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Global value chains and export growth in South Africa: evidence from dynamic ARDL simulations*

Godwin Olasehinde-Williams^{a,b}  and Ayodele Folorunso Oshodi^a

^aDepartment of Economics, Faculty of Social Sciences, University of Ilorin, Ilorin, Nigeria; ^bNanchang Institute of Technology, Nanchang, China

ABSTRACT

Over the past few decades, the international trading system has become strongly organised around global value chains. Theoretical and empirical research show that there are numerous benefits associated with participation in global value chains. However, empirical findings on the importance of backward and forward linkages into global value chains are still limited. This paper makes a contribution to the global value chains literature by exploring the relationship between different measures of global value chains participation and export growth in South Africa. Empirical evidence on the relationship is obtained through the use of dynamic autoregressive-distributed lag simulations on data covering the period 1990–2019. Findings indicate the following; the backward linkages (foreign value added) and domestic value added in exports both have significant long-run increasing effects on export growth in South Africa. Indirect value added (forward linkages) has significant short-run and long-run increasing impact on export growth in the country.

ARTICLE HISTORY

Received 24 March 2021
Revised 1 July 2021
Accepted 20 July 2021

KEYWORDS

South Africa; global value chains; export growth; dynamic ARDL simulation; International trade

JEL CODES

C32; F14; F15; F23

1. Introduction

The deregulation and liberalisation of trade, along with the unprecedented development recorded in the information and communication industry in recent decades, has drastically changed the structure of international trade (Kano et al., 2020; Li et al., 2020). The new trade structure has introduced global value chains that are characterised by sophisticated and spatially dispersed arrangements of labour division, fragmentation of transnational production processes, and network trade in which producers of intermediate goods often located in developing countries are closely connected to firms producing finished goods in more developed countries. The advent of global value chains has introduced new complexities into the trade policies of emerging economies. Modifications are being made to existing policies so as to adjust to the new realities in the international trading system. The new policy challenges triggered by global value chains has also sparked a new debate on its importance across various academic disciplines such as international trade, international political economy, economic sociology, supply chains management, and regional and development studies (see Kano et al., 2020). The consensus so far is that integration into global value chains is generally beneficial.

As the international trading system becomes more and more organised around global value chains, the popular position in the international trade literature is that participation in global value chains is beneficial on many fronts to domestic economies. For instance, it has been established that a country's ability to achieve economic prosperity is tied to global value chains participation (Gereffi & Lee, 2012). Global value chains participation positively impacts income per capita and productivity (Ignatenko et al., 2019). Integration into global value chains also provides countries opportunities to industrialise (Foster-Mcgregor, 2019) and provides developing countries new opportunities to integrate into the global economy by allowing firms to join international production networks rather than having to build their own production network from the scratch (Kowalski et al., 2015). It has gradually transformed global production and is becoming an increasingly important determining factor for future trade, foreign direct investment (FDI) pattern and growth opportunities. According to Dollar et al. (2017), global value chain-related activities are the most important driving forces for global GDP growth.

CONTACT Godwin Olasehinde-William  alanisey@gmail.com  Department of Economics, Faculty of Social Sciences, University of Ilorin, Ilorin, Nigeria

*The article is a reprint of a previously in-press article published by Taylor & Francis.
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The international fragmentation of the production process that characterises global value chains compels countries to concentrate on specific activities within the production process. Good quality inputs required in the production process may not be readily available within the domestic economy. Backward integration into global value chains facilitates easy access to these inputs and therefore serves as an important channel through which global value chains participation stimulates productivity and consequently exports in emerging economies (Obasaju et al., 2019). Forward integration into global value chains however brings manufacturers of intermediate inputs in emerging economies closer to manufacturers of final goods in the more advanced economies, thereby permitting emerging economies to integrate into already-existing supply chains rather than build them from scratch (Baldwin, 2011).

In spite of the numerous benefits associated with global value chains participation, it does not feature explicitly in South Africa's trade policy; as a matter of fact, the country's trade policy does not encourage participation in global value chains (Strydom & Viviers, 2015). The emphasis of South Africa's trade policy has been on the manufacture and exports of final goods. As shown in the study carried out by the World Trade Organisation (WTO, 2014), in a group of 30 developing and developed nations, only South Africa and Cambodia failed to increase their integration into global value chains over the period 1995–2009. South Africa's unimpressive performance in global value chains participation is worthy of closer examination as African countries (South Africa inclusive) cannot afford to be left out of global value chains which is fast becoming the bedrock of global trade.

South Africa has not fully exploited the advantage of global value chains to improve her export performance, although it has the potential of leveraging on its comparative advantages in mining, light manufacturing, agrobusiness, tourism and textile. The significance of the study stems from the fact that the findings would be of immense benefits in deepening South Africa's integration into global value chains. This study contributes to the ongoing debate on the desirability and benefits of developing countries participating in global value chains in order to integrate, industrialise and be competitive in exports. This paper therefore empirically examines the impact of South Africa's global value chains participation, through backward and forward linkages, on her export competitiveness.

This paper contributes to the trade literature both theoretically and empirically. In general, empirical investigation of the impact of South Africa's participation in global value chains is relatively limited. Moreover, no study so far has attempted to compare the impacts of forward integration and backward integration on South Africa's export competitiveness with the intention of determining which contributes more. This serves as the theoretical motivation for this research. The specific objectives of the study are as follows; first, to determine the short-run (cyclical) and long-run (structural) impacts of global value chains participation on the export performance of South Africa. Second, to determine the type of global value chains participation (forward integration or backward integration) that is most useful for export growth in South Africa. On the empirical front, this paper is the first to employ the novel dynamic ARDL simulations of Jordan and Philips (2018) in examining the export benefits of global value chains participation in South Africa. The rest of the paper is sectioned thus; Section 2 reviews relevant literature, Section 3 presents the model specification, data description and estimation technique employed in the study, Section 4 discusses the empirical results, while Section 5 concludes the study.

2. Literature review

Global value chains have been defined by several authors. The promoter of global value chains, Porter (1986), describes value chains as a set of interdependent and coordinated activities allowing the creation of identifiable and measurable values if possible, and encompassing all backward and forward activities leading to the production of a product or service. Mensah and Fofana (2018) refers to global value chains as global supply chains, international production network, outsourcing vertical specialisation and production fragmentation. According to Hollweg (2020), global value chains is the unbundling of the production process whereby goods that were formally produced by a country are now fragmented and distributed across the global network of production.

2.1. Participation in global value chains

Participation in global value chains can either be forward or backward, simple or complex, and upstream or downstream. A country is said to enjoy forward integration when it provides inputs for another country's export

production, while it enjoys backward integration when its exports production is sourced from foreign inputs (Conde et al., 2015). Put differently, forward linkages relate to a trading relationship where a country supplies domestic value-added to another country for export processing or final consumption, while backward linkages relate to the extent to which a local economy imports foreign value-added for its own consumption or for export processing (Mouanda-Mouanda, 2019). Simple global value chains refer to domestic or foreign value-added that is exported or imported and directly absorbed by trading partners, while complex global value chains symbolise domestic/foreign value-added crossing at least two borders before consumption (Mouanda-Mouanda, 2019). A country is involved in the upstream activities when it engages in the first stages of production, and its participation in forward linkage might be higher than in backward linkage. Conversely, a country involved in downstream activities specialises in the final steps of production, and therefore, its highest global value chains participation comes from backward linkage (Mouanda-Mouanda, 2019).

2.2. The relationship between global value chains participation and export performance

Global value chains refer to a production arrangement based on division of labour, in which various tasks are taken up by different companies across different countries (Grossman & Rossi-Hansberg, 2008). According to Antràs and Yeaple (2014), the unique characteristics of global value chains are the contractualisation of trading relationships and the internationalisation of the production structure. Due to these factors, global value chains exhibit highly complex networks of international production. The depth of a country's participation in global value chains is understood by examining the value added in the products on the basis of their origin and destination (Tinta, 2017). Using this approach, in extant literature, backward integration referred to as foreign value added is the proportion of imported value added found in a country's exports, whereas, forward integration referred to as indirect value added is the proportion of exported domestic value added reflected in the exports of other countries. The domestic value added is the sum of domestic value addition to products either directly consumed abroad or used in the production process of other countries (Lenzen et al., 2013; Tinta, 2017). The combination of forward and backward integration provides a clear insight into a country's level of participation in global value chains.

Integration into global value chains has both theoretical and empirical support from extant literature. The theoretical reason for the participation of firms and countries in global value chains stems from the economic benefits derived from production fragmentation and specialisation (comparative advantages) derivable from global trade. Integration into global value chains facilitates access to large foreign markets, which makes it possible for firms to enjoy economies of scale, learn new technology and become innovative (Baldwin & Yan, 2014). In addition, cheaper intermediate products are made available with greater variety of products (higher quality of foreign input), consequently resulting in efficiency and cost reduction. Furthermore, participation in international trade may compel firms to improve efficiency in production in order to remain competitive (Baldwin & Yan, 2014). Since global value chains involve international production fragmentation, it enables firms to participate in different production tasks, thus causing the transfer of technological know-how to developing countries. By focussing on specific tasks, developing countries can thus integrate into global value chains without having to build their own value chain from scratch. This way, they are able to minimise production cost (Dutta, 2021). Integration into global value chains therefore leads to job creation, higher labour productivity, and consequently, vertical specialisation and higher output (Dutta, 2021).

On the empirical front, although rapidly expanding, especially with increasing data availability, empirical studies on the effects of integration into global value chains on export performance are still limited. Beltralmello et al. (2012) analyse the export performance of a group of developed and emerging economies from 1995 to 2009 and find that backward linkage into global value chains significantly determine the export competitiveness of countries in final goods. Similarly, Hummels et al. (2001) show from the input-output tables of four emerging market economies and 10 OECD economies that backward integration into global value chains is responsible for about 30% of export growth in the sampled countries. Timmer et al. (2014) argue that global value chains participation widens the opportunities of countries to specialise in the production processes for which they have comparative advantage and hence gain from international trade. The authors therefore conclude that on the average, participation in global value chains is welfare-improving.

Türkcan and Saygılı (2018) study the impacts of various economic integration agreements between Turkey and its trading partners on machine exports. By applying a discrete-time probit model with random effects to data series spanning 1998–2013, they show that the positive impact of such agreements are relatively greater for parts and components exports (forward linkages) than for finished products exports (backward linkages) within the global production network. Also, the investigation of the performance of global value chains during the global financial crisis carried out by Altomonte et al. (2013) shows that the success or failure of the international trading system is closely tied to the performance of global value chains. What remains understudied in the literature is the comparison of the impacts of backward and forward linkages on export performance, especially for emerging economies like South Africa.

2.3. Where does South Africa stand in global or regional value chains?

Africa's regional participation in global value chains reveals that Southern Africa and Northern Africa account for 78% of the continent's total value chain trade, West Africa accounts for 14%, East Africa accounts for 5% and Central Africa accounts for 3%. It is instructive to note that South Africa accounts for 50% of Africa's backward integration, with the bulk of its intermediate inputs sourced mainly from the United States and China (Conde et al., 2015).

At the regional level, trade within Southern Africa is dominated by South Africa, which serves as a major source of intermediates for other Southern African countries. South Africa enjoys trade surplus in the region as the value of intermediate imports from the country embedded in the exports of other Southern African countries grew five times from \$675 million to nearly \$3.5 billion between 1995 and 2011, while the value of South Africa's use of intermediate imports from other Southern African countries increased nine times between 1995 and 2011, increasing from \$78 million to \$686 million (AfDB, OECD/UNDP, 2014; Banga & Balchin, 2019). Thus, South Africa is a key driver of regional value chains (RVCs), both as a supplier of inputs and as a destination market for exports. For instance, it plays a leading role in driving the existing RVCs, being an exporter of processed food and consumer goods (Keane, 2015).

Southern African countries export the highest share of domestic value-added to direct partners, although North African countries are the top importers of foreign inputs in simple global value chains. For complex global value chains, Africa's participation in forward linkage is insignificant, while the engagement in complex backward linkage is important for West Africa. At the sectoral level, South Africa is the chief participant in the primary sector for simple forward and complex backward linkages, while Central Africa is the most involved in the secondary sector for simple forward participation, even though North Africa absorbs the greatest proportion of foreign inputs. For complex global value chains, West Africa is the top importer of intermediate goods coming from abroad. As regards the tertiary sector, North Africa and South Africa display the highest level of participation in simple forward and backward linkages (Mouanda-Mouanda, 2019).

Allard et al. (2016), in their study, reveal that deeper integration in global value chains as measured by a higher share of foreign value added (FVA) is positively correlated with the indicators of human capital development and availability, while it is hindered by higher tariff rates and unfavourable business environments. Thus, with lower tariffs, human capital development and conducive business environments, sub-Saharan African countries would deepen their integration and participate fully in global value chains. OECD (2013) reports that the upstream and downstream links explain South Africa's participation in global value chains through its exports. It is observed that the use of foreign intermediates in South Africa's exports (its backward participation) is a bit higher than the use of South Africa's intermediates in other countries' exports (forward participation). Moreover, the country strongly participates in the mining sector as a result of its mineral resources which end up in the exports of countries further down the value chain, followed by its fair participation in manufacturing global value chains for basic metals, chemicals and transportation equipment through sourcing of intermediates from abroad. However, its participation in global value chains is reduced in other manufacturing and services.

3. Model specification, data description and estimation technique

3.1. Model specification

To empirically evaluate the impact of global value chains participation on export growth in South Africa, the following econometric models are specified;

$$LEXP_t = \beta_0 + \beta_1 LFVA_t + \beta_2 LREXR_t + \beta_3 LCPI_t + \beta_4 LGDPPC_t + \beta_5 LFDI_t + e_t, \quad (1)$$

$$LEXP_t = \beta_0 + \beta_1 LDVA_t + \beta_2 LREXR_t + \beta_3 LCPI_t + \beta_4 LGDPPC_t + \beta_5 LFDI_t + e_t, \quad (2)$$

$$LEXP_t = \beta_0 + \beta_1 LDVX_t + \beta_2 LREXR_t + \beta_3 LCPI_t + \beta_4 LGDPPC_t + \beta_5 LFDI_t + e_t, \quad (3)$$

where $t = 1, \dots, T$. $LEXP$ is the log of export volume. $LFVA$ is the log of foreign value added in exports. $LDVA$ is the log of domestic value added in exports. $LDVX$ is the log of indirect value added. $LREXR$ is the log of real exchange rate. $LCPI$ is the log of consumer price index. $LGDPPC$ is the log of per-capita gross domestic product. $LFDI$ is the log of foreign direct investment.

Exports as share of gross domestic product in South Africa is the dependent variable in the empirical analysis. In Equation (1), backward linkages, measured through foreign value added in exports, serves as the measure of global value chains integration, while in Equation (2), forward linkages, proxied via indirect value added, is the measure of global value chains participation. In Equation (3), domestic value added in exports is used as the measure of global value chains participation.

In addition to the three different measures of global value chains participation, following economic theory and empirics, Equations (1–3) also include a set of control variables—real exchange rates, consumer price index, per-capita gross domestic product and foreign direct investment. Real exchange rate is included in the models to control for the impact of relative price differences between South Africa and its trading partners. Higher real exchange rate values indicate cheaper (costlier) exports (imports). Consumer price index is included to control for general price level changes in South Africa. Per-capita gross domestic product is included to control for purchasing power differentials between South Africa and its trading partners. Foreign direct investment is included to control for the domestic supply capacity in South Africa.

3.2. Data description

Time series data extending from 1990 to 2019 (the longest available dataset for South Africa) is collected for all the variables in Equations (1–3). FVA, DVX and DVA are measured in United States dollars and are freely obtainable at the UNCTAD-Eora Global Value Chain Database (<https://worldmrio.com/unctadgvc/>). A detailed description of the empirical methodology employed in constructing the global value chain figures is provided in Casella et al. (2019). Data on export volume, real exchange rate, per-capita gross domestic product, consumer price index and foreign direct investment are collected from the World Development Indicators of the World Bank (<https://databank.worldbank.org/source/world-development-indicators>). The logarithmic forms of all the variables are used for econometric analysis for ease of interpretation and also to deal with non-normality, non-linearity and heteroscedasticity in the data series.

Table 1 presents the summary statistics for the variables included in Equations (1–3). The dependent variable—EXP—ranges between 20.704 and 35.622 with an average value of 27.130. As for the independent variables of interest, FVA ranges between 1.99 million USD and 20.5 million USD with a mean value of 10.17 million USD, DVX ranges between 5.52 million USD and 44.94 million USD with an average value of 22.82 million USD, DVA ranges between 14.77 million USD and 89.74 million USD with an average value of 48.8 million USD. Based on the Jarque-Bera test statistics, EXP, FVA, DVX and DVA are all normally distributed. The plots of the variables of interest—EXP, FVA, DVX and DVA—over the sample period are presented in Figure 1. FVA, DVX and DVA values are reported on the left axis of the graph, and that of EXP is on the right axis of the graph. A look at the plot of EXP shown in Figure 1 reveals that export volume has been on a steady rise over time in South Africa, with sharp spikes in the early and late 2000s. The plots also show that all three variables of interest have been on a steady and continuous rise over time. Domestic value added in exports however exceeds both foreign value added in

Table 1. Summary statistics.

	EXP	FVA	DVA	DVX	REXR	GDPCC	CPI	FDI
Mean	27.130	10175664	48811184	22818034	7.239	6556.405	77.645	1.221
Median	27.535	7441157	39164505	17889965	6.993	6369.061	73.009	0.775
Maximum	35.622	20514870	89737520	44944430	14.705	7563.993	152.633	5.983
Minimum	20.704	1997318	14772650	5517693	2.587	5517.530	25.431	−0.066
Std. Dev.	3.844	6847484	28163399	14590916	3.369	790.176	36.459	1.316
Skewness	−0.036	0.334	0.370	0.315	0.588	0.072	0.522	1.923
Kurtosis	2.214	1.419	1.469	1.418	2.638	1.278	2.282	7.205
Jarque-Bera (p-val)	0.695	0.179	0.185	0.184	0.413	0.175	0.392	0.000

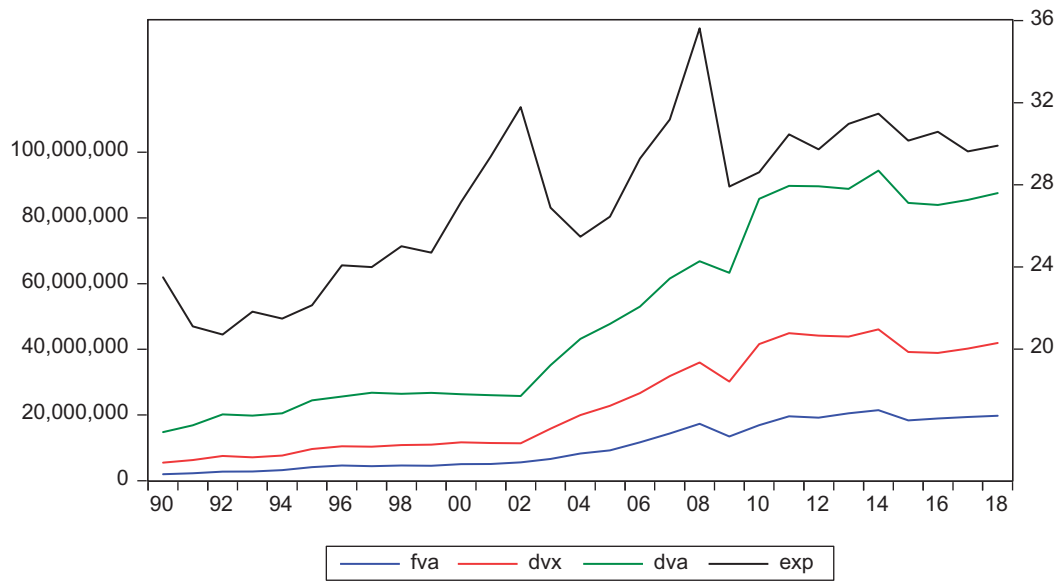


Figure 1. Time series plots of exports, foreign value added in exports (FVA), indirect value added (DVX), and domestic value added in exports (DVA).

Table 2. Correlation matrix.

Variables	EXP	FVA	DVA	DVX	REXR	GDPPC	CPI	FDI
EXP	1.000							
FVA	0.171** (0.025)	1.000						
DVA	0.160** (0.035)	0.937*** (0.000)	1.000					
DVX	0.228*** (0.003)	0.871*** (0.000)	0.976*** (0.000)	1.000				
REXR	−0.154** (0.043)	−0.045 (0.555)	0.201*** (0.002)	0.216*** (0.004)	1.000			
GDPPC	0.152** (0.046)	0.546*** (0.000)	0.551*** (0.000)	0.509*** (0.000)	−0.023 (0.766)	1.000		
CPI	0.0035 (0.964)	0.296*** (0.000)	0.411*** (0.000)	0.405*** (0.000)	0.348*** (0.000)	0.239*** (0.002)	1.000	
FDI	0.198*** (0.009)	−0.148* (0.052)	−0.218*** (0.004)	−0.219*** (0.004)	−0.196*** (0.009)	−0.274*** (0.000)	0.204*** (0.007)	1.000

exports and indirect value added over the entire sample period, indicating that domestic value addition to exports has remained greater than both backward and forward linkages into global value chains in South Africa. It is also worthy of mention that over the period studied, forward linkages (DVX) consistently exceed backward linkages (FVA). Finally, Table 2 shows the results of Pearson's correlation. The correlation coefficients indicate that all the three measures of global value chains integration are positively correlated with export performance. In addition, the extremely high correlation between the three different measures show that they are highly interrelated. This is an indication that modelling all the three measures in a single equation would most certainly lead to multicollinearity and its associated econometric problems.

3.3. Estimation technique

The ARDL model of Pesaran et al. (2001) is very widely employed in empirical analyses due to its usefulness for testing numerous theoretically important theories (Jordan & Philips, 2018). There are two key benefits of the ARDL approach. First, it is able to generate reliable results, irrespective of whether the variables are integrated of order $I(0)$ or integrated of order $I(1)$ or mutually co-integrated (Pesaran et al., 2001). Second, the approach is able to generate unbiased estimates even when some of the independent variables are endogenous (Harris & Sollis, 2003). For these reasons, the ARDL approach is preferred for this study. There are

however two limitations to the conventional ARDL approach. First, when it is applied to small sample time-series data (time points of 80 and below), the result tends to more often than not suggest the absence of cointegration when it is present. Moreover, ARDL models often exhibit complex dynamic structures containing several lags, contemporaneous values, first differences and lags of first differences. This complex dynamic structure makes the interpretation of the short- and long-run effects of the regressors difficult (Jordan & Philips, 2018).

To address the challenges of the complex dynamic structure of ARDL models, Jordan and Philips (2018) recently proposed the dynamic ARDL model. This approach is a flexible procedure which allows the dynamic simulation of various ARDL models. Rather than adopt the conventional hypothesis testing of parameter estimates, dynamic simulations report the significance of the results via counterfactual scenarios. The approach is able to estimate, simulate and plot the changes in the explained variable due to changes in an independent variable, *ceteris paribus*. This novel method can estimate and simulate changes in the dependent variable that are due to a regressor, *ceteris paribus*. Due to its ability to improve the robustness of the conventional ARDL model, the dynamic ARDL model is employed in this paper.

The dynamic ARDL simulations of the econometric models specified in Equations (1–3) in the error correction form is derived as follows;

$$\Delta LEXP_t = \beta_0 + \beta_1 LEXP_{t-i} + \beta_2 \Delta LFVA_t + \beta_3 LFVA_{t-i} + \beta_4 \Delta LREXR_t + \beta_5 LREXR_{t-i} + \beta_6 \Delta LCPI_t + \beta_7 LCPI_{t-i} + \beta_8 \Delta LGDPPC_t + \beta_9 LGDPPC_{t-i} + \beta_{10} \Delta LFDI_t + \beta_{11} LFDI_{t-i} + e_t, \quad (4)$$

$$\Delta LEXP_t = \beta_0 + \beta_1 LEXP_{t-i} + \beta_2 \Delta LDVA_t + \beta_3 LDVA_{t-i} + \beta_4 \Delta LREXR_t + \beta_5 LREXR_{t-i} + \beta_6 \Delta LCPI_t + \beta_7 LCPI_{t-i} + \beta_8 \Delta LGDPPC_t + \beta_9 LGDPPC_{t-i} + \beta_{10} \Delta LFDI_t + \beta_{11} LFDI_{t-i} + e_t, \quad (5)$$

$$\Delta LEXP_t = \beta_0 + \beta_1 LEXP_{t-i} + \beta_2 \Delta LDVX_t + \beta_3 LDVX_{t-i} + \beta_4 \Delta LREXR_t + \beta_5 LREXR_{t-i} + \beta_6 \Delta LCPI_t + \beta_7 LCPI_{t-i} + \beta_8 \Delta LGDPPC_t + \beta_9 LGDPPC_{t-i} + \beta_{10} \Delta LFDI_t + \beta_{11} LFDI_{t-i} + e_t, \quad (6)$$

4. Empirical results

4.1. Preliminary investigation

To ensure the validity of the outcomes generated from the dynamic ARDL simulations, certain conditions must be met. First, the target variable must strictly be first difference stationary $[I(1)]$. Second, none of the regressors must be integrated of an order higher than one. Third, cointegration must exist between the variables included in the model (Sarkodie & Owusu, 2020). To ensure that the first two conditions are not violated, the stationarity properties of all the variables were examined through a battery of unit root tests—augmented Dickey and Fuller (1979), Phillips and Perron (1988), and Kwiatkowski et al. (1992). The tests were conducted under the specification ‘intercept with trend’ both at level and at first difference. Table 3 presents the unit root test results. The conclusion reached on the basis of the results is that all the variables contain unit root at level but become stationary after first difference. They are therefore all integrated of order one.

To ensure that the third condition is satisfied, the modified Pesaran et al. (2001) bounds test with Kripfganz and Schneider (2020) critical values is implemented to determine whether the variables are co-integrated. This approach is the most preferable for determining the upper and lower bound critical values in cases where the underlying variables are either integrated of order zero or of order one (Sarkodie & Adams, 2018; Ulucak, 2020). Table 4 shows the results obtained from the cointegration tests for each of the models. Since the F-statistic

Table 3. Unit root results.

Variables	EXP	FVA	DVA	DVX	REXR	CPI	GDP	FDI
ADF	−3.085	−2.039	−1.766	−1.789	−2.675	−0.319	−2.016	−0.602
Δ ADF	−5.175***	−5.718***	−5.359***	−5.466***	−3.943**	−3.801**	−2.948*	−6.414***
PP	−2.993	−2.081	−1.901	−1.921	−2.173	0.913	−2.525	−1.625
Δ PP	−8.276***	−5.765***	−5.359***	−5.462***	−3.836**	−2.939*	−8.944**	−5.469***
KPSS	0.601**	0.657**	0.663**	0.654**	0.631**	0.704**	0.627**	0.303**
Δ KPSS	0.100	0.121	0.124	0.115	0.091	0.120	0.192	0.228

*, **, *** denote the rejection of the null hypothesis of nonstationarity for ADF and PP at 10%, 5% and 1% significance levels respectively. *, **, *** denote the rejection of the null hypothesis of stationarity for KPSS at 10%, 5% and 1% significance levels respectively. (3) Specification selected is ‘intercept and trend’.

Table 4. Pesaran, Shin and Smith bounds testing.

Model	F-Stat	10%		5%		1%	
		I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
(1) $Lexp = f(lfva, lfdi, rexr, lcpi, lgdppc)$	88.60	2.58	3.86	3.13	4.61	4.54	6.37
(2) $Lexp = f(ldva, lfdi, lrexr, lcpi, lgdppc)$	44.36	2.58	3.86	3.13	4.61	4.54	6.37
(3) $Lexp = f(ldvx, lfdi, lrexr, lcpi, lgdppc)$	71.30	2.58	3.86	3.13	4.61	4.54	6.37

I(0) is the lower bound critical value of the Pesaran, Shin and Smith bounds test. I(1) is the upper bound critical value of Pesaran, Shin and Smith bounds test. *, **, *** denote the rejection of the null hypothesis of no cointegration at 10%, 5% and 1% significance levels respectively. A maximum lag of one is used in all cases for ease of comparison.

Table 5. Estimation based on dynamic ARDL simulations for South Africa.

	Model 1	Model 2	Model 3
$LEXP_{t-1}$	−0.531** [0.031]	−0.589** [0.018]	−0.645*** [0.001]
$\Delta LFVA_t$	0.093 [0.431]		
$LFVA_{t-1}$	0.361* [0.054]		
$\Delta LDVA_t$		0.093 [0.439]	
$LDVA_{t-1}$		0.318* [0.056]	
$\Delta LDVX_t$			0.223** [0.015]
$LDVX_{t-1}$			0.538*** [0.000]
$\Delta LFDI_t$	0.008 [0.986]	0.004 [0.381]	0.002 [0.576]
$LFDI_{t-1}$	0.005 [0.921]	0.004 [0.544]	0.001 [0.742]
$\Delta LREXR_t$	0.121 [0.219]	0.106 [0.325]	0.179** [0.035]
$LREXR_{t-1}$	0.408** [0.011]	0.383** [0.012]	0.530*** [0.000]
$\Delta LCPI_t$	−0.568 [0.200]	−0.307 [0.406]	0.053 [0.808]
$LCPI_{t-1}$	−0.737*** [0.020]	−0.652** [0.022]	−0.831*** [0.000]
$\Delta LGDPPC_t$	−0.917 [0.193]	−0.587 [0.348]	−1.215 [0.115]
$LGDPPC_{t-1}$	−0.383 [0.349]	−0.272 [0.460]	−1.224 [0.103]
_cons	−0.223	−2.017	0.526
Adj. R^2	0.833	0.802	0.840
Prob > F	0.000	0.000	0.000
Diagnostic tests			
Prob > Archlm	0.945	0.203	0.175
Prob > Breusch Godfrey	0.183	0.197	0.754
Prob > Jarque Bera	0.741	0.915	0.706

Standard errors are reported in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1% respectively. 50000 simulations are conducted.

obtained in each case exceeds the upper bound critical values, the null hypothesis of no cointegration is rejected in all cases, confirming the presence of cointegration among the variables included in the models.

4.2. Short-run and long-run estimates

Since all the required preconditions are met, the short-run and long-run effects of global value chains integration, along with the other control variables on export growth, is estimated through dynamic ARDL simulations. The short-run and long-run estimates for each of the models are reported in Table 5. As shown in the table, two of the measures of global value chains integration (FVA and DVA) have no short-run impact on the growth of exports in South Africa. However, in the long run, their impacts are positive and statistically significant. Specifically, a percentage rise in FVA causes South African exports to grow by 0.361 percent (this outcome is significant at $p < 0.1$). A percentage increase in domestic value added in exports causes South African exports to grow by 0.318 percent (the result is significant at $p < 0.1$). Contrarily, DVX has both short-run and long-run effects on South Africa's export growth. A percentage increase in DVX results in 0.223 percent and 0.538 percent

increases in export growth in the short run and long run respectively (the results are significant at $p < 0.5$ and $p < 0.01$, respectively). The implication of these findings is that while both forward and backward linkages into global value chains are vital to export growth, the impact of forward linkages outweighs that of backward linkages by a significant margin. As expected, the result also indicates that domestic value addition to locally produced goods for exports is an important requirement for export growth in South Africa, although not as important as forward and backward linkages into global value chains.

Concerning the other regressors, all three models unanimously agree that real exchange rate has a significant and positive long-run impact on export growth, while the general price level has a significant and negative long-run impact on export growth. The long-run impact of a percentage rise in real exchange rate ranges between 0.383 percent and 0.530 percent and the results are significant at $p < 0.05$ or better, that of the general price level ranges between -0.652 percent and -0.831 percent. In addition, model 3 also indicates that real exchange rate has a short-run impact of about 0.179 percent on export growth. These findings confirm the fact that higher real exchange rate values indicate cheaper exports, and that relatively higher domestic prices encourage imports and discourages exports. The results also show that past export values significantly impact the current values. The short-run and long-run coefficients for foreign direct investment and per-capita GDP are statistically insignificant; therefore, no inferences are made about their impacts on export growth. The results in all cases successfully pass the diagnostic tests conducted.

4.3. Predicted effects of counterfactual shocks to global value chains integration

As a final step, the predicted impacts of one standard deviation counterfactual shocks to the measures of global value chains integration—FVA, DVA and DVX—are simulated and plotted as presented in Figures 2–4. Figure 2 shows the effect of both positive and negative one standard deviation shocks to LFVA on LEXP. The first graph in Figure 2 shows that a positive shock to FVA will stimulate a significant increase in LEXP in the short run, that eventually reaches a long-run value of about 4.1. The second graph shows that a negative shock to FVA will cause a significant decline in LEXP in the short run, to a sustained long-run value of about 2.7. These outcomes indicate that positive shocks to South Africa's backward linkage into global value chains will cause an increase in export growth, while negative shocks will cause a decrease in export growth.

Figure 3 plots the impact of positive and negative one standard deviation shocks to LDVA on LEXP. As shown in the first graph, a positive one standard deviation shock in LDVA significantly raises LEXP to a sustained long-run value of about 3.8. In the second graph, a negative one standard deviation shock in LDVA lowers LEXP to about 2.75 in the long run. The results confirm that domestic value addition to exports is a significant driver of export growth in South Africa.

Figure 4 similarly shows that a one standard deviation positive shock to DVX raises LEXP to a sustained long-run value of approximately 4.2 and that a one standard deviation negative shock lowers LEXP to a sustained long-run value

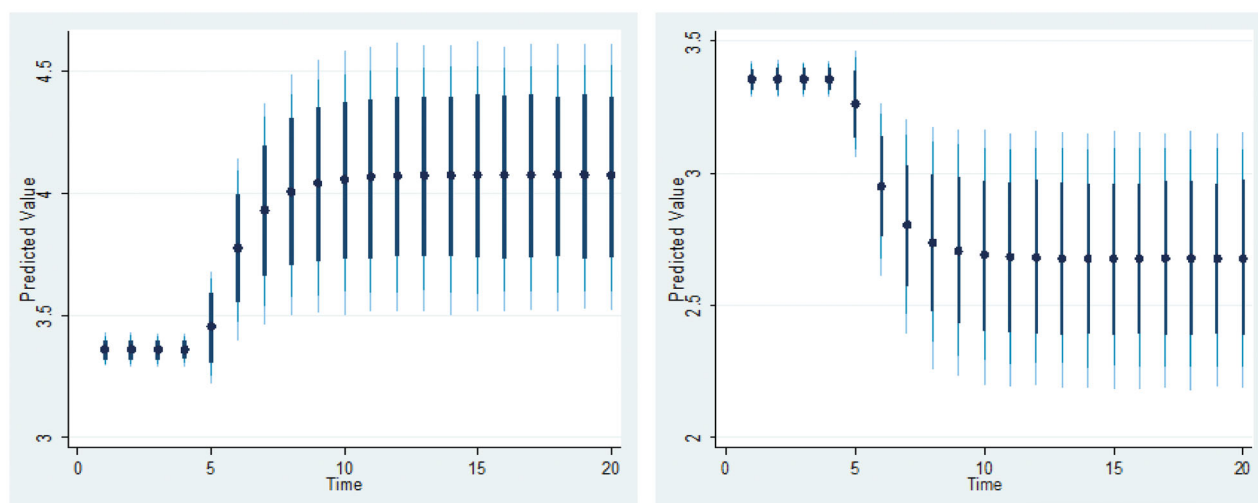


Figure 2. Representation of the predicted impact of a ± 1 shock in LFVA at $t = 5$ on LEXP. The dark spots are the predicted mean values; the blue lines, from darkest to lightest are the 75%, 90% and 95% confidence intervals, respectively.

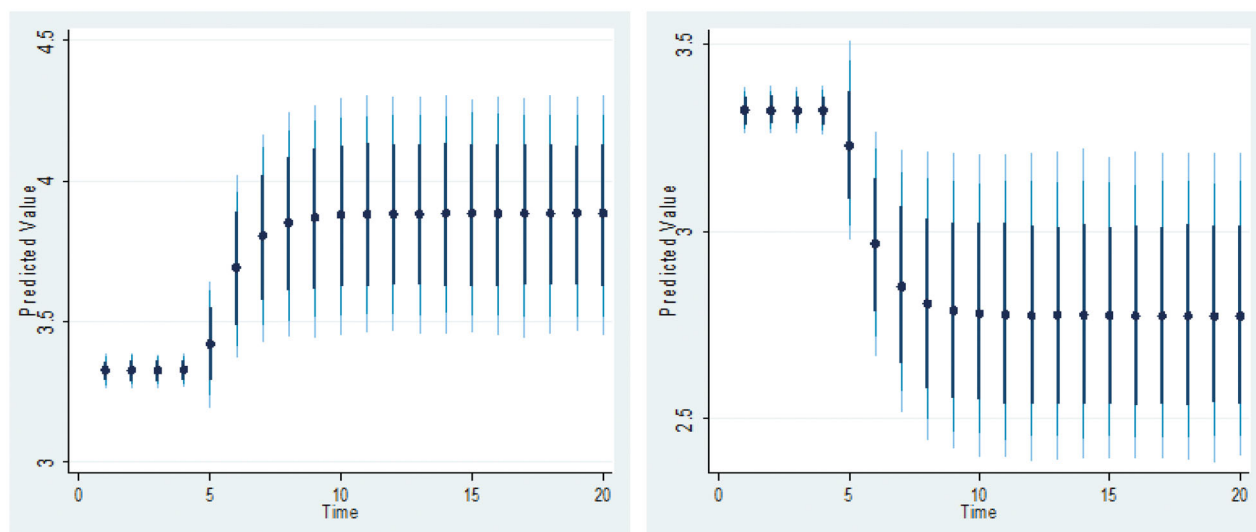


Figure 3. Representation of the predicted impact of a ± 1 shock in LDVA at $t = 5$ on LEXP. The dark spots are the predicted mean values; the blue lines, from darkest to lightest are the 75%, 90% and 95% confidence intervals, respectively.

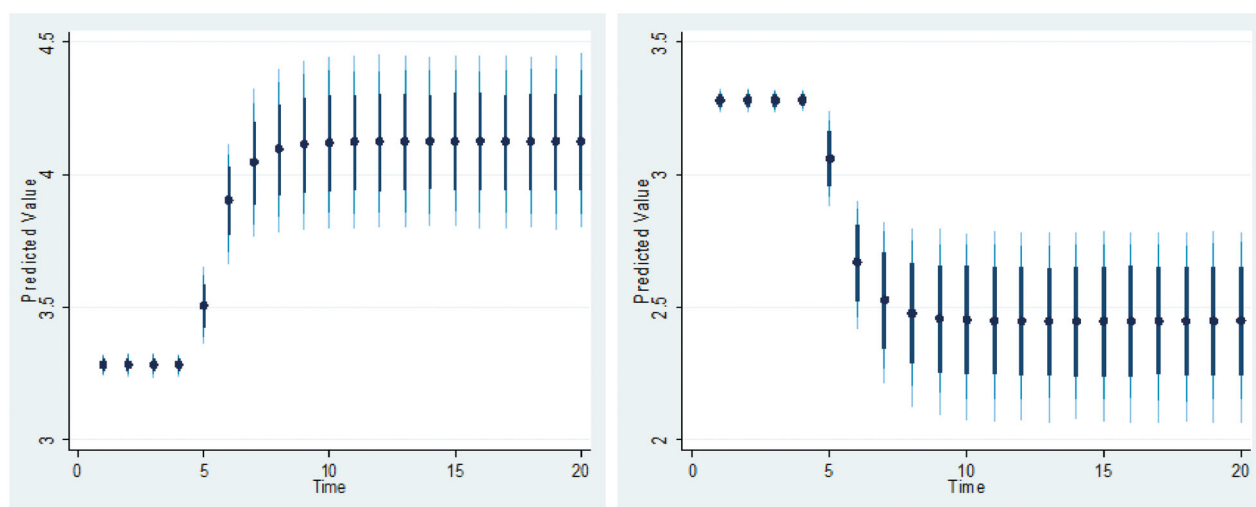


Figure 4. Representation of the predicted impact of a ± 1 shock in LDVX at $t = 5$ on LEXP. The dark spots are the predicted mean values; the blue lines, from darkest to lightest are the 75%, 90% and 95% confidence intervals, respectively.

of approximately 2.4. The results confirm that positive shocks to forward linkages into global value chains cause an increase export growth in South Africa, whereas, negative shocks cause a decline in export growth.

The reaction of South Africa's export growth to global value chains counterfactual shocks again confirm that integration into global value chains positively impact export growth. The results again indicate that although both forward and backward linkages are useful drivers of export growth, forward linkages have a greater impact than backward linkages. The importance of domestic value addition to locally produced goods for export growth is also established, although the plot of the reaction of export growth indicates that domestic value addition is not as important as forward and backward linkages into global value chains. Overall, the study findings agree with Kowalski et al. (2015) that countries with relatively strong backward linkages often display relatively weaker forward linkages, while those with relatively weak backward linkages often exhibit relatively weaker forward linkages.

5. Conclusion

South Africa is a key driver of value chains in Africa, both as a supplier of inputs and as a destination market for exports. Trade within the Southern African region is dominated by South Africa, which serves as a major source

of intermediates for other African countries. This paper therefore empirically studies the short-run and long-run impacts of South Africa's integration into global value chains on its export growth over the period 1990–2019. Three different measures of global value chains participation—foreign value added in exports (backward linkages), domestic value added in exports, and indirect value added (forward linkages) were used. These different measures were also compared with the intention to determine which is more important for export growth in the country.

In the empirical analysis, the modified Pesaran et al. (2001) bounds test with Kripfganz and Schneider (2020) critical values confirmed that a long-run relationship exists between global value chains participation and exports, along with the other control variables for the sampled period in South Africa. In addition, the short-run and long-run dynamics were estimated through the use of dynamic ARDL model simulations. Several interesting results were revealed through the simulations. First, the estimations revealed that backward linkages (foreign value added), and domestic value added in exports both have significant long-run increasing effects on export growth in South Africa. Second, the estimations also revealed that indirect value added (forward linkages) has significant short-run and long-run increasing impact on export growth in the country. Third, the results show that in addition to being the only measure of global value chains participation with a short-run impact on export growth, indirect value added (forward linkages) also has a greater long-run impact on export growth when compared with the other measures.

The study findings have important economic implications. First, South Africa's participation in global value chains has a significant impact on its international trade as it stimulates export growth and consequently improves its export revenues and foreign exchange earnings. Second, since South Africa benefits more from forward linkages, based on the theory of comparative advantage, it should specialise in the production of less sophisticated goods or processes within the global value chain. Third, the study findings may be a reflection of the fact that South African exports are placed at the beginning of global value chains in the form of forward integration such that a significant proportion of its exports serves as input for the exports of other countries. This is probably a reflection of the dominance of commodities in South African exports. In conclusion, since integration into global value chains is beneficial to the economy, policymakers in South Africa should adopt trade policies that boost global value chains participation.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes on contributors

Godwin Olasehinde-Williams Earned a B.Sc. degree in Economics from Ajayi Crowther University in Nigeria where he graduated as the valedictorian. He also has both Masters and Doctorate degrees in Economics from Eastern Mediterranean University, Turkey. He has published several research articles in reputable international academic journals. His areas of interest include Macroeconomics, Applied Econometrics, Energy and Environmental Economics.

Ayodele Folorunso OSHODI is a lecturer at the Department of Economics, University of Ilorin, Nigeria. He holds a Ph.D. degree in Economics from the University of Ilorin with 19 years of teaching and research experience and has several publications to his credit. His areas of specialisation and interest include: International Economics, Industrial Economics and Development Economics.

ORCID

Godwin Olasehinde-Williams  <http://orcid.org/0000-0002-3710-6146>

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