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SPECIALIZATION VERSUS DIVERSIFICATION AS ALTERNATIVE STRATEGIES FOR SUSTAINABLE GROWTH IN RESOURCE-RICH DEVELOPING COUNTRIES. CASE OF NIGERIA

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Abstract. The question of whether developing countries should pursue specialization or diversification in export as a driver of sustainable economic growth has been a subject of an intense debate in economic literature. At present, one understanding of the debate, as postulated by Imbs and Wacziarg (2003), is that economies grow through two stages of diversification and concentration as income grows: they initially diversify but re-specialize once a (relatively) high level of income per capita is attained. A U-shaped curve best explains the notion. With Nigeria as a reference country, we employed ARDL procedure and examined the aforementioned exposition over the period 1960-2019. Specifically, the non-monotonic relationship between diversification and growth is examined. In furtherance, we examined the impact of diversification on the effect of non-oil exports on growth. Employing an augmented production-function framework and two distinct measures of diversification, we find, contrary to the Imbs-Wacziarg notion, a monotonic (increasing) relationship between diversification and growth, suggesting that diversification, rather than specialization, continues with growth. Applying a similar framework and five different measures of non-oil exports, we find that the impact of diversification on the effects of agricultural and industrial sectors on growth is higher, as compared to building and construction, wholesale and retail, services sectors.

Keywords: Diversification, Specialization, Imbs-Wacziarg hypothesis, Resource-Rich Developing Countries.

JEL Classification: F10, O10, O11, O13, O20, O40.

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1. Introduction

The debate on whether developing countries should pursue specialization or diversification in export as a driver of sustainable economic growth has received a great deal of attention in economic literature. Theoretically, there are two opposite strands of literature to this debate. On the one hand, beginning with Ricardo's theory of comparative advantage in the early 19th-century, proponents of one strand of the literature hold the notion that specialization, in accordance with the country's comparative advantage, is good for growth. On the other hand, following Prebisch's (1950) and Singer's (1950) innovative works, exponents of the other (particularly the structuralist theory) advocate greater export diversity as more apt for growth.
A substantial number of studies have examined the relevance and macroeconomic implications of these propositions. However, studies have failed to suggest an overall dominance of one notion over the other. While some studies (such as those by Romer, 1987; Marshall, Schwartz and Ziliak, 1991; Dalum, Laursen & Verspagen, 1999; Plümper & Graff, 2001; Wörz, 2003; Batista, 2004; Gallardo, 2005; Naudé, Bosker, & Matthee, 2010; Lee, 2011; Murshed & Serino, 2011; Jarreau & Poncet, 2012; Van Oort, de Geus & Dogaru, 2015; Kemeny & Storper, 2015; Simonen, Svento & Juutinen, 2015; Stefaniak-Kopoboru & Kuczewska, 2016; Nabi & Kaur 2019) found evidence consistent with the Ricardian model; on the contrary, others (Stokes & Jaffee, 1982; Love, 1986; De Piñeres & Ferrantino, 1997; Al-Marhubi, 2000; Balaguer & Cantavella-Jorda, 2004a, 2004b; Ben Hammouda, Karingi, Njuguna & Sadni Jallab, 2006; Herzer & Nowak-Lehmann 2006; Agosin, 2007; Lederman & Maloney, 2007; Matthee & Naudé 2008; Feenstra & Kee, 2008; De Benedictis, Gallegati & Tamberi, 2009; Arip, Yee & Abdul Karim, 2010; Kadyrova, 2011; Aditya & Acharyya, 2013; Pede, 2013; Hamed, Hadi, & Hossein, 2014; Lugeiyamu, 2016; McIntyre, Xin Li, Wang & Yun, 2018; Mania & Rieber, 2019; Jongwanich, 2020) have also validated the structuralist exposition.
Lately, as a reconciliation to the two scenarios, Imbs and Wacziarg (2003) in their path-breaking work, Stages of Diversification, postulate that economies grow through two distinct stages of initial diversification and eventual concentration (Batista & Potin, 2014). At first, as the level of per capita income increases, countries first diversify, in the sense that economic activity is spread more equally across sectors (Imbs & Wacziarg, 2003), but there exist, relatively late in the development process, a point at which they start specializing again. A U-shaped curve best explains the notion. Studies, albeit still at the preliminary stage, have investigated the predictions and implications of the exposition. While some, as section (2) highlights, have lent credence to this view; others (such as Kaulich, 2012; Hodey, Oduro & Senadza, 2015) have refuted the existence of a re-specialization, and instead maintain that the diversification process continues.

As is the case in many resource-rich developing countries (RRDCs), particularly in oil-producing nations, crude-oil export has been the mainstay of the Nigerian economy. Historically, since the discovery in 1956, it accounts for nearly 90-95 percent of the country's foreign exchange earnings, 25 percent of its gross domestic product (GDP) and over 80 percent of government revenue (Olayungbo, 2019). Indeed, ever since Nigeria joined the ranks of oil producers in 1958 when its oil field came on stream producing 5,100 barrels per day, oil has made invaluable contributions to the economy and has continued to play a dominant role. Regrettably, the country's extreme reliance on oil export has triggered structural difficulties (Aigbedion & Iyayi, 2007) and complicated macroeconomic management (Akinlo, 2012) for the economy as earnings from oil fluctuate along with market trends; acute unemployment rate (Uzonwanne, 2015) as the sector could only employ a limited number of the population and worse still, only experts; high and rising level of poverty; and poor infrastructural development which are exacerbated by the neglect of non-oil sectors (Riti, Gubak & Madina, 2016) of the economy where the potential remains great but largely unexploited.
To break off the near-total dependence of the country on oil with all its attendant problems, restructure, and more importantly diversify the productive base of the economy, several economic policies and programs were introduced and implemented at different periods by successive governments. Notable among these are the Economic Stabilization Act of 1982; Structural Adjustment Policy of 1986; Rolling Plan of 1990-1998; National Economic Empowerment and Development Strategy of 2004; Subsidy Re-investment and Intervention Programme of 2012-2015; and recent Economic Recovery and Growth Plan of 2017-2020. Albeit, the contents of these policies and programs are plausible and positive changes were noticed during the implementation, nevertheless, the full-anticipated benefits are far from being realized as the oil still dominates. A number of factors have been identified as a possible cause of the failure of these policies.
Noticeable among these are the incoherent implementation of the policies and the neglect of country-specific circumstances which ought to, as a matter of necessity, be considered. Informed by the need to take cognizance of the implementation problems and the country's peculiar circumstances, the question as to which priority sectors Nigeria should target for export diversification strategy and how best to promote the policy has come up in literature. As a follow-up, numerous studies (such as those by Ayodele, Akongwale & Nnadozie, 2013; Eko, Utting & Onun, 2013; Mbaegbu, 2016; Olalekan, Afees & Ayodele, 2016; Chukwuma, 2018; Tonuchi & Onyebuchi, 2019) have suggested agricultural, tourism, industrial (solid-minerals, manufacturing, energy), services and many others sectors as viable options for diversifying the economy.

Motivated by the novel work of Imbs and Wacziarg (2003), with the unresolved debate, and the government's long-standing efforts to diversify the productive base of the economy, this paper aims to ascertain the nature of the relationship between export diversification and economic growth in Nigeria, in a dynamic and multivariate growth framework. Albeit, as evinced in most of the above-cited studies, the literature holds a replete of empirical contributions on the subject. However, an in-depth reading of the literature suggests that, other than the fact that findings are mixed and do not provide conclusive evidence, the bulk of these studies predominantly focused on European, Asian and American than African economies. Moreover, the attention of most of these studies has been heavily biased towards cross-country and cross-section (sometimes, panel) econometric analysis for a particular region. Apart from these, as section (2) highlights, country-specific studies examining the aforesaid relationship, within the context of African countries, have received little or no attention in economic literature. In fact, based on the assessment of the literature, hardly has any study been reported exclusively for Nigeria. The paper, thus, fills the gap.

Using annual time series data, for the period 1960-2019, we employ Autoregressive Distributed Lag (ARDL) procedure to examine the non-monotonic relationship between diversification and growth within the context of the Nigerian economy. In furtherance, we examined the impact of diversification on the effect of non-oil exports on growth.

The paper contributes to the literature in three-fold. First, it evaluates the diversification-growth relationship in a dynamic growth framework and in particular considers whether it may in fact be non-monotonic, providing a more robust and rigorous approach than has been attempted. Second, it examines the impact of diversification on the effect of non-oil exports on growth. Since different export components, as suggested by Bbaale and Mutenyo (2011), have a differential influence on growth, to unmask the important differences between different export categories, following Ugochukwu and Chinyere (2013); Raheem (2016); and taking into cognizance the country and objective of the study, the paper decomposes aggregate exports into non-oil and oil sectors. The idea is that insights on the differential impact of export components on growth is requisite to successful policy formulation, analysis and advocacy.

Also, to add richness, flexibility and provide an intuitive insight to the analysis, the interaction terms between the index of diversification and non-oil exports (which we further divided into agricultural, industrial, building and construction, wholesale and retail, as well as, services sectors) are incorporated. This is in light of the argument documented by Cuaresma and Wörz (2005) that efficiency, knowledge spillover, and economies of scale are different across export components.

Finally, it examines the subject in the context of the African perspective, particularly the Nigerian economy. To date, existing evidence on Nigeria lacks comprehensive insights on the theme. The bulk of the existing studies (such as those by Suberu, Ajala, Akande & Olure-Bank, 2015; Anyaehie & Areji, 2015; Nworu, 2017; Isukul, Chizea & Agbugba, 2019) is descriptive and/or qualitative rather than quantitative. Several others (Alabi, 2018; Duru & Ehidiamhen, 2018; Nwosa, Tosin, & Ikechukwu, 2019; Doki & Tyokohol, 2019; Huseyin & Shuaibu, 2020; Owan, Ndibe & Anyanwu, 2020) investigate the impact of diversification on growth but failed to account for the non-monotonic relationship between diversification and growth. Still others (Onodugo, Ikpe & Anowor, 2013; Abogan, Akinola, & Baruwa, 2014; Vincent, 2017; Akanegbu & Chizea, 2017; Onuorah, 2018; Olayungbo, & Olayemi, 2018; Zoramawa, Ezekiel & Umar, 2020) examine the role/impact of non-oil export on growth which by their nature have been far from being definitive on the impact of diversification on the effect of non-oil exports on growth.
Following the introduction, the remainder of the paper is structured as follows. First, a brief review is presented of theoretical and empirical evidence. Next, the econometric methodology adopted in the paper and data is discussed. This is followed by estimation techniques and empirical analysis. Afterward, findings from the analysis, conclusions and policy recommendations are presented.

2. Review of Related Literature

In this section, a brief review is presented of empirical evidence on the theme. Importantly, to retain brevity, attention is given to studies from the late 1980s. Starting with the literature on the specialization-growth relationship, in his novel work, Romer (1987) models increasing returns that arise because of specialization. He highlights the role of specialization in increasing returns from investments in knowledge and external effects due to spillovers of knowledge, both of which foster growth. Using a data set on growth and trade in 11 manufacturing sectors, over the period 1965-1988, for the Organization for Economic Cooperation and Development (OECD) area, Dalum et al (1999) maintain that specialization does matter for growth.
Plümper and Graff (2001), in a study of ninety (developed and developing) countries, find that specialization, contrary to the structuralist theorists' expositions, matters for growth. Wörz (2003) analyzes trade patterns for six different groups of countries (OECD north and south, South and East Asia, Latin America, Central and Eastern Europe). A few general features were observed. Importantly, specialization in exports is clearly more pronounced, with differing patterns between country groups, than specialization in imports. Given Latin America's general specialization in resource-based products (RBPs), Batista (2004) finds that exports of countries that

specialized in differentiated or highly differentiated goods tend to be much more dynamic than those that specialized in homogenous goods.

Gallardo (2005) discovers that specialization according to comparative advantage indeed benefits a country. Krugman and Obstfeld (2006) posit that countries benefit from opening to trade and specializing in the production of goods in which they a comparative advantage. Applying export data from 354 magisterial districts of South Africa for 1996-2001, Naudé et al. (2010) find that specialization, rather than diversification, has been associated with local economic growth.

Lee (2011), based on a sample of 71 countries since 1970, suggests that economies tend to grow more rapidly when they have increasingly specialized in exporting high-technology as opposed to traditional or low technology goods. Employing dynamic panel data and disaggregated trade data sets, Murshed and Serino (2011) maintain that only specialization in unprocessed natural resource products slows down growth, as it impedes the emergence of more dynamic patterns of specialization. Jarreau and Poncet (2012), over the period 1997-2009, find that regions specializing in more sophisticated goods grow faster. Stefaniak-Kopoboru and Kuczewska (2016) analyze the specialization of the Visegrad countries (namely Czech Republic, Hungary, Poland and Slovakia). Nabi and Kaur (2019), over the period 1995-2017, evaluate the export specialization of India with the top five agricultural economies (the USA, UK, UAE, Singapore and China).

Despite the apparent need for specialization as motivated by the literature surveyed above, a thread of skepticism has remained with regard to the appropriateness and practicality of specialization in RRDCs. Stokes and Jaffee (1982), for instance, find that specializing in the export of goods with low levels of processing has a significant negative effect on growth. Love (1986) suggests that, first, heavy concentration on one/few products lessens a country's chances of having fluctuations in some of its export commodities offset, partially or completely, with sectors in which stability prevails and, secondly, diversification is a useful strategy to reduce instability in export earnings experienced by developing countries. De Piñeres and Ferrantino (1997), for the period 1962-1991, find that Chilean growth has been accompanied by export diversification. Al-Marhubi (2000) maintains that diversification, rather than a specification, promotes growth in developing countries. Similar results were likewise uncovered by Balaguer and Cantavella-Jorda (2004a; 2004b); Ben Hammouda et al (2006); with respect to Spain and African countries, respectively.

Herzer and Nowak-Lehmann (2006), based on annual time series data for Chile, suggest that diversification plays an important role in growth. Lederman and Maloney (2007) in a cross-country framework, for the period 1975-1999, find evidence that export concentration was negatively related to growth. Agosin (2007), over the period 1980-2003, finds that diversification, alone and interacted with per capita export growth (a measure of diversification-weighted export growth rate), is significant in explaining per capita GDP growth in Asia and Latin America. Using data from 19 sectors within 354 sub-national districts of South Africa and various measures of sub-national export diversity, Matthee and Naudé (2008) find that regions with less specialization and more diversified exports generally experienced higher growth rates. Applying the monopolistic competition model to heterogeneous firms across 48 countries from 1980-2000, Feenstra and Kee (2008) show that export variety leads to productivity improvements.

Calderon and Schmidt-Hebbel (2008), using a sample of 82 countries over the period 1975-2005, find that output fluctuations stabilize when trade openness is associated with well-diversified trade structures. Applying a generalized addictive model with country-specific fixed effects and controlling for countries' heterogeneity, De Benedictis et al (2009) show that, on average, countries do not specialize; on the contrary, they diversify. Using annual data from 1980-2007, Arip et al. (2010) find that diversification plays a significant role in the economic growth of Malaysia. With a sample of 88 countries over the period 1962-2009, Kadyrova (2011) provides evidence on the positive impact of diversification on countries' income per capita growth, with a stronger effect on developing countries. Pede (2013), over the period 1990-2007, finds that diversity has a positive impact on growth for US counties.

Employing the generalized method of moments, over the period 2000-2009, Hamed et al (2014) investigate the role of diversification in the growth of some selected developing countries. They find that reducing specialization and consequently increasing diversification has significant positive effects on the rate of growth of the countries. Sannassee, Seetanah and Lamport (2014), over the period 1980-2010, for Mauritius, find a positive relationship between diversification and growth, both in short- and long-run periods. Using a cross-section dataset for the period 1998-2009, across Africa, Lugeiyamu (2016) find that countries with more diversified exports generally experienced faster growth.

McIntyre et al. (2018) assess the economic performance of different groups of 34 small states over the period 1990-2015 and find that those more diversified experienced lower output volatility and higher average growth than most other small states. Based on econometric estimates of panel data of Latin America, Sub-Saharan Africa and Developing Asia, over the period 1995-2015, Mania and Rieber (2019) find that diversification facilitates structural transformation and is conducive to growth via cross-sectoral technology spillover effects. Jongwanich (2020), over the period 2002-2016, at the industry level, using Thailand as a case study, finds that the effects of diversification and margins on growth vary across industries. Diversification helps boost growth in some sectors, including electronics, automotive and chemicals, plastic and rubber.

A more general finding that the specialization-diversification-growth relationship varies with a country's stage of development in a non-monotonic fashion has also come up in literature. In their innovative study, Imbs and Wacziarg (2003), employing data on sector-level employment and value-added, covering a wide cross-section of (developing and developed) countries at various levels of disaggregation, find that economies grow through two different stages of diversification and concentration as per capita income grows: they initially diversify but re-specialize once a relatively high level of income per capital is reached (Imbs, 2004). The turning point for countries that switch from domestic diversification to specialization is fairly robust at around US$9,000 per capita. Following the Imbs and Wacziarg (2003)'s pioneering work, notable studies (such as those by Klinger & Lederman, 2004; Parteka, 2007; Hesse, 2008; Naudé & Rossouw, 2008, 2011; Cadot, Carrère, & Strauss-Kahn, 2011; Aditya and Acharyya, 2013; Gozgor, & Can, 2016; Munir & Javed, 2018) have suggested that low-income countries tend to diversify, and it is not until they have grown to relatively high levels of income per capita that incentives to specialize take over as the dominant economic force.

In summary, from theoretical and empirical perspectives, the debate on whether developing countries should pursue specialization or diversification in export as a driver of economic growth and development has received considerable attention and generated an extensive body of economic literature from different countries and time periods. However, in spite of a large and burgeoning literature, a careful reading of these studies suggests that findings are mixed and do not provide conclusive evidence. Moreover, aside from the ambivalent findings, hardly any empirical studies have been reported exclusively for African economies, as the bulk of the extant studies largely focussed on European, Asian and American countries.

Besides, the focus of these studies has been biased towards cross-section/cross-country/panel econometric analysis and fails to use long period data. The problem with such discourse, as it is argued in Siddiqui and Ahmed (2019), apart from the general methodological flaws relating to model specification and econometric procedure, is the implicit assumption of homogeneity in the observed relationship across countries, which is likely to be violated given the heterogeneity of economies with regard to economic conditions, technological as well as institutional development, and trade policy. Further, in light of the enormous differences with respect to the nature of data (Siddiqui & Ahmed, 2019), cross-country comparison is fraught with danger. Given the above backdrop, there is the need to not only shed more light on the extent of contradiction-prone evidence and the related policy issues but also examine the subject from the country-specific viewpoint. This study, thus, fills the gap.

3. Methodology

3.1 Model

Following Jalil, Mahmood and Idrees (2013), we adopt the theoretical framework of the neoclassical growth model and specify a Cobb-Douglas production function, with constant returns, having Hicks-neutral technological progress, as follows:

$$q_t = \phi_t P_t \quad (1)$$

where q is real GDP per capita; ϕ and P denote respectively, total factor productivity and capital per worker; and the subscript t signifies time. In the theoretical and empirical literature analyzing the macroeconomic of determinants growth, equation (1) has been expanded in several ways. Numerous studies have suggested a number of robust and important long-/short-term variables, such as fiscal policy, natural resource endowment, domestic demand, monetary policy, human capital, aggregate exports, diversification index, trade openness, inflation and exchange rates, etc, affecting growth. Thus, as in Jalil et al (2013), we assume that

$$\phi_t = f(\rho, T) \quad (2)$$

where ρ is a vector of growth-enhancing variables like indicators of human capital, aggregate exports, index of diversification, trade openness, inflation rate, and other macroeconomic policies, and T incorporating the time dynamics. To retain simplicity, we follow Jongwanich (2020), in the selection of covariates — human capital accumulation, aggregate exports, index of diversification — incorporated in (2). Thus, to derive an econometric model used in examining the non-monotonic relationship between diversification and growth, the importance of stocks of human capital, aggregate exports, and diversification index are first analyzed.

Consequently, we augment equation (1) and specify an econometrically estimable equation (following Ram, 1985; Fosu, 1990; Aditya & Acharyya, 2013; Hodey et al, 2015; Munir & Javed, 2018) with few modifications, as follows:

$$q_t = \alpha_0 + \alpha_1 P_t + \alpha_2 H_t + \alpha_3 X_t + \alpha_4 D_t + \alpha_5 C_t + \varepsilon_t \quad (3)$$

where q is real GDP per capita (economic growth); $P, H, X, D, C,$ and α_0 denote, respectively, physical capital stocks, human capital accumulation, aggregate exports, index of diversification, control variables (a matrix of all other explanatory variables) and intercept; $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ and α_5 are the respective parameters; ε depicts white-noise error term; and the subscript t signifies time.

It is anticipated a priori that physical capital, stocks of human capital, and index of diversification will enhance growth. Thus, the expected signs of the coefficients $\alpha_1, \alpha_2,$ and α_4 are positive. However, concerning α_3 (the impact of aggregate exports on growth), heterogeneity of the export sector, as argued in Fosu (1990), suggests that α_3 may not be constant but would be a function of the composition of exports. As pointed out in Hausmann, Hwang, & Rodrik (2007) and Matthee & Naudé (2008), since not all export products are alike in terms of their consequences for economic performance, thus, the beneficial effects of exports expansion on output, from a policy perspective, extends beyond the influence of aggregate exports on growth and dwells on whether different exports components have differential stimulating power on growth.

Taking into account the country and objective of the study (following Greenaway, Morgan & Wright, 1999; Herzer, Nowak-Lehmann & Siliverstovs, 2006; Merza, 2007) to unmask the important differences between different export categories, we decompose aggregate exports into non-oil and oil exports (which we denote by N_t and M_t, respectively) and incorporate into equation (3) as follows.

$$q_t = \beta_0 + \beta_1 P_t + \beta_2 H_t + \beta_3 N_t + \beta_4 M_t + \beta_5 D_t + \beta_6 C_t + \varepsilon_{2t} \quad (4)$$

Further, as regards the specification of the control variables, based on prior works in the literature and data availability, inflation and openness, along with physical capital, human capital, export (non-oil and oil exports), economic diversification index, are included in (4) as regressors.

The debate on the impact of inflation on growth has been a subject of controversy in economic literature. Theoretically, there are two contentious views to this debate. The first — whose idea is grounded in structuralist theory — holds the notion that inflation is necessary and beneficial for economic growth. Proponents of this strand of literature emphasize that high inflation positively affects growth by lowering unemployment rates (Kasidi & Mwakanemela, 2013; Khan & Khan, 2018). Advocates of the second view — whose standpoint is based on monetarist theory — maintain that inflation is detrimental to economic growth. Numerous studies have examined the implications of these expositions. However, overall conclusions are, at best, mixed and contradictory.

With respect to the growing impact of openness, available evidence, are quite divergent. Studies by Chang, Kaltani & Loayza (2009), Dritsakis & Stamatiou (2016), and Keho (2017) confirm the positive and significant impact of openness on growth. In contrast, Vamvakidis (2002) and Eris & Ulasan (2013) find no support for the openness-led growth hypothesis. Others (Polat, Shahbaz, Rehman, & Satti, 2015; Musila & Yiheyis, 2015) provide evidence of the negative impact of trade on economic growth. This contradictory evidence motivates the study to include openness as an explanatory variable.

In line with these arguments, to examine the non-monotonic relationship between diversification and growth posited by Imbs and Wacziarg (2003), equation (4) is thus

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modified and augmented, by adding openness, inflation and the square term of diversification index, as follows:

$$q_t = \delta_0 + \delta_1 P_t + \delta_2 H_t + \delta_3 N_t + \delta_4 M_t + \delta_5 T_t + \delta_6 (dI_t) + \delta_7 D_t + \delta_8 D_t^2 + \varepsilon_{3t} \quad (5)$$

where P, H, N, M, D, and t are as earlier defined; T and dI denote, respectively, openness and inflation; δ_i {for $i = 1 \ldots 6$} denote the respective coefficients of physical capital, human capital, non-oil export, oil export, openness and inflation rate; ε_{3t} is error term and δ_0 signifies intercept δ_7, and δ_8 represent coefficients of diversification index and its square term respectively.

It is important to note that δ_7 δ_8 and cannot be interpreted directly as the respective share of diversification and its square term. Following Kumar & Stauvermann (2016), Zaman, Shahbaz, Loganathan & Raza (2016), Shahzad, Kumar, Zakaria & Hurr (2017), the coefficients δ_7 and δ_8 obtained are evaluated on the basis of the following five possibilities:

i. $\delta_7 < 0$, $\delta_8 > 0$ imply that the diversification index has a significant negative value, while its square term has a significant positive value. This confirms the U-shaped relationship between growth and diversification.

ii. $\delta_7 > 0$, $\delta_8 < 0$ show that the diversification index has a significant positive value, while its square term has a significant negative value. This suggests an inverted U-shaped relationship between diversification and growth.

iii. $\delta_7 < 0$, $\delta_8 = 0$ reveal that the diversification index has a significant negative value, while its square term has an insignificant value. This implies a monotonic decreasing relationship between growth and diversification.

iv. $\delta_7 > 0$, $\delta_8 = 0$ indicate that the diversification index has a significant positive value, while its square term has an insignificant value. This indicates a monotonic increasing relationship between growth and index of diversification.

v. $\delta_7 = 0$, $\delta_8 = 0$ show that there is flat/no relationship between diversification and growth.

Furthermore, partially differentiating equation (5) with respect to diversification index and equating that to zero yields the critical point (value) at which the turnaround in real GDP per capita occurs in relation to diversification as follows:

$$\frac{\partial q_t}{\partial D_t} = \delta_7 + 2\delta_8 D_t = 0 \quad (6)$$

After setting the first derivative equal to zero, the first-order condition obtained is specified as follows:

$$D_t = -\frac{\delta_7}{2\delta_8} \tag{7}$$

If the respective second-order derivative, evaluated at D^*, exceeds zero $\left\{\frac{\partial^2(q_t)}{\partial(D_t)^2} > 0\right\}$ then, D^* represents a minimum and implies a U-shaped relationship between economic growth and diversification, and D^* denotes a threshold. By the same token, if $\left\{\frac{\partial^2(q_t)}{\partial(D_t)^2} < 0\right\}$, evaluated D^*, then an inverted U-shaped relationship between economic growth and diversification results, indicating maximum. Nonetheless, if $\left\{\frac{\partial^2(q_t)}{\partial(D_t)^2} = 0\right\}$, then the relationship is monotonic and D^* represents a saddle point. In a statistical sense, where δ_8 is not statistically significant within the conventional levels, then the study rejects the non-monotonic relationship and accepts a monotonic relationship between growth and diversification.

Additionally, in order to strengthen the robustness of this analysis, an attempt is also made to examine the impact of diversification on the effect of non-oil exports on growth. As discussed in section (2), studies such as those by Agosin (2007) and, Calderon & Schmidt-Hebbel (2008) reveal that export together with diversification is an important determinant of growth. Following Jongwanich (2020), equation (4) is modified and augmented to include the interaction term, $(D_t * N_t)$ between diversification index and non-oil exports. In this case, to avoid potential multicollinearity problems, we exclude variables N and D, as specified in equation (8), as follows:

$$q_t = \phi_0 + \phi_1 P_t + \phi_2 H_t + \phi_3 (D_t * N_t) + \phi_4 M_t + \phi_5 T_t + \phi_6 (dI_t) + \varepsilon_{5t} \tag{8}$$

One key limitation of equations (5) and (8) is that they do not allow policymakers to separate between the short-run contributions of the factors, to growth, from the long-run contributions. Although growth policies are targeted towards attaining long-run results, production decisions generally take into cognizance the short-run contributions of the factors. Thus, by neglecting the short-run dynamics of the models, key insights are lost. Besides, with the upward trending nature of economic growth, it is plausible to assume that the growth levels of countries in a particular period may depend on that of previous years' levels. How fast-growth levels change at the end of this period may depend on the initial levels of growth. Moreover, over a longer horizon, the determinants of growth may be non-stationary.

In line with the above discussions, to allow for a degree of persistence in the data generating process, equations (5) and (8) are further modified as dynamic econometric models. To this end, following Orji, Ogwu, Mba & Anthony-Orji (2021), we employ the ARDL procedure of Pesaran, Shin & Smith (2001). This technique is adopted and considered apt for three reasons. Firstly, it can be applied regardless of whether the underlying series are I(0), I(1), or fractionally integrated. Secondly, it enables short-run and long-run parameters of the models to be estimated simultaneously. Lastly, given the nature of interrelations between real GDP per capita, physical capital stocks, human capital accumulation, non-oil and oil exports, as well as openness, inflation, diversification index and its square term in (5), on the one hand, and real GDP per capita, physical capital, stocks of human capital, diversification and the non-oil export interaction term, as well as openness and inflation in (8), on the other hand, the ARDL is suitable to address possible endogeneity issues. As noted by Pesaran et al (2001), "appropriate modification of the orders of the ARDL model is sufficient to simultaneously correct the residual serial correlation and the problem of endogenous regressors" (Samantaraya & Patra, 2014).

Hence, taking log transformation of equations 5 and 8 (with the exception of inflation rate) yield, respectively, the dynamic ARDL models for estimation as:

$$\begin{aligned}\Delta \ln q_t &= \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta \ln q_{t-i} + \sum_{i=0}^{q} \alpha_{2i} \Delta \ln P_{t-i} + \sum_{i=0}^{r} \alpha_{3i} \Delta \ln H_{t-i} + \sum_{i=0}^{s} \alpha_{4i} \Delta \ln N_{t-i} + \\ &\sum_{i=0}^{t} \alpha_{5i} \Delta \ln M_{t-1} + \sum_{i=0}^{u} \alpha_{6i} \Delta \ln T_{t-i} + \sum_{i=0}^{v} \alpha_{7i} \Delta dI_{t-i} + \sum_{i=0}^{w} \alpha_{8i} \Delta \ln D_{t-i} + \sum_{i=0}^{x} \alpha_{9i} \left(\Delta \ln D_{t-1}\right)^2 + \\ &\lambda_1 \ln q_{t-1} + \lambda_2 \ln P_{t-1} + \lambda_3 \ln H_{t-1} + \lambda_4 \ln N_{t-1} + \lambda_5 \ln M_{t-1} + \lambda_6 \ln T_{t-1} + \lambda_7 dI_{t-1} + \lambda_8 D_{t-1} + \\ &\lambda_9 \left(\ln D_{t-1}\right)^2 + \varepsilon_{6t} \end{aligned} \qquad (9)$$

$$\begin{aligned}\Delta \ln q_t &= \sigma_0 + \sum_{i=1}^{a} \sigma_{1i} \Delta \ln q_{t-i} + \sum_{i=0}^{b} \sigma_{2i} \Delta \ln P_{t-i} + \sum_{i=0}^{c} \sigma_{3i} \Delta \ln H_{t-i} + \sum_{i=0}^{d} \sigma_{4i} \Delta\left(\ln D_{t-i} * \ln N_{t-i}\right) + \\ &\sum_{i=0}^{e} \sigma_{5i} \Delta \ln M_{t-i} + \sum_{i=0}^{f} \sigma_{6i} \Delta \ln T_{t-i} + \sum_{i=0}^{g} \sigma_{7i} \Delta dI_{t-i} + \rho_1 \ln q_{t-1} + \rho_2 \ln P_{t-1} + \rho_3 \ln \ln H_{t-1} + \\ &\rho_4 \left(\ln D_{t-1} * \ln N_{t-1}\right) + \rho_5 \ln M_{t-1} + \rho_6 \ln T_{t-1} + \rho_7 dI_{t-1} + \varepsilon_{7t} \end{aligned} \qquad (10)$$

where ε_{6t}, and ε_{7t} are residuals; $\lambda's$ and $\rho's$ are long-run parameters $\alpha's$, and $\sigma's$ are short-run coefficients; ln represents natural logarithm; {*p, q, r, s, t, u, v, w, x*} {*a, b, c, d, e, f, g*} and denote, respectively, the maximum number of lags for models (9) and (10); Δ is the first difference operator, α_0 and σ_0 depict drift components.

As regards the diversification index, studies have used different variables as a proxy for economic diversity. The key reason for this, besides the difference in conceptualizing diversification, has been the paucity of comprehensive and reliable data, particularly, for developing countries. Nonetheless, as pointed out by United Nations (2016), the conventional standard often used to measure the variable has largely been categorized into three distinct measures: employment-, export-concentration-, and income-based measures. To retain simplicity, we approximate it by measures of export concentration (which is by far, the most reliable and widely used measure in literature). Further, several indices including the well-known Normalized Herfindahl-Hirschman index, IMF Theil Index, Shannon Index, Finger-Kreinin index, and Gini index have been the most commonly used indices of export-concentration. Based on data availability, following Evans & Saibu (2017), the index of diversification is measured using two distinct variables: the IMF Theil Index and Shannon Index.

Essentially, as computed by the IMF, the Theil index is designed to reflect the diversity within as well as among sectors and groups. The index comprises of two components, i.e., the intensive and extensive margins. Intensive margins refer to an increase in export through expanding extant products, extensive margin relates to expanding exports to new products and new markets. Equally, to provide further intuitive insights, we incorporate the Shannon index as a measure of economic diversification. As argued in Pede (2013), the index is apt where one or two sectors are dominant, such as the oil sector in Nigeria, as it captures evenness, dominance, and maximum diversity. Based on prior works in the literature, the Shannon index is computed, using the formula, as shown in equation (11):

$$Div = -\sum_{s=1}^{S}\left(\frac{S_{output}}{GDP}\right)\ln\left(\frac{S_{output}}{GDP}\right) \quad (11)$$

where Div S S_{output}, and GDP, respectively, index of economic diversification, the total number of sectors in the economy (as classified by Central Bank of Nigeria, CBN, Statistical Bulletin), Gross Domestic Product.

To add more richness, flexibility and versatility to the analysis, two different model specifications of equation (9), as stated above, were estimated. The models are afterward referred to as versions X and Y. First, in model X, diversification is measured using the IMF Theil index. Second, in model Y, we repeated the exercise employing the Shannon index as a proxy for diversification.

Moreover, to provide an intuitive insight on the impact of diversification on the effect of non-oil exports on growth, five distinct model versions of equation (10), hereafter referred to as A, B, C, D and E, were estimated. In model A, we include the interaction term between diversification index and non-oil exports {proxied as agriculture sector output, G }. Afterward, in model B, the interaction term between diversification and non-oil exports {approximated by industrial sector output, R } was included. Next, in model C, we repeated the exercise by including the interaction term between diversification and non-oil export {measured by building and construction sector output, V }.

In model version D, we incorporated the interaction term between the index of diversification and non-oil export {proxy by wholesale and retail trade sector output, W }. Finally, in model version E, the interaction term between diversification and non-oil exports {measured by service sector output, S } was included. As earlier stated, the key reason for this; besides the fact that insights on the differential impact of export components on growth is requisite to successful policy formulation, analysis and advocacy; is in light of the argument documented by Cuaresma and Wörz (2005) that efficiency, knowledge spillover, and economies of scale are different across export components.

3.2 Data Sources, Measurement and Descriptive Statistics of Key Variables

Annual time-series data, for the period 1960-2019, sourced primarily from the Penn World Table version 10.0 by Feenstra, Inklaar & Timmer (2015), World Development Indicators (2020) database maintained by World Bank, International Monetary Fund and CBN Statistical Bulletin (2020) were utilized. The specific source for each series and their descriptive statistics, respectively, are presented in Tables 1 and 2. Data on growth and trade openness were compiled from World Bank (WDI) database. Physical and human capital was sourced from PWT. Data on oil exports, non-oil exports and inflation were obtained from the CBN Statistical Bulletin 2020 edition. As discussed in the previous section, the index of diversification is measured using two alternatives: the IMF Theil and Shannon indices. Data on the Theil Index for 1962-2014 were compiled from the IMF database, while those of 1960-1961 and 2015-2019 were obtained using the linear forecasting technique. Data of GDP and indices of all the sectors, compiled from the CBN Statistical Bulletin, were used in setting up the Shannon index. To remove or lessen considerably any heteroskedasticity in the residuals of the estimated models, the variables (except inflation rate) were transformed to their logarithm form and hence are interpreted in terms of elasticity.

Table 1 Data Sources and Variable Definitions

Variable	Proxy	Sources
Economic Growth (q)	GDP per capita (constant 2010 US$)	World Development Indicators (2020)
Physical Capital (P)	Capital stock at current PPPs (in mil. 2011US$)	Penn World Table Version 9.1
Human Capital (H)	Human Capital Index	Penn World Table Version 9.1
Non-Oil Exports (N)	Exports Unadjusted for Balance of Payments (N' Billion)	CBN Statistical Bulletin and National Bureau of Statistics (2020)
Agricultural Sector (G)	Agricultural Sector Output (N' Billion)	CBN Statistical Bulletin (2020)
Industrial Sector (R)	Industrial Sector Output (N' Billion)	CBN Statistical Bulletin (2020)
Building & Construction Sector (V)	Building and Construction Sector Output (N' Billion)	CBN Statistical Bulletin (2020)
Wholesale & Retail Sector (W)	Wholesale and Retail Sector Output (N' Billion)	CBN Statistical Bulletin (2020)
Services Sector (S)	Services Sector Output (N' Billion)	CBN Statistical Bulletin (2020)
Oil Exports (M)	Crude Petroleum & Natural Gas (N' Billion)	CBN Statistical Bulletin (2020)
Trade Openness (T)	Ratio of sum of export and import to GDP (N' Billion)	World Development Indicators (2020)
Inflation Rate (I)	Annual Percentage Change in Consumer Price Index	CBN Statistical Bulletin (2020)
Economic Diversification Index (D)	IMF Theil Index & Shannon Index	International Monetary Fund (2020) & CBN Statistical Bulletin (2020)

Source: Prepared by the Author
Note: CBN, Central Bank of Nigeria

Table 2 Descriptive Statistics of the Key Variables

	LNQ	LNP	LNH	LNN	LNG	LNR	LNV	LNW	LNS	LNM	LNT	LNI	LNA	LNA2	LNB	LNB2
Mean	12.758	12.657	1.386	8.688	11.750	11.481	9.021	10.832	10.710	11.009	0.019	19.427	5.848	34.198	6.659	15.472
Median	12.392	12.406	1.221	8.040	11.247	11.530	8.318	10.436	10.092	11.380	0.019	12.901	5.539	31.307	6.743	12.791
Maximum	17.763	14.864	1.992	13.545	16.708	16.791	13.554	15.984	15.691	16.726	0.037	22.793	6.216	38.641	12.357	15.685
Minimum	7.711	11.085	1.152	5.314	7.255	4.898	4.552	5.648	5.714	1.946	0.007	10.101	3.714	13.791	0.222	5.360
Std. Dev.	3.525	1.100	0.270	2.882	3.432	3.942	2.897	3.565	3.397	4.451	0.007	133.831	0.800	7.891	4.331	56.287
Skewness	0.029	0.557	0.897	0.376	0.114	0.153	0.134	0.013	0.067	-0.339	0.408	1.257	1.545	1.470	0.164	0.303
Kurtosis	1.529	2.153	2.323	1.550	1.456	1.655	1.808	1.590	1.596	1.905	2.953	3.216	3.685	3.504	1.555	1.459
Jarque-Bera	5.418	4.893	9.188	6.668	6.086	4.753	3.730	4.969	4.974	4.145	1.668	15.907	25.035	22.253	5.487	6.858
Probability	0.067	0.087	0.100	0.306	0.408	0.093	0.155	0.083	0.083	0.126	0.434	0.350	0.400	0.150	0.064	0.230
Sum	765.459	759.415	83.181	521.256	704.979	688.839	541.274	649.897	642.628	660.534	1.127	596.563	332.322	187.841	399.557	376.746
Sum Sq. Dev.	73.298	71.453	4.315	489.926	694.974	916.781	495.316	750.014	680.721	116.888	0.003	105.673	37.778	3673.645	1106.695	186.924
Observations	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60

Note: Std. Dev. and Sum Sq. Dev. denote, respectively, standard deviation and the sum of squared deviation; lnA and lnA2 denote, respectively, IMF Theil Index and its square term; lnB and lnB2 represent, respectively, Shannon Index and its square term.

Source: Prepared by the Author

With respect to descriptive statistics of key variables, as evidenced in Table 2, the mean and median of all the variables in the data set displayed a high consistency as their mean and median values are within the maximum and minimum values of the series. Moreover, almost all the data series have the values of their mean and median almost the same. This shows that the distributions are nearly symmetrical. Likewise, the low standard deviation of nearly all the data series indicates that the deviations of actual data from their mean are very small. Besides, the skewness statistic (a measure of the asymmetry of the distribution of the series around the mean), kurtosis statistic (a measure of the thickness of the tail of the distribution) and Jarque-Bera statistic which is used to test the null hypothesis where each variable is considered to have a normal distribution reveal that all the series are normally distributed at 5% critical value.

4. Estimation Techniques and Empirical Results

4.1 Stationarity, Optimal Lag-Length Selection and ARDL Cointegration Tests Results

As a preliminary step, before detailed estimations of equations (9) and (10) were undertaken, to avert the pitfall of spurious regression and ascertain the stationarity status of the data, we applied the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests. First with intercept only, and afterward with intercept and trend, at 1, 5, and 10 percent significance level. Results of the ADF and PP tests, respectively, presented in Tables 3 and 4, show that all the variables are integrated of order one, I (1).

Hereafter, to avert the misspecification problem and loss of the degrees of freedom, the optimal lag-length incorporated for each variable in the models was established. To this end, the VAR lag-order selection criteria attributed to the Log-likelihood (LogL), sequential modified-LR test statistic (each test at 5 percent), Final prediction error (FPE), Akaike-information criterion (AIC), Schwartz-Bayesian information criterion (SC), Hannan-Quinn information criterion (HQ) were considered. Pesaran & Shin (1998) argued that the SC should be used in preference to other model specification criteria because it often has more parsimonious models with great explanatory predictive power. Following Verma (2007) and taking cognizance of the length of sample data, more parsimonious models were selected using the SC criterion with the maximum lag order of one. The results are depicted in Tables 5 and 6, respectively, for equations (9) and (10).

Next, the existence of a long-run cointegrating relationship among the variables was ascertained using the ARDL procedure, by conducting F-test for the joint significance of the coefficients of the lagged level variables of equations (9) and (10). To this end, a two-step procedure was followed.

First, we estimated equations (9) and (10) using the ordinary least squares technique. Second, the null hypotheses $\lambda_1=\lambda_2=\lambda_3=\lambda_4=\lambda_5=\lambda_6=\lambda_7=\lambda_8=\lambda_9=0$ and $\rho_1=\rho_2=\rho_3=\rho_4=$

$=\rho_5=\rho_6=\rho_7=\rho_8=\rho_9=0$, respectively, were tested against the alternative hypotheses $\lambda_1\neq\lambda_2\neq\lambda_3\neq\lambda_4\neq\lambda_5\neq\lambda_6\neq\lambda_7\neq\lambda_8\neq\lambda_9\neq0$ $\rho_1\neq\rho_2\neq\rho_3\neq\rho_4\neq\rho_5\neq\rho_6\neq\rho_7\neq\rho_8\neq\rho_9\neq0$.

Table 3 Stationarity Tests of Variables: ADF

Variables	Level						1st Difference					
	Test Statistics	Critical Values			P-Value	Remarks	Test Statistics	Critical Values			P-Value	Remarks
		1%	5%	10%				1%	5%	10%		
ADF (With Intercept Only)												
lnq	-0.235	-3.546	-2.912	-2.594	0.928	NS	-5.643	-3.548	-2.913	-2.594	0.000	I(1)
lnP	-1.838	-3.548	-2.913	-2.594	0.359	NS	-6.840	-3.548	-2.913	-2.594	0.000	I(1)
lnH	0.708	-3.548	-2.913	-2.594	0.991	NS	-8.916	-3.548	-2.913	-2.594	0.000	I(1)
lnN	0.130	-3.548	-2.913	-2.594	0.965	NS	-9.908	-3.548	-2.913	-2.594	0.000	I(1)
lnD*lnG	-1.448	-3.546	-2.912	-2.594	0.553	NS	-6.151	-3.548	-2.913	-2.594	0.000	I(1)
lnD*lnR	-1.652	-3.546	-2.912	-2.594	0.450	NS	-7.059	-3.548	-2.913	-2.594	0.000	I(1)
lnD*lnV	-1.185	-3.546	-2.912	-2.594	0.676	NS	-6.342	-3.548	-2.913	-2.594	0.000	I(1)
lnD*lnW	-1.301	-3.546	-2.912	-2.594	0.624	NS	-6.975	-3.548	-2.913	-2.594	0.000	I(1)
lnD*lnS	-1.486	-3.546	-2.912	-2.594	0.534	NS	-6.054	-3.548	-2.913	-2.594	0.000	I(1)
lnM	-2.180	-3.546	-2.912	-2.594	0.216	NS	-7.453	-3.548	-2.913	-2.594	0.000	I(1)
lnT	-2.777	-3.546	-2.912	-2.594	0.068	NS	-9.438	-3.548	-2.913	-2.594	0.000	I(1)
dlnI	1.813	-3.548	-2.913	-2.594	0.999	NS	-6.692	-3.548	-2.913	-2.594	0.000	I(1)
lnA	-2.514	-3.546	-2.912	-2.594	0.117	NS	-6.121	-3.548	-2.913	-2.594	0.000	I(1)
lnA2	-2.392	-3.546	-2.912	-2.594	0.148	NS	-6.356	-3.548	-2.913	-2.594	0.000	I(1)
lnB	-1.321	-3.546	-2.912	-2.594	0.614	NS	-5.677	-3.548	-2.913	-2.594	0.000	I(1)
lnB2	0.672	-3.548	-2.913	-2.594	0.991	NS	-4.877	-3.548	-2.913	-2.594	0.000	I(1)
ADF (With Intercept & Trend)												
lnq	-1.380	-4.121	-3.488	-3.172	0.857	NS	-5.591	-4.124	-3.489	-3.173	0.000	I(1)
lnP	-2.952	-4.124	-3.489	-3.173	0.155	NS	-6.776	-4.124	-3.489	-3.173	0.000	I(1)
lnH	-1.230	-4.124	-3.489	-3.173	0.895	NS	-8.797	-4.124	-3.489	-3.173	0.000	I(1)
lnN	-2.687	-4.121	-3.488	-3.172	0.246	NS	-9.894	-4.124	-3.489	-3.173	0.000	I(1)
lnD*lnG	-0.377	-4.121	-3.488	-3.172	0.986	NS	-6.342	-4.124	-3.489	-3.173	0.000	I(1)
lnD*lnR	-1.040	-4.121	-3.488	-3.172	0.930	NS	-7.276	-4.124	-3.489	-3.173	0.000	I(1)
lnD*lnV	-1.430	-4.121	-3.488	-3.172	0.842	NS	-6.376	-4.124	-3.489	-3.173	0.000	I(1)
lnD*lnW	-1.065	-4.121	-3.488	-3.172	0.926	NS	-7.097	-4.124	-3.489	-3.173	0.000	I(1)
lnD*lnS	-0.728	-4.121	-3.488	-3.172	0.966	NS	-6.213	-4.124	-3.489	-3.173	0.000	I(1)
lnM	-2.053	-4.121	-3.488	-3.172	0.561	NS	-7.631	-4.124	-3.489	-3.173	0.000	I(1)
lnT	-2.750	-4.121	-3.488	-3.172	0.222	NS	-9.359	-4.124	-3.489	-3.173	0.000	I(1)
dlnI	0.533	-4.124	-3.489	-3.173	0.999	NS	-6.657	-4.124	-3.489	-3.173	0.000	I(1)
lnA	-1.297	-4.121	-3.488	-3.172	0.879	NS	-6.626	-4.124	-3.489	-3.173	0.000	I(1)
lnA2	-1.262	-4.121	-3.488	-3.172	0.888	NS	-6.833	-4.124	-3.489	-3.173	0.000	I(1)
lnB	0.026	-4.121	-3.488	-3.172	0.996	NS	-5.783	-4.124	-3.489	-3.173	0.000	I(1)
lnB2	-2.313	-4.124	-3.489	-3.173	0.420	NS	-5.047	-4.124	-3.489	-3.173	0.001	I(1)

Note: NS depicts Non-Stationary; lnA and lnA2 denote, respectively, IMF Theil Index and its square term; lnB and lnB2 depict, respectively, Shannon Index and its square term

Source: Prepared by the Author

Table 4 Stationarity Tests of Variables: PP

Variables	Level						1st Difference					
	Test Statistics	Critical Values			P-Value	Remarks	Test Statistics	Critical Values			P-Value	Remarks
		1%	5%	10%				1%	5%	10%		
PP (With Intercept Only)												
lnq	-0.287	-3.546	-2.912	-2.594	0.920	NS	-5.620	-3.548	-2.913	-2.594	0.000	I(1)
lnP	-0.583	-3.546	-2.912	-2.594	0.866	NS	-6.808	-3.548	-2.913	-2.594	0.000	I(1)
lnH	4.302	-3.546	-2.912	-2.594	0.715	NS	-8.916	-3.548	-2.913	-2.594	0.000	I(1)
lnN	0.450	-3.546	-2.912	-2.594	0.984	NS	-9.870	-3.548	-2.913	-2.594	0.000	I(1)
lnD*lnG	-1.363	-3.546	-2.912	-2.594	0.595	NS	-6.151	-3.548	-2.913	-2.594	0.000	I(1)
lnD*lnR	-1.688	-3.546	-2.912	-2.594	0.432	NS	-7.061	-3.548	-2.913	-2.594	0.000	I(1)
lnD*lnV	-1.133	-3.546	-2.912	-2.594	0.697	NS	-6.373	-3.548	-2.913	-2.594	0.000	I(1)
lnD*lnW	-1.275	-3.546	-2.912	-2.594	0.636	NS	-6.978	-3.548	-2.913	-2.594	0.000	I(1)
lnD*lnS	-1.411	-3.546	-2.912	-2.594	0.571	NS	-6.054	-3.548	-2.913	-2.594	0.000	I(1)
lnM	-2.761	-3.546	-2.912	-2.594	0.070	NS	-7.491	-3.548	-2.913	-2.594	0.000	I(1)
lnT	-2.751	-3.546	-2.912	-2.594	0.072	NS	-9.474	-3.548	-2.913	-2.594	0.000	I(1)
dlnI	-1.055	-3.546	-2.912	-2.594	0.723	NS	-14.502	-3.548	-2.913	-2.594	0.000	I(1)
lnA	-2.379	-3.546	-2.912	-2.594	0.152	NS	-6.151	-3.548	-2.913	-2.594	0.000	I(1)
lnA2	-2.297	-3.546	-2.912	-2.594	0.176	NS	-6.378	-3.548	-2.913	-2.594	0.000	I(1)
lnB	-1.162	-3.546	-2.912	-2.594	0.685	NS	-5.681	-3.548	-2.913	-2.594	0.000	I(1)
lnB2	0.897	-3.546	-2.912	-2.594	0.995	NS	-4.814	-3.548	-2.913	-2.594	0.000	I(1)
PP (With Intercept & Trend)												
lnq	-1.895	-4.121	-3.488	-3.172	0.645	NS	-5.566	-4.124	-3.489	-3.173	0.000	I(1)
lnP	-1.337	-4.121	-3.488	-3.172	0.869	NS	-6.740	-4.124	-3.489	-3.173	0.000	I(1)
lnH	-0.424	-4.121	-3.488	-3.172	0.984	NS	-8.797	-4.124	-3.489	-3.173	0.000	I(1)
lnN	-2.532	-4.121	-3.488	-3.172	0.312	NS	-9.919	-4.124	-3.489	-3.173	0.000	I(1)
lnD*lnG	-0.653	-4.121	-3.488	-3.172	0.972	NS	-6.311	-4.124	-3.489	-3.173	0.000	I(1)
lnD*lnR	-1.105	-4.121	-3.488	-3.172	0.919	NS	-7.273	-4.124	-3.489	-3.173	0.000	I(1)
lnD*lnV	-1.808	-4.121	-3.488	-3.172	0.688	NS	-6.402	-4.124	-3.489	-3.173	0.000	I(1)
lnD*lnW	-1.314	-4.121	-3.488	-3.172	0.875	NS	-7.095	-4.124	-3.489	-3.173	0.000	I(1)
lnD*lnS	-1.022	-4.121	-3.488	-3.172	0.933	NS	-6.164	-4.124	-3.489	-3.173	0.000	I(1)
lnM	-2.014	-4.121	-3.488	-3.172	0.582	NS	-8.142	-4.124	-3.489	-3.173	0.000	I(1)
lnT	-2.724	-4.121	-3.488	-3.172	0.231	NS	-9.399	-4.124	-3.489	-3.173	0.000	I(1)
dlnI	2.014	-4.121	-3.488	-3.172	0.093	NS	-16.450	-4.124	-3.489	-3.173	0.000	I(1)
lnA	-1.361	-4.121	-3.488	-3.172	0.862	NS	-6.626	-4.124	-3.489	-3.173	0.000	I(1)
lnA2	-1.317	-4.121	-3.488	-3.172	0.874	NS	-6.833	-4.124	-3.489	-3.173	0.000	I(1)
lnB	-0.437	-4.121	-3.488	-3.172	0.984	NS	-5.783	-4.124	-3.489	-3.173	0.000	I(1)
lnB2	-2.366	-4.121	-3.488	-3.172	0.393	NS	-5.013	-4.124	-3.489	-3.173	0.001	I(1)

Note: NS depicts Non-Stationary; lnA and lnA2 denote, respectively, IMF Theil Index and its square term; lnB and lnB2 depict, respectively, Shannon Index and its square term

Source: Prepared by the Author

Accordingly, given the equations (9) and (10), with the maximum lag-length of one, during the analysis, 256 different ARDL models for X and 256 different ARDL models for Y (of equation 9); using the log of IMF Theil index as proxy for diversification, 64 different ARDL models for A, 64 different ARDL models for B, 64 different ARDL models for C, 64 different ARDL models for D, and 64 different ARDL models for E (of equation 10); and employing the log of Shannon index as measure for diversification, 64 different ARDL models for A, 64 different ARDL models for B, 64 different ARDL models for C, 64 different ARDL models for D, and 64 different ARDL models for E (of equation 10); were considered and their respective most suitable ARDL models (1, 1, 0, 0, 1, 0, 0, 1, 1), (1, 0, 0, 0, 1, 1, 0, 1, 0), (1, 0, 0, 0, 1, 0, 0), (1, 1, 0, 1, 0, 0, 0), (1, 1, 0, 1, 0, 0, 0), (1, 1, 0, 1, 0, 0, 1), (1, 1, 0, 1, 0, 0, 0), (1, 0, 0, 1, 0, 0, 1), (1, 0, 0, 1, 1, 0, 1), (1, 1, 0, 1, 0, 0, 1), (1, 0, 0, 1, 1, 0, 1), and (1, 0, 0, 1, 1, 0, 1) were selected for this study.

Table 5 VAR Lag-Length Selection Results (for Equation 9)

Using the IMF Theil Index as measure of Diversification						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-167.0705	NA	4.35E-09	6.288233	6.613736	6.41443
1	521.9146	1131.904	1.67E-18	-15.42552	-12.17049*	-14.16355*
2	615.898	124.1923*	1.31E-18	-15.88921	-9.704659	-13.49148
3	696.3708	80.47281	2.52E-18	-15.87039	-6.756304	-12.33688
4	841.6108	98.55567	1.15e-18*	-18.16467*	-6.121061	-13.49539
Using the Shannon Index as measure of Diversification						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-290.3108	NA	3.55E-07	10.68967	11.01517	10.81587
1	459.0826	1231.146*	1.58e-17*	-13.18152	-9.926490*	-11.91955*
2	521.1761	82.05211	3.85E-17	-12.50629	-6.321732	-10.10855
3	615.6386	94.46251	4.50E-17	-12.98709	-3.873009	-9.453581
4	742.8625	86.33054	3.92E-17	-14.63795*	-2.594338	-9.968665

Source: Prepared by the Author

Table 6 VAR LAG-Length Selection Results for Equation 10

Using the IMF Theil Index as measure of Diversification

Lag	LogL	LR	FPE	AIC	SC	HQ
			Model A			
0	-258.868	NA	3.73E-05	9.667914	9.923393	9.76671
1	381.2115	1093.953	1.75E-14	-11.82587	-9.782043*	-11.03551*
2	433.525	76.09237*	1.69e-14*	-11.94636	-8.114182	-10.46443
3	482.6002	58.89019	2.12E-14	-11.9491	-6.328564	-9.775591
4	531.8234	46.53836	3.46E-14	-11.95722	-4.548331	-9.09214
5	602.8751	49.09023	4.11E-14	-12.75909*	-3.561858	-9.202448
			Model B			
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-260.665	NA	3.98E-05	9.733269	9.988748	9.832065
1	370.0704	1077.984	2.62e-14*	-11.42074	-9.376913*	-10.63038*
2	419.4036	71.75737*	2.82E-14	-11.43286	-7.600677	-9.950923
3	471.8744	62.96499	3.14E-14	-11.55907	-5.938538	-9.385565
4	523.2735	48.59545	4.72E-14	-11.64631*	-4.237424	-8.781233
5	572.2378	33.8299	1.25E-13	-11.64501	-2.447775	-8.088366
			Model C			
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-274.751	NA	6.64E-05	10.2455	10.50098	10.3443
1	366.302	1095.618	3.01e-14*	-11.28371	-9.239879*	-10.49334*
2	417.2483	74.10374*	3.05E-14	-11.35448	-7.522303	-9.872549
3	460.3959	51.77713	4.76E-14	-11.14167	-5.521138	-8.968165
4	497.7769	35.34201	1.19E-13	-10.71916	-3.310277	-7.854085
5	571.685	51.06376	1.28E-13	-11.62491*	-2.427673	-8.068264
			Model D			
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-265.874	NA	4.81E-05	9.922684	10.17816	10.02148
1	364.3995	1077.194	3.23e-14*	-11.21453*	-9.170697*	-10.42416*
2	410.7542	67.42503*	3.86E-14	-11.11833	-7.286153	-9.636399
3	451.5946	49.0085	6.56E-14	-10.82162	-5.201089	-8.648117
4	493.327	39.45609	1.40E-13	-10.55735	-3.148461	-7.69227
5	558.6443	45.12834	2.05E-13	-11.1507	-1.953468	-7.594058
			Model E			
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-265.44	NA	4.73E-05	9.906899	10.16238	10.00569
1	368.6421	1083.704*	2.76e-14*	-11.3688	-9.324974*	-10.57844*
2	414.1443	66.18494	3.42E-14	-11.24161	-7.409428	-9.759674
3	459.0543	53.89203	5.00E-14	-11.09288	-5.47235	-8.919377
4	511.6431	49.72038	7.21E-14	-11.22339	-3.814503	-8.358312
5	567.0587	38.28712	1.51E-13	-11.45668*	-2.259445	-7.900035

Source: Prepared by the Author

Table 6 Continued

Using the Shannon Index as measure of Diversification

Model A

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-268.731	NA	5.34E-05	10.02656	10.28204	10.12536
1	377.281	1104.093	2.02e-14*	-11.68295	-9.639120*	-10.89258*
2	423.259	66.87620*	2.45E-14	-11.57304	-7.740855	-10.0911
3	472.576	59.18057	3.06E-14	-11.58457	-5.964036	-9.411064
4	520.274	45.0966	5.26E-14	-11.53724	-4.128351	-8.67216
5	607.555	60.30304	3.47E-14	-12.92926*	-3.732026	-9.372616

Model B

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-285.76	NA	9.91E-05	10.64582	10.9013	10.74461
1	355.272	1095.581*	4.50e-14*	-10.88261	-8.838779*	-10.09224*
2	400.12	65.23354	5.69E-14	-10.73163	-6.899447	-9.249693
3	446.066	55.1359	8.02E-14	-10.6206	-5.000063	-8.44709
4	488.78	40.38358	1.65E-13	-10.39199	-2.983108	-7.526917
5	553.534	44.73923	2.47E-13	-10.96487*	-1.767635	-7.408225

Model C

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-277.186	NA	7.26E-05	10.33404	10.58952	10.43284
1	360.248	1089.433	3.75E-14	-11.06357	-9.019738*	-10.27320*
2	411.962	75.22050*	3.70e-14*	-11.16226	-7.330081	-9.680327
3	460.955	58.79178	4.67E-14	-11.16201	-5.541481	-8.988508
4	501.064	37.92094	1.06E-13	-10.83869	-3.429809	-7.973618
5	562.17	42.21856	1.81E-13	-11.27890*	-2.081669	-7.722259

Model D

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-266.545	NA	4.93E-05	9.947087	10.20257	10.04588
1	380.473	1105.813	1.80e-14*	-11.79902	-9.755190*	-11.00865*
2	428.972	70.54341	1.99E-14	-11.78079	-7.948606	-10.29885
3	486.624	69.18298*	1.83E-14	-12.09542	-6.47489	-9.921918
4	529.209	40.26161	3.80E-14	-11.86213	-4.453244	-8.997053
5	609.975	55.80226	3.17E-14	-13.01727*	-3.820035	-9.460626

Model E

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-263.295	NA	4.38E-05	9.828897	10.08438	9.927693
1	393.992	1123.363*	1.10e-14*	-12.29063	-10.24680*	-11.50027*
2	437.846	63.78717	1.44E-14	-12.10349	-8.271311	-10.62156
3	484.051	55.44565	2.01E-14	-12.00185	-6.381312	-9.82834
4	527.783	41.34677	4.01E-14	-11.81029	-4.401403	-8.945212
5	599.352	49.44797	4.67E-14	-12.63099*	-3.433758	-9.074349

Source: Prepared by the Author
* indicates lag order selected by the criterion

Figures 1-12 provide graphs of the AIC of the top twenty models, showing the relative superiority of the selected models against alternatives. Then, we applied the ARDL procedure to examine the cointegrating relationship. Results presented in Tables 7 and 8 reveal that, in each case, the computed F-statistic is greater than upper bond values (at a 5 percent significance level). Hence, we reject the null hypotheses of no cointegrating relationship.

Table 7 Cointegration Results (for Equation 9)

Level of Significance (%)	Bounds Values		F Statistic
Using the IMF Theil Index as measure of Diversification (Model X)			
	Lower 1(0)	Upper I(1)	
10	1.85	2.85	
5	2.11	3.15	13.34653
2.5	2.33	3.42	
1	2.62	3.77	
Using the Shannon Index as measure of Diversification (Model Y)			
10	1.85	2.85	
5	2.11	3.15	6.538352
2.5	2.33	3.42	
1	2.62	3.77	

Source**:** Prepared by the Author

Table 8 Cointegration Results (for Equation 10)

Level of Significance (%)	Bounds Values		F Statistic
Using the IMF Theil Index as measure of Diversification			
Model A			
	Lower 1(0)	Upper I(1)	
10	1.99	2.94	
5	2.27	3.28	15.06307
2.5	2.55	3.61	
1	2.88	3.99	
Model B			
10	1.99	2.94	
5	2.27	3.28	15.75444
2.5	2.55	3.61	
1	2.88	3.99	
Model C			
10	1.99	2.94	
5	2.27	3.28	15.53373
2.5	2.55	3.61	
1	2.88	3.99	
Model D			
10	1.99	2.94	
5	2.27	3.28	11.86606
2.5	2.55	3.61	
1	2.88	3.99	
Model E			
10	1.99	2.94	
5	2.27	3.28	14.85576
2.5	2.55	3.61	
1	2.88	3.99	

Table 8 Continued

Using the Shannon Index as measure of Diversification			
	Model A		
Level of Significance (%)	Bounds Values		F Statistic
	Lower 1(0)	Upper I(1)	
10	1.99	2.94	
5	2.27	3.28	4.352375
2.5	2.55	3.61	
1	2.88	3.99	
	Model B		
10	1.99	2.94	
5	2.27	3.28	4.566993
2.5	2.55	3.61	
1	2.88	3.99	
	Model C		
10	1.99	2.94	
5	2.27	3.28	4.0318
2.5	2.55	3.61	
1	2.88	3.99	
	Model D		
10	1.99	2.94	
5	2.27	3.28	4.810682
2.5	2.55	3.61	
1	2.88	3.99	
	Model E		
10	1.99	2.94	
5	2.27	3.28	5.339203
2.5	2.55	3.61	
1	2.88	3.99	

Source: Prepared by the Author

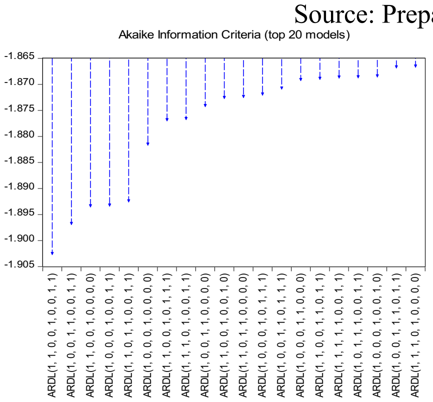

Figure 1

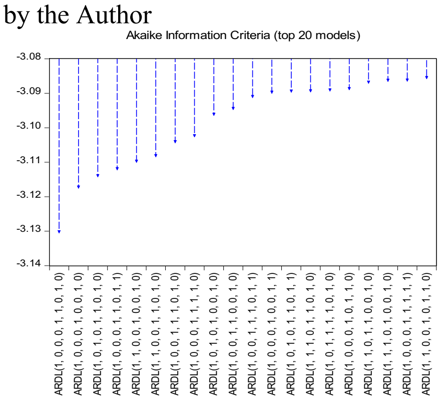

Figure 2

Figures 1 & 2 denote, respectively, model selection criteria for specifications X and Y.
Source: Prepared the Author using E-view 10

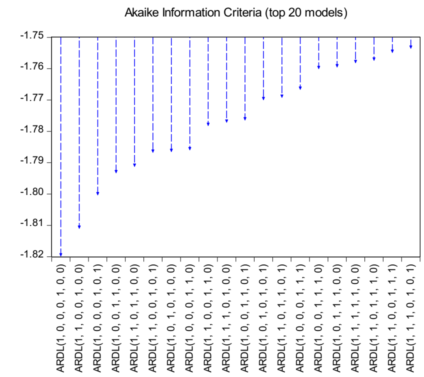

Figure 3

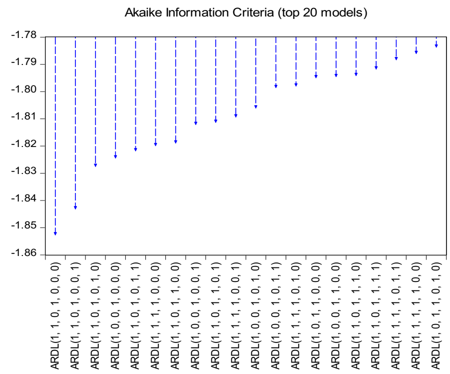

Figure 4

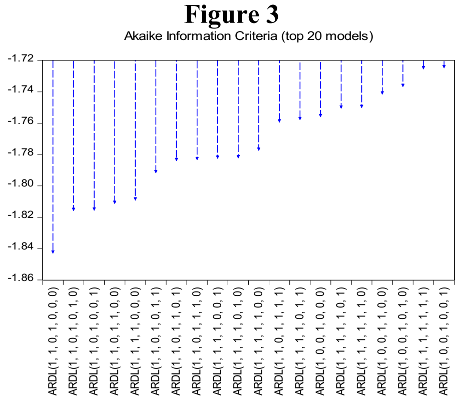

Figure 5

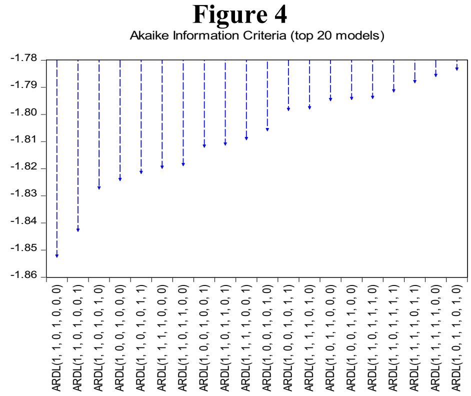

Figure 6

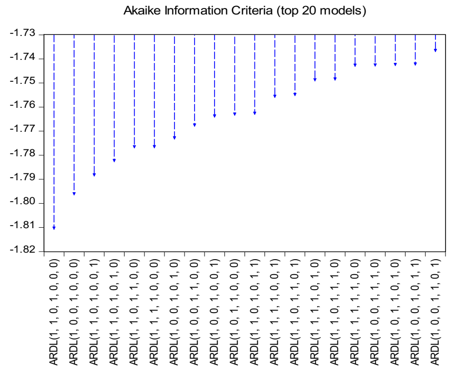

Figure 7

Figures 3-7 denote, respectively, model selection criteria for specifications A, B, C, D, and E (using IMF Theil Index)
Source: Prepared the Author using E-view 10

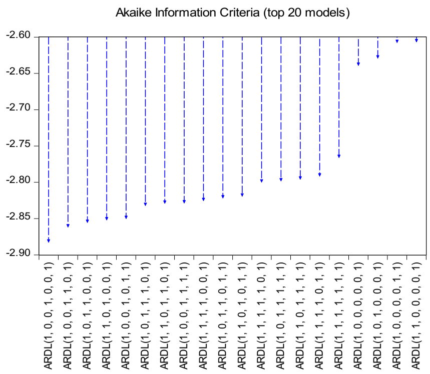

Figure 8

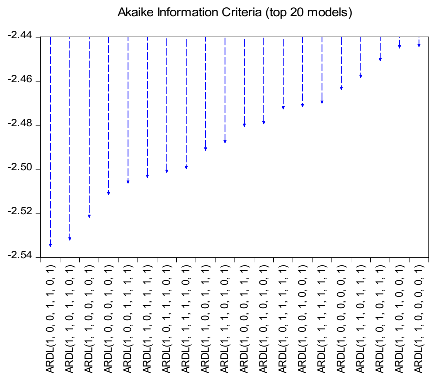

Figure 9

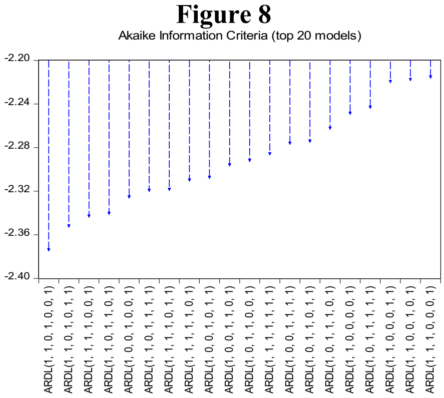

Figure 10

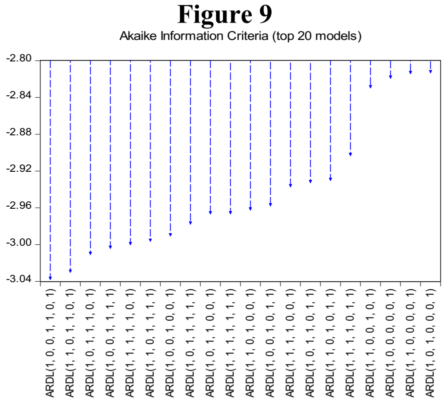

Figure 11

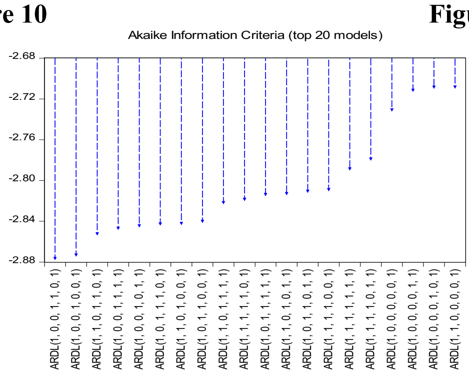

Figure 12

Figures 8-12 denote, respectively, model selection criteria for specifications A, B, C, D, and E (using Shannon Index)

Source: Prepared the Author using E-view 10

Table 9 Short- and Long-Run Estimates of the Relationship between Diversification and Growth

Explanatory Variables	X		Y	
	{1}	{2}	{1}	{2}
ECM {-1}		-0.376* [0.029] ((-12.655)) {0.000}		-0.279* [0.032] ((-8.842)) {0.000}
C	6.803* [2.147] ((3.169)) {0.005}	0.212* [0.059] ((3.585)) {0.001}	5.217* [2.589] ((2.015)) {0.049}	0.240* [0.056] ((4.312)) {0.000}
lnP	0.298* [0.118] ((2.539)) {0.015}	0.386* [0.198] ((1.951)) {0.050}	0.278* [0.073] ((3.824)) {0.000}	0.212* [0.059] ((3.585)) {0.000}
lnH	3.498* [1.589] ((2.201)) {0.006}	2.817* [1.272] ((2.215)) {0.032}	2.618* [1.147] ((2.282)) {0.027}	2.279* [0.637] ((3.576)) {0.001}
lnN	0.099* [0.079] ((1.255)) {0.216}	0.038* [0.029] ((1.259)) {0.215}	0.113* [0.059] ((1.926)) {0.060}	0.102* [0.063] ((1.613)) {0.114}
lnM	0.639* [0.095] ((6.724)) {0.000}	0.379* [0.047] ((8.162)) {0.000}	0.199* [0.059] ((3.379)) {0.002}	0.032* [0.015] ((2.079)) {0.043}

Having established the existence of the cointegrating relationship, the numerical estimates associated with the selected ARDL models were ascertained. Results of the non-monotonic relationship between diversification and growth, as well as, the impact of diversification on the effect of non-oil exports on growth, respectively, are presented in Tables 9 and 10. In both tables, for the purpose of comprehension, the columns labeled as {1} and {2}, respectively, depict the estimated long-run and short-run coefficients.

4.2 Short and Long-Run Estimates of the Relationship between Diversification and Growth

Beginning from error correction (ECM) terms in the short-run models (of Table 9), in specifications (X) and (Y) of equation 9, the unrestricted ECM (-1) coefficients follow a priori expectation in that they are all negative and statistically significant at 5 percent level, implying that the short-run disequilibrium is corrected in the long-run equilibrium. As table 9 illustrates, in models X and Y, the results suggest that deviation from the long-run equilibrium level of growth in one year is corrected by 37.6 and 27.9 percent in the following year, respectively.

With regard to the impact of physical capital on growth, in all specifications, the estimated long-run and short-run results obtained obviously underscored the relevance of physical capital in growth, as anticipated. To be more specific, from the estimated model X, as table 9 depicts, a one-percent increase in physical capital stocks leads to a 0.298 and 0.386 increase in growth, respectively, in the long-run and short-run. This result is in line with the study's expectation, the neoclassical and endogenous growth models. Similar findings were observed by Iyke & Ho (2017) and Neagu, Haiduc & Anghelina (2021).

Similar to physical capital stocks, the elasticity coefficients of human capital accumulation are positive and statistically significant in both specifications. This suggests that the labor force, equipped with proper training and education as well as balanced health facilities and assisted by necessary tools and implements, is a vital determinant of growth in Nigeria. In line with a priori expectation, in specification X, as table 9 elucidates, for a one-percent increase in human capital stocks, 3.498 and 2.817 percent increase in growth is induced, respectively, in the long run, and short-run. The result is consistent with economic theory (advocated by Lucas, 1988; Romer, 1990; Mankiw, Romer, & Weil, 1992) and corroborates the findings of Sieng & Yussof (2014) and Karambakuwa, Ncwadi & Phiri (2020).

Across all specifications, non-oil export has a positive but statistically insignificant impact on growth. This insignificant positive effect depicts the underdeveloped state of the country's non-oil sector. Likewise, in terms of policy, it suggests that to maximize the potential benefits inherent in the non-oil export sector, policies and programs aimed at increasing the volume and exportation of value-added commodities (because of its relatively high price and income elasticities of demand over primary products) should be developed and pursued. In specific terms, from the estimated model X, as table 9 reveals, a one-percent increase in non-oil export will bring about a 0.099 and 0.038 percent increase in growth, respectively, in the long-run and short-run. Similar results were also obtained in Akinlo (2012) and Onodugo et al. (2013).

In relation to the growing impact of oil export, a careful look at Table 9 revealed that, in all specifications, the elasticity coefficients of oil-export are positive and statistically significant, as anticipated. Specifically, from the estimated model X, for a one-percent increase in oil export, 0.639 and 0.379 percent increase in growth is induced, respectively, in the long-run and short-run. In view of this finding, to ensure that oil continues to foster growth, there is a need to channel revenue from oil export to develop other strategic non-oil (notably agricultural and industrial) sectors of the economy that would improve the country's revenue base and also lessen vulnerability to macroeconomic risks. The result coincides with the findings of Aminu & Raifu (2019).

As regards the relationship between openness and growth, an insight from the long-run and short-run estimates suggests that the impact of trade openness on growth is deteriorative, across all specifications. As table 9 reveals, in specification X, a one-percent increase in openness will bring about a 0.624 and 0.211 percent decrease in growth, respectively, in the long-run and short-run. The results seem plausible and indeed depicts the Nigerian economy where export volume is dominated by oil (whose quantity and the price is determined in the international market and has little or no relation with economic reality in the country) and import is skewed towards semi-processed goods deceitfully packed as raw materials (which hinders the development of local industries). This result corroborates the findings of Olufemi (2004), Polat et al. (2015), Musila & Yiheyis (2015), Ajayi & Araoye (2019), but in contrast to those by Nwadike, Johnmary & Alamba (2020).

Regarding the impact of inflation on growth, across all specifications, the estimated long-run and short-run results reveal that inflation is harmful and detrimental to growth. From the estimated model Y, as table 9 depicts, a one-percent increase in inflation hinders growth by 0.139 and 0.475 percent, respectively, in the long-run and short-run. This significant negative effect suggests that to attain and sustain the desired economic growth level, the pragmatic effort is needed by monetary authorities to target and keep inflation at a possible minimum rate. The finding is consistent with a monetarist theory which argues that inflation has retarding effect on output growth. Moreover, the result is in line with the findings of Ahmed & Mortaza (2005), Kasidi & Mwakanemela (2013), Khan & Khan (2018) and Adaramola & Dada (2020). However, it contradicts the finding of Simionescu (2018) for the case of Bulgaria, Croatia, Czech Republic, Hungary, Romania, Slovak Republic, and Slovenia.

With respect to the relationship between diversification and growth, as expected, in all specifications, for the period 1960-2019, the elasticity coefficients of diversification (measured by IMF Theil and Shannon indices) are positive and statistically significant, suggesting that diversification increases with real GDP per capita (growth). Specifically, from the estimated model X, a one-percent increase in diversification will bring about a 0.386 and 0.335 percent increase in growth, respectively, in the long run, and in the short run. These results corroborate the findings of Al-Marhubi (2000), Agosin (2007), Hesse (2008), Yokoyama & Alemu (2009), and Hodey et al. (2015).

Further, across all specifications, as table 9 illustrates, the estimated impact of squared terms of diversification index on growth is negative, though statistically insignificant, thus invalidating the Imbs and Wacziarg (2003)'s hypothesis of a non-monotonic relationship between diversification and growth. By implication, the result refutes the existence of a re-specialization and instead suggests that the diversification process continues. Similar findings were likewise observed by Hamed et al (2014), Hodey et al (2015), and Lugeiyamu (2016), but in contrast to those obtained by Hesse (2008), Aditya & Acharyya (2013), and Munir & Javed (2018).

In conclusion, the F-statistic which measures the overall significance of the estimated models was statistically significant, suggesting that the selected ARDL models are fit and suitable for the empirical investigations. Also, as table 9 illustrates, the R-squared (which indicates the proportion of the variance in the dependent variable that the independent variables explain collectively) of the models is high. In furtherance, the adjusted R-squared which measures the proportion of variation jointly explained by the explanatory variables after the effects of insignificant regressors have been removed are likewise high. Moreover, the Durbin-Watson statistic displayed the absence of serial autocorrelation.

Table 9 Continued

Explanatory Variables	X		Y	
	{1}	{2}	{1}	{2}
lnT	-0.624*	-0.211*	-0.212*	-0.072*
	[0.081]	[0.059]	[0.043]	[0.023]
	((-7.669))	((-3.585))	((-4.900))	((-3.198))
	{0.000}	{0.001}	{0.000}	{0.004}
lnI	-0.009*	-0.003*	-0.139*	-0.475*
	[0.004]	[0.002]	[0.045]	[0.060]
	((-2.495))	((-2.072))	((-3.092))	((-7.856))
	{0.016}	{0.044}	{0.003}	{0.000}
lnD	0.386*	0.335*	0.379*	0.212*
	[0.084]	[0.116]	[0.025]	[0.046]
	((4.615))	((2.888))	((15.482))	((4.643))
	{0.000}	{0.006}	{0.006}	{0.018}
lnD2	-0.273*	-0.109*	-0.018*	-0.108*
	[0.141]	[0.063]	[0.014]	[0.814]
	((-1.929))	((-1.723))	((-1.303))	((-0.132))
	{0.066}	{0.092}	{0.199}	{0.895}

NOTE:*, [ ], (( )), and { } denote, respectively, Coefficient, Std. Error, t-Statistic, and Prob.

Source: Prepared by the Author

Table 9 Continued

Goodness of Fit Measures	**X**	**Y**
R-squared	0.885	0.706
Adjusted R-squared	0.794	0.733
F-statistic	7629.523	27886.26
Prob(F-statistic)	0.000	0.000
Durbin-Watson stat	1.816	1.637
Diagnostic Statistical Checking		
Breusch-Godfrey Serial Correlation LM Test	6.106*** {0.407}	3.738*** {0.154}
Breusch-Pagan-Godfrey test Heteroskedasticity	24.859*** {0.2041}	18.56591*** {0.910}
ARCH test for Heteroskedasticity	1.451*** {0.228}	1.184*** {0.277}
Jarque-Bera Normality Test	10.974** {0.410}	6.019** {0.493}
Ramsey RESET Specification Test	[1.009] {0.319}	[0.726] {0.472}

Note: *** and ** denote, respectively, Obs R-squared and Jarque-Bera Statistic
{ } and [ ] depict, respectively, Probability and t-Statistics
Source: Prepared by the Author

4.3 Short and Long-Run Estimates of the Impact of Diversification on the Effect of Non-Oil Export on Growth

Table 10 presents the long-run and short-run estimates of the impact of diversification (approximated by IMF Theil index) on the effect of non-oil exports on growth. As indicated earlier, the columns labeled as {1} and {2}, respectively, depict the estimated long-run and short-run coefficients. It is worth noting that estimated results in other models employing the Shannon index as a measure for diversification are consistent. However, to conserve space, those results are not reported. We preferred the IMF Theil index because it reflects diversity not only within the sector (intensive margins) but also across the sector (extensive margins).
As the table illustrates, the estimates appear quite robust, the significance and sign of the estimated coefficients are consistent across all specifications. In line with theoretical expectation, the coefficients of the ECM (-1) are negative and statistically significant confirming the evidence of a long-run relationship among the variables. With respect to specification B, the coefficient suggests that a deviation from the long-run equilibrium level of growth in one year is corrected by 32 percent in the following year.
As regards the growth effect of physical capital, across all specifications, as table 10 depicts, the coefficient of physical capital stock is positive and statistically significant as anticipated. In specific terms, from the estimated model C, a one-percent increase in physical capital stocks leads to 0.626 and 0.710 increase in

growth, respectively, in the long-run and short-run. This finding further corroborates the impact of physical capital on growth obtained in the preceding section.

Consistent with theoretical expectations, as well as, the long-run and short-run results in table 9, the estimated impact of human capital on growth is positive and statistically significant. Surprisingly, as in the previous section, in all specifications, stocks of human capital have the biggest effects on growth. These significant positive effects, as table 10 elucidates, suggest that investment in human capital is an important key to accelerating diversification and the progress of Nigeria towards becoming a high-income economy. In terms of policy, it likewise suggests that any policy aiming at economic diversification may not be successful in the long term if it is not accompanied by an investment in human capital formation. Hence, other than focusing on diversification policies, policymakers should consider policy reforms relating to education and training by observing the successful education models adopted by other developed countries (such as Singapore, South Korea, Japan, and the United Kingdom).

As discussed in section 1, to add richness, flexibility and provide an intuitive insight to the analysis, the diversification index is interacted with non-oil exports to examine the impact of diversification on the effect of non-oil exports on growth. As Table 10 reveals, in all specifications, the coefficients of interacted variables are positive and significant as expected, albeit with different magnitudes. Importantly, as can be seen, the impact of diversification on the effects of agricultural and industrial sectors on growth is higher, as compared to building and construction, wholesale and retail sectors, services, in the long-run and short-run. One plausible implication of these findings is that the country's non-oil sectors, particularly agricultural and industrial sectors — if properly harnessed and diversified — have the potential to improve the revenue base of the economy, lessen the country's vulnerability to macroeconomic risks, reduce the level of unemployment and poverty, provide raw materials for industries, food for the human population, improve the international competitiveness of domestic industries, which in turn, bolster growth. Hence, in terms of policy, emphasis should be placed on promoting infrastructural development and industrialization both in the agricultural and industrial sectors to enhance productivity and competitiveness. Similar findings were also observed by Ayodele et al. (2013), Eko et al. (2013), Mbaegbu (2016), Olalekan et al. (2016), and Chukwuma (2018).

With regard to the effect of oil export on growth, an insight from the long-run and short-run estimates suggests that, over the period 1960-2019, the oil sector has a significant positive impact on growth, as anticipated. Specifically, from the estimated model C, a one-percent increase in oil export raises growth by 0.379 and 0.109 percent, respectively, in the long-run and short-run. The significant positive effects further reinforced the fact that the finding, in the preceding section, is of policy significance. The result is coherent with Akinlo (2012) and Olayungbo (2019).

With respect to the relationship between openness and growth, in all the five specifications, as depicted in the table, an increasing level of openness worsens and impedes long-run and short-run growth in Nigeria. In specific terms, according to specification C, for a one-percentage-point increase in openness, 0.294 and 0.090 percent decrease in growth is induced, respectively, in the long-run and short-run. The finding further corroborates the growth effect of openness to trade obtained in Table 9.

Table 10 Short- and Long-Run Estimates of the Impact of Diversification on the Effect of Non-Oil Exports on Growth

Explanatory Variables	A		B		C		D		E	
	{1}	{2}	{1}	{2}	{1}	{2}	{1}	{2}	{1}	{2}
ECM {-1}		-0.294* [0.047] ((-6.308)) {0.000}		-0.320* [0.027] ((-12.002)) {0.000}		-0.287* [0.024] ((-11.917)) {0.000}		-0.311* [0.029] ((-10.429)) {0.000}		-0.319* [0.027] ((-11.654)) {0.000}
C	0.037* [0.004] ((10.685)) {0.001}	0.706* [0.071] ((9.930)) {0.000}	0.229* [0.048] ((4.766)) {0.000}	0.507* [0.201] ((2.517)) {0.015}	0.710* [0.227] ((3.131)) {0.003}	0.275* [0.036] ((7.664)) {0.000}	0.0214* [0.008] ((2.644)) {0.011}	0.554* [0.189] ((2.936)) {0.005}	0.214* [0.037] ((5.813)) {0.000}	0.028* [0.004] ((6.664)) {0.002}
lnP	0.186* [0.022] ((8.459)) {0.004}	2.097* [0.848] ((2.472)) {0.017}	0.476* [0.114] ((4.178)) {0.000}	0.153* [0.038] ((3.988)) {0.000}	0.626* [0.176] ((3.558)) {0.001}	0.710* [0.105] ((6.779)) {0.000}	0.485* [0.104] ((4.669)) {0.003}	0.554* [0.088] ((6.255)) {0.000}	0.478* [0.121] ((3.956)) {0.000}	0.153* [0.043] ((3.525)) {0.001}
lnH	7.132* [1.776] ((4.015)) {0.000}	3.861* [1.029] ((3.750)) {0.001}	10.783* [2.320] ((4.648)) {0.000}	3.452* [1.262] ((2.735)) {0.009}	11.460* [2.537] ((4.518)) {0.000}	3.291* [1.258] ((2.617)) {0.012}	10.588* [2.203] ((4.806)) {0.000}	3.292* [1.251] ((2.630)) {0.011}	8.564* [2.813] ((3.045)) {0.004}	2.734* [1.262] ((2.167)) {0.035}
(lnD)*(lnG)	0.069* [0.019] ((3.501)) {0.001}	0.037* [0.004] ((10.685)) {0.000}								
(lnD)*(lnR)			0.061* [0.024] ((2.578)) {0.013}	0.031* [0.006] ((5.382)) {0.000}						
(lnD)*(lnB)					0.058* [0.026] ((2.226)) {0.031}	0.020* [0.008] ((2.422)) {0.019}				
(lnD)*ln(W)							0.054* [0.026] ((2.119) {0.039}	0.028* [0.002] ((11.474)) {0.000}		
(lnD)*ln(S)									0.035* [0.008] ((4.264)) {0.000}	0.017* [0.007] ((2.305)) {0.025}

NOTE:*, [ ], (( )), and { } denote, respectively, Coefficient, Std. Error, t-Statistic, and Prob.

Regarding the impact of inflation (measured by the annual percentage change in consumer price index) on growth, the empirical results not only validate the monetarist propositions but also invalidate the structuralist economists' expositions.

As Table 10 illustrates, in all specifications, the elasticity coefficients of inflation rates are negative and statistically significant, indicating that a higher inflation rate is not conducive for growth. To be specific, from the estimated model A, a one-percent increase in inflation will bring about a 0.287 and 0.179 percent decrease in growth, respectively, in the long-run and short-run. The result substantiates that of the preceding section.

Lastly, the R-squared, adjusted R-squared, F-statistic, and Durbin-Watson statistics show that the selected models are fit and apt for the empirical investigations. As Table 10 reveals, the F-statistic is statistically significant at the 5% level. This reinforces the fact the results reported are of policy significance. In addition, the Durbin-Watson statistic revealed the absence of serial autocorrelation. Also, the explanatory power (i.e. the R-squared) of the models and the adjusted R-squared is high.

Table 10 Continued

Goodness of Fit Measures	**A**	**B**	**C**	**D**	**E**
R-squared	0.852	0.865	0.809	0.776	0.814
Adjusted R-squared	0.789	0.776	0.789	0.765	0.789
F-statistic	10699.060	9963.591	9863.029	10937.370	9554.121
Prob(F-statistic)	0.000	0.000	0.000	0.000	0.000
Durbin-Watson stat	2.004	1.937	2.055	2.057	1.960
Diagnostic Statistical Checking					
Breusch-Godfrey Serial	0.706***	0.977***	1.593***	0.691***	0.275***
Correlation LM Test	{0.703}	{0.614}	{0.451}	{0.708}	{0.872}
Breusch-Pagan-Godfrey test	20.784***	18.001***	17.711***	16.530***	20.871***
Heteroskedasticity	{0.770}	{0.356}	{0.309}	{0.805}	{0.103}
ARCH test for	1.059***	0.475***	0.118***	0.194***	0.706***
Heteroskedasticity	{0.303}	{0.491}	{0.731}	{0.609}	{0.401}
Jarque-Bera Normality Test	11.003**	12.312**	11.105**	15.342**	7.715**
	{0.400}	{0.210}	{0.380}	{0.408}	{0.211}
Ramsey RESET	[1.308]	[0.562]	[0.398]	[0.606]	[1.002]
Specification Test	{0.197}	{0.577}	{0.692}	{0.547}	{0.321}

Note: *** and ** denote, respectively, Obs R-squared and Jarque-Bera Statistic
{ } and [ ] depict, respectively, Probability and t-Statistics
Source: Prepared by the Author

4.4 Stability and Diagnostic Tests

Following the long-run and short-run estimations of the elasticities coefficients associated with the selected ARDL models, to check the adequacy of the selected models and reliability of the results, Breusch-Godfrey Serial Correlation LM test, Jacque-Bera normality test, Ramsey RESET specification test, Breusch-Pagan-Godfrey and Autoregressive Conditional Heteroskedasticity tests were conducted. Estimated results of these diagnostics tests are depicted in the lowest segments of Tables 9 and 10. All the results disclosed that the models possess the apt Best Linear

Unbiased Estimator (BLUE) properties. Also, the stability of the long-run estimates was tested by applying the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squared of recursive residuals (CUSUMQ) tests. The results clearly indicate the absence of instability as the plot of the CUSUM and CUSUMQ statistic(s) is within the confines of the 5 percent critical bonds. However, to conserve space, they are not presented but are available upon request.

5. Conclusions

Motivated by the novel work of Imbs and Wacziarg (2003), we empirically examined the nature of the relationship between diversification and growth in Nigeria, in a dynamic growth framework, over the period 1960-2019. Specifically, the non-monotonic relationship between diversification and growth is examined using the ARDL procedure. Likewise, we examined the impact of diversification on the effect of non-oil export on growth. Employing an augmented production-function framework and two measures of diversification, we find, contrary to the Imbs and Wacziarg exposition, evidence of a monotonic (increasing) relationship between diversification and growth, signifying that diversification, rather than specialization, continues with real GDP per capita. Using a similar framework and five alternative measures of non-oil exports, we find that the impact of diversification on the effects of agricultural and industrial sectors on growth is higher, as compared to building and construction, wholesale and retail, services sectors.

In line with the findings, several wide-ranging implications are deduced. First, to lessen the country's vulnerability to macroeconomic risks, there is the need for policymakers to develop the nation's vast resources, notably, in the agricultural and industrial sectors where the potentials remain great but largely unexploited. Thus, extant policies and initiatives should be reviewed and strengthened to facilitate the rapid expansion of non-oil sectors. Second, in the coming decades, for non-oil sectors to become a major player in the Nigerian economy with value-addition and value-chain, targeted efforts should be directed towards industrialization. To this end, the government should create an enabling that will ensure the functioning and survival of the ailing industries.

Thirdly, the problem of infrastructural deficits (notably in power, telecommunication, agriculture, transportation sectors) should be tackled by massive private investment and public expenditure, as this will enhance productivity in the non-oil sectors. Finally, to accelerate diversification, investment in human capital formation needs to be accorded high priority. The success of Canada, Germany, Australia, Japan, South Korea, Singapore, Taiwan, and Hong Kong provide very clear evidence.

One of the major limitations of time series analysis is the fact that it is very difficult to capture all variables influencing a particular variable of interest. Given that the paper employed time series analysis, it bears the same defect. Aside from physical capital, human capital, exports (non-oil and oil), diversification, openness and inflation, there are other factors affecting growth. These include, among others, resource endowment, financial deepening, imports, the share of sectoral employment, monetary and fiscal policies. These are areas open to other researchers to contribute. Likewise, for future research, it would be of interest to show the composition of the sectors in GDP, Exports, and the share of sectoral employment to emphasize the role of oil in total product, which is beyond the scope of this study.

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Author Contributions
The author conceived the study and was responsible for the design and development of the data analysis. He was responsible for data collection and analysis and also for data interpretation.

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