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THE COMPLEMENTARITY EFFECT OF INTENSIVE AND EXTENSIVE MARGINS OF EXPORTS DIVERSIFICATION ON GROWTH: EMPIRICAL EVIDENCE FROM NIGERIAN DATA

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Abstract

Research background: Two main theoretical patterns of exports diversification have evolved in development economics: the intensive- and extensive-export margins. Myriads of studies have assessed the relative merits of both patterns of diversification in promoting economic growth. Empirical literature, however, has thus far produced mixed and inconclusive results.
Purpose: This paper aims to examine the impact of complementarity between the aforementioned patterns of exports diversification on economic growth in Nigeria.
Research methodology: The study utilized the dynamic linear autoregressive distributed lag bounds testing procedure for the time-series analysis covering the period 1960–2022.
Results: Empirical results revealed that both patterns of diversification significantly reinforce each other and jointly exert a strong positive effect on growth. These findings have numerous insightful and far-reaching policy implications. First, to maximize the growth-enhancing effect of export diversification patterns, both margins should not be considered in isolation. Second, apt simultaneous policies are needed to strengthen/enhance their effects on growth.

Novelty: To date, there has been almost no attention paid in the literature to the complementarity impact of both patterns of diversification in advancing growth (as existing studies largely focus on individual impacts of extensive and intensive margins on growth). This study accordingly fills this research gap.

Keywords: ARDL, export diversification, extensive-margin, intensive-margin, non-oil sector

JEL classification: C22, O11

Introduction

In the last-five-and-a half decades, two main theoretical patterns of export diversification have evolved in the development economics literature: intensive-margin and extensive-margin of export. On the one hand, building on the national product differentiation model put forward by Armington (1969), proponents of the intensive-margin notion hold that, exports of old goods (at higher volumes or higher prices or both) to old geographic markets destinations as the main avenue for exports diversification. Contrarily, starting with Krugman's (1980) and Lancaster's (1980) international trade models, advocates of the extensive-margin contend that the exports of old goods to new markets destinations or exports of completely new goods to new (or old) market locations is more appropriate for diversification.

A vast body of empirical literature has assessed the relative merits of both patterns of diversification in promoting growth. Empirical results, nevertheless, remain ambiguous and inconclusive to date. Some studies give credence to intensive-margin (Zhang et al., 2017; Can, Gozgor, 2018; Tanasritunyakul, 2022; Fedyunina et al., 2023). Others studies, nevertheless, maintain an opposite view, contending that extensive-margin is the primary driver of export diversification (Huchet-Bourdon et al., 2018; Bista, Sheridan, 2021; Lee, Zhang, 2022; Young, 2023).

Like many resource-abundant sub-Saharan African (SSA) countries (particularly, oil-rich economies), Nigeria's extreme dependence on oil exports (exacerbated by the persistent fall in oil prices since mid-2014) has triggered complex macroeconomic problems and structural difficulties for the economy, namely huge-revenue gaps, debilitating debts burden and debts overhang, severe fiscal contractions, de-industrialization, worsening terms-of-trade and balance of payment position, widespread distortions and imbalances in the economy, sharp and disruptive fiscal contractions, adverse income redistribution, structural inefficiency, a heavily

subsidized welfare system, and more fundamentally, an anemic growth. These deleterious impacts of heavy reliance on oil have, in the last five decades, heightened the call for the diversification of the economy's production base.

To respond to the call for diversification, numerous policy programmes (at various times) were formulated and introduced by Nigeria's successive governments. Paramount amidst these is the first National Developments Plans (NDP, 1962–1968), the second NDP (1970–1974), the third NDP (1975–1980), the fourth NDP (1981–1985), the Economic Stabilization (Temporary Provisions) Acts (1982), the 1986 structural adjustment programme, the National Rolling Plans (1990–1992, 1993–1995, 1994–1996, 1997–1999), the 1999–2003 Nigeria's National Economic Direction, the National Economic Empowerment and Development Strategy, 2003–2007, the Economic Recovery and Growth Plans 2017–2020, etc. The policy programmes have many strategic goals and objectives. Notable amidst these is the intent to lessen Nigeria's extreme dependence on oil, restructure, broaden and diversify the economy's export base toward a non-oil sector (where there is still enormous potential that is virtually untapped). However, whilst the policies' contents are practicable, and feasible developments were observed during implementation, the whole-expected gains remained elusive. This disappointing result has been linked to three key factors: the unwieldy scope of the policies, incoherent implementation, and negligence of the economy's peculiar circumstances.

To take cognizance of the onerous scope along with the implementation of the problem and country-specific idiosyncrasies, an intense debate has emerged in both policy and academic circles on which of the non-oil revenue-earnings sectors should the country prioritize for diversification, and how can the policy be effectively promoted. To this end, myriads of studies (Obafemi, 2022) have advocated industrial (notably, manufacturing, solid minerals and energy), agriculture, trade and services, and many alternative non-oil subsectors as feasible choices for the Nigerian economy's diversification.

Motivated by the Nigerian government's efforts to diversify the economy, together with the quest for appropriate export diversification patterns, and unresolved economic growth – export diversification debate, this study empirically examines the impact of complementarity between the aforesaid patterns of export diversification on economic growth in Nigeria. Although, as noted in the literature, there are a plethora of empirical inquiries, nevertheless, an objective/detailed reading of the literature indicates that, aside the ambivalent nature of the findings, almost no attention has been given in the literature to the impact of complementarity between the two patterns of diversification on growth (as existing studies largely focus on individual impacts of extensive- and intensive-margin on economic growth). Moreover, the

overwhelming majority of the literature is based on the advanced and industrial economies (in Latin America, Asia, and Europe), affording SSA countries either very little coverage or none at all. Also, generalized empirical investigations across countries using panel (and/or cross-country and cross-sectional) data seems to dominate this literature. Specifically, empirical inquires on countries like Nigeria are almost non-existent to date. This study accordingly fills this research gap.

In the light of the above discussion, this paper aims to examine the complementarity effect of intensive and extensive margins of export diversification on growth in Nigeria, from 1960 to 2022, using the autoregressive distributed lag (ARDL) bounds test procedure. The study contributes to the literature on development economics in two-fold. Firstly, unlike previous studies (which only consider the effect of either intensive-margin or extensive-margin on growth separately), it investigates the complementarity impact of the aforementioned patterns of diversification on growth, offering new insights into the extensively-debated patterns of export diversification and related policy issues. Secondly, contrary to prior empirical inquiries that relied on cross-country and cross-sectional (sometimes, panel) regressions, which are likely to suffer from problems of data comparability and heterogeneity, it utilizes pure time series data. Therefore, specific policy guidance will be made possible by the study's findings on the subject. The rest of the paper is organized as follows. First, a brief review is presented of the empirical literature. The next section outlines methodology and data. This is followed by empirical findings and their discussions. Concluding remarks and policy implications are highlighted afterwards.

1. Literature review

In this section, a brief review is presented of the extant empirical inquiries on the subject. Importantly, for brevity's sake, the study reviews relevant studies published in the last two decades. Starting with the empirical literature on extensive-margin, Funke and Ruhwedel (2001) between 1989–1996 for 19 OECD (Organization for Economic Cooperation and Development) countries, find that export variety to significantly enhance growth. Funke and Ruhwedel (2002) for 15 OECD countries, from 1989–1997, establish that export performance is significantly and positively influenced by export variety.

In a study of 34 countries from 1982–1997, Feenstra and Kee (2004) find that export variety significantly affect productivity across countries. Utilizing the trade data of 59 importing and 126 exporting countries for the year 1995, Hummels and Klenow (2005) establish that

extensive-margin constitutes the bulk of exports of larger economies. Using a broad cross-section of 48 countries, Feenstra and Kee (2008) discover that countries with higher export variety likewise have higher productivity. Helpman et al. (2008) in a study of 158 countries, for 1970–1997, find that extensive-margin is particularly essential in determining trade flow responses across countries.

Based on detailed export data for 156 countries, Cadot et al. (2011), from 1988–2006, find that the diversification of export takes place primarily at extensive-margin. Dutt et al. (2013), over the period 1988–2006, for 150 countries, maintain that WTO-membership enhances extensive margin but lessens intensive margin. A similar result was uncovered by Beverelli et al. (2015) for 26 OECD and 107 non-OECD countries. Zhao et al. (2013), for 2000-2007, find that extensive-margin contributes more to trade expansion in China. Kehoe and Ruhl (2013) in a study of 1,900 country pairs, over the period 1995–2005, establish that extensive-margin is the primary driver of export growth in developing countries. Aldan and Çulha (2016) argue that the rapid growth of Turkey's exports is primarily along extensive-margin.

With a sample of 169 countries, for the period 1988–2014, Huchet-Bourdon et al. (2018) find that the effect of an increase in export variety seems positive for almost all countries (save for countries with low levels of exported variety). Cho and Díaz (2018), between 1995 and 2008, for 10 transition countries, at the industry and product level, find a positive correlation between extensive-margin and productivity growth. Rahmouni (2020), between 1999–2018, for Saudi Arabia, finds that old products new destinations strategy (extensive-margin) increases the value of exports. Based on a cross-country sample of 162 countries, over the 1950–2013 period, Bista and Sheridan (2021) find that, for all countries, in comparison to intensive-margin, extensive-margin is more important.

Analysing 69 (least-developed, middle-income, and high-income) countries, from 1997–2014, Mora and Olabisi (2021) establish that extensive-margin is more important for economic growth than intensive-export margin, in least-developed countries. Lee and Zhang (2022), in a study of 51 countries, for the period 2001–2015, find that diversification in exports markets (or partners) promotes economic growth and stability. Using Nigerian data from 1960–2021, Young (2023) discovered that the beneficial impacts of extensive-export margin on growth outweigh that of intensive-export margin. Elumalai and Kumar (2023), for 2001–2020, established that extensive-margin plays a more important role in India's agricultural exports.

Despite the apparent need for extensive-margin as motivated by the economic literature surveyed above, there is still some scepticism as regards the aptness and feasibility of extensive export margin. For example, based on the export performance of 23 developing countries for

1970–1997, Evenett and Venables (2002) contend that expanding extant products in extant markets is much more important for export growth than diversifying into new geographic markets and products. Brunner and Calì (2006), over the period 1991–2002, argue that the quantity expansion of extant products has been the main driver of South Asia's export growth. Besedeš and Prusa (2011), based on the detailed export data of 46 countries, for 1975–2003, maintain that intensive-export margin accounts for the majority of trade growth. Using data from China's export trade with 140 partners for 2001–2007, Bingzhan (2011) argue that the increased export of extant product is the principal force behind China's export growth. Gao et al. (2014) using China's export data, over the period 1995–2010, find that export growth depends less and less on quantity expansion, but more and more on price increases.

Utilizing country level panel data from 15 Latin America countries (LAC), over the 1990–2012 period, Agosin and Arango (2015) discover that, in the LAC, extant exports have a stronger impact on export growth than new exports. Matthee et al. (2016), for South-Africa, using firm-level data, for the period 2002–2012, find that intensive-margin, rather than extensive-margin, matters more for growth. Zhang et al. (2017), for 1995–2013, contend that China's agricultural exports have grown via both extensive- and intensive-margin. However, between 2001–2006, the contribution from intensive-margin increased rapidly and has generally remained above 75%. Otamurodov et al. (2017), for the period 2004–2014, find that Belarus's exports had grown primarily due to intensive-export margin during the studied period. Using data on the Philippines' exports alongside imports from its trading partners, for 1975–2012, Adelan and Kakinaka (2018) contend that the Philippines' feeble export performance can be attributable primarily to its poor performance at intensive-export margin.

Employing a panel of 115 (high-income, middle-income, and low-income) countries, for 1970–2010, Can and Gozgor (2018) argue that intensive-margin (rather than extensive-margin) matters more for export quality in low-and-middle-income countries. Bojnec et al. (2021), using a sample of 11 Central and European (CEE) countries for the period 2007–2013, establish that many CEE –11-countries – notably Poland, the Slovak Republic, Estonia, Hungary, and Czechia – successfully achieved export expansion along intensive-margin. In a study of 21 Asian countries from 1990–2017, Tanasritunyakul (2022) contend that, for export success, deepening of extant products is far more crucial than the introduction of new ones. Fedyunina et al. (2023), over the period 2015–2021, for Russia, find that the contribution to growth of intensive-margin, in aggregate, outweighs that of extensive-margin.

In summary, as is evident from the above, myriads of studies have examined the relative merits of intensive-margin and extensive-margin in promoting growth. Empirical literature,

nevertheless, has thus far produced mixed and inconclusive results. Likewise, the bulk of prior literature concentrated primarily on generalized empirical inquiries across countries employing panel (cross-country and/or cross-section) data analysis which might not adequately address country-specific peculiarities and are likely to suffer from the problems of heterogeneity and data comparability. Moreover, the overwhelming majority of the extant works focused on advanced and industrial nations (in Latin America, Asia, and Europe) affording SSA countries little coverage and in some instances none at all. Also, there has been almost no attention paid in the literature to the complementarity impact of both patterns of diversification in advancing growth. Most importantly, to date, empirical inquiries on countries like Nigeria are almost non-existent. Thus, the paper attempts to close this gap.

2. Empirical model and data

Following Esfahani (1991) and Pahlavani (2005), the paper adopts and builds on Feder's theoretical framework to obtain the empirical model in the econometric estimation. To begin with, as in Feder's formulation, the economy's overall output $\{Q\}$ is presumed to be produced by two distinctive sectors, namely the export-oriented sector $\{Q_E\}$ and the domestic-oriented sector $\{Q_D\}$ mathematically expressed as:

$$Q = Q_E + Q_D \tag{1}$$

Moreover, rather than aggregate national production function, it is assumed that production functions for both Q_E and Q_D sectors are of the forms:

$$Q_E + G\{K_E, L_E\} \tag{2}$$

$$Q_D + F\{K_D, L_D, Q_E\} \tag{3}$$

where Q_E & Q_D represent the outputs of export and non-export sectors, respectively; K_E & K_D denote respective capital stocks; and L_E & L_D signify respective labour forces.

Furthermore, as illustrated respectively in (2) and (3), following Feder's (1983) model, it is assumed that while the output of Q_E sector is a function of $\{K_E\}$ & $\{L_E\}$, the output of Q_D sector is not solely dependent on $\{K_D\}$ & $\{L_D\}$, but additionally on the output of Q_E sector. The representation, as revealed in (3), denote the spillover effects of Q_E sector on Q_D sector (e.g., the introduction of improved production techniques, internationally competitive and efficient managements practices, steadier flow of imported input, and the training of more

productive labour} These beneficial/spillover effects are known as externalities since they do not reflect in market prices.

Taking the total differential of equations (2–3) yields, respectively:

$$\dot{Q}_E = G_{K_E}\dot{K}_E + G_{L_E}\dot{L}_E \tag{4}$$

$$\dot{Q}_D = F_{K_D}\dot{K}_D + F_{L_D}\dot{L}_D + F_{Q_E}\dot{Q}_E \tag{5}$$

where the dot above the variable represents its time derivative (or rate of growth); G_{K_E} & F_{K_D} denote marginal physical products (MPP) of stock of capital in Q_E & Q_D, respectively; G_{L_E} & F_{L_D}represent marginal physical products (MPP) of labour in Q_E & Q_D, respectively; while F_{Q_E} indicates marginal externality effects of Q_E sector on Q_D sector.

Following Feder (1983), let Q be the economy's real Gross Domestic Product {GDP}, and since by definition $Q = Q_E + Q_D$; it follows that:

$$\dot{Q} = \dot{Q}_E + \dot{Q}_D \tag{6}$$

Using equations (4–5) in equation (6) yields

$$\dot{Q} = G_{K_E}\dot{K}_E + G_{L_E}\dot{L}_E + F_{K_D}\dot{K}_D + F_{L_D}\dot{L}_D + F_{Q_E}\dot{Q}_E \tag{7}$$

Moreover, as in Feder's (1983) formulation, marginal products of capital G_{K_i} & labour G_{L_i} {for $i = E$ and D} are postulated to be higher in the Q_E sector than in the Q_D sector because of several reasons. First is the more globally competitive business climate that export-focused businesses operate. A highly competitive environment encourages adaptability, innovation, ingeniousness and greater efficiency in resource use. Second, higher perceived uncertainty alongside several constraint and regulations {such as foreign exchange and credit rationing} inherent in export enterprises. Therefore, as explicated in equation (8), the ratio of the two sectors' marginal factor productivities differs from unity by the added factor ∂, that is:

$$\frac{G_{K_E}}{F_{K_D}} = \frac{G_{L_E}}{F_{L_D}} = 1 + \delta \tag{8}$$

where the subscripts signify partial derivatives.

Incorporating equation (8) in (7) yields

$$\dot{Q} = \{1+\delta\} F_{K_D}.\dot{K}_E + \{1+\delta\}\ F_{L_D}.\dot{L}_E + \ F_{K_D}\ \dot{K}_D + F_{L_D}\ \dot{L}_D + \ F_{Q_E}\ \dot{Q}_E \tag{9}$$

$$\dot{Q} = F_{K_D}.\dot{K}_E + \delta F_{K_D}.\dot{K}_E + F_{L_D}.\dot{L}_E + \delta F_{L_D}.\dot{L}_E + F_{K_D}\dot{K}_D + F_{L_D}\dot{L}_D + F_{Q_E}\dot{Q}_E \quad (10)$$

$$\dot{Q} = F_{K_D}.\dot{K}_E + F_{K_D}\dot{K}_D + F_{L_D}.\dot{L}_E + F_{L_D}\dot{L}_D + \delta F_{K_D}.\dot{K}_E + \delta F_{L_D}.\dot{L}_E + F_{Q_E}\dot{Q}_E \quad (11)$$

$$\dot{Q} = F_{K_D}\left\{\dot{K}_E + \dot{K}_D\right\} + F_{L_D}\left\{\dot{L}_E + \dot{L}_D\right\} + \delta\left\{F_{K_D}.\dot{K}_E + F_{L_D}.\dot{L}_E\right\} + F_{Q_E}\dot{Q}_E \quad (12)$$

Expressing (8) in terms of G_s and substituting them into $\left\{F_{K_D}.\dot{K}_E + F_{L_D}.\dot{L}_E\right\}$

$$F_{K_D}.\dot{K}_E + F_{L_D}.\dot{L}_E = \frac{G_{K_E}}{1+\delta}.\dot{K}_E + \frac{G_{L_E}}{1+\delta}.\dot{L}_E = \frac{1}{1+\delta}\left\{G_{K_E}.\dot{K}_E + G_{L_E}.\dot{L}_E\right\} \quad (13)$$

Recall that $\dot{Q}_E = G_{K_E}\dot{K}_E + G_{L_E}\dot{L}_E$ {in 5}. Consequently, (13) is rewritten as follows:

$$F_{K_D}.\dot{K}_E + F_{L_D}.\dot{L}_E = \frac{G_{K_E}}{1+\delta}.\dot{K}_E + \frac{G_{L_E}}{1+\delta}.\dot{L}_E = \frac{1}{1+\delta}\left\{G_{K_E}.\dot{K}_E + G_{L_E}.\dot{L}_E\right\} = \frac{\dot{Q}_E}{1+\delta} \quad (14)$$

Using (14) in (12) yields

$$\dot{Q} = F_{K_D}\left\{\dot{K}_E + \dot{K}_D\right\} + F_{L_D}\left\{\dot{L}_E + \dot{L}_D\right\} + \left\{\delta\frac{\dot{Q}_E}{1+\delta}\right\} + F_{Q_E}\dot{Q}_E \quad (15)$$

$$\dot{Q} = F_{K_D}\left\{\dot{K}_E + \dot{K}_D\right\} + F_{L_D}\left\{\dot{L}_E + \dot{L}_D\right\} + \left\{\frac{\delta}{1+\delta} + F_{Q_E}\right\}\dot{Q}_E \quad (16)$$

By defining $\dot{K} = \dot{K}_E + \dot{K}_D$ and $\dot{L} = \dot{L}_E + \dot{L}_D$ and substituting into (16) yields

$$\dot{Q} = F_{K_D}\dot{K} + F_{L_D}\dot{L} + \left\{\frac{\delta}{1+\delta} + F_{Q_E}\right\}\dot{Q}_E \quad (17)$$

To simplify the empirical specification, suppose in (17) that F_{K_D} & F_{L_D} {MPP capital and labour} respectively are α & β; and $\frac{\delta}{1+\delta} + F_{Q_E}$ {productivity differentials and the export sector's marginal externality effects} is θ; equation (17) is rewritten as follows:

$$\dot{Q} = \alpha\dot{K} + \beta\dot{L} + \theta\dot{Q}_E \quad (18)$$

This representation in (18), which resembles the traditional neoclassical framework, provides the basis for the empirical models utilized in the econometric estimation. Based on the equation, real GDP growth rate is a function of growth rates of capital, labour, and merchandise exports. Accordingly, in line with the theoretical framework, an econometric expression of (18) which includes an intercept, θ_0, and an error term, μ, is specified as follows:

$$q_t = \theta_0 + \theta_1 k_t + \theta_2 l_t + \theta_3 x_t + \mu_t \tag{19}$$

Lower-case letters represent natural logarithms, q implies real aggregate output; k and l are, respectively, physical capital and labour inputs; x signifies merchandise exports; and subscript t denotes the time period (1960–2022).

Following Shahzad et al. (2021), merchandise export is measured using two alternatives, namely intensive- and extensive-margin (depict respectively by i_t and e_t). Furthermore, the study incorporates human capital (proxied by index of human capital, h, measurement of the amount of human capital that a child born today can anticipate to attain by age eighteen) instead of total labour force as regressor. The primary contention, as noted in development economics, is that a well-educated and healthy labour force is more inventive and creative. Finally, to examine the complementarity effect of both patterns of export diversification on growth, the multiplicative interactive term $\{i_t \times e_t\}$ is incorporated in model (19) as a predictor.

In light of these, the study modifies and extends the estimable model (19) as follows:

$$q_t = \theta_0 + \theta_1 k_t + \theta_2 h_t + \theta_3 i_t + \theta_4 e_t + \theta_5 \{i_t \times e_t\} + \mu_t \tag{20}$$

Before leaving the subsection, attempts are further made to explain the growth equation (20) by means of macroeconomic stability and economic reforms variables. Based on data availability and prior works, the study incorporates inflation and FDI (foreign direct investment) in (20) as covariates (following, Zhang, 2001; Adrián-Risso, Carrera, 2009; Hossin, 2015).

The role of inflation in the growth process has been a subject of intense debate. Theoretically, this debate is polarized between two prevalent opposite viewpoints, namely the monetarists and structuralists expositions. The former holds the notion that inflation is inimical and harmful to growth. Contrarily, exponents of the latter postulate that inflation rate is essential/advantageous to growth (see Paul et al. 1997). Numerous studies have examined the growth-inflation nexus. Econometric results, however, remain ambiguous and inconclusive to date. Similar to inflation rate, two competing theoretical notions on how FDI and growth are related have evolved in development economics: the modernization and dependency theories. The modernization exposition, whose notions are grounded in the neoclassical and endogenous growth models, argue that inflow of FDI is beneficial for a hosts economic growth. In contrast, the dependency theorists contend that the growth prospects of the recipient economies are negatively impacted by FDI inflows. A plethora of studies have investigated the role of FDI in promoting economic growth. Extant findings, nevertheless, are at best mixed and inconclusive.

Against this backdrop, equation (20) is redefined to include inflation rate, $\{\partial r_t\}$, and FDI inflow, $\{f_t\}$, as follows:

$$q_t = \sigma_0 + \sigma_1 k_t + \sigma_2 h_t + \sigma_3 i_t + \sigma_4 e_t + \sigma_5 \{\partial r_t\} + \sigma_6 f_t + \sigma_7 \{i_t \times e_t\} + \mu_{2t} \tag{21}$$

For more in-depth analyses, and most importantly to evade potential multicollinearity problems, two variants of equation 21 are estimated. To this end, following Nikoloski and Gveroski (2017), the study re-specifies the baseline model obtained in (21) to exclude either variable *i* and *e* as follows:

$$q_t = \theta_0 + \theta_1 k_t + \theta_2 h_t + \theta_3 i_t + \theta_4 \{\partial r_t\} + \theta_5 f_t + \theta_6 \{i_t \times e_t\} + \mu_{3t} \tag{22}$$

$$q_t = \beta_0 + \beta_1 k_t + \beta_2 h_t + \beta_3 e_t + \beta_4 \{\partial r_t\} + \beta_5 f_t + \beta_6 \{i_t \times e_t\} + \mu_{4t} \tag{23}$$

All the variables (save for inflation rate) are in their natural log forms. The coefficients of interests are: θ_3, β_3, θ_6, and β_6. Following theoretical and empirical arguments surrounding *i* and *e*, the study expects θ_3, and β_3, to have positive impacts on growth. θ_6 and β_6, which are the interactive coefficients between *i* and *e* are expected to be positive. A priori, a positive sign would be consistent with complementarity hypothesis where both intensive-margin and extensive-margin complement each other to drive growth. θ_1, β_1, θ_2 and β_2 are expected to be positive; while θ_4, β_4, θ_5 and β_5 are anticipated to be either positive or negative. Subscript *t* depicts the time dimension, μ*'s* denote error term, θ_0 and β_0 represent the intercept.

One main limitation of equations 22–23 is that they do not allow policymakers to differentiate betwixt the long-run contributions of factors, to GDP per capita growth, from the short-run contributions. Though growth policies are aimed at obtaining long-term results, production decisions usually take account of the short-run contribution of factors of production. Therefore, by ignoring the short-run dynamics of the models, important insights are lost. Also, with the upward trending nature of GDP per capita growth, it is feasible and reasonable to presume that countries' growth levels in a particular period may be influenced by previous years' levels. How quickly growth levels change at the end of this period may be dependent on initial growth levels.

Thus, the study respecifies the growth models to account for both short-run and long-run dynamics. To this end, the ARDL-bounds test procedure is employed. The technique is applied and deemed apt for two reasons. One, it is applicable regardless of the integrational properties of the variables and has better statistical properties in testing the presence of cointegration. Two, considering how closely GDP per capita growth, physical capital stocks, human capital index, intensive-margin, extensive-margin, inflation and FDI included in 22–23, the procedure is apt

to handle any possible endogeneity problems and thus eliminates the possibility of inconclusive inference. Arising from the above, the ARDL representations (of 22 and 23, respectively) are stated as follows:

$$\begin{aligned}\Delta q_t = {} & \varphi_0 + \varphi_1 q_{t-1} + \varphi_2 k_{t-1} + \varphi_3 h_{t-1} + \varphi_4 i_{t-1} + \varphi_5 \{\delta r_{t-1}\} + \varphi_6 f_{t-1} + \varphi_7 \{i_{t-1} \times e_{t-1}\} + \\ & + \sum_{j=1}^{\delta} \rho_{1j} \Delta q_{t-j} + \sum_{j=0}^{\gamma} \rho_{2j} \Delta k_{t-j} + \sum_{j=0}^{\sigma} \rho_{3j} \Delta h_{t-j} + \sum_{j=0}^{\tau} \rho_{4j} \Delta i_{t-j} + \sum_{j=0}^{\vartheta} \rho_{5j} \Delta \{\delta r_{t-j}\} + \\ & + \sum_{j=0}^{\psi} \rho_{6j} \Delta f_{t-j} + \sum_{j=0}^{\beta} \rho_{7j} \Delta \{i_{t-j} \times e_{t-j}\} + \epsilon_{1t} \end{aligned} \tag{24}$$

$$\begin{aligned}\Delta q_t = {} & \partial_0 + \partial_1 q_{t-1} + \partial_2 k_{t-1} + \partial_3 h_{t-1} + \partial_4 e_{t-1} + \partial_5 \{\delta r_{t-1}\} + \partial_6 f_{t-1} + \partial_7 \{i_{t-1} \times e_{t-1}\} + \\ & + \sum_{j=1}^{m} \alpha_{1j} \Delta q_{t-j} + \sum_{j=0}^{x} \alpha_{2j} \Delta k_{t-j} + \sum_{j=0}^{s} \alpha_{3j} \Delta h_{t-j} + \sum_{j=0}^{v} \alpha_{4j} \Delta e_{t-j} + \sum_{j=0}^{d} \alpha_{5j} \Delta \{\delta r_{t-j}\} + \\ & + \sum_{j=0}^{n} \alpha_{6j} \Delta f_{t-j} + \sum_{j=0}^{o} \alpha_{7j} \Delta \{i_{t-j} \times e_{t-j}\} + \epsilon_{2t} \end{aligned} \tag{25}$$

where Δ is the first difference of the series concerned; φ's & ∂'s are long-run estimates; ρ's and α's are short-run parameters; $\{\delta, \gamma, \sigma, \tau, \vartheta, \psi, \beta\}$ and $\{m, x, s, v, d, n, o\}$ are, respectively, optimal lag structure for models (24 and 25) selected by the Schwarz-information criterion (SIC). α_0 and ∂_0 represent the drift parameters, ϵ's connote white noise residuals. Other variables are as explained before. Annual data from 1960–2022 were employed in the study. These data were sourced from the 2022 World Development Indicators published by the World Bank, export quality and diversification databases of the international monetary fund and Penn World Tables 10.01 database.

3. Results and discussion

3.1. Stationary test, lag-length selection, and cointegration results

At first, to avert spurious regressions, the study begins by investigating the integrational properties of the data series. In this respect, the Augmented Dickey-Fuller (ADF) test alongside the Phillips and Perron (PP) test are employed. Estimated ADF and PP results obtained and presented in Table 1 clearly show that, at 5% significance levels, all the series are integrated of order one (save for inflation rate which is found to be stationary in level).

Having established the order of integration, the existence of the cointegrating relationship amongst the variables was also ascertained using the ARDL-bounds testing procedure. However, before the study proceeds with the bounds test, to avoid mis-specification and loss

of degrees of freedom, apt lag-length two incorporated in the first-differenced terms was first ascertained by SIC. Table 2 presents the results of the optimal lag selection.

With the lag length two: 393,366 distinct ARDL specifications for models 24 and 25 were considered and the most apt models (2, 1, 2, 2, 0, 0, 0, 0, 2, 0) and (2, 1, 2, 2, 0, 0, 0, 0, 2, 0) were selected respectively for models 24 and 25. Accordingly, the ARDL-bounds test procedures were employed to establish cointegration among variables. The bounds test results presented in Table 3 reveal that, in each case, the estimated F-statistic value is evidently larger than the upper bound value at 5% significance level, suggesting that the variables are cointegrated.

Table 1. Unit-root tests results (with constant and trend)

Variables	ADF		PP	
	level	1st. diff.	level	1st. diff.
q	–2.2113*	–4.8510*	–1.7876*	–4.8654*
k	–1.2967*	–11.2978*	–1.8368*	–10.6746*
h	–2.3951*	–7.6332*	–1.7213*	–7.6332*
i	–2.2121*	–7.6007*	–4.4242*	–6.8815*
e	–2.0964*	–8.8777*	–4.2241*	–13.7115*
f	–2.4606*	–12.9468*	–1.1448*	–13.3337*
∂r	–4.5805*	NA	–4.5572*	NA

* and NA denote, 5% significance level and not applicable, respectively.

Source: the authors.

Table 2. Lag-length selection results

Lag	LogL	LR	FPE	AIC	SIC	HQ
Equation 24						
0	–5.8528	NA	0.0000	0.5374	0.8895	0.6748
1	612.8044	1006.6290	0.0000	–17.0442	–13.1708*	–15.5322
2	725.4726	145.1319	0.0000	–17.4737	–10.0790	–14.5871
3	885.1349	151.5438	0.0000	–19.4961	–8.5802	–15.2350
4	1131.9770	150.6154*	2.87e–22*	–24.4738*	–10.0367	–18.8381*
Equation 25						
0	–18.8365	NA	0.0000	0.9775	1.3296	1.1150
1	606.6693	1017.772	0.0000	–16.8363	–12.9629*	–15.3242
2	718.6920	144.3005	0.0000	–17.2438	–9.8492	–14.3572
3	871.5182	145.0553	0.0000	–19.0345	–8.1186	–14.7734
4	1122.6870	153.2555*	3.93e–22*	–24.1589*	–9.7218	–18.5232*

* Indicates the lag order chosen by the criterion (at 5% significance level).

Source: the authors.

Table 3. Cointegration results

Level of Significance (%)	Bounds values		F-Statistic
	lower I(0)	upper I(1)	
Equation 24			
10.0	1.80	2.80	4.13
5.0	2.04	2.08	
2.5	2.24	3.35	
1.0	2.50	3.68	
Equation 25			
10.0	1.80	2.80	4.16
5.0	2.04	2.08	
2.5	2.24	3.35	
1.0	2.5	3.68	

Source: the authors.

3.2. Long-run and short-run estimates

After ascertaining the presence of cointegration, the coefficient estimates of models 24 and 25 provided in Table 4 were established. To retain brevity, the columns labelled {1} and {2} respectively present the estimates of short- and long-run coefficients. Starting from the error correction term ECT, as seen in the Table, the speed of adjustment coefficients, in line with the theoretical assumptions, are statistically significant, suggesting that disequilibrium occasioned by the previous year's shock dissipates and the economy converges back to a long-run equilibrium in the present year.

On the physical capital-economic growth nexus, in all of the regressions, the estimated long- and short-run dynamics that were obtained reveal that physical capital accumulation (notably investments in fixed assets) plays a vital and important role in driving growth. Similar results are documented in Oyeleke and Akinlo (2020) for Nigeria. As for human capital impact on growth, as anticipated, in all of the reported regressions, the estimation results evidently underline the importance of human capital development as an essential ingredient of a successful growth strategy. The results are consistent with the findings by Keji (2021). In line with a priori expectation, estimated impacts of intensive-margin and extensive-margin reveal that both margins significantly enhance growth. However, the contribution to growth of extensive-margin outweighs that of intensive-margin. The result seems to support Krugman's (1980) and

Lancaster's (1980) arguments that intensive-margin might not be growth- enhancing as much as extensive-margin. Similar results were observed by Young (2023).

As regards the effect of inflation on growth, the results not only validate the monetarists' exposition but also invalidate the structuralists' proposition. As shown in Table 4, in models 24 and 25, high inflation hurts and worsens short- and long-run growth. Similar findings were reported by Uddin and Rahman (2023). As to the FDI – growth nexus, in all of the reported regressions, the estimated results suggest that foreign capital contributes positively to short and long run growth, as anticipated. These results, however, are insignificant and weak. A plausible rationale for this insignificance impact could be because the bulk of FDI to Nigeria are concentrated mainly in the extractive industry (mostly in the oil sector) with little or no spill overs to other (agriculture, solid minerals and manufacturing) sectors. These results are in line with Akinlo (2004).

With respect to the variables of interest, in all of the regressions, the results reveal that both margins significantly reinforce/complement each other and jointly exert a strong positive effect on growth. These findings confirm the importance of both patterns of diversification and align with the argument in the literature that neither the intensive- nor extensive-margin is a perfect substitute for the other. Lastly, a range of diagnostic tests (presented in panels 2 and 3 of Table 4) were conducted to ascertain that the models are apt and fit for an empirical analysis. The results revealed that the models possess the apt best linear unbiased estimator properties. The cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) of recursive residuals were also plotted to ascertain the stability of the estimated coefficients. The results clearly indicate the absence of instability. However, to conserve space, they are not presented but are available upon request.

Table 4. Estimation results

Panel 1. Short- and long-run estimates				
Regressors	Model 24		Model 25	
	1	2	1	2
ECT (–1)	–0.3153 {–10.7115}*		–0.3852 {–6.6235}*	
C		1.2419 {2.0024}*		1.6082 {8.7402}*
k	1.4100 {4.4145}*	3.0019 {2.1951}*	1.3730 {1.8459}*	3.1377 {2.2074}*
h	2.1277 {4.0823}*	3.3335 {3.0183}*	2.3360 {3.4237}*	3.3254 {3.5869}*
i	0.5015 {3.9364}*	1.1901 {2.1202}*		

Continuation of table 4

e			1.1472 {6.0602}*	2.3161 {4.1920}*
∂r	–0.4995 {–2.1840}*	–1.0254 {–8.2097}*	–0.3282 {–3.2276}*	–1.0478 {4.8352}
f	0.0056 {0.2328}*	0.0654 {1.3063}*	0.0005 {0.0304}*	0.0431 {1.6734}*
i*e	3.7773 {2.8142}*	4.7686 {2.9156}*	3.3025 {2.9760}*	4.7372 {2.3031}*
Panel 2: Goodness of fit measures				
R-squared	0.9844		0.9722	
Adjusted R-squared	0.9797		0.9603	
F-statistic	111.0513		101.6620	
Probability (F-statistic)	0.0000****		0.0000****	
Durbin-Watson	2.1204		2.3414	
Panel 3: Diagnostic tests				
Serial Correlation LM		3.0125** 0.6021****		3.3342** 0.4866****
Heteroskedasticity		1.0869** 0.6814****		1.0703** 0.5759****
Normality		10.7561*** 0.6852****		10.9204*** 0.6311****
Functional Form		{3.4499}* 0.7015****		{2.0239}* 0.6383****

Figures in parentheses are t-statistics. Statistical significance at 5% is indicated by *. Values with **, ***, and **** depict, respectively, Obs R-squared, Jarque-Bera Statistic, and Probability.

Source: the authors.

Conclusions

Two distinct patterns of export diversification have emerged in the last five-and-a-half decades, namely intensive-margin and extensive-margin of export. The paper studied the effect of complementarity between the aforesaid patterns of export diversification on economic growth, with specific reference to Nigeria, for the period 1960–2022, using the ARDL-bounds test procedure. The study finds that both patterns of diversification significantly complement each other and jointly exert a strong positive effect on growth, in the long-and-short-run. These findings suggest several insightful and far-reaching policy implications. First, to take full advantage of the potential growth-enhancing effect of an export diversification strategy, both patterns of export diversification should not be considered in isolation by government policymakers. Secondly, simultaneous policies should be designed and implemented to enhance their impacts on growth. Thirdly, there is the need for the country to implement policies

for industrial development that can help facilitate the intensive-margin (price and quantity diversification) and extensive-margin (geographic and product diversification). Importantly, intentional measures must be taken to promote FDI into non-oil (non-traditional) sectors like manufacturing and solid minerals, primary product development, and initiatives to improve the quality of extant exports. In this context, encouraging export processing zones, industrial parks, special economic zones, etc., are plausible and beneficial avenues. The success of China and South Korea provides very clear evidence of this.

Fourthly, public-private partnerships for infrastructure finance and export diversification initiatives should be initiated by the government. This is a financing method that involves sharing risks and mitigating investment risk between public and private parties. Build-Own-Operate-Transfer (BOOT), Build-Own-Operate (BOO), Build-Lease-Transfer (BLT), Build-Transfer-Operate (BTO), and Build-Transfer (BT) are some of the available possibilities. Lastly, Nigeria must facilitate trade by harmonizing and streamlining customs procedures (which is crucial for lowering the cost of exports), in addition to offering a wide range of financial services at lower costs for small and new exporters (who may have the potential to develop new export lines). This will allow Nigerian companies to export more and diversify their exports.

In conclusion, the factors influencing both margins and their combined impact on the non-oil sector's efficacy to promote growth should be the subject of future studies (which is outside the scope of this study).

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