Analysing South Africa's export diversification and sustainability: A country comparison

DM Vorster

orcid.org/0000-0003-3772-6588

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Supervisor: Dr C Bezuidenhout

Assistant Supervisor: Dr EF Idsardi

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Student number: 28576926

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ABSTRACT

There is a well-established link between exports and economic growth, which is why many countries have adopted export-oriented growth strategies. South Africa regards exports as one of the keys to unlocking the economy's potential and ensuring stronger growth. However, various studies conducted over the years provide evidence that South Africa's export growth has been lagging behind that of several of its peer countries at similar levels of economic development. While these studies involved doing a decomposition of South Africa's export growth, there has been a dearth of recent analyses and country comparisons. Clearly, a more contemporary view of South Africa's export growth trajectory, opportunities and challenges is necessary.

The purpose of this study was to conduct a decomposition of South Africa's export performance and sustainability and to compare the findings with those for a selected group of peer countries, namely Colombia, Ecuador, Egypt and Peru. This was intended to reveal where South Africa's export growth is concentrated within the intensive margin of trade and why it is not keeping pace with that of its peers.

The literature shows that export growth – especially growth along the intensive margin – is very important for developing countries. Growing exports along the intensive margin means exporting more existing products to traditional markets, while growing exports along the extensive margin means exporting new products or establishing new trading relationships. Growing exports through the intensive margin is better suited to developing countries which often lack the expertise and resources to develop new products and/or make inroads into new export markets. Nevertheless, an over-emphasis on export growth through the intensive margin is usually a sign that a country is finding it difficult to diversity its exports, which could adversely affect export volumes and economic growth prospects.

In this study, South Africa's export growth was decomposed along the intensive margin by first grouping South Africa's and the selected peer countries' export relationships into three dimensions within the intensive margin, namely *increases*, *decreases* and *extinctions*. The countries' export products were then grouped into six product categories according to their technology and skill intensity to determine the countries' export growth in terms of these categories. It was then established if the aggregate

export value in each of the product categories had increased, decreased or become extinct over the period 2007–2019.

Thereafter, the sustainability of these exports was determined by analysing the factor endowments (human and physical capital capabilities) of South Africa and the selected peer countries, using the physical capital intensity index and the revealed human capital intensity index. This was to determine whether each country's factor endowments were sufficient to produce the export products on an ongoing basis, which is a hallmark of export growth through the intensive margin. Using data from the World Bank, South Africa's and the selected peer countries' current human and physical capital endowment points were determined and then compared with the human and physical capital intensity required to sustainably produce the export products in question. Finally, correlation analysis was performed to determine if there was a significant relationship between the dynamics within the countries' intensive margin and the 'distance' between the countries' human and physical capital and the products' factor intensities and endowments.

Among the key results of the study are that while South Africa has a more diversified export profile than that of the selected peer countries, the average aggregate value of its export relationships is lower than that of its peers. Also worrying is the fact that South Africa's largest decrease has been in the medium-skill and technology-intensive manufactures product category, suggesting that the country has been unable to drive more value-added production and exports. Another important finding is that South Africa's human (in particular) and physical capital endowments are insufficient to support its current export basket – contrary to the findings for the selected peer countries.

Two key recommendations flowing from the study are that South Africa should direct its productive resources at expanding exports of products it already specialises in, such as vehicles and iron and steel, and invest much more strategically in the development of effective human and physical capital, using an enhanced education system as the main vehicle for encouraging a transition away from primary and resource-based export dependency.

Keywords: Export growth, Intensive Margin, South Africa, revealed factor intensity, Developing countries

OPSOMMING

Daar is 'n gevestigde verband tussen uitvoer groei en ekonomiese groei, en daarom het baie lande begin om uitvoer gerigte groei strategieë aan te neem. Suid-Afrika beskou uitvoere as een van die sleutels om sterker ekonomiese groei te verseker. Verskeie studies wat oor die jare gedoen is, lewer egter bewyse dat Suid-Afrika se uitvoer groei agter dié van verskeie van sy eweknie lande wat op soortgelyke vlakke van ekonomiese ontwikkeling was. Terwyl hierdie studies gefokus het op 'n ontbinding van Suid-Afrika se uitvoer groei, was daar 'n gebrek aan onlangse ontledings en lande vergelykings. Dit is duidelik dat ’n meer kontemporêre ontleding van Suid-Afrika se uitvoer groei, geleenthede en uitdagings nodig is.

Die doel van hierdie studie was om 'n ontbinding van Suid-Afrika se uitvoer prestasie en volhoubaarheid te doen en om die bevindinge te vergelyk met dié van 'n geselekteerde groep eweknie lande, naamlik Colombia, Ecuador, Egipte en Peru. Dit was bedoel om te wys waar Suid-Afrika se uitvoer groei binne die intensiewe handels marge gekonsentreer is en hoekom dit nie vergelyk met dié van sy eweknieë nie.

Die literatuur toon dat uitvoer groei – veral groei langs die intensiewe marge – baie belangrik is vir ontwikkelende lande. Groeiende uitvoere langs die intensiewe marge beteken die uitvoer van meer bestaande produkte na huidige markte, terwyl groeiende uitvoere langs die uitgebreide marge die uitvoer van nuwe produkte of die vestiging van nuwe handelsverhoudinge beteken. Groeiende uitvoere deur die intensiewe marge is beter geskik vir ontwikkelende lande wat dikwels nie die kundigheid en hulpbronne het om nuwe produkte te ontwikkel en/of ingang te maak in nuwe uitvoermarkte nie. Nietemin is 'n oorbeklemtoning van uitvoer groei deur die intensiewe marge gewoonlik 'n teken dat 'n land dit moeilik vind om sy uitvoere te diversifiseer, wat uitvoer volumes en ekonomiese groei vooruitsigte nadelig kan beïnvloed.

In hierdie studie is Suid-Afrika se uitvoer groei langs die intensiewe marge ontbind deur eers Suid-Afrika en die geselekteerde eweknie lande se uitvoer verhoudings in drie dimensies binne die intensiewe marge te groepeer, naamlik stygings, afnames en uitsterwings. Die lande se uitvoerprodukte is toe in ses produk kategorieë gegroepeer volgens hul tegnologie en vaardigheids intensiteit om die lande se uitvoer groei in

terme van hierdie kategorieë te bepaal. Daar is toe vasgestel of die totale uitvoerwaarde in elk van die produk kategorieë oor die tydperk 2007–2019 toegeneem, afgeneem of uitgesterf het.

Daarna is die volhoubaarheid van hierdie uitvoere bepaal deur die produksie faktore (menslike en fisiese kapitaal) van Suid-Afrika en die geselekteerde eweknie lande te ontleed, deur die fisiese kapitaal intensiteitsindeks en die mensekapitaal intensiteitsindeks te gebruik. Dit was om te bepaal of elke land se faktore voldoende was om die uitvoerprodukte op 'n deurlopende basis te produseer, wat 'n kenmerk is van uitvoer groei deur die intensiewe marge. Deur gebruik te maak van data van die Wêreldbank is Suid-Afrika en die geselekteerde eweknie lande se huidige menslike en fisieke kapitaal toekeerpunte bepaal en dan vergelyk met die menslike en fisiese kapitaalintensiteit wat benodig word om die betrokke uitvoerprodukte volhoubaar te produseer. Laastens is korrelasie-analise uitgevoer om te bepaal of daar 'n beduidende verband tussen die dinamika binne die lande se intensiewe marge en die 'afstand' tussen die lande se menslike en fisiese kapitaal en die produkte se faktorintensiteite was.

Van die sleutelresultate van die studie is dat hoewel Suid-Afrika 'n meer gediversifiseerde uitvoerprofiel as dié van die geselekteerde eweknie lande het, is die gemiddelde totale waarde van sy uitvoer verhoudings laer as dié van sy eweknieë. Ook kommerwekkend is die feit dat Suid-Afrika se grootste afname in die produkkategorie vir medium-skill and technology-intensive manufactures was, wat daarop dui dat die land nie meer waardetoegevoegde produksie en uitvoere kon aandryf nie. Nog ’n belangrike bevinding is dat Suid-Afrika se menslike (veral) en fisieke kapitaal faktore onvoldoende is om sy huidige uitvoer mandjie te ondersteun – in teenstelling met die bevindinge vir die geselekteerde eweknie lande.

Twee sleutel aanbevelings wat uit die studie voortvloei, is dat Suid-Afrika sy produktiewe hulpbronne moet rig op die uitbreiding van die uitvoer van produkte waarin hy reeds spesialiseer, soos voertuie, yster en staal, en baie meer strategies moet toewy aan die ontwikkeling van doeltreffende menslike en fisiese kapitaal, deur gebruik te maak van 'n verbeterde onderwysstelsel as die hoof drywer om weg te beweeg van die uitvoer van primêre produkte.

Sleutelwoorde: Uitvoergroei, intensiewe marge, Suid-Afrika, Revealed factor intensity, ontwikkelende lande

ABBREVIATIONS

AfCFTA	African Continental Free Trade Area
AU	African Union
BRICS	Brazil, Russia, India, China and South Africa
COMESA	Common Market for Eastern and Southern Africa
DTI	Department of Trade and Industry
EAC	East African Community
ECI	Economic Complexity Index
EPA	Economic Partnership Agreement
EU	European Union
EU-SA FTA	European Union-South African Free Trade Agreement
FTA	Free Trade Area/Free Trade Agreement
GDP	Gross Domestic Product
HS	Harmonised System
NDP	National Development Plan
NES	National Export Strategy
NUTS	Nomenclature of Territorial Units for Statistics
NWU	North-West University
OECD	Organisation for Economic Cooperation and Development
RCA	Revealed Comparative Advantage
R&D	Research and Development
RHCI	Revealed Human Capital Index
RPCI	Revealed Physical Capital Index
SA	South Africa
SACU	Southern African Customs Union
SADC	Southern African Development Community
SITC	Standard International Trade Classification
SSA	Sub-Saharan Africa
TFTA	Tripartite Free Trade Area
UK	United Kingdom
UN	United Nations
UN COMTRADE	United Nations Commodity Trade Statistics (Database)
UNCTAD	United Nations Conference on Trade and Development

US	United States of America
USD	United States Dollar

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CHAPTER 1: INTRODUCTION

1.1 Introduction and background to the study

Numerous studies confirm that export diversification is very important for the development and growth of a country's economy (Evenett & Venables, 2002; Hummels & Klenow, 2005; Felbermayr & Kohler 2006; Helpman, Melitz & Rubinstein, 2008; Amiti & Freund, 2010; Matthee, Idsardi & Krugell, 2016; Matthee & Santana-Gallego, 2017). This is particularly true for countries in Africa where diversified exports have been shown to mitigate the effects of worldwide economic shocks (Lugeiyamu, 2016:22). Other benefits of export diversification for African countries include knowledge spill-overs as well as an increase in returns to scale (Kumar, 2018). Owing to the positive relationship between export diversification and economic growth, the African Union (AU) made a policy shift towards export diversification at their Summit in 2012 (Lugeiyamu, 2016:22). It is important for countries in Africa to adopt this kind of expansionary policy as they are among the poorest in the world. In his paper, 'Is export diversification a key force to Africa's economic growth?', Lugeiyamu (2016:22) shows that African countries with a diversified export profile grow faster than other countries on the continent. This has led to the conclusion that African countries should adopt a policy of export diversification with a view to growing their economies.

Export diversification is closely linked to structural transformation. Structural transformation refers to a progressive process of reallocating productive resources, such as capital and labour, across economic activities (Fernandes *et al.,* 2018). Export growth can occur through the intensive or the extensive margin (Reis & Farole, 2012). The extensive margin refers to exporting a new product to existing trading partners or exporting new and existing products to new trading partners (Reis & Farole, 2012). The intensive margin refers to increasing the volume of goods exported to existing trading partners because of the better utilisation of resources (Reis & Farole, 2012). In their paper, 'Patterns of export diversification in developing countries: Intensive and extensive margins', Amurgo-Pacheco and Pierola (2008) found that exports in the intensive margin account for the largest growth in the trade of developing countries. This is because new exporters struggle to survive against more established exporters.

South Africa is a good example of a developing country that has placed strong emphasis on its export sector to stimulate economic growth, having democratised and liberalised its trade after 1994. The National Development Plan (NDP) was designed as a blueprint for South Africa to secure its economic future and is built on six pillars. The third pillar is concerned with stimulating economic growth, promoting exports and making the economy more labour absorbing. In the Department of Economic Development's (2011) policy document, 'The New Growth Path: Framework', one of the proposed strategies is to expand the market for South African goods and services by putting a stronger focus on exports to the surrounding region and other rapidly growing economies. The objectives of the National Export Strategy (NES), in turn, include growing South Africa's exports both in terms of volume and value, diversifying export products and markets, and diversifying the export base (DTI, 2021:5). If South Africa's exports grow by 6% per annum, its gross domestic product (GDP) will grow by 5.4%, which could create 11 million new jobs by 2030 (Ferreira & Steenkamp, 2020). Reaching these objectives is thus very important and could lead to enhanced economic growth and development for South Africa (Karriem & Hoskins, 2016).

Rossouw and Naudé (2008) investigated export diversification and specialisation in South Africa over the period 1962–2000. Their findings suggest that although South Africa's export profile is diverse, it is much less diverse than that of other emerging markets, such as China, Brazil and India. They also confirm that, as the literature suggests, the diversification of South Africa's exports would lead to heightened economic growth. Choga and Tsegaye (2015) arrive at a similar finding when examining export diversification and structural changes in South Africa over the period 1980–2012. They also found that South Africa still relies on primary and low value-added exports. However, Siswana and Phiri (2020), in their study, 'Is export diversification or export specialization responsible for economic growth in BRICS countries?', found that export specialisation has a positive effect on trade in the BRICS (Brazil, Russia, India, China and South Africa) countries while export diversification has a negative effect on export growth. Export specialisation refers to the degree to which a country's exports are concentrated in a small group of goods and countries (Siswana & Phiri, 2020). The authors advise policymakers in the BRICS countries to reconfigure their basket of export products since they may have passed the second stage of development in which diversification does not improve growth.

Previous studies on South Africa's export performance provide evidence that South Africa is lagging behind its peers, such as Malaysia, Brazil and India (Edwards & Lawrence, 2008; Rossouw & Naudé, 2008, Choga & Tsegave, 2015; Matthee *et al.,* 2016; Matthee & Santana-Gallego, 2017). Edwards and Lawrence (2008) conducted a detailed analysis of South Africa's trade over the period 1970–2005. In their study, they compared non-gold commodities with non-commodities. Non-gold commodities comprise primary commodities and manufactured goods that have a large number of primary commodity inputs when exported, while non-commodities comprise other manufactured goods and services (with fewer commodity inputs) (Edwards & Lawrence, 2008). Non-gold commodity exports include products like wood, basic chemicals and steel, while non-commodity exports include goods such as computers and software.

Edwards and Lawrence (2008) found that in the period 2000–2005, export growth was slow and that South Africa lost market share in the periods 1970–1983 and 1985–2000. This was due to South Africa's high dependence on commodity exports. Matthee *et al.* (2016) found that South Africa's exports of non-fuel primary commodities (such as corn and cotton), as well as medium-skill and technology-intensive manufactured products (such as hairdryers), increased over the period 1994–2012, while their exports of resource-intensive manufactures decreased. They also showed that growth in exports of non-fuel primary commodities was driven by Chinese demand, and that product categories that saw declines and extinctions included precious stones, iron and steel products, and paper-, wool- and leather-related products. This led to the conclusion that in the years to come, slower and less resource-intensive growth in the Chinese economy will be to the detriment of South African exports.

Matthee and Santana-Gallego (2017) made a further contribution to the literature on South Africa's export performance by revealing the most influential determinants of its intensive and extensive margins, using the gravity model of trade. Their results show that South Africa exports a wide range of goods to a limited number of countries. Factors that have a positive impact on both the extensive and intensive margins include importing countries' GDP, population, cultural ties and existing free trade agreements (FTAs) with the Southern African Development Community (SADC) (Matthee & Santana-Gallego, 2017). Factors that have a negative influence on the

extensive and intensive margins include distance and trade costs. They conclude that weak infrastructure, difficulties in finding market-related information and shortcomings in South Africa's regulatory environment could all be reasons for South Africa showing stronger growth in the intensive margin (Matthee & Santana-Gallego, 2017).

An analysis performed by Purifield *et al.* (2014) on the factor content of South Africa's export basket showed that South Africa's endowment capabilities are not sufficient to support the products that the country exports. Factor content and endowment capabilities refer to the human (labour) and physical capital that a country (in this case South Africa) has. In other words, South Africa has insufficient capital and labour to drive export growth in the products that are currently exported. This finding is supported by a paper written by Alleyne and Subramanian (2001) who assert that South Africa is not utilising its labour capabilities. In their paper, they state that South Africa has an abundance of labour, but its trade patterns show that the country is capital abundant. The fact that South Africa is not utilising its labour capabilities is confirmed by its high unemployment rate. The World Bank reiterates that labour markets in South Africa are weak, especially as there is a high percentage of unskilled workers (World Bank, 2018).

Hausmann and Klinger (2007) assert that every product needs factor capabilities specific to that product to develop. For instance, if a country develops a new product that is similar to products that it already exports, it will find it easier to export that product because the capabilities to do so already exist. Banjeree (2001) indicates that export patterns are determined by human and physical capital levels. In this regard, Matthee *et al.* (2016) state that South Africa's factor endowment levels in terms of human and physical capital are low, which implies that it is more difficult for South Africa to produce goods that require high levels of human and physical capital. Mhonyera*,* Steenkamp and Matthee (2018) confirm this in their study, 'Evaluating South Africa's utilisation of sustained export potential in Sub-Saharan Africa', stating that only 42 products that they identified as sustainable exports (products consistently exported by the country) fall within South Africa's factor endowment point, while 484 products fall outside the factor endowment point. (Factor endowments refer to the amount of land, labour, capital and/or entrepreneurship to which a country has access.)

Since the studies discussed above focused on the period up to 2014, it is important to consider more recent data on South Africa's export performance and sustainability. A recent World Bank report shows that South African exporters are expected to benefit from the end of a super commodity cycle and serious drought (World Bank, 2018). A commodity super cycle is an extended period in which commodity prices exceed or drop below their long-term trend (World Bank, 2018). In addition, heightened regional integration has the potential to drive stronger export performance in South Africa. In this regard, negotiations for the African Continental Free Trade Area (AfCFTA) commenced in 2015 under the auspices of the AU and the FTA was launched in 2018 (Onyema, 2019). According to Onwuka and Udegbunam (2018), this FTA, in creating a single market for Africa, was forecast to unlock 52% of intra-Africa trade by 2022.

The agreement underpinning the AfCFTA is the largest trade agreement in the world in terms of countries participating and is set to have a significant effect on trade within Africa, which has been relatively limited for many years. There are, however, numerous stumbling blocks to the implementation of this agreement, including weak infrastructure, challenges in harmonising regulations and widespread protectionism (Onyema, 2019). It is therefore important to determine if these evolving trading conditions have improved or hindered export performance in South Africa in recent years.

1.2 Motivation and problem statement

Although previous studies have done decompositions of South Africa's export performance, recent analyses and comparisons have not been conducted (Matthee *et al., 2016)*. As export growth is key to South Africa's economic growth and the country's trading conditions have changed, it is important to do a decomposition of recent export performance and compare this to the performance of a selected group of peer countries (Steenkamp, 2018). This will reveal where South Africa's export growth is currently concentrated within the intensive margin. Furthermore, a comparison will enable South Africa to learn from the selected peer countries, which in turn should encourage stronger export and economic growth.

Research question: How have South Africa's exports diversified over the past decade and is this sustainable?

1.3 Theoretical perspective and framework

There are several reasons why some countries perform better than others when it comes to export and economic growth. The mercantilists believed that a country should increase its gold and silver holdings by exporting more than they imported. This would create a trade surplus which would lead to the country being wealthier than others (Sen, 2010). According to Adam Smith's theory (1776) of absolute advantage, countries should engage in free trade, which would promote competition (Sen, 2010). This would help countries grow. The free trade argument also underpinned David Ricardo's (1817) theory of comparative advantage and the Heckscher-Ohlin theory (1919) (Coats & Ricardo, 1973). However, economists can broadly be divided into two groups: one group supports the idea of specialisation, which is intended to drive a country's growth and development, while the other group supports the idea of diversification. Specialisation, on the one hand, involves countries focusing all their resources on products that they have the knowledge and capabilities to produce (Imbs & Wacziarg, 2001). Diversification, on the other hand, involves countries changing their export structure (Imbs & Wacziarg, 2001).

The theory of comparative advantage is one of the first theories to support specialisation. It suggests that countries with a comparative advantage in one product should export that product, while importing the products in which they have a disadvantage. Comparative advantage refers to a country's ability to produce a good or service at a lower opportunity cost than another country (Scheidel, 2013). This makes trade possible since a country with a comparative advantage in producing one product can focus its resources on that product and export it, while importing the other products that it needs from another country that has a comparative advantage in producing those needed products (Caliendo, 2010). This is due to technological differences between countries. The Heckscher-Ohlin theory, in turn, argues that countries with high capital capabilities and lower labour capabilities will tend to export goods that need more capital and import goods that need more labour, and vice versa (Caliendo, 2010).

In terms of this theory, the main reason for trade between countries is factor endowments. New trade theory supports the idea of diversification and suggests that trade is possible when countries have the same factor endowments, technology and

tastes (Krugman, 1979). Countries trade more because information and technology move across borders faster than they did previously. This is where the ‘love-of-variety’ concept plays a role since consumers tend to want more differentiated products. Some countries export a wider variety of products and a higher percentage of their total produced goods, which leads to more growth (Erdogan, 2014). Recently, a heavy focus has been placed on promoting exports through diversification. Some economists, like Hummels and Klenow (2005), claim that more growth takes place in the extensive margin, while others, like Felbermayr and Kohler (2006), assert that more growth takes place in the intensive margin. However, Amurgo-Pacheco and Pierola (2008) are of the view that most growth in developing countries takes place in the intensive margin.

1.4 Objectives

1.4.1 Primary objective

The primary objective of this study is to do a decomposition of South Africa’s export performance and sustainability and compare the findings with those of selected peer countries.

The primary objective is broken down into secondary objectives, classified under theoretical and empirical objectives respectively.

1.4.2 Theoretical objectives

The theoretical objectives of this study are to:

1. Review the traditional and modern trade theories relating to export diversification and factor endowments.
2. Define and discuss the intensive and extensive margins (of export performance) by reviewing relevant literature, with a special focus on South Africa.
3. Review the relevant literature on technology and factor intensities of production.
4. Provide an overview of South Africa’s export trends.

1.4.3 Empirical objectives

To achieve the primary objective, the empirical objectives of this study are to:

5. Conduct a decomposition of South Africa's, and the selected peer countries', export growth in the intensive margin over the period 2007–2019.
6. Determine the export sustainability of South Africa and the selected peer countries from a factor intensity perspective.
7. Compare the findings with those of the selected peer countries, namely Colombia, Ecuador, Egypt and Peru.

1.5 Research design and methodology

The research design relating to the specific objectives has two dimensions, namely a literature review (addressing objectives 1–4) and an empirical study (addressing objectives 5–7).

1.5.1 Literature review

The literature review will provide a discussion on traditional and modern trade theories relating to this study (addressing objective 1). It will include an overview of the literature on the intensive and extensive margins of export diversification, while focusing on South Africa (addressing objective 2). The literature review will also include an evaluation of technology and revealed factor intensities by investigating previous studies (addressing objective 3). Furthermore, it will discuss South Africa's current export statistics and trends (addressing objective 4).

1.5.2 Empirical study design and context

This study has a quantitative empirical design since the study uses the total export data of numerous countries. The empirical section of this study encompasses the methods of analysis and the data and data sources.

1.5.2.1 Methods of analysis

The methods of analysis are two-fold. Firstly, this study will do a decomposition of South Africa's and the selected peer countries' exports within their respective intensive margins (see objective 5). This will reveal if their export relationships (South Africa and

the countries to which it exports) have increased, decreased or become extinct over the period 2007–2019. This will be done by analysing how South Africa and the selected peer countries' current exports have changed between 2007–2009 and 2017–2019. For instance, if a product has an export value of USD 100 in 2007–2009 and USD 200 in 2017–2019, it is seen as an increase of USD 100. If the opposite occurs, it is seen as a decrease. If the product is exported in 2007–2009 and then has an export value of USD 0 in 2017–2019, it is seen as extinct.

The study will furthermore do a decomposition of South Africa's and the selected peer countries' exports by grouping products into six categories according to their technology and skill intensity. This process was first motivated by Lall (2000) who grouped products into four categories according to their skill and technology complexity, and further motivated by Basu and Das (2011) who proved that per capita GDP could be increased through higher-quality exports. Basu (forthcoming) classified these categories at the Harmonised System (HS) 6-digit level. The categories are as follows:

1. Primary commodities (e.g. maize);
2. Resource-intensive manufactures (e.g. leather handbags);
3. Low-skill and technology-intensive manufactures (e.g. motorboats);
4. Medium-skill and technology-intensive manufactures (e.g. hairdryers);
5. High-skill and technology-intensive manufactures (e.g. aircraft); and
6. Unclassified products (e.g. petroleum).

Secondly, the study will determine the revealed factor intensities (human capital and capital stock) of export products to determine the sustainability of South Africa's exports (thus addressing objective 6). Human capital is very important for a country since it is seen as a way of increasing productivity and thus profitability. Capital stock, in turn, is important since it helps businesses to expand. To this end, products will be separated (Lall, 2000) into the six product categories described above, using the Shirotori, Tumurchudur and Cadot (2010) measure (updated by McLaren, Saygili & Shirotori, 2018) to analyse South Africa's factor content and to compare the results

with those of the selected peer countries. The distance between the products within the intensive margin of South Africa and their endowment point will then be analysed.

The revealed factor intensities of products that are imported and exported reflect the human capital and physical capital content of a country's exports (Reis & Farole, 2012). The indices are compiled by weighting the factor endowments of all countries that export a specific good. A modified version of revealed comparative advantage (RCA) is used to get these weights. Average years of schooling is the measurement for human capital whereas capital stock is the measurement for physical capital (Reis & Farole, 2012). The Spearman correlation test will be used to test the relationship between the dynamics between South Africa's and the selected peer countries' intensive margins and the distance between each country's endowment point, and the revealed human capital intensity and revealed physical capital intensity of each country's exports.

To compare South Africa's results (see objective 7), four peer countries were selected on the basis of their economic classification, GDP per capita and export profile. Countries with the same economic classification as South Africa are better for comparison purposes than countries that have other classifications. The reason for this is that, when it comes to growing their exports, what works for bigger economies will probably not work for South Africa because bigger economies have more resources than South Africa. Economies with the same classification as South Africa will yield more valuable insights into how they have used their resources to increase their exports. This will be more valuable to South African policymakers and researchers.

Countries with the same export structure as South Africa were chosen because if they export the same products and grow while South Africa does not grow, it is necessary to investigate what they do differently. This will again help South African policymakers make better decisions about how to grow the country's exports. Based on this and data availability, Colombia, Ecuador, Egypt and Peru were chosen as South Africa's peer countries. According to the World Bank (2021a), all these countries are middle-income countries, with Ecuador, Peru and South Africa classified as upper-middle-income countries and Colombia and Egypt classified as lower-middle-income countries. In addition, all these peer countries export similar baskets of goods to those

exported by South Africa and all export at least three of South Africa's top 10 export products.

1.5.2.2 Secondary data and data sources

The methods of analysis discussed above will be applied to secondary data gathered from the United Nations Commodity Trade Statistics (UN COMTRADE) database for the period 2007–2019. The period chosen excludes 2020 since the effects of COVID-19 on trade could give misleading results. The UN COMTRADE database has detailed statistics on nearly 200 countries. Containing data from 1962 to the current year, it is perceived as the most comprehensive trade database globally, containing more than 1 billion records. The data are publicly available and do not require any human intervention. The UN COMTRADE database will be used to calculate the changes in export relationships between South Africa and its peers along the intensive margin. The revealed factor intensity indices, developed by Shirotori *et al.* (2010) and updated by McLaren *et al.* (2018), will be used to analyse South Africa's and the selected peer countries' factor content within the intensive margin. The revealed factor intensity indices are available from the United Nations Conference on Trade and Development (UNCTAD) database, while the data on years of schooling and capital stock will be obtained from the World Bank and UNCTAD databases.

1.6 Chapter classification

Chapter 1: Introduction and background to the study: This chapter comprises the introduction and background to the study along with the problem statement. It also includes the research objectives and study design.

Chapter 2: Literature review: The literature review has two dimensions: a theoretical framework and a contextual framework. The first part (the theoretical framework) consists of an overview of traditional and modern trade theories relating to this study, a discussion of the intensive and extensive margins of export diversification (with a specific South African focus), and an evaluation of technology and factor intensities. The second part (the contextual framework) consists of South Africa's current export statistics and trends.

Chapter 3: Research design and methodology: This chapter explains the methodology used to conduct a decomposition of South Africa's exports in the intensive margin and calculates South Africa's factor endowments.

Chapter 4: Results and findings: This chapter presents the results and findings of the study and compares them to those of previous studies.

Chapter 5: Conclusions and recommendations: This chapter provides a summary of the study and the main findings and conclusions, and also recommends possible future studies.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The introduction and background to the study were provided in the previous chapter. This laid the foundation for the formulation of the problem statement and research objectives. Chapter 2 provides an overview of the theoretical and empirical literature relating to export diversification and sustainability.

The chapter is divided into five sections. It starts (section 2.2) with a discussion of traditional and modern trade theories relating to export diversification and sustainability. These theories include the theory of absolute advantage, the theory of comparative advantage, the Heckscher-Ohlin model, the specific factor model and the modern trade theories relating to economies of scale and technology. The chapter then explores the literature on the relationship between export growth and economic growth, with a specific focus on export growth through diversification (section 2.3). Section 2.4 summarises previous work done on technology and skill intensities of production and section 2.5 looks at previous studies done on factor intensities with a specific focus on South Africa. The last section (section 2.6) in this chapter provides an in-depth evaluation of South Africa's current export statistics and trends.

2.2 Trade theories

2.2.1 Traditional trade theories

Traditional trade theories can be divided into classical theories (namely, absolute advantage and comparative advantage) and neo-classical theories (namely, Heckscher-Ohlin and the specific factor model) (Van Berkum & Van Meijl, 1998). These theories focus on the differences between countries, which lead to trade. On the one hand, the classical theories focus on the differences in technology, which relate to export diversification in this study. On the other hand, the neo-classical theories focus on the differences in factor endowments, which relate to the export sustainability dimension of this study (Van Berkum & Van Meijl, 1998).

Adam Smith proposed the theory of absolute advantage in 1776 in response to the views of the mercantilists (Smith, 1776). According to Adam Smith, trade should only

occur when there are absolute cost differences between countries. He proposed that countries should export the goods in which they have an absolute cost advantage and import the goods in which they have an absolute disadvantage (Smith, 1776). Once they have done this, they can enter into free trade arrangements with other countries, which would prompt countries to trade more with each other (Kreager, 2017). Adam Smith also asserts that governments should not interfere in the process of trade (through the imposition of trade barriers) but also recognises that there are some areas in which only the government can act effectively (Smith, 1776).

The theory of absolute advantage would make sense if we lived in a world in which countries had an absolute advantage in producing different goods. However, not all countries have such an absolute cost advantage; yet they still establish trading relationships with other countries (Seretis & Tsaliki, 2016). The theory of absolute advantage also assumes (simplistically) that trade is between two countries, only two commodities are traded, there is free trade between the countries and the only factor of production that has an effect on trade is labour. These assumptions are not a true reflection of the trading environment, especially since countries' trade relationships are continuously evolving (Gupta, 2015). Thus, the theory of absolute advantage cannot explain why countries with an absolute advantage in producing all goods still trade with countries that are not efficient in producing any goods (Seretis & Tsaliki, 2016).

David Ricardo explains the shortcomings of the theory of absolute advantage. He argues that even when a country has an absolute advantage in producing all categories of goods, trade can still take place and be beneficial due to the comparative advantage phenomenon (Ricardo, 1817). David Ricardo's theory is known as the theory of comparative advantage. A comparative advantage exists when a country can produce a product at a lower opportunity cost than another country. This is possibly due to the technology differences between the countries (Yu, 2011). Opportunity cost refers to the loss of one alternative (in this case a product) when another is chosen (Dong & Wong, 2016). According to David Ricardo, the country with a comparative advantage in producing one product over another should export that product and import the other product (Ricardo, 1817). This will increase output for both countries. According to the theory of comparative advantage, labour is the only factor of

production and provides an explanation for trade differences between countries (Okubo, 2011). The theory of comparative advantage is associated with export diversification as both concepts focus on countries trading with other countries according to their comparative advantages.

The theories of absolute and comparative advantage do not help countries understand which products could give them an advantage in trade. They merely assume that free and open markets will help countries decide which products to produce. The Heckscher-Ohlin theory builds on the absolute and comparative advantage theories by adding more production factors. The primary work in this area was done by Swedish economist Eli Heckscher and his student, Bertil Ohlin (Morrow, 2010). The original model was later expanded by Paul Samuelson. As a result, this theory is also referred to as the Heckscher-Ohlin-Samuelson theory.

The Heckscher-Ohlin-Samuelson theory is different from the classical theories as it assumes identical production techniques for all countries, constant returns to scale, identical consumer preferences and perfect competition (Morrow, 2010). This means that differences in factor endowments are the only reason for trade between countries. The greater the differences in factor endowment capabilities between countries, the more opportunities there are for trade between the countries (Nyahoho, 2010). This relates to the sustainability of exports. A country exports the product that involves making the best use of the factors of production (labour, capital or land) that the country has in abundance. Thus, if a country has more labour, it should produce more labour-intensive products, such as those produced in the agricultural sector. If a country is capital abundant, it should produce more capital-intensive products, such as those produced in the automobile industry (Ito, Rotunno & Vézina, 2016).

The Heckscher-Ohlin model assumes that all factors of production can move freely between industries. This is where the specific factor model, first introduced by Jacob Viner in 1931 and later further developed by Ronald Jones, builds on the Heckscher-Ohlin model (Jones, 1971). The specific factor model suggests that one factor is specific to a particular industry, which makes the factor immobile while other factors are mobile. Factors are immobile for different reasons. For instance, some are expressly designed (such as capital) or expressly trained (such as labour) for specific

processes (Van Berkum & Van Meijl, 1998). This makes it difficult for the factor in question to move between different industries (Özkan, 2012).

In the next section the focus shifts from the traditional trade theories to the modern trade theories. The modern trade theories relate to the export diversification and sustainability themes of this study as they focus on new products that create a comparative advantage for countries and the cycles in which products move from one factor of production to another.

2.2.2 Modern trade theories

Interestingly, in contradiction to the Heckscher-Ohlin theory, some studies have proved that countries with the same factor endowments trade more with each other (Leontief, 1953; Soo, 2009). As a result, economists had to search for new theories, which are known today as the new trade theories. Working on the framework of the neo-classical economists, these theories removed the assumptions of perfect competition and constant returns to scale and replaced them with increasing returns to scale and imperfect competition (Grinols & Silva, 2006). The new trade theories suggest that trade between countries is possible when countries have the same factor endowments, technologies and tastes. The motivation for trade under these theories is economies of scale. Economies of scale are cost advantages that a company attains when production becomes more efficient (Grinols & Silva, 2006). This means that when the company increases its production, it reduces its costs.

The main difference between new trade theories and neo-classical theory is that the direction of specialisation in terms of economies of scale is often unknown. These new trade theories point to differences in technology, with better and new products being a reason for the differences seen in trade between countries. This is relevant to this study which analyses differences in the technology and skill intensity of products in countries to see if this explains the differences between South Africa's and its peers' export growth.

Economies of scale can be external or internal. When they are external, a country that has established a large industry can keep the advantage, even when another country can establish the same industry and produce the goods more cheaply (Armenter & Koren, 2014). In such a case, welfare between countries can be distributed unequally

on the basis of the specialisation pattern and terms of trade (Armenter & Koren, 2014). This is where trade policies can help industries gain an advantage when they would otherwise lose out from a trade perspective. Internal economies of scale, in contrast, are the main mechanism for trade when there is monopolistic competition. This is where industries have similar firms producing differentiated products (Armenter & Koren, 2014). The result is greater variety across industries in different countries. Paul Krugman produced his seminal work on the 'love-of variety' concept in 1979 (Krugman, 1979). Since people display a love of variety, countries export different types of products (a form of export diversification) and import different types of products from other countries (Broda & Weinstein, 2006). This stimulates intra-industry trade, while trade without large income-distributional effects is expected to follow between countries with similar factor endowments (Soo, 2009).

Technology-orientated theories point to technological change as the cause of differing trade patterns (Borkakoti, 1998). These theories put the emphasis on technological differences between countries that cause innovation, which leads to lower-cost production. This means that firms can produce better or new products (export diversification), which gives a firm a comparative advantage since technological innovation is not free of charge (Borkakoti, 1998). The differences between these theories and the Ricardian trade model are that trade is not caused by differences in technology but rather by new products that other countries are unable to supply.

The first contribution to the technology-orientated theories was made by Kravis (1956) who explains that the availability of different products from different nations leads to trade. This was developed further by Posner (1961) who shows that new products and processes (export diversification) in one country will give that country a technological advantage over other countries for a short period – until those products and processes are copied by the other countries. Over time, the country loses the initial comparative advantage, but as new products are developed, a new comparative advantage in the innovating country is created. These new products go through a cycle of technological change. This is in line with this study as the products that countries export are analysed according to Lall (2000) product categories, which are based on the technology and skill intensity of the products produced in the countries. Lall (2000) groups products

into different categories according to the skill and technology it takes to produce the products.

Hirsch (1967) was the first to explain how products go through a cycle of technological change. He argues that new products require a large amount of skilled labour when they are first introduced into the market. As the product becomes more popular and demand increases, more capital-intensive production processes are needed. As the product matures, the production process is standardised and less skill is required. Krugman (1979), in turn, was the first to provide the basis for explaining trade in terms of technology. Lall (2000) used this concept to explain increasing trade in developing countries, saying that countries that have a strong technological learning system in place are able to absorb technologies efficiently and react competitively in the face of changing technological conditions (Lall, 2000). This prompted Lall, Weiss and Zhang (2005) to classify products according to their technological intensity.

Traditional trade theories are not helpful in investigations of diversification patterns as they do not account for zero trade flows. This is why new trade theories are important as they take into account the fact that not all firms export. In the next section, the intensive and extensive margins of trade diversification are investigated, with reference to previous studies on the subject.

2.3 Export growth

International trade theories have provided economists with a foundation to explain different trade patterns. In this section, different studies relating to export growth are analysed. Firstly, export growth and why *what* one exports matters are discussed (see section 2.3.1). This is followed by a discussion of previous studies on the intensive and extensive margins of trade.

2.3.1 Export growth and why what one exports matters

Export growth is seen to have a positive relationship with economic growth (Matthee *et al.,* 2016). Lee and Huang (2002) confirm this in their study, 'The relationship between exports and economic growth in East Asian countries: A multivariate threshold autoregressive approach'. They found that for four out of the five Asian countries that they analysed, export growth led to economic growth. Rangasamy

(2009) arrived at the same finding when looking at the relationship between export growth and economic growth in South Africa. He found that policies geared towards export growth will enhance the prospects of economic growth in South Africa. His results also suggest that more attention should be given to non-primary exports in South Africa as they could play a bigger role in the export growth process. Wa Cipamba (2015) arrived at the same conclusion when investigating South Africa's economic growth and output relationship over the period 1970–2012. He showed that policies aimed at export growth will lead to more economic and employment growth. However, economists differ in their views on whether it is diversification or specialisation that leads to economic growth and development.

There are essentially two groups of economists: one group supports the idea of specialisation leading to growth and development in a country, while the other group supports the idea of diversification leading to growth and development. On the one hand, specialisation involves countries focusing all their resources on products that they have the knowledge and capabilities to produce (Imbs & Wacziarg, 2001). On the other hand, diversification involves countries changing their export structure (Imbs & Wacziarg, 2001).

David Ricardo is one of the first economists to promote specialisation as a way for countries to increase their gains from trade. The thinking here was that countries should produce and export products that they can produce at a lower opportunity cost relative to other countries (as discussed in section 2.2.1). However, a sizeable amount of literature exists that shows that diversification is closely linked to economic growth (Kuznets, 1971; Taylor, Grossman & Helpman, 1993). These economists based their views on countries diversifying their economic activities, thus reducing the effects of external shocks. Countries that focus on specialisation acquire expertise in a limited number of products, which means productivity increases. More recently, Imbs and Warcziag (2001) have shown that a country's specialisation adopts a U-shaped pattern. When countries have low levels of income, they tend to specialise in products. When their income increases, they diversify until they reach a certain point at which they start to specialise again.

However, most developing countries are commodity dependent (UNCTAD, 2016). UNCTAD defines commodity-dependent countries as countries in which 60% of their

total exports (in value terms) are made up of commodities (UNCTAD, 2016). In 2017, 91 of 135 developing countries were commodity dependent, according to this definition (UNCTAD, 2019). Although South Africa is not one of these countries, 50% of its exports are still made up of commodities (UNCTAD, 2019). These commodity-dependent countries are caught up in the so-called 'natural resource curse'. The natural resource curse hypothesis states that countries that have large amounts of natural resources tend to grow more slowly than countries that have limited natural resources (Satti *et al.,* 2014).

Satti *et al.* (2014) highlight this in their paper, 'Empirical evidence on the resource curse hypothesis in an oil abundant economy'. In their study, they tested the relationship between resource abundance and economic growth in Venezuela. They found that natural resource abundance impeded Venezuela's economic growth (Satti *et al.,* 2014). Kim and Lin (2018) arrived at the same conclusion when, in a sample of developing countries[1] over the period 1990–2012, they found that resource abundance had a negative impact on a country in the long run. However, in a recent study, Rahim *et al.* (2021) found that while natural resource abundance slows economic growth, human capital and natural resources have a joint, positive impact on economic growth. Thus, it is important to invest in human capital when a country is rich in natural resources (Rahim *et al.,* 2021).

Although studies provide evidence that countries should diversify away from natural resource products towards manufactured products, new evidence from Rahim *et al.* (2021) shows that the natural resource curse can be negated by investing more heavily in a country's human resources. South Africa (a country rich in natural resources) has, however, struggled with human resource development (Lynham & Cunningham, 2004; Kleynhans, 2006). Wilhelm (2017) found in his study, 'Capital intensity, employment and sustainability in the South African manufacturing sector', that South Africa's revealed comparative advantage (RCA) has shifted towards capital-intensive products, especially for 'heavy industry' (which refers to the

[1] The sample of 40 developing countries comprised: Algeria, Argentina, Brazil, Benin, Bolivia, China, Colombia, Costa Rica, Ecuador, Egypt, El Salvador, Guatemala, Honduras, Hungary, India, Indonesia, Jordan, Kenya, Madagascar, Malawi, Malaysia, Mauritius, Mexico, Morocco, Nicaragua, Pakistan, Panama, Paraguay, Peru, Philippines, Romania, Senegal, South Africa, Suriname, Thailand, Togo, Tunisia, Turkey, Venezuela, Zimbabwe.

manufacture of large items, such as for the mining industry). He concluded that a policy shift is required to make South Africa more labour absorbing as the country has an abundance of unutilised labour (Wilhelm, 2017).

Gamede (2017) identified several factors hindering human capital development in South Africa, including a lack of infrastructure and rising numbers of students dropping out of school and university (Gamede, 2017). It is therefore important for South Africa to invest in its human capital and to promote learning and innovation with a view to leveraging its strong natural resource base (World Bank, 2021a). One way for South Africa to do this is to diversify its export base by exporting more existing products (intensive margin) or exporting new products or forming new trading relationships (extensive margin). This will create new jobs and learning opportunities and enable the country to capitalise on its unutilised labour. The next section deals with the intensive and extensive margins of trade.

2.3.2 Export growth through the intensive and extensive margins

Export growth can occur through the intensive margin or the extensive margin of trade. Economists define the intensive and extensive margins in different ways. For instance, Hummels and Klenow (2005) and Amiti and Freund (2010) define the intensive and extensive margins of trade at the product level. Thus, the intensive margin is exporting a greater volume of goods while the extensive margin is exporting a wider range of goods.

Helpman *et al.* (2008) and Steenkamp (2018) define the intensive and extensive margins of trade at the country level. Therefore, the intensive margin is a bilateral relationship that grows over time and the extensive margin is a newly established bilateral trading relationship. Furthermore, Evenett and Venables (2002) and Matthee *et al.* (2016) define the intensive and extensive margins of trade at the country–product level. Thus, the intensive margin is an increase in existing export volumes to existing trading partners. The extensive margin is exporting new products to new or existing trading partners as well as exporting existing products to new trading partners. Evenett and Venables (2002) and Matthee *et al.* (2016) provide more extensive definitions of these margins than the other economists. More data are used, which means that policymakers are afforded a bigger picture of the issues under consideration.

Past studies on the importance of the intensive and extensive margins to export growth have come to different conclusions. Some papers have found that most growth takes place through the extensive margin, while others have found that growth largely occurs through the intensive margin. In their study, 'The variety and quality of a nation's exports', Hummels and Klenow (2005) indicate that 60% of bigger economies' export growth comes from the extensive margin. They used trade data for 1994–1995 covering 126 exporting countries, 59 importing countries and 5000 product categories to determine whether bigger economies grow more through the intensive or extensive margin. Amiti and Freund (2010) conducted a similar study to that of Amurgo-Pacheco and Pierola (2008) in which they decomposed China's exports over the period 1992–2005. In their study, they found that most of China's exports grew through the intensive margin.

Felbermayr and Kohler (2006) measured the intensive and extensive margins of world trade over the period 1950–1997 using a gravity model and found that the intensive margin had a greater effect on world export growth. Helpman *et al.* (2008) arrived at the same result when conducting a similar study (using a generalised gravity equation) in which they analysed export data for 158 countries over the period 1970–1997. Eaton *et al.* (2009) examined Colombian exports over the period 1996–2007 and also found that most export growth occurred through the intensive margin. Amurgo-Pacheco and Pierola (2008) found that the intensive margin accounted for most trade growth in developing countries over the period 1990–2005. Besedeš and Prusa (2011) investigated and compared 46 countries'[2] export growth at the extensive and intensive margins over the period 1975–2003. They found that most export relationships are short-lived, which impacts export performance. They also provided evidence that the intensive margin has the largest impact on a country's export growth but that the extensive margin is still important.

[2] The sample of 46 countries comprised: Algeria, Argentina, Austria, Barbados, Belgium-Luxemburg, Bolivia, Brazil, Chile, Colombia, Costa Rica, Denmark, Ecuador, Egypt, El Salvador, Finland, France, Germany, Greece, Guatemala, Honduras, India, Indonesia, Ireland, Italy, Madagascar, Malaysia, Mexico, Morocco, Netherlands, Nicaragua, Paraguay, Peru, Philippines, Portugal, Singapore, South Korea, Spain, Sweden, Thailand, Jamaica, Trinidad and Tobago, Tunisia, the United Kingdom, Uruguay, the United States and Venezuela.

In their study, ‘Identifying the determinants of South Africa’s extensive and intensive trade margins: A gravity model approach’, Matthee and Santana-Gallego (2017) examined the determinants of South Africa’s intensive and extensive margins for the year 2012. They found that inadequate market-related information, weak infrastructure and shortcomings in South Africa’s regulatory environment could all be factors contributing to more growth occurring through the intensive margin. Overcoming these obstacles would enable South Africa to enter new markets and develop new products. Steenkamp (2018) showed in her study, ‘The dynamics and determinants of South African exports’, that the extensive margin is the largest contributor to South Africa’s export growth (especially entry into new markets) although the intensive margin is still the most important. She went on to show that relative endowments contribute to shaping middle-income countries’ export structure which is becoming increasingly capital intensive (Steenkamp, 2018).

Evenett and Venables (2002) looked at the export growth of developing countries over the period 1970–1997 and found that the extensive margin accounted for almost one-third of these countries’ exports. Clearly, the intensive margin plays a major role in developing countries, accounting for 60% of the growth in these countries’ exports (Evenett & Venables, 2002). Zahler (2011) decomposed world export growth over the period 1984–2000. He found that the intensive margin played a critical role in export growth in developed and developing countries (82.9% and 55.3% respectively). He also showed that exporting existing products (as opposed to new products) to new destinations contributed more to export growth in both developed and developing nations (16.7% and 37.4% respectively).

Matthee *et al.* (2016) conducted a decomposition of South Africa’s intensive margin in their study, ‘Can South Africa sustain and diversify its exports?’. In analysing South Africa’s intensive margin over the period 1994–2012, they found that the product category showing the largest increase was non-fuel primary commodities with an increase of 38%, followed by medium-skill technology manufactures with an increase of 22%. The product category showing the largest decrease was resource-intensive manufactures with a decrease of 50%. They found that the increases in non-fuel primary commodities were ascribed to Chinese demand and that decreases and extinctions in the intensive margin were due to lower demand in the United States (US)

and China. Matthee *et al.* (2016) also showed that diversification away from South Africa's endowment point would be very difficult since the further a product is from the country's endowment point, the less it contributes to increases in the intensive margin. They concluded that diversification will only be possible if South Africa invests more heavily in its human capital and infrastructure (Matthee *et al.,* 2016).

To invest more in a country's human capital, knowledge of new technological developments is necessary. The next section discusses technology and skill intensities.

2.4 Technology and skill intensities

The technology-orientated trade theories point to technological change as the cause of different trade patterns (Borkakoti, 1998). To realise the benefits of international trade, it is important for firms in different countries to participate in international value chains, but also to 'move up' these value chains (OECD, 2013). To do this, firms have to increase the technological complexity of their products because advanced exports are associated with increased profitability (OECD, 2013). Technological complexity refers to the technological level needed to produce a product, taking into consideration its characteristics and performance (Tani & Cimatti, 2009).

Sultanuzzaman *et al.* (2019) examined the effects that exports and technology have on economic growth by looking at emerging Asian markets over the period 2000–2016. Their results show that exports and technology have a significant positive effect on economic growth. Mewes and Broekel (2020) confirmed this in their study on the effect of technological complexity on regional economic growth in 159 European regions over the period 2000–2014. In this regard, the Nomenclature of Territorial Units for Statistics (NUTS) is a geocode standard for referencing the administrative divisions of European countries for statistical purposes. Their results suggest that technological complexity plays a critical role in regional economic growth, e.g. a 10% increase in technological complexity leads to a 0.45% increase in regional economic growth.

As technological complexity increases, the demand for more skilled workers grows (Broekel, 2019). Thus, industries and countries that have more skilled workers will have a better chance of producing technologically complex products. Nepelski and De Prato (2020) arrived at similar results when they created a global technology space

for countries and derived complexity measures that positioned countries in that space over the period 1991–2009. Countries' positions in this technology space affected their level of income and development. Their results confirmed that technological complexity has a positive impact on a country's income and development (Nepelski & De Prato, 2020). Thus, countries that export technologically complex products will develop more.

Klotz (2015) investigated whether Bangladesh, Ethiopia, Ghana, Madagascar, South Africa and Viet Nam had changed the technological intensity of their exports over the period 2001–2014. His findings suggest that of all these countries, South Africa and Viet Nam have the most diversified exports and are the most integrated into global value chains (Klotz, 2015). However, South Africa is the only country in the group that showed a decrease in the complexity of its export products over the period in question. This is also supported by Matthee *et al.* (2016) who showed that South Africa's exports are still concentrated in primary commodities. They found, when doing a decomposition of South Africa's intensive margin, that the biggest increase in the intensive margin was in non-fuel primary commodities (Matthee *et al.,* 2016).

In their study, Matthee *et al.* (2016) also looked at the human and physical capital endowment levels in South Africa. These factor endowments show the ability of a country to produce certain products and are very important for diversification. Countries that have more diverse or larger factor endowments are wealthier than others (Matthee *et al.,* 2016). This is supported by Steenkamp (2018) who showed that South Africa's relative factor endowments help to shape the country's export patterns. It is thus important to investigate a country's factor endowment levels, as these influence which products can and cannot be exported. Factor endowments and revealed factor intensity indices are discussed in the next section.

2.5 Revealed factor intensities

To diversify their exports, countries need to develop their factor endowments (human and physical capital) (Ali & Khan, 2017). Although there are many other factors underpinning export sustainability, only factor endowments are analysed in this study; other factors fall outside the scope of the study. The endowment point refers to a country's factor content of human and physical capital (Matthee *et al.,* 2016). In this

study, human capital refers to the average number of years that a person is expected to go to school in the country. Physical capital, in contrast, refers to the current capital stock in the country. The more a country increases its endowment point, the more diverse its exports are expected to be (Ali & Khan, 2017). This is because different products need different combinations of human and physical capital to be able to be exported.

South Africa has been focusing on diversifying away from exports of mineral products (Steenkamp, 2018). What has driven this shift in thinking is the assumption that for a country to develop, it needs to produce and export goods that it has traditionally not produced/exported. A major factor contributing to this move is the development of the human and physical capital in the country. Although this is more concentrated in the extensive margin of trade, one can also see it occurring in the intensive margin of trade if one evaluates whether the country has increased its exports of higher value-added products.

Schott (2003) shows in his paper, 'One size fits all? Heckscher-Ohlin specialization in global production', that countries that acquire more wealth move between different diversification cones. Vale and De França (2017) describe diversification cones as 'the geometric area in the plane of factors of production where factor prices are equal'. When countries acquire wealth, they stop exporting products in one cone and start exporting products in another cone (Vale & De França, 2017). Cadot, Carrère and Strauss-Kahn (2011), in contrast, assert that countries continue to export the products in the cone in which they started. Countries that are more developed, however, start to re-gear their export structure towards specialisation (Cadot *et al.,* 2011).

As the endowment point (defined above) increases, products that become further removed from the endowment point are dropped while others are still exported. Klinger and Lederman (2011) indicate that countries are more likely to export products that are similar to those that they already export. As the country has already gained the knowledge and technology to produce these goods, the production process for other, similar goods will be easier and quicker. Thus, industries closer to the country's endowment point are more likely to export more products (Klinger & Lederman, 2011).

This line of thinking is used in this study to determine whether South Africa's and its peers' exports are sustainable. Products require a certain amount of human and physical capital to be produced and exported efficiently (McLaren *et al.,* 2018). Therefore, countries that have an endowment point below the product's endowment point will not be able to sustain that product in the future. Bernard, Redding and Schott (2007) showed that the endowment point of a country plays a critical role in explaining entry into export markets. In their study, they proved that new exporting opportunities, caused by new firms entering an industry, occur more readily in industries that are close to the country's endowment point. According to Matthee *et al.* (2016), it would be difficult for South Africa to diversify away from its endowment point. They showed that products that are further away from South Africa's endowment point contribute less to the country's growth along the intensive margin of trade (Matthee *et al.,* 2016). They also found that products that are further away from the endowment point have more decreases and extinctions (are more likely to fail) along the intensive margin of trade (Matthee *et al.,* 2016). Conversely, products that are closer to South Africa's endowment point are more likely to succeed in the future.

While most trade theories have adopted new explanations of trade patterns, comparative-based explanations are still important. This is evident in studies such as Bernard *et al.* (2007) and Matthee *et al.* (2016) which provide evidence that a country's factor endowments still shape its export structure. Therefore, products closer to the country's endowment point will be exported more since the country has the ability to sustain those exports. To acquire a better understanding of South Africa's current export structure, it is necessary to analyse the country's current export statistics and trends. These are covered in the next section.

2.6 South Africa's export statistics

South Africa has one of the largest economies in Africa. However, judging from its export statistics, the country still has a long way to go before it can compete with the biggest economies in the world. In 2019, South Africa ranked 36th in the world (out of 146 countries) in terms of GDP (current USD), 36th in terms of total exports, 39th in terms of imports and 99th in terms of GDP per capita. South Africa was also ranked 57th on the Economic Complexity Index (ECI) (OECD, 2021). In this section, South Africa's key export statistics and trends are examined to provide some background on

South Africa's export characteristics and an overview of the country's current export position.

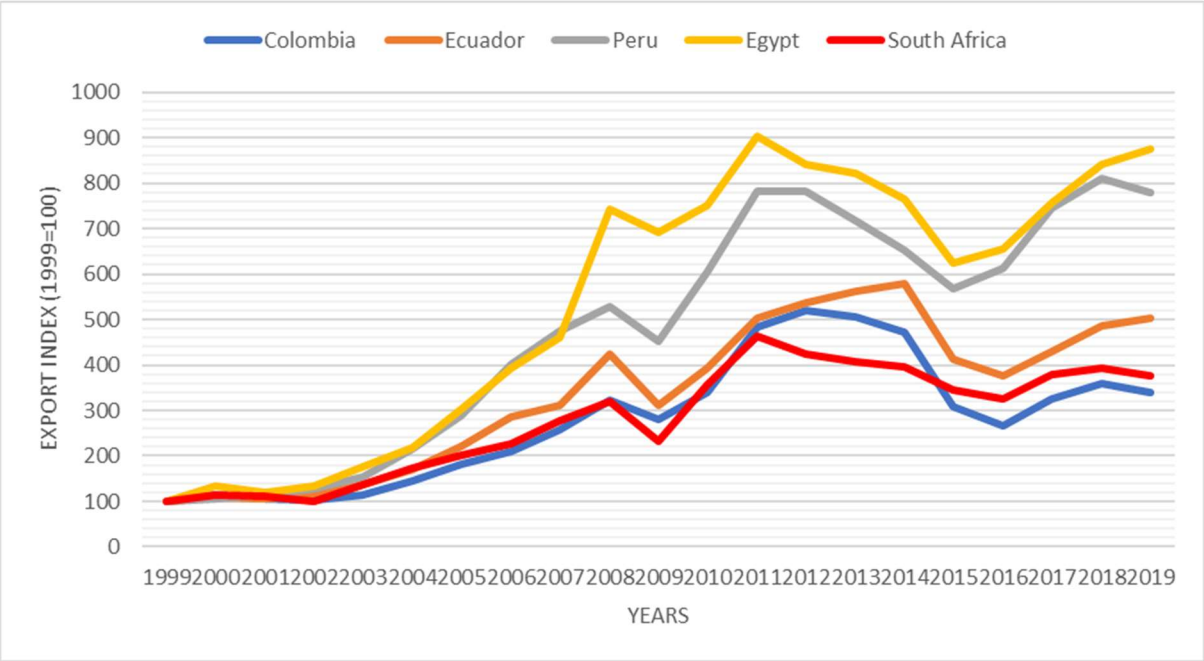

Figure 2-1: South Africa's export growth compared to selected peer countries (USD1000)

Source: Author's own calculations based on data from UN COMTRADE (2021)

In Figure 2.1, South Africa's export growth over the period 1999–2019 is compared with that of a number of peer[3] countries. It is clear that South Africa has lagged behind its peers in terms of export growth – a finding that is supported by Eyraud (2009) and Matthee *et al.* (2016) who arrived at the same conclusion. Figure 2.1 shows that Egypt's (yellow line) export growth is the highest, followed by Peru (grey line), Ecuador (orange line), Colombia (blue line) and finally South Africa (red line). South Africa's and Colombia's export growth trends are very similar. South Africa's exports grew by only 0.9% over the period 2010–2013 (World Bank, 2015). Moreover, in the period 2013–2016, the country's growth rate remained low before increasing slightly in the period 2017–2019.

From Figure 2.1, two different overall growth patterns can be observed. First, all countries displayed a similar growth trend in the period 1999–2008. The overall slow

[3] Peer countries were selected on the basis of their economic classification, GDP per capita and export profile.

export growth after 2008 can be attributed to the financial crisis of 2007–2008. In the period 2009–2019, Egypt, Peru and Ecuador experienced faster growth than Colombia and South Africa. Export growth picked up after 2008 (2009–2011) before decreasing again (2012–2016). Export growth started to pick up again in 2017–2019.

A low export growth rate is concerning for a developing country like South Africa and highlights the need to put much more emphasis on the country's export sector with a view to growing and developing the economy. This calls into question the methods that South Africa has been using to grow its exports and why growth in the country's exports is trailing that of its peer countries.

Faure (2017) attributes South Africa's slow export growth (2005–2017) to a slowdown in commodity prices, especially as China's demand for commodities has declined. Iron ore prices, in particular, have been attributed to the slowdown in export growth (Faure, 2017). Faure (2017) also highlights that South Africa's manufacturing sector contracted by 20% over the period 2000–2016, resulting in a loss of 15% in market share compared to other emerging markets. In addition, South Africa's exports of manufactured goods have been negatively influenced by the lack of non-price competitiveness, evidenced in factors like insufficient product diversification and material constraints (Faure, 2017).

Figure 2.2 takes a more specific look at South Africa's annual export growth rates over the period 1999–2019.

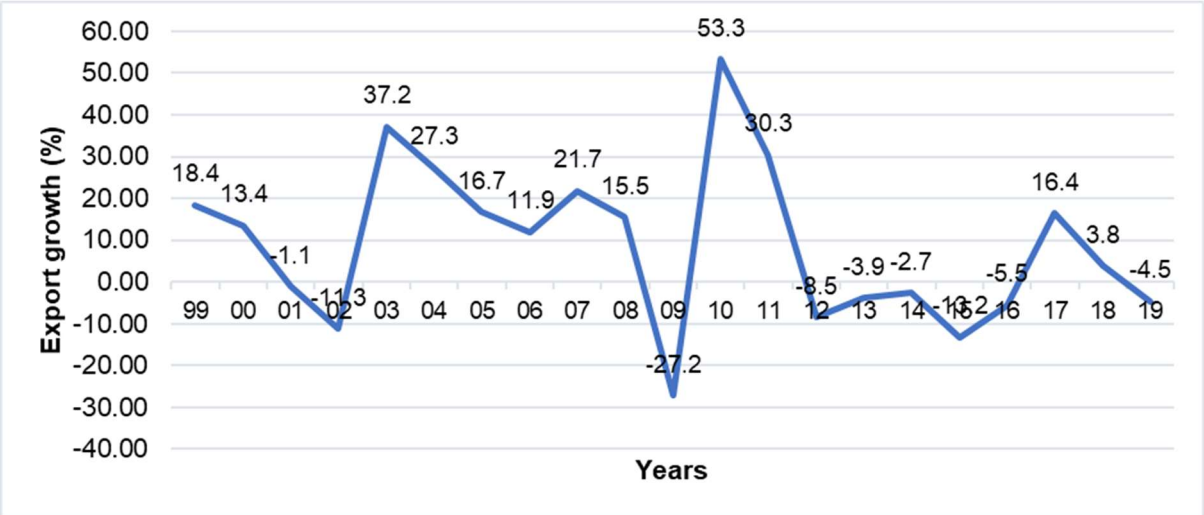

Figure 2-2: South Africa's annual export growth rates (%)

Source: Author's own calculations based on data from UN COMTRADE (2021)

From Figure 2.2 it is clear that export growth differed substantially from year to year over the period in question. The largest growth occurred in 2010 when South Africa's exports grew by 53.28%. This followed the drop in 2008–2009 when export growth contracted by 27.18%, which could be attributed to the 2007–2008 financial crisis. Export growth is very important for a country since it is expected to create jobs, bring higher wages and increase residents' living standards (Van Niekerk & Viviers, 2014). It therefore follows that a decrease in export growth is associated with job losses and lower wages (Van Niekerk & Viviers, 2014).

To provide a more nuanced picture of export growth, Figure 2.3 presents South Africa's annual export growth rates through the intensive and extensive margins of trade (using total exports at the product–country level) over the period 1999–2019.

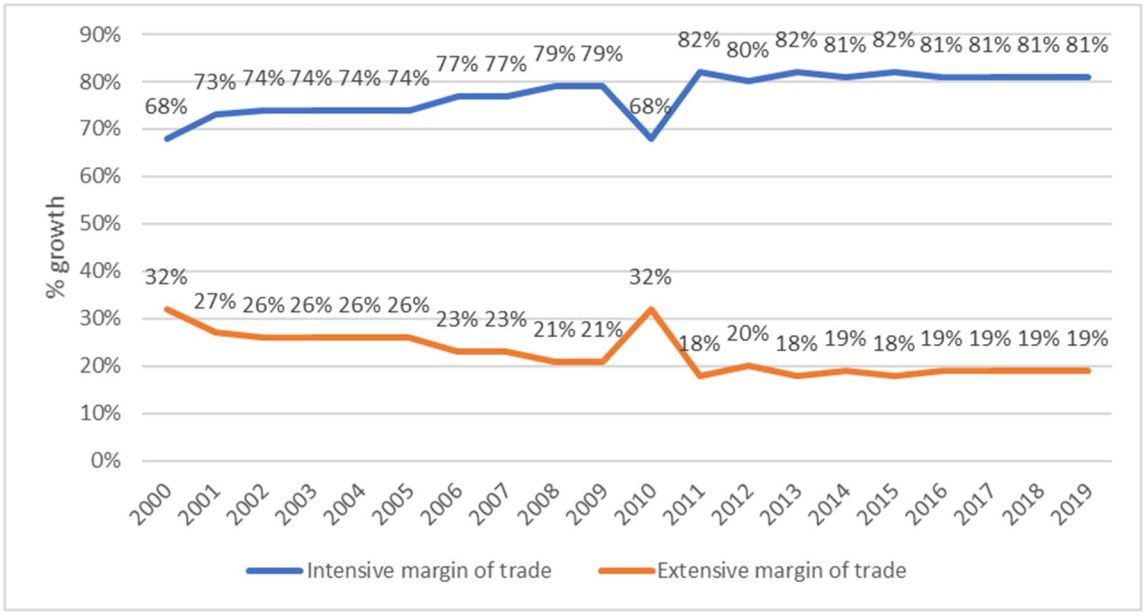

Figure 2-3: South Africa's annual export growth rates (%) through the intensive and extensive margins (1999–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021)

From Figure 2.3 it is clear that most of South Africa's export growth occurred through the intensive margin. This was the expected outcome following the analysis of previous papers on the diversification of South Africa's exports (Matthee *et al.,* 2016;

Matthee & Santana-Gallego 2017; Steenkamp, 2018). Over the period 2000–2019, South Africa's intensive margin showed an increase in export growth while South Africa's extensive margin showed a decrease in export growth. The only exception was in 2009–2010 when the extensive margin increased before decreasing again in 2011.

Figure 2.4 takes the analysis further by showing the top regions to which South Africa exported over the period 1999–2019 and how exports to these regions grew.

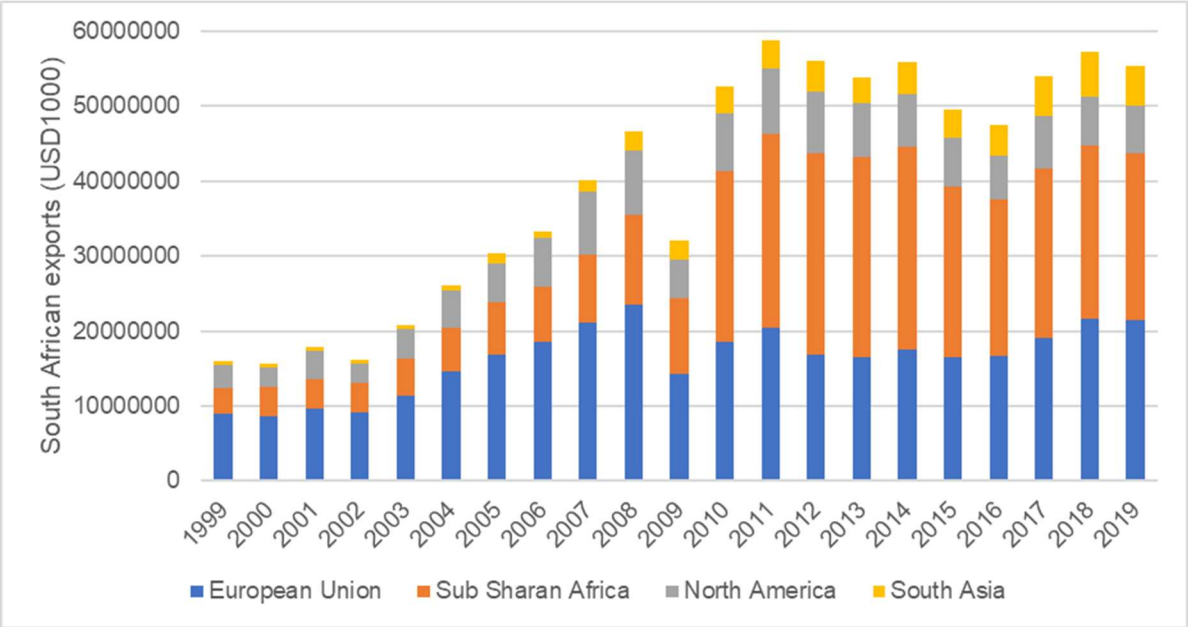

Figure 2-4: South African exports to selected regions (1999–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021)

Particularly strong growth was evident in South Africa's exports to the European Union (EU) (indicated in blue) and Sub-Saharan Africa (SSA) (indicated in orange). South Africa's exports to the EU grew more than its exports to SSA in the period 1999–2008. However, in the period 2009–2019, South Africa's exports to SSA began to grow more than its exports to the EU. This could be due to more attention being paid to regional integration in Africa, such as with the formation of SADC in 1992, SADC's establishment of a free trade area in 2008 and the formation of the Tripartite Free Trade Area (TFTA) in 2015 (Farahat, 2016).

In Sub-Saharan Africa, South Africa is a member of the Southern African Customs Union (SACU), along with Botswana, Lesotho, Namibia and Eswatini (formerly Swaziland). These countries also belong to SADC whose members are Angola, Botswana, Comoros, Democratic Republic of Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe. In addition, they are members of the TFTA which connects SADC to the Common Market for Eastern and Southern Africa (COMESA) and the East African Community (EAC). These regional trading blocs, in turn, form the building blocks of the African Continental Free Trade Area (ACFTA) which holds great potential for South African exporters.

In 2000, the EU and South Africa formed the EU–SA Free Trade Agreement. Under this agreement, 95% of South Africa's exports would enter the European market duty-free within 10 years and 86% of the EU's exports would enter the South African market duty-free within 12 years (Guei, Mugano & Le Roux, 2017). The purpose of the agreement was to boost EU–South Africa trade. However, Guei *et al.* (2017) point out that the agreement fell short of expectations as South African trade with certain parts of the EU decreased, including that with the United Kingdom (UK). Notwithstanding this, South Africa's welfare gains from the partnership have been significant. South Africa is also a signature to the EU–SADC Economic Partnership Agreement (EPA), which comprises all the EU and SADC member countries, and in 2012 signed a Trade and Investment Framework agreement with the US.

The abovementioned alliances and agreements are all important for South Africa's trade. However, some of South Africa's trade partners are more important than others. Figure 2.5 shows South Africa's top 10 export destinations (arranged according to value of goods exported) in 2019.

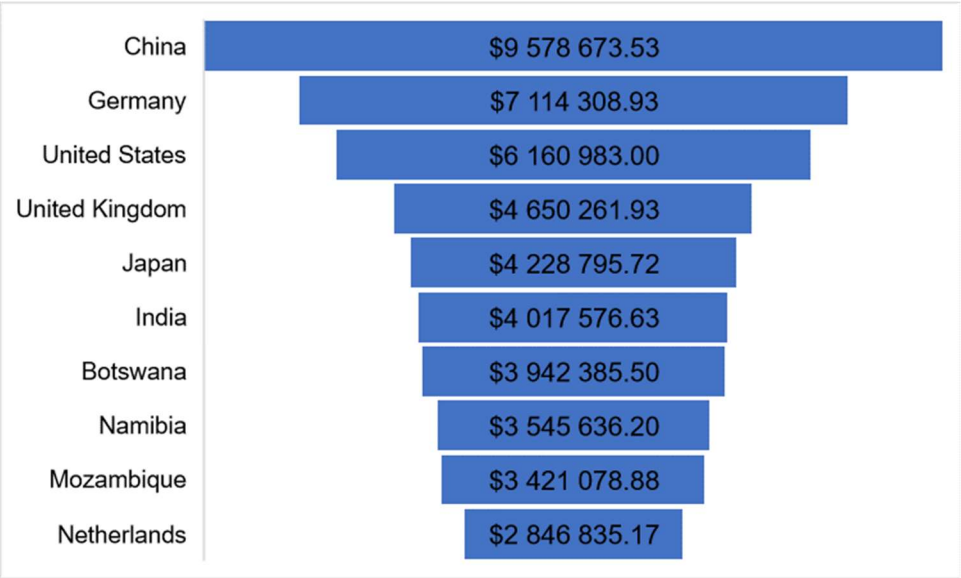

Figure 2-5: South Africa's top 10 export destinations in 2019 (USD 1000)

Source: Author's own calculations based on data from UN COMTRADE (2021)

Figure 2.5 shows that China was South Africa's largest export destination in 2019, followed by Germany and the US. Included in the top 10 export destinations that year were three Asian countries (China, Japan and India), three European countries (Germany, the UK and the Netherlands), three African countries (Botswana, Namibia and Mozambique) and one American country (the US). China plays a major role in South Africa's trade activities and South Africa is China's biggest export partner in Africa. A recurring problem, however, is that while South Africa exports a wide range of products to countries like China, these exports are mainly raw materials. South Africa, in turn, imports consumer and capital goods from China (Edwards & Jenkins, 2015). This is reflected in the trade balance – South Africa has a large surplus in raw materials but large deficits in consumer and capital goods (Edwards & Jenkins, 2015).

This imbalance is particularly problematic when slow demand from a trading partner like China has a significantly adverse impact on the South African economy. If a country relies on only one large export destination (such as China), it can become dependent on that country (Faure, 2017). Both Matthee *et al.* (2016) and Faure (2017) assert that slower demand from China has had and will continue to have a negative impact on South Africa and its export growth prospects.

Figure 2.6 shows which products South Africa exports the most to its trading partners around the world. It provides a more detailed picture of South Africa's export sector by considering exports at the industry level.

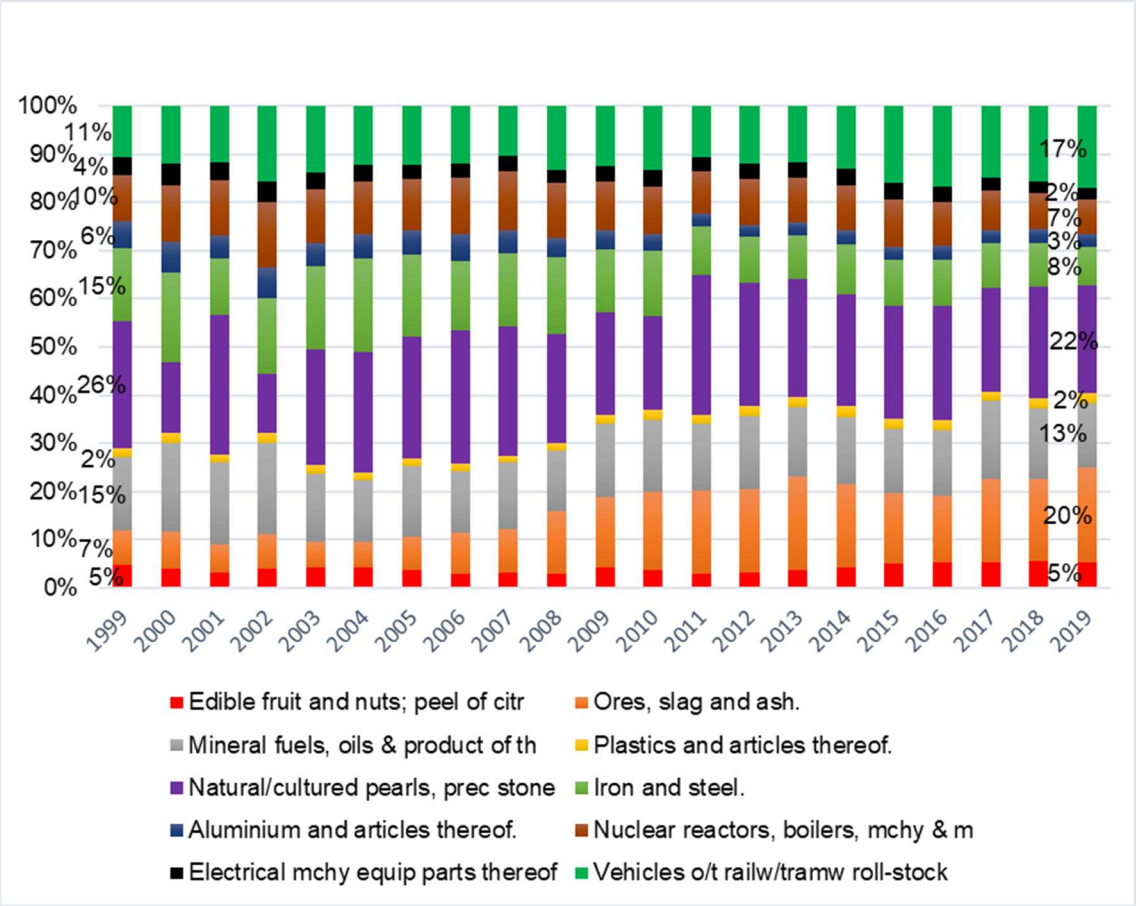

Figure 2-6: Structure of South Africa's exports (1999–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021)

Figure 2.6 presents South Africa's top 10 export products in 2019 according to their percentage contribution (in USD 1000) to South Africa's exports over the period 1999–2019. Some products' contribution to South Africa's total exports grew over the period, while other products' contribution decreased.

The contribution of Ores, slag and ash and Vehicles (indicated in orange) to South Africa's total exports grew the most over the period. Ores, slag and ash accounted for 7% of the top 10 products in 1999 and 20% in 2019, which shows an increase of 13%. Vehicles (indicated in dark green) accounted for 11% of the top 10 products in 1999 and 17% in 2019, which shows an increase of 6%. The most noteworthy drop was in Iron and steel (indicated in light green) which accounted for 15% of the top 10 products

in 1999 and only 8% in 2019. Natural pearls and precious stones (indicated in purple), Nuclear reactors, boilers and machinery (indicated in brown) and Aluminium and articles thereof (indicated in blue) also dropped slightly during the period (4%, 3% and 3% respectively). The rest of the products accounted for more or less the same percentages of the top 10 exports over the period 1999–2019.

Figure 2.7 shows South Africa's top 10 categories of export products and their values (in USD 1000) in 2019.

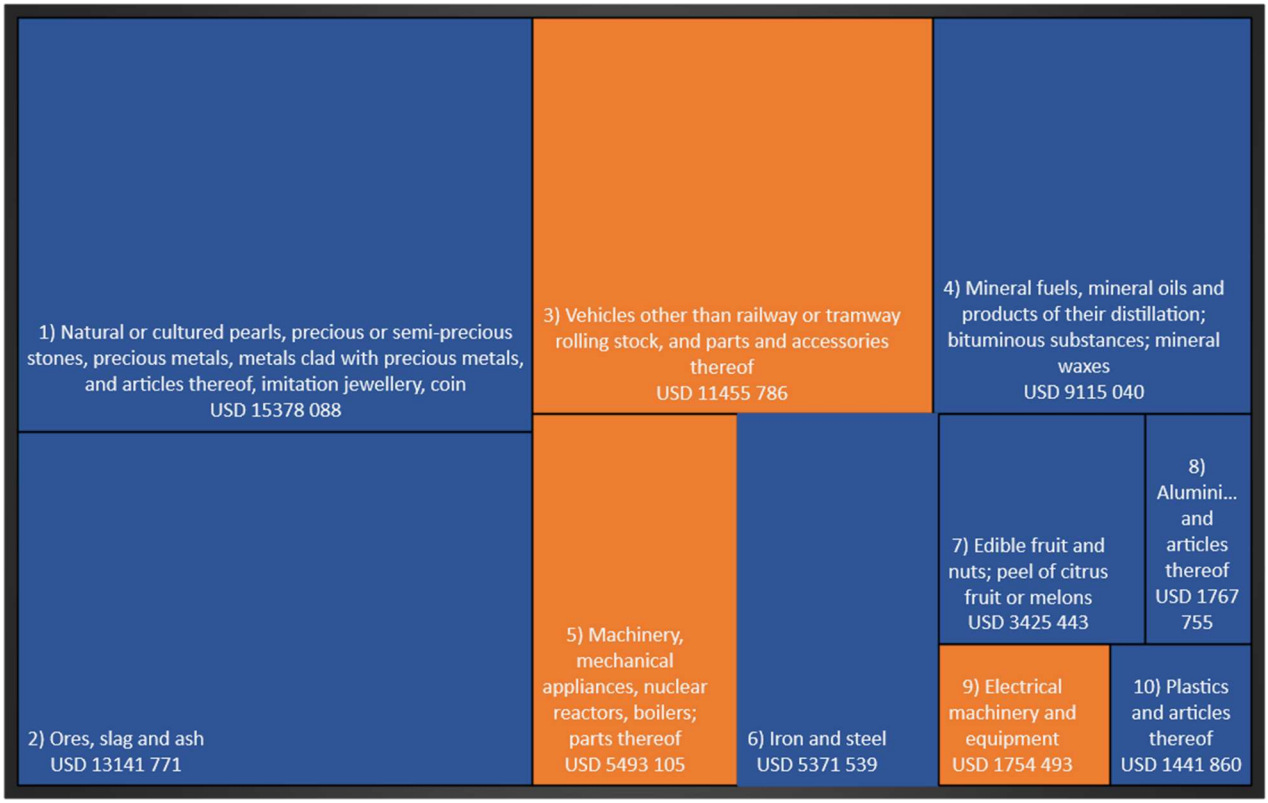

Figure 2-7: South Africa's top 10 export products at HS 6-digit level in 2019

Source: Author's own calculations based on data from UN COMTRADE (2021)

It is clear from Figure 2.7 that primary products (indicated in blue) still dominate South Africa's export basket, as seven[4] of the top 10 products are primary products. The

[4] Primary products in South Africa's top 10 export products: Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metals, and articles thereof, imitation jewellery, coin; Ores, slag and ash; Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes; Iron and steel; Edible fruit and nuts; peel of citrus fruit or melons; Aluminium and articles thereof and Plastics and articles thereof.

remaining three[5] of the top 10 products are manufactured products (indicated in orange). Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal, and articles thereof, imitation jewellery, coin were South Africa's top export products in 2019 with a value of approximately USD 15.3 billion. Vehicles other than railway or tramway rolling stock, and parts and accessories thereof were South Africa's top manufactured export product with a value of approximately USD 11.5 billion. According to Robinson (2017), South Africa's dependence on primary products makes it difficult for the country to diversify its export portfolio. This adds to the country's vulnerability to commodity shocks.

2.7 Conclusion

The main aim of this study is to do a decomposition of South Africa's export performance and sustainability and to compare the findings with those of selected peer countries. This chapter contextualised the study into the literature.

The literature on traditional and modern trade theories highlighted the importance of trade for countries and explained where the concepts of export diversification and export sustainability originated. Other subjects discussed were that exports are critical to a country's well-being, that there is a relationship between export growth and economic growth, and that developing economies need to invest more time and money in their human and physical capital to offset their commodity dependency. The analysis of the empirical literature on export growth through the intensive and extensive margins of trade revealed that developing countries tend to show more growth along the intensive margin. This can to some extent be explained by countries' technology and skill intensities. For example, while South Africa is economically diversified, it struggles to increase the technological complexity of its products.

In addition, the importance of human and physical capital in a country was discussed, along with the origin of the revealed factor intensities. Such discussions are an essential element in this study as they provide insight into the research method

[5] Manufactured products in South Africa's top 10 export products: Vehicles other than railway or tramway rolling stock, and parts and accessories thereof; Machinery, mechanical appliances, nuclear reactors, boilers; parts thereof and Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles

applied. An analysis of South Africa's current export statistics and position revealed that exports accounted for 25% of the country's GDP in 2019 and that export growth along the intensive margin (81%) far exceeded export growth along the extensive margin (19%) that year. Moreover, South Africa's exports to SSA have shown consistent growth, while China is the country's top export destination. Its main export products are Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metals, and articles thereof, imitation jewellery, coin. Throughout the literature review, reference was made to South Africa (where applicable) as the empirical study will be based on South Africa's export performance and sustainability through the intensive margin of trade.

The next chapter explains the research methods used in the study to determine South Africa's export performance and sustainability in the intensive margin, while also comparing the results with those of selected peer countries. The characteristics of the data used in each method are also examined. Lastly, the test used to explain the relationship between the intensive margin and the distance to the country's endowment point for physical and human capital – the Spearman rank-order correlation test – is explained.

CHAPTER 3: METHODOLOGY

3.1 Introduction

Chapter 2 discussed the traditional and modern trade theories relevant to this study. Furthermore, it reviewed the literature on export growth and economic development, the technology and skill intensities of production, and revealed factor intensities. The chapter closed with an in-depth look at South Africa's current export performance. Chapter 2 thus provided the literature framework on which this study is built.

In this chapter, the methodology and data for the decomposition of South Africa's export performance and sustainability are discussed. The chapter is divided into three sections which relate to the three main concepts introduced in the study. The first section explains how South Africa's export relationships with the selected peer countries in the intensive margin will be determined (to address objective 5) in terms of *increase*, *decrease* and *extinction* (see section 3.2). The next section discusses the approach used to determine if South Africa's, and the selected peer countries', endowments of human and physical capital are sufficient (to address objective 6) for the products they export (see sections 3.3, 3.4 and 3.5). The last section describes the method used to determine the relationship dynamics in the country's intensive margin and the distance between its factor endowments and the revealed factor intensities of the products it exports (to address objective 6). Section 3.7 concludes the chapter.

3.2 Decomposition of export growth in the intensive margin

A country's export growth can occur through the intensive margin or the extensive margin (Steenkamp, 2018). As discussed in section 2.3.2, depending on data availability, different economists define the intensive and extensive margins in different ways. This is important to bear in mind since one study may measure a trade relationship as extensive margin growth while another study may measure the relationship as intensive margin growth.

Following Brenton and Newfarmer (2009), this study defines the intensive and extensive margins at the product–destination level. The intensive margin measures growth in existing trade relationships, while the extensive margin measures growth in

new trade relationships (Matthee *et al*., 2016*)*. Researchers can analyse export growth through the intensive and extensive margins in two ways. The first approach is to do a decomposition of the level of trade at a particular point in time. Hummels and Klenow (2005) use this method – where the intensive margin is measured as the country's market share in world trade in terms of the products they export (also see section 2.3.2). The extensive margin is measured by comparing the span of a country's export basket with all the exports that exist in the world (Hummels & Klenow, 2005).

The second approach is to do a decomposition of the value of export growth over time. As the name suggests, the value of export growth is measured along the intensive and extensive margins between two points in time (Besedeš & Prusa, 2011). This approach is used by most researchers when conducting a decomposition of the export growth of countries over a period of time, including Eaton *et al.* (2009), who analysed Colombian exports over the period 1996–2007, Amiti and Freund (2010), who analysed China's export growth over the period 1992–2005, and Zahler (2011), who examined world export growth over the period 1984–2000 (also see section 2.3.2), and Matthee *et al.* (2016), who took an in-depth look at South Africa's export growth along the intensive margin over the period 1994–2012 (also see section 2.3.2).

For the purposes of this study, the second approach will be used to do a decomposition of the intensive margin of South Africa's export relationships over the period 2007–2019 (to address objective 7). The period 2007–2019 has been chosen because export growth in South Africa's intensive margin has not been analysed during this period. An 'export relationship' refers to a product–country combination. As discussed in section 2.3.2, a decomposition of South Africa's intensive margin will produce better results when product–destination combinations are used. To this end, the products that South Africa and the selected peer countries export were combined with the countries (destinations) to which the products were exported, to form a product–country export relationship (a product–destination combination). As discussed in Chapter 1, to compare South Africa's results (see objective 7), four peer countries were selected on the basis of their economic classification, GDP per capita and export profile (see section 1.5.2.1).

Export relationships on the product–country level can either increase, decrease or become extinct, depending on the value of their exports over a specific period. In this

study, growth along South Africa's intensive margin of trade is measured by grouping export relationships into three categories, namely *increases*, *decreases* and *extinctions*. This is done by calculating how the aggregate value of 2007, 2008 and 2009 changed to the aggregate value of 2017, 2018 and 2019. Instead of comparing exports between two single years, such as 2009 and 2019, the aggregate value over three years is used. This is to account for export relationships where export values were missing or left out in one of the years due to administrative and reporting errors as well as to balance out shocks and the effects of drought experienced in the country. This includes values of exports not reported by an industry for one year. Therefore, the aggregate value for 2007, 2008 and 2009 was used to determine an increase, decrease or extinction value for the aggregate value of 2017, 2018 and 2019.

Table 3.1 shows the number of product–country combinations for each exporting country, the aggregate exports for 2007–2009 and 2017–2019, and the percentage growth in export value over the period 2007–2019.

Table 3-1: Number of product–country combinations and value of aggregate exports

Country	Number of product–country combinations	Aggregate exports 2007–2009 (USD 1000)	Aggregate exports 2017–2019 (USD 1000)	% growth in the value of aggregate exports between 2007-2009 and 2017-2019.
South Africa	131 059	171 730 334	274 131 743	60%
Egypt	32 378	52 175 126	52 978 648	1.5%
Peru	37 169	83 794 325	121 552 022	45%
Ecuador	17 487	61 718 783	78 369 629	27%
Colombia	42 357	115 456 968	146 889 599	27%

Source: Author's own compilation based on data from UN COMTRADE (2021)

From Table 3.1 it is clear that South Africa had many more product–country combinations than the other selected peer countries. This already indicates that South Africa has a more diversified export structure as it exports more products, and exports to more countries, than the selected peer countries do. The country with the fewest export relationships was Ecuador. Interestingly, while Ecuador had just under half the number of export relationships that Egypt had, it had a higher aggregate export value than Egypt. South Africa's aggregate export value was much higher than that of its peers in the period 2007–2019. Of the peer countries, Peru had the highest growth rate in value terms in the period 2007–2019, while Egypt showed almost no growth.

In this study, the product–country combination is defined as an export relationship. An export relationship is classified as an *increase* when its aggregate value for 2007–2009 was larger than its aggregate value for 2017–2019, e.g. when South Africa's exports of apples to Botswana had an aggregate value of USD 250 for 2007–2009 and the export relationship grew by USD 150 to an aggregate value of USD 400 for 2017–2019.

An export relationship is classified as a *decrease* when its aggregate value for 2007–2009 was smaller than its aggregate value for 2017–2019, e.g. when South Africa's exports of lemons to Egypt had an aggregate value of USD 250 for 2007–2009 and the export relationship decreased by USD 150 to an aggregate value of USD 100 for 2017–2019.

Lastly, an export relationship is classified as an *extinction* when it had an aggregate value for 2007–2009 but its aggregate value for 2017–2019 was equal to zero (or missing), e.g. when South Africa's exports of avocados to India had an aggregate value of USD 250 for 2007-2009 and the export relationship had an aggregate value of USD 0 for 2017-2019.

To count the export relationships that increased, decreased or became extinct, dummy variables (which were divided into these three categories) were assigned. Table 3.2 shows the three categories for export dynamics.

Table 3.2: Three categories for export dynamics

Export dynamics	Description	Dummy variable
Increased	$Aggregate\ value_{'07-'09} > Aggregate\ value_{'17-'19}$	= 1
Decreased	$Aggregate\ value_{07-09} < Aggregate\ value_{17-19}$	= 2
Extinct	$Aggregate\ value_{07-09} > 0\ and\ Aggregate\ value_{17-19} = 0$	= 0

The three categories were also used to determine the value of the increase or decrease in the export relationship. Table 3.3 shows how this was done.

Table 3.3: Calculation of increase, decrease and extinction value

Export dynamics	Calculation
Increased dummy variable = 1	Then $Aggregate\ value_{17-19} - Aggregate\ value_{07-09}$

Decreased dummy variable = 2	Then $Aggregate\ value_{17-19} - Aggregate\ value_{07-09}$
Extinct dummy variable = 0	A value of 0

Since some countries have more export relationships than other countries, the average increase, decrease and extinction per export relationship is given so as to make the comparison between South Africa and the selected peer countries easier. Averages are used since they facilitate the comparison of different quantities of the same categories (Nissan & Niroomand, 2012).

In this study, three types of data are combined into one dataset, namely export data, physical and human capital data (see section 3.5) and product data classifications (see section 3.4). The export data were obtained from the UN COMTRADE database for Colombia, Ecuador, Egypt, Peru and South Africa at the 6-digit level of the Harmonised System (HS) of classification for the period 2007–2019. The 1988/1992 revision of the HS classification was chosen to ensure that a consistent set of product categories is analysed for the longest period of time. To compile a dataset from the abovementioned sources, it was necessary to do some data cleaning. All trade relationships valued at less than USD 10 000 per year were excluded to reduce the risk of misleading results. As South Africa had a median export value of USD 29 000 (World Bank, 2012), the median exporter was not excluded but smaller export values were excluded.

According to Reis and Farole (2012), one of the first indicators when looking at a country's export orientation is the decomposition of export growth over the past 15–20 years. The richer countries become, the more they participate in the trade environment (Reis & Farole, 2012). Therefore, countries whose exports grow faster will become richer, which will lead to more jobs and less poverty in the country. When comparing this with the selected peer countries, a clear picture emerges as to whether or not the country is achieving its growth objectives. A next step would be to compare the changing shares of export products (according to the product classification under which a country exports to selected peer countries) to acquire a more comprehensive view of the country's export structure. Such a comparison will help South Africa to learn from its peer countries. These products are divided into different categories

according to their technology and skill intensity. The next section examines technology and skill intensities more closely.

3.3 Export composition

In this section, different approaches used to measure the technological content of export products are discussed (see objective 6). Countries with more high-skill and technologically advanced products develop faster than other countries (Matthee *et al.,* 2016). One of the approaches used to measure the technological content of products was developed by the OECD in 1984 and is based on research and development (R&D) intensity. This method was used to classify the OECD countries' sectors according to their level of technology. The second approach was originally developed by Lall (2000) and further developed by Basu and Das (2011) and Basu (forthcoming). They divided products into groups according to their level of technology and skill intensity.

3.3.1 The OECD classification

The OECD has written a series of papers in which it divides economic activities into groups according to their R&D intensity, thereby providing a more appropriate method of analysing international trade (Papaconstantinou, Sakurai & Wyckoff, 1996; Hatzichronoglou, 1997; OECD, 2002; OECD, 2003; OECD, 2010; OECD, 2015a; OECD, 2015b). According to the OECD, R&D can be defined as 'creative work undertaken on a systematic basis in order to increase the stock of human knowledge and to devise new applications based upon it'. In their first paper in 1984, the OECD divided industries into three groups, namely high, medium and low R&D industries (Aboal, Arza & Rovira, 2016). These three groups were further categorised into six groups in both the high and medium R&D industries and into nine groups in the low R&D industries. However, the OECD did not provide a description of how groups were determined.

Hatzichronoglou (1997) grouped industries according to technological classification by using estimations of internal R&D intensity, with measures of R&D obtained from information on purchases of capital and intermediate goods produced locally and imported from other countries. In this new classification, the idea of technology intensity was expanded to include the level of technology specific to a sector and the

embodied technology when a company buys intermediate and capital goods. Table 3.4 provides the classifications of industries as developed by Hatzichronoglou (1997).

Table 3-4: Industry classifications based on R&D intensity

Classification	Examples
Low-technology industries	Wood, pulp, paper, paper products, printing and publishing; Food products, beverages and tobacco.
Medium-low-technology industries	Building and repairing of ships and boats; Rubber and plastics products; Basic metals and fabricated metal products.
Medium-high-technology industries	Electrical machinery and apparatus; Motor vehicles, trailers and semi-trailers; Chemicals excluding pharmaceuticals.
High-technology industries	Aircraft and spacecraft; Pharmaceuticals; Radio, TV and communications equipment.

Source: Author's own compilation based on Hatzichronoglou (1997)

In 2003, the OECD produced an update of these classifications based on R&D intensity (OECD, 2003). R&D intensity refers to a firm's investment in research and development divided by the firm's revenue. The more a firm spends on R&D, the more technologically complex its products will be. However, a more recent paper by the OECD (2010, 2015a) suggests that innovation is a better measure than R&D. The basis of this is that not all firms that are innovative are R&D intensive but may instead be efficient adopters of technology that they have not developed themselves. A study by the OECD (2010) provides alternative indicators of R&D intensity.

Goldin and Reinert (2005) state that products with an R&D intensity above the industry average are considered high tech. However, the methodology behind the R&D intensity of products remains unclear and has the following shortcomings (Galindo-Rueda & Verger, 2016):

- Research and development are not the only way to acquire knowledge. Knowledge can also be acquired through the formal training of staff, inter-firm collaboration or firm–industry collaborations.
- The OECD taxonomy is based on manufacturing sectors and thus it is difficult to analyse developing economies that mainly export primary products.
- The OECD taxonomy was built on data from the developed OECD countries, which makes it difficult to analyse other countries.

- The main shortcoming is that all products in an industry are classified under the same technology group and thus not according to their technological content. Cars and tyres, for instance, are grouped together, but cars have more technological content than tyres. Thus, aggregation bias occurs as the technology intensity of cars is different from that of tyres.

Therefore, it is more advantageous for a country to know the level of technology and skill intensity embodied in its exports than the R&D intensity of its exports. This will help to determine if the country is diversifying and thus developing, or stagnating. The approach developed by the OECD not only has limited categories; it is also focused on industries. This is where the second approach developed by Lall (2000) assists countries to divide their products into different categories according to their technology and skill intensities.

3.3.2 Technology and skill classification

Gereffi (2010) defines industrial upgrading as countries, firms and people entering a new level of production, moving from low value-added activities to high value-added activities. This resonates with Lall *et al.* (2005) who suggest that the knowledge and skills that a country needs to export technology-intensive products are higher than those needed to export primary products. Using export figures, Lall (2000) developed a technological classification system for exports to assess a country's technological knowledge. Products were divided into four groups at the HS 6-digit level, namely resource-based, low technology, medium technology and high technology.

A country's export basket in terms of the embedded skills and technological capabilities provides evidence of its growth path. This is supported by Basu and Das (2011) who show that per capita GDP could increase through higher-quality exports. They build on Lall (2000) by using the generalized kernel estimation methodology and dividing products into six categories according to their technology and skill intensity, which includes *primary products* and *unclassified products*. This classification system does not suffer from aggregation bias as each product is separated into its own category according to its embedded technology and skill intensity. The various categories are presented in Table 3.5.

Table 3-5: Technology and skill product classifications

Classification	Examples
Primary products	040110 -- Dairy produce; milk and cream, not concentrated, not containing added sugar or other sweetening matter, of a fat content not exceeding 1% (by weight)
Resource-based manufactures	070110 -- Vegetables; seed potatoes, fresh or chilled
Low-skill and technology-intensive manufactures	610319 -- Suits; men's or boys', of textile materials (other than wool, fine animal hair or synthetic fibres), knitted or crocheted
Medium-skill and technology-intensive manufactures	850131 -- Electric motors and generators; DC, of an output not exceeding 750W
High-skill and technology-intensive manufactures	852711 -- Radio-broadcast receivers; operational without external power source, combined with sound recording or reproducing apparatus, including apparatus capable of receiving radio-telephony or radio-telegraphy
Unclassified products	970600 -- Antiques; of an age exceeding one hundred years

Source: Author's own compilation based on Basu and Das (2011)

Table 3.5 provides examples of the different product categories used in this study. The technology and skill intensity increases as one moves down the table. *Primary products* refer to raw materials that do not call for a great deal of skill and technology to produce. *Low-skill and technology-intensive manufactures* need more skill and technology. For example, more machinery and skills are needed to produce suits than to produce *primary products* and *resource-based manufactures*, like milk and vegetables. Likewise, *medium-skill and technology-intensive manufactures* and *high-skill and technology-intensive manufactures,* such as vehicles and radios, require even more skills and technology to produce. *Unclassified products* refer to products that are not already covered by the other categories, such as art pieces.

3.4 Decomposing export growth according to skills and technological content

To analyse South Africa's export growth and sustainability along its intensive margin, the country's export products were categorised into the six categories listed in Table 3.5. The same was done for the selected peer countries to determine in which product category they grow the most and also to determine if their respective factor endowments have an effect on the products that they export. Once the products have been allocated to the relevant categories, export dynamic categories are used to determine how much of the countries' increases, decreases and extinctions occurred in each of the product categories. This is shown in Table 3.6.

Table 3-6: Product category in which increase, decrease and extinction occurred

Skills and technology intensity	Increase	Decrease	Extinction
Primary products	% increase	% decrease	% extinction
Resource-based manufactures	% increase	% decrease	% extinction
Low-skill and technology-intensive manufactures	% increase	% decrease	% extinction
Medium-skill and technology-intensive manufactures	% increase	% decrease	% extinction
High-skill and technology-intensive manufactures	% increase	% decrease	% extinction
Unclassified products	% increase	% decrease	% extinction

Source: Author's own compilation based on Matthee et al. (2016)

This makes it possible to determine in which skill/technology category the most increases, decreases and extinctions occurred for the countries under investigation, as well as to compare South Africa and the selected peer countries. If South Africa, for instance, has a higher (proportional) increase in exports of low-technology manufactured products and Peru has a higher increase in primary products, one can assume that South Africa can develop and diversify faster than Peru.

Thereafter, South Africa's and the selected peer countries' export compositions are analysed from a geographical perspective. The export countries and regions were chosen in the context of South Africa's top export regions/destinations. The Lall (2000) product classifications for South Africa and the selected peer countries (in terms of technology and skill intensity) were obtained from UNCTAD's database. South Africa's and the selected peer countries' intensive margins are then analysed according to the Lall (2000) product classification to examine the structural transformation in these countries' export profiles over the period 2007–2019. The Lall (2000) products are classified according to the Standard International Trade Classification (SITC), while the export data obtained are classified at the HS 6-digit level. To link the Lall (2000) product classifications to the export data, a match is done using a conversion table (United Nations, 2021). These changes are necessary for the study since the Lall (2000) product classifications are used to do the decomposition of South Africa's intensive margin.

The human and physical endowments of a country could also have an impact on the way it diversifies or upgrades from one product category to another (Shirotori *et al.,* 2010). It is thus important to evaluate whether South Africa and the selected peer countries have the factor endowments to sustain exports of the products they are exporting. The methodology is discussed in the next section.

3.5 Sustainability of exports

The idea of factor endowments being the main reason for trade between countries was first proposed in the Heckscher-Ohlin model (see section 2.2.1). Hausmann and Klinger (2007) argue that one of the most important determinants of the product that a country decides to export is the 'distance' between that product and the goods already exported by the country. A country will find it easier to produce a product similar to the products that it is currently exporting, since it already has the capabilities to do so. However, economists usually do not consider the effects that products produced in a country have on the development and growth of the country (Steenkamp, 2018).

Hausmann, Hwang and Rodrik (2006) classify products according to the income of the countries exporting the products. For example, if a product like a car is mostly exported by rich countries, the product is classified as sophisticated. However, when it is mostly exported by poor countries, it is classified as an unsophisticated product. They developed a measure called PRODY which is a weighted average of the per capita GDP of the countries producing that product. All the products' PRODY values are then usually weighted by each product's share in the total exports of a country and added together to determine the country's level of GDP per capita, as shown by the sophistication of its export basket (Reis & Farole, 2012). EXPY, in turn, can be defined as the sophistication level associated with the products that a country exports (McCann, 2007). Whereas PRODY and EXPY show the income content of a country's exports, the revealed factor intensities of products show the human and physical capital content of products.

The sustainability of exports can be measured by using the indices for revealed factor intensities (to address objective 6). This includes the physical and human capital that a product would need based on the trade-weighted averages of factor endowments of

the countries that export the product. The idea behind the measure is that products that are usually exported by capital-abundant countries are produced using capital-intensive measures, thus following the Heckscher-Ohlin school of thought (see section 2.2.1). The indices are compiled by weighting the factor endowments of all countries that export a specific product. A modified version of the revealed comparative advantage (RCA) is used to arrive at these weights.

The set of indicators include revealed physical capital intensity index, revealed human capital intensity index and revealed natural resource intensity index for every product classified at the HS 6-digit level. Human capital is measured by average years of schooling and physical capital is measured by capital stock. Moreover, capital stock is measured by reconstructing capital stocks from investment earnings by adding the previous period's capital stock (with suitable depreciation) to current investment flows (Reis & Farole, 2012). These data are used to determine the revealed human capital intensity and revealed physical capital intensity of products with a view to understanding whether or not countries have the means to export the products they are currently exporting.

The revealed factor intensities are calculated in a similar way to how PRODY is calculated but they have a stronger theoretical link to the Heckscher-Ohlin theory, as described above (see section 2.2.1). This is because products that are mostly exported by countries that are rich in human capital are revealed to be human-capital intensive. Products that are mostly exported by countries rich in physical capital are revealed to be physical-capital intensive. Products that are exported by countries that are rich in human and physical capital are labelled either human-capital intensive or physical-capital intensive, depending on which factor endowment the country has in abundance.

For the purposes of this study, the revealed physical-capital intensity index and revealed human-capital intensity index are used. McLaren *et al.* (2018) show that there is a correlation between human capital and physical capital. This means that a product that needs a large amount of human capital tends to need a large amount of physical capital. This does not apply to arable land and physical or human capital. Thus, the index for natural factor intensity is not included in the study. The formulae for human and physical capital are as follows (Reis & Farole, 2012):

$$RPCI_k = \sum_k \frac{\left(\frac{x_{jk}}{X_j}\right)}{\sum \frac{x_{jk}}{X_j}} * \frac{K_j}{L_j} \quad (1)$$

$$RHCI_k = \sum_k \frac{\left(\frac{x_{jk}}{X_j}\right)}{\sum \frac{x_{jk}}{X_j}} * H_j \quad (2)$$

Where K_j refers to country j capital stock, L_j refers to the country's work force and H_j refers to the average years of schooling achieved by an average person in country j. Countries with a stronger presence/RCA in a specific export product have a stronger weight in the index.

Using these indices at the product level, the factor intensities of all the products classified as increases, decreases and extinctions for South Africa and the selected peer countries in the period 2007–2019 are determined. This allows the distance between the factor endowments of products and the factor endowment point in the countries to be determined. Products that are far from the endowment point need a different mix of human and physical capital than that currently supported by the economy. This will show if South Africa's and the selected peer countries' exports are sustainable or not.

The index of the revealed factor intensity was first developed by Shirotori *et al.* (2010) and subsequently updated by UNCTAD in 2018. This data can be extracted from the UNCTAD revealed factor intensity database for each product at the HS 6-digit level in the 1988/1992 revision. The database provides information on three indicators of revealed factor intensity over the period 1988–2014 (updated from 1988–2007). The HS 1988/1992 revision of the HS 6-digit classification is used since it allows product categories to be examined over a longer period. It also correlates with the revealed factor intensity data provided in this revision in the UNCTAD database.

Since the factor intensities of products have only been updated up to 2014 in the UNCTAD database, using the human and physical capital data from 2020 will not provide an accurate picture of the situation in the various countries. Furthermore, this study is based on the period 2007–2019 and therefore 2014 is within the time frame,

while 2020 is not within the time frame. However, 2020 data were included to show how the human and physical capital endowments changed between 2014 and 2020. South Africa's and the selected peer countries' human and physical capital endowments for 2020 were obtained from the World Bank database at the HS 6-digit level.

To test if the distance between a product's physical and human capital intensity and the physical and human capital endowments of a country have an impact on the increases, decreases and extinctions in these markets, a correlation analysis will be applied. The methodological approach supporting this correlation analysis is discussed in the next section.

3.6 Correlation analysis

A correlation refers to a bivariate analysis that estimates the strength of the relationship between two variables (Schober, Boer & Schwarte, 2018). The value of correlation coefficients varies between +1 and -1, where +1 indicates a strong positive degree of association between two variables and -1 shows a strong negative association between two variables. As the value moves to zero, the correlation between the two variables becomes weaker until it reaches zero, which indicates no correlation between the two variables. Therefore, anything larger than 0.7 indicates a strong positive relationship between the two variables, while anything smaller than -0.7 indicates a strong negative relationship between the two variables. When r is between 0.5 and 0.7, it indicates a moderate positive relationship and when r is between -0.5 and -0.7, it indicates a moderate negative relationship. Lastly, when r is between 0.3 and 0.5, it indicates a weak positive relationship and when r is between -0.3 and -0.5, it indicates a weak negative relationship.

A correlation analysis has a p-value which indicates the probability that the relationship is equal to zero (has no relationship). In this study, the correlation is statistically significant when the p-value is less than 0.05 and 0.01.

There are four types of correlation analysis, namely the Pearson correlation analysis, the Kendall rank correlation analysis, the Spearman correlation analysis and the Point-Biserial correlation analysis (Munandar *et al.,* 2020). In this study, only the Pearson correlation and Spearman correlation will be examined as the Kendall rank correlation

is used when the sample size is small and the Point-Biserial correlation is used when correlating a continuous variable with a dichotomous variable (Munandar, Sumiati & Rosalina, 2020). These conditions do not apply to this study in view of its large sample size (working with countries with large export transactions) and the fact that no dichotomous variables are used.

3.6.1 Pearson correlation

The Pearson correlation is the most frequently used correlation test and estimates the linear relationship between two continuous variables (Munandar *et al.,* 2020). A relationship is considered to be linear when a change in one variable causes a massive change in the other variable (Munandar *et al.,* 2020). The following assumptions need to be true before the Pearson correlation can be used:

1. Both variables need to be normally distributed.
2. There needs to be linearity between the two variables (straight-line relationship).
3. There needs to be homoscedasticity (the data are distributed equally around the regression line).

The formula used in the Pearson correlation is as follows (Wang, 2015):

$$r_{xy} = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n\sum x_i^2 - (\sum x_i)^2}\sqrt{n\sum y_i^2 - (\sum y_i)^2}} \quad (3)$$

The hypotheses for the Pearson correlation are as follows:

H_0: There is no correlation between the two variables (r=0).

H_1: There is a correlation between the two coefficients (r≠0).

3.6.2 Spearman rank correlation

The Spearman correlation is a non-parametric test which shows the correlation between two variables (Warrens, 2017). The difference between the Pearson correlation and the Spearman correlation is that there is no assumption that data should be normally distributed. However, there must be a monotonic relationship. In a monotonic relationship, as one variable increases the other increases or decreases,

but not at a constant rate as in a linear relationship (Warrens, 2017). The formula used in the Spearman correlation is as follows (Wang, 2015):

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)} \qquad (4)$$

The hypotheses for the Spearman correlation are as follows:

H_0: There is no correlation between the two variables (r=0).

H_1: There is a correlation between the two coefficients (r≠0).

As the data used in the study were not normally distributed (see Figure A5-1), one of the Pearson assumptions is not true, which means that the Spearman correlation coefficient was best suited for this study. The data distribution was tested in R by creating a scatterplot graph with the variables used in the study. Another indication was that there were no distinct linear relationships. Therefore, it can be concluded that the Spearman test would provide better results than the Pearson test.

This study used the R software package to run the Spearman correlation analysis. This is done for South Africa and the selected peer countries to measure if the dynamics in a country's intensive margin have a statistically significant relationship with the distance between the country's endowment point and the factor intensities of its export products (to address objective 6). Increases in countries' intensive margins are expected to have a negative relationship with the distance to the countries' endowment points. Therefore, the further away an export product is from a country's endowment point, the smaller its contribution will be to increases in the intensive margin. Conversely, decreases in countries' intensive margins are expected to have a positive relationship with the distance to the countries' endowment points. Therefore, the further away an export product is from a country's endowment point, the greater its contribution will be to decreases in the intensive margin. This will reveal whether South Africa's comparative advantage in these factors affects the patterns witnessed in the intensive margin.

3.7 Conclusion

In conclusion, this chapter set out to discuss the methods and data used to do a decomposition of South Africa's export performance and sustainability and to compare the findings with those of selected peer countries.

The export dynamics in the countries' intensive margin were determined using dummy variables and by dividing products into the product classifications developed by Lall (2000) (see section 3.2). This was done by measuring the value of export growth in the intensive margin between two points in time. Thereafter, the countries' physical and human capital endowments were examined to determine if the countries' exports will be sustainable in the future (see sections 3.3–3.5). UNCTAD's revealed factor intensity indices were used to determine the human and physical capital needed to sustain the export relationships that showed increases. Finally, the Spearman correlation was identified as the appropriate correlation analysis to identify whether there was a relationship between the distance between the countries' physical and human capital and the factor intensities of products as well as the dynamics in South Africa's and selected peer countries' intensive margins (see section 3.6).

The results of the study are presented in the next chapter and constitute the basis for a series of recommendations for policymakers on the way forward.

CHAPTER 4: RESULTS

4.1 Introduction

Chapter 3 provided an in-depth look at the different methods applied in this study. These methods were used to determine the dynamics within the intensive margin of South Africa's exports (see objective 5), as well as the sustainability thereof (see objective 6). In this chapter, the results of these methods are presented and compared with the results of South Africa's peer countries (see objective 7), thus providing a clear indication as to why South Africa's peers' exports are growing at a faster rate than South Africa's exports. These insights will enable South Africa to learn from the selected peer countries with a view to mobilising stronger export growth.

This chapter is divided into four sections, starting with the composition of South Africa's and the selected peers' intensive margins (section 4.2). This is followed by the skill and technology composition of the countries' exports (section 4.3) and the factor intensities of the countries' dynamics within the intensive margin (section 4.4). The fourth section presents the results of the Spearman correlation analysis (section 4.5). Finally, section 4.6 summarises and concludes the chapter.

4.2 Decomposition of the intensive margin of export growth

This section provides the results of the decomposition approach used in this study (as discussed in section 3.2), which addresses objective 5. In this regard, a decomposition of South Africa's and the selected peer countries' export growth in the intensive margin was conducted. As discussed in section 3.2, the value of trade growth over time was analysed for both South Africa and the selected peer countries. In Figures 4.1–4.3, South Africa's, Colombia's, Ecuador's, Egypt's and Peru's dynamics within the intensive margin are presented for the periods 2007–2009 and 2017–2019.

The intensive margin measures growth in existing trade relationships (in other words, all the relationships already established in the period 2007–2009). In the decomposition of the intensive margin, an export relationship can either be classified as increased, decreased or extinct. On the one hand, an export relationship was classified as *increased* when its aggregate export value increased from 2007–2009 to 2017–2019. This means that the 'value of changes' refers to the aggregate sum of the

value by which the export relationships increased between 2007–2009 and 2017–2019. On the other hand, an export relationship was classified as *decreased* when its aggregate export value decreased from 2007–2009 to 2017–2019. This means that the 'value of changes' refers to the aggregate sum of the value by which the export relationships decreased between 2007–2009 and 2017–2019. When an export relationship had an existing export value in 2007–2009 and the value was 0 in 2017–2019, the export relationship was classified as *extinct*.

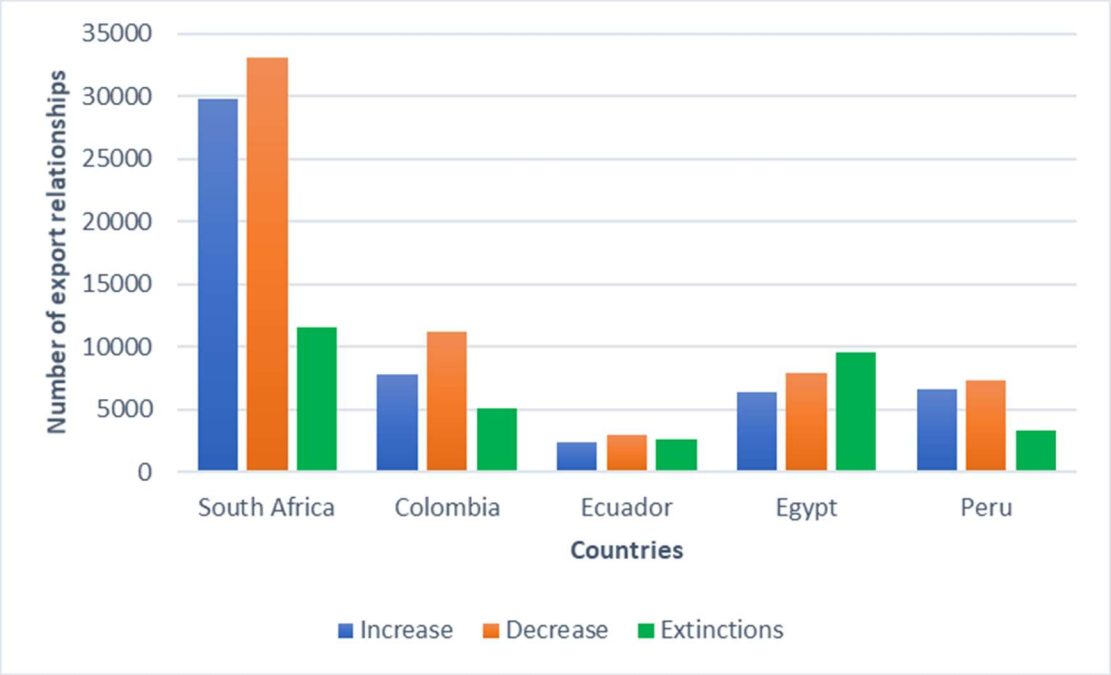

Figure 4-1: The number of export relationships according to the dynamics in the intensive margin of selected countries (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021)

In Figure 4.1, South Africa's growth along the intensive margin is compared with that of the selected peer countries between 2007–2009 and 2017–2019. It is clear that, relative to the selected peer countries, South Africa had the highest number of export relationships – in fact, it had three times more export relationships than the other countries.

Steenkamp (2018) shows that South Africa exports a wide range of products to a wide range of countries. Between the periods 2007–2009 and 2017–2019, South Africa had 29 859 export relationships that increased, 33 104 export relationships that decreased and 11 532 export relationships that became extinct. When considering the total

number of export relationships that increased, decreased or became extinct between 2007–2009 and 2017–2019, South Africa had 74 495 export relationships. In contrast, Colombia, Ecuador, Egypt and Peru had a total of 24 012, 7 991, 23 866 and 17 269 export relationships respectively (see Tables A1-1–A1-5). These numbers are much lower than the total for South Africa and confirm that South Africa has a more diversified export profile in terms of products and markets relative to the selected peer countries. Figure 4.2 goes further by considering the value of these relationships.

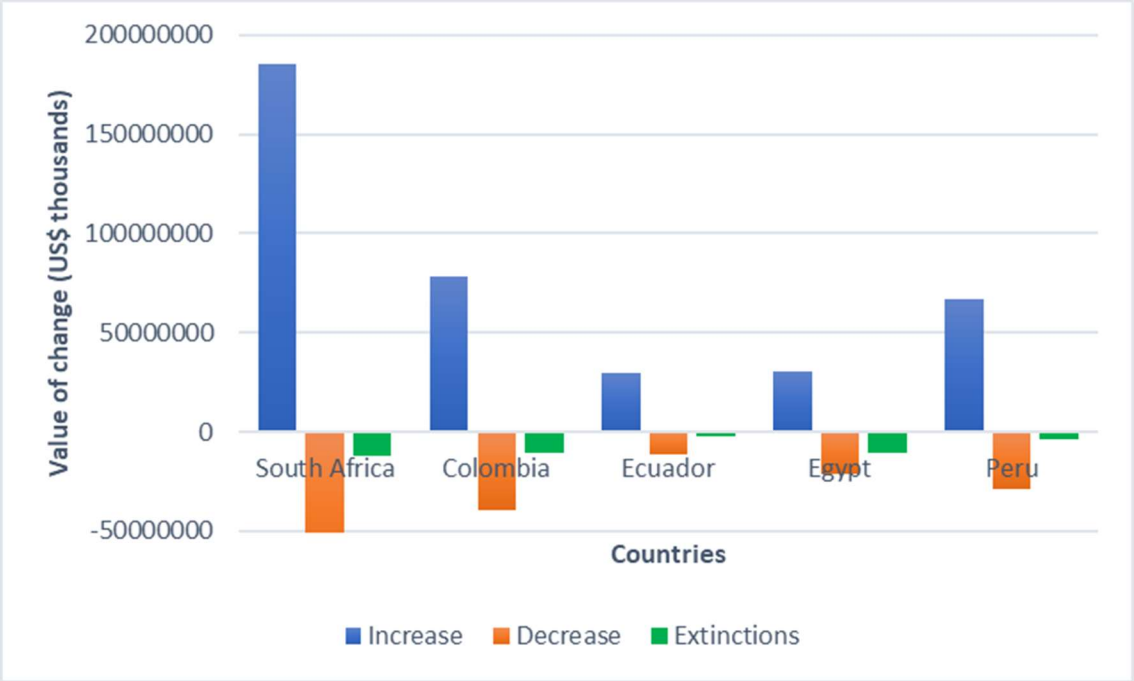

Figure 4-2: The value of change in export relationships according to the dynamics in the intensive margin of selected countries (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021)

When comparing the increases and decreases in terms of number of export relationships (Figure 4.1) and the value thereof (Figure 4.2), it is interesting to note that the number of South African export relationships that decreased in the intensive margin exceeded the number of export relationships that increased. However, in terms of value (Figure 4.2), the number of export relationships that increased exceeded the number of export relationships that decreased. It is therefore clear that South Africa's exports within the intensive margin grew over the period under investigation (from 2007–2009 to 2017–2019).

Of the four selected peer countries, Colombia had the highest number of export relationships and the highest value of export relationships, as seen in Figure 4.1 and Figure 4.2. However, these numbers are much lower than those for South Africa. This indicates that South Africa generates more income from its exports than the selected peer countries. When taking this into consideration, the question can be asked: why is South Africa's export growth lagging behind that of the selected peer countries (as observed in Figure 2.1)? To answer the question, one should look at the dynamics in the intensive margin by combining Figures 4.1 and 4.2 with a view to calculating the average value per export relationship, which is shown in Figure 4.3 (Nissan & Niroomand, 2012).

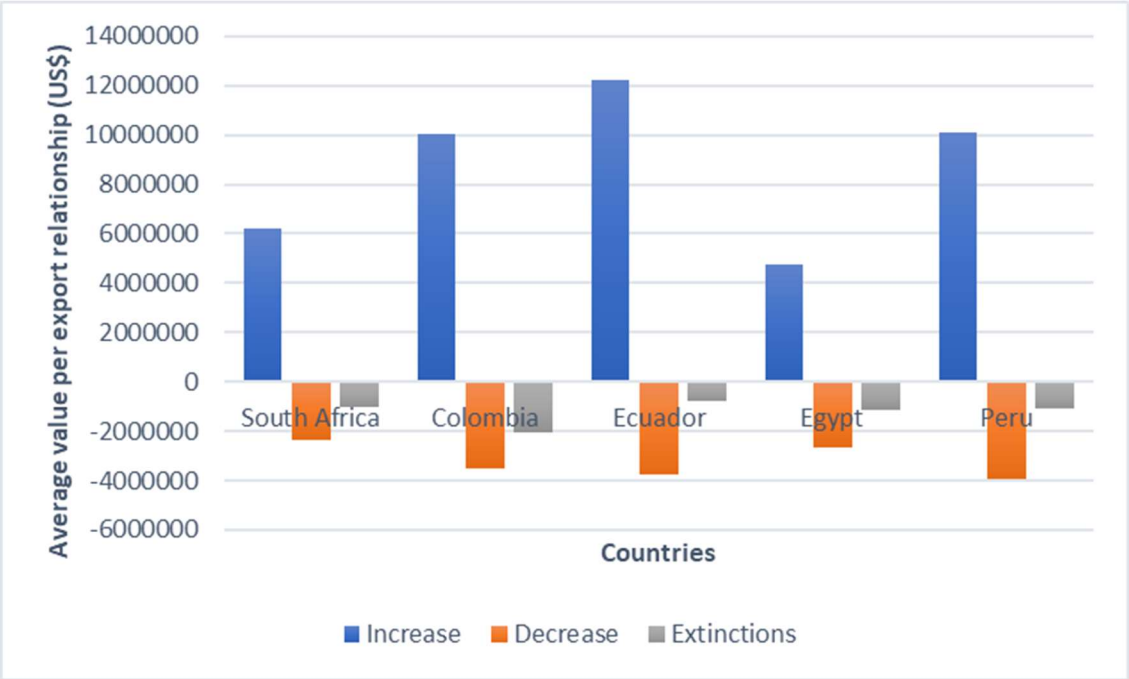

Figure 4-3: The average value per export relationship according to the dynamics in the intensive margin of selected countries (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021)

Figure 4.3 shows that South Africa's export growth in the intensive margin is lower than that of selected peer countries, with the exception of Egypt. Averages are used, as explained in section 3.2, since they make it easier to compare different quantities of the same categories of goods (Nissan & Niroomand, 2012). When one looks at Egypt's aggregate value of its decreases and extinctions, it becomes clear that it is the only selected peer country that contracts more than it increases between 2007–2009 and 2017–2019.

However, when South Africa is compared to Colombia, Ecuador and Peru, its average increase per export relationship is lower than that for most of the selected peer countries. Therefore, even though South Africa, relative to the selected peer countries, focuses on a broader set of product–country combinations, the average value of increase per export relationship is lower. This could explain the differences in export growth between South Africa and the selected peer countries (see section 1.1) in that it could be an indication that South Africa perhaps needs to produce fewer products in order to build on its current comparative advantages.

As discussed in section 2.3.1, there are two schools of thought on how to increase exports: diversification and specialisation. With reference to the results presented in Figures 4.1–4.3, a possible explanation for South Africa's lower export growth and the selected peer countries' higher export growth is that the peer countries specialise and do not diversify. This is evidenced in the fact that they have fewer export relationships, but the value of (and growth in) the relationships that they do have are higher than those of South Africa. The value of an export relationship (product–country combination) can also be influenced by the type of product being exported (Nepelski & De Prato, 2020).

4.3 Technology and skill intensity of the intensive margin of exports growth

Nepelski and De Prato (2020) indicate that countries that export higher-skill and technologically advanced goods grow faster, as seen in section 2.4. It is therefore important to establish where a country's exports are concentrated. In this section, countries' exports are divided into Lall (2000) product categories to analyse their export growth along the intensive margin of trade over the period 2007–2019 (addressing objective 5).

The shares that each product grouping holds in the different dynamic categories of the intensive margin (i.e. increases, decreases and extinctions) are presented in Figures 4.4–4.6 for Colombia, Ecuador, Egypt, Peru and South Africa. The products are classified according to categories of exports that reflect different technology and skill intensity (Lall, 2000). The technology and skill intensity increases from one product category to the next, starting with *primary products* and working towards *high-technology and high-skill manufactures*. *Primary products* refer to raw materials and

high-technology and high-skill manufactures refer to products that require high skill levels as well as advanced technology (as discussed in section 3.5).

Figure 4.4 shows the product categories within the intensive margin of South Africa's exports and those of the selected peer countries between 2007–2009 and 2017–2019. It displays the percentages by which the product categories increased.

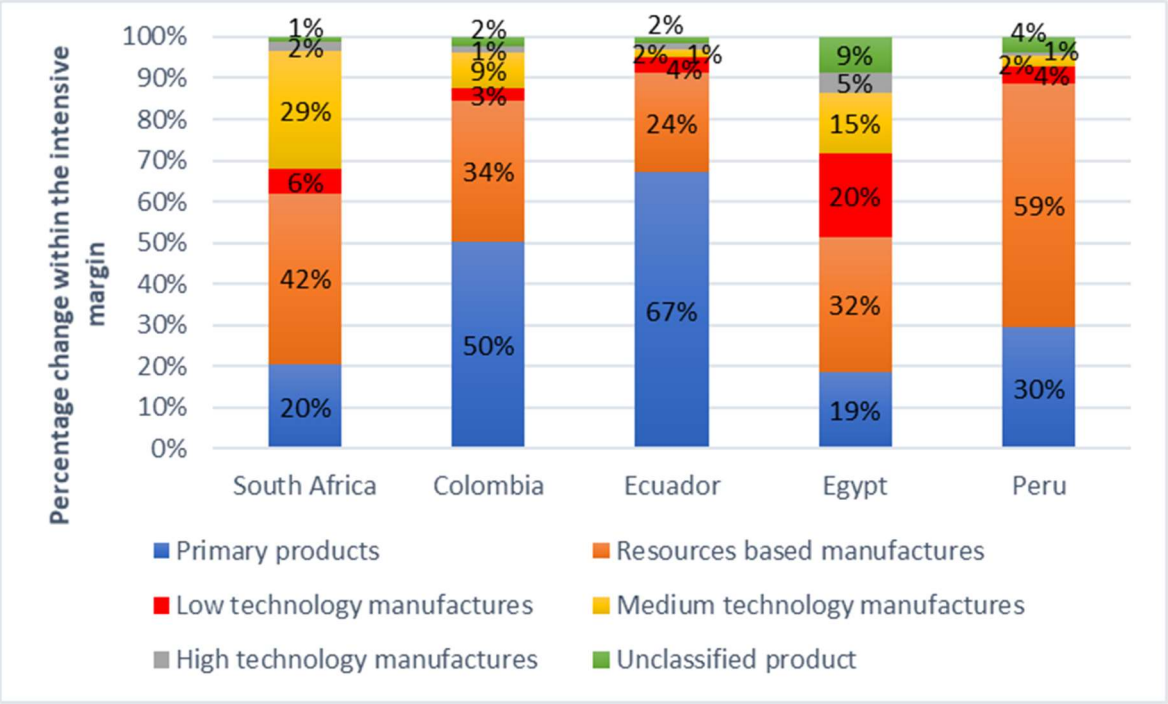

Figure 4-4: South Africa's and the selected peer countries' percentage change in increases in product categories in the intensive margin (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021)

Figure 4.4 shows that South Africa's largest increase in exports (42%) is attributed to the *resource-based manufactures* category. This product category is dominated by iron, chromium and magnesium ores as well as petroleum oils (see Table A2-1). Tables A2-1–A2-15 show South Africa's and the selected peer countries' top 30 export relationships that increased, decreased and became extinct over the period 2007–2019. This corresponds with the findings of Matthee *et al.* (2016) who also noted a large (38%) increase in iron, chromium and magnesium ores, and petroleum oils over the period 1994–2012. Other studies, such as Matthee and Santana-Gallego (2017) and Ferreira and Steenkamp (2020), confirm South Africa's high dependence on these types of resource-based exports.

Furthermore, it is evident from Figure 4.4 that South Africa's second-largest increase (29%) was in the product category *medium-skill and technology-intensive manufactures*. Automobiles dominate this category (see Table A2-1). Again, this is very similar to the results of the study by Matthee *et al.* (2016) in which the m*edium-skill and technology-intensive manufactures* category accounted for 22% of the increases in South Africa's intensive margin over the period 1994–2012.

Regarding the selected peer countries, the largest increases in exports were in the *primary products* and *resource-based manufactures* categories. For three (Colombia, Peru and Ecuador) of the four peer countries, these two product categories contributed more than 80% of their increases in the intensive margin. The exports of these three countries were dominated by exports of animals and fish, fruit, and copper and iron concentrates (see Tables A2-4, A2-7 and A2-13).

The country whose increases were most similar to those of South Africa within the intensive margin was Egypt. Nineteen per cent of Egypt's increases in the intensive margin consisted of *primary products*, 32% consisted of *resource-based manufactures*, and 20% and 15% consisted of *medium-skill and low-skill and technology-intensive manufactures* respectively. Egypt's exports mostly consisted of petroleum oils and fruit (*primary products* and *resource-based manufactures*), textile materials (*low-skill and technology-intensive manufactures*) and polypropylene and electric conductors (*medium-skill and technology-intensive manufactures*) (see Table A2-10).

Although it is important to consider product categories that increased over the period 2007–2019, it is equally important to determine which product categories declined in that period. Figure 4.5 presents the decreases. Similar to Figure 4.4, Figure 4.5 shows South Africa's and the selected peer countries' percentage change in decreases in product categories within the intensive margin in the period 2007–2019.

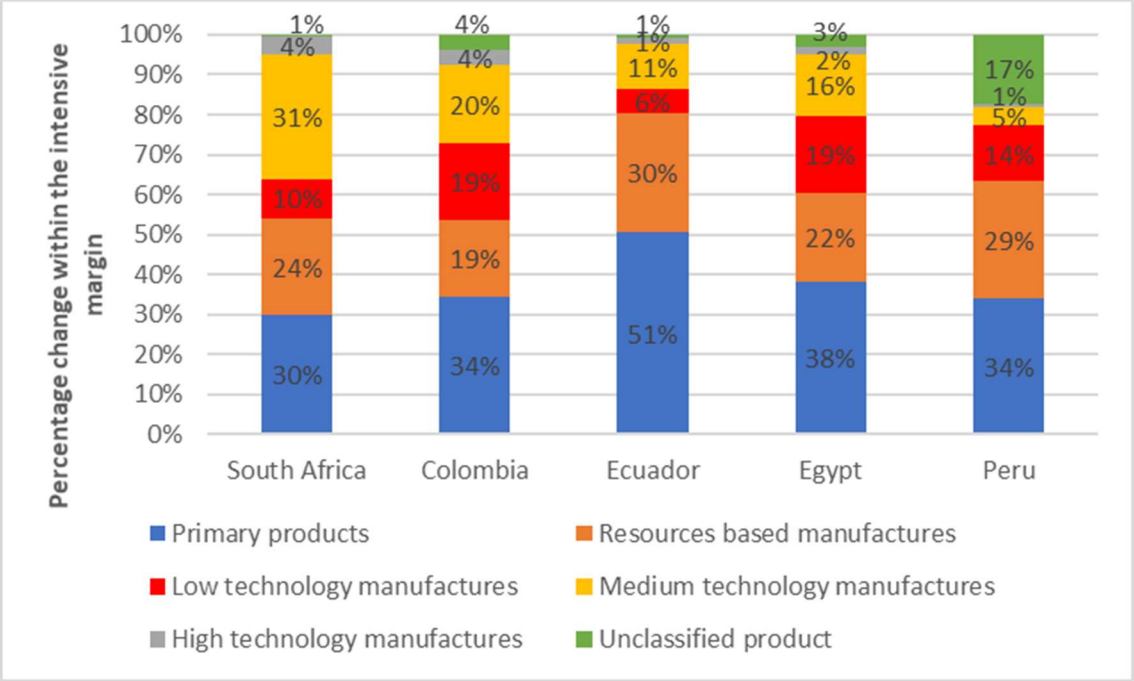

Figure 4-5: South Africa's and the selected peer countries' percentage change in decreases in product categories within the intensive margin (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021)

The results presented in Figure 4.5 indicate that South Africa's largest decreases were in *medium-skill and technology-intensive manufactures* (31%), *primary products* (30%) and *resource-based manufactures* (24%). Together these account for 85% of the decreases in South Africa's intensive margin and are mainly made up of automobiles and machinery (*medium-skill and technology-intensive manufactures*), platinum and coal (*primary products*) and iron and copper ores and concentrates. and petroleum oils (*resource-based manufactures*) (see Table A2-2).

There has been a shift in the decreases within the intensive margin. In this regard, Matthee *et al.* (2016) found that 50% of decreases were in the *resource-based manufactures* category in the period 1994–2012. This included decreases in exports of diamonds, textiles and textile articles, paper and pulp products and leather-related products. As discussed previously, export relationships can also become extinct. This means that the countries lacked the means to sustain the relationship. Figure 4.6 shows South Africa's and the selected peer countries' percentage change in extinctions within the intensive margin over the period 2007–2019.

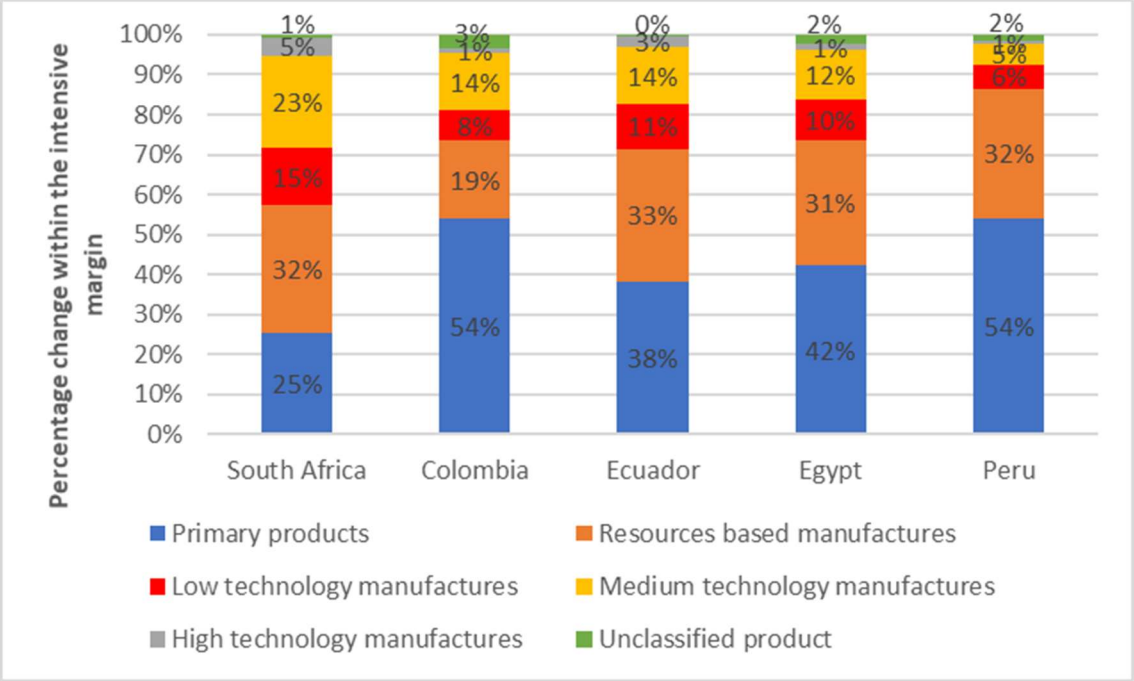

Figure 4-6: South Africa's and the selected peer countries' percentage change in extinctions within the intensive margin (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021)

As seen in Figure 4.6, there has also been a shift in extinctions in South Africa's intensive margin, as most extinctions occur in these three categories. The extinct export relationships mostly relate to saturated monohydric alcohols, ferro-manganese and propylene (*medium-skill and technology-intensive manufactures*), platinum, aluminium and coal (*primary products*) and iron, nickel and copper concentrates (*resource-based manufactures*) (see Table A2-3).

Regarding the selected peer countries, Figures 4.4 and 4.5 show that most of their decreases and extinctions occurred in the *primary products* category. The decreases and extinctions in Egypt's export relationships were dominated by liquefied natural gas and petroleum and oil; in Colombia by animals and fish products; in Peru by redefined copper, oils and fish; and in Ecuador by petroleum oils (see Tables A2-11, A2-5, A2-14 and A2-8 respectively). Although Egypt's decreases and extinctions were mostly in the *primary products* and *resource-based manufactures* categories, the country had the most similar pattern to South Africa.

In this section, South Africa's percentage change in increases within the intensive margin over the period 2007–2019 was compared to that of the selected peer

countries. Section 4.2 emphasised that South Africa has a more diverse export profile while that of the selected peer countries is specialised. In terms of increases and decreases in product categories, it is clear that the selected peer countries' exports were concentrated in the *resource-based manufactures* and *primary products* categories, while South Africa's exports were scattered across the *resource-based manufactures*, *primary products* and *medium-skill and technology-intensive manufactures* categories. However, Egypt – with the most similar pattern to South Africa – showed more decreases in the *primary products* category.

South Africa showed high decreases in export relationships in those product categories in which it experienced its top increases. South Africa is still on the same export path that it was on when Matthee *et al.* (2016) investigated the country's growth along the intensive margin over the period 1994–2012. They found that most growth took place in *non-fuel primary commodities,* which is captured in the *resource-based manufactures* category in this study, and in *medium-skill and technology-intensive manufactures*, which is the same as in this study. *Non-fuel primary commodities* constitute primary products that are not products of oil and gas, such as plastics, fertilisers and more.

However, the decreases and extinctions have occurred in these same product categories, which indicates that although South Africa is gaining ground in some export markets in these categories, they are losing ground in the same categories. South Africa needs to revise its export portfolio as its resources are scattered across too many product categories. The selected peer countries are focusing more of their resources on a certain group of products while South Africa is focusing its resource on a variety of product categories. This could possibly explain the differences in export growth between these countries.

A country's exports to its most important markets/regions can reveal where the country's exports are concentrated. In this regard, the next section evaluates South Africa's skills and technology composition of its exports from a geographical perspective.

4.4 Skills and technology composition of exports from a geographical perspective

Previous studies have revealed the importance of consideration being given to the composition of exports from a geographical perspective (Piazolo, 1997; Edwards & Schoër, 2001; Matthee *et al.,* 2016). This section therefore analyses the composition of South Africa's exports from a geographical point of view (thus addressing objective 5).

Figures 4.7, 4.8 and 4.9 show how the different product categories increased, decreased and became extinct in selected export countries/regions, as discussed in section 3.4. This provides an indication of how the composition of South Africa's main export markets has changed from 2012 – when a similar study by Matthee *et al*. (2016) was conducted – to 2019.

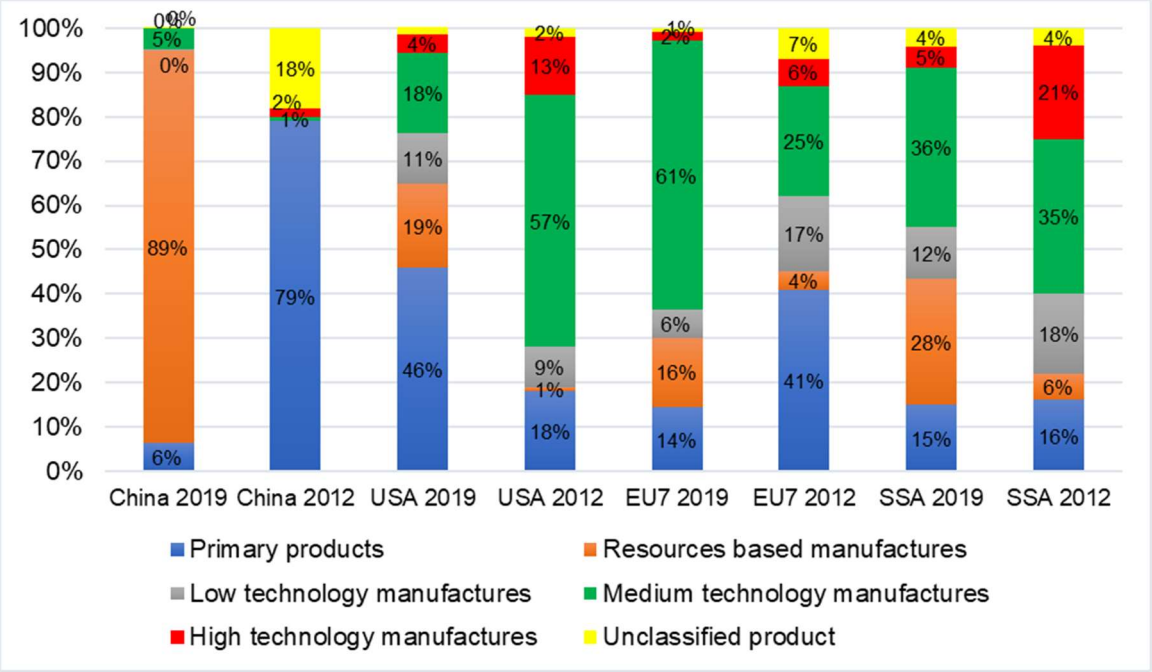

Figure 4-7: Skills and technology composition of increases in South Africa's intensive margin from a geographical perspective (2012–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021), Lall (2000) and Matthee et al. (2016)

Figure 4.7 shows the skills and technology composition of increases in South Africa's intensive margin for its main export markets. As seen in Figure 2.5, these countries/regions make up South Africa's top 10 export markets, with the exception of

Japan and India. When comparing the results in Figure 4.7 with the findings of Matthee *et al.* (2016) for the period 1994–2012, it will be noted that South Africa's export relationship with China has shifted from one of exporting *primary products* (indicated in blue) to exporting *resource-based manufactures* (indicated in orange). Interestingly, South Africa exported fewer *medium-skill and technology-intensive manufactures* (indicated in green) and more *primary products* to the US. This is very concerning as exports of higher-skill products are linked to more development. However, the opposite occurred with the EU7, with South Africa increasing its exports of *medium-skill and technology-intensive manufactures* to the EU7. This could be a sign of growth in their relationship, which is good for South Africa. South Africa has strong trade ties with the EU – evidenced in the fact that the country is the EU's largest trading partner in Africa and also has an FTA with the EU. This could have a positive effect on its growth.

Moreover, South Africa increased its exports of higher-skill products to its main trading partners. These exports consist of *resource-based manufactures* like polypropylene and *medium-skill and technology-intensive manufactures* like automobiles (see Table A4-1). The same can be observed when analysing the composition of decreases in South Africa's intensive margin for the different regions, with exports of *primary products* to China, the US and the EU7 decreasing substantially. This is much more pronounced than in the study by Matthee *et al.* (2016), which could be an indication of diversification into other product categories.

Figure 4.8 presents the skills and technology composition of decreases in South Africa's intensive margin from a geographical perspective.

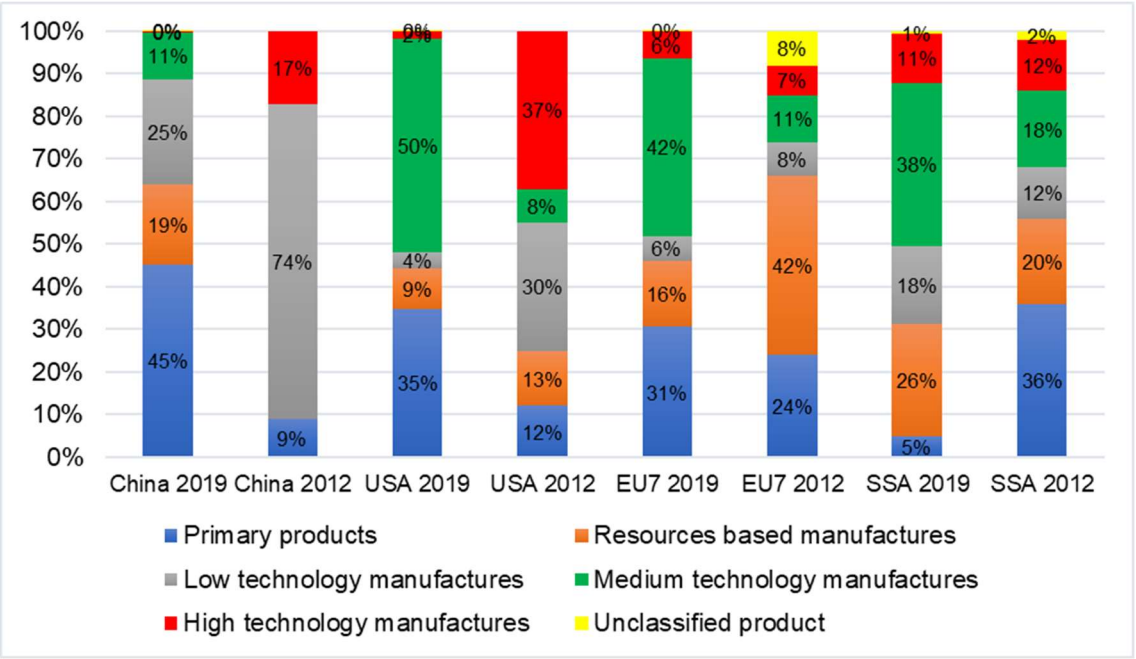

Figure 4-8: Skills and technology composition of decreases in South Africa's intensive margin from a geographical perspective (2012 vs2019)

Source: Author's own calculations based on data from UN COMTRADE (2021), Lall (2000) and Matthee et al. (2016)

Figure 4.8 shows South Africa's export relationships that decreased in value in the period 2012–2019. Of South Africa's exports of *low-skill and technology-intensive manufactures* to China that decreased over the period, the value of these exports was lower in 2019 than in 2012. Matthee *et al.* (2016) found that these products accounted for 74% of the decrease in exports over the period 1994–2012. The decrease in exports of *low-skill and technology-intensive manufactures* from South Africa to China related to exports of precious steel (see Table A4-2), which can be due to the US in 2018 imposing a tariff of 25% on steel imports (Liu, 2018). This came in the wake of a trade war between China and the US in which each country imposed tariffs on the other, the effects of which spilled over into other countries like South Africa (Liu, 2018).

Exports of *medium-skill and technology-intensive manufactures* to the US, EU7 and SSA showed a much more substantial decrease in 2019 than in 2012. In the US, the drop in 2019 was due to South Africa exporting fewer automobiles. In addition, South African exports of ferro-chromium and filtering decreased to the EU7, while its exports of purifying machinery to the SSA decreased substantially (see Table A4-2).

Regarding exports to South Africa's top export markets, Figure 4.9 shows that the product categories that decreased the most (as seen in Figure 4.8) also had the highest percentage of extinctions. Extinctions are those export relationships that had an export value in the period 2007–2009, but no export value in the period 2017–2019 (as discussed in section 3.2).

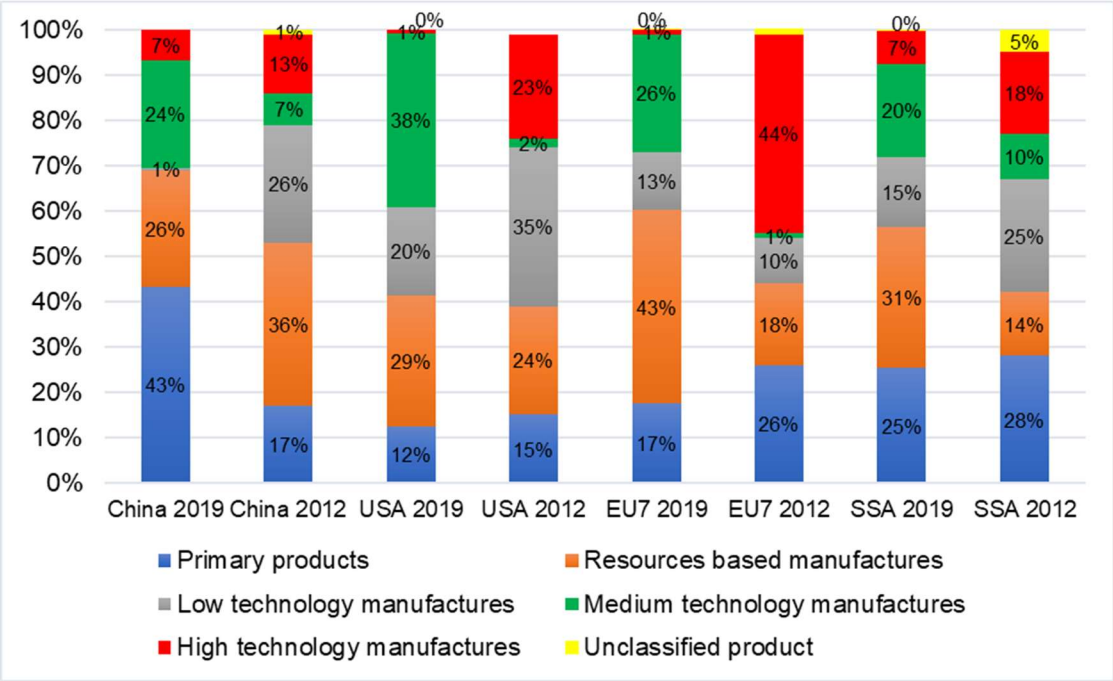

Figure 4-9: Skills and technology composition of extinctions in South Africa's intensive margin from a geographical perspective (2012–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021), Lall (2000) and Matthee et al. (2016)

Figure 4.9 presents the skills and technology composition of extinctions in South Africa's intensive margin from a geographical perspective. South Africa's exports of *primary products* (indicated in blue) to China experienced the most extinctions, followed by *resource-based manufactures* (indicated in orange) and *medium-skill and technology-intensive manufactures* (indicated in green). The extinctions in 2012 mostly consisted of *resource-based manufactures* whereas in 2019 the extinctions mostly consisted of *primary products.* This could point to some growth in technological exports to China.

What also stands out is that South Africa's exports of *medium-skill and technology-intensive manufactures* experienced quite heavy extinctions in the US, the EU7 and the SSA in 2019. This signals a change as in 2012 the largest extinctions in these

regions were the result of *high-skill and technology-intensive manufactures.* The results presented in Figures 4.7–4.9 show that South Africa's exports of *resource-based manufactures* to China grew in 2019, whereas South Africa's exports of *primary products* to China mostly decreased and became extinct between 2007–2009 and 2017–2019.

South Africa's export relationship with the US was characterised by an increase in exports of *primary products* (Figure 4.7) in 2019. However, South Africa's exports of *medium-skill and technology-intensive manufactures* to the US decreased or became extinct (Figures 4.7 and 4.8). This is quite concerning as Matthee *et al.* (2016) showed that in the period 1994–2012, South Africa's exports of *medium-skill and technology-intensive manufactures* to the US had shown the highest increase of all the export categories. This is a sign that the export relationship between South Africa and the US has changed in the last decade. Moreover, instead of moving forward by exporting larger volumes of high-skill products, South Africa is now exporting more *primary products* to the US, demonstrating a lack of structural improvement on South Africa's part. This could be one of the factors contributing to South Africa's stagnant export growth.

In contrast, South Africa's export relationship with the EU7 has changed, since its largest increases (Figure 4.7) and decreases (Figure 4.8) in export categories relate to *medium-skill and technology-intensive manufactures*. Yet, in the period 1994–2012, the largest increases and decreases in export categories related to *primary products* (Matthee *et al.,* 2016). This shows that South Africa's export relationship with the EU7 is maturing as it is exporting more higher-skill and technology-intensive products to the EU7.

It is evident from Figures 4.7–4.9 that South Africa's export relationship with SSA has stayed relatively the same as that described in Matthee *et al.* (2016). South Africa has experienced large increases in exports of *medium-skill and technology-intensive manufactures* and large decreases and extinctions in *resource-based manufactures* and *primary products*. Moreover, exports of *medium-skill and technology-intensive manufactures* to SSA decreased substantially (Figure 4.8, indicated in green), revealing a shift in county–product pairs within this product grouping.

Overall, South Africa has not increased its exports of *high-technology manufactures* (represented in red), while its exports of *primary products* and *resource-based manufactures* are still too large – trends that can also be observed in the country's exports to some of its biggest trading partners.

To determine if South Africa can sustain its current export structure, as described in this section, it is necessary to investigate the composition of its factor endowments which support its production and exports (Steenkamp, 2018). In the next section, South Africa's and the selected peer countries' factor endowments are investigated.

4.5 Revealed factor intensities

The discussion in section 3.5 highlights the fact that a country's human and physical capital is an important factor contributing to export sustainability (Rahim *et al.,* 2021). Therefore, this section focuses on analysing the factor endowments of South Africa and the selected peer countries to establish whether their exports are sustainable (thus addressing objective 7). It is important to note that there are many other factors driving export sustainability. However, only factor endowments are analysed as the other factors fall outside the scope of this study (as discussed in section 2.5). For the purposes of this study, the revealed physical capital intensity index and the revealed human capital intensity index are used to measure the sustainability of South Africa's and the selected peer countries' exports (as discussed in section 3.5).

Figure 4.10 shows the distance between each country's endowment point and the revealed human capital intensity and revealed physical capital intensity needed to produce the export product. The diagrams are based on all the products that showed increases along South Africa's and the selected peer countries' intensive margins. The endowment point is the point at which South Africa's human and physical capital endowments come together (as discussed in section 2.5). Furthermore, the endowment point refers to the current human and physical capital available in the country. The revealed human capital intensity and revealed physical capital intensity refer to the human and physical capital that the products require to be exported (Shirotori *et al.,* 2010). The distance between these factors may explain the sustainability of South Africa's and the selected peer countries' export relationships.

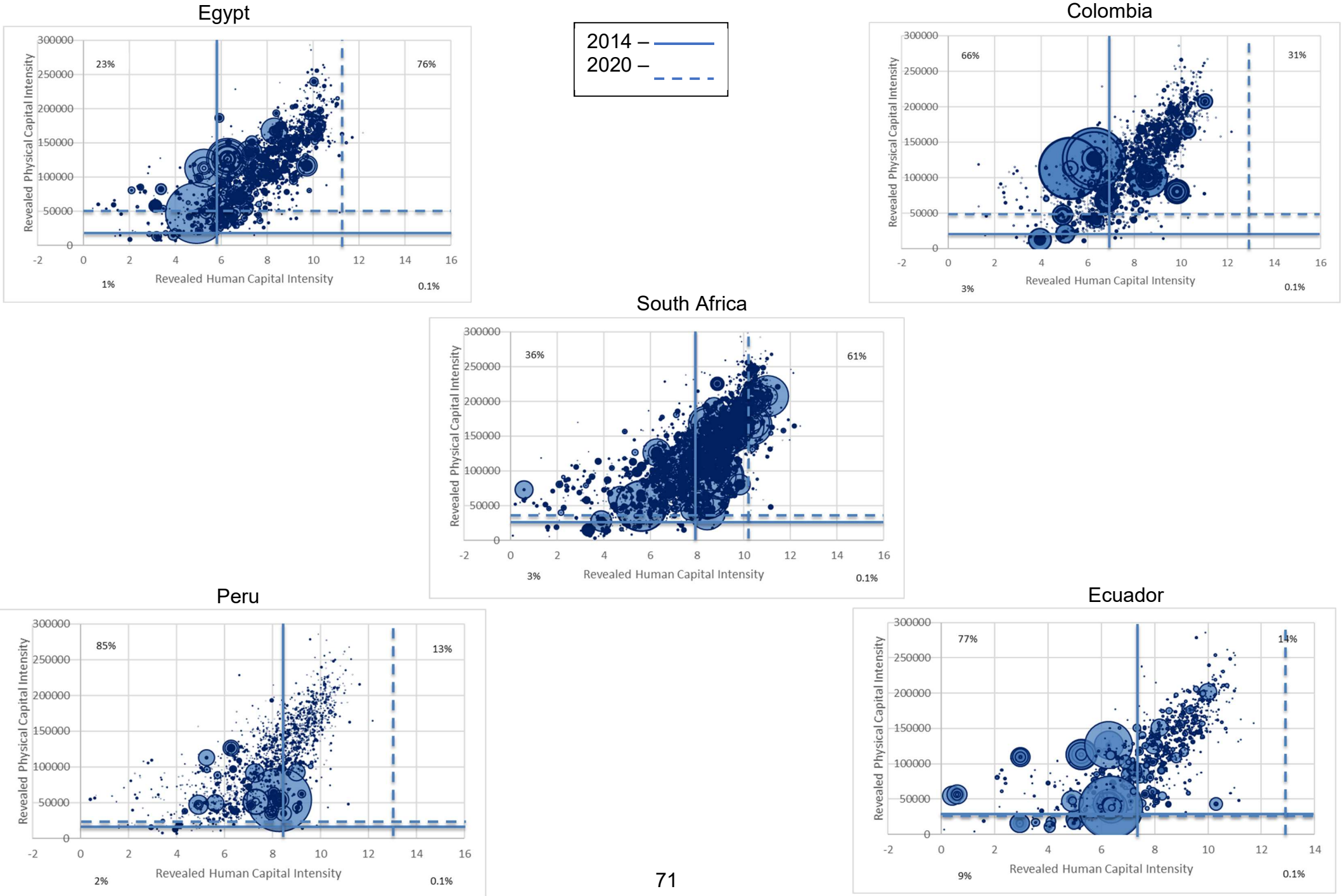

Figure 4-10: Increases in the intensive margin relative to factor endowments

Source: Author's own calculations based on data from UN COMTRADE and McLaren et al. (2018)

In Figure 4.10, the quadrants for each country are formed by using the physical and human capital endowments for the years 2014 (solid lines) and 2020 (dashed lines) respectively. Each product requires a different mix of human and physical capital (as discussed in section 3.5). If a product falls within the top left quadrant, it means that the country has enough human capital to produce the product but not sufficient physical capital. If a product falls within the top right quadrant, it means that the country does not have sufficient embedded human capital or physical capital to produce the product. If a product falls within the bottom left quadrant, it means that the country has enough human capital and physical capital to produce the product. Finally, if a product falls within the bottom right quadrant, it means that the country has enough physical capital to produce the product but not sufficient human capital. The percentages (in the corners) in each quadrant reflect the value share of the exports that increased in the intensive margin.

These figures show the 2014 and 2020 human and physical capital endowment points for South Africa and the selected peer countries. This is because the revealed factor intensities of products are only available for 2014; hence, 2020 is not comparable but provides a good indication of how things developed. Revealed factor intensities can be calculated for each year. However, this study used existing data since building a new factor-intensity database falls outside the scope of the study. Nevertheless, it is evident that South Africa's human and physical capital levels have increased, and this provides some insight into the country's development. Table 4.1 presents a summary of South Africa's and the selected peer countries' human and physical capital for 2014 and 2020 respectively.

Table 4-1: Countries' human and physical capital (2014 and 2020)

Country	Human capital 2014	Human capital 2020	Physical capital 2014	Physical capital 2020
South Africa	7.93 years	10.2 years	USD 28 409 110	USD 37 518 250
Colombia	6.95 years	12.9 years	USD 21 154 830	USD 51 104 920
Ecuador	7.39 years	12.9 years	USD 28 968 250	USD 22 840 900
Egypt	5.86 years	11.5 years	USD 15 281 250	USD 50 180 910
Peru	8.36 years	13 years	USD 22 873 190	USD 36 000 460

Source: Author's own compilation based on data from UN COMTRADE (2021) and the World Bank (2021)

Table 4.1 shows that South Africa's human capital endowment, measured by average years of schooling, was 7.93 years in 2014 and 10.2 years in 2020. South Africa's physical capital endowment (reflected in capital stock) was approximately USD 28.4

million in 2014 and approximately USD 37.5 million in 2020 (World Bank, 2021b). From the table it is clear that in 2014 South Africa's human and physical capital exceeded those of Egypt. However, this situation changed between 2014 and 2020. South Africa had a human capital endowment of 10.2 years of schooling in 2020, while Egypt had a human capital endowment of 11.5 years of schooling that year. South Africa had a physical capital endowment of approximately USD 37.5 million in 2020, while Egypt had a physical capital endowment of approximately USD 50.1 million. This implies that Egypt invested more in the development of its human and physical capital in the period 2014–2020, which could be a factor contributing to the difference in export growth between the countries. Table 4.1 also shows that most of South Africa's peer countries yielded the same result, especially where countries' human capital endowment increased more than that of South Africa.

When it comes to what South Africa needs in order to produce the export products (see Figure 4.10), its current levels of physical and human capital are not enough to support these products. Most of the products fall outside South Africa's endowment point, indicating that it will be difficult for the country to sustain these exports in the future. In relation to the factor endowment levels in 2014, as shown in Figure 4.10, 61% of the products that increased in South Africa's intensive margin exceed the revealed factor content of the country's factor endowment point (as seen in the top right quadrant). This can be attributed to the widespread differences in education levels in South Africa (OECD, 2019). While upper secondary education levels (high school) have been rising in South Africa, with 77% of young adults (25–34 years) having upper secondary education, only 6% of young adults have tertiary education (OECD, 2019). However, the revealed factor content of only 36% of the products that increased fall within the human capital endowment of South Africa; yet this still exceeds the country's physical capital endowment (as seen in the top left quadrant). In other words, although South Africa has the knowledge to produce these products, it lacks the machinery, buildings and other necessary capital resources, which means that the production of these products may be under pressure and difficult to sustain.

The factor content of only 3% of South Africa's products that increased in the intensive margin between 2007–2009 and 2017–2019 falls within its endowment point (as seen in the bottom left quadrant). This means that with respect to all the products that

increased in South Africa's intensive margin, the country has enough human and physical capital to sustain 3% of these.

When comparing South Africa's results with those of the selected peer countries, it becomes clear that the factor content of most of the countries' increases is more within their human capital capabilities. While only 13% of the products increased in Peru's intensive margin, the factor content exceeds the country's factor endowment point. While only 14% of the products increased in Ecuador's intensive margin, the factor content exceeds the country's factor endowment point. Colombia has more products, of which the revealed factor content exceeds the endowment point, but the proportion is still less than that for South Africa (as seen in the top right quadrant).

When considering the percentage of exported products that fall within the selected peer countries' human capital endowment, it is clear that all the peer countries have a higher percentage of products in the top left quadrant than South Africa. In Peru, 87% of increases in the intensive margin fall within the country's human capital endowment. Ecuador shows a similar result, with 86% falling within its human capital endowment, while Colombia has 66% falling within its human capital endowment. Ecuador has the highest percentage of products with factor content falling within the human and physical capital endowment point of the country (9%) (as seen in the bottom left quadrant). Egypt shows a pattern that is more similar to that of South Africa, with 76% of the factor content of the products that increased in the intensive margin exceeding its endowment point. The factor content of 23% of the products that increased falls within the human capital endowment of Egypt but still exceeds its physical capital endowment.

South Africa can also learn from Peru and Ecuador as most of the products that they export fall within their human capital endowment. This means that these countries build on their current knowledge of producing products, which helps them to produce products more effectively in the future and produce products that need similar resources (Hausmann & Klinger, 2007). It is also easier to produce the goods that these countries currently export since they already have the knowledge to produce such goods, as reflected in their human capital endowment.

The analysis of the revealed factor intensities provides an indication of whether the increases in South Africa's and the selected peer countries' intensive margins are sustainable or not. The revealed factor intensities of the decreases in South Africa's and the selected peer countries' intensive margins may provide valuable insights into why the exports were not sustained over time.

Figure 4.11 shows the distance between the countries' endowment point and the revealed human and physical capital intensity of their exports which showed decreases within the intensive margin over the period 2007–2019. Most (66%) of South Africa's decreases are located in the upper right quadrant. This implies that South Africa does not have sufficient human or physical capital to sustain these products. South Africa has sufficient human capital to export 33% of the decreases in its intensive margin but does not have enough embedded physical capital to maintain these exports (as seen in the first quadrant). Only 1% (as seen in the lower left quadrant) of decreases in South Africa's intensive margin fall within its endowment capabilities, which means that it is difficult for South Africa to sustain the 99% of exports that fall outside its endowment point.

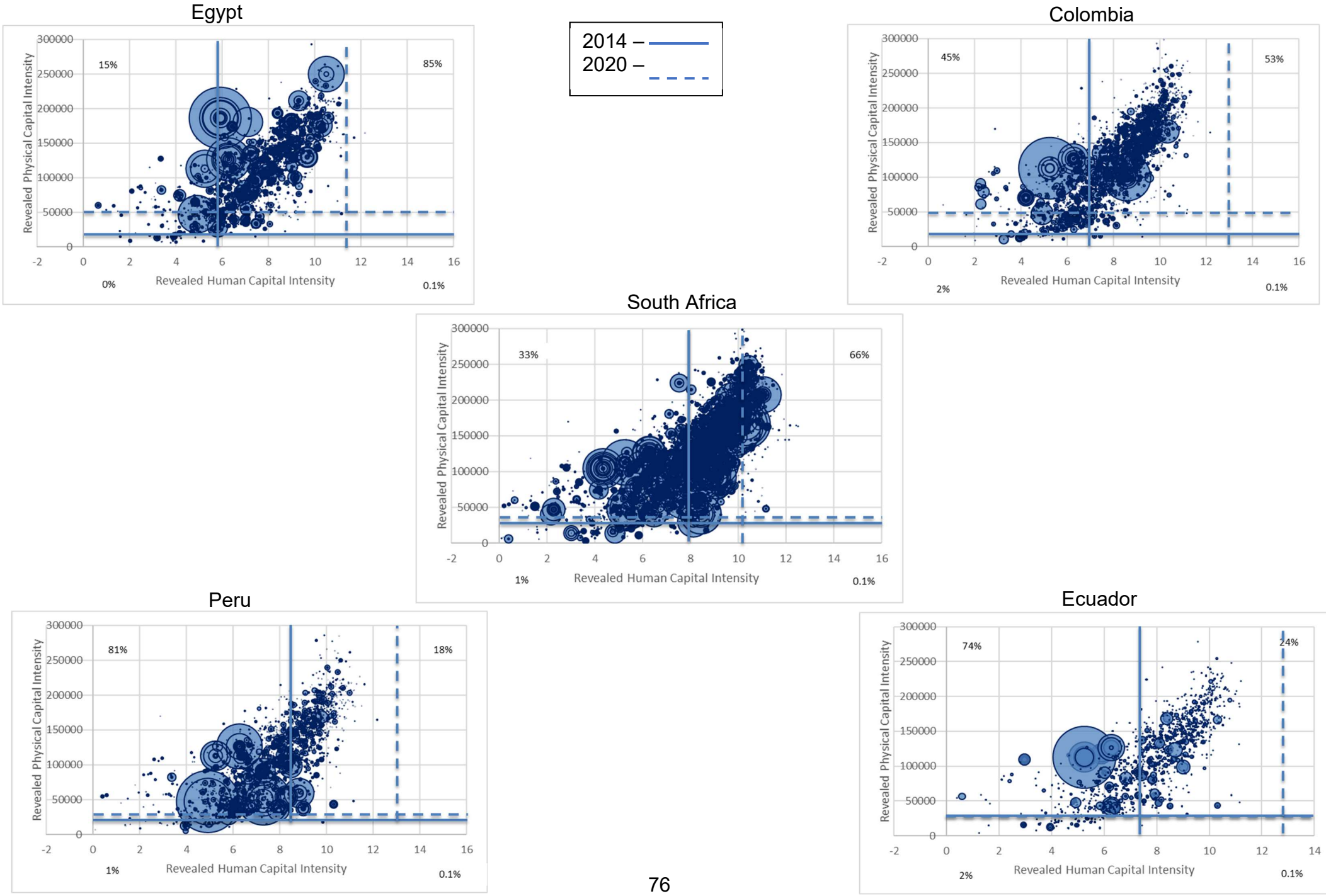

Figure 4-11: Decreases in the intensive margin relative to factor endowments

Source: Author's own calculations based on data from UN COMTRADE and McLaren et al. (2018)

When comparing these results with those of the selected peer countries (also see Figure 4.11), it is clear that, while South Africa's decreases are mostly attributed to a lack of physical and human capital, Peru's and Ecuador's decreases are mostly due to a lack of physical capital. This could be an indication that South Africa needs to invest more in its human capital endowment.

The factor intensities of the extinctions within the intensive margins of South Africa and the selected peer countries will provide further insights into why these specific exports ceased. Figure 4.12 shows the distance between the countries' endowment point and the revealed human and physical capital intensities of their exports which became extinct along the intensive margin over the period 2007–2019. Of South Africa's products that became extinct, 68% are located in the upper right quadrant. This implies that these products exceeded South Africa's physical and human capital endowments. A further 28% of South Africa's export extinctions fall within its human capital endowment but exceed its physical capital endowment (located in the upper left quadrant); as a result, these exports ceased. Of South Africa's export extinctions, 4% fall both within the human and physical capital endowment, which could be an indication that South Africa is diversifying away from some of its current export products. This could be prompted by declining interest in the market in the export products in question and businesses gravitating towards new products, or businesses failing in the face of financial loss (Steenkamp, 2018).

With reference to the peer countries, Peru's and Ecuador's exports that became extinct show the same results as the countries' decreases within the intensive margin. Peru and Ecuador both had sufficient human capital to sustain these exports; yet their levels of physical capital were insufficient. However, Colombia shows a similar result to the other two countries since most of its extinctions are due to a lack of physical capital. Therefore, most of the selected peer countries have a higher level of human capital than physical capital since most of their exports fall within their human capital endowment. In contrast, as seen in Table 4.1, South Africa's level of human capital grew at a slower pace than that of the selected peer countries in the period 2014–2020, which could be a factor contributing to its slow export growth compared to that of its peer countries (World Bank, 2021a).

To determine if there is a relationship between the dynamics in South Africa's and the selected peer countries' intensive margins and the distance between their endowment point and the factor intensities of their export products, the Spearman correlation analysis was run. This was aimed at indicating if South Africa's and the selected peer countries' factor endowments influence the dynamics in their intensive margins.

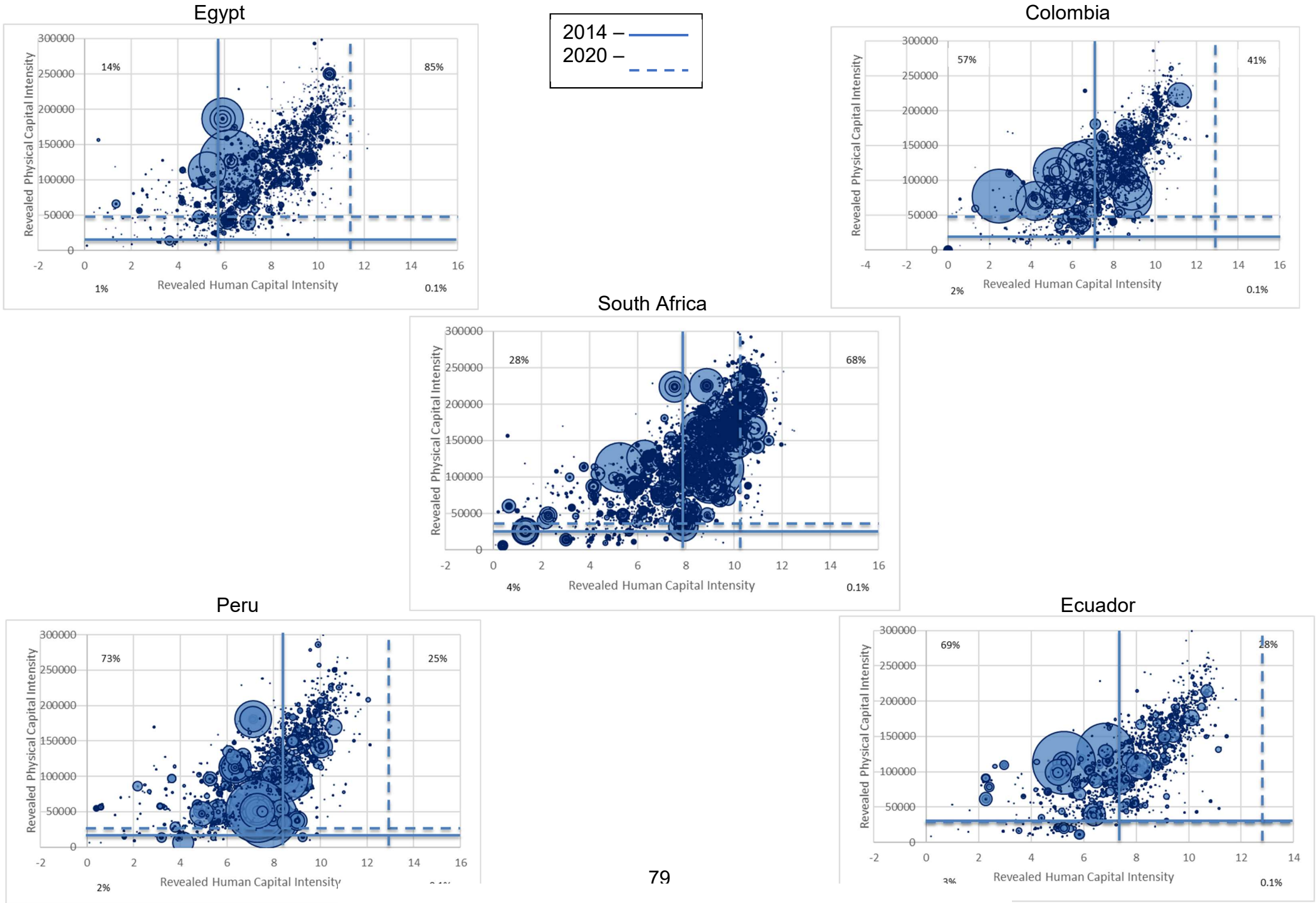

Figure 4-12: Extinctions in the intensive margin relative to factor endowments

Source: Author's own calculations based on data from UN COMTRADE and McLaren et al. (2018)

4.6 Spearman correlation analysis

To test the relationship between the dynamics in South Africa's and the selected peer countries' intensive margins and the distance between their endowment point and the factor intensities of their export products (to address objective 6), a correlation analysis was run in R (as discussed in section 3.6.2).

In Table 4.2, the results of the Spearman correlation analysis are presented for Colombia, Ecuador, Egypt, Peru and South Africa. *D_RPCI* refers to the distance between the countries' physical capital and the factor intensities of their export products. *D_RHCI* refers to the distance between the countries' human capital and the factor intensities of their export products.

The results in Table 4.2 show that South Africa's increases within its intensive margin are negatively correlated with the distance between South Africa's human and physical capital endowment and the human and physical capital intensity of these exports. As the coefficients for physical and human capital are less than -0.3, it indicates a very weak negative relationship. This means that the further away the product is from South Africa's endowment point, the smaller its contribution will be to increases in the intensive margin. This relationship is in line with what was expected from the literature.

Furthermore, South Africa's decreases and extinctions within its intensive margin are negatively correlated with the distance between South Africa's endowment point and the factor intensity of the human and physical capital. This means that the further away the product is from South Africa's endowment point, the less its contribution will be to decreases and extinctions in the intensive margin. On the one hand, it is clear that decreases within the intensive margin have a very weak correlation (-0.044 and -0.028) with the distance between South Africa's endowment point and the factor intensities of its export products. On the other hand, extinctions within South Africa's intensive margin have no relationship with the distance between South Africa's physical capital and the factor intensities of its export products. However, extinctions within South Africa's intensive margin do have a weak relationship with the distance between South Africa's human capital and the factor intensities of its export products.

Thus, although there are relationships between the dynamics in South Africa's intensive margin and the distance between its endowment point and the factor intensities of its export products, they are relatively weak. However, they are still statistically significant, which means it is worth taking them into consideration. Although the distance to South Africa's endowment point affects the increases in its intensive margin in the way that was expected, the decreases and extinctions are not affected in the way that was expected (as discussed in section 3.6.2).

Table 4-2: Correlation analysis of the distance to factor endowments within the intensive margin

Countries	Distance	Increase	Decrease	Extinction
South Africa	*D_RPCI*	-0.054*	-0.044*	0.004
	D_RHCI	-0.048*	-0.028*	-0.021**
Egypt	*D_RPCI*	-0.034*	0.023**	0.013
	D_RHCI	-0.026**	0.045*	0.012*
Colombia	*D_RPCI*	-0.041**	0.009	0.040*
	D_RHCI	-0.025**	0.020**	0.057*
Peru	*D_RPCI*	-0.101*	0.071*	0.147*
	D_RHCI	-0.066*	0.05*	0.114*
Ecuador	*D_RPCI*	-0.214*	0.088*	0.12*
	D_RHCI	-0.223*	0.071*	0.134*

Source: Author's own calculations (2021)

Note: * significant at the 0.01 level, ** significant at the 0.05 level.

On the other hand, Egypt, Colombia, Peru and Ecuador reflect the results that were expected (as explained in section 3.6.2). This means that all the selected peer countries' increases within their intensive margin correlate negatively with the distance between the countries' endowment point and the factor intensity of the human and physical capital. While weak, these relationships are still statistically significant. Thus, the further away the export product is from the countries' endowment point, the smaller its contribution is to increases in their intensive margins.

However, decreases and extinctions within the countries' intensive margin correlate positively with the distance between the countries' endowment point and the factor intensity of the human and physical capital. This implies that the further away the export product is from the country's endowment point, the larger its contribution is to decreases in their intensive margins. Clearly, then, changes within the countries'

intensive margins are to some degree influenced by the distance between the dynamics in their intensive margins and the distance between their endowment points and the factor intensities of their export products. Even though there are other factors influencing the sustainability of a country's exports (as discussed in section 2.5), the results presented in Table 4.2 show that increasing human and physical capital will enhance the sustainability of the countries' exports.

4.7 Conclusion

This chapter set out to determine the dynamics within the intensive margin of South Africa's and selected peer countries' exports, as well as the sustainability thereof, by using the data and methods discussed in Chapter 3.

The results confirm that although South Africa has a more diverse export portfolio than that of selected peer countries, it is still growing at a slower pace. As a result, the theoretical tension between diversification and specialisation becomes a feature of this study. The results suggest that South Africa needs to embrace specialisation as this is the main differentiating factor between South Africa and selected peer countries whose export growth performance is better. This is particularly evident in the countries' increases, decreases and extinctions in its intensive margins. South Africa's increases, decreases and extinctions are scattered across many products, while the selected peer countries' increases, decreases and extinctions are confined to a small group of products.

When looking at the composition of South Africa's decreases from a geographical perspective, it is notable that exports of *primary products* to China, the US and the EU7 have decreased by a substantial amount. This could be an indication that the country is diversifying into other export product categories as the decreases are much more pronounced than those noted by Matthee *et al.* (2016). However, South Africa needs to build up its current human capital as this is where South Africa and the selected peer countries differ markedly. This could possibly be contributing to the country's slow pace of export growth compared to that of the selected peer countries.

The results of this study therefore support the views of Matthee *et al.* (2016) which suggest that South Africa needs to invest more heavily in its human and physical capital endowments. However, South Africa must also focus its attention on a smaller,

more specific group of products as opposed to a large group of products. This is a factor that could be influencing the different export growth performance of South Africa and the selected peer countries respectively.

Chapter 5 provides a summary of and conclusion to the study and also presents some recommendations based on the results discussed in this chapter.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Many scholars have emphasised the importance of export diversification for countries' economic growth and development. This applies in particular to African countries whose commodity dependency has long made them vulnerable to global economic shocks and shielded them from many of the product- and market-related opportunities provided by regional and global value chains as well as broader economic integration initiatives across the continent.

Economic growth and export growth are strongly intertwined. A country's exports can grow along the intensive margin of trade (existing trade flows are enhanced) or along the extensive margin of trade (new trade flows are created). According to Amurgo-Pacheco and Pierola (2008), developing countries' exports mostly grow along the intensive margin. In other words, these countries tend to export higher volumes of existing products to existing trading partners. This is an indication that developing countries often find it difficult – because of limited resources, expertise and global connections – to make inroads into new (non-traditional) export markets and/or to develop new, value-added products that will withstand global competition.

Although South Africa's exports are relatively diverse by African standards, they are less diverse than those of other emerging markets like China and India. South Africa's export growth along the intensive margin (81%) far exceeded that along the extensive margin (19%) in 2018–2019. This means that most export growth is due to increasing existing trade flows as opposed to creating new trade flows, thus highlighting the difficulty the country faces in growing and diversifying its exports. South Africa still relies heavily on primary and low value-added exports. Yet export growth is critical for spurring much-needed economic growth, which will enable the country to tackle its many longstanding development challenges, including widespread poverty. Of particular concern is the fact that South Africa's endowment capabilities (physical labour and capital) are insufficient to drive sustainable export growth in the products it is currently exporting. This is notwithstanding South Africa's abundance of labour – albeit largely of the unskilled variety. In this regard, there is much empirical evidence

to suggest that increasing the human and physical intensity of exports leads to an increase in technological complexity, which is value enhancing.

Based on the findings from a comprehensive literature review, the empirical part of this study involved conducting a decomposition of South Africa's export performance and sustainability and comparing the findings with those for a selected group of peer countries (Colombia, Ecuador, Egypt and Peru). This was aimed at arriving at a better understanding of where South Africa's export growth is concentrated within the intensive margin and why the country is lagging behind many of its peers in terms of export performance, despite having a sizeable economy with economic activities straddling a wide range of sectors. Through this comparative approach, South Africa could potentially learn some valuable lessons from its peers.

Chapter 2 contextualised the study by discussing the traditional and modern trade theories, analysing the empirical literature on export growth through the intensive and extensive margins, examining the impact of technology and skill intensities as well as the revealed factor intensities of export products, and providing an overview of South Africa's export trends. Chapter 3 explained the methods applied in the study to, firstly, analyse South Africa's export growth along the intensive margin and, secondly, determine if the country's export portfolio is sustainable from a factor endowment perspective. Chapter 4 then provided the results of the analysis, which included a benchmarking of South Africa's export performance against that of the selected peer countries.

Table 5.1 looks at how the objectives of the study (as set out in Chapter 1) were achieved with reference to specific chapters.

Table 5-1: Achievement of the research objectives

Number	Research objectives	Chapter in which addressed
Theoretical objectives		
1	Review the traditional and modern trade theories relating to export diversification and factor endowments.	Chapter 2
2	Define and discuss the intensive and extensive margins (of export performance) by reviewing relevant literature, with a special focus on South Africa.	Chapter 2
3	Review the relevant literature on technology and factor intensities of production.	Chapter 2
4	Provide an overview of South Africa's export trends.	Chapter 2

Empirical objectives		
5	Conduct a decomposition of South Africa's, and the selected peer countries', export growth in the intensive margin over the period 2007–2019.	Chapter 4
6.	Determine the export sustainability of South Africa and the selected peer countries from a factor intensity perspective.	Chapter 4
7	Compare the findings with those of the selected peer countries, namely Colombia, Ecuador, Egypt and Peru.	Chapter 4

Source: Author's own compilation

In the next section a summary and conclusion of the study are provided.

5.2 Summary of the results and conclusions of the study

Numerous studies have drawn attention to the fact that South Africa's export performance has been lagging behind that of its peers (Edwards & Lawrence, 2008; Rossouw & Naudé, 2008; Choga & Tsegaye, 2015; Matthee *et al.,* 2016; Matthee & Santana-Gallego, 2017). However, as these studies were only up to date as of 2014, it was important to also consider more recent data in order to arrive at a contemporary view of South Africa's export performance and sustainability prospects – particularly against the backdrop of the ongoing ebbs and flows in the global commodity cycle and the launch of Africa's ambitious integration project, the African Continental Free Trade Area (AfCFTA).

To this end, South Africa's export growth was decomposed along the intensive margin by grouping products into different product categories according to their technology and skill intensities. This revealed where most growth occurred. The results were then compared with those for the selected peer countries, which helped to throw light on what these countries were doing differently and why they may be outpacing South Africa in terms of export growth. Such insights into peer countries' export activities could help to inform and guide South Africa's export strategy going forward and lay the foundation for a more diversified, and thus economically empowering, export product–market mix.

The intensive and extensive margin of export growth can be analysed using two approaches: the first approach is to analyse the decomposition of the level of trade at one point in time, while the second approach is to analyse the decomposition of trade growth over time. For the purposes of (and considering the nature of) this study, the second approach was used for the period 2007–2019.

In brief, growth along South Africa's intensive margin of exports was measured by first grouping export relationships into the three dimensions of the intensive margin, namely *increases*, *decreases* and *extinctions*. Subsequently, products were grouped into Lall's (2000) six product categories according to their technology and skill intensity to see in which product categories the most growth took place. Finally, it was determined whether the aggregate export value in each of these six-product categories increased, decreased or became extinct over the period 2007–2019. This was done by calculating how the aggregate value in exports changed in these categories during the period in question.

To determine if South Africa's exports are sustainable from a factor endowment perspective (physical and human capital), factor intensity indices of export products were used, developed by Shirotori *et al.* (2010) and updated by McLaren *et al.* (2018). Human capital was measured by average years of schooling in the country while physical capital was measured by capital stock. Although there are many other essential factors of production, these two particular factors make a particularly important contribution to export growth. For the purposes of this study, the revealed physical capital intensity index and revealed human capital intensity index were used. Products that were mostly exported by countries that are rich in human capital were shown to be human capital intensive. Products that were mostly exported by countries rich in physical capital were shown to be physical capital intensive.

McLaren *et al.* (2018) assert that there is a strong correlation between human capital and physical capital, which means that a product that needs a high level of human capital in turn needs a high level of physical capital. Using data from the World Bank, South Africa's and the selected peer countries' current human and physical capital endowment points were determined and then compared with the physical and human capital intensity required to produce the export products in question. It was then determined how far removed the countries' export products were from their respective factor endowment points for both human and physical capital. This step was taken to provide some perspectives on the sustainability of countries' exports within the intensive margin.

Finally, correlation analysis was performed to determine if there was a significant relationship between the dynamics within the countries' intensive margin of export

growth and the distance between the countries' physical and human capital and the products' factor intensities.

Table 5.2 provides a brief summary of the results of the empirical analysis.

Table 5-2: Summary of the results

Analysis	Results
South Africa's export growth along the intensive margin (2007–2019) (To address research objective 5)	• South Africa had 29 859 export relationships that increased, 33 104 that decreased and 11 532 export relationships that became extinct. • In terms of aggregate value, this represented an increase of approximately USD 185.3 billion, a decrease of approximately USD 77.2 billion and an extinction of approximately USD 12.0 billion.
Comparison with the results for the selected peer countries (To address research objective 7)	• South Africa had more export relationships than the other countries. • However, the average aggregate value per export relationship of Ecuador, Peru and Colombia was higher than that of South Africa. • Three of the peer countries focused on a small group of product–country combinations (export relationships), whereas South Africa focused on a larger group of product–country combinations. • Despite South Africa having a larger group of product–country combinations, the average value of each additional export relationship was lower.
Skill and technology intensity categories: • *Primary products;* • *Resource-based manufactures;* • *Low-skill and technology-intensive manufactures;* • *Medium-skill and technology-intensive manufactures;* • *High-skill and technology-intensive manufactures;* • *Unclassified products.* (To address research objective 6)	• South Africa's largest increase in value exported in the period 2007–2019 was in the *resource-based manufactures* category (42%) followed by the *medium-skill and technology-intensive manufactures* (29%) category. • South Africa's largest decrease in value exported in the period 2007–2019 was in the *medium-skill and technology-intensive manufactures* category (31%) followed by the *primary products* (30%) category. • South Africa's largest extinction in value exported in the period 2007–2019 was in the *resource-based manufactures* category (32%) followed by the *primary products* (25%) category. • South Africa's export relationships with its main trading partners have been changing. Instead of moving forward by exporting larger amounts of higher-skill products, South Africa reveals an absence of structural improvement by exporting more *primary products* to the US. By contrast, Matthee *et al.* (2016) had pointed to an increase in exports of *medium-skill and technology-intensive manufactures* for the period 1994-2012. The opposite occurred with exports to the EU7 as South Africa exports more higher skilled products to the EU7 compared to the study done by Matthee et al. (2016). This study differed as the time period was different and the study compares the results with other countries.

Comparison with the results for the selected peer countries (To address research objective 7)	• The largest increases in value exported in the period 2007 – 2019 among the selected peer countries were mainly in the *primary products* and *resource-based manufactures* categories (with the exception of Egypt). • Egypt's results were most similar to those for South Africa; however, the country's decreases were mostly in the *primary products* category, whereas South Africa's decreases were in those product categories that showed the largest increase in export value in the period 2007–2019.
Revealed factor intensities (To address research objective 6)	• Increases in South Africa's intensive margin are not sustainable from a factor endowment perspective, as 97% of products fall outside South Africa's endowment point. The reason for this is that South Africa lacks the necessary human and physical capital endowments to sustainably produce these export products. • South Africa's human and physical capital endowments have not shown much change between 2014 and 2020.
Comparison with the results for the selected peer countries (To address research objective 7)	• Most of Peru's and Ecuador's increases in the intensive margin were within their human capital endowment. • Egypt displayed the most similar pattern to South Africa; however, its human capital endowment increased substantially more than that of South Africa between 2014 and 2020. • The selected peer countries' level of human capital had increased substantially more than that of South Africa.
Correlation analysis (To address research objective 6)	• As expected, South Africa's increases in the intensive margin have a negative correlation with its human and physical capital endowments. This implies that the further away the export product is from South Africa's endowment point, the smaller is its contribution to increases in the intensive margin. • South Africa's decreases and extinctions within its intensive margin are also negatively correlated with the distance between South Africa's endowment point and the factor intensity of its human and physical capital. This implies that the further away the export product is from South Africa's endowment point, the smaller is its contribution to increases in the intensive margin.
Comparison with the results for the selected peer countries (To address research objective 7)	• There is a significant relationship between the dynamics within the intensive margin of the exports of Colombia, Ecuador, Egypt and Peru and their human and physical capital endowments. The relationship is in line with what was expected from the literature.

From Table 5.2 it is evident that South Africa's peer countries focus on a smaller group of product–country combinations (export relationships), whereas South Africa focuses on a larger group of product–country combinations. Even though South Africa has

more export relationships than its peer countries, the average value of each additional export relationship is lower. This could possibly explain the differences between South Africa's and the selected peer countries' export growth rates. South Africa's increases and decreases in one product category amount to about the same. For example, South Africa's increases in *medium-skill and technology-intensive manufactures* was 29% over the period 2007–2019, while its decreases and extinctions in *medium-skill and technology-intensive manufactures* were 31% and 23% respectively.

A similar pattern can be observed in South Africa's exports to its main trading partners. In a previous study on South Africa's export growth along the intensive margin over the period 1994–2012, exports to the US showed the highest increase in *medium-skill and technology-intensive manufactures* (Matthee *et al., 2016)*. However, in this study (covering the period 1997–2019), South Africa's exports to the US showed the highest decreases and extinctions in this product category – thus demonstrating that South Africa is struggling to maintain growth in technology- and skill-intensive product categories which would help to spur growth and development in the country.

Taking the above into consideration, the question must be posed: why is South Africa finding it difficult to sustain export growth in the more advanced product categories? The literature on export sustainability suggests that South Africa needs to give serious attention to its levels of human and physical capital development (Reis & Farole, 2012). Compared with the selected peer countries, South Africa's human and physical capital is growing at a slow pace. This could be a significant factor which translates into the lacklustre export growth seen in South Africa. This is especially true when it comes to the attention given to human capital endowment. Indeed, South Africa has much potential human capital that is not being utilised, which is exacerbated by highly variable education standards across the country.

A number of recommendations are provided in the next section which bring the study to a close.

5.3 Recommendations

On the basis of the theoretical and empirical findings in the study, the following recommendations can be made:

- South Africa has a more diverse export profile than that of the selected peer countries. South Africa also focuses on a larger group of product–country combinations (i.e. it has relatively more export relationships). Yet, relative to its peers, the average value of each additional export relationship is lower. Therefore, it is recommended that South Africa focus its productive resources on expanding exports of products it already specialises in, such as vehicles and iron and steel. This will require the introduction of more policies and measures (such as subsidies) aimed at helping the industries in question to grow.

- South Africa needs to give urgent attention to growing its human and physical capital as the results of the study show that South Africa's export growth is trailing behind that of the selected peer countries. Without adequate levels of human and physical capital, a country will struggle to grow its exports and its economy. Furthermore, without the necessary human and physical capabilities, it is difficult for countries to wean themselves off their dependence on exports of primary commodities. A critical priority for policymakers, therefore, is to invest (and facilitate investment) in innovative and inclusive education initiatives that are designed to build sustainable skills and industries in the country and a globally competitive mind-set.

- South Africa should learn from its peers who, despite facing typical developing-country challenges, are nevertheless further ahead both in terms of secondary educational achievement and in tackling youth unemployment. For example, South Africa has the highest percentage globally (80%) of children who cannot read or understand simple text by the end of primary school (World Bank, 2021b). The equivalent percentage for Colombia is 49%, Ecuador 63%, Egypt 70% and Peru (56%) (World Bank, 2021b). Similarly, South Africa has the highest unemployment rate among young adults (57%), compared with Colombia's 24%, Ecuador's 18%, Egypt's 31% and Peru's 16% (World Bank, 2021b). Educational achievement and employment naturally go hand in hand, and there is no substitute for getting both of these right in a country if the objective is stronger and more sustainable and inclusive economic growth.

With a view to building on this study, it would be useful to calculate a more recent measure of factor intensities as the factor intensities of the products examined in this study were only up to date as of 2014. Future research could also extend this study by comparing South Africa's export growth along the intensive and extensive margins in relation to developed countries. This would undoubtedly provide valuable insights into how these countries have developed their export sectors (and their economies more broadly) by producing and exporting higher-skill and technology-intensive products.

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ANNEXURE 1:

COUNTRIES' INTENSIVE MARGINS (2007–2009 and 2017–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021)

Table A1-1: South Africa's intensive margin (2007–2009 and 2017–2019)

	Number of export relationships	Value of change (USD)	Average value per export relationship (USD)
Increase	29 859	185 311 416 659	6 206 216
Decrease	33 104	-77 227 630 720	-2 332 879
Extinctions	11 532	-12 074 350 142	-1 047 030

Table A1-2: Egypt's intensive margin (2007–2009 and 2017–2019)

	Number of export relationships	Value of change (USD)	Average value per export relationship (USD)
Increase	6 399	30 591 322 881	4 780 641
Decrease	7 928	-21 114 828 264	-2 663 323
Extinctions	9 539	-10 638 217 044	-1 115 234

Table A1-3: Columbia's intensive margin (2007–2009 and 2017–2019)

	Number of export relationships	Value of change (USD)	Average value per export relationship (USD)
Increase	7 767	78 192 703 439	10 067 297
Decrease	11 162	-39 415 275 539	-3 531 202
Extinctions	5 083	-10 516 674 207	-2 068 989

Table A1-4: Peru's intensive margin (2007–2009 and 2017–2019)

	Number of export relationships	Value of change (USD)	Average value per export relationship (USD)
Increase	6 654	67 282 115 459	10 111 529
Decrease	7 305	-28 858 219 584	-3 950 475
Extinctions	3 310	-3 647 870 157	-1 102 075

Table A1-5: Ecuador's intensive margin (2007–2009 and 2017–2019)

	Number of export relationships	Value of change (USD)	Average value per export relationship (USD)
Increase	2 401	29 371 478 517	12 233 018
Decrease	2 940	-11 091 775 370	-3 772 713
Extinctions	2 650	-2 081 371 184	-785 650

Table A1-6: South Africa's percentage change within the intensive margin (2007–2009)

Technology and skill intensity	Increase	Decrease	Extinction
Primary products	**20%**	**30%**	**25%**
Resource-based manufactures	**42%**	**24%**	**32%**
Low-skill and technology-intensive manufactures	6%	10%	15%
Medium-skill and technology-intensive manufactures	**29%**	**31%**	**23%**
High-skill and technology-intensive manufactures	2%	4%	5%
Unclassified products	1%	1%	1%

Table A1-7: Columbia's percentage change within the intensive margin (2007–2009)

Technology and skill intensity	Increase	Decrease	Extinction
Primary products	**50%**	**34%**	**54%**
Resource-based manufactures	**34%**	**19%**	**19%**
Low-skill and technology-intensive manufactures	3%	**19%**	8%
Medium-skill and technology-intensive manufactures	9%	**20%**	**14%**
High-skill and technology-intensive manufactures	1%	4%	1%
Unclassified products	2%	4%	3%

Table A1-8: Ecuador's percentage change within the intensive margin (2007–2009)

Technology and skill intensity	Increase	Decrease	Extinction
Primary products	**67%**	**51%**	**38%**
Resource-based manufactures	**24%**	**30%**	**33%**
Low-skill and technology-intensive manufactures	4%	6%	11%
Medium-skill and technology-intensive manufactures	2%	11%	14%
High-skill and technology-intensive manufactures	1%	1%	3%
Unclassified products	2%	1%	0%

Table A1-9: Egypt's percentage change within the intensive margin (2007–2009)

Technology and skill intensity	Increase	Decrease	Extinction
Primary products	**19%**	**38%**	**42%**
Resource-based manufactures	**32%**	**22%**	**31%**
Low-skill and technology-intensive manufactures	**20%**	**19%**	10%
Medium-skill and technology-intensive manufactures	15%	16%	**12%**
High-skill and technology-intensive manufactures	5%	2%	1%
Unclassified products	9%	3%	2%

Table A1-10: Peru's percentage change within the intensive margin (2007–2009)

Technology and skill intensity	Increase	Decrease	Extinction
Primary products	**30%**	**34%**	**54%**
Resource-based manufactures	**59%**	**29%**	**32%**
Low-skill and technology-intensive manufactures	4%	14%	6%
Medium-skill and technology-intensive manufactures	2%	5%	5%
High-skill and technology-intensive manufactures	1%	1%	1%
Unclassified products	4%	17%	2%

ANNEXURE 2:

COUNTRIES' TOP EXPORT RELATIONSHIPS (2007–2009 and 2017–2019)

Table A2-1: South Africa's top 30 export relationships that increased (2007–2019)

Product code	Country product grouping	Lall groupings
260200	CHNManganese ores and concentrates, in	Resource-based manufactures
260200	CHNManganese ores and concentrates, in	Resource-based manufactures
260200	CHNManganese ores and concentrates, in	Resource-based manufactures
260111	CHNIron ores and concentrates, other t	Resource-based manufactures
260111	CHNIron ores and concentrates, other t	Resource-based manufactures
260111	CHNIron ores and concentrates, other t	Resource-based manufactures
260112	CHNIron ores and concentrates, other t	Resource-based manufactures
711019	GBRPlatinum :-- Other	Primary product
261000	CHNChromium ores and concentrates.	Resource-based manufactures
261000	CHNChromium ores and concentrates.	Resource-based manufactures
260112	CHNIron ores and concentrates, other t	Resource-based manufactures
870322	DEUOther vehicles, with spark-ignition	Medium-technology manufacture
870324	DEUOther vehicles, with spark-ignition	Medium-technology manufacture
870323	DEUOther vehicles, with spark-ignition	Medium-technology manufacture
261000	CHNChromium ores and concentrates.	Resource-based manufactures
270112	PAKCoal, whether or not pulverised, bu	Primary product
711021	USAPalladium :-- Unwrought or in powde	Primary product
711021	JPNPalladium :-- Unwrought or in powde	Primary product
720241	CHNFerro-chromium :-- Containing by we	Medium-technology manufacture
261000	MOZChromium ores and concentrates.	Resource-based manufactures
870422	GBROther, with compression-ignition in	Medium-technology manufacture
870423	GBROther, with compression-ignition in	Medium-technology manufacture
870421	GBROther, with compression-ignition in	Medium-technology manufacture
260112	CHNIron ores and concentrates, other t	Resource-based manufactures
870331	DEUOther vehicles, with compression-ig	Medium-technology manufacture
870332	DEUOther vehicles, with compression-ig	Medium-technology manufacture
870333	DEUOther vehicles, with compression-ig	Medium-technology manufacture
870422	DEUOther, with compression-ignition in	Medium-technology manufacture
870423	DEUOther, with compression-ignition in	Medium-technology manufacture
870423	BELOther, with compression-ignition in	Medium-technology manufacture

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-2: South Africa's top 30 export relationships that decreased (2007–2019)

Product code	Country product grouping	Lall groupings
710231	GBRNon-industrial :-- Unworked or simp	Resource-based manufactures
711019	JPNPlatinum :-- Other	Primary product
270112	INDCoal, whether or not pulverised, bu	Primary product
711031	USARhodium :-- Unwrought or in powder	Primary product
711039	JPNRhodium :-- Other	Primary product
870323	USAOther vehicles, with spark-ignition	Medium-technology manufacture
711011	USAPlatinum :-- Unwrought or in powder	Primary product
270900	CHNPetroleum oils and oils obtained fr	Primary product
260112	JPNIron ores and concentrates, other t	Resource-based manufactures
870323	JPNOther vehicles, with spark-ignition	Medium-technology manufacture
280920	INDPhosphoric acid and polyphosphoric	Resource-based manufactures
720241	DEUFerro-chromium :-- Containing by we	Medium-technology manufacture
720241	OASFerro-chromium :-- Containing by we	Medium-technology manufacture
842139	DEUFiltering or purifying machinery an	Medium-technology manufacture
270112	INDCoal, whether or not pulverised, bu	Primary product
760110	JPNAluminium, not alloyed	Primary product
270112	NLDCoal, whether or not pulverised, bu	Primary product
870324	USAOther vehicles, with spark-ignition	Medium-technology manufacture
280920	INDPhosphoric acid and polyphosphoric	Resource-based manufactures
270112	ITACoal, whether or not pulverised, bu	Primary product
840820	DEUEngines of a kind used for the prop	Medium-technology manufacture
711011	JPNPlatinum :-- Unwrought or in powder	Primary product
870322	USAOther vehicles, with spark-ignition	Medium-technology manufacture
870321	USAOther vehicles, with spark-ignition	Medium-technology manufacture
270112	GBRCoal, whether or not pulverised, bu	Primary product
842139	ESPFiltering or purifying machinery an	Medium-technology manufacture
271000	BUNPetroleum oils and oils obtained fr	Resource-based manufactures
711031	GBRRhodium :-- Unwrought or in powder	Primary product
260112	JPNIron ores and concentrates, other t	Resource-based manufactures
271000	BUNPetroleum oils and oils obtained fr	Resource-based manufactures

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-3: South Africa's top 30 export relationships that became extinct (2007–2019)

Product code	Country product grouping	Lall groupings
711011	CHEPlatinum :-- Unwrought or in powder	Primary product
270900	URYPetroleum oils and oils obtained fr	Primary product
870421	DZAOther, with compression-ignition in	Medium-technology manufacture
260112	PRKIron ores and concentrates, other t	Resource-based manufactures
750110	NORNickel mattes	Resource-based manufactures
271000	URYPetroleum oils and oils obtained fr	Resource-based manufactures
290129	NLDUnsaturated:-- Other	Resource-based manufactures
721049	BELOtherwise plated or coated with zin	Low-technology manufacture
720839	SAUOther, in coils, not further worked	Low-technology manufacture
811100	MOZManganese and articles thereof, inc	Resource-based manufactures
270740	NLDNaphthalene	Resource-based manufactures
880240	BMUAeroplanes and other aircraft, of a	High-technology manufacture
260400	CANNickel ores and concentrates.	Resource-based manufactures
260112	PRKIron ores and concentrates, other t	Resource-based manufactures
290513	NLDSaturated monohydric alcohols:-- Bu	Medium-technology manufacture
750610	CHNOf nickel, not alloyed	Primary product
260112	PRKIron ores and concentrates, other t	Resource-based manufactures
840734	BRAReciprocating piston engines of a k	Medium-technology manufacture
750610	JPNOf nickel, not alloyed	Primary product
721913	MEXNot further worked than hot-rolled,	Low-technology manufacture
740329	NORCopper alloys :-- Other copper allo	Primary product
840734	ESPReciprocating piston engines of a k	Medium-technology manufacture
285000	USAHydrides, nitrides, azides, silicid	Medium-technology manufacture
170111	IDNRaw sugar not containing added flav	Resource-based manufactures
721049	ITAOtherwise plated or coated with zin	Low-technology manufacture
721230	BELOtherwise plated or coated with zin	Low-technology manufacture
170112	KORRaw sugar not containing added flav	Resource-based manufactures
760110	NGAAluminium, not alloyed	Primary product
282300	USATitanium oxides	Resource-based manufactures
260700	BELLead ores and concentrates.	Resource-based manufactures

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-4: Colombia's top 30 export relationships that increased (2007–2019)

Product code	Country product groupings	Lall groupings
271000	CHNPetroleum oils and oils obtained fr	Resource-based manufactures
270900	CHNPetroleum oils and oils obtained fr	Primary product
270900	CHNPetroleum oils and oils obtained fr	Primary product

271000	PANPetroleum oils and oils obtained fr	Resource-based manufactures
270112	TURCoal, whether or not pulverised, bu	Primary product
270119	MEXCoal, whether or not pulverised, bu	Primary product
270111	MEXCoal, whether or not pulverised, bu	Primary product
270112	MEXCoal, whether or not pulverised, bu	Primary product
271000	BHSPetroleum oils and oils obtained fr	Resource-based manufactures
090111	USACoffee, not roasted :-- Not decaffe	Primary product
270111	CHLCoal, whether or not pulverised, bu	Primary product
270119	CHLCoal, whether or not pulverised, bu	Primary product
710812	FRENon-monetary :-- Other unwrought fo	Unclassified product
270112	CHLCoal, whether or not pulverised, bu	Primary product
060310	USAFresh	Primary product
270400	BRACoke and semi-coke of coal, of lign	Resource-based manufactures
270119	BRACoal, whether or not pulverised, bu	Primary product
270112	BRACoal, whether or not pulverised, bu	Primary product
270111	ESPCoal, whether or not pulverised, bu	Primary product
270119	ESPCoal, whether or not pulverised, bu	Primary product
270112	ISRCoal, whether or not pulverised, bu	Primary product
270900	ESPPetroleum oils and oils obtained fr	Primary product
870323	MEXOther vehicles, with spark-ignition	Medium-technology manufacture
870324	MEXOther vehicles, with spark-ignition	Medium-technology manufacture
710812	ITANon-monetary :-- Other unwrought fo	Unclassified product
270112	ESPCoal, whether or not pulverised, bu	Primary product
271000	ECUPetroleum oils and oils obtained fr	Resource-based manufactures
271000	PERPetroleum oils and oils obtained fr	Resource-based manufactures
271000	NLDPetroleum oils and oils obtained fr	Resource-based manufactures
270400	MEXCoke and semi-coke of coal, of lign	Resource-based manufactures

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-5: Colombia's top 30 export relationships that decreased (2007–2019)

Product code	Country product groupings	Lall groupings
270900	USAPetroleum oils and oils obtained fr	Primary product
270112	USACoal, whether or not pulverised, bu	Primary product
271000	USAPetroleum oils and oils obtained fr	Resource-based manufactures
870323	VENOther vehicles, with spark-ignition	Medium-technology manufacture
271000	DOMPetroleum oils and oils obtained fr	Resource-based manufactures
270900	TTOPetroleum oils and oils obtained fr	Primary product
270900	CYPPetroleum oils and oils obtained fr	Primary product
270112	GBRCoal, whether or not pulverised, bu	Primary product

710812	CHENon-monetary :-- Other unwrought fo	Unclassified product
270112	NLDCoal, whether or not pulverised, bu	Primary product
270112	DNKCoal, whether or not pulverised, bu	Primary product
270900	DOMPetroleum oils and oils obtained fr	Primary product
271000	TTOPetroleum oils and oils obtained fr	Resource-based manufactures
720260	ESPFerro-nickel	Medium-technology manufacture
730620	USACasing and tubing of a kind used in	Medium-technology manufacture
600230	VENOf a width exceeding 30 cm, contain	Low-technology manufacture
270112	FRACoal, whether or not pulverised, bu	Primary product
481840	VENSanitary towels and tampons, napkin	Low-technology manufacture
720260	USAFerro-nickel	Medium-technology manufacture
841810	VENCombined refrigerator-freezers, fit	Medium-technology manufacture
711210	USAOf gold, including metal clad with	Unclassified product
720260	CHNFerro-nickel	Medium-technology manufacture
271000	GBRPetroleum oils and oils obtained fr	Resource-based manufactures
720260	NLDFerro-nickel	Medium-technology manufacture
271000	CHLPetroleum oils and oils obtained fr	Resource-based manufactures
030342	FRETunas (of the genus Thunnus), skipj	Primary product
271600	ECUElectrical energy. (optional headin	Unclassified product
151110	DEUCrude oil	Resource-based manufactures
271000	FRAPetroleum oils and oils obtained fr	Resource-based manufactures
010290	VENOther	Primary product

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-6: Colombia's top 30 export relationships that became extinct (2007–2019)

Product code	Country product grouping	Lall groupings
020110	VENCarcasses and half-carcasses	Primary product
020210	VENCarcasses and half-carcasses	Primary product
270900	CHEPetroleum oils and oils obtained fr	Primary product
270112	CYMCoal, whether or not pulverised, bu	Primary product
271000	CHEPetroleum oils and oils obtained fr	Resource-based manufactures
020130	VENBoneless	Primary product
720260	ITAFerro-nickel	Medium-technology manufacture
020230	VENBoneless	Primary product
711210	CHEOf gold, including metal clad with	Unclassified product
271121	VENIn gaseous state :-- Natural gas	Primary product
270900	OASPetroleum oils and oils obtained fr	Primary product
051110	VENBovine semen	Primary product
252329	USAPortland cement :-- Other	Resource-based manufactures

151110	GBRCrude oil	Resource-based manufactures
841821	VENRefrigerators, household type :-- C	Medium-technology manufacture
271121	VENIn gaseous state :-- Natural gas	Primary product
270400	PERCoke and semi-coke of coal, of lign	Resource-based manufactures
401120	FREOf a kind used on buses or lorries	Resource-based manufactures
720260	BELFerro-nickel	Medium-technology manufacture
271000	VGBPetroleum oils and oils obtained fr	Resource-based manufactures
870431	VENOther, with spark-ignition internal	Medium-technology manufacture
030613	FREFrozen :-- Shrimps and prawns	Primary product
270900	CYMPetroleum oils and oils obtained fr	Primary product
720260	BRAFerro-nickel	Medium-technology manufacture
870422	VENOther, with compression-ignition in	Medium-technology manufacture
440920	VENNon-coniferous	Resource-based manufactures
481840	FRESanitary towels and tampons, napkin	Low-technology manufacture
620422	VENEnsembles :-- Of cotton	Low-technology manufacture
251511	VENMarble and travertine :-- Crude or	Primary product
750300	NLDNickel waste and scrap.	Resource-based manufactures

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-7: Ecuador's top 30 export relationships that increased (2007–2019)

Product code	Country product grouping	Lall groupings
030613	VNMFrozen :-- Shrimps and prawns	Primary product
030613	CHNFrozen :-- Shrimps and prawns	Primary product
271000	USAPetroleum oils and oils obtained fr	Resource-based manufactures
030613	USAFrozen :-- Shrimps and prawns	Primary product
270900	CHLPetroleum oils and oils obtained fr	Primary product
080300	RUSBananas, including plantains, fresh	Primary product
270900	CHNPetroleum oils and oils obtained fr	Primary product
271000	PERPetroleum oils and oils obtained fr	Resource-based manufactures
270900	JPNPetroleum oils and oils obtained fr	Primary product
080300	TURBananas, including plantains, fresh	Primary product
080300	CHNBananas, including plantains, fresh	Primary product
080300	USABananas, including plantains, fresh	Primary product
030613	FRAFrozen :-- Shrimps and prawns	Primary product
030613	ESPFrozen :-- Shrimps and prawns	Primary product
710812	USANon-monetary :-- Other unwrought fo	Unclassified product
160413	ESPFish, whole or in pieces, but not m	Resource-based manufactures
160415	ESPFish, whole or in pieces, but not m	Resource-based manufactures
160419	ESPFish, whole or in pieces, but not m	Resource-based manufactures

060310	USAFresh	Primary product
180100	MYSCocoa beans, whole or broken, raw o	Primary product
180100	MYSCocoa beans, whole or broken, raw o	Primary product
160414	ITAFish, whole or in pieces, but not m	Resource-based manufactures
270900	INDPetroleum oils and oils obtained fr	Primary product
151110	COLCrude oil	Resource-based manufactures
080300	SAUBananas, including plantains, fresh	Primary product
080300	NLDBananas, including plantains, fresh	Primary product
160414	ESPFish, whole or in pieces, but not m	Resource-based manufactures
080300	ARGBananas, including plantains, fresh	Primary product
030613	ITAFrozen :-- Shrimps and prawns	Primary product
030374	USAOther fish, excluding livers and ro	Primary product

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-8: Ecuador's top 30 export relationships that decreased (2007–2019)

Product code	Country product grouping	Lall groupings
270900	USAPetroleum oils and oils obtained fr	Primary product
270900	PERPetroleum oils and oils obtained fr	Primary product
271000	GTMPetroleum oils and oils obtained fr	Resource-based manufactures
270900	SLVPetroleum oils and oils obtained fr	Primary product
160420	ESPOther prepared or preserved fish	Resource-based manufactures
271000	SLVPetroleum oils and oils obtained fr	Resource-based manufactures
270900	VENPetroleum oils and oils obtained fr	Primary product
080300	ITABananas, including plantains, fresh	Primary product
160420	VENOther prepared or preserved fish	Resource-based manufactures
271000	PANPetroleum oils and oils obtained fr	Resource-based manufactures
160420	ITAOther prepared or preserved fish	Resource-based manufactures
270900	NICPetroleum oils and oils obtained fr	Primary product
870421	COLOther, with compression-ignition in	Medium-technology manufacture
080300	SERBananas, including plantains, fresh	Primary product
271000	HNDPetroleum oils and oils obtained fr	Resource-based manufactures
870431	VENOther, with spark-ignition internal	Medium-technology manufacture
030410	USAFresh or chilled	Primary product
732111	VENCooking appliances and plate warmer	Low-technology manufacture
870423	COLOther, with compression-ignition in	Medium-technology manufacture
160414	VENFish, whole or in pieces, but not m	Resource-based manufactures
151110	VENCrude oil	Resource-based manufactures
160413	VENFish, whole or in pieces, but not m	Resource-based manufactures
870322	VENOther vehicles, with spark-ignition	Medium-technology manufacture

710812	CHENon-monetary :-- Other unwrought fo	Unclassified product
732112	VENCooking appliances and plate warmer	Low-technology manufacture
210111	POLExtracts, essences and concentrates	Primary product
870431	COLOther, with spark-ignition internal	Medium-technology manufacture
160414	COLFish, whole or in pieces, but not m	Resource-based manufactures
160413	COLFish, whole or in pieces, but not m	Resource-based manufactures
200980	NLDJuice of any other single fruit or	Resource-based manufactures

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-9: Ecuador's top 30 export relationships that became extinct (2007–2019)

Product code	Country product grouping	Lall groupings
270900	ANTPetroleum oils and oils obtained fr	Primary product
270750	USAOther aromatic hydrocarbon mixtures	Resource-based manufactures
870210	VENWith compression-ignition internal	Medium-technology manufacture
581100	VENQuilted textile products in the pie	Low-technology manufacture
070410	USACauliflowers and headed broccoli	Primary product
151110	FRECrude oil	Resource-based manufactures
270900	CANPetroleum oils and oils obtained fr	Primary product
070410	DEUCauliflowers and headed broccoli	Primary product
581100	VENQuilted textile products in the pie	Low-technology manufacture
870210	COLWith compression-ignition internal	Medium-technology manufacture
853110	VENBurglar or fire alarms and similar	High-technology manufacture
151110	UNSCrude oil	Resource-based manufactures
270900	CYMPetroleum oils and oils obtained fr	Primary product
070410	NLDCauliflowers and headed broccoli	Primary product
270750	LCAOther aromatic hydrocarbon mixtures	Resource-based manufactures
270750	CYMOther aromatic hydrocarbon mixtures	Resource-based manufactures
845020	VENMachines, each of a dry linen capac	Medium-technology manufacture
100610	VENRice in the husk (paddy or rough)	Primary product
731021	FREOf a capacity of less than 50 l :--	Low-technology manufacture
030343	FRETunas (of the genus Thunnus), skipj	Primary product
270750	ITAOther aromatic hydrocarbon mixtures	Resource-based manufactures
845019	VENMachines, each of a dry linen capac	Medium-technology manufacture
842481	VENOther appliances :-- Agricultural o	Medium-technology manufacture
591131	VENTextile fabrics and felts, endless	Low-technology manufacture
845012	VENMachines, each of a dry linen capac	Medium-technology manufacture
720441	VNMOther waste and scrap :-- Turnings,	Resource-based manufactures
070410	SWECauliflowers and headed broccoli	Primary product
551311	VENUnbleached or bleached :-- Of polye	Medium-technology manufacture

480529	COLMulti-ply paper and paperboard :--	Resource-based manufactures
720430	KORWaste and scrap of tinned iron or s	Resource-based manufactures

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-10: Egypt's top 30 export relationships that increased (2007–2019)

Product code	Country product groupings	Lall groupings
710812	ARENon-monetary:-- Other unwrought fo	Unclassified product
271000	MLTPetroleum oils and oils obtained fr	Resource-based manufactures
270900	UNSPetroleum oils and oils obtained fr	Primary product
271000	UNSPetroleum oils and oils obtained fr	Resource-based manufactures
271000	TUNPetroleum oils and oils obtained fr	Resource-based manufactures
271000	ESPPetroleum oils and oils obtained fr	Resource-based manufactures
390210	TURPolypropylene	Medium-technology manufacture
271000	DZAPetroleum oils and oils obtained fr	Resource-based manufactures
271000	GBRPetroleum oils and oils obtained fr	Resource-based manufactures
310210	TURUrea, whether or not in aqueous sol	Medium-technology manufacture
271000	GRCPetroleum oils and oils obtained fr	Resource-based manufactures
270900	ESPPetroleum oils and oils obtained fr	Primary product
852812	AREReception apparatus for television,	High-technology manufacture
271000	FRAPetroleum oils and oils obtained fr	Resource-based manufactures
852812	SAUReception apparatus for television,	High-technology manufacture
80510	CHNOranges	Primary product
310210	BRAUrea, whether or not in aqueous sol	Medium-technology manufacture
271000	SAUPetroleum oils and oils obtained fr	Resource-based manufactures
271000	INDPetroleum oils and oils obtained fr	Resource-based manufactures
271000	CHNPetroleum oils and oils obtained fr	Resource-based manufactures
854430	GBRIgnition wiring sets and other wiri	Medium-technology manufacture
271000	MARPetroleum oils and oils obtained fr	Resource-based manufactures
611490	USAOf other textile materials	Low-technology manufacture
621390	USAOf other textile materials	Low-technology manufacture
621590	USAOf other textile materials	Low-technology manufacture
611090	USAOf other textile materials	Low-technology manufacture
610590	USAOf other textile materials	Low-technology manufacture
611190	USAOf other textile materials	Low-technology manufacture
610290	USAOf other textile materials	Low-technology manufacture
610690	USAOf other textile materials	Low-technology manufacture

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-11: Egypt's top 30 export relationships that decreased (2007–2019)

Product code	Country product groupings	Lall groupings
271111	ESPLiquefied :-- Natural gas	Primary product
271000	NLDPetroleum oils and oils obtained fr	Resource-based manufactures
271111	JPNLiquefied :-- Natural gas	Primary product
710812	CHENon-monetary :-- Other unwrought fo	Unclassified product
270900	ITAPetroleum oils and oils obtained fr	Primary product
271111	JORLiquefied :-- Natural gas	Primary product
380700	NLDWood tar; wood tar oils; wood creos	Medium-technology manufacture
271111	KORLiquefied :-- Natural gas	Primary product
271000	OASPetroleum oils and oils obtained fr	Resource-based manufactures
271000	NGAPetroleum oils and oils obtained fr	Resource-based manufactures
271112	ITALiquefied :-- Propane	Primary product
270900	INDPetroleum oils and oils obtained fr	Primary product
271000	SGPPetroleum oils and oils obtained fr	Resource-based manufactures
720837	ITAOther, in coils, not further worked	Low-technology manufacture
740911	SYROf refined copper :-- In coils	Primary product
701391	CHNOther glassware :-- Of lead crystal	Low-technology manufacture
610910	USAOf cotton	Low-technology manufacture
271111	FRALiquefied :-- Natural gas	Primary product
740911	SAUOf refined copper :-- In coils	Primary product
40690	SAUOther cheese	Resource-based manufactures
251512	CHNMarble and travertine :-- Merely cu	Primary product
310210	FRAUrea, whether or not in aqueous sol	Medium-technology manufacture
854420	LBYCo-axial cable and other co-axial e	Medium-technology manufacture
720837	TUROther, in coils, not further worked	Low-technology manufacture
854420	SAUCo-axial cable and other co-axial e	Medium-technology manufacture
380700	ITAWood tar; wood tar oils; wood creos	Medium-technology manufacture
581100	USAQuilted textile products in the pie	Low-technology manufacture
40690	IRQOther cheese	Resource-based manufactures
310210	GBRUrea, whether or not in aqueous sol	Medium-technology manufacture
854420	QATCo-axial cable and other co-axial e	Medium-technology manufacture

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-12: Egypt's top 30 export relationships that became extinct (2007–2019)

Product code	Country product groupings	Lall groupings
271000	BUNPetroleum oils and oils obtained fr	Resource-based manufactures
271111	USALiquefied :-- Natural gas	Primary product
270900	BUNPetroleum oils and oils obtained fr	Primary product

271111	MEXLiquefied :-- Natural gas	Primary product
251512	UNSMarble and travertine :-- Merely cu	Primary product
100630	SYRSemi-milled or wholly milled rice,	Primary product
271111	SYRLiquefied :-- Natural gas	Primary product
251010	UNSUnground	Primary product
740911	LBYOf refined copper :-- In coils	Primary product
271000	MACPetroleum oils and oils obtained fr	Resource-based manufactures
80510	IRNOranges	Primary product
271000	BELPetroleum oils and oils obtained fr	Resource-based manufactures
710812	JORNon-monetary :-- Other unwrought fo	Unclassified product
100630	UNSSemi-milled or wholly milled rice,	Primary product
100630	TURSemi-milled or wholly milled rice,	Primary product
270112	INDCoal, whether or not pulverised, bu	Primary product
380700	CHNWood tar; wood tar oils; wood creos	Medium-technology manufacture
270400	CYPCoke and semi-coke of coal, of lign	Resource-based manufactures
252329	SDNPortland cement :-- Other	Resource-based manufactures
271600	LBNElectrical energy. (optional headin	Unclassified product
740911	QATOf refined copper :-- In coils	Primary product
740911	OMNOf refined copper :-- In coils	Primary product
310100	FRAAnimal or vegetable fertilisers, wh	Primary product
854212	AREMonolithic digital integrated circu	High-technology manufacture
100630	LBYSemi-milled or wholly milled rice,	Primary product
310210	CHNUrea, whether or not in aqueous sol	Medium-technology manufacture
281410	UNSAnhydrous ammonia	Resource-based manufactures
100630	JORSemi-milled or wholly milled rice,	Primary product
271111	ARGLiquefied :-- Natural gas	Primary product
720837	BELOther, in coils, not further worked	Low-technology manufacture

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-13: Peru's top 30 export relationships that increased (2007–2019)

Product code	Country product groupings	Lall groupings
260300	CHNCopper ores and concentrates.	Resource-based manufactures
740311	CHNRefined copper :-- Cathodes and sec	Primary product
740311	CHNRefined copper :-- Cathodes and sec	Primary product
710812	USANon-monetary :-- Other unwrought fo	Unclassified product
260300	KORCopper ores and concentrates.	Resource-based manufactures
230120	CHNFlours, meals and pellets, of fish	Primary product
260112	CHNIron ores and concentrates, other t	Resource-based manufactures
260111	CHNIron ores and concentrates, other t	Resource-based manufactures

270900	BRAPetroleum oils and oils obtained fr	Primary product
271000	BRAPetroleum oils and oils obtained fr	Resource-based manufactures
261610	CHNSilver ores and concentrates	Resource-based manufactures
260300	BRACopper ores and concentrates.	Resource-based manufactures
260700	KORLead ores and concentrates.	Resource-based manufactures
260800	CHNZinc ores and concentrates.	Resource-based manufactures
260300	PHLCopper ores and concentrates.	Resource-based manufactures
260300	PHLCopper ores and concentrates.	Resource-based manufactures
271000	PANPetroleum oils and oils obtained fr	Resource-based manufactures
80440	NLDAvocados	Primary product
80440	USAAvocados	Primary product
260300	INDCopper ores and concentrates.	Resource-based manufactures
200560	USAAsparagus	Resource-based manufactures
30799	ESPOther, including flours, meals and	Primary product
260700	CANLead ores and concentrates.	Resource-based manufactures
710812	GBRNon-monetary :-- Other unwrought fo	Unclassified product
260800	BRAZinc ores and concentrates.	Resource-based manufactures
260300	NAMCopper ores and concentrates.	Resource-based manufactures
260800	KORZinc ores and concentrates.	Resource-based manufactures
260300	BGRCopper ores and concentrates.	Resource-based manufactures
260300	NAMCopper ores and concentrates.	Resource-based manufactures
260800	ESPZinc ores and concentrates.	Resource-based manufactures

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-14: Peru's top 30 export relationships that decreased (2007–2019)

Product code	Country product groupings	Lall groupings
710812	CHENon-monetary :-- Other unwrought fo	Unclassified product
740311	USARefined copper :-- Cathodes and sec	Primary product
710812	CANNon-monetary :-- Other unwrought fo	Unclassified product
271000	USAPetroleum oils and oils obtained fr	Resource-based manufactures
740311	OASRefined copper :-- Cathodes and sec	Primary product
270900	USAPetroleum oils and oils obtained fr	Primary product
261390	CHLOther	Resource-based manufactures
740311	ITARefined copper :-- Cathodes and sec	Primary product
271000	CANPetroleum oils and oils obtained fr	Resource-based manufactures
230120	DEUFlours, meals and pellets, of fish	Primary product
270900	CHLPetroleum oils and oils obtained fr	Primary product
710691	USAOther :-- Unwrought	Primary product
260300	FINCopper ores and concentrates.	Resource-based manufactures

260700	CHNLead ores and concentrates.	Resource-based manufactures
610910	USAOf cotton	Low-technology manufacture
260300	CANCopper ores and concentrates.	Resource-based manufactures
740311	BRARefined copper :-- Cathodes and sec	Primary product
260300	CHLCopper ores and concentrates.	Resource-based manufactures
260300	SWECopper ores and concentrates.	Resource-based manufactures
710691	BRAOther :-- Unwrought	Primary product
261390	NLDOther	Resource-based manufactures
610510	USAOf cotton	Low-technology manufacture
260800	USAZinc ores and concentrates.	Resource-based manufactures
780110	BRARefined lead	Primary product
260300	PRKCopper ores and concentrates.	Resource-based manufactures
800110	USATin, not alloyed	Primary product
230120	JPNFlours, meals and pellets, of fish	Primary product
200590	ESPOther vegetables and mixtures of ve	Resource-based manufactures
270900	CHNPetroleum oils and oils obtained fr	Primary product
722830	CHLOther bars and rods, not further wo	Low-technology manufacture
260800	CANZinc ores and concentrates.	Resource-based manufactures
230120	TURFlours, meals and pellets, of fish	Primary product

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

Table A2-15: Peru's top 30 export relationships that became extinct (2007–2019)

Product code	Country product groupings	Lall groupings
740311	NLDRefined copper :-- Cathodes and sec	Primary product
740200	BELUnrefined copper; copper anodes for	Primary product
740311	JPNRefined copper :-- Cathodes and sec	Primary product
710691	JPNOther :-- Unwrought	Primary product
260800	DZAZinc ores and concentrates.	Resource-based manufactures
260800	THAZinc ores and concentrates.	Resource-based manufactures
271112	ECULiquefied :-- Propane	Primary product
260800	ZAFZinc ores and concentrates.	Resource-based manufactures
260800	ITAZinc ores and concentrates.	Resource-based manufactures
740311	MEXRefined copper :-- Cathodes and sec	Primary product
780110	OASRefined lead	Primary product
710691	GBROther :-- Unwrought	Primary product
261610	MEXSilver ores and concentrates	Resource-based manufactures
260112	TTOIron ores and concentrates, other t	Resource-based manufactures
780110	ITARefined lead	Primary product
740311	VENRefined copper :-- Cathodes and sec	Primary product

780110	VENRefined lead	Primary product
271113	ECULiquefied :-- Butanes	Primary product
260800	INDZinc ores and concentrates.	Resource-based manufactures
260111	MEXIron ores and concentrates, other t	Resource-based manufactures
260700	MARLead ores and concentrates.	Resource-based manufactures
710812	MEXNon-monetary :-- Other unwrought fo	Unclassified product
740311	MEXRefined copper :-- Cathodes and sec	Primary product
810600	BELBismuth and articles thereof, inclu	Resource-based manufactures
230120	NORFlours, meals and pellets, of fish	Primary product
392330	VENCarboys, bottles, flasks and simila	Low-technology manufacture
740311	DEURefined copper :-- Cathodes and sec	Primary product
261100	USATungsten ores and concentrates.	Resource-based manufactures
260112	MEXIron ores and concentrates, other t	Resource-based manufactures
260112	KORIron ores and concentrates, other t	Resource-based manufactures

Source: Author's own compilation based on data from UN COMTRADE (2021) and Lall (2000)

ANNEXURE 3:

SKILLS AND TECHNOLOGY COMPOSITION OF THE SELECTED PEER COUNTRIES' INTENSIVE MARGINS FROM A GEOGRAPHICAL PERSPECTIVE (2007–2019)

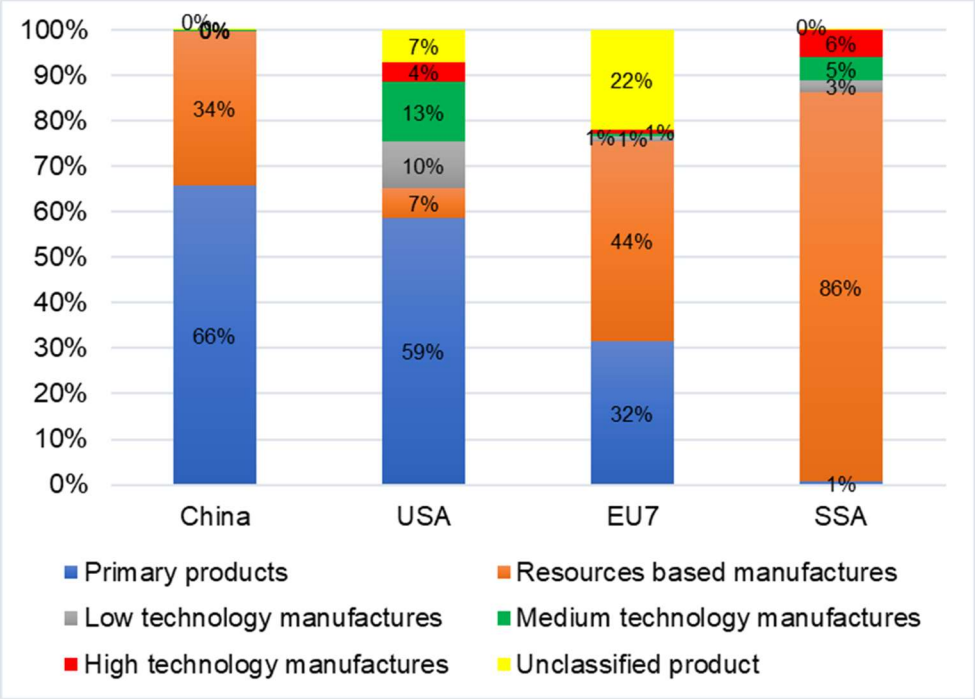

Figure A3-1: Skills and technology composition of increases in Colombia's intensive margin from a geographical perspective (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021) and Lall (2000)

In Figure A3-1, the skills and technology composition of increases in Colombia's intensive margin for different regions is shown. Colombia's exports to China were dominated by *primary products* (66%), while its exports to the US also mostly consisted of *primary products* (59%). *Resource-based manufactures* were mostly exported to SSA (86%) and the EU7[6] (44%). *Primary products* also constituted a large percentage of exports to the EU7 (32%). Petroleum oils dominated exports to China, while coffee was the largest export to the US. Petroleum and crude oils (*resource-based manufactures*) and bananas (*primary products*) were the biggest exports to the

[6] The EU7 comprises the UK, Luxemburg, Belgium, Germany, France, Italy and the Netherlands.

EU7, while petroleum oils dominated exports to SSA. Petroleum oils contributed the most to Colombia's exports.

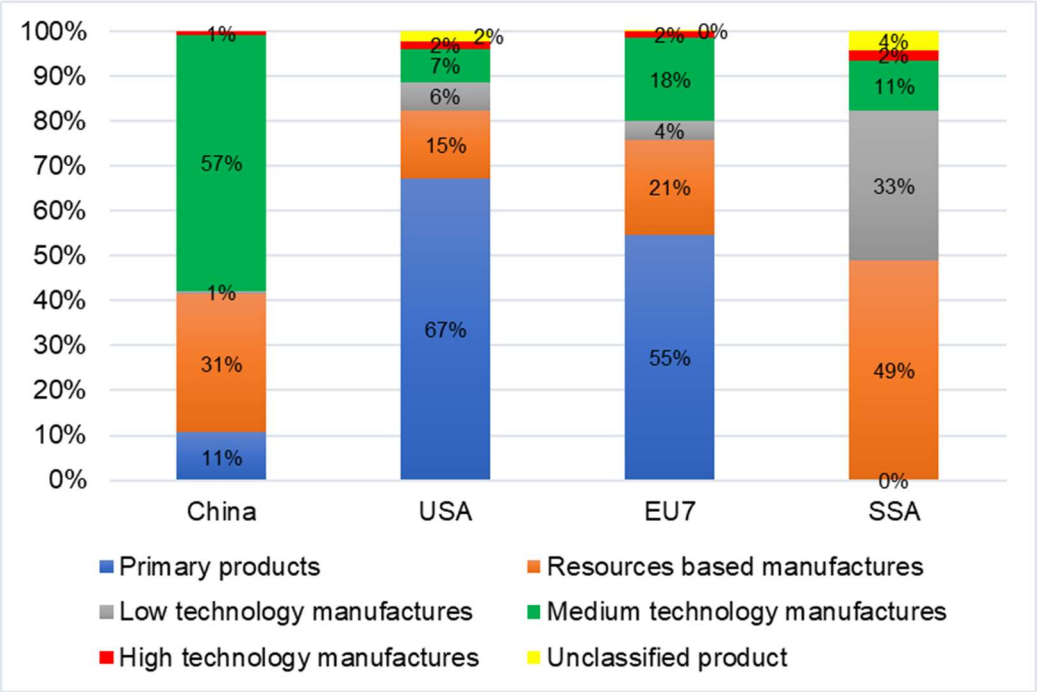

Figure A3-2: Skills and technology composition of decreases in Colombia's intensive margin from a geographical perspective (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021) and Lall (2000)

In Figure A3-2, the skills and technology composition of decreases in Colombia's intensive margin for different regions is shown. Exports of *medium-skill and technology-intensive manufactures* from Colombia to China decreased substantially (57%), as did exports of *primary products* to the US (67%) and the EU7 (55%). Exports of *low-skill and technology-intensive manufactures* (33%) and *resource-based manufactures* (49%) from Colombia to SSA also decreased substantially. The large drop in *primary products* to the US and the EU7 is largely attributed to Colombia exporting less petroleum oils and coal. A sizeable decrease in exports of *low-skill and technology-intensive manufactures* to SSA related to exports of hand-held electronic appliances, while the drop in exports of *resource-based manufactures* can be attributed to a decrease in exports of sweet biscuits, waffles and wafers, and petroleum oils. The decreases in exports of *medium-skill and technology-intensive*

manufactures to China were the result of decreases in exports of ferro-nickel and polypropylene.

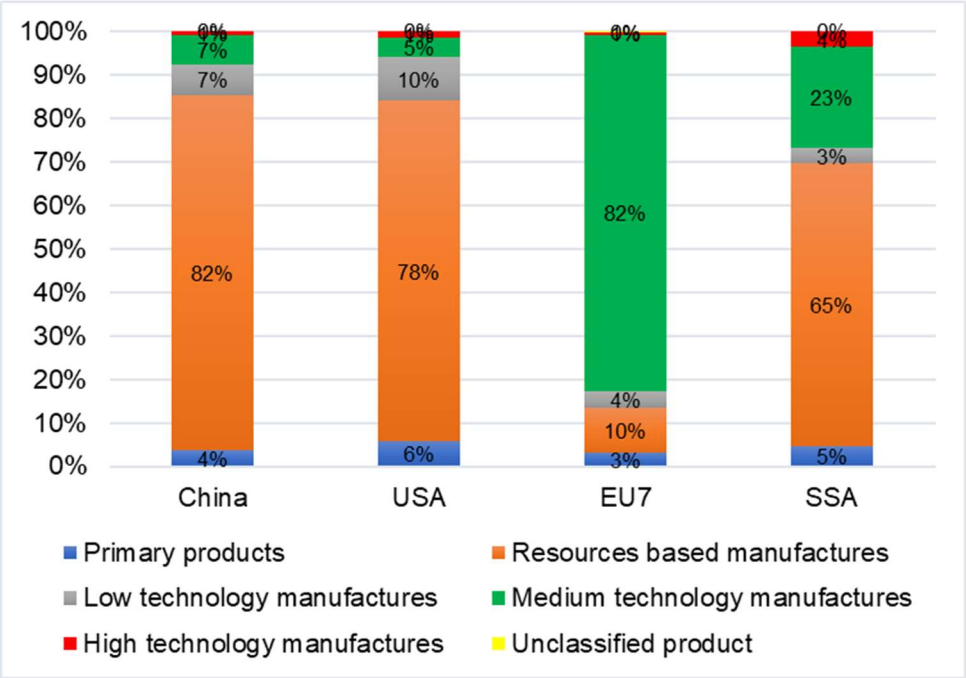

Figure A3-3: Skills and technology composition of extinctions in Colombia's intensive margin from a geographical perspective (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021) and Lall (2000)

In Figure A3-3, the skills and technology composition of extinctions in Colombia's intensive margin for different regions is shown. Colombia's exports of *resource-based manufactures* to China represented the largest extinction (82%). The extinctions were mostly attributed to lactams, carbon, and waste and scrap of tinned goods. Colombia's exports of *resource-based manufactures* to the US constituted the largest extinction (78%) where the extinctions were mostly related to Portland cement. Colombia's exports of *medium-skill and technology-intensive manufactures* to China were the largest extinction (82%) where the extinctions were mostly related to ferro-nickel. Colombia's exports of *resource-based manufactures* to the SSA were the largest extinction (65%), followed by *medium-skill and technology-intensive manufactures* (23%). The extinctions mostly related to petroleum bitumen (*resource-based manufactures*) and continuous-action elevators (*medium-skill and technology-intensive manufactures*).

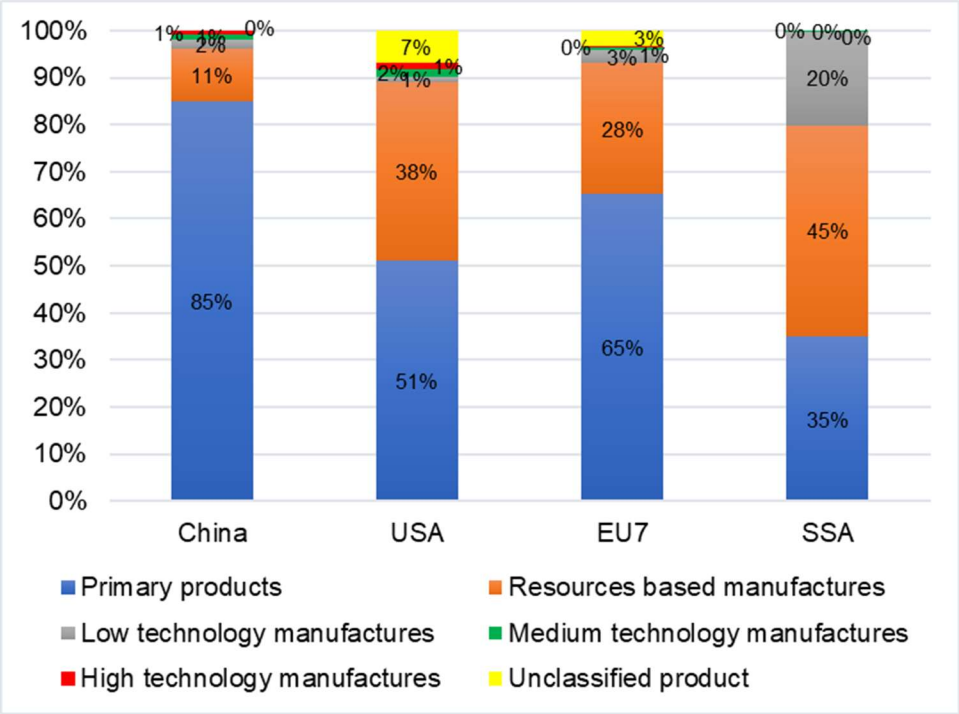

Figure A3-4: Skills and technology composition of increases in Ecuador's intensive margin from a geographical perspective (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021) and Lall (2000)

In Figure A3-4, the skills and technology composition of increases in Ecuador's intensive margin for different regions is shown. Ecuador's exports to China were dominated by *primary products*. Ecuador's exports of *primary products* (51%) constituted most of its exports, followed by *resource-based manufactures* (38%). *Primary products* (65%) and *resource-based manufactures* (28%) were mostly exported to the EU7, while *resource-based manufactures* (45%) and *primary products* (35%) also constituted a large percentage of Ecuador's exports to SSA. Shrimp and prawns, petroleum oils and bananas dominated Ecuador's exports to China. Shrimp and prawns, petroleum oils and bananas were also Ecuador's biggest exports to the US. Shrimp and prawns, and bananas (*primary products*) and fish (*resource-based manufactures*) were Ecuador's biggest exports to the EU7, while other goods not specified dominated exports to SSA. It is clear that shrimp and prawns, petroleum oils and bananas dominated Ecuador's exports.

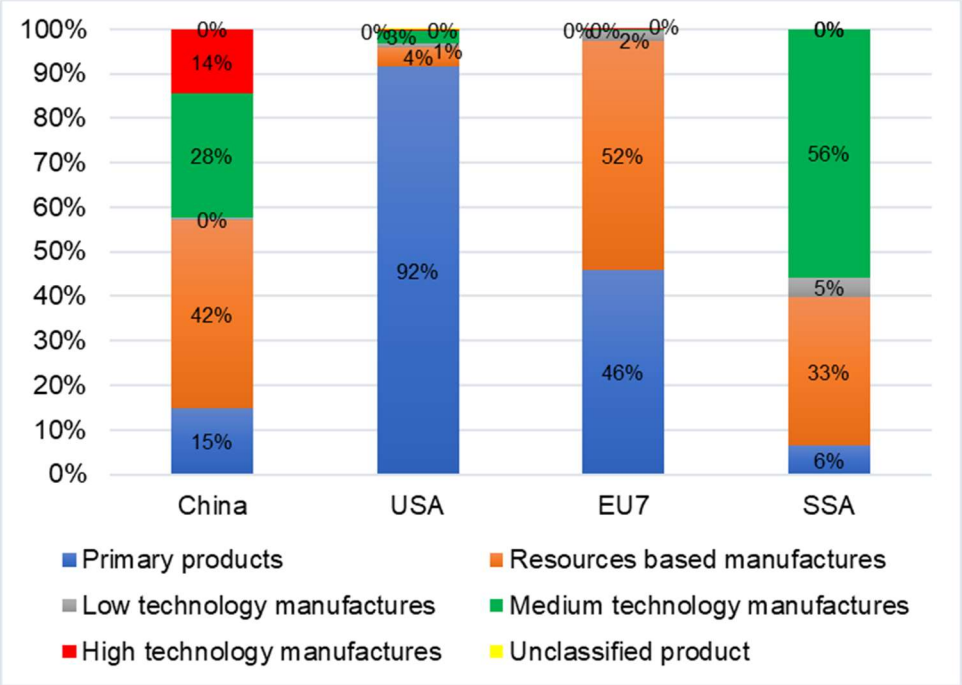

Figure A3-5: Skills and technology composition of decreases in Ecuador's intensive margin from a geographical perspective (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021) and Lall (2000)

In Figure A3-5, the skills and technology composition of decreases in Ecuador's intensive margin for different regions is shown. Ecuador's exports of *medium-skill and technology-intensive manufactures* (28%) and *resource-based manufactures* (42%) to China decreased significantly, while Ecuador's exports of *primary products* to the US (92%) and EU7 (46%) also decreased substantially. Similarly, Ecuador's exports of *medium-skill and technology-intensive manufactures* (56%) and *resource-based manufactures* (33%) to SSA saw a sharp decline. Ecuador's exports of *resource-based manufactures* to the EU7 also dropped significantly. The big drop in Ecuador's exports of *primary products* to the US and the EU7 largely related to petroleum oils and bananas. A big decrease in Ecuador's exports of *medium-skill and technology-intensive manufactures* to SSA and China was linked to imports of machinery. The drop in Ecuador's exports of *resource-based manufactures* to China, the EU7 and SSA can be attributed to reduced exports of fish, aluminium and zinc concentrates.

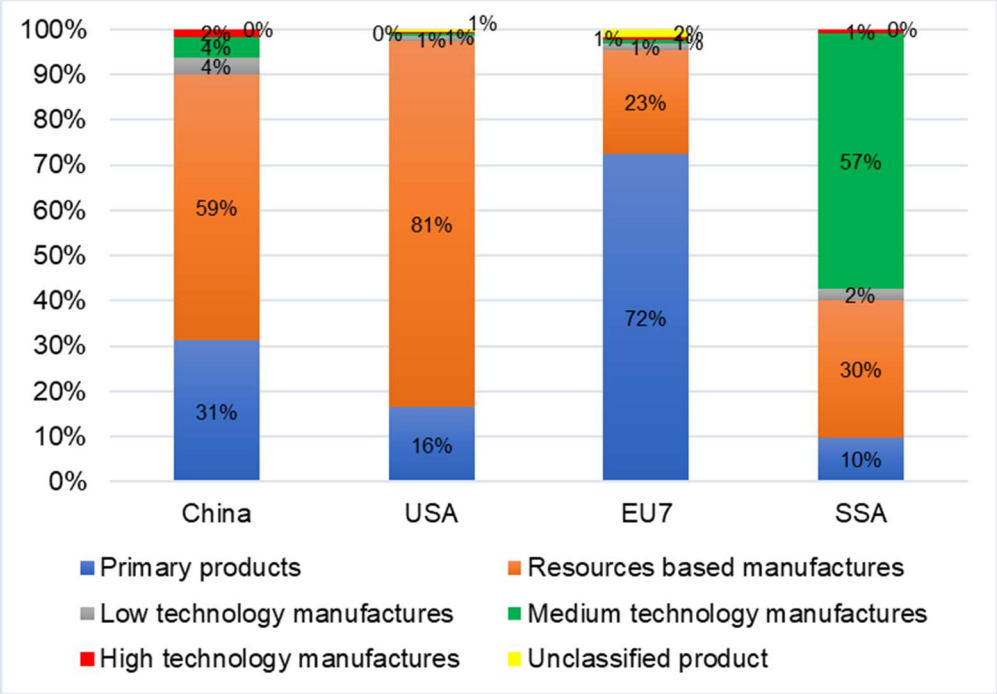

Figure A3-6: Skills and technology composition of extinctions in Ecuador's intensive margin from a geographical perspective (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021) and Lall (2000)

In Figure A3-6, the skills and technology composition of extinctions in Ecuador's intensive margin for different regions is shown. Ecuador's exports of *resource-based manufactures* to China constituted the largest extinction (59%), followed by *primary products* (31%). The extinctions mostly related to waste and scrap of tinned iron (*resource-based manufactures*) and copper (*primary products*). Ecuador's exports of *resource-based manufactures* to the US were the largest extinction (81%). The extinctions related to other aromatic hydrocarbon mixtures, industrial fatty alcohols and unbleached kraft paper or paperboard. Ecuador's exports of *primary products* to the EU7 represented the largest extinction (72%), followed by *resource-based manufactures* (23%). The extinctions mostly related to cauliflower and headed broccoli (*primary products*) and other aromatic hydrocarbon mixtures (*resource-based manufactures*). Ecuador's exports of *medium-skill and technology-intensive manufactures* to SSA saw the largest extinction (57%), followed by *resource-based manufactures* (30%). The extinctions mostly related to prefabricated buildings (*medium-technology manufactures*) and fish (*resource-based manufactures*).

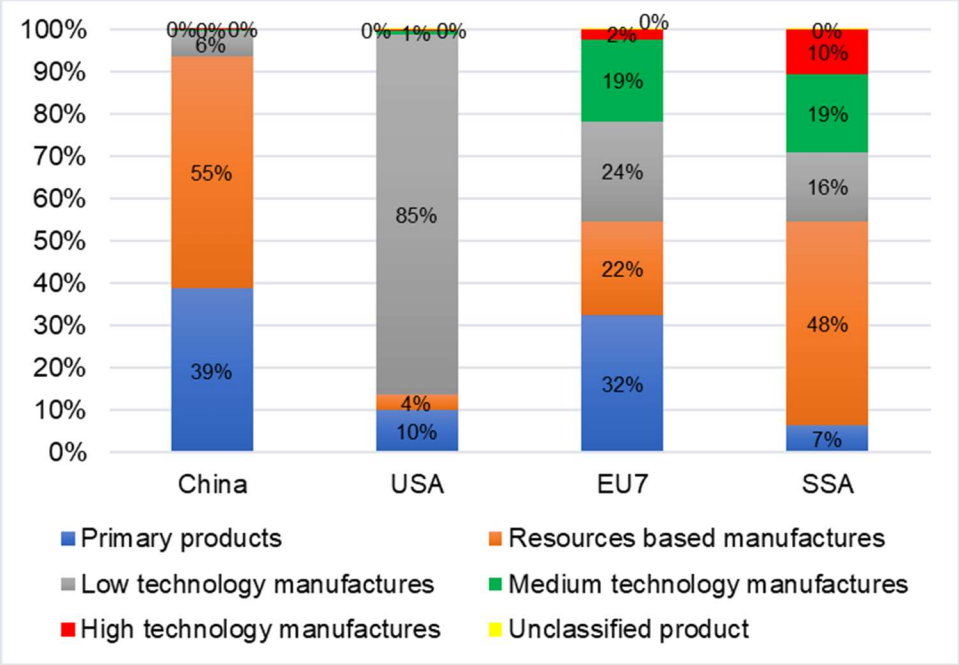

Figure A3-7: Skills and technology composition of increases in Egypt's intensive margin from a geographical perspective (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021) and Lall (2000)

In Figure A3-7, the skills and technology composition of increases in Egypt's intensive margin for different regions is shown. Egypt's exports of *resource-based manufactures* (55%) and *primary products* (39%) dominated exports to China. Egypt's exports of *low-skill and technology-intensive manufactures* constituted most of its exports to the US (85%). *Primary products* (32%) and *low-skill and technology-intensive manufactures* (24%) were mostly exported to the EU7, while *resource-based manufactures* dominated Egypt's exports to SSA (48%). Petroleum oils (*resource-based manufactures*), oranges and natural gas (*primary products*) dominated Egypt's exports to China, while textile materials were Egypt's largest export the US. Petroleum oils were Egypt's largest export to the EU7, while wheat or meslin flour, toilet or facial tissue stock, and cement clinkers dominated Egypt's exports to SSA. Egypt's export profile is also more diverse than that of Colombia, Ecuador and Peru, but most of its increases are still focused on a small group of products.

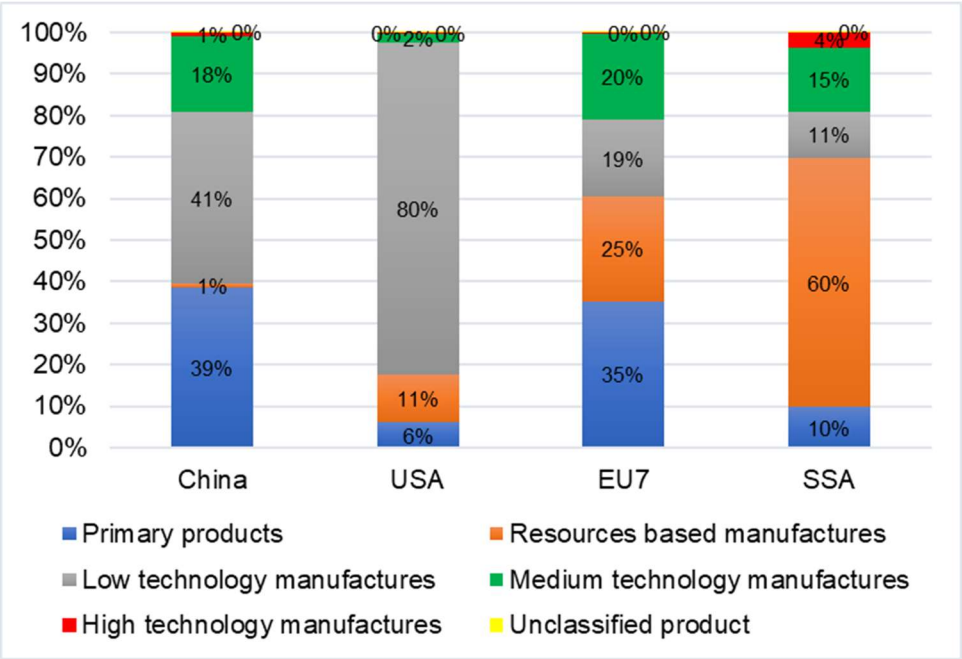

Figure A3-8: Skills and technology composition of decreases in Egypt's intensive margin from a geographical perspective (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021) and Lall (2000)

In Figure A3-8, the skills and technology composition of decreases in Egypt's intensive margin for different regions is shown. Egypt's exports of *low-skill and technology-intensive manufactures* (41%) and *primary products* (39%) to China decreased substantially. Egypt's exports of *low-skill and technology-intensive manufactures* to the US (80%) showed the largest drop. Egypt's exports of *primary products* to the EU7 decreased the most, while *resource-based manufactures* (60%) to SSA decreased substantially. Egypt's exports of *resource-based manufactures* to the EU7 (25%) also showed a sharp drop. The large decrease in Egypt's exports of *low-skill and technology-intensive manufactures* to China and the US largely related to glassware and cotton. The sizeable decrease in Egypt's exports of *primary products* to China and the EU7 related to exports of marble and travertine, and petroleum oils, while the drop in Egypt's exports of *resource-based manufactures* to SSA was associated with a decrease in exports of petroleum oils.

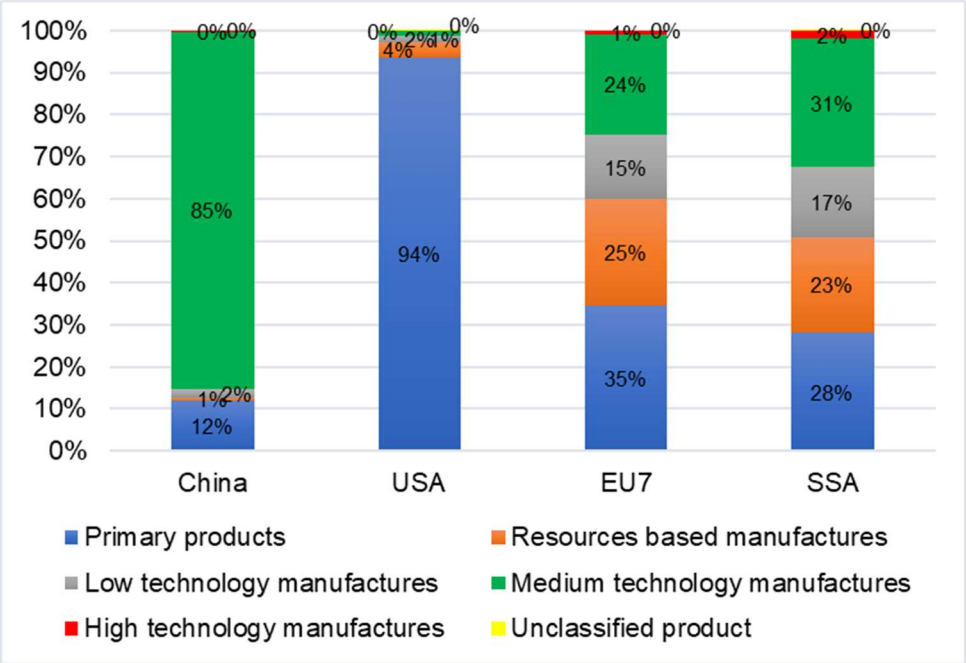

Figure A3-9: Skills and technology composition of extinctions in Egypt's intensive margin from a geographical perspective (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021) and Lall (2000)

In Figure A3-9, the skills and technology composition of extinctions in Egypt's intensive margin for different regions is shown. Egypt's exports of *medium-skill and technology-intensive manufactures* to China (85%) constituted the largest extinction where the extinctions were related to wood tar and wood tar oils. Egypt's exports of *primary products* were the largest extinction in the US (94%) where the extinctions mostly related to liquefied natural gas. Egypt's exports of *primary products* were the largest extinction in the EU7 (35%), followed by *resource-based manufactures* (25%) and *medium-skill and technology-intensive manufactures* (24%). The extinctions mostly related to animal or vegetable fertilisers and refined copper (*primary products*), ketone-alcohols and ketone-aldehyde (*resource-based manufactures*) and urea (*medium-skill and technology-intensive manufactures*). Egypt's exports of *medium-skill and technology-intensive manufactures* constituted the largest extinction (31%) in SSA, followed by *primary products* (30%). The extinctions mostly related to urea (*medium-skill and technology-intensive manufactures*) and coal (*primary products*).

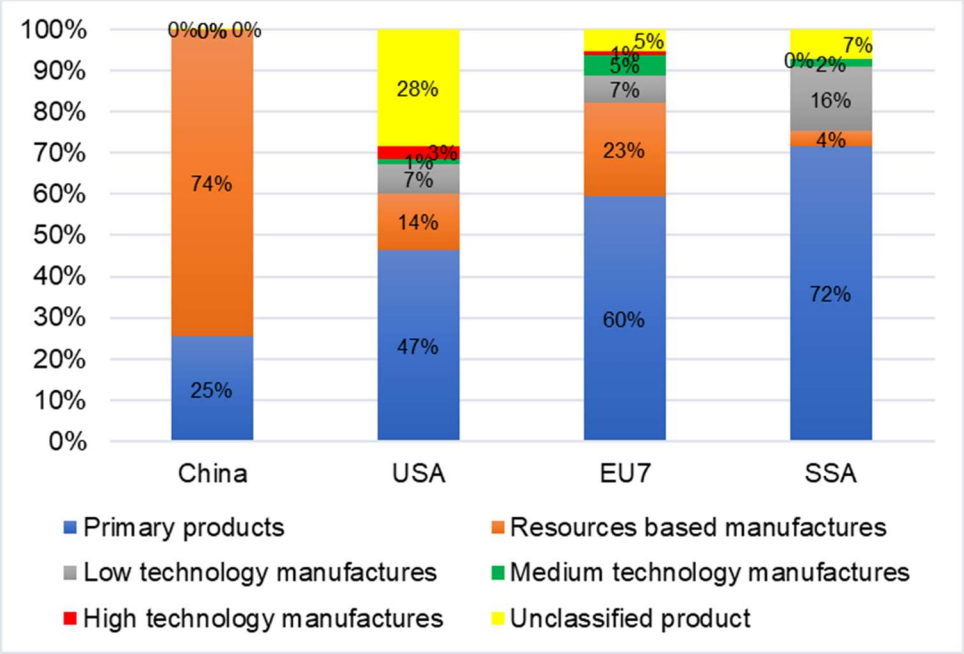

Figure A3-10: Skills and technology composition of increases in Peru's intensive margin from a geographical perspective (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021) and Lall (2000)

In Figure A3-10, the skills and technology composition of increases in Peru's intensive margin for different regions is shown. Peru's exports of *resource-based manufactures* dominated exports to China (74%). Peru's exports of *primary products* (47%) and *unclassified products* (28%) constituted most of its exports to the US. Peru's exports of *primary products* dominated exports to the EU7 (60%) and SSA (72%). Copper, iron, silver and zinc ores and concentrates dominated Peru's exports to China. Fruit, such as bananas, guavas and mangoes, as well as zinc were Peru's biggest exports the US and EU7, while fish dominated Peru's exports to SSA. Peru's increases were also concentrated in a group of products.

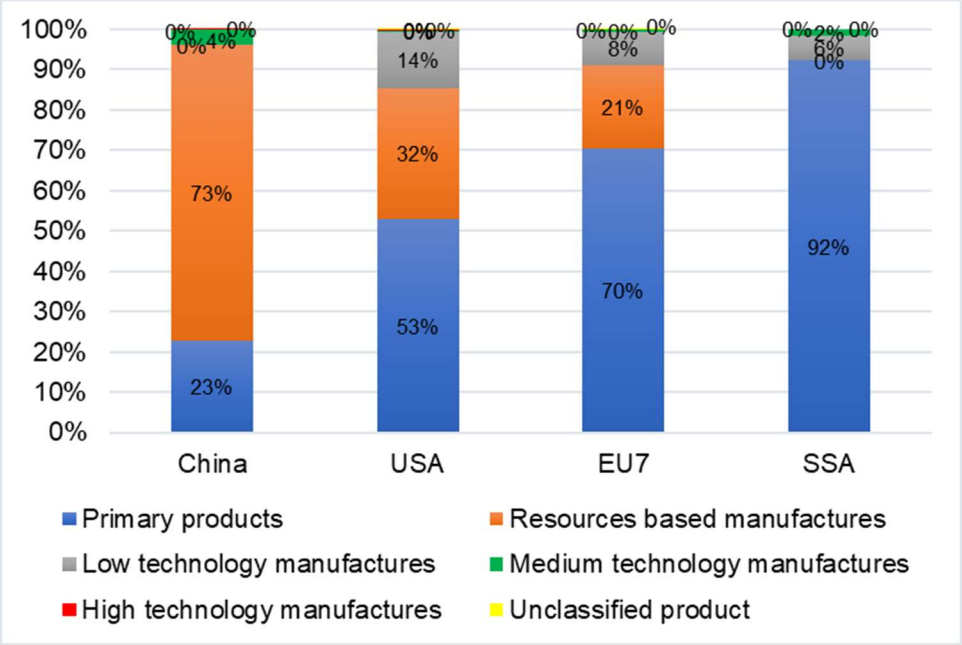

Figure A3-11: Skills and technology composition of decreases in Peru's intensive margin from a geographical perspective (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021) and Lall (2000)

In Figure A3-11, the skills and technology composition of decreases in Peru's intensive margin for different regions is shown. Peru's exports of *resource-based manufactures* (73%) and *primary products* (23%) to China decreased substantially. Peru's exports of *primary products* decreased the most to SSA (92%), the EU7 (70%) and the US (53%), while exports of *resource-based manufactures* to the US (32%) and the EU7 (21%) saw a significant decrease. The large drop in Peru's exports of *resource-based manufactures* to China largely related to lead ores and concentrates, and petroleum oils. The sizeable decrease observed in Peru's exports of *primary products* to the US, the EU7 and SSA related to refined copper and zinc plates, sheets, strip and foil. The drop in Peru's exports of *resource-based manufactures* to the US and the EU7 related to a drop in exports of lead ores and concentrates, and petroleum oils.

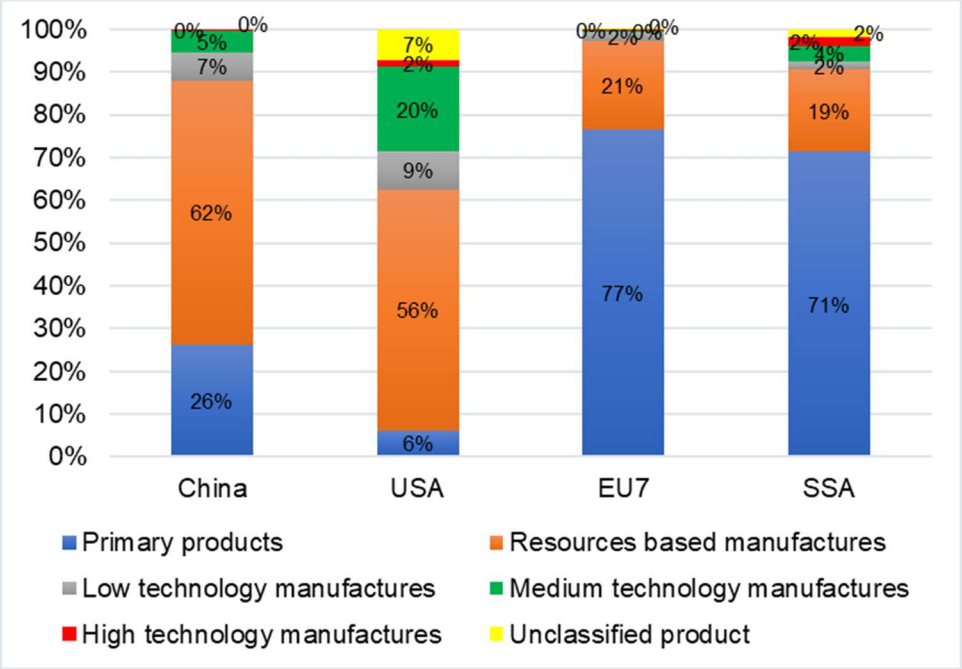

Figure A3-12: Skills and technology composition of extinctions in Peru's intensive margin from a geographical perspective (2007–2019)

Source: Author's own calculations based on data from UN COMTRADE (2021) and Lall (2000)

In Figure A3-12, the skills and technology composition of extinctions in Peru's intensive margin for different regions is shown. Peru's exports of *resource-based manufactures* were the largest extinction in China (62%). The extinctions mostly related to coniferous and selenium. Peru's exports of *resource-based manufactures* were the largest extinction (56%) where the extinctions mostly related to tungsten ores and concentrates. Peru's exports of *primary products* were the largest extinction in the EU7 (82%) where the extinctions mostly related to refined copper and refined lead. Peru's exports of *primary products* were the largest extinction (71%) in SSA where the extinctions mostly related to cocoa and zinc.

ANNEXURE 4:

COUNTRIES' TOP 10 EXPORT RELATIONSHIPS THAT INCREASED TO SELECTED REGIONS BETWEEN 2007 - 2019

Table A4-1: South Africa's and the selected peer countries' top 10 export relationships that increased to selected regions (2007–2019)

Country	Top 10 country product groupings	Increase in value (USD)
China	CHNManganese ores and concentrates, in	5 045 019
	CHNManganese ores and concentrates, in	4 688 929
	CHNManganese ores and concentrates, in	4 487 680
	CHNIron ores and concentrates, other t	3 411 846
	CHNIron ores and concentrates, other t	3 374 580
	CHNIron ores and concentrates, other t	3 264 916
	CHNIron ores and concentrates, other t	2 855 641
	CHNChromium ores and concentrates.	2 614 579
	CHNChromium ores and concentrates.	2 552 426
	CHNIron ores and concentrates, other t	2 508 136
US	USAPalladium :-- Unwrought or in powde	1 806 427
	USAGranulated slag (slag sand) from th	559 062
	USAAluminium, not alloyed	519 480
	USAPalladium :-- Other	285 125
	USAFerro-chromium :-- Containing by we	281 841
	USARhodium :-- Other	208 116
	USANickel alloys	160 860
	USAPetroleum oils and oils obtained fr	158 329
	USAOtherwise plated or coated with zin	148 441
	USATitanium ores and concentrates.	122 288
EU7	DEUOther vehicles, with spark-ignition	2 216 890
	DEUOther vehicles, with spark-ignition	2 216 147
	DEUOther vehicles, with spark-ignition	2 215 540
	DEUOther vehicles, with compression-ig	1 275 925
	DEUOther vehicles, with compression-ig	1 275 213
	DEUOther vehicles, with compression-ig	1 275 136
	DEUOther, with compression-ignition in	1 172 757
	DEUOther, with compression-ignition in	1 172 441
	DEUOther, with compression-ignition in	1 141 120
	FRAOther, with compression-ignition in	583 470
SSA	MOZChromium ores and concentrates.	1 601 074
	MOZElectrical energy. (optional headin	520 825
	MOZCopper ores and concentrates.	490 518
	MOZFerro-chromium :-- Containing by we	269 391
	ZWEElectrical energy. (optional headin	256 635

	NGAPolypropylene	220 232
	KENContaining by weight less than 0.25	126 108
	MOZCoal, whether or not pulverised, bu	125 566
	KENContaining by weight less than 0.25	125 429
	KENOther, with compression-ignition in	120 717

Source: Author's own compilation based on data from UN COMTRADE (2021)

Table A4-2: South Africa's and the selected peer countries' top 10 export relationships that decreased to selected regions (2007–2019)

Country	Top 10 country product groupings	Decrease in value (USD)
China	CHNPetroleum oils and oils obtained fr	-870 728
	CHNPlatinum :-- Unwrought or in powder	-224 955
	CHNCopper ores and concentrates.	-187 541
	CHNNot further worked than hot-rolled,	-156 418
	CHNCopper waste and scrap.	-139 769
	CHNNot further worked than hot-rolled,	-106 689
	CHNNot further worked than hot-rolled,	-100 249
	CHNCopper ores and concentrates.	-94 360
	CHNRectangular (including square) :--	-81 385
	CHNFerro-silico-manganese	-71 602
US	USARhodium :-- Unwrought or in powder	-1 095 555
	USAOther vehicles, with spark-ignition	-988 375
	USAPlatinum :-- Unwrought or in powder	-877 967
	USAOther vehicles, with spark-ignition	-553 066
	USAOther vehicles, with spark-ignition	-513 341
	USAOther vehicles, with spark-ignition	-513 323
	USAFerro-manganese :-- Containing by w	-312 806
	USANon-industrial :-- Other	-265 731
	USAFiltering or purifying machinery an	-264 745
	USAIridium, osmium and ruthenium :-- U	-263 293
EU7	DEUFerro-chromium :-- Containing by we	-687 154
	DEUFiltering or purifying machinery an	-671 447
	NLDCoal, whether or not pulverised, bu	-585 498
	ITACoal, whether or not pulverised, bu	-527 395
	DEUEngines of a kind used for the prop	-521 381
	DEUOther	-412 118
	FRAFiltering or purifying machinery an	-371 562
	DEUParts	-333 846
	FRACoal, whether or not pulverised, bu	-322 504
	DEUOther	-300 728
SSA	ZWEPetroleum oils and oils obtained fr	-173 520
	NGATowers and lattice masts	-144 883
	ZMBPetroleum oils and oils obtained fr	-127 278
	NGAOther, with spark-ignition internal	-124 267

	MOZRaw sugar not containing added flav	-105 876
	ZMBMineral or chemical fertilisers con	-74 347
	NGAPetroleum oils and oils obtained fr	-74 320
	MOZElectro-diagnostic apparatus (inclu	-72 000
	MOZElectro-diagnostic apparatus (inclu	-70 776
	MOZElectro-diagnostic apparatus (inclu	-70 195

Source: Author's own compilation based on data from UN COMTRADE (2021)

Table A4-3: South Africa's and the selected peer countries' top 10 export relationships that became extinct to selected regions (2007–2019)

Country	Top 10 country product groupings	Extinction value (USD)
China	CHNOf nickel, not alloyed	-98 517
	CHNHydrides, nitrides, azides, silicid	-17 448
	CHNOther :-- Ferro-vanadium	-15 909
	CHNTitanium oxides	-10 133
	CHNHydrides, nitrides, azides, silicid	-9 702
	CHNXylole	-9 582
	CHNHydrides, nitrides, azides, silicid	-9 470
	CHNElectrodes :-- Of a kind used for f	-9 411
	CHNOther paper and paperboard, not con	-9 409
	CHNUnbleached :-- Coniferous	-8 279
USA	USAHydrides, nitrides, azides, silicid	-75 126
	USATitanium oxides	-61 597
	USASlag, dross (other than granulated	-32 398
	USAOther, not in coils, not further wo	-27 470
	USAFerro-chromium :-- Other	-14 141
	USAOther vehicles, with compression-ig	-11 637
	USANickel ores and concentrates.	-10 470
	USAOther, not in coils, not further wo	-7 743
	USAOther, not in coils, not further wo	-7 740
	USAOther paper and paperboard, not con	-7 158
EU7	NLDUnsaturated:-- Other	-161 135
	NLDNaphthalene	-134 134
	NLDSaturated monohydric alcohols:-- Bu	-100 910
	ITAOtherwise plated or coated with zin	-72 169
	NLDHydrides, nitrides, azides, silicid	-60 724
	DEUVanadium oxides and hydroxides	-40 898
	DEUUnrefined copper; copper anodes for	-33 819
	DEUCopper alloys :-- Other copper allo	-27 996
	NLDSaturated monohydric alcohols:-- Pr	-27 262
	NLDPlatinum :-- Unwrought or in powder	-24 367
SSA	MOZManganese and articles thereof, inc	-142 812
	NGAAluminium, not alloyed	-64 629
	GHAAluminium, not alloyed	-35 176

	KENPlatinum :-- Other	-23 963
	NGAPetroleum bitumen	-22 373
	KENRhodium :-- Unwrought or in powder	-18 687
	KENZinc, not alloyed :-- Containing by	-17 862
	SYCAeroplanes and other aircraft, of a	-16 783
	TZAWith compression-ignition internal	-16 581
	NGAIn coils, not further worked than c	-15 883

Source: Author's own compilation based on data from UN COMTRADE (2021)

ANNEXURE 5:

DISTRIBUTION OF INCREASES IN SOUTH AFRICA'S INTENSIVE MARGIN

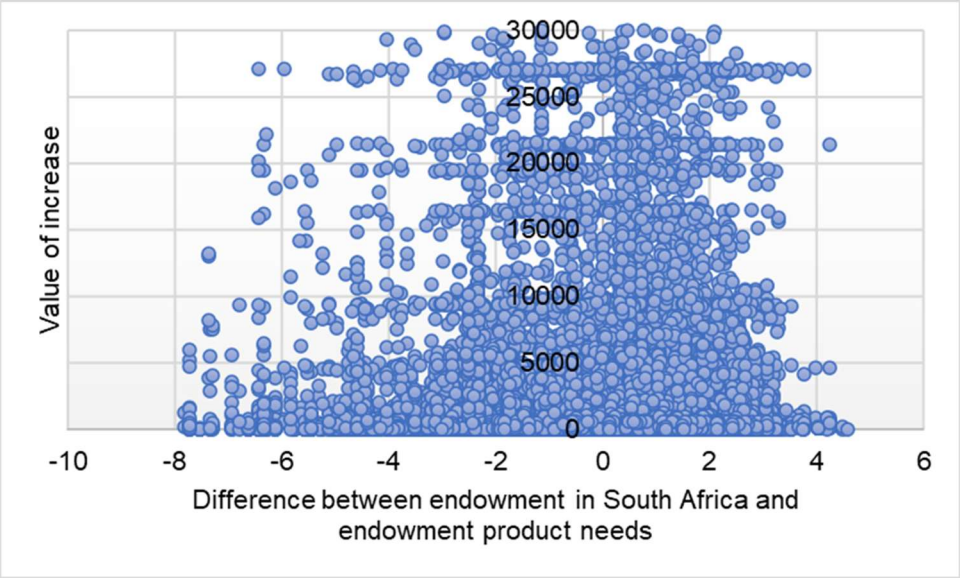

Figure A5-1: Distribution of increases in South Africa's intensive margin

Source: Author's own calculations based on data from UN COMTRADE (2021)

ANNEXURE 6:

SITC REV.3 PRODUCTS, BY TECHNOLOGICAL CATEGORIES

Table A6-1: SITC rev.3 products, by technological categories (Lall, 2000)

LDC01	Primary products (Lall classification)
001	Live animals other than animals of division 03
011	Meat of bovine animals, fresh, chilled or frozen
012	Other meat and edible meat offal
022	Milk, cream and milk products (excluding butter, cheese)
025	Birds' eggs, and eggs' yolks; egg albumin
034	Fish, fresh (live or dead), chilled or frozen
036	Crustaceans, mollusks and aquatic invertebrates
041	Wheat (including spelt) and meslin, unmilled
042	Rice
043	Barley, unmilled
044	Maize (not including sweet corn), unmilled

045	Cereals, unmilled (excluding wheat, rice, barley, maize)
054	Vegetables
057	Fruits and nuts (excluding oil nuts), fresh or dried
071	Coffee and coffee substitutes
072	Cocoa
074	Tea and mate
075	Spices
081	Feeding stuff for animals (no unmilled cereals)
091	Margarine and shortening
121	Tobacco, unmanufactured; tobacco refuse
211	Hides and skins (except furskins), raw
212	Furskins, raw, other than hides & skins of group 211
222	Oil seeds and oleaginous fruits (excluding flour)
223	Oil seeds & oleaginous fruits (incl. flour, n.e.s.)
231	Natural rubber & similar gums, in primary forms
244	Cork, natural, raw & waste (incl. blocks, sheets)
245	Fuel wood (excluding wood waste) and wood charcoal
246	Wood in chips or particles and wood waste
261	Silk
263	Cotton
268	Wool and other animal hair (incl. wool tops)
272	Crude fertilizers (excluding those of division 56)
273	Stone, sand and gravel
274	Sulphur and unroasted iron pyrites
277	Natural abrasives, n.e.s. (incl. industri. diamonds)
278	Other crude minerals
291	Crude animal materials, n.e.s.
292	Crude vegetable materials, n.e.s.
321	Coal, whether or not pulverized, not agglomerated
333	Petroleum oils, oils from bitumin. materials, crude
342	Liquefied propane and butane
343	Natural gas, whether or not liquefied
344	Petroleum gases, other gaseous hydrocarbons, n.e.s.
345	Coal gas, water gas & similar gases (excluding hydrocar.)
681	Silver, platinum, other metals of the platinum group
682	Copper
683	Nickel
684	Aluminium
685	Lead
686	Zinc
687	Tin
LDC02	Resource-based manufactures: agro-based (Lall classification)
016	Meat, edible meat offal, salted, dried; flours, meals
017	Meat, edible meat offal, prepared, preserved, n.e.s.

023	Butter and other fats and oils derived from milk
024	Cheese and curd
035	Fish, dried, salted or in brine; smoked fish
037	Fish, aqua. invertebrates, prepared, preserved, n.e.s.
046	Meal and flour of wheat and flour of meslin
047	Other cereal meals and flour
048	Cereal preparations, flour of fruits or vegetables
056	Vegetables, roots, tubers, prepared, preserved, n.e.s.
058	Fruit, preserved, and fruit preparations (no juice)
059	Fruit and vegetable juices, unfermented, no spirit
061	Sugar, molasses and honey
062	Sugar confectionery
073	Chocolate, food preparations with cocoa, n.e.s.
098	Edible products and preparations, n.e.s.
111	Non-alcoholic beverages, n.e.s.
112	Alcoholic beverages
122	Tobacco, manufactured
232	Synthetic rubber
247	Wood in the rough or roughly squared
248	Wood simply worked, and railway sleepers of wood
251	Pulp and waste paper
264	Jute, other textile bast fibre, n.e.s., not spun; tow
265	Vegetable textile fibres, not spun; waste of them
269	Worn clothing and other worn textile articles
421	Fixed vegetable fats & oils, crude, refined, fractio.
422	Fixed vegetable fats & oils, crude, refined, fract.
431	Animal or veg. oils & fats, processed, n.e.s.; mixt.
621	Materials of rubber (pastes, plates, sheets, etc.)
625	Rubber tyres, tyre treads or flaps & inner tubes
629	Articles of rubber, n.e.s.
633	Cork manufactures
634	Veneers, plywood, and other wood, worked, n.e.s.
635	Wood manufacture, n.e.s.
641	Paper and paperboard
LDC03	Resource-based manufactures: other (Lall classification)
281	Iron ore and concentrates
282	Ferrous waste, scrape; remelting ingots, iron, steel
283	Copper ores and concentrates; copper mattes, cemen
284	Nickel ores & concentrates; nickel mattes, etc.
285	Aluminium ores and concentrates (incl. alumina)
286	Ores and concentrates of uranium or thorium
287	Ores and concentrates of base metals, n.e.s.
288	Non-ferrous base metal waste and scrap, n.e.s.
289	Ores & concentrates of precious metals; waste, scrap

322	Briquettes, lignites and peat
325	Coke & semi-cokes of coal, lign., peat; retort carbon
334	Petroleum oils or bituminous minerals > 70 % oil
335	Residual petroleum products, n.e.s., related mater.
411	Animals oils and fats
511	Hydrocarbons, n.e.s., & halogenated, nitr. Derivative
514	Nitrogen-function compounds
515	Organo-inorganic, heterocycl. compounds, nucl. Acids
516	Other organic chemicals
522	Inorganic chemical elements, oxides & halogen salts
523	Metallic salts & peroxysalts, of inorganic acids
524	Other inorganic chemicals
531	Synth. organic colouring matter & colouring lakes
532	Dyeing & tanning extracts, synth. tanning materials
551	Essential oils, perfume & flavour materials
592	Starche, wheat gluten; albuminoidal substances; glues
661	Lime, cement, fabrica. constr. mat. (excludingglass, clay)
662	Clay construction, refracto. construction materials
663	Mineral manufactures, n.e.s.
664	Glass
667	Pearls, precious & semi-precious stones
689	Miscellaneous no-ferrous base metals for metallur.
LDC04	Low-technology manufactures: textile, garment and footwear (Lall classification)
611	Leather
612	Manufactures of leather, n.e.s.; saddlery & harness
613	Furskins, tanned or dressed, excluding those of 8483
651	Textile yarn
652	Cotton fabrics, woven
654	Other textile fabrics, woven
655	Knitted or crocheted fabrics, n.e.s.
656	Tulles, trimmings, lace, ribbons & other small wares
657	Special yarn, special textile fabrics & related
658	Made-up articles, of textile materials, n.e.s.
659	Floor coverings, etc.
831	Travel goods, handbags & similar containers
841	Men's clothing of textile fabrics, not knitted
842	Women's clothing, of textile fabrics
843	Men's or boy's clothing, of textile, knitted, croche.
844	Women's clothing, of textile, knitted or crocheted
845	Articles of apparel, of textile fabrics, n.e.s.
846	Clothing accessories, of textile fabrics
848	Articles of apparel, clothing access., excluding textile
851	Footwear
LDC05	Low-technology manufactures: other products (Lall classification)

642	Paper & paperboard, cut to shape or size, articles
665	Glassware
666	Pottery
673	Flat-rolled prod., iron, non-alloy steel, not coated
674	Flat-rolled prod., iron, non-alloy steel, coated, clad
675	Flat-rolled products of alloy steel
676	Iron & steel bars, rods, angles, shapes & sections
677	Rails & railway track construction mat., iron, steel
678	Wire of iron or steel
691	Structures & parts, n.e.s., of iron, steel, aluminium
692	Metal containers for storage or transport
693	Wire products (excluding electrical) and fencing grills
694	Nails, screws, nuts, bolts, rivets & the like, of metal
695	Tools for use in the hand or in machine
696	Cutlery
697	Household equipment of base metal, n.e.s.
699	Manufactures of base metal, n.e.s.
821	Furniture & parts
893	Articles, n.e.s., of plastics
894	Baby carriages, toys, games & sporting goods
895	Office & stationery supplies, n.e.s.
897	Jewellery & articles of precious materia., n.e.s.
898	Musical instruments, parts; records, tapes & similar
899	Miscellaneous manufactured articles, n.e.s.
LDC06	Medium-technology manufactures: automotive (Lall classification)
781	Motor vehicles for the transport of persons
782	Motor vehic. for transport of goods, special purpo.
783	Road motor vehicles, n.e.s.
784	Parts & accessories of vehicles of 722, 781, 782, 783
785	Motorcycles & cycles
LDC07	Medium-technology manufactures: process (Lall classification)
266	Synthetic fibres suitable for spinning
267	Other man-made fibres suitable for spinning
512	Alcohols, phenols, halogenat., sulfonat., nitrat. der.
513	Carboxylic acids, anhydrides, halides, per.; derivati.
533	Pigments, paints, varnishes and related materials
553	Perfumery, cosmetics or toilet prepar. (excluding soaps)
554	Soaps, cleansing and polishing preparations
562	Fertilizers (other than those of group 272)
571	Polymers of ethylene, in primary forms
572	Polymers of styrene, in primary forms
573	Polymers of vinyl chloride or halogenated olefins
574	Polyethers, epoxide resins; polycarbonat., polyesters
575	Other plastics, in primary forms

579	Waste, parings and scrap, of plastics
581	Tubes, pipes and hoses of plastics
582	Plates, sheets, films, foil & strip, of plastics
583	Monofilaments, of plastics, cross-section > 1mm
591	Insectides & similar products, for retail sale
593	Explosives and pyrotechnic products
597	Prepared addit. for miner. oils; lubricat., de-icing
598	Miscellaneous chemical products, n.e.s.
653	Fabrics, woven, of man-made fabrics
671	Pig iron & spiegeleisen, sponge iron, powder & granu
672	Ingots, primary forms, of iron or steel; semi-finis.
679	Tubes, pipes & hollow profiles, fittings, iron, steel
786	Trailers & semi-trailers
791	Railway vehicles & associated equipment
882	Cinematographic & photographic supplies
LDC08	Medium-technology manufactures: engineering (Lall classification)
711	Vapour generating boilers, auxiliary plant; parts
713	Internal combustion piston engines, parts, n.e.s.
714	Engines & motors, non-electric; parts, n.e.s.
721	Agricultural machinery (excluding tractors) & parts
722	Tractors (excluding those of 71414 & 74415)
723	Civil engineering & contractors' plant & equipment
724	Textile & leather machinery, & parts thereof, n.e.s.
725	Paper mill, pulp mill machinery; paper articles man.
726	Printing & bookbinding machinery, & parts thereof
727	Food-processing machines (excluding domestic)
728	Other machinery for particular industries, n.e.s.
731	Machine-tools working by removing material
733	Mach.-tools for working metal, excluding removing mate.
735	Parts, n.e.s., & accessories for machines of 731, 733
737	Metalworking machinery (excluding machine-tools) & parts
741	Heating & cooling equipment & parts thereof, n.e.s.
742	Pumps for liquids
743	Pumps (excluding liquid), gas compressors & fans; centr.
744	Mechanical handling equipment, & parts, n.e.s.
745	Other non-electr. machinery, tools & mechan. appar.
746	Ball or roller bearings
747	Appliances for pipes, boiler shells, tanks, vats, etc.
748	Transmis. Shafts
749	Non-electric parts & accessor. of machinery, n.e.s.
762	Radio-broadcast receivers, whether or not combined
763	Sound recorders or reproducers
772	Apparatus for electrical circuits; board, panels
773	Equipment for distributing electricity, n.e.s.

775	Household type equipment, electrical or not, n.e.s.
793	Ships, boats & floating structures
811	Prefabricated buildings
812	Sanitary, plumbing, heating fixtures, fittings, n.e.s.
813	Lighting fixtures & fittings, n.e.s.
872	Instruments & appliances, n.e.s., for medical, etc.
873	Meters & counters, n.e.s.
884	Optical goods, n.e.s.
885	Watches & clocks
891	Arms & ammunition
LDC09	High-technology manufactures: electronic and electrical (Lall classification)
716	Rotating electric plant & parts thereof, n.e.s.
718	Other power generating machinery & parts, n.e.s.
751	Office machines
752	Automatic data processing machines, n.e.s.
759	Parts, accessories for machines of groups 751, 752
761	Television receivers, whether or not combined
764	Telecommunication equipment, n.e.s.; & parts, n.e.s.
771	Electric power machinery, and parts thereof
774	Electro-diagnostic appa. for medical sciences, etc.
776	Cathode valves & tubes
778	Electrical machinery & apparatus, n.e.s.
LDC10	High-technology manufactures: other (Lall classification)
525	Radio-actives and associated materials
541	Medicinal and pharmaceutical products, excluding 542
542	Medicaments (incl. veterinary medicaments)
712	Steam turbines & other vapour turbin., parts, n.e.s.
792	Aircraft & associated equipment; spacecraft, etc.
871	Optical instruments & apparatus, n.e.s.
874	Measuring, analysing & controlling apparatus, n.e.s.
881	Photographic apparatus & equipment, n.e.s.
LDC99	Unclassified products (Lall classification)
351	Electric current
883	Cinematograph films, exposed & developed
892	Printed matter
896	Works of art, collectors' pieces & antiques
961	Coin (other than gold coin), not being legal tender
971	Gold, non-monetary (excluding gold ores and concentrates)

Based on Lall (2000) product classification, accessed from UNCTAD (2021)