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South Africa's integration into global value chains: status, risks and challenges

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South Africa's integration into global value chains: status, risks and challenges

Guannan Miao*

Abstract

South Africa's global value chain (GVC) integration lags behind other small open economies, and this is particularly well illustrated with the automotive industry. This paper seeks to understand the causes of this lag. It finds that the level of South Africa's GVC integration is determined largely by its economic structure and factor endowment, such as distance to market, the size of manufacturing and revenues from natural resources. Other contributing factors include the country's economic policies, such as free trade agreements, its openness to foreign direct investment and the qualities of its institutions. As countries rethink their approach to GVCs in the wake of the food and energy crisis, South Africa should reflect on how to reshape its industrial policies and revamp its value chains to boost growth.

JEL classification

F13, F14, F15

Key words

Global value chains, trade in value added, trade policy, industrial policy, South Africa

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1. Introduction

Post-apartheid South Africa does not lack advocates for global value chains (GVCs) (see Siddiqui 1999; Carmody 2002; Strydom and Viviers 2015; and Strydom, Viviers and Parry 2018). Indeed, over the past three decades the emergence of GVCs have created opportunities for growth in many economies, especially developing countries. Well-defined specialisation improves efficiency, thereby increasing production, creating jobs, generating wealth and lifting many out of poverty (Hummels, Ishii and Yi 2001; Organisation for Economic Co-operation and Development (OECD) 2013; Baldwin 2016).

The pre-eminent example of advocacy for GVC integration in South Africa is in the automotive industry, where it has been largely driven by government initiatives such as the Motor Industry Development Programme, launched in 1995, and its replacement, the Automotive Production and Development Programme, launched in 2013. [1] The automotive industry's integration into GVCs is characterised by cooperation with multinational enterprises, which has helped to connect domestic supply chains with international markets.[2]

However, the results of GVC integration across the South African economy have only been somewhat satisfactory. According to indicators measuring economic integration, South Africa trails many Southeast Asian and Eastern European countries (Farole 2016). Trade liberalisation in South Africa since 1995, when it joined the World Trade Organization (WTO), has resulted in lower import tariffs but has not brought about more diversified manufacturing exports, with only a few capital-intensive and resource-based businesses pocketing the benefits.

Globally, the outlook for GVC integration is not bright. Previously very low unit labour costs in developing countries have been rising and international transportation costs

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1 The Motor Industry Development Programme reduced tariffs and provided strong support for exports. The Automotive Production Development Programme aimed at promoting production volumes in the motor vehicle industry and promoting added value in the automotive component industry thus creating employment across the automotive value chain.

2 See African Union Commission and OECD (2022) for further information on the automotive industry's integration into GVCs in Southern Africa.

are very low and unlikely to decrease further.[3] In addition, the so-called fourth industrial revolution driven by automation will not spur further demand for cheap labour inputs.

These poor prospects for globalisation coincide with rising protectionism (prompted by job losses and the polarisation of wealth) and greater awareness of supply chain risks (magnified by the COVID-19 pandemic and geopolitical disputes). In fact, global trade as a share of world gross domestic product (GDP) has stalled since the Global Financial Crisis (GFC) (Antràs 2020), and a great deal of literature has pointed to a slowdown in the fragmentation of production (OECD 2020; OECD 2021; Timmer et al. 2021; Miroudot 2022). More voices are calling for domestic policies to diversify supply chains and to alleviate and absorb the adverse effects of globalisation.

In this context, understanding the trends and determinants of GVC integration is particularly pertinent. Why has South Africa not fared well with GVC integration and how should it respond if globalisation takes a turn for the worst and a process sets in of diminishing interconnections among nation states? This paper examines the long-term trends of South Africa's GVC integration and the reasons for its middling performance despite the substantial support of domestic economic policies. The paper also offers some insight into the risks and challenges that South Africa may have to face in the current climate with a rising appetite for 'reshoring' or 'nearshoring'.[4]

The primary objective of this paper is to examine the status and the trends of South Africa's integration into GVCs. The key findings are:

- South Africa's backward GVC participation lags behind other small open economies.
- The data points to a reduction in *backward GVC participation* globally since 2013. Moreover, *export intensity* has also stagnated globally since 2008. South Africa shows no different trends.
- GVC integration in the South African automotive industry has lacked momentum.

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3 In fact, the costs of transportation and insurance for international trade have been rising recently, especially if taking the weight of products into account (see Miao and Wegner 2022).

4 Reshoring refers to the practice of transferring a business operation that was moved overseas back to the country where it was originally located; nearshoring refers to the practice of transferring a business operation to a nearby country, especially in preference to a more distant one.

- South Africa relies on natural resource exports. In 1995, nearly half of its gross exports were mining-related (mining and basic metals) products, but since then this share has gradually decreased, reaching 40% in 2018. However, when measuring exports in value-added terms, only a quarter were mining-related products in 2018.
- There has been a notable increase in services exports, led by the wholesale and retail and transport and storage services industries. The value-added exports of the two leading services industries have increased not only directly, but also indirectly by taking up supporting functions for mining and manufacturing exports.
- China's and India's trade with South Africa has soared in the past two decades. For example, in 2017, a quarter of South Africa's exports were destined for China, and the figure was slightly (3 percentage points) lower when measured in value-added terms.

Country-specific characteristics matter when it comes to predicting which countries are better integrated into GVCs. To test the magnitude of countries' integration in GVCs, and South Africa's in particular, this paper takes a macro approach (as opposed to a micro approach that views GVC participation as a collective of firm-level decisions, as explained by Gereffi, Humphrey and Sturgeon 2005 or Antràs 2020). This is to better understand how different variables related to the country's economic structure and policies influence its economic integration.

In contrast to most research examining the determinants of GVC integration (Kowalski et al. 2015; Farole 2016; Ziemann and Guérard 2017; and Kummritz, Taglioni and Winkler 2017), this study compares three indicators that measure GVC integration: backward GVC participation, export intensity and processing. Each indicator highlights a different aspect of GVC integration, demonstrating that countries' factor endowments, economic structures and policies affect these indicators to different degrees.[5] This study finds that a country's economic structure, such as its distance to

[5] The research question and modelling work adopted in this paper are directly comparable to Kowalski et al. (2015) and Ziemann and Guérard (2017). Kowalski et al. (2015) and Ziemann and Guérard (2017) were interested in backward and forward GVC participation. Backward GVC participation measures foreign value added embodied in domestic exports (see definition in section 2); forward GVC participation refers to domestic value added that is then used as an input to produce exports in the destination country. In this paper, I tested the impact of policy and non-policy variables on backward GVC participation, export intensity and processing. Export intensity measures wider flows than forward GVC participation and also includes the domestic value-added

market, the size of its manufacturing sector and its revenues from natural resources, explains over half of its GVC integration, whereas a country's economic policies, openness to foreign direct investment and institutional qualities have less pronounced effects. There are considerable variations in how these explanatory variables affect the GVC indicators in question. Adjusted for its economic and structural constraints, notably the relatively great distance to market and the large amount of natural resources in its exports, South Africa's GVC integration turns out to be on par with the models' predictions. The paper also highlights the need for the right set of structural policies to improve business operating environments in order to make existing industrial policy more effective.

The paper is structured as follows. Section 2 summarises the international initiatives that measure GVC integration and explains how to interpret the GVC indicators. Section 3 assesses the current status of South Africa's integration into GVCs. Section 4 sets up the empirical work using structural and policy indicators as explanatory variables (such as the share of services in the domestic economy, skills and the quality of legal institutions) to find the determinants of GVC integration. Section 5 interprets the results with a specific focus on South Africa. Section 6 briefly discusses South Africa's policy settings and its constraints before section 7 offers conclusions on the future of GVC integration in South Africa.

2. Measuring GVC integration

The rise of GVC integration calls for a better accounting framework. Increasingly fragmented global production chains/networks have inflated aggregate export figures because intermediate goods and services cross over national borders several times for processing before they reach the final consumer. There are thus good grounds for arguing that what is needed are new statistics and new ways to link existing datasets that measure and analyse cross-border trade, in order to account for changes in the global economy (Sturgeon and Gereffi 2009).

content consumed directly by the destination country.

Academics and international organisations have taken big strides in providing the statistical infrastructure to measure GVC integration, in the form of what are known as multi-regional input-output tables or inter-country input-output (ICIO) tables.[6] By integrating the production functions of multiple countries, these tables are able to track where goods and services are coming from and where they are going. The GVC indicators calculated from these tables show the degree to which a given country is dependent on others for production and consumption.

This statistical infrastructure can provide insight into critical issues such as how trade contributes to the domestic economy in terms of output, industry linkages and employment. Understanding a country's current participation in value chains is key to ensuring that a country's industrial and trade policies remain well tailored to its needs.

The OECD's Trade in Value Added (TiVA) indicators are calculated from the ICIO tables, which are based on either national statistics or estimates, both compiled according to the 2008 System of National Accounts and International Standard Industrial Classification (ISIC) Revision 4. The new edition of the database was released in December 2021, and covers 66 countries and 45 industries for the period 1995–2018 (see annexures 1 and 2 for details).[7] The most relevant indicators for this paper are the following.

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6 The OECD, Asian Development Bank, World Input-Output Database and Eurostat have done similar work on this front (see OECD-WTO 2011 and Timmer et al. 2012 for data sources, methodology and challenges). The construction of the ICIO tables – the underlying statistical infrastructure to calculate TiVA indicators – is a daunting task. Most of the time, countries do not use the same industry classification, thus combining data requires many assumptions. A number of issues also arise from combining the national accounts data and the international trade statistics. First, capturing international trade transactions using the ownership principle, as recommended in the System of National Accounts and the Balance of Payments Manual (BPM6), provides a lower bound of the estimate as these indicators cannot capture, for example, 'goods sent abroad for processing' when there is no change of ownership (because there is no transaction recorded). Second, the ICIO requires a 'balanced' view of international trade (where a country's export to another country is the same as the other country's imports), which is often not the case due to the differences in valuation (the cost, insurance and freight prices for imports versus free-on-board prices for exports) and in definition (country of origin for imports and last-known destination for exports). Third, the technical challenge concerns the assumptions made to the allocation of trade in services by Extended Balance of Payments Services categories to International Standard Industry Classification, which has an impact on the subsequent interpretation of the imported services content by the industry origin.

7 For details of the release see: https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm. See Martins Guilhoto, Webb and Yamono (2022) for documentation and a brief explanation of all indicators.

Foreign value-added content of gross exports measures the value of imported intermediate goods and services that are embodied in an industry's exports. The value added can come from any foreign industry upstream in the production chain. In other words, it captures integration of the production process through sourcing from other countries (see Hummels, Ishii and Yi 2001; and Koopman, Wang and Wei 2014).[8] It is also referred to as 'backward GVC participation' or 'vertical specialisation' when expressed as a percentage of gross exports.

Domestic value-added content of exports represents the exported value added that has been generated anywhere in the domestic economy. *Domestic value-added content of exports* and *foreign value-added content of exports* add up to total gross exports. This indicator can be split further into three components: direct domestic industry value added, indirect domestic value added and re-imported domestic value added. It can also be split by the sourcing industry, that is, the service content of manufacturing exports.

Domestic value added embodied in foreign final demand shows a country's domestic production driven by the final consumption in other countries. It removes so-called 'double-counted' trade in intermediate goods and services, and captures in addition indirect exports, that is, a country's exports to another country where there seems to be no direct purchases. The measure reflects how domestic industries (upstream in a value chain) are connected to consumers abroad. It can be interpreted as 'value-added exports' (see Johnson and Noguera 2017)[9] or 'export intensity' when expressed as a percentage of total value added.

Foreign value added embodied in domestic final demand reveals the amount of foreign value added present in final goods or services purchased by households, governments, non-profit institutions serving households, or as investments. It is the 'import' equivalent of *domestic value added embodied in foreign final demand* and can show how industries abroad (upstream in a value chain) are connected to domestic

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8 Koopman, Wang and Wei (2014) propose an accounting framework that breaks up a country's gross exports into various value-added components by their sources and additional double-counted terms.

9 Johnson and Noguera (2017) use a term called value added to export ratio, which, in essence, is computed as the sum of value-added exports divided by the sum of gross exports.

consumers, even where no direct trade relationship exists. It can be interpreted as 'value-added imports'.

Re-exported intermediate imports as a share of total intermediate imports tracks the quantity of goods and services imported as intermediate inputs that are subsequently exported. This indicator provides a measure of the importance of intermediate imports for exports (see Martins Guilhoto, Webb and Yamono 2022) and is often referred to as 'processing'. A higher share likely enhances domestic productivity and therefore increases international competitiveness.

Box 1: Review of GVC integration literature: the causes, trends and impact

The literature on GVCs and GVC integration has flourished on multiple fronts since Gereffi (1994) popularised the concept of the global commodity chain. The phenomenon has underpinned fast-growing global trade over the last two decades. The concept has evolved since then and has several variants, such as global supply chains or GVCs, depending on the context. The motivations of these GVC-related papers can be roughly grouped into three categories: the causes and governance of GVCs, GVC indicators and their trends, and the impact of GVCs.

The causes and governance of GVCs

The formation of GVCs has both micro and macro foundations. The micro foundations explain why it is profitable for businesses to relocate their productions using a theoretical framework (see, for example, Grossman and Rossi-Hansberg 2008, Antràs 2003 and 2020, and Antràs et al. 2012) and how these are governed (Gereffi 1994; Humphrey and Schmitz 2002; Gereffi, Humphrey and Sturgeon 2005; Bair 2009; Keane 2012; Farole 2016; and Stephenson and Pfister 2016). The macro foundations describe the enablers of GVCs, such as the dramatic reductions in transportation costs and the deployment of information and communication technologies in the 1990s (Baldwin 2011, 2013 and 2016 and Antràs 2020).

GVC indicators and their trends

The calculation or estimation of GVC indicators is based on the ICIO tables or multi-regional input-output tables. There are a number of research papers that look at the decomposition of exports or final demand, and some use these indicators to explain the fast-growing GVC phenomenon (see De Backer and Miroudot 2013; OECD 2013; Koopman, Wang and Wei 2014; Timmer et al. 2015; Johnson and Noguera 2017; Johnson 2018; Borin and Mancini 2019; Fortanier et al. 2020; Martins Guilhoto, Webb and Yamono 2022; and Miroudot 2022).

The impact of GVCs

GVCs offer countries, particularly developing countries, a new opportunity for growth by specialising in a segment of the value chain (Baldwin 2011), promoting technology transfer and providing firms a chance to upgrade[10] by moving towards higher value-added activities (Humphrey and Schmitz 2002; Gereffi et al. 2005; Giuliani, Pietrobelli and Rabellotti 2005; Blalock and Veloso 2007; Pietrobelli and Rabellotti 2010; Pahl and Timmer 2019; World Bank 2020; and Asian Development Bank et al. 2021).

3. South Africa's GVC integration: state of play

3.1 South Africa's backward GVC participation lags behind other small open economies

Despite being a small open economy, South Africa's integration into GVCs is only somewhat satisfactory based on its backward GVC participation indicator. This has been largely determined by its resource-based export structure – about 40% of the country's gross exports are mining products and basic metals. This puts South Africa roughly in the same league as the OECD countries, but behind European Union (EU27) and Association of Southeast Asian Nations (ASEAN) countries (Figure 1). In comparison, this share is higher than those of Southern Common Market (MERCOSUR) and some large economies, for example, the United States (US) and China. In particular, South Africa's GVC integration is much higher than that of Australia, which shares a similar export structure.

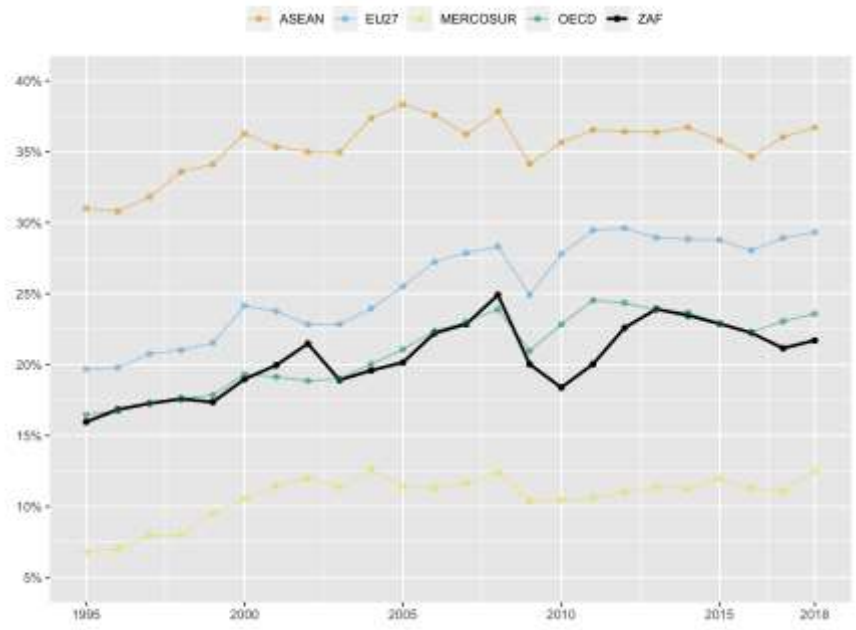
South Africa's backward GVC participation has declined steadily in recent years, dropping 3 percentage points between 2013 and 2017, from 24% to 21% (Figure 1). This share rebounded slightly in 2018. The contraction in GVC participation was in line

10 'Upgrade' or 'upgrading' in GVCs can be described in terms of one type, or a combination of four different types: product (the development of new products), process (the improvement of productive efficiency within and between value chain segments), functional (the shift toward higher value-added activities along the value chain) and intersectoral (the transfer of capabilities into entirely different value chains, e.g. from automobiles to aeroplanes) (Kaplinsky and Morris 2001). Gereffi et al. (2005) define 'industrial upgrading' or 'economic upgrading' as "the process by which economic actors – nations, firms, and workers – move from low-value to relatively high-value activities in global production networks". The definition has been broadened since then. Milberg and Winkler (2011) concluded that economic upgrading is usually defined in terms of efficiency of the production process or characteristics of the product or activities performed. And more recently, it has often been associated with increasing competitiveness in higher value-added products, tasks and sectors (Taglioni and Winkler 2016). I refer to economic upgrading in the broadest sense.

with the global trend, where most countries experienced reductions in GVC participation.[11]

Figure 1: Long-term trends of South Africa's backward GVC participation, 1995–2018

Foreign value-added content of exports as a percentage of total exports, South Africa and other regional aggregations



Source: Author's calculation using OECD TiVA database (accessed April 2022).

MERCOSUR: offically known as Southern Common Market, a South American trade bloc established by the Treaty of Asunción in 1991 and Protocol of Ouro Preto in 1994. Data is available for Agentina and Brazil, but not Uruguay and Paraguay.

3.2 GVC integration of the services sector holds up

Data also point to reductions in backward GVC participation across most of the manufacturing industries, notably in basic metals, chemicals and motor vehicles (Figure 2a). Foreign inputs represented as much as 43% of South African exports of automobiles in 2008, reaching their highest point just before the GFC hit. However, the latest data show that only 37% of intermediate inputs in the motor vehicle industry[12] were foreign. The same trend was observed in the mining sector. In contrast, the services sector remained stable in its backward GVC participation, albeit at a lower

[11] Price changes are the missing factor in the OECD's GVC accounting framework, and are therefore excluded from this analysis. The price fluctuations of intermediate imports, such as the price of crude oil, could change the estimates of GVC indicators (see Miroudot (2022) for a detailed discussion). This is a topic that has gained some momentum in the past few years at the OECD, but the data have not yet been published.

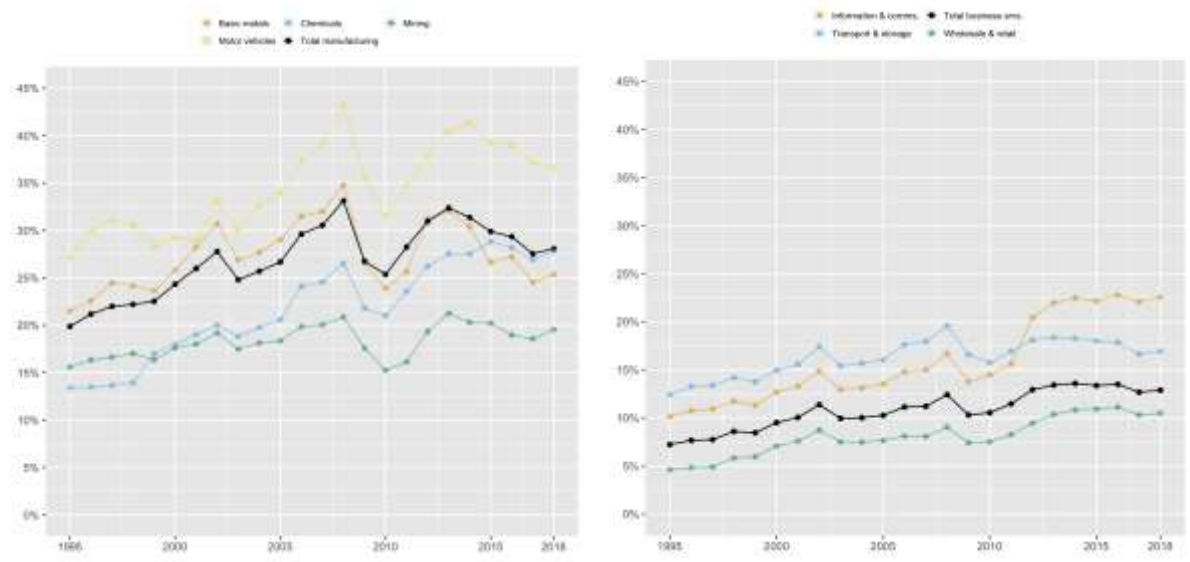
[12] The motor vehicle industry and the automotive industry are used interchangeably in this paper.

level than the manufacturing sector. The information and communication services industry experienced a significant upward lift in 2012 (Figure 2b).

Figure 2: The services sector's backward GVC participation holds up, 1995–2018

Foreign value-added content of gross exports as a percentage of gross exports

a) Mining and manufacturing **b) Services industries**



Source: OECD TiVA database (accessed April 2022).

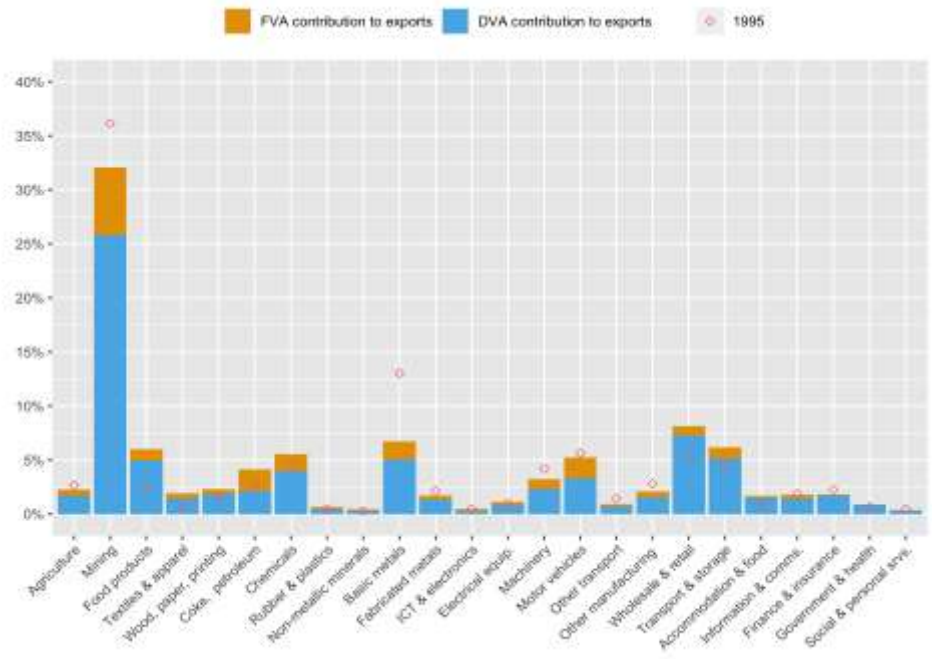
3.3 Declining natural resource exports, rising services exports

In 2018, one third of South Africa's exports were mining products, most of which were energy-related (Figure 3). A further 7% of its exports were basic metals. However, the shares of these products in exports declined slowly over the past two decades (except during the GFC, likely as a result of price increases). The same figures added up to nearly half of South Africa's gross exports in 1995 (mining represented 35% and basic metals 12%). Driving the decline in mining exports was domestic value-added content, which contributed to a smaller share of South Africa's gross exports, while foreign value-added content was mostly stable during this period.

The manufacturing sector collectively represented 40% of South Africa's exports in 2018 (Figure 3), and this share has been stable since 1995. However, there have been shifts within the manufacturing sector: food products and chemicals represented larger shares of total gross exports in 2018 than in 1995, for example.

Services exports collectively represented a rising share of South Africa's exports, from 16% in 1995 to nearly 23% in 2018 (Figure 3), with both domestic and foreign value-added shares contributing to this growth. The largest sectors that led the increase in services exports, and were well-integrated in GVCs, were wholesale and retail and transport and storage services.

Figure 3: Declining natural resource exports, rising services exports, 1995 and 2018
Domestic and foreign value-added content as a percentage of total gross exports



Source: OECD TiVA database (accessed April 2022).

3.4 South Africa does not stand out in processing

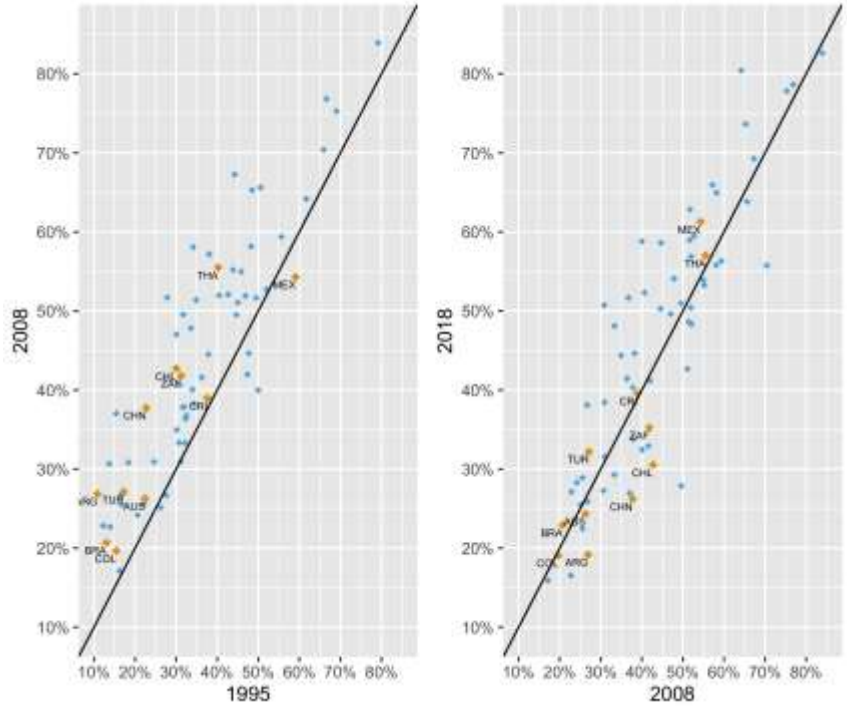
Figure 4a illustrates that most countries experienced increases in processing during the period 1995–2008 (i.e. the dots situated above the 45-degree line). South Africa's share of imports in intermediates for processing grew by 11 percentage points during this period, with mining and manufacturing industries contributing the most. Meanwhile, the share of imports in intermediates for processing increased substantially in other developing countries too, such as Argentina, Chile, China, Thailand and Turkey. While China's processing grew by 33 percentage points through the integration of computer and electronic equipment into value chains, Thailand's processing growth was led by the integration of basic metals and the automotive industry.

However, there have not been any significant increases in processing since the GFC (Figure 4b). About 35% of South Africa's imports in intermediates were re-exported in 2018, 7 percentage points lower than the pre-crisis level in 2008 and led by declines in the mining sector. The falls in processing trade have been particularly notable in Argentina, Chile and China. In contrast, Mexico and Turkey have managed exceptional increases in processing (at 5 percentage points or above) since 2008.

Figure 4: Processing has decelerated in the past decade to 2018

Imported intermediate inputs used for exports as a percentage of intermediate imports

a) 1995 and 2008 **b) 2008 and 2018**



Source: OECD TiVA database (accessed April 2022).

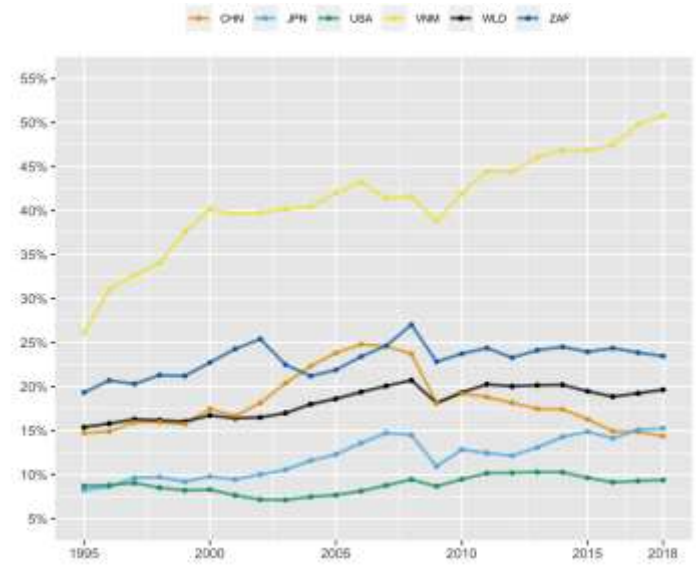
3.5 South Africa's export intensity has been stagnant since the GFC

Similarly, the export intensity of the global economy can be characterised into an increasing phase from 1995 to 2008 and a stagnating phase from 2008 to 2018 (Figure 5). This also shows the extent to which a country's production depends on foreign demand. In fact, the internalisation of the Chinese market (i.e. a higher proportion of value-added production is to serve the domestic market) underpins this global trend. In contrast, Japan's and Vietnam's export intensity have been increasing. Japan's rising export intensity is led by high-tech products such as machinery and motor vehicles. Vietnam's rising export intensity, meanwhile, is explained by increasing shares of exports in textiles and mining products.

South Africa's export intensity increased slowly from 20% in 1995 to 27% (the highest) in 2008, and it settled at a slightly lower level after the GFC, at around 20% in 2018. There was a drop in the export intensity of mining and basic metals, both of which exported as much as 90% of their production in 2008: the export intensity of the mining industry decreased by 5 percentage points and the export intensity of the basic metal industry decreased by 20 percentage points. Exports of food and chemical products compensated for the decrease in South Africa's total export intensity.

Figure 5: Stagnating export intensity since the GFC, 1995–2018

Domestic value added embodied in foreign final demand as a share of total value added, total economy



Source: OECD TiVA database (accessed April 2022).

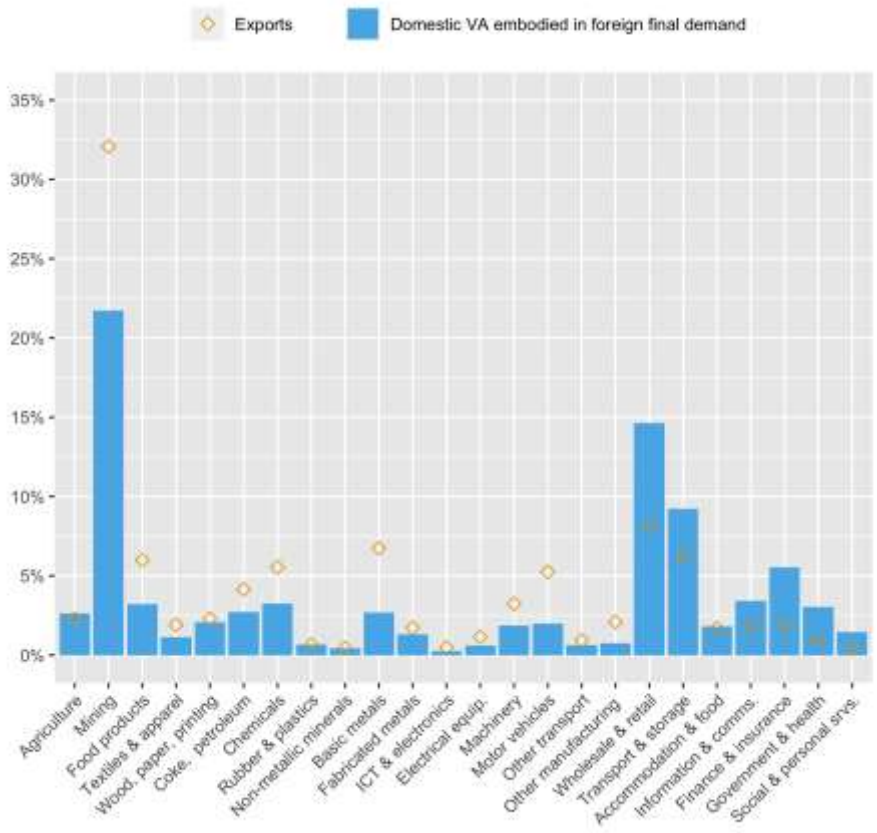
3.6 The role of services in manufacturing exports

Figure 6 shows South Africa's export decomposition by industry according to gross exports and value-added exports (i.e. stripping out trade in intermediate goods and services). Mining in South Africa remains the largest exporting industry, but it represents a lower share in value-added exports than in gross terms. Value-added export shares of most manufacturing industries have revealed the same pattern. However, it is the opposite for the services sector, as services exports often have higher value-added content (less imports in intermediate goods and services) than the primary and manufacturing industries, and are often embedded in the exports of mining

and manufacturing products. Therefore, the services' contribution to exports is higher in value-added terms than in gross terms.

Figure 6: Services represent a higher share of South Africa's exports in value-added terms, 2018

Exports by industry, in gross and value-added terms

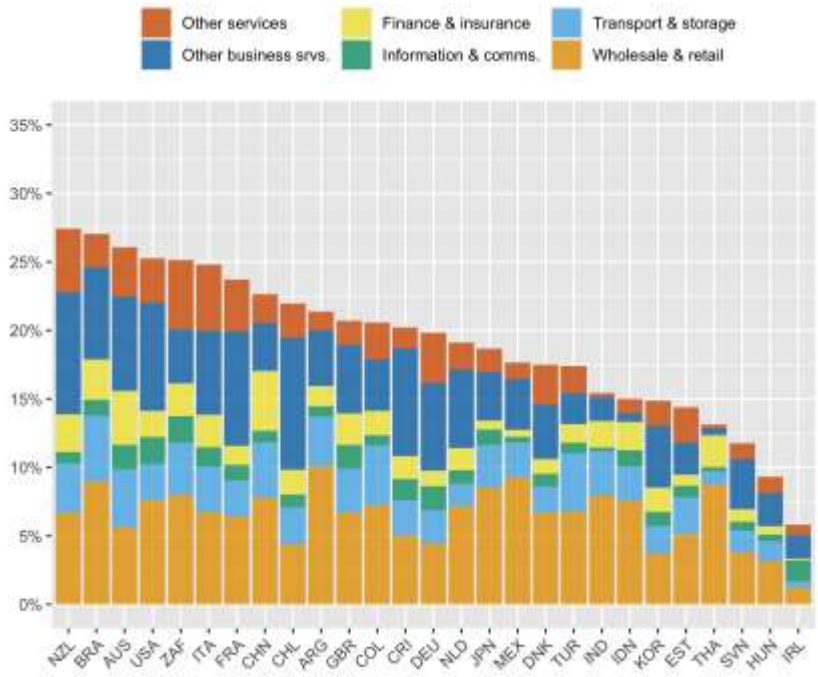


Source: OECD TiVA database (accessed April 2022).

Another way to gauge the role of services in exports is to decompose manufacturing exports by its country and industry origin – with the origin of domestic value-added content which can be further traced, for example from either the agriculture or services sector. Figure 7 shows that nearly a quarter of South Africa's manufacturing exports are value-added content provided by the services sector, the second highest in non-OECD countries (just behind Brazil). South Africa is also ranked among the highest when comparing it with the OECD countries.

Figure 7: South Africa's services content in manufacturing exports are among the highest, 2018

Services content of gross exports as a percentage of gross exports by source of services industries



Source: OECD TiVA database (accessed April 2022).

Note: Other business services include professional, scientific and technical activities (69T75) and admin support activities (77T82). Other services include public administration (84), education (85), health (86T88), recreation (90T93) and other services (94T96).

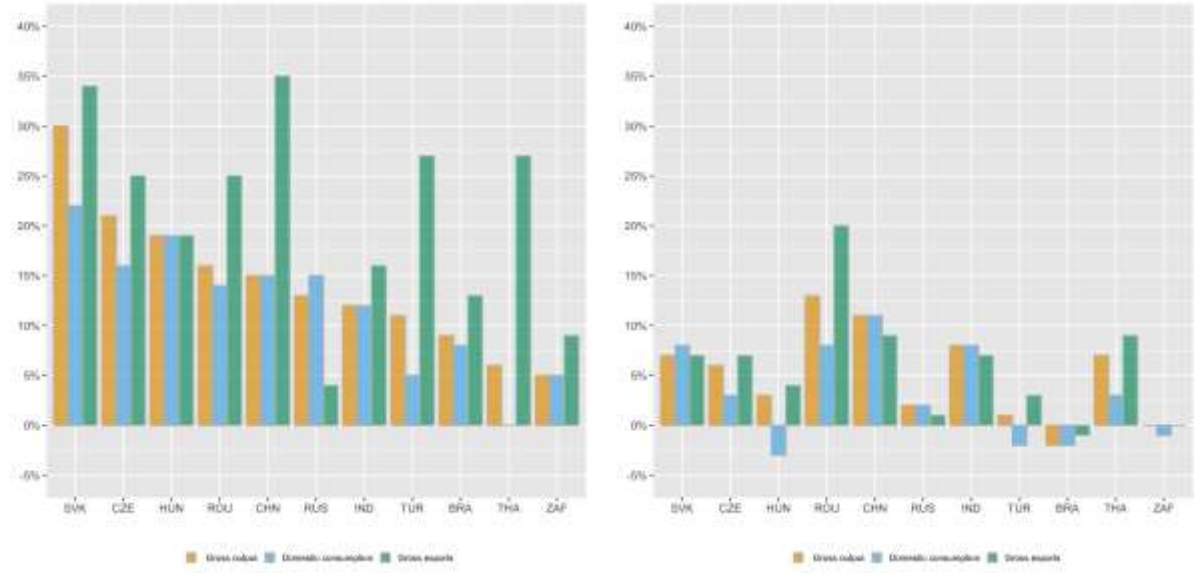
3.7 The GVC integration of South Africa's automotive industry trails other developing countries

South Africa's automotive sector, as one of the national priorities, was promoted through the Motor Industry Development Programme from 1995 to 2007 and the Automotive Production Development Programme from 2013 to 2020. Exporters of automotive vehicles and components earned import rebates, which offset import duties on components and vehicles not produced in South Africa. The Motor Industry Development Programme lowered import tariffs on both vehicles and components from 80% in 1999 to 30% in 2007. The Automotive Production Development Programme maintained the same level of import tariff, but aimed to increase economies of scale and create jobs at the assembly level, and promote growth and diversification of value added.

However, this sector's output only increased by about 5% per year between 1995 and 2007, the lowest among BRICS countries (Figure 8a).[13] Domestic consumption (a share of output to meet domestic demand) did not outperform any of the other BRICS countries either. During the same period, exports grew faster than domestic demand at 9% per year, but this growth rate was not comparable with the rapid export growth in China, India and Thailand. South Africa also fell behind some OECD countries where production was dominated by external demand, such as the Czech Republic, Hungary and Slovakia.

The decade from 2007 was marked by an even more underwhelming performance in South Africa (Figure 8b). There was minimal growth in production and exports, and domestic consumption shrunk by about 1% per year on average. In contrast, in countries such as China, India, Romania and Thailand production was sustained. Growth in Romania and Thailand was predominantly spurred by exports, whereas growth in China and India was driven by domestic consumption.

Figure 8: External demand fuelled rapid output expansion of automotives for many countries
a) Compound annual growth rate, 1995–2007 b) Compound annual growth rate, 2007–2018



Source: Author's calculation based on OECD TiVA database (accessed April 2022).
Note: Domestic consumption is defined as gross output less gross exports.

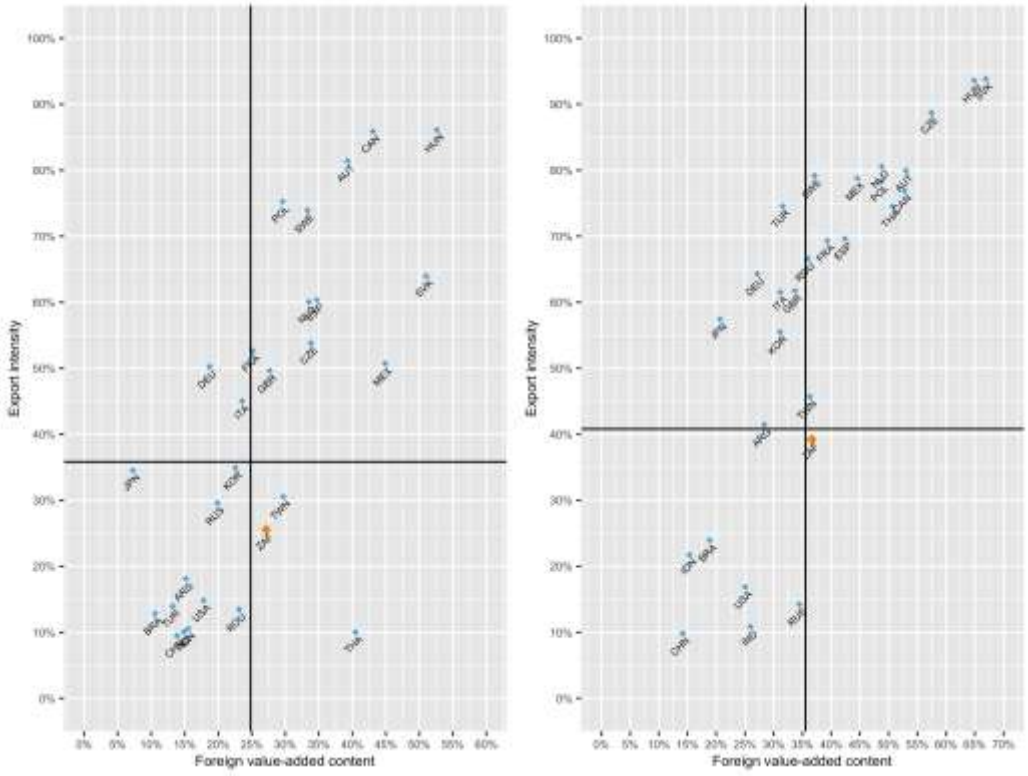
[13] Barnes and Morris (2008) highlight the emergence of new low-cost production locations principally in Asia. BRICS stands for Brazil, Russia, India, China and South Africa.

As a result, the automotive industry's export intensity increased from 25% in 1995 to nearly 40% in 2018, while the foreign value-added content increased from 27% to 35% in South Africa (Figure 9). South Africa is the only country that lies within the bottom-right quadrant, indicating 'higher-than-the-world-average' backward GVC participation but 'lower-than-the-world-average' export intensity in 2018 (the horizontal lines indicate the global average backward GVC participation; the vertical lines show the global average export intensity). This also suggests that South Africa's automobile export intensity has nearly caught up with the world average, but its performance is mediocre when compared with other developing countries. The countries in the top-right quadrant are well-integrated in GVCs, often by specialising in the production of certain parts and components, and they also export a significant share of their output: Austria, Canada and Hungary in 1995 (Figure 9a) and Czech Republic, Hungary and Slovakia in 2018 (Figure 9b).

Figure 9: Automotive industry's integration into GVCs lacked momentum, 1995 and 2018

Correlation between foreign value-added and export intensity

a) 1995 **b) 2018**



Source: OECD TiVA database (accessed April 2022).

3.8 China and India have become important trade partners with South Africa in value-added terms

In 2017, South Africa's top five trading partners in value-added terms were China, the US, Germany, India and Great Britain, for both imports and exports. There has been an increase in value-added export concentration: value-added exports to these five countries represented 45% of South Africa's total value-added exports in 2017, 8 percentage points higher than in 1995 (Figure 10a). In contrast, total value-added imports from these five countries only increased by 1 percentage point (Figure 10b).

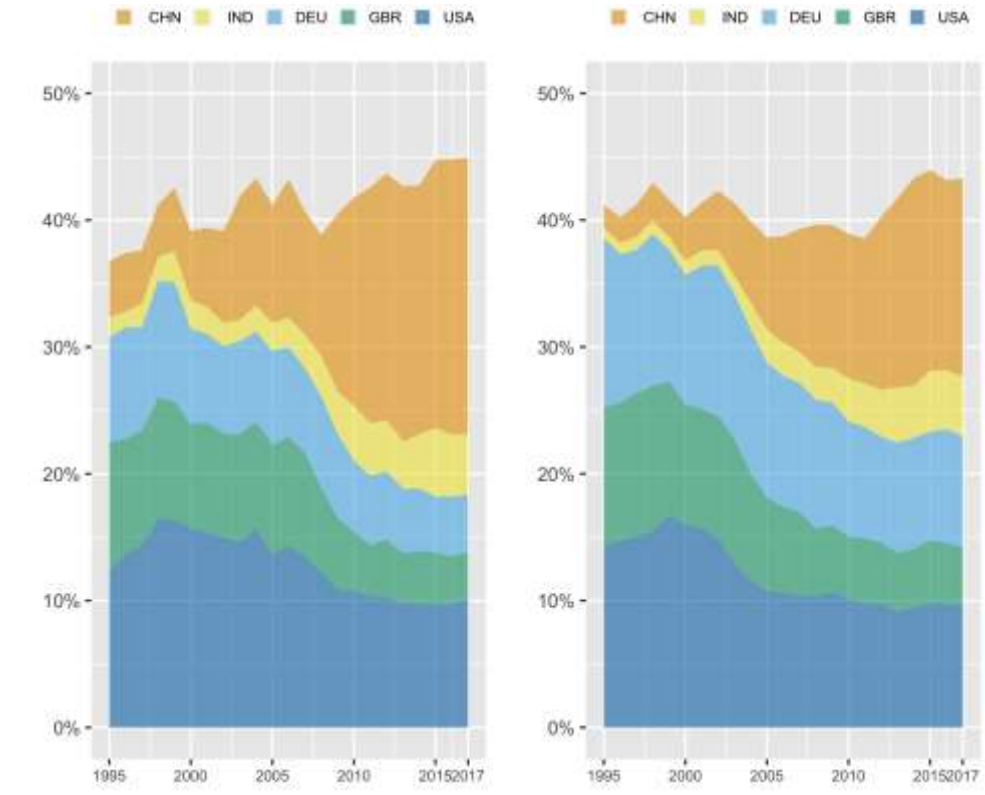
There have been significant increases in supply from and demand in China and India, at the cost of trading with Germany, Great Britain and the US.[14] In 1995, China as a trade partner represented less than 5% of the market, for both value-added exports and value-added imports, and these figures increased to 22% and 16% respectively in 2017. This also means that up to 4.5% of South Africa's GDP was driven by Chinese demand. South Africa's trade in value-added terms with India has also increased.

[14] Jabalameli and Rasoulinezhad (2018) also examine BRICS countries' trends in shifting trade with developing countries.

Figure 10: Increasing shares of value-added trade with China and India

South Africa's top 5 trade partners, imports and exports in value-added terms

a) Value-added exports **b) Value-added imports**



Source: OECD TiVA database (accessed April 2022).

Note: 2018 data is omitted due to quality concerns. The countries listed are the five largest trading partners based on 2017 data.

3.9 Declining value-added exports with high digital intensity

Over the past two decades, about 20% of South Africa's value-added exports were goods and services of high digital intensity (such as automobile and other transport equipment in the manufacturing sector and telecommunications in the services sector) (see Annexure 1 for digital intensity classification). This share was mostly stable until 2010, but a slight decline began in the next eight years (Figure 11a). In the same period, goods and services of high digital intensity gained an increasing share of global exports, accounting for 25% in 2018 (Figure 11b). This contrast reflects South Africa's relatively slow growth in exports of products from industries with high digital intensity.

Value-added exports of industries with relatively low digital intensity (such as agriculture, fishing and mining in the primary sector and transport and storage services) have increased in South Africa, accounting for 46% of total exports in 2018. In the world economy, this share was around merely 30%, and mostly stable. Such

growth is due to the exports of wholesale and retail and transport and storage services, both of which have low digital intensity. This has also demonstrated trade expansion and South Africa's growing role as a distributional hub in the region.

Figure 11: Declining value-added exports with high digital intensity in South Africa

a) South Africa **b) World**

Source: OECD TiVA database (accessed April 2022).

Note: The OECD proposed classifying economic activity into four categories of digital intensity (see Annexure 1).

4. Sizing South Africa's GVC integration: explanatory variables and empirical framework

4.1 Explanatory variables

A country's economic structure and domestic economic policy have been identified as important drivers of GVC integration (see Kowalski et al. 2015; Farole 2016; Ziemann and Guérard 2017). To understand the determinants of GVC participation, and thus the right set of policy recommendations that should follow, this section highlights a number of factors that may influence the degree and type of GVC integration. Although the boundaries may be blurry sometimes, these factors can be broadly grouped into two categories:

1. Economic structure and other 'fixed' factors, which are not related to policy, or at least not easily influenced by policy variables in the short or medium term.
2. Economic policy or policy-related factors, which are directly reflected in measures such as trade and investment.

For the list of explanatory variables used in this paper and their availabilities, please refer to Annexure 3.

4.1.1 Economic structure and other 'fixed' factors

Market size and the level of development

A country's market size is proxied by its GDP (in US dollars) and the rail line in kilometres, both of which are sourced from the World Bank world development indicators (WB WDI) and expressed in natural logarithm. The rail line in kilometres measures the length of railway routes available, irrespective of the number of parallel tracks. The level of development is represented by GDP per capita (in natural logarithm and available from WB WDI).

Labour market conditions

Education attainment, school enrolment and labour force participation represent labour market conditions. *Education attainment* is proxied by the average years of schooling attained (from Barro and Lee 2013).[15] *Gross tertiary enrolment ratio* is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to tertiary education (from WB WDI). Two variables representing labour force participation are *labor force participation rate with advanced education* (as a percentage of total working-age population with advanced education) and *labor force participation rate for ages 15–24* (as a percentage of the population aged 15–24 that is economically active based on the International Labour Organization's estimation) (sourced from WB WDI).

Degree of industrialisation and natural resources rents

A country's economic structure is proxied by (i) manufacturing as a share of a country's total value-added production (author's calculation using OECD TiVA) and (ii) natural

[15] Data is available from 1950 to 2015 at five-year intervals. Missing data between the collections, for instance during 2006–2009 and 2011–2014, are linearly extrapolated. The 2015 data is simply carried forward for the years of 2016–2018.

resources rents, that is, the sum of oil, natural gas, coal, mineral and forest rents, as a percentage of nominal GDP (sourced from WB WDI).[16]

Distance to market

The distance to market measures the trade-weighted distance of a country from all of its trading partners, expressed in natural logarithm. Bilateral distance data refers to the weighted distance between the largest cities of two countries (sourced from Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)).[17] The distance data is then aggregated using merchandise trade (sourced from OECD Bilateral Trade Database by Industry and End-use) as weights.

4.1.2 Economic policy or policy-related indicators

Regional trade agreements and applied tariff rates

The first trade policy indicator is sourced from the WTO Regional Trade Agreement (RTA) database.[18] The WTO database contains information such as the date of signature, the date of entry into force, the inactive date if appropriate, and all signatories (countries or territories) involved. The active agreements between countries are treated as dummy variables: if there is at least one active agreement between two countries, it is assigned the value of 1 regardless of coverage (goods, services or both). The dummies of 1s are then summed by country and represent the number of partner countries with which the country has at least one active preferential trade agreement.

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16 The World Bank WDI database defines *natural gas rents* as the difference between the value of natural gas production at regional prices and total costs of production. By the same definition, *natural resources rents* measure the difference between the value of the production at regional prices and total costs of production for oil, natural gas, coal, mineral and forest.

17 CEPII's weighted distance indicator uses city-level data to assess the geographic distribution of the population inside each country, and then calculates the distance between two countries based on bilateral distances between the largest cities of those two countries, with inter-city distances within a country being weighted by the share of the city in the overall country's population.

18 The WTO RTA database provides a list of existing regional trade agreements since the establishment of the WTO (which replaced the General Agreement on Trade and Tariffs (GATT)). These agreements amount to nearly 800 accumulative notifications, of which about 350 of them are currently in force. For up-to-date information on RTAs as provided to the GATT/WTO, visit the WTO webpage: https://rtais.wto.org/UI/PublicMaintainRTAHome.aspx. Data was downloaded in April 2022.

A country's trade policy is also measured by the applied tariff rates (sourced from WB WDI). The applied tariff is the average of effectively applied rates weighted by the product import shares corresponding to each partner country.

Openness to foreign direct investment

Investment openness is represented by foreign direct investment (FDI) net inflows and FDI net outflows as percentages of nominal GDP (sourced from WB WDI). It is commonly believed that FDI net inflows contribute to GVC integration (see Kowalski et al. 2015; Ziemann and Guérard 2017). Arguably, FDI net outflows are also correlated with GVC integration due to the financial ties between the investing country and host economy.

Quality of institutions

Two sets of institutional quality indicator are used as proxies for economic policy over which governments typically exercise control. The first indicator is the Economic Freedom of the World (EFW) by the Fraser Institute. The data include one summary statistic and scores on five sub-areas.[19] The scores range between 0 and 10, with 10 being the highest freedom. The second indicator is the Economic Freedom Score (EFS) by the Heritage Foundation, downloadable from the World Bank website. Similarly, the data include a summary index, as well as scores on four key aspects of the economic environment and 12 specific components, each of which is graded on a scale of 0–100, with 100 being the highest freedom.[20] These indicators are often different measurements of similar aspects and therefore highly correlated to each other.[21]

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19 The data consist of economic freedom measures in the following areas: (i) size of government; (ii) legal system and security of property rights; (iii) sound money; (iv) freedom to trade internationally and (v) regulation. A summary index is also provided based on the score of the these five areas. For more details visit https://www.fraserinstitute.org/economic-freedom/.

20 The four aspects and 12 components are:

1) Rule of law: property rights, judicial effectiveness and government integrity;

2) Government size: tax burden, government spending and fiscal freedom;

3) Regulatory efficiency: business freedom, labor freedom and monetary freedom; and

4) Market openness: trade freedom, investment freedom and financial freedom.

To access the data, see https://tcdata360.worldbank.org/indicators/idx.econ.free.scr.

For methodology, refer to https://www.heritage.org/index/pdf/2022/book/02_2022_IndexOfEconomicFreedom_METHODOLOGY.pdf.

21 The time coverage of EFS is better than that of EFW.

Logistics performance border-related procedures

The quantitative measures of business climate are from the logistics performance index (LPI), doing business survey (both sourced from the World Bank), and global competitiveness indicators (World Economic Forum). The LPI summarises the logistics professional's perception of a country's logistic business services, and scores (ranged from 1 to 5, with 5 being the best) are averaged across all respondents. The evaluations consist of one score for overall logistics services and six sub-areas.[22]

Doing business indicators of choice for this research are (i) the ease of doing business; (ii) the time required to start a business; and (iii) the cost of business start-up procedures. The ease of doing business scores benchmark economies with respect to regulatory best practice, showing the proximity to the best regulatory performance on each doing business indicator. An economy's score is indicated on a scale of 0 to 100, with 100 being the best regulatory performance. The time required to start a business is the number of calendar days needed to complete the procedures to legally operate a business. Lastly, the cost of business start-up procedures indicates the expenses of registering a business, which is normalised by presenting it as a percentage of gross national income (GNI) per capita. The burden of customs procedures (ranging from 1 to 7, with 7 being the best) are from global competitiveness indicators (sourced from the World Economic Forum).[23]

The quality of transport infrastructure

The quality of transport infrastructure, such as the quality of roads, railways, ports and air transport, is important to facilitate the movement of goods and services. The indicators on the quality of infrastructure are sourced from the global competitiveness indicators. Like some of the logistics and institutional quality variables explained earlier, the quality of transport infrastructure also has an overall index.

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22 These include (i) efficiency of customs clearance process; (ii) quality of trade and transport-related infrastructure; (iii) ease of arranging competitively priced shipments; (iv) competence and quality of logistics services; (v) frequency with which shipments reach consignee within scheduled or expected time; and (vi) ability to track and trace consignments.

23 For the estimation of each variable from global competitiveness indicators, see https://reports.weforum.org/global-competitiveness-index-2016-2017/appendix-a-methodology-and-computation-of-the-global-competitiveness-index-2016-2017/.

4.2 The empirical framework

To test the determinants of and to evaluate the potential of GVC integration, a standard fixed-effects model for industry *i* of country *c* at the time of *t* is specified as the following:

$$GVC_{c,i,t} = \alpha + \beta' C_{c,t} + \gamma_t + \gamma_i + \varepsilon_{c,i,t} \quad (1)$$

The term $GVC_{c,i,t}$ represents a country's GVC integration for a particular industry at a given time. Backward GVC participation, export intensity and processing are tested separately. The explanatory variables $C_{c,t}$ indicate country-specific economic structure and factor endowment, as well as economic policy tools that aim to promote business operations and facilitate better trade and GVC integration.

The model includes year fixed effects γ_t to control for omitted time-varying shocks (e.g. global macroeconomic shocks, such as the GFC, or the fluctuation of commodity prices) and industry fixed effects γ_i to control for time non-variant industry factors (e.g. the difference in sourcing strategies with respect to each industry). This choice of fixed effects implies that the goal is to identify a country's within-industry difference in GVC participation, while isolating the data from time-varying aggregate shocks.[24] Two robustness tests are also included in the analysis, with additional income-group fixed effects and the split before the GFC and thereafter.

5. Where South Africa stands in GVC integration: results and discussion

5.1 Results

A country's characteristics and economic structure, such as distance to market, the size of manufacturing and rents from natural resources, play a fundamental role in its GVC integration (see Table A4 and Table A5 in Annexure 4 for the results of regression analysis). The size of its domestic economy (GDP), its rail line in kilometres (RT.RAIL), and its distance to market (DISTW) have a negative influence on a country's integration into GVCs. Years of schooling (YRSCH) and share of manufacturing sector (MFGSH) have a positive influence on a country's integration into GVCs.

[24] Applies OLS estimation. GLS method doesn't improve the results.

The signs of coefficients for GDP and MFGSH are in line with expectations. The larger the country's economy, the less likely it engages in GVCs. For example, most transactions are more likely to take place within the boundaries of large countries with diversified businesses and production capacities, like China and the US. The higher the share of the manufacturing sector in GDP, the higher GVC participation. Another indicator that captures the size of the domestic market is rail line in kilometres; in most cases, it is significant and negatively correlated with GVC indicators.

The coefficients of the distance to market, in most cases, are negative and significant. Arguably, even with the significant reductions in trade costs, the distance to market still matters (Table A4 model 1-3 for instance). Positive signs for years of schooling indicate that a higher level of education facilitates GVC participation. This also holds true when controlling the model by income groups (Table A6).

The rents from natural resources as a share of GDP (RESRC) have the opposite effect on the indicators in question. A higher share of rents from natural resources in a country indicates that it is more likely to connect with the rest of the world through providing upstream goods and services via exports or processing. But this also means that the country is less likely engaged in trade through backward GVC participation.

Policy variables are also significant. The number of active free trade agreements (FTAs) is positively associated with a country's GVC integration, and it is consistently observed in all models. Meanwhile, trade weight active tariff rates are negatively correlated with three GVC indicators – mostly insignificant at country level but significant at country and industry level (likely due to a larger number of observations at country and industry level). Moreover, the coefficients of trade policy are the highest for the indicator that measures processing, suggesting that processing is highly responsive to a country's trade policy.

FDI net outflows and FDI net inflows (FDI.X and FDI.M) as a share of GDP are significant and positive across all models. The direction of these flows also matters: FDI net inflows are more likely to facilitate GVC integration as the coefficients of FDI net inflows often are twice as large as the coefficients of FDI net outflows.

The two summary indices representing countries' institutional qualities are correlated. Therefore, these variables are tested separately and only one is presented in Annexure 4. The economic freedom score from the Heritage Foundation is significant in all three indicators, with larger coefficients in the two models that predict export intensity and processing than in the model that predicts backward GVC participation. The result highlights that GVC integration is not only a function of industrial policy but also the broader institutional environment, which attracts foreign investment.

Furthermore, the overall score of the LPI is positive and significant in all models: the higher the LPI scores, the better a country's integration into GVCs. The high costs of business start-up procedures discourage GVC participation, and this only becomes significant in the models with industry and year fixed effects. However, both the time required to start a business and the burden of customs procedures have a positive influence on countries' GVC participation, which does not coincide with the typical expected prediction.[25] In fact, GVC indicators are positively correlated with the burden of customs procedures (all three) and time required to start a business (two out of three). Therefore, an alternative explanation is that countries highly integrated in GVCs are likely to introduce more administrative procedures for measurement purposes.

Table 1: Summary table of the regression results

Variables/GVC indicators	Backward GVC participation	Export intensity	Processing
GDP	- significant	- significant	- significant
Natural resource rent (RESRC)	- significant	+ significant	+ significant
Manufacturing share (MFGSH)	+ significant	+ significant	+ significant
Years of schooling (YRSCH)	+ mostly significant	+ significant	+ significant
Trade-weighted distances (DISTW)	- mostly insignificant	- significant	- mostly significant
Rail line in kilometres (RT.RAIL)	- significant	- significant	- significant
FDI net inflows (FDI.M)	+ significant	+ significant	+ significant
FDI net outflows (FDI.X)	+ mostly insignificant	+ mostly significant	+ mostly insignificant
Free trade agreements (FTA)	+ significant	+ significant	+ significant

[25] The World Bank's LPI and three indicators from the doing business survey and the World Economic Forum's burden of customs procedures and quality of transport infrastructure data from the Global Competitiveness Index are not combined in the same model due to the differences in data coverage. LPI data became available from 2007 and subsequently available biannually from 2010 onwards. The cost of business start-up and time required to start a business are available from 2003 onwards. The indicator *ease of doing business* is excluded from Annexure 4 because of its shorter coverage (from 2015 onwards) than the other two variables. The data from the Global Competitiveness Index are available from 2010 onwards.

Applied tariff rate (TARIFF)	- mostly insignificant	- mostly insignificant	- mostly significant
Institutional quality summary index (SUM.EFS)	+ significant	+ significant	+ significant
Cost of business start-up (BNS.CST)	- mostly insignificant	- significant	- mostly insignificant
Time required to start a business (BNS.DUR)	+ significant	+ significant	+ significant
Burden of customs procedure (BUR.CUS)	+ significant	+ significant	+ significant
Overall logistics performance (LPI.ALL)	+ significant	+ significant	+ significant
Quality infrastructure, Air (QI_AIR)	- mostly insignificant	+ significant	+ mostly insignificant
Quality infrastructure, Port (QI_PORT)	- mostly significant	- mostly insignificant	- mostly insignificant
Quality infrastructure, Rail (QI_RAIL)	+ significant	+ significant	+ significant
Quality infrastructure, Road (QI_ROAD)	- mostly insignificant	- mostly insignificant	- mostly insignificant

Note: summary based on Annexure 4 Table A4-A7.

The quality of a country's infrastructure for various means of transport are tested. The quality of railroad transport stands out in all the models and facilitates a country's GVC integration. The rail line in kilometres, in contrast, should not be taken as a proxy for infrastructure quality for transport as it is highly correlated with GDP.

Robustness test results are also included in Annexure 4 (see Table A6 and Table A7). The first includes the country's income group as a fixed effect. The coefficients obtained from these models with additional fixed effects are similar to those presented in the baseline analysis (Table A4). The second robustness test split the data into two periods: before and after the GFC. The coefficients of a country's size, the number of free trade agreements and FDI net inflows, for example, have a greater influence on the target variables after the GFC than before the GFC. In contrast, the magnitudes of the FDI net outflows and distance to market effects have weakened after the GFC. Moreover, the rail line per kilometre has become less relevant after the GFC (Table 1 provides a brief summary of Annexure tables A4–A7).

5.2 Economic structure explains at least half of GVC integration

The variance decomposition analysis[26] shows that a country's economic structure explains at least half of the variances (Figure 12). The two most prominent determinants of a country's GVC integration are GDP and rail line in kilometres (highly correlated with GDP), which are responsible for approximately 35–40% of the variances explained in the baseline model (1). The reason is that countries with a large domestic market usually have more diverse production capacities and complex economic structures for a wider range of domestic products that satisfy domestic business needs. It also suggests that smaller countries should actively support their businesses' integration into GVCs through backward linkage, exports or processing.

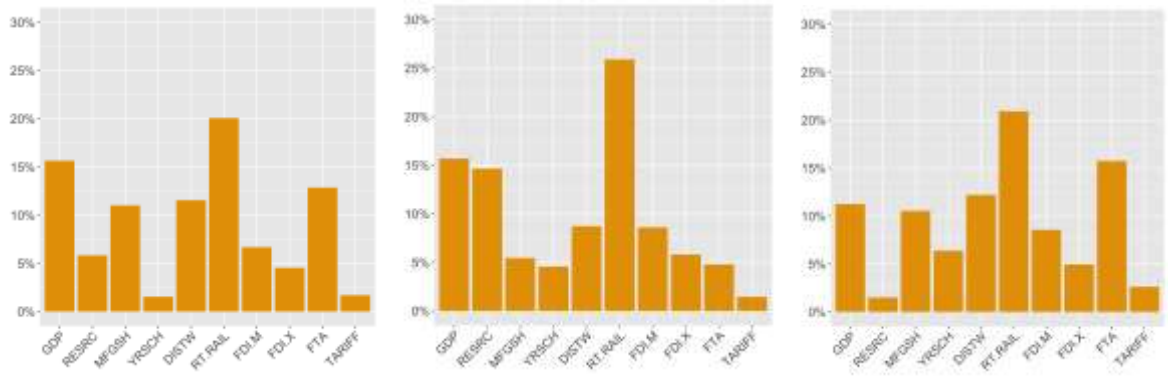
In contrast, the rents from natural resources determine a larger share of the variances of export intensity than those of the other two indicators, while the share of manufacturing sector in GDP has a stronger influence in backward GVC participation and in processing.

[26] Also referred to as the sequential analysis. R-squared can be broken down into contributions from each variable (using analysis of variance (ANOVA)) to evaluate its relative importance. The technique has come with a disadvantage: the order of explanatory variables in a regression determines their explanatory power. For example, the amount of variance explained would be different if a variable is the first regressor or the last regressor in the model. Therefore, a common practice is to calculate all possible sequences of the regressors, and then the explanatory power of a particular variable is calculated as the simple average of all possible sequences (Lindemann, Merenda and Gold 1980) (see also relative importance: https://rdrr.io/cran/relaimpo/man/calc.relimp.html).

Figure 12: Economic structure explains at least half of models' variances

Estimates according to the baseline model (1)

a) Backward GVC participation **b) Export intensity** **c) Processing**



Note: The results presented here are based on the model 1 in Table A4. The charts represent the amount of variance explained by dependent variables. Each dependent variable is added to the model sequentially, and the amount of variance explained by the variable is averaged out over all possible orders among regressors. The contributions are normalised to 100% (year fixed effect is omitted). See Annexure 5 for variance explained for all models 1–6. In addition, all policy variables are benchmarked to the influence of RTAs.

GDP: GDP (current US$)
RESRC: Nature resource rent
MFGSH: Manufacturing share of the economy
YRSCH: Years of schooling (average, in years)
DISTW: Trade-weighted distance to market
RT.RAIL: Rail line in kilometres
FDI.X: FDI net outflow (% GDP)
FDI.M: FDI net inflow (% GDP)
FTA: Free trade agreements (no. of partners)
TARIFF: Applied tariff rate

The number of active FTAs is the most important policy indicator in predicting the outcome of backward GVC participation and processing (Figure 12). Other policy variables, such as economic freedom, the logistics performance index, and the doing business indicators, equate to only a smaller fraction of variance-explained (see Annexure 5). Macroeconomic conditions (year fixed effect) predict 5–10% of the variances (excluded from both Figure 12 and Annexure 5), which highlights the importance of macroeconomic stability, directed in part through monetary or fiscal policies, in helping businesses connected to the world market.

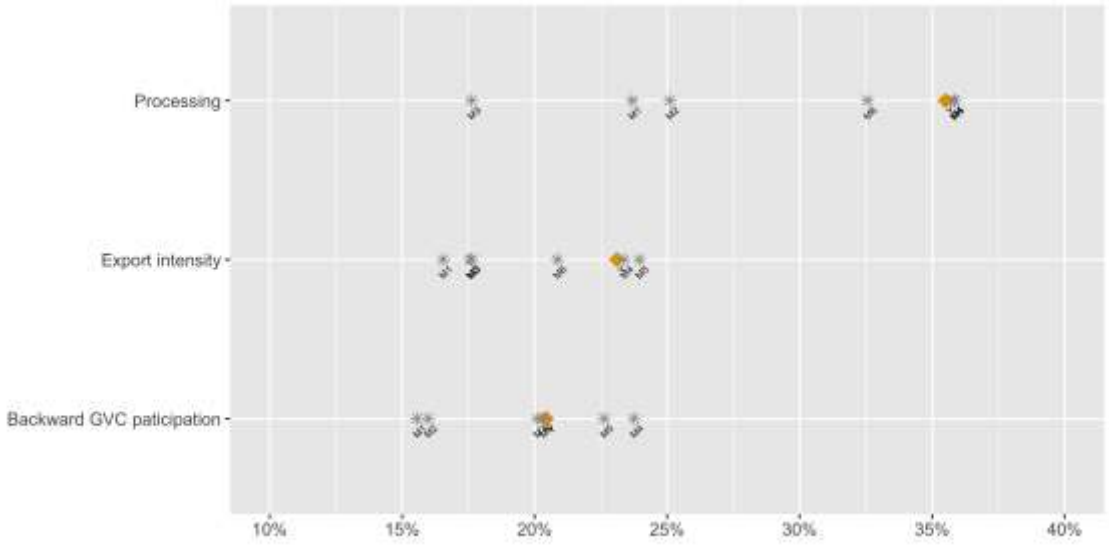
Taking the country's economic structure and economic policies into account, South Africa's GVC integration at the total economy level is not under-performing (Figure 13a). The orange dots in Figure 13a represent the means of South Africa's GVC integration during 1995 and 2018 with respect to each GVC indicator, namely backward GVC participation, export intensity and processing; the asterisks represent the average of GVC integration predicted by the models. It shows that South Africa's

GVC indicators are above the predictions of models 1–3 and 6, but below those of models 4 and 5.

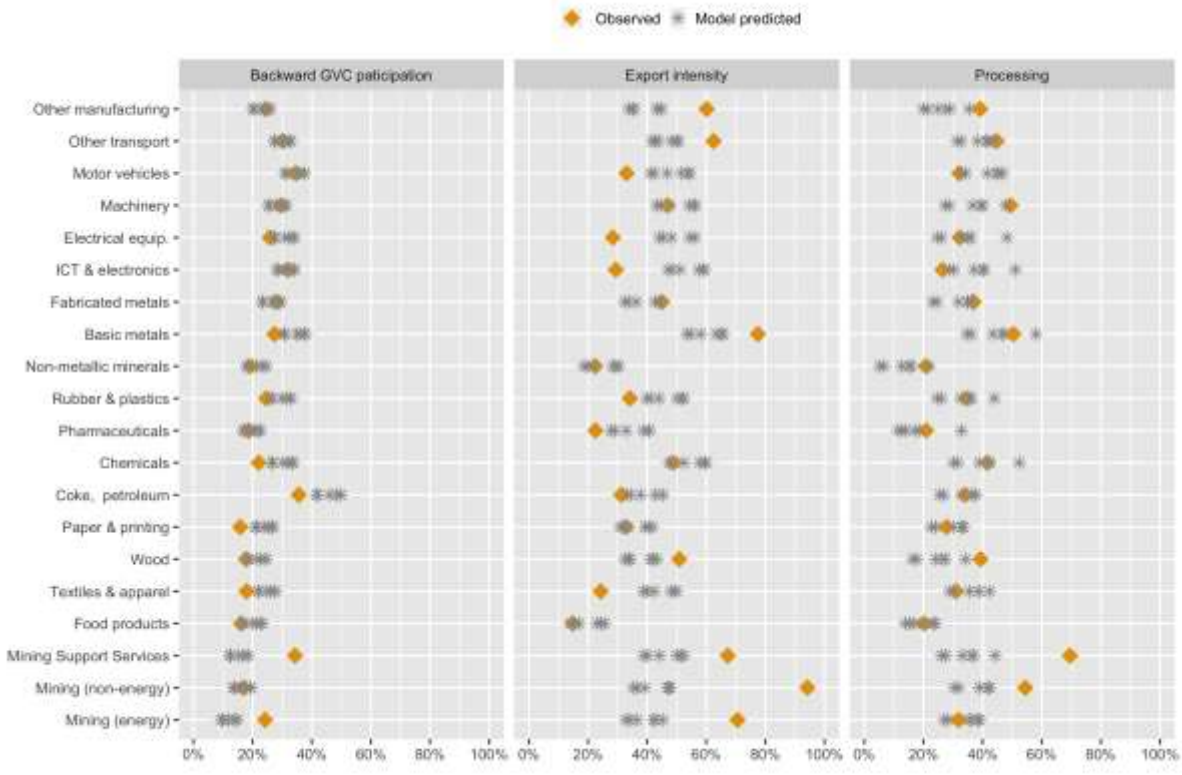
Figure 13b shows the gaps between observed and model-predicted GVC integration for the mining and manufacturing sectors. South Africa's backward GVC participation is often on the lower bound of the estimates or within the expected ranges. The energy-related mining and mining support services industries are exceptions, where the foreign value-added content of these industries are above all of the models' predictions. In contrast, there are several resource-based industries that have higher-than-model-predicted export intensity and processing, such as mining, wood and basic metals.

Figure 13: Models confirm South Africa's GVC performance

a) Total economy, 1995–2018



b) Mining and manufacturing sectors, 1995–2018



Note: M1-M6: models' estimates based on models 1–6 listed in Table A4 and A5 (Annexure 4).

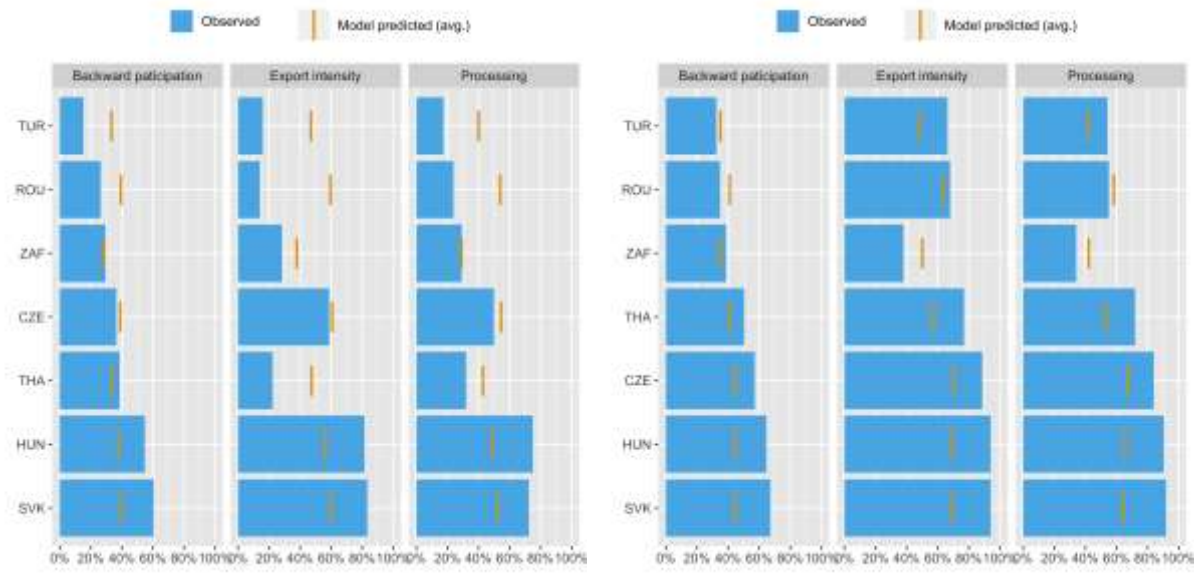
The model projections cover different periods depending on the availability of the explanatory variables (M1's and M2's coverage:1995–2018; M3's coverage: 2003–2018; M4: 2008–2017, M5: 2007, 2010, 2012, 2014, 2016 and 2018; and M6: 2010–2017).

5.3 The automotive industry's GVC performance is mediocre

Figure 14 reflects poor growth even after adjusting for other policy and non-policy constraints. The industry's backward GVC participation and processing were roughly in line with what was predicted for the period 1995–1999, but its export intensity trailed behind (Figure 14a). The same assessment for the period 2014–2018 shows that GVC integration measures for both export intensity and processing were less than the models' predictions, and backward GVC participation was slightly higher (Figure 14b). GVC integration grew significantly in countries such as Romania, Thailand and Turkey during the same period.

Figure 14: Automotive industry's integration into GVCs subdued

a) 1995–1999 average **b) 2014–2018 average**



Note: The models' projections cover different time periods depending on the availability of the explanatory variables. Model-predicted values in Figure 14a are based on the projections of M1 and M2, whereas model-predicted values in Figure 14b are based on the projections of M1–M6.

The South African automotive industry showed lacklustre performance despite receiving substantial government funding: as much as R25 billion per year, which accounted for more than half of the government's spending on industry incentives (see Stern and Ramkolowan 2021 and Department of Planning, Monitoring and Evaluation 2018). The Motor Industry Development Programme and the Automotive Production Development Programme sparked wide debate among academics and policymakers on the effectiveness of industrial policy. Some considered that the programmes "helped to develop dynamic competitive advantage" (Barnes, Kaplinsky and Morris

2004) and had “notable successes” (Hirsch 2005), whereas others argued that the industry “would have collapsed in the absence of government support” (Flatters 2005) and that these programmes represented “heavy costs” in the government’s budget (Flatters and Netshitomboni 2017).

The recent South African Automotive Masterplan (SAAM)[27] can be seen as an extension of the Automotive Production Development Programme, broadening the objectives and emphasising ‘economic upgrade’, that is, to increase production, domestic content and employment. The SAAM also includes multiple targets such as improving social cohesion and reducing income inequality (see Table 2). The SAAM is more ambitious than the two previous programmes supporting the growth of South Africa’s automotive industry. However, it will require greater government spending on the industry and has complex objectives that may be hard to achieve.

Table 2: Summary of SAAM objectives and estimated impact

Objective	Estimated impact
1. Grow South African vehicle production to 1% of global output	• Complete Built Up production to 1.39 million units annually (129% higher than 2015 levels) • Increase value of vehicle production to R314 billion
2. Increase local content in South African assembled vehicles to up to 60%	• Increase of R135.4 billion on 2015 local content levels • Local content increase of 21.3% per vehicle produced (55% increase) • Increase automotive component aftermarket and export production at the same rate as local content growth
3. Double employment in the auto value chain	• Employment growth of 112 000 • Aggregate employment from 112 000 to 124 000
4. Improve auto industry competitive levels to that of leading international competitors	• Sustainable automotive industry based on comparative price and non-price competitiveness versus leading international competitiveness • Sustained export competitiveness
5. Transform the South African automotive value chain	• 25% black-owned involvement at Tier 2 and Tier 3 component manufacturer levels, as well as in dealership networks and authorised repair facilities • Amplified skills development of black South Africans • Enhanced employment equity at senior management, artisan and professional employment levels across automotive value chain
6. Deepen value addition within the South African automotive value chains	• Growth in research and development and other innovation metrics within the South African automotive value chain

Source: Geared for Growth South Africa’s Automotive Industry Master Plan to 2035

[27] http://www.thedtic.gov.za/wp-content/uploads/Masterplan-Automotive_Industry.pdf

6. South Africa's GVC performance in policy context: from trade liberalisation to multi-pronged development targets

The ebb and flow of South Africa's GVC integration is not merely a part of the global phenomenon, but also reflects the two phases of economic and industrial policies with fundamental shifts in beliefs and priorities.[28] The first phase dated from 1994 to 2007 and is principally characterised by trade liberalisation. The effectively applied tariff rates (weighted by the product import shares) were halved since joining the WTO in 1995 (Figure 15), with the sharp decrease of import tariffs in the automotive industry being just one of many examples.

The second phase with better-targeted industrial policy was elaborated in the National Industrial Policy Framework in 2007, and subsequently in the series of industrial policy action plans. The new policy aims to facilitate a more diversified economy and shift from an economic structure that overly relies on traditional commodities and non-tradable services. The four priorities of the industrial strategies are promoting export diversification with more domestic value-added content, creating more jobs, favouring historically disadvantaged people and marginalised regions, and, more generally, moving towards a knowledge-based economy. The SAAM captures the essence of these priorities.

Ultimately, both sets of policies are somewhat flawed. It is believed that the market approach during phase one promoted export growth and economic growth (Flatters and Stern 2007; Edwards and Lawrence 2008). As a result, it entrenched highly concentrated, capital-intensive and resource-based industries that had international comparative advantages, but suffocated other manufacturing industries and associated jobs. As highlighted by Hausmann (2008), "greater processing of natural resource exports does not constitute either an easy or a natural next step in the process of structural transformation, especially in South Africa".[29] The more targeted approach during phase two mobilises as much as 3% of government budget on industry incentives that support economic diversification and upgrading, but remain limited in scope, scale and influence (Department of Planning, Monitoring and Evaluation 2018).

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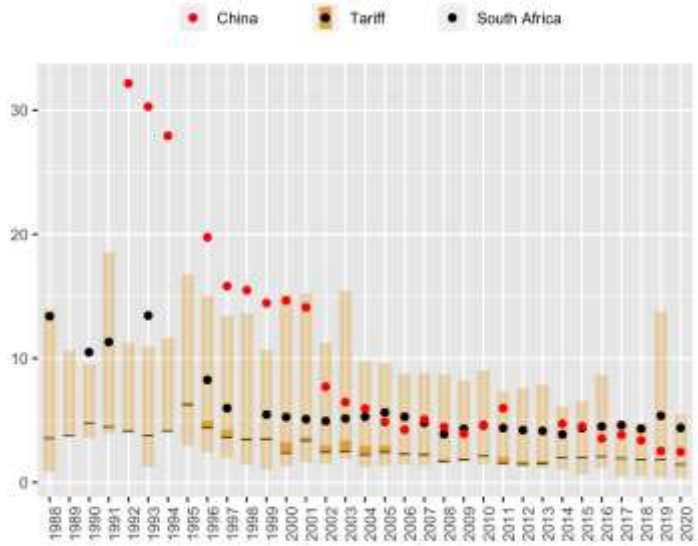
28 Refer to Zalk (2014) for further elaboration.

29 See also Zalk (2014).

Figure 15: South Africa's effectively applied tariff rates halved post-Uruguay round

OECD countries, China and South Africa



Source: World Bank WDI

Note: The light-shaded areas show the range of the indicators between the minimum and the maximum and dark-shaded areas show the range between the first and third quartiles of the indicators for the OECD countries. The indicators for South Africa and China are labelled separately.

The National Industrial Policy Framework and the industrial policy action plans introduced 'preferential treatments', such as leveraging public and private procurement to raise domestic production and employment, and differentiated tariffs determined by strategic sectoral priorities (lower for industries that produce intermediate inputs for downstream businesses), local content requirements [30] and black economic empowerment. However, these have in fact rendered South Africa's economic policy more restrictive than before. They have also been undermined by a lack of support from other key areas of economic policymaking and a deteriorating economic operating environment, including business infrastructure and logistics services (Figure 16, benchmarking against the OECD countries and China).

For example, the OECD has increased South Africa's rating (on a scale of restrictiveness) when it comes to benchmarking services market regulation in the areas of transport, logistics and distribution (Figure 16a), revealing a trend of more restrictive policy measures than in the majority of OECD countries in 2021 than in 2014.[31]

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30 Although many countries have local content requirements, their automotive businesses grew. Examples include China, Malaysia and Thailand (see Lee, Qu and Mao 2020).

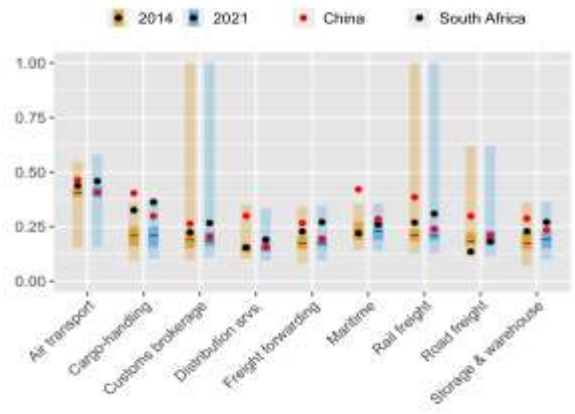
31 The OECD services trade restrictiveness index (STRI) collects information on services trade

Meanwhile, the overall score of logistics performance has worsened, with the greatest deterioration in *quality of trade and transport-related infrastructure* and *the competence and quality of logistics services* (see Figure 16b).

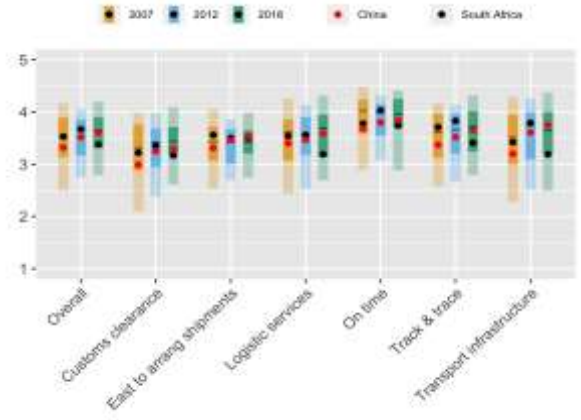
Figure 16: Deteriorated business operating environment

Benchmark to the OECD countries and China

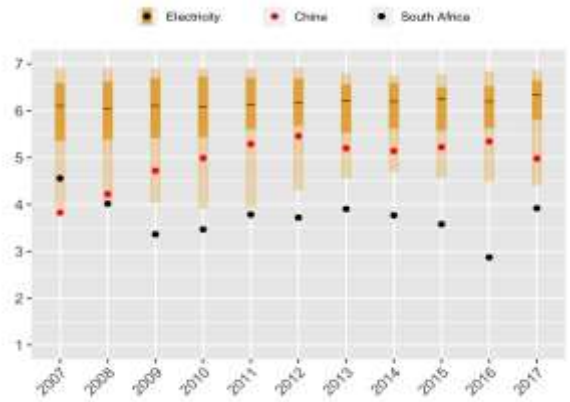
a) Services trade restrictiveness



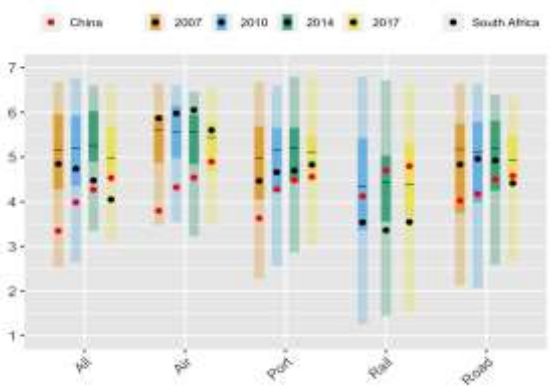
b) Logistics performance



c) Quality of electricity supply



d) Quality of transport infrastructure



Source: (a) OECD Services Trade Restrictiveness Index, (b) World Bank WDI, and (c) and (d) World Economic Forum Global Competitiveness Index.

Note: The light-shaded areas show the range of the indicators between the minimum and the maximum and dark-shaded areas show the range between the first and third quartiles of the indicators for the OECD countries. The indicators for South Africa and China are labelled separately.

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restrictions across 22 major services sectors. It provides valuable instruments to benchmark countries' services market regulation against best practices and enables the impact of trade liberalisation to be assessed. Composite indices quantify the identified restrictions across five standard policy categories (restrictions on foreign entry, restrictions on the movement of people, other discriminatory measures, barriers to competition and regulatory transparency), with values between zero and one (with one being the most restrictive). The overall STRI is weighted based on the score of these five categories. The services sectors that potentially have an influence on GVC performance are logistics services (include cargo-handling, storage & warehouse, freight forwarding, customs brokerage), transport services (air transport, maritime freight, rail freight, road freight) and distribution services. See Geloso Grosso et al. (2015) for methodology.

Electricity is also problematic in South Africa, with the country facing continuous and worsening supply shortages. The Global Competitiveness Index reflected this reality: the quality of South Africa's electricity remained lower than any of the OECD countries (Figure 16c). Moreover, the longstanding lack of investment in infrastructure has begun to bite. The overall quality of transport infrastructure declined rapidly from 2007 to 2017, while the worst performance was the quality of rail lines, which was among the bottom quartile of the OECD countries. However, in this period the quality of ports increased, with the gap between South Africa and the OECD median narrowing (Figure 16d).

7. Conclusions

This study has shown that South Africa trails behind other small open economies in its GVC integration. Although the OECD's Trade in Value Added data shows that the country's GVC integration has stagnated in recent years, an alternative approach using economic models suggests that the country's integration in GVCs is roughly in line with expectations. However, both data and modelling have shown that the high government incentives in the automotive industry beget neither a high rating in GVC integration nor the expected economic upgrade in South Africa.

There are obviously structural reasons for South Africa not integrating into GVCs as well as other emerging economies. The country's location far from global markets, its relatively high labour costs and its resource-based economic structure have rendered it less competitive than its peers. Trade policies, gestures to welcome foreign direct investments and a streamlined business operating environment are crucial for South Africa's success in tapping into GVCs and fostering economic upgrade.

This analysis points to the need to continuously assess the effectiveness of different policy tools to achieve the best outcomes at the lowest possible cost. For example, the South African government's strong support for the automotive sector has generated growth relative to other domestic sectors but this rate of growth is well below that achieved in other countries.

Although industry policies have always been instrumental in the national economic toolkit, which offers over 240 different business incentives in the form of loans, grants

or tax incentives (see Department of Planning, Monitoring and Evaluation 2018), the question remains: can industry policies alone be sustainable in achieving long-term multi-pronged development goals? The poor economic 'infrastructure' (such as logistic services and services trade restrictiveness) might have made the costly government business incentives less effective than they should have been. In other words, South Africa should have put more emphasis on the accompanying structural policy to improve the macroeconomic climate, that is, improving the business environment, financing derailed investment in infrastructure, reducing barriers to market entry, and having more transparent regulations (Andreoni et al. 2021). The services sector, in particular logistic services, also should be examined in order to better facilitate international trade of the primary and manufacturing sector.

The COVID-19 pandemic and a series of geopolitical events have further highlighted the vulnerabilities of supply chains. With efficiency- and profit-driven attitudes giving way to a more conservative approach to operating businesses, countries have already been looking afresh to GVC integration. Under these circumstances, for small open economies like South Africa, managing supply chain risks well requires better targeted trade liberalisation and the development of stronger ties with trade partners, specifically other African countries (Hausmann 2008; African Development Bank et al. 2014; Allard et al. 2016; Barnes et al. 2019; Brenton, Ferrantino and Maleszewska 2022).

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Annexures

Annexure 1: Industry classification

Table A1: List of industries and their digital intensity classification

Code	Industry	ISIC Rev.4	Digital intensity (2013–15)
D01T02	Agriculture, hunting, forestry	01, 02	Low
D03	Fishing and aquaculture	03	Low
D05T06	Mining and quarrying, energy-producing products	05, 06	Low
D07T08	Mining and quarrying, non-energy-producing products	07, 08	Low
D09	Mining support service activities	09	Low
D10T12	Food products, beverages and tobacco	10, 11, 12	Low
D13T15	Textiles, textile products, leather and footwear	13, 14, 15	Medium-low
D16	Wood and products of wood and cork	16	Medium-high
D17T18	Paper products and printing	17, 18	Medium-high
D19	Coke and refined petroleum products	19	Medium-low
D20	Chemical and chemical products	20	Medium-low
D21	Pharmaceuticals, medicinal chemical and botanical products	21	Medium-low
D22	Rubber and plastics products	22	Medium-low
D23	Other non-metallic mineral products	23	Medium-low
D24	Basic metals	24	Medium-low
D25	Fabricated metal products	25	Medium-low
D26	Computer, electronic and optical equipment	26	Medium-high
D27	Electrical equipment	27	Medium-high
D28	Machinery and equipment, nec	28	Medium-high
D29	Motor vehicles, trailers and semi-trailers	29	High
D30	Other transport equipment	30	High
D31T33	Manufacturing nec; repair and installation of machinery and equipment	31, 32, 33	Medium-high
D35	Electricity, gas, steam and air-conditioning supply	35	Low
D36T39	Water supply; sewerage, waste management and remediation activities	36, 37, 38, 39	Low
D41T43	Construction	41, 42, 43	Low
D45T47	Wholesale and retail trade; repair of motor vehicles	45, 46, 47	Medium-high
D49	Land transport and transport via pipelines	49	Low
D50	Water transport	50	Low
D51	Air transport	51	Low
D52	Warehousing and support activities for transportation	52	Low
D53	Postal and courier activities	53	Low
D55T56	Accommodation and food service activities	55, 56	Low
D58T60	Publishing, audiovisual and broadcasting activities	58, 59, 60	Medium-high
D61	Telecommunications	61	High
D62T63	IT and other information services	62, 63	High
D64T66	Financial and insurance activities	64, 65, 66	High
D68	Real estate activities	68	Low
D69T75	Professional, scientific and technical activities	69 to 75	High
D77T82	Administrative and support services	77 to 82	High
D84	Public administration and defence; compulsory social security	84	Medium-high
D85	Education	85	Medium-low
D86T88	Human health and social work activities	86, 87, 88	Medium-low
D90T93	Arts, entertainment and recreation	90, 91, 92, 93	Medium-high
D94T96	Other service activities	94,95, 96	High
D97T98	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	97, 98	N/A

Note: See Calvino et al. (2018) for digital intensity classification. ‘High’ identifies sectors in the top quartile of the distribution of the values underpinning the taxonomy based on the countries’ data available, ‘medium-high’ the second highest quartile, ‘medium-low’ the second lowest, and ‘low’ the bottom quartile.

Annexure 2: List of countries

Table A2: Country/territory coverage in the OECD TiVA database

ISO3	Country	ISO3	Country
ARG	Argentina	**KAZ**	Kazakhstan
AUS	Australia	**KHM**	Cambodia
AUT	Austria	**KOR**	Korea
BEL	Belgium	**LAO**	Lao People's Democratic Republic
BGR	Bulgaria	**LTU**	Lithuania
BRA	Brazil	**LUX**	Luxembourg
BRN	Brunei Darussalam	**LVA**	Latvia
CAN	Canada	**MAR**	Morocco
CHE	Switzerland	**MEX**	Mexico
CHL	Chile	**MLT**	Malta
CHN	China (People's Republic of)	**MMR**	Myanmar
COL	Colombia	**MYS**	Malaysia
CRI	Costa Rica	**NLD**	Netherlands
CYP	Cyprus	**NOR**	Norway
CZE	Czechia	**NZL**	New Zealand
DEU	Germany	**PER**	Peru
DNK	Denmark	**PHL**	Philippines
ESP	Spain	**POL**	Poland
EST	Estonia	**PRT**	Portugal
FIN	Finland	**ROU**	Romania
FRA	France	**RUS**	Russian Federation
GBR	United Kingdom	**SAU**	Saudi Arabia
GRC	Greece	**SGP**	Singapore
HKG	Hong Kong, China	**SVK**	Slovak Republic
HRV	Croatia	**SVN**	Slovenia
HUN	Hungary	**SWE**	Sweden
IDN	Indonesia	**THA**	Thailand
IND	India	**TUN**	Tunisia
IRL	Ireland	**TUR**	Turkey
ISL	Iceland	**USA**	United States
ISR	Israel	**VNM**	Vietnam
ITA	Italy	**ZAF**	South Africa
JPN	Japan		

Annexure 3: List of variables

Table A3: List of explanatory variables

Variable	Abbreviation	Years available	Data source
Free trade agreements (no. of partners)	FTA	1995–2018	WTO Free Trade Agreement database
FDI net inflow (% GDP)	FDI.M	1995–2018	WB WDI
FDI net outflow (% GDP)	FDI.X	1995–2018	WB WDI
Rail line in kilometres	RT.RAIL	1995–2018	WB WDI
Ease of doing business	BNS.BES	2015–2018	WB WDI
Cost of business start-up procedures (% GNI per capita)	BNS.CST	2003–2018	WB WDI
Time required to start a business (no. of days)	BNS.DUR	2003–2018	WB WDI
Overall logistics performance index, 1–5 (best)	LPI.ALL	2007, 2010–2018 on even years	WB WDI
Efficiency of customs clearance process, 1–5 (best)	LPI.CUS	2007, 2010–2018 on even years	WB WDI
Quality of trade and transport-related infrastructure, 1–5 (best)	LPI.INF	2007, 2010–2018 on even years	WB WDI
Ease of arranging competitively priced shipments, 1–5 (best)	LPI.ITR	2007, 2010–2018 on even years	WB WDI
Competence and quality of logistics services, 1–5 (best)	LPI.LOG	2007, 2010–2018 on even years	WB WDI
Frequency with which shipments reach consignee within scheduled or expected time, 1–5 (best)	LPI.TME	2007, 2010–2018 on even years	WB WDI
Ability to track and trace consignments, 1–5 (best)	LPI.TRC	2007, 2010–2018 on even years	WB WDI
GDP (current US$)	GDP	1995–2018	WB WDI
Nature resource rent*	RESRC	1995–2018	WB WDI
Gross tertiary enrollment ratio	ENL.TER	1995–2018	WB WDI
Labor force participation rate (young, 15–24)	LBR.YNG	1995–2018	WB WDI
Labor force participation rate (advanced education)	LBR.AVD	1995–2018	WB WDI
Applied tariff rate	TARIFF	1995–2018	WB WDI
Manufacturing share of the economy	MFGSH	1995–2018	OECD TiVA
Years of schooling (average, in years)**	YRSCH	1995, 2000, 2005, 2010 and 2015	Barro and Lee 2013
Trade-weighted distance to market***	DISTW	1995–2018	CEPII and OECD BTDIxE
Summary index (EFS), 0–100 (best)	SUM.EFS	1995–2018	Heritage Foundation
Property rights, 0–100 (best)	LAW.PTY	1995–2018	Heritage Foundation
Fiscal freedom, 0–100 (best)	GOV.FIS	2017–2018	Heritage Foundation
Government spending, 0–100 (best)	GOV.XPD	1995–2018	Heritage Foundation
Business freedom, 0–100 (best)	REG.BNS	1995–2018	Heritage Foundation
Labor freedom, 0–100 (best)	REG.LBR	2005–2018	Heritage Foundation
Monetary freedom, 0–100 (best)	REG.MNY	1995–2018	Heritage Foundation
Trade freedom, 0–100 (best)	MKT.TRD	1995–2018	Heritage Foundation
Investment freedom, 0–100 (best)	MKT.INV	1995–2018	Heritage Foundation
Financial freedom, 0–100 (best)	MKT.FIN	1995–2018	Heritage Foundation
Government integrity, 0–100 (best)	LAW.IGT	1995–2018	Heritage Foundation
Judicial effectiveness, 0–100 (best)	LAW.JDC	2017–2018	Heritage Foundation
Tax burden, 0-100 (best)	GOV.TAX	1995–2018	Heritage Foundation
Summary index (EFW), 0–10 (best)	SUM.EFW	1995–2018	Fraser Institute

Size of government, 0–10 (best)	A1GOV	1995–2018	Fraser Institute
Legal system and security of property right, 0–10 (best)	A2PTY	1995–2018	Fraser Institute
Sound money, 0-10 (best)	A3MNY	1995–2018	Fraser Institute
Freedom to trade internationally, 0–10 (best)	A4TRD	1995–2018	Fraser Institute
Regulation, 0-10 (best)	A5REG	1995–2018	Fraser Institute
Burden of customs procedures, 1–7 (best)	BUR.CUS	2008–2017	Global Competitiveness Index
Quality of overall infrastructure, 1–7 (best)	QI_ALL	2007–2017	Global Competitiveness Index
Quality of port infrastructure, 1–7 (best)	QI_PORT	2007–2017	Global Competitiveness Index
Quality of railroad infrastructure, 1–7 (best)	QI_RAIL	2010–2017	Global Competitiveness Index
Quality of roads, 1-7 (best)	QI_ROAD	2007–2018	Global Competitiveness Index

Note: *The sum of oil, natural gas, coal, mineral, and forest rents as a percentage of nominal GDP.

**The missing data is linearly extrapolated.

***Author's calculation based on CEPII and OECD BTDIxE databases

Not all data is used in the final selection of the models because some of these variables are highly correlated with one another. Annexure 6 shows the variance-covariance matrix of dependent variables in models 1–6. The variance-covariance matrices of some highly corelated variables are also presented in Annexure 6.

The policy indicators that quantified on various scales are standardised to a unique scale of 0–100. For instance, EFW and LPI indicators are adjusted (multiplied by 10 and 20 respectively) so that the estimates, i.e. coefficients, are directly comparable with EFS and doing business indicators.

Annexure 4: Regression results

Table A4: Total economy, with year fixed effect

	Dependent variable:																	
	Backward GVC participation						Export intensity						Processing					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
GDP	-1.98***	-2.28***	-2.24***	-3.70***	-4.06***	-4.10***	-1.18***	-1.94***	-1.26***	-1.96***	-4.16***	-3.55***	-1.42***	-2.45***	-1.95***	-4.82***	-5.87***	-5.92***
	(0.27)	(0.28)	(0.40)	(0.66)	(0.84)	(0.72)	(0.25)	(0.24)	(0.35)	(0.53)	(0.67)	(0.57)	(0.39)	(0.39)	(0.55)	(0.82)	(1.04)	(0.88)
RESRC	-0.24***	-0.21***	-0.26***	-0.21**	-0.22*	-0.45***	0.86***	0.96***	0.91***	1.00***	1.05***	0.97***	0.17***	0.29***	0.22***	0.35***	0.38***	0.21
	(0.04)	(0.05)	(0.06)	(0.09)	(0.11)	(0.13)	(0.04)	(0.04)	(0.05)	(0.07)	(0.09)	(0.10)	(0.06)	(0.06)	(0.08)	(0.11)	(0.14)	(0.16)
MFGSH	0.58***	0.61***	0.59***	0.53***	0.61***	0.51***	0.58***	0.66***	0.64***	0.65***	0.68***	0.68***	0.88***	0.98***	0.91***	0.86***	0.95***	0.86***
	(0.04)	(0.04)	(0.05)	(0.06)	(0.08)	(0.07)	(0.04)	(0.04)	(0.05)	(0.05)	(0.07)	(0.06)	(0.06)	(0.06)	(0.07)	(0.08)	(0.10)	(0.09)
YRSCH	0.39***	0.16	0.39**	0.12	0.10	0.02	1.19***	0.52***	1.43***	1.18***	1.00***	1.28***	1.57***	0.70***	1.82***	1.35***	1.22***	1.32***
	(0.13)	(0.15)	(0.18)	(0.24)	(0.31)	(0.25)	(0.12)	(0.12)	(0.16)	(0.19)	(0.25)	(0.20)	(0.18)	(0.20)	(0.24)	(0.30)	(0.38)	(0.30)
DISTW	-1.75***	-2.03***	-0.60	1.60	1.75	2.40	-3.37***	-4.33***	-3.64***	-3.01***	-1.82	-2.21*	-3.78***	-4.94***	-3.14**	0.69	0.57	0.89
	(0.60)	(0.61)	(0.92)	(1.43)	(1.79)	(1.66)	(0.54)	(0.52)	(0.81)	(1.15)	(1.41)	(1.32)	(0.86)	(0.84)	(1.25)	(1.79)	(2.21)	(2.03)
RT.RAIL	-1.80***	-1.40***	-1.95***	-0.59	-0.75	-0.27	-3.05***	-1.96***	-3.27***	-2.41***	-1.46**	-1.22**	-3.34***	-1.89***	-3.01***	-0.42	-0.35	0.09
	(0.28)	(0.30)	(0.40)	(0.61)	(0.72)	(0.63)	(0.25)	(0.25)	(0.35)	(0.49)	(0.57)	(0.50)	(0.40)	(0.41)	(0.55)	(0.75)	(0.89)	(0.77)
FDI.M	0.21***	0.20***	0.21***	0.31***	0.21***	0.41***	0.27***	0.25***	0.25***	0.27***	0.21***	0.30***	0.32***	0.29***	0.30***	0.34***	0.25***	0.33***
	(0.03)	(0.03)	(0.03)	(0.07)	(0.04)	(0.08)	(0.03)	(0.03)	(0.03)	(0.06)	(0.03)	(0.07)	(0.04)	(0.04)	(0.05)	(0.09)	(0.05)	(0.10)
FDI.X	0.07**	0.07**	0.05	0.06	0.03	-0.01	0.11***	0.09***	0.09***	0.15***	0.04	0.17***	0.10**	0.08*	0.06	0.08	0.02	0.11
	(0.03)	(0.03)	(0.03)	(0.06)	(0.04)	(0.07)	(0.03)	(0.03)	(0.03)	(0.05)	(0.03)	(0.06)	(0.04)	(0.04)	(0.04)	(0.08)	(0.05)	(0.09)
FTA	0.10***	0.10***	0.13***	0.15***	0.14***	0.16***	0.08***	0.08***	0.09***	0.10***	0.09***	0.10***	0.18***	0.19***	0.21***	0.24***	0.23***	0.26***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
TARIFF	-0.10	-0.12	-0.12	-0.22	-0.30	-0.37	-0.03	-0.07	-0.15	-0.29	-0.29	-0.58***	-0.10	-0.15	-0.27	-0.78***	-0.92**	-1.13***
	(0.07)	(0.07)	(0.14)	(0.24)	(0.31)	(0.27)	(0.07)	(0.06)	(0.13)	(0.19)	(0.24)	(0.22)	(0.10)	(0.10)	(0.20)	(0.30)	(0.38)	(0.34)
SUM.EFS		0.12***						0.35***						0.44***				
		(0.04)						(0.03)						(0.05)				
BNS.CST			-0.01	0.10					-0.01	-0.15**					-0.003	0.02		
			(0.01)	(0.08)					(0.01)	(0.06)					(0.02)	(0.10)		
BNS.DUR			0.11***	0.15***					0.04**	0.13***					0.07**	0.15***		
			(0.02)	(0.04)					(0.02)	(0.03)					(0.03)	(0.05)		
BUR.CUS				0.17***						0.16***						0.33***		
				(0.05)						(0.04)						(0.06)		
LPI.ALL					0.18**						0.38***						0.40***	
					(0.09)						(0.07)						(0.11)	
QI_AIR						-0.02						0.08*						0.05
						(0.06)						(0.05)						(0.07)
QI_PORT						-0.10*						-0.04						-0.09
						(0.05)						(0.04)						(0.07)
QI_RAIL						0.10***						0.07**						0.16***
						(0.04)						(0.03)						(0.04)
QI_ROAD						-0.000						-0.000						-0.000
						(0.000)						(0.000)						(0.000)
Obs.	984	973	600	372	239	315	984	973	600	372	239	315	984	973	600	372	239	315
R2	0.62	0.63	0.62	0.66	0.66	0.68	0.71	0.75	0.72	0.79	0.79	0.80	0.61	0.65	0.61	0.71	0.71	0.74
Adjusted R2	0.61	0.62	0.61	0.64	0.64	0.66	0.70	0.74	0.71	0.78	0.77	0.79	0.60	0.63	0.60	0.69	0.69	0.72
Residual Std. Error	6.68	6.67	6.83	6.77	7.04	6.88	6.04	5.65	5.98	5.43	5.57	5.48	9.52	9.11	9.26	8.44	8.69	8.41
F Statistic	47.94***	47.00***	35.26***	31.27***	27.07***	29.71***	69.63***	81.14***	54.35***	60.20***	51.88***	56.21***	45.37***	50.49***	33.82***	38.14***	34.63***	39.91***

Note: Standard errors in parentheses; significance level: *p<0.1; **p<0.05; ***p<0.01

Not all data is used in the final selection of the models because some of these variables are highly correlated with one another. Annexure 6 shows the variance-covariance matrix of dependent variables

in models 1–6. The variance-covariance matrices of some highly corelated variables are also presented in Annexure 6.

Table A5: Industry level, with year and industry fixed effects

	Dependent variable:																	
	Backward GVC participation						Export Intensity						Processing					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
GDP	-1.63***	-1.89***	-1.60***	-2.34***	-3.20***	-2.85***	-1.96***	-2.82***	-2.11***	-3.99***	-5.72***	-5.37***	-1.53***	-2.49***	-1.81***	-3.91***	-5.29***	-4.96***
	(0.05)	(0.05)	(0.07)	(0.12)	(0.15)	(0.13)	(0.09)	(0.09)	(0.13)	(0.20)	(0.25)	(0.22)	(0.07)	(0.07)	(0.10)	(0.15)	(0.18)	(0.16)
RESRC	0.08***	0.11***	0.09***	0.12***	0.15***	0.06***	0.15***	0.25***	0.15***	0.16***	0.29***	0.14***	0.22***	0.33***	0.27***	0.37***	0.42***	0.32***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.03)	(0.03)	(0.04)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)
MFGSH	0.30***	0.32***	0.33***	0.33***	0.34***	0.35***	0.38***	0.47***	0.41***	0.43***	0.45***	0.46***	0.66***	0.75***	0.70***	0.69***	0.73***	0.69***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
YRSCH	0.26***	0.04	0.24***	0.004	0.002	0.04	1.12***	0.40***	1.29***	0.75***	0.70***	0.88***	1.34***	0.53***	1.51***	1.03***	0.92***	1.10***
	(0.02)	(0.03)	(0.03)	(0.04)	(0.06)	(0.05)	(0.04)	(0.05)	(0.06)	(0.07)	(0.09)	(0.07)	(0.03)	(0.04)	(0.04)	(0.05)	(0.07)	(0.05)
DISTW	-1.47***	-1.75***	-0.76***	0.62**	0.30	0.16	-3.97***	-4.93***	-3.54***	-0.86*	-1.93***	-1.89***	-3.51***	-4.59***	-3.02***	-0.36	-0.54	-0.78**
	(0.11)	(0.11)	(0.17)	(0.27)	(0.32)	(0.31)	(0.20)	(0.20)	(0.29)	(0.44)	(0.53)	(0.51)	(0.15)	(0.15)	(0.22)	(0.32)	(0.39)	(0.36)
RT.RAIL	-1.47***	-1.09***	-1.64***	-0.85***	-0.85***	-0.50***	-2.16***	-0.94***	-2.13***	-0.28	0.18	0.53***	-2.68***	-1.32***	-2.74***	-0.68***	-0.43***	-0.13
	(0.05)	(0.06)	(0.07)	(0.11)	(0.13)	(0.12)	(0.09)	(0.10)	(0.13)	(0.19)	(0.21)	(0.19)	(0.07)	(0.07)	(0.10)	(0.14)	(0.16)	(0.14)
FDI.M	0.10***	0.10***	0.10***	0.15***	0.08***	0.18***	0.19***	0.17***	0.17***	0.17***	0.12***	0.15***	0.30***	0.27***	0.27***	0.32***	0.22***	0.31***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.03)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
FDI.X	0.07***	0.06***	0.06***	0.06***	0.03***	0.04***	0.07***	0.06***	0.05***	0.06***	0.01	0.12***	0.12***	0.10***	0.09***	0.11***	0.04***	0.15***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
FTA	0.05***	0.05***	0.07***	0.09***	0.06***	0.08***	0.13***	0.13***	0.14***	0.16***	0.13***	0.15***	0.16***	0.17***	0.18***	0.21***	0.19***	0.21***
	(0.002)	(0.002)	(0.003)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.01)	(0.01)	(0.01)	(0.01)	(0.003)	(0.003)	(0.004)	(0.005)	(0.01)	(0.01)
TARIFF	-0.16***	-0.17***	-0.16***	-0.13***	-0.07	-0.21***	-0.13***	-0.18***	-0.23***	-0.54***	-0.44***	-0.80***	-0.12***	-0.17***	-0.28***	-0.64***	-0.66***	-0.93***
	(0.01)	(0.01)	(0.03)	(0.05)	(0.06)	(0.05)	(0.02)	(0.02)	(0.05)	(0.07)	(0.09)	(0.08)	(0.02)	(0.02)	(0.03)	(0.05)	(0.07)	(0.06)
SUM.EFS		0.12***						0.37***						0.42***				
		(0.01)						(0.01)						(0.01)				
BNS.CST			-0.01***	-0.01					-0.02***	-0.17***					-0.02***	-0.09***		
			(0.003)	(0.01)					(0.004)	(0.02)					(0.003)	(0.02)		
BNS.DUR			0.05***	0.08***					0.03***	0.10***					0.05***	0.13***		
			(0.004)	(0.01)					(0.01)	(0.01)					(0.005)	(0.01)		
BUR.CUS				0.14***						0.29***						0.29***		
				(0.01)						(0.02)						(0.01)		
LPI.ALL					0.27***						0.50***						0.43***	
					(0.02)						(0.03)						(0.02)	
QI_AIR						0.09***						0.15***						0.07***
						(0.01)						(0.02)						(0.01)
QI_PORT						-0.01						-0.01						-0.04***
						(0.01)						(0.02)						(0.01)
QI_RAIL						0.03***						0.10***						0.12***
						(0.01)						(0.01)						(0.01)
QI_ROAD						-0.00***						-0.00***						-0.00***
						(0.000)						(0.000)						(0.000)
Obs.	44,280	43,785	27,000	16,740	10,755	14,175	44,280	43,785	27,000	16,740	10,755	14,175	44,280	43,785	27,000	16,740	10,755	14,175
R^2	0.66	0.66	0.67	0.68	0.68	0.67	0.65	0.66	0.69	0.71	0.71	0.72	0.59	0.62	0.61	0.68	0.68	0.70
Adjusted R^2	0.66	0.66	0.67	0.68	0.68	0.67	0.65	0.66	0.68	0.71	0.71	0.71	0.59	0.62	0.61	0.68	0.68	0.70
Residual Std. Error	8.26	8.25	8.47	8.53	8.46	8.56	14.85	14.67	14.46	14.04	14.05	14.06	11.05	10.75	10.85	10.13	10.32	10.12
F Statistic	1,105.45***	1,091.08***	756.96***	528.89***	378.96***	450.65***	1,086.17***	1,101.21***	826.28***	631.94***	437.73***	547.18***	834.92***	897.76***	603.03***	543.90***	375.74***	504.09***

Note: Standard errors in parentheses; significance level: *p<0.1; **p<0.05; ***p<0.01
Not all data is used in the final selection of the models because some of these variables are highly correlated with one another. Annexure 6 shows the variance-covariance matrix of dependent variables in models 1–6. The variance-covariance matrices of some highly corelated variables are also presented in Annexure 6.

Table A6: Robustness test: Total economy, with year and income-group fixed effect

	Dependent variable:																	
	Backward GVC participation						Export intensity						Processing					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
GDP	-1.86***	-2.04***	-2.06***	-3.48***	-3.94***	-4.14***	-1.07***	-1.51***	-0.93**	-1.58***	-3.86***	-3.29***	-1.34***	-1.95***	-2.05***	-4.59***	-5.82***	-6.15***
	(0.31)	(0.31)	(0.45)	(0.67)	(0.86)	(0.75)	(0.28)	(0.26)	(0.39)	(0.53)	(0.68)	(0.59)	(0.44)	(0.42)	(0.61)	(0.84)	(1.06)	(0.91)
RESRC	-0.24***	-0.21***	-0.25***	-0.22**	-0.23**	-0.44***	0.86***	0.95***	0.91***	0.98***	1.03***	0.92***	0.16**	0.27***	0.22***	0.33***	0.37**	0.23
	(0.05)	(0.05)	(0.06)	(0.09)	(0.11)	(0.13)	(0.04)	(0.04)	(0.05)	(0.07)	(0.09)	(0.11)	(0.06)	(0.06)	(0.08)	(0.11)	(0.14)	(0.16)
MFGSH	0.57***	0.60***	0.57***	0.51***	0.60***	0.51***	0.57***	0.63***	0.62***	0.62***	0.65***	0.66***	0.88***	0.95***	0.92***	0.85***	0.96***	0.87***
	(0.04)	(0.04)	(0.05)	(0.07)	(0.08)	(0.07)	(0.04)	(0.04)	(0.05)	(0.05)	(0.07)	(0.06)	(0.06)	(0.06)	(0.07)	(0.08)	(0.10)	(0.09)
YRSCH	0.54***	0.39**	0.67***	0.44	0.38	-0.01	1.23***	0.79***	1.72***	1.61***	1.47***	1.62***	1.49***	0.91***	1.72***	1.44***	1.05**	0.81*
	(0.17)	(0.18)	(0.26)	(0.34)	(0.42)	(0.37)	(0.16)	(0.15)	(0.23)	(0.27)	(0.33)	(0.29)	(0.25)	(0.25)	(0.35)	(0.42)	(0.52)	(0.45)
DISTW	-1.94***	-2.50***	-0.87	1.14	1.38	2.45	-3.53***	-5.20***	-4.15***	-3.73***	-2.61*	-2.82**	-3.90***	-5.94***	-3.00**	0.35	0.55	1.81
	(0.64)	(0.67)	(0.97)	(1.47)	(1.85)	(1.74)	(0.58)	(0.56)	(0.85)	(1.16)	(1.45)	(1.38)	(0.91)	(0.91)	(1.32)	(1.82)	(2.28)	(2.11)
RT.RAIL	-1.90***	-1.58***	-2.06***	-0.77	-0.85	-0.21	-3.16***	-2.36***	-3.57***	-2.79***	-1.80***	-1.47***	-3.46***	-2.38***	-2.93***	-0.78	-0.54	0.08
	(0.31)	(0.32)	(0.45)	(0.62)	(0.76)	(0.67)	(0.28)	(0.27)	(0.39)	(0.49)	(0.60)	(0.53)	(0.44)	(0.44)	(0.61)	(0.77)	(0.94)	(0.81)
FDI.M	0.21***	0.20***	0.21***	0.30***	0.20***	0.41***	0.27***	0.24***	0.24***	0.25***	0.20***	0.28***	0.32***	0.27***	0.30***	0.32***	0.25***	0.33***
	(0.03)	(0.03)	(0.03)	(0.07)	(0.04)	(0.08)	(0.03)	(0.03)	(0.03)	(0.06)	(0.03)	(0.07)	(0.04)	(0.04)	(0.05)	(0.09)	(0.05)	(0.10)
FDI.X	0.07**	0.06**	0.05	0.06	0.03	-0.01	0.10***	0.09***	0.08***	0.15***	0.04	0.17***	0.10**	0.08*	0.07	0.09	0.02	0.10
	(0.03)	(0.03)	(0.03)	(0.06)	(0.04)	(0.07)	(0.03)	(0.03)	(0.03)	(0.05)	(0.03)	(0.06)	(0.04)	(0.04)	(0.04)	(0.08)	(0.05)	(0.09)
FTA	0.10***	0.10***	0.13***	0.16***	0.14***	0.16***	0.08***	0.08***	0.10***	0.11***	0.09***	0.11***	0.19***	0.19***	0.21***	0.25***	0.23***	0.26***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
TARIFF	-0.13*	-0.15**	-0.22	-0.28	-0.38	-0.37	-0.02	-0.06	-0.20	-0.34*	-0.37	-0.63***	-0.04	-0.11	-0.25	-0.72**	-0.82**	-1.06***
	(0.08)	(0.08)	(0.16)	(0.25)	(0.32)	(0.28)	(0.07)	(0.06)	(0.14)	(0.20)	(0.25)	(0.22)	(0.11)	(0.10)	(0.21)	(0.31)	(0.40)	(0.34)
SUM.EFS		0.14***						0.38***						0.48***				
		(0.04)						(0.03)						(0.05)				
BNS.CST			-0.005	0.12					-0.002	-0.11*					-0.004	0.05		
			(0.01)	(0.08)					(0.01)	(0.06)					(0.02)	(0.10)		
BNS.DUR			0.11***	0.14***					0.04**	0.13***					0.07**	0.16***		
			(0.02)	(0.04)					(0.02)	(0.03)					(0.03)	(0.05)		
BUR.CUS				0.20***						0.22***						0.38***		
				(0.06)						(0.05)						(0.07)		
LPI.ALL					0.20**						0.43***						0.41***	
					(0.09)						(0.07)						(0.11)	
QI_AIR						-0.02						0.08*						0.04
						(0.06)						(0.05)						(0.07)
QI_PORT						-0.10*						-0.03						-0.10
						(0.06)						(0.04)						(0.07)
QI_RAIL						0.10***						0.07**						0.17***
						(0.04)						(0.03)						(0.05)
QI_ROAD						-0.0000						-0.0000						-0.0000
						(0.0000)						(0.0000)						(0.0000)
FE: Lower middle income	1.97	2.97**	3.33*	3.00	3.04	-0.22	0.18	2.92**	2.74	3.80*	4.89**	3.20	-1.69	1.75	-1.05	-0.01	-2.23	-5.45
	(1.36)	(1.39)	(1.97)	(2.51)	(3.14)	(2.77)	(1.23)	(1.17)	(1.73)	(1.99)	(2.46)	(2.19)	(1.94)	(1.90)	(2.68)	(3.12)	(3.88)	(3.36)
FE: Upper middle income	0.54	1.37	0.83	2.20	1.23	-0.47	0.70	2.96***	1.75*	4.13***	3.25**	2.32	0.78	3.65***	-0.47	3.26*	0.86	-0.82
	(0.82)	(0.86)	(1.12)	(1.59)	(1.99)	(1.79)	(0.74)	(0.72)	(0.98)	(1.26)	(1.56)	(1.42)	(1.17)	(1.17)	(1.53)	(1.97)	(2.45)	(2.18)
Obs.	984	973	600	372	239	315	984	973	600	372	239	315	984	973	600	372	239	315
R^2	0.63	0.63	0.63	0.67	0.66	0.68	0.71	0.75	0.72	0.80	0.79	0.80	0.61	0.65	0.61	0.71	0.72	0.74
Adjusted R^2	0.61	0.62	0.61	0.64	0.63	0.66	0.70	0.74	0.71	0.78	0.78	0.79	0.60	0.64	0.60	0.69	0.69	0.72
Residual Std. Error	6.68	6.66	6.83	6.77	7.05	6.90	6.04	5.60	5.98	5.36	5.53	5.47	9.51	9.07	9.28	8.41	8.70	8.38
F Statistic	45.27***	44.65***	32.99***	28.76***	24.00***	26.96***	65.63***	78.32***	50.87***	57.03***	47.00***	51.60***	42.90***	48.48***	31.40***	35.41***	30.76***	36.81***

Note: Standard errors in parentheses; significance level: *p<0.1; **p<0.05; ***p<0.01

Not all data is used in the final selection of the models because some of these variables are highly correlated with one another. Annexure 6 shows the variance-covariance matrix of dependent variables in models 1–6. The variance-covariance matrices of some highly corelated variables are also presented in Annexure 6.

Table A7: Robustness test: Total economy, with year fixed effect, before and after the GFC

	Before the GFC (<=2008)						After the GFC (>=2008)					
	Backward GVC participation		Export intensity		Processing		Backward GVC participation		Export intensity		Processing	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
GDP	-1.56***	-1.95***	-0.54*	-1.54***	-0.23	-1.52***	-3.35***	-3.50***	-2.17***	-2.51***	-4.08***	-4.53***
	(0.30)	(0.32)	(0.29)	(0.29)	(0.46)	(0.48)	(0.56)	(0.56)	(0.47)	(0.45)	(0.70)	(0.69)
RESRC	-0.23***	-0.19***	0.80***	0.91***	0.12*	0.26***	-0.25***	-0.22***	0.96***	1.02***	0.30***	0.38***
	(0.05)	(0.05)	(0.05)	(0.04)	(0.07)	(0.07)	(0.08)	(0.09)	(0.07)	(0.07)	(0.11)	(0.10)
MFGSH	0.61***	0.65***	0.56***	0.66***	0.95***	1.07***	0.57***	0.59***	0.64***	0.67***	0.89***	0.93***
	(0.05)	(0.06)	(0.05)	(0.05)	(0.08)	(0.08)	(0.06)	(0.06)	(0.05)	(0.05)	(0.08)	(0.07)
YRSCH	0.53***	0.32*	0.88***	0.29*	1.41***	0.66**	0.22	-0.05	1.47***	0.89***	1.73***	0.96***
	(0.16)	(0.18)	(0.15)	(0.16)	(0.25)	(0.26)	(0.20)	(0.24)	(0.17)	(0.19)	(0.26)	(0.29)
DISTW	-2.47***	-2.92***	-3.25***	-4.54***	-3.97***	-5.53***	1.34	1.14	-3.02***	-3.44***	-0.48	-1.05
	(0.63)	(0.65)	(0.60)	(0.59)	(0.98)	(0.98)	(1.36)	(1.35)	(1.13)	(1.09)	(1.70)	(1.66)
RT.RAIL	-2.08***	-1.56***	-3.41***	-2.07***	-4.29***	-2.55***	-0.88*	-0.65	-2.37***	-1.88***	-1.21*	-0.55
	(0.32)	(0.36)	(0.30)	(0.32)	(0.49)	(0.53)	(0.51)	(0.52)	(0.43)	(0.42)	(0.64)	(0.64)
FDI.M	0.18***	0.17***	0.26***	0.23***	0.33***	0.29***	0.36***	0.35***	0.33***	0.30***	0.39***	0.35***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)	(0.07)	(0.07)	(0.06)	(0.06)	(0.09)	(0.09)
FDI.X	0.08**	0.07**	0.10***	0.07**	0.14**	0.11**	-0.03	-0.03	0.07	0.07	0.01	0.01
	(0.04)	(0.04)	(0.03)	(0.03)	(0.06)	(0.05)	(0.06)	(0.06)	(0.05)	(0.05)	(0.08)	(0.08)
FTA	0.06***	0.06***	0.04***	0.06***	0.11***	0.14***	0.16***	0.16***	0.11***	0.11***	0.26***	0.26***
	(0.02)	(0.02)	(0.02)	(0.01)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
TARIFF	-0.01	-0.03	-0.03	-0.08	0.001	-0.06	-0.29	-0.22	-0.42**	-0.26	-0.89***	-0.67**
	(0.08)	(0.08)	(0.07)	(0.07)	(0.12)	(0.11)	(0.23)	(0.23)	(0.19)	(0.18)	(0.28)	(0.28)
SUM.EFS		0.13***		0.36***		0.45***		0.13**		0.28***		0.37***
		(0.04)		(0.04)		(0.07)		(0.06)		(0.05)		(0.08)
Observations	592	581	592	581	592	581	438	438	438	438	438	438
R^2	0.61	0.62	0.68	0.72	0.54	0.58	0.65	0.65	0.76	0.78	0.70	0.72
Adjusted R^2	0.60	0.61	0.66	0.71	0.52	0.57	0.63	0.63	0.75	0.77	0.68	0.70
Residual Std. Error	6.23	6.22	5.98	5.57	9.68	9.31	7.06	7.04	5.86	5.65	8.85	8.61
F Statistic	39.21***	38.05***	51.42***	60.34***	29.36***	32.39***	38.21***	36.88***	66.80***	69.85***	48.49***	49.96***

Note: Standard errors in parentheses; significance level: *p<0.1; **p<0.05; ***p<0.01

Only those explanatory variables with long time series coverage can be split into before and after GFC, therefore models 3–6, as in Table A4, are not split here. Annexure 6 shows the variance-covariance matrix of dependent variables in models 1–6. The variance-covariance matrices of some highly corelated variables are also presented in Annexure 6.

Annexure 5: Variance decomposition and relative importance to free trade agreements

Table A8: Variance decomposition analysis for models 1–6 as presented in Table A4

	Backward GVC participation						Export intensity						Processing					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
GDP	0.156	0.242	0.158	0.169	0.200	0.175	0.157	0.163	0.155	0.169	0.232	0.213	0.113	0.120	0.119	0.150	0.190	0.185
RESRC	0.058	0.016	0.072	0.045	0.056	0.069	0.146	0.156	0.171	0.098	0.101	0.044	0.015	0.015	0.019	0.016	0.021	0.026
MFGSH	0.110	0.074	0.152	0.117	0.112	0.093	0.055	0.064	0.082	0.091	0.075	0.085	0.105	0.117	0.158	0.128	0.111	0.101
YRSCH	0.015	0.006	0.008	0003	0.005	0.004	0.046	0.027	0.053	0.037	0.034	0.048	0.064	0.040	0.071	0.034	0.031	0.032
DISTW	0.115	0.126	0.096	0,087	0.109	0.103	0.087	0.091	0.074	0.086	0.121	0.129	0.122	0.126	0.114	0.109	0.138	0.145
RT.RAIL	0.201	0.237	0.182	0.176	0.215	0.180	0.259	0.224	0.236	0.176	0.220	0.177	0.209	0.177	0.176	0.141	0.184	0.154
FDI.M	0.067	0.073	0.082	0.095	0.089	0.098	0.086	0.073	0.097	0.100	0.084	0.107	0.086	0.072	0.096	0.080	0.070	0.069
FDI.X	0.045	0.067	0.039	0.077	0.024	0.066	0.058	0.052	0.053	0.106	0.027	0.109	0.050	0.044	0.041	0.071	0.019	0.066
FTA	0.129	0.103	0.121	0.125	0.132	0.150	0.048	0.044	0.033	0.030	0.044	0.044	0.157	0.146	0.146	0.133	0.154	0.154
TARIFF	0.017	0.006	0.004	0.004	0.007	0.008	0.015	0.012	0.008	0.008	0.010	0.015	0.026	0.022	0.014	0.016	0.024	0.026
SUM.EFS		0.030						0.054						0.072				
BNS.CST			0.001	0.006					0.001	0.031					0.003	0.016		
BNS.DUR			0.024	0.031					0.007	0.016					0.008	0.015		
BUR.CUS				0.033						0.038						0.072		
LPI.ALL					0.024						0.037						0.043	
QI_AIR						0.007						0.009						0.007
QI_PORT						0.007						0.004						0.007
QI_RAIL						0.012						0.012						0.018
QI_ROAD						0.002						0.001						0.002
Relative importance to FTA																		
FDI.M	52%	71%	68%	76%	67%	65%	179%	166%	294%	333%	191%	243%	55%	49%	66%	60%	45%	45%
FDI.X	35%	65%	32%	62%	18%	44%	121%	118%	161%	353%	61%	248%	32%	30%	28%	53%	12%	43%
FTA	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*
TARIFF	13%	6%	3%	3%	5%	5%	31%	27%	24%	27%	23%	34%	17%	15%	10%	12%	16%	17%
SUM.EFS		29%						123%						49%				
BNS.CST			1%	5%					3%	103%					2%	12%		
BNS.DUR			20%	25%					21%	53%					5%	11%		
BUR.CUS				26%						127%						54%		
LPI.ALL					18%						84%						28%	
QI_AIR						5%						20%						5%
QI_PORT						5%						9%						5%
QI_RAIL						8%						27%						12%
QI_ROAD						1%						2%						1%

Note: The second half of the table shows the size of importance of policy variables, i.e., the amount of variance explained by these policy variables. The relative importance (variance explained) of FTA is standardised to 100% and all the other policy variables are benchmarked to the FTA, with >=100% meaning that the variable explains higher variances of the model than RTA.

Annexure 6: Variance-covariance matrices

Table A9: Independent variables as in the models 1–6

	GDP	RESRC	MFGSH	RT.RAIL	YRSCH	DISTW	FDI.X	FDI.M	FTA	TARIFF	SUM.EFS	BNS.CST	BNS.DUR	BUR.CUS	LPI.ALL	QI_ALL	QI_PORT	QI_RAIL	QI_ROAD
GDP	1																		
RESRC	-0.071	1																	
MFGSH	0.089	-0.204	1																
RT.RAIL	0.715	0.008	0.078	1															
YRSCH	0.296	-0.192	-0.201	0.103	1														
DISTW	0.316	0.252	0.062	0.303	-0.311	1													
FDI.X	-0.158	-0.065	-0.148	-0.182	0.081	-0.046	1												
FDI.M	-0.054	-0.08	-0.174	-0.176	0.12	-0.074	0.812	1											
FTA	0.214	-0.293	0.017	-0.17	0.085	-0.21	0.008	0.051	1										
TARIFF	-0.093	0.151	0.24	0.014	-0.575	0.28	-0.099	-0.112	-0.091	1									
SUM.EFS	0.225	-0.214	-0.248	-0.148	0.566	0.067	0.107	0.163	0.098	-0.388	1								
BNS.CST	-0.231	0.076	0.22	-0.109	-0.448	0.14	-0.009	-0.033	-0.169	0.358	-0.262	1							
BNS.DUR	-0.383	0.251	0.134	-0.037	-0.485	0.089	-0.069	-0.12	-0.357	0.276	-0.45	0.383	1						
BUR.CUS	-0.002	-0.196	-0.234	-0.234	0.512	-0.2	0.161	0.153	0.171	-0.468	0.789	-0.407	-0.421	1					
LPI.ALL	0.532	-0.333	-0.098	0.156	0.598	-0.058	0.019	0.099	0.289	-0.399	0.67	-0.377	-0.482	0.676	1				
QI_PORT	0.156	-0.203	-0.246	-0.042	0.472	-0.119	0.11	0.118	0.191	-0.345	0.666	-0.319	-0.477	0.816	0.756	1			
QI_RAIL	0.385	-0.229	-0.097	0.235	0.514	-0.243	0.203	0.345	0.094	-0.331	0.516	-0.366	-0.451	0.661	0.746	0.724	1		
QI_ROAD	-0.064	0.092	-0.022	0.017	-0.022	-0.007	-0.008	-0.007	-0.04	-0.042	0.002	-0.001	0.124	-0.001	-0.041	-0.012	-0.04	1	
QI_AIR	0.229	-0.171	-0.287	0.042	0.383	0.016	0.093	0.112	0.12	-0.296	0.662	-0.316	-0.377	0.748	0.741	0.842	0.676	-0.031	1

Table A10: Institution quality index

	SUM.EFS	LAW.PTY	GOV.FIS	GOV.XPD	REG.BNS	REG.LBR	REG.MNY	MKT.TRD	MKT.INV	MKT.FIN	LAW.IGT	LAW.JDC	GOV.TAX	SUM.EFW	A1GOV	A2PTY	A3MNY	A4TRD	A5REG
SUM.EFS	1																		
LAW.PTY	0.82	1																	
GOV.FIS	0.517	0.171	1																
GOV.XPD	-0.137	-0.462	0.136	1															
REG.BNS	0.786	0.722	0.145	-0.335	1														
REG.LBR	0.554	0.327	0.22	0.041	0.379	1													
REG.MNY	0.574	0.452	0.165	-0.211	0.403	0.259	1												
MKT.TRD	0.594	0.478	0.289	-0.35	0.459	0.198	0.347	1											
MKT.INV	0.739	0.69	0.264	-0.393	0.607	0.184	0.334	0.493	1										
MKT.FIN	0.78	0.683	0.292	-0.36	0.615	0.34	0.385	0.486	0.724	1									
LAW.IGT	0.79	0.86	0.189	-0.504	0.71	0.342	0.511	0.506	0.61	0.624	1								
LAW.JDC	0.734	0.858	0.105	-0.412	0.702	0.275	0.481	0.493	0.596	0.631	0.882	1							
GOV.TAX	0.015	-0.371	0.128	0.678	-0.174	0.124	-0.11	-0.079	-0.248	-0.196	-0.397	-0.423	1						
SUM.EFW	0.87	0.763	0.335	-0.297	0.659	0.45	0.646	0.63	0.717	0.73	0.757	0.711	-0.139	1					
A1GOV	0.124	-0.145	0.205	0.669	-0.141	0.164	-0.048	-0.092	-0.077	-0.034	-0.268	-0.311	0.6	0.145	1				
A2PTY	0.772	0.867	0.161	-0.537	0.712	0.327	0.497	0.54	0.669	0.676	0.91	0.874	-0.449	0.808	-0.247	1			
A3MNY	0.616	0.541	0.291	-0.351	0.448	0.213	0.727	0.559	0.539	0.551	0.571	0.526	-0.19	0.825	-0.046	0.577	1		
A4TRD	0.712	0.683	0.228	-0.431	0.584	0.282	0.507	0.582	0.748	0.651	0.654	0.583	-0.258	0.831	-0.065	0.687	0.653	1	
A5REG	0.786	0.615	0.302	-0.22	0.636	0.615	0.505	0.558	0.565	0.658	0.653	0.629	-0.024	0.828	0.047	0.668	0.585	0.588	1

Table A11: Logistics performance index

	LPI.ALL	LPI.CUS	LPI.INF	LPI.ITR	LPI.LOG	LPI.TME	LPI.TRC
LPI.ALL	1						
LPI.CUS	0.962	1					
LPI.INF	0.973	0.943	1				
LPI.ITR	0.919	0.856	0.855	1			
LPI.LOG	0.978	0.933	0.957	0.875	1		
LPI.TME	0.933	0.863	0.877	0.84	0.891	1	
LPI.TRC	0.966	0.904	0.933	0.861	0.944	0.891	1

Table A12: Services trade restrictiveness index

	LSCAR	LSSTG	LSFGT	LSCUS	DS	TRAIR	TRMAR	TRRAI	TRROF
LSCAR	1								
LSSTG	0.969	1							
LSFGT	0.742	0.711	1						
LSCUS	0.445	0.409	0.567	1					
DS	0.522	0.507	0.749	0.297	1				
TRAIR	0.451	0.472	0.472	0.155	0.488	1			
TRMAR	0.699	0.678	0.823	0.355	0.754	0.511	1		
TRRAI	0.562	0.554	0.525	0.271	0.422	0.428	0.549	1	
TRROF	0.567	0.557	0.77	0.824	0.656	0.372	0.635	0.353	1