-Saharan Africa. This corroborates the work of Lucas (1988) and Romer (1990), who argue that private investment fosters the accumulation of physical and human capital, thereby stimulating innovation and productive transformation. Similarly, the work of Hausmann et al. (2014) also confirmed this hypothesis. According to them, private investment enhances productive capacities, enabling the export of more complex products.

This validates the hypothesis of our study that private investment positively affects the vertical diversification of exports in Sub-Saharan Africa. Finally, the various analyses carried out on the basis of the study's hypothesis and in light of the estimation results lead us to propose the following economic policy recommendations to governments: encourage a favourable climate for investment, promote diversification across investment sectors, and develop infrastructure.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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