THE DYNAMICS AND DETERMINANTS OF SOUTH AFRICAN EXPORTS

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Declaration

I confirm that this thesis presented for the degree of Doctor of Philosophy, has

1. been composed entirely by myself
2. been solely the result of my own work
3. not been submitted for any other degree of professional qualification

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ABSTRACT

The thesis generates a deeper understanding of the dynamics and composition of a middle-income country's – South Africa – export structure, and the factors that are driving this evolution. The focus is the nature, composition and determinants of the extensive margin. Two key factors that shape export patterns are considered: endowments and trade policy. The thesis also systematically unpacks the nature of the relationship between export patterns and economic development, by critically appraising assumptions regarding this relationship that are implicit in South African economic policy.

The broad contribution of this thesis is to explore the export patterns of a recently liberalised, natural resource rich, middle-income country, and examine the role that endowments and trade policy play in shaping these export patterns, particularly adjustments along the extensive margin. The middle-income context is of conceptual relevance, and thus contributes to the broader discussion on the developmental implications of evolving export patterns.

Although no singular unified policy exists, the broad thrust of South Africa's export strategy is to diversify its export structure toward manufacturing, targeting emerging economies and regional markets, and using trade policy as an instrument to facilitate the diversification of its export structure. Drawing on the theoretical and empirical literature, Chapter 2 sets out to critically appraise this broad policy stance and the assumptions behind it. By drawing on lessons from the literature, the chapter looks to provide policy guidance.

Chapter 3 aims to gain an understanding of the dynamics driving the evolution of South Africa's export structure in the post-apartheid period. The analysis provides a picture of the sources of export growth, and the dynamics driving changes in the composition of South Africa's export structure along the product and destination dimensions. Zahler's (2011) *product variety style decomposition approach* is used to decompose South Africa's export growth along the intensive and extensive margins. This approach is augmented to measure whether growth along the intensive margin is driven by price or quantity effects.

The extensive margin is a relatively important source of export growth, particularly entry into new geographic markets. The intensive margin is dominated by the price effect.

Chapter 4 examines the role of endowments in shaping South Africa’s export structure, as well as its evolving export structure. The Baldwin (1971) cross-commodity regression approach is employed, and advanced along two dimensions: Firstly, the approach is extended from a static to a dynamic analysis, and secondly, from an industry- to a product-level analysis. South Africa’s export structure reveals it to be natural-resource and labour abundant, yet paradoxically human capital abundant. Endowments are shown to play a role in shaping South Africa’s evolving export structure, with its export structure, paradoxically, becoming increasingly capital-intensive. South Africa, a middle-income country, is shown to occupy a ‘middle position’ between its trading partners, indicating that the relative endowments of a middle-income country, such as South Africa, play a role in shaping its export structure across trading partners.

Chapter 5 considers the role of tariff liberalisation, emerging from the Trade, Development and Cooperation Agreement (TDCA), in driving the growth and diversification of South African exports into European Union (EU) country markets, specifically EU10 markets. The analysis tests whether the revealed trade effects are consistent with the theoretical predictions of the Besedeš & Cole (2017) heterogeneous firm model. To measure the trade effect, the triple difference-in-differences estimator from Frazer & Van Biesebroeck (2010) is adapted and employed. The analysis deals with the endogeneity concern by using the extension of EU membership as an exogenous shock to identify the effect of trade preferences on South African exports. The expansion of the EU provides a unique event whereby a trade agreement negotiated between two parties (the EU15 countries and South Africa) is extended unilaterally and exogenously to another party (the EU10 countries). The analysis reveals a positive aggregate trade effect. Consistent with the Besedeš & Cole (2017) model, both aggregate and extensive margin growth effects are stronger in differentiated product markets relative to homogeneous product markets. The tariff liberalisation has been effective in driving the diversification of South African exports into EU10 countries.

CHAPTER 1: INTRODUCTION

1.1 Overview

In 2005 an international advisory panel for the Accelerated Shared Growth Initiative (ASGISA) was tasked with identifying the key constraints to economic growth in South Africa. South Africa was identified as suffering from an 'external constraint', which refers to its inability to grow without running into balance of payments constraints (Hausmann, 2008).[1] Trade performance, particularly export performance, is a central factor behind the external constraint. Hausmann & Klinger (2008) point to South Africa's relatively poor export performance over a 40-year period, stating that exports per capita in 2004 are no higher than they were 40 years earlier. Arguably, the 'external constraint' is an economic development challenge facing not only South Africa, but many other developing economies, particularly middle-income economies looking to transition to high-income status.

The over-arching policy solution to this economic imperative comprises two parts: firstly, South Africa needs to grow its tradable sector relative to its non-tradable sector (Department of Trade and Industry [DTI], 2007:2). Secondly, the South African economy needs to diversify its export structure (DTI, 2007:2). Implicit in this policy prescription is the assumption that the growth and diversification of exports leads to higher levels of economic growth and development. This suggests that the nature of developing country export patterns has significant implications for economic development. Therefore, gaining an understanding of the export patterns of a middle-income country and the factors driving these patterns is of key interest.

The broad contribution of this thesis is to explore the export patterns of a recently liberalised, natural resource rich, middle-income country, and examine the role that endowments and trade policy play in shaping these export patterns, particularly adjustments along the extensive margin. The extensive margin refers to the extension of exports into new trade relationships.[2] The analysis is informed by recent theoretical developments in the international trade literature, notably heterogeneous firm trade theory. The middle-income context is of conceptual

[1] Higher domestic growth requires greater imports, which need to be financed by exports, otherwise the economy will run into an 'external constraint' – a lack of foreign exchange required to finance the import of intermediates (Bell, Farrell & Cassim (2002:182-185; Edwards & Lawrence, 2008: 586, 595).

[2] A complementary measure, the intensive margin, refers to the intensification of existing export relationships.

relevance, and thus contributes to the broader discussion on the economic development implications of evolving export patterns. The thesis also systematically unpacks the nature of the relationship between export patterns and economic development, by critically appraising the assumptions regarding this relationship that are implicit in South African economic policy.

The structure of this thesis is as follows: Chapter 2 draws on the theoretical and empirical literature, and critically appraises the key assumptions implicit in South Africa's economic policy targeting export growth and diversification. In Chapter 3, the dynamics driving South Africa's evolving export pattern in the post-apartheid period are examined. The remaining two empirical chapters consider factors that influence export patterns. Chapter 4 and Chapter 5 examine the role of endowments and trade policy in shaping South Africa's evolving export structure, respectively.

1.2 Outline of thesis

Chapter 2 explores the relationship between export patterns and economic development. This is achieved by drawing on the theoretical and empirical literature, and correspondingly appraising the assumptions regarding this relationship that are implicit in South Africa's economic policy. These assumptions include: first, export growth and diversification are positively linked to economic growth and higher levels of economic development. Second, diversification of the export structure along the product and destination dimensions, toward manufactured products and proximate and fast-growing destinations, is associated with higher levels of economic growth and development. Third, for a country to develop, it needs to diversify out of traditional comparative advantage products. Fourth, trade policy can be used to facilitate export diversification. This chapter unpacks and critically assesses these relationships in the context of middle-income countries, such as South Africa. Drawing on lessons from the literature, this chapter provides policy guidance to South Africa's export strategy.

Chapter 3 presents an empirical analysis of the dynamics driving the evolution of South Africa's export structure in the post-apartheid period. Using Zahler's (2011) *product variety style decomposition approach*, the analysis provides a detailed picture of the sources of export growth, and the dynamics driving changes in the composition of South Africa's export structure along the product and destination dimensions. The chapter details the extent to which entry into new markets has driven export growth in the post-apartheid period, a period marked by South

Africa's reintegration into the global economy. Insight is gained into the response of South African exports to the changing global economic environment, which is characterised by the rising prominence of emerging economies, such as China and India. Drawing on the discussion in Chapter 2 regarding the link between export patterns and economic development, the analysis considers the growth implications associated with South Africa's evolving export structure.

Chapter 3 also shows a resource abundant country's response to the commodities super cycle, particularly the extent to which the price and quantity margins have driven the intensification of existing export relationships – the intensive margin of export growth. A limitation of the product variety style decomposition approach is that it does not decompose intensive margin growth, and thus abstracts from the price and quantity dynamics driving this source of growth. Therefore, the decomposition approach is extended to measure these price and quantity effects. This extension of the Zahler (2011) product variety style decomposition approach serves as a methodological contribution.

A key finding in Chapter 3 is that the extensive margin is an important source of export growth, and that growth along this margin varies by destination region. Chapter 4 builds on this finding by examining the role of endowments in shaping South Africa's export structure, as well as the role of endowments in driving its evolving export structure. The Heckscher-Ohlin model predicts how endowments shape trade patterns across countries. The chapter assesses whether the predictions emerging from this model is consistent with South Africa's export outcomes. Cadot, Carrère & Strauss-Kahn (2011) show how endowments play a role in driving the evolution of a country's export structure. They show that as middle-income economies advance from low-income status, they accumulate capital and produce a growing variety of increasingly capital-intensive products. Chapter 4 assesses whether this claim of increased capital-intensity in production is consistent with South Africa's experience as a middle-income country. The empirical literature points to a paradox regarding the factor content of South Africa's trade and its endowment structure. Alleyne & Subramanian (2001) show that South Africa's factor content of trade reveal it to be capital abundant, which stands in contrast to its labour abundance. The chapter examines whether this paradox remains when using disaggregated product-level data, and whether it is evident in South Africa's evolving export structure. Finally, Chapter 4 analyses whether South Africa occupies a 'middle position', where relative endowments shape its export structure across high-, middle- and low-income trading partners.

To examine the role of endowments in shaping South Africa's export structure, Chapter 4 employs the Baldwin (1971) cross-commodity regression approach. The chapter advances the application of this approach along two dimensions, thereby making a methodological contribution: firstly, the cross-commodity regression approach is extended from a static to a dynamic analysis. Secondly, using highly disaggregated product-level trade data, and matching revealed factor intensity data, it is extended from the broad industry-level to the detailed product-level. These extensions allow one to examine the link between endowments and evolving export patterns, at a highly disaggregated product-level.

The decomposition analysis in Chapter 3 shows strong extensive margin growth into European countries, particularly in manufactured products. The data point to the geographic diversification of exports into EU10 destination markets.[3] This extensive margin growth has coincided with the establishment of the Trade, Development and Cooperation Agreement (TDCA) and the expansion of European Union (EU) membership. Therefore, Chapter 5 considers the role of TDCA tariff liberalisation in driving export growth into the European regional market. The analysis examines the role of TDCA tariff liberalisation in driving the diversification of South Africa's export structure into the EU. It also examines the effectiveness of the TDCA in driving diversification into differentiated product export markets. The chapter tests whether the revealed trade effects are consistent with the theoretical predictions of the Besedeš & Cole (2017) heterogeneous firm model.

To measure the trade effect of the TDCA tariff liberalisation on South African export flows into the EU10 countries, the triple difference-in-differences estimator from Frazer & Van Biesebroeck (2010) is adapted and employed. Empirical analyses measuring the impact of trade agreements on trade are plagued by the endogeneity concern (Kohl, 2014; Baier & Bergstrand, 2007). This is also evident in existing work pertaining to South Africa. Kwaramba, Kwenda-Magejo & Rankin (2015) fail to deal with this concern when measuring the impact of TDCA driven tariff liberalisation on South Africa's exports into the EU, and thus potentially bias their estimates. Chapter 5 contributes to the empirical literature by employing a novel way of dealing with the endogeneity concern. The chapter deals with endogeneity by using the extension of EU membership as an exogenous shock to identify the effect of trade preferences on South African exports. EU10 countries were not party to the TDCA trade negotiations and were thus

3 The EU10 refers to European countries that joined the EU in 2004, namely, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia.

unable to influence the structure of the tariff liberalisation. As such, the tariff liberalisation is imposed exogenously onto these countries. This allows for the identification of the trade effect resulting from TDCA-driven tariff liberalisation.

1.3 Why South Africa?

Before proceeding, it is important to consider why South Africa represents an interesting case study. Firstly, South Africa is a resource-rich middle-income economy with an established industrial base. The country faces the economic development challenge of being squeezed on both sides. South African firms struggle to compete with high- and low-income country firms in 'rich country' and 'poor country' products, respectively. This challenge characterising the middle-income country space provides an interesting nuance to the broader discussion on the economic development implications of evolving export patterns.

The middle-income context is especially evident in the second motivation for using South Africa as a case study. South Africa's endowment structure is characterised by natural resource and labour abundance. Its relative endowment structure is likely to lead to diverging export patterns across product and destination markets. Cadot et al. (2011) find that the manner in which countries adjust along the extensive margin – in terms of entering and exiting products – is consistent with the notion of travelling across diversification cones. This may be especially interesting in the case of a middle-income country, such as South Africa, since these adjustments along the extensive margin may vary according to its relative factor endowments. With this in mind, Chapter 4 examines whether South Africa's evolving export pattern is consistent with its factor endowments. Of key interest is whether endowments shape changes along the extensive margin, and whether this varies across destination.

A third motivation relates to South Africa embarking on a liberalisation plan in the post-apartheid period, which included a free trade agreement with the EU. Trade liberalisation drives changes in export flows, particularly adjustments along the extensive margin (Dutt, Mihov & Van Zandt, 2013). Thus, given recent trade liberalisation, South Africa provides an interesting case for examining how shifts toward tariff liberalisation drive changes in a middle-income country's export structure. The analysis in Chapter 5 explores this in further detail by examining the impact of TDCA driven tariff liberalisation on South African exports into the EU.

CHAPTER 2: ECONOMIC DEVELOPMENT AND EXPORT PATTERNS: AN APPRAISAL OF SOUTH AFRICA'S EXPORT POLICY

2.1 Introduction

Policy designed to stimulate economic growth and development typically incorporates export growth as a key objective. Combined with the goal of generating export growth, there is emphasis on whether the composition of the growing export structure is growth promoting. As such, governments are interested in the composition of a 'desirable' export structure, and hence diversifying, or growing along the extensive margin, toward such structure.

This observation holds for South Africa as well, as is illustrated in various excerpts from recent South African policy documents:

> *"To facilitate diversification beyond our current reliance upon traditional commodities and non-tradable services. This requires the promotion of increased value-addition per capita characterised particularly by movement into non-traditional tradable goods and services that compete in export markets as well as against imports." (DTI, 2007:2)*
>
> *"…the share of exports in South African output will rise and the profile will be more diverse with a growing portion of non-mineral manufactures and services. A greater proportion of exports will be directed to emerging markets…" (National Planning Commission [NPC], 2011:93)*
>
> *"...to widen the market for South African goods and services through a stronger focus on exports to the region and other rapidly growing economies" (Economic Development Department [EDD], 2011: 21)*
>
> *"…trade policy and strategy in South Africa can make a contribution to meeting the objectives of upgrading and diversifying the economic base in order to produce and export increasingly sophisticated, value added products that generate employment." (DTI, 2010: 10)*

These policy prescriptions embed five assumptions: firstly, export growth and diversification are positively linked to economic growth and higher levels of economic development. Secondly, the diversification of a country's export structure toward manufacturing is associated with higher levels of economic growth and development. Thirdly, the diversification of a country's export structure toward proximate and fast-growing destination markets is expected to facilitate higher levels of economic growth. Fourthly, for a country to develop, it needs to change its comparative advantage and diversify out of traditional comparative advantage products. Finally, trade policy can be actively used to facilitate diversification toward desirable export markets.

However, these trade-growth assumptions are contested in the literature. It is thus important to assess whether these assumptions provide a solid foundation for the formulation of policy. Therefore, drawing on the theoretical and empirical literature, this chapter appraises these assumptions implicit in South Africa's economic policy. In so doing, the chapter critically reflects on South Africa's economic policy. Further, drawing on lessons from the literature, this chapter provides policy guidance and recommendations in regard to South Africa's export strategy.

At the outset it must be noted that while this chapter focuses on the goods dimension of exports, it is important to acknowledge the services dimension. Trends in international trade indicate that services exports have increased in importance relative to goods exports since the 1970s (Loungani, Mishra, Papageorgiou & Wang, 2017). As such, services exports are considered as a key element of export growth and diversification (Brenton, Newfarmer, Shaw & Walkenhorst, 2009). This growth in services trade has been linked to higher levels of economic growth (Hoekman & Mattoo, 2008). Ghani & Kharas (2010) shows that the South Asian growth performance in the 2000s, particularly in India, is one largely driven by growth in services trade. As such, she argues that services trade offers an alternative growth path to the East-Asian manufacturing-led growth path for developing countries. Unsurprisingly, services export growth is mentioned in the policy prescriptions listed above. Nevertheless, while the importance of services trade is acknowledged, in order to align with the overall scope of the thesis, this chapter focuses explicitly on goods trade.

The chapter proceeds as follows: Section 2.2 considers the literature exploring the links between, firstly, export growth and economic growth, and secondly, export diversification and economic growth and development. Section 2.3 explores the literature that examines the linkage between export composition, both in terms of what a country exports and where it exports, and economic growth and development. Section 2.4 considers the literature that investigates the drivers of export diversification or growth along the extensive margin. In particular, and in line with the objectives in Chapters 4 and 5 of this thesis, focus is placed on studies looking at the role that endowments and trade policy respectively play in driving the diversification of a country's export structure. Section 2.5 concludes.

2.2 Growth and diversification of exports and economic growth and development

South African economic policy calls for the growth and diversification of exports. Implicit in this policy aim is the assumption that there is a positive link between the growth and diversification of exports, and economic growth and development. This section critically evaluates this policy assumption by consulting the literature that examines, firstly, the link between export growth and economic growth, and secondly, export diversification and economic growth and development.

2.2.1 Export growth and economic growth

The higher trade levels, and export levels, associated with increased trade openness, is linked to higher levels of economic growth. The notion that outward-orientated economies outperform economies with restrictive trade regimes, formed the basis for the literature investigating the relationship between trade openness and economic growth.[4] Initial cross-country studies confirmed the expected positive relationship between openness and growth (Dollar, 1992; Sachs & Warner, 1995a; Edwards, 1998; Frankel & Romer, 1999).

However, the strength of these findings is contested by Rodriguez & Rodrik (2000). They critique these initial cross-country studies by questioning, firstly, the measurement of openness used in the estimations, and secondly, whether the endogeneity present in the estimated growth equation is appropriately accounted for.

Despite the econometric difficulties in confirming a robust positive link between openness and growth in cross-country studies, Winters (2004) states that the evidence is clearly in that direction. Harrison & Rodriguez-Clare (2010) find a strong correlation between openness and growth when openness is measured in trade volumes, but a weak correlation when openness is measured using trade policy tools.[5] In a later paper, Rodriguez (2007) concludes that there is a

4 For reviews of this literature, see: Rodriguez & Rodrik (2000), Winters (2004), Rodriguez (2007), and Harrison & Rodriguez-Clare (2010).

5 Whether the economic growth resulting from higher trade volumes is due to trade liberalisation (e.g. lowering of tariff protections), or other factors (e.g. falling costs of trade), and whether these two effects can be estimated separately, remains a key empirical challenge in this literature. For the purposes of the discussion to follow, I'm interested in whether higher levels of trade, in particular higher levels of exports, is growth enhancing.

strong positive correlation between trade volumes and growth. Therefore, there is evidence in the literature pointing toward higher levels of trade – and hence exports – being linked to higher levels of economic growth.

The policy assumption that higher export levels is positively linked to economic growth, finds validation in the literature. However, it is also evident in the South African policy stance that export growth on its own is insufficient. Policy also places emphasis on generating export growth by means of diversifying into new export markets. The next section considers literature exploring the link between an evolving export structure, and economic growth and development.

2.2.2 Export diversification and economic growth and development

Focus shifts to the literature examining whether export diversification, driven by adjustment along the extensive margin, is linked to economic growth and development. South African economic policy assumes a positive link. This section critically evaluates the strength of this policy assumption. The section starts with a discussion on the channels through which export diversification influences economic growth and development, as asserted in the theoretical literature. This is followed by an assessment of the related empirical literature.

2.2.2.1 Channels explaining the link between export diversification and growth

The theoretical literature provides a strong basis for the aforementioned policy assumption. It also makes a case for reduced reliance on traditional commodities, and diversification toward non-mineral manufactures. There are a number of channels that explain the growth-inducing effects of export diversification.

The *structuralist argument*, as per the Prebisch-Singer hypothesis, claims that developing countries, which are typically dependent on natural resource exports, experience deteriorating terms of trade (Prebisch, 1959; Cuddington, Ludema & Jayasuriya, 2007). It is argued that vertical diversification away from natural-resource based exports towards manufactured exports leads to sustained economic growth.

Instead of placing concern on the deteriorating terms of trade associated with natural resource-based exports, the *export portfolio argument* is concerned with the instability of export earnings in volatile commodity markets (Agosin, 2007; Hesse, 2009). Similarly, to the *structuralist* *argument*, the *portfolio argument* pertains to developing countries whose export structure is concentrated in commodities. Exposure to extreme price and volume fluctuations in commodity markets, exposes a country to export earnings volatility, exchange rate volatility, and reduced investment, which adversely affects economic growth. As with the portfolio effect in finance, by diversifying its export structure, a country can minimise its exposure to volatile commodity markets, stabilise export earnings, and ultimately generate sustained and stable economic growth.

Endogenous growth models such as Matsuyama (1992) or market failure models such as Hausmann & Rodrik (2003), place emphasis on the positive externalities resulting from 'learning by exporting', as a country diversifies its export portfolio. Externalities in the form of knowledge spillovers, new techniques in production, more efficient management styles, improved marketing practices, incorporation of international technology, and the like, aid productivity growth in exporting industries. These productivity improvements spillover from export industries into other industries. Therefore, producing an expanded set of products, particularly manufactured products, generates a dynamic process of knowledge spillovers, increased productivity, and ultimately increased economic growth.

2.2.2.2 Empirical evidence on the link between export diversification and economic growth and development

Building on the theoretical basis for the positive link between export diversification and growth, it is important to consider whether it is empirically verifiable. Two bodies of empirical literature are considered in this sub-section: firstly, that looking at the link between export diversification and economic growth, and secondly, that looking at the link between export diversification and economic development.

Although, there is relatively little empirical work analysing the link between export diversification and economic growth, there is consensus among existing studies, that the link is positive (Hesse, 2009). Al-Marhubi (2000) estimates cross-sectional growth regressions using aggregate data across 91 countries averaged over the period 1961 to 1988 and finds evidence of a positive link. Using more recent data, 1980 to 2003, but focusing on Asian and Latin American countries, Agosin (2007) comes to the same conclusion. He emphasises the economic significance of this link by showing that a significant share of the differential in economic growth rates between the two regions, can be explained by differences in the extent and speed of export diversification.

Given the drawbacks associated with cross-country growth regressions, subsequent studies have confirmed the positive link, using applied time series and panel estimation methods.[6] Examining time series data for the Chilean economy over the period 1962 to 2001, Herzer & Nowak-Lehnmann (2006) find that both vertical and horizontal diversification have a positive effect on economic growth in the Chilean economy.[7] Using data for 65 countries over the period 1975 to 1999, Lederman & Maloney (2007; 2009) estimate a cross-country panel regression. They find evidence indicating that export concentration has a negative impact on growth, and hence diversification fosters economic growth.

A further question posed in the empirical literature is whether the pattern of diversification varies as a country shifts to higher levels of economic development. The literature examining the link between export diversification and economic development is contested, suggesting a complex relationship.

There are two opposing views in the empirical literature, the first of which finds a u-shaped relationship between export diversification and economic development.[8] Using domestic production and employment data by sector, Imbs & Wacziarg (2003) investigate whether there is a path of diversification along which countries evolve as they develop. Their estimates indicate that at low levels of economic development, sectoral concentration is high. As an economy shifts away from lower levels of development, there is increased sectoral diversification. At a relatively high level of development a turning point is reached, after which an economy starts to re-specialise. More recent studies, such as Cadot et al. (2011), have substantiated this finding by analysing the path of export diversification as countries develop.[9]

De Benedictis, Gallegati & Tamberi (2009) and Parteka (2010) contest the u-shaped relationship, and instead find a non-linear monotonically increasing relationship. The basis of

[6] Lederman & Maloney (2007; 2009) discuss some of the drawbacks associated with cross-country growth regressions. Firstly, results are sensitive to the inclusion of explanatory variables. Secondly, bias introduced by correlation of unobserved country-specific factors with the variable of interest (diversification measure). Thirdly, the endogenous relationship between the dependent variable and the variable of interest.

[7] In this paper vertical diversification is defined as a shift in the production and export of primary products to manufactured products. Horizontal diversification is defined as an increased number of products produced and exported.

[8] Diversification and specialisation are treated as antonyms in the literature, thus implying that an increase in diversification is equivalent to a decrease in specialisation (De Benedictis, Gallegati & Tamberi, 2009). The u-shape relationship is evident if a concentration measure is used on the y-axis, and inverse u-shape, if a diversification measure is used.

[9] Also see Koren & Tenreyro (2007), Klinger & Lederman (2006; 2009; 2011), and Hesse (2009).

their contestation rests on empirical approach. They show that previous studies tend to use different measures of concentration (absolute versus relative measures), use different types of data (trade data versus domestic production and employment data), apply different estimation techniques (parametric versus non-parametric), and follow different approaches to the inclusion of country fixed effects. Given that results across studies differ according to these empirical features, De Benedictis, Gallegati & Tamberi (2009) propose an optimal method for the estimation of specialisation curves. Using a semi-parametric estimation technique, adopting relative concentration measures, and controlling for country fixed effects, they analyse export data for 539 manufacturing sectors across 39 countries over the period 1985 to 2001, and find a non-linear monotonically increasing relationship between diversification and development.

It is argued that the path of diversification as economies develop, is driven by product discovery, or growth along the product extensive margin (Klinger & Lederman, 2011; Cadot et al., 2011). Using 6-digit product-level export data for a sample of 73 countries over the period 1992 to 2003, Klinger & Lederman (2011) find that at relatively low levels of development, export discoveries rise, but as countries develop further, the frequency of these discoveries fall. They find an inverted u-shaped relationship between export diversification and economic development. This finding is supported by Cadot et al. (2011), who find that diversification before the turning point and specialisation after the turning point, is driven mostly by adjustments along the product extensive margin.

The composition of exports at different points along the diversification path, explain volatility in export growth. Koren & Tenreyro (2007) extend the Imbs & Wacziarg (2003) analysis, by exploring the development-volatility link and how diversification influences this link. Using two sources of employment and value-added data across a varying sample of developed and developing countries, across a range of sectors over time, they discover a number of empirical regularities[10]: firstly, global- and country-specific sectoral shocks decrease with the level of development, thus implying that production tends to shift to less volatile sectors as a country diversifies and develops. Secondly, in reference to the u-shaped diversification curve, the high levels of concentration at low levels of development are typically characterised by volatile sectors. In contrast, the relatively higher levels of concentration associated with higher levels

[10] Koren & Tenereyro (2007) employ two datasets: Firstly, the UNIDO (2002) dataset, which has employment and value-added data for 28 sectors (which they reduce to 19 categories), across 45 developed and developing countries over the period 1963 to 1998. Secondly, the OECDs STAN Industrial Structure Analysis (2003) dataset, which reports annual GDP data across mainly developed countries, across 18 sectors over the period 1978 to 1999.

of development, is in sectors associated with lower levels of volatility. Thirdly, country volatility decreases with the level of development. In essence, poor countries are more volatile because they specialise in fewer sectors, which tend to be more volatile, and because they experience more frequent and severe aggregate shocks.

Both the theoretical and empirical literature provide a sound basis for the policy assumption regarding the positive link between export diversification and economic growth. However, the contested nature of the empirical literature suggests that there is complexity in the manner in which diversification evolves as a country develops. Policy should take into account this complexity. The analysis in Koren & Tenreyro (2007) suggests that diversification is not enough, and that the composition of a diversifying export structure is important for sustained economic growth, which ultimately leads to higher levels of economic development. Therefore, the next section examines literature focused on the types of products that spur or hinder economic development.

2.3 Economic growth and development and the evolving composition of exports

This section considers two assumptions implicit in South African economic policy regarding exports. Firstly, reduced dependence on natural resource-based products and diversification toward manufacturing has growth-inducing effects. Secondly, diversification toward proximate and fast-growing emerging economies has growth-inducing effects. The evolving product and destination composition of a country's export structure, via adjustment along the extensive margin, impacts on economic performance. The section starts by critically examining literature pertaining to the product dimension, followed by the destination dimension.

2.3.1 Product composition – 'What you export matters'

The term 'what you export matters' was first used in Hausmann, Hwang & Rodrik (2007). They argue that the composition of a country's export bundle has important implications for economic growth, and that extensive margin growth into 'rich-country' products is linked to economic growth and development. Conversely, remaining in 'poor country' products results in stagnation. Following Lederman & Maloney (2012), this section examines literature pertaining to 'bad' products, and that pertaining to 'good' products.

2.3.1.1 'Bad products' – natural resource curse

The policy aimed at diversifying toward manufactures, and decreasing dependence on natural resource-based products, arguably finds its basis in the natural resource curse literature. The natural resource curse hypothesis advances the view that, on average, resource-rich countries tend to grow slower than resource-poor countries. The paradox of the natural resource curse hypothesis suggests that natural riches are a drag on development as opposed to a boon.

Various channels have been provided to explain this counterintuitive result:[11] firstly, drawing on Prebisch (1959), it is argued that the price of commodities relative to manufactures is said to follow a downward trajectory over the long-run. Thus, developing countries, which are specialised in natural resource-based activities, experience declining terms of trade. Prebisch (1950; 1959) and Singer (1950) argue that this coupled with natural resource industries being characterised by limited potential for technological progress, explains why natural-resource intensive developing economies lagged behind advanced industrialised economies. Secondly, it is argued that world prices of agricultural and mineral commodities are highly volatile and that this adversely impacts on economic growth. The third mechanism is when a resource boom and subsequent growth in the resource sector 'crowds-out' manufacturing activity (i.e. the 'Dutch disease'). Fourthly, it is argued that resource abundant countries may be less likely to develop sound institutions due to elites attempting to capture natural resource rents. It is also argued that countries with weak institutions, resulting from the contest over resource rents, have a higher tendency toward armed conflict. Finally, the combination of export concentration in commodities and the volatility of commodity world prices, generates increased macroeconomic volatility.

The use of the term 'resource curse' came into use after a number of studies estimating cross-country growth regressions found a negative coefficient on the proxy variable for natural resource abundance.[12] The most influential of the cross-country studies proposing the 'resource curse' were those by Sachs & Warner (1995b; 1997; 2001a; 2001b). Sachs & Warner (1995b; 1997) use cross sectional country-level data for between 69 and 97 developed and developing countries, whose GDP growth was calculated over the period 1970 to 1990. The coefficient estimate for the explanatory variable that proxies for resource abundance – primary product

[11] Lederman & Maloney (2007; 2012) and Frankel (2010b) provide six mechanisms (or channels) and their arguments.
[12] See Auty (2000; 2001), Gylfason (2001), Gylfason, Herbertsson & Zoega (1999) and Sachs & Warner (1995b; 1997; 2001a; 2001b). Also see Frankel (2010b) and Lederman & Maloney (2007) for summaries of the broader literature.

exports as a share of GDP – is negative and statistically significant even after controlling for other growth variables. In light of concerns over omitted variable bias, Sachs & Warner (2001b) include variables controlling for geography and climate and find that the 'resource curse' result remains.

However, subsequent research has contested the empirical soundness of these analyses, thus suggesting a more complex relationship. This research can be separated into two groups. Firstly, studies acknowledging the heterogeneity in experience of resource-rich countries, and thus positing a 'conditional resource curse'. Secondly, studies arguing that there is no 'resource curse'.

Studies advancing the 'conditional resource curse' still hold to the notion that the average impact of resource abundance on growth is negative, but that this adverse impact holds under certain conditions. From an empirical perspective, these studies advance Sachs & Warner (1995b; 1997; 2001b), by addressing omitted variable bias. Mehlum, Moene & Torvik (2006) contest the finding in Sachs & Warner (2001b), which argues that institutions do not affect the occurrence of the 'resource curse'. Using the same dataset as Sachs & Warner (1997), they show that resource-rich countries combined with weak 'grabber friendly' institutions or strong 'producer friendly' institutions, leads to low and high growth, respectively.

Bravo-Ortega & de Gregorio (2007) show that the curse is conditional on a country's human capital. Using a country-level panel for the period 1970 to 1990, they find that at very low levels of human capital, natural resource abundance has a negative effect on growth, but that over a certain human capital threshold, natural resource abundance is growth promoting.

Another group of studies contend that there is no resource curse at all. Analysing panel data for 65 countries over the period 1975 to 1999, using the Generalised Method of Moments estimation technique, Lederman & Maloney (2007; 2009) assess the credibility of the resource curse hypothesis. They find little evidence for the curse, and when the curse is confirmed they find questionable statistical methods. Instead the authors express the view that it is important to distinguish between the effects of exporting natural resources, and a concentrated export basket, thus suggesting that the 'resource curse' is rather a 'concentration curse'.

An alternative explanation for the 'resource curse' can be found in the foreign debt overhang facing resource-rich developing economies (Manzano & Rigobón, 2007). Manzano & Rigobón (2007) show that the 'resource curse' falls away after shifting to panel analysis and controlling for unobserved country characteristics. They contend that international debt and imperfect credit markets provide an explanation for the ‘resource curse’ finding. High commodity prices in the 1970s led developing countries to use their resources as collateral for investment funding debt. However, when commodity prices fell in the 1980s, many developing countries were left with unsustainable debt problems.

Brunnschweiler & Bulte (2008) question the proxy variable for resource abundance in the growth equation and argue that this variable measures resource dependence. Resource dependence enters endogenously into the growth regression and is determined by resource abundance, constitutions and institutions. They argue that an actual measure of resource abundance needs to be used in the growth regression. Using an instrumental variable approach, the authors find that resource dependence does not affect growth, and that resource abundance positively affects growth and institutional quality.

A number of other studies adopt a case study approach to the question of the ‘resource curse’, for example, by analysing the Latin American (Maloney, 2007) and Scandinavian (Blomström & Kokko, 2007) country experience. Maloney (2007) argues that the Latin American countries’ (LAC) poor performance is due to impediments to technological adoption and innovation, arising from weak national learning capacity, as well as perverse incentives endemic to the protectionist era in these countries. Blomström & Kokko (2007) explain how resource-rich Scandinavian countries, such as Sweden and Finland, increased the technological intensity of their resource industries, which ultimately laid the basis for diversification into high-tech manufacturing industries. For instance, the authors argue that success in the Swedish forestry industry was based on: successful import and adoption of foreign technology, development of universities and institutes supplying skills and knowledge to these industries, and encouragement of an environment of knowledge-intensive resource-based activities.

Putting South Africa’s economic policy into perspective, a number of points emerge: firstly, the studies advancing the ‘resource curse’ hypothesis provide strong validation for policy efforts aimed at reducing dependence on commodity-based exports, and in turn diversification toward manufactures. Secondly, however, recent research has suggested nuance in the effect of resource abundance on economic performance. The ‘resource curse’ can be negated by the promotion and development of strong institutions and investment in human capital. Thirdly, export concentration, especially in resource-based products, is of more concern, and this provides support for the policy emphasis on export diversification. Fourthly, it may be argued that a country's shift away from commodity exports, and thus a shift away from its endowment-driven comparative advantage, may prevent it from realising the economic benefits from its resource abundance. The economic blessing of resource abundance is best realised in knowledge- and technology-intensive economies that promote learning and innovation (Maloney, 2007; Blomström & Kokko, 2007).

2.3.1.2 'Good products' – picking winners

A related branch of the literature identifies products that a country should export, since these products yield positive externalities or spillovers that lead to economic growth. This literature provides a strong basis for the policy aim of diversifying toward non-commodity manufacturing products.

Exporting high productivity 'rich country' products is beneficial for economic growth. This is described in Hausmann & Rodrik's (2003) 'cost discovery' model, where a firm producing a high productivity product signals to other entrepreneurs the level of productivity possible, drawing them to produce the product, and thereby resulting in a rise in aggregate productivity. Hausmann et al. (2007) develop a measure to identify 'rich country' products. Using product-level trade data, they generate an associated income (productivity) level for each product – called PRODY. The PRODY for a traded product is calculated as a weighted average of per capita GDP of countries producing the product, with weights derived from revealed comparative advantage. They then construct the income (productivity) level associated with a country's export basket – called EXPY. This is calculated by summing all the PRODY values for the products exported by a country, and these are weighted by each product's share in total exports. Countries that specialise in high PRODY 'rich country' products, have a higher EXPY. EXPY is positively correlated with per capita GDP, thus indicating that specialisation in 'rich country' products is associated with higher levels of development. They also find that variation from the average EXPY, for a given level of development, predicts future economic growth.

Relatedly, diversifying exports toward more complex products is linked to higher levels of economic development and growth. Hidalgo, Hausmann & Dasgupta (2009) advance the PRODY and EXPY measures, by using network analytics to generate the analogous, product (PCI) and economic complexity (ECI) indices. ECI and PCI indices are indirect measures of the productive capabilities, possessed by a country and implicit in the production of a product, respectively. Complex countries that have more productive capabilities are able to produce complex products that require more productive capabilities. Hidalgo et al. (2009) find a strong correlation between economic complexity and GDP per capita, and find that variation in economic complexity from the average, for a given level of development, predicts future economic growth. Felipe, Kumar, Abdon & Bacate (2012) show that the major exporters of high PCI products are high-income countries, and major exporters of the low PCI products are low- to middle-income countries.

An alternative approach argues that shifting a country's export structure toward technology-intensive products leads to economic growth (Lall, 2000). Lall (2000) posits that key to a country's growth prospects, is its ability to successfully incorporate technology-intensive production activities, and thereby produce products with a high-technology content.

However, the process of shifting into technology-intensive, complex, or 'rich country' products is path-dependent and heterogeneous. Conventional trade theory suggests that the utilisation of technology-intensive production activities by developing countries, is simply a matter of imitation, provided the country has the capacity. Hence, the process of technology transfer across countries is homogeneous. Lall (2000) argues that it's not solely about capacity, but more importantly about the capability to absorb, learn, and incorporate new technologies. Countries differ in their capability to successfully incorporate technology-intensive production activities, and thus the process of structural transformation is heterogeneous across countries.

Hausmann & Klinger (2006) claim that the ability of a country to diversify into complex 'rich country' products is influenced by its current production structure and is thus path dependent. This idea is represented in the *product space* mapping developed by Hidalgo, Klinger, Barabási & Hausmann (2007) (henceforth HKBH, 2007). The *product space* represents a proximity network between the products that countries export. The proximity or distance between two products is based on the ease in which the productive capabilities embodied in the production of one product, can be adapted to the production of another product. The probability of a country moving to a new product will depend upon how proximate the capabilities embodied in its current productive structure are to those required by the new product. The *product space* mapping measures the distances between all products and shows them to be heterogeneous. This has implications for the process of structural transformation. For instance, it is easier to shift from shirts to jackets, than from shirts to catalytic converters.

HKBH (2007) find that developing countries mainly produce resource-based products in the periphery of the *product space*, and thus jumping to 'rich country' manufacturing products in the core of the *product space* is relatively difficult. This is due to the capabilities embodied in the production of peripheral products being substantially unrelated from those needed to produce products in the core of the *product space*. Conversely, developed countries tend to produce products in the core of the product space, and can easily move to other products in the core, since the capabilities embodied in the production of core products are relatively similar or related to those needed in other core products.

The policy implication of 'picking winners' is to diversify toward manufacturing products. This is apparent in South African economic policy. However, it is important to ask, what manufacturing products, and how does one identify them? The path dependent nature of structural transformation suggests that it is important to consider a country's current productive capabilities, its ability to absorb, learn, and incorporate new technologies, and based on its capabilities, what products it is best positioned to shift toward. South Africa's Industrial Policy Action Plan 2017 targets a number of manufacturing sectors, however, information on the identification process is limited.[13]

2.3.1.3 *Cautionary note on 'picking winners' – 'how you export matters'*

Diversification toward complex, technology-intensive, 'rich-country' manufacturing products may not realise the expected growth-inducing positive externalities associated with the production of such products. The critique of 'picking winners' lies in the assumption that the product, as evident in trade data, is a homogeneous unit of analysis that is produced in a uniform manner across countries (Lederman & Maloney, 2012). There is a great deal of cross-country heterogeneity hidden within narrowly defined product categories. How products are produced varies across countries, and this determines the extent to which growth-inducing positive externalities are realised.

Differences in quality, within narrowly defined product categories across countries, offers insight into how products are produced differently across countries. Measuring unit values within highly disaggregated product categories, shows substantial differentiation along the

[13] Identification of targeted sectors is based on: potential to generate growth and employment, potential for export diversification and growth, and research and self-discovery processes (DTI, 2007).

quality dimension.[14] Schott (2004) and Hummels & Klenow (2005) show that average unit values increase with the level of development. From a developmental perspective, this suggests that what is important is '*not whether an economy exports wine…it is whether the economy produces Chateau Margaux for US$2,000 or Charles Shaw's Two-buck Chuck*' (Lederman & Maloney, 2012). Thus, the key issue is not that the country produces wine, but how it produces that wine. The implication is that export quality and its dynamics offer potential insight into the growth process and its determinants, and may thus inform policy (Lederman & Maloney, 2012).

Evidence of heterogeneity in the production of goods may suggest that the type of product being produced by countries is not the best way of thinking about how exports drive economic growth and development (Lederman & Maloney, 2012). Lederman & Maloney (2012) pose a question on whether the technology and learning externalities associated with the high-tech products produced by advanced countries, are guaranteed to materialise for developing countries producing the same products. The authors show that two developing countries, Mexico and Brazil, producing products in high-tech industries, computers and aircraft, respectively, do not experience the knowledge spillovers and externalities associated with successful production in such industries. This is consistent with Baldwin (1969) who cautions that expanding production in a sector associated with potential externalities does not necessarily imply that they will automatically occur. The same product can be produced in different ways and thus not realise the same externalities.[15]

The globally fragmented nature of the production process offers another potential explanation on how products are produced differently across countries. Lederman & Maloney (2012) contend that what may appear as a developing country producing a high productivity product in the trade data, may in reality be the assembly of the final product, and represent a fraction of the total value added.[16] The key issue is not whether there are positive externalities associated with the assembly of the final product, arguably there are. Rather the issue is that

[14] The unit value is measured as the value of the exported product divided by the quantity of the product exported. This measure is considered as a proxy for quality (Schott, 2004).

[15] Just because an innovative company such as Nokia emerged from the forestry industry in Finland, does not imply that the same sort of company will emerge from the forestry industry in Brazil or Chile (Lederman & Maloney, 2012). Nokia did not come about because of the product being produced (e.g. paper and pulp, rubber and cables), but because the conglomerate of companies it belonged to were highly innovative and knowledge-intensive.

[16] For example, the iPod is a high-tech product exported by China. However, Linden, Kraemer & Dedrick (2009) find that only a fraction (approx. 1%) of the value-added is accrued to China, whose labour are largely responsible for the assembly of the product.

by indicating this high productivity export flow, the trade data overstates the nature of the product, and the likely skills and innovations associated with its export.

Therefore, merely imitating the production of 'rich country' manufacturing products, does not imply that the same favourable externalities will materialise in a developing country. Lederman & Maloney (2012) caution against the policy approach of picking 'winners'. They conclude that from a developmental and policy perspective, the notion of how a product is produced is as important as what is produced.

2.3.2 Destination composition – 'Where you export matters'

The product is one of two dimensions that constitute a product-level trade flow. Destination being the other. A key question arising from this, is whether the destination composition of exports is linked to economic growth? South African economic policy suggests that this is the case, since it implicitly assumes that diversification toward proximate and fast-growing economies, has growth-inducing effects. This section evaluates this policy assumption by drawing on the empirical literature.

The destination margin of export growth is an important element of export growth, yet neglected in the literature. Brenton & Newfarmer (2009) define the export process for a product and argue that the discovery phase, emphasised in Hausmann & Rodrik (2003), is merely one stage in the process. In terms of policy, to focus solely on this stage is too narrow. They assert this argument by decomposing export growth for a sample of developing countries over the period 1995 to 2004. Export success is driven mainly by the intensification of existing trade relationships, and the expansion into new destination markets. The contribution made by product discovery is minimal. Regressing export growth against the channels of export growth, they find that the product discovery and destination diversification channels significantly determine export growth, with the latter being greater in magnitude.

Unlike the 'what you export matters' literature, there is actually very little literature exploring the growth-inducing effects of the destination margin. Arora & Vamvakadis (2005) touch on the importance of destinations by analysing whether the economic conditions in trading partner countries impact on domestic growth. They find that countries benefit from trading with fast-growing and relatively richer countries. They argue that this is driven by the spillover effects of trading with relatively more advanced countries. Bacchetta, Jansen, Lennon & Piermartini (2009) show that increased diversification along the destination margin acts as a buffer against volatility associated with concentrated trade flow structures. However, these studies do not examine the direct link between a country's economic growth and the nature of the trading partners it exports to.

Baliamoune-Lutz (2011) claims to be the only paper to directly explore the relationship between economic growth and export destinations. Using panel data over the period 1995 to 2008, she examines the effect of exports to China and OECD countries on economic growth in African countries. She finds that exporting to OECD countries has a positive impact on growth, while there is no evidence that exporting to China increases growth unconditionally. A positive growth effect resulting from exports to China is conditional on the level of concentration of exports. The implication is that African countries exporting concentrated baskets of primary products to China benefit more than countries exporting more diverse export baskets. Therefore, the author concludes that these results support the hypothesis of growth by destination.

Exports to high-income countries are of greater quality and associated with higher skill intensity and higher wages, than exports to developing countries. Although the literature exploring the direct relationship between economic growth and destination composition is limited, the literature does touch on characteristics of export growth that may be indirectly related to economic growth. Brambilla, Lederman & Porto (2012) find that Argentine firms in Buenos Aires exporting to high-income countries, use more skills and pay higher wages than firms that export to other middle-income countries (typically neighbouring countries), or produce solely for the domestic market. Bastos & Silva (2010) explore the quality of Portuguese firms' exports and find that more productive firms export higher quantities at higher unit values, which is consistent with higher levels of quality. They also find that across firm and within firm product unit values tend to be higher for exports to richer countries. Since exports to high-income destinations tend to be of a higher quality and more skill-intensive, it could be argued that exports to high-income destinations may be more likely to yield positive spillover effects.

Although relatively underexplored, the literature does point to growth-inducing effects associated with exporting to high-income destinations. In contrast, South African policy targets diversification into proximate and fast-growing emerging markets and is thus at odds with the literature. It is worth noting that developed country markets already comprise a substantial share of South African exports, and it may be the case that policy is focused on diversifying into other destination markets in order to reduce dependence on established export relationships.

2.4 Drivers of extensive margin growth

The literature points to the importance of the composition of a country's export structure, especially in terms of what it exports, and where it exports to. Changes in the composition of a country's export structure, via adjustment along the extensive margin, has the potential to drive economic growth and shift it to higher levels of economic development. As such, it is important to consider the factors driving extensive margin growth. With the purpose of aligning with Chapters 4 and 5 of this thesis, focus is restricted to the literature exploring the role of endowments and trade policy in driving extensive margin growth.

2.4.1 Endowments and the extensive margin

Diversification away from traditional commodities and toward non-mineral manufactures is a key element of South African economic policy. Implicit in this policy is the assumption that for a country to shift to higher levels of development, it needs to change its comparative advantage and diversify out of traditional comparative advantage products. This sub-section evaluates this assumption by drawing on the literature examining the link between the extensive margin and factor endowments.[17]

Movement along the diversification path, which is driven primarily by adjustment along the extensive margin is similar to the movement across diversification cones, thus pointing to a link between extensive margin growth and endowments (Cadot et al., 2011). Schott (2003) shows that as countries accumulate capital they travel across diversification cones, and products in the old cone are no longer exported while products in the new cone are exported.[18] Observing relatively high levels of diversification among middle-income economies, Cadot et al. (2011) contend that diversification occurs because of production 'inertia' where countries continue to produce the set of products from the previous, less capital-intensive, diversification cone. Cadot et al. (2011) also show that the export structures of countries at high levels of economic development start to re-specialise. The products that are dropped are distant from

[17] This literature is relatively underexplored, and existing studies tend to investigate the link between the extensive margin and factor endowments, as a secondary element to the analysis.

[18] The notion of diversification cones relates to an extension of the Heckscher-Ohlin model, namely the multiple-cone model, where a country produces a subset of products within a diversification cone that aligns with its relative factor endowments. The accumulation of capital results in a shift to a new diversification cone, and thus a new subset of products associated with higher levels of capital-intensity (Schott, 2003).

their factor endowments, and thus less capital- and skill-intensive than the products that they continue to export. The relatively diversified export structure characteristic to middle-income economies is essentially a temporary position between two steady states in the industrialisation process.

However, the findings of Cadot et al. (2011) need to be moderated against the findings of Klinger & Lederman (2011). Klinger & Lederman (2011) also interrogate what may be driving product discovery as a country develops. They test the structural transformation hypothesis, which suggests that export discoveries are likely to be concentrated in industries that intensively use the factor currently being accumulated by a country.[19] They find little evidence to support the structural transformation hypothesis, and thus their findings run contrary to those of Cadot et al. (2011).

The systematic variation of within product unit values according to relative factor endowments provides an additional avenue of endowment-driven trade patterns. Using product-level US import data, Schott (2004) examines unit values across products and within products from importing countries. Both high-wage and low-wage countries tend to export similar products to the US, and hence there is little evidence in favour of factor-proportions specialisation across products. Instead, he finds that unit values within product categories vary systematically according to relative factor endowments. Of countries exporting the same product to the US, unit values are higher for those that are more capital and skill abundant, relative to those that are more labour abundant and less skill abundant. As such, the results are consistent with factor-proportions specialisation within products.

While the recent literature on heterogeneous firm trade models provides a basis for explaining trade adjustments along the extensive margin, there is relatively little said about the role of endowments. Heterogeneous firm trade models, along the lines of Melitz (2003), show that the selection and entry of firms into export markets is determined by variation in firm productivity relative to the fixed and variables costs, and hence profitability, associated with these markets. These models explicitly account for patterns of entry into export markets, and hence the

[19] Using HS6-digit product-level export data for a sample of 73 countries over the period 1992 to 2003, Klinger & Lederman (2011) estimate the average GDP per capita level at the maximum point on the product discovery curve (the inverted u-shaped curve showing the evolution of product discovery at different levels of development) across Leamer (1984) commodity groups. They find that these commodity groups, which vary by capital and labour intensity, hit their maximum discovery point within a narrow range of GDP per capita. In contrast, the structural transformation hypothesis predicts labour-intensive commodity groups to reach their maximum discovery point at a much lower level of development than capital-intensive commodity groups.

extensive margin. However, they typically assume one factor and do not account for whether cross-country differences in factor endowments and cross-industry differences in factor intensity impact on firm-level trade patterns.

The Bernard, Redding & Schott (2007) heterogenous firm trade model fills this gap in the literature. They model how heterogeneity in firm-level productivity explains patterns of entry into export markets, and how this pattern is asymmetric according to endowment-driven comparative advantage. This is achieved by embedding a heterogeneous firm model into a model of Heckscher-Ohlin comparative advantage. Modelling the effect of a transition from autarky to costly trade, they show that the increase in export opportunities, modelled as a drop in the export productivity cut-off and a rise in the number of exporting firms, is more pronounced in comparative advantage industries. Therefore, the model predicts that the magnitude of the extensive margin effect is constrained by endowments. Further, the aggregate productivity growth resulting from this reduction in trade costs is again more pronounced in comparative advantage industries.

While trade theory has evolved away from comparative advantage-based explanations of trade patterns, models such as the Bernard, Redding & Schott (2007) heterogeneous firm model, still indicate that endowments matter in shaping export structures. Thus, drawing on Cadot et al. (2011), middle-income countries looking to advance to high-income status need to change their comparative advantage and diversify out of traditional comparative advantage products. In the case of natural resource abundant South Africa, the policy aim of diversifying away from traditional commodity-based products is consistent with this assertion. In the Heckscher-Ohlin sense, this would involve the accumulation of endowments, such as physical and human capital.

2.4.2 Trade policy and the extensive margin

Implicit in South African economic policy is the assumption that trade policy can be actively used to facilitate diversification into new export markets. Therefore, this sub-section evaluates this assumption by drawing on the literature examining the link between trade policy and the extensive margin.

Before engaging the empirical literature, it is important to refer to the evolving theoretical literature on heterogenous firms, which provides a theoretical basis for expecting strong extensive margin effects resulting from tariff liberalisation. The seminal work of Melitz (2003) shows how the selection of firms into export markets is shaped by heterogeneity in firm productivity relative to the fixed and variables costs associated with entry into these export markets. In response to a drop in variable trade costs, such as tariffs, the Melitz (2003) model predicts entry of new firms into export markets (i.e. extensive margin growth) and the expansion of exports by incumbents (i.e. intensive margin growth).

Chaney (2008) builds on the Melitz (2003) model by allowing one to predict whether the response to trade barriers along these dual margins varies according to product characteristic, particularly, the elasticity of substitution associated with a product. If the elasticity of substitution is high, then the response to trade barriers is strong along the intensive margin and mild along the extensive margin. The converse applies to products with low elasticities substitution. Besedeš & Cole (2017) extend Chaney (2008) by modelling how this extensive margin response to a change in variable trade costs varies depending on whether the cost is quantity based – such as transport costs – or value based – such as tariffs.[20]

As such, when estimating the impact of trade policy on trade it is important to take into account the extensive margin. The initial convention when estimating gravity equations was to only consider positive trade flows and ignore the 'zeros'.[21] Helpman, Melitz & Rubenstein (2008) argue that by ignoring countries that do not trade with one another these earlier studies omit important information contained in the data and thus produce biased estimates. Determining the impact of trade policy on trade has thus evolved from measuring the impact on aggregate trade flows to measuring the impact on the intensive and extensive margins of trade.

The importance of an appropriately specified gravity equation, which considers both the intensive and extensive margins is evident in studies contributing to the General Agreement on Tariffs and Trade (GATT)/World Trade Organisation (WTO) debate. Using a standard gravity model approach and a large panel of bilateral trade data covering 175 countries over a 50-year period, Rose (2004) finds that GATT/WTO membership is not associated with higher trade volumes. Subsequent studies either contested (Subramanian & Wei, 2007; Tomz, Goldstein & Rivers, 2007) or confirmed (Eicher & Henn, 2011) this 'non-result'.

20 The Besedeš & Cole (2017) model provides the theoretical framework for the analysis in Chapter 5 and is thus discussed further in that section.
21 For example, see Feenstra (2002), Anderson & van Wincoop (2003) and Rose (2004).

Arguably, the debate was only put to rest once the ‘zeros’, and thus the extensive margin of trade, was taken into account when estimating the gravity equation.[22] For example, Helpman et al. (2008) develop a heterogeneous firm model, which yields a gravity equation that accounts for the self-selection of firms into export markets and their impact on trade volumes. Employing a Heckman-style estimation procedure on bilateral country-level trade data for 158 countries over the period 1970 to 1997 they find that the GATT/WTO has a strong and significant effect on the formation of bilateral trade relationships. Their estimates indicate that if two countries both join the WTO, the probability of them trading increases by 15 percent.

Liu (2009) adopts an alternative approach to dealing with the ‘zeros’. Drawing on the Silva & Tenreyro (2006) critique, Liu (2009) argues that the log linear gravity equation specification is inconsistent due to heteroscedasticity and non-normality of bilateral trade flows. Employing the Poisson Psuedo-Maximuum Likelihood (PPML) estimator on a panel of 210 countries over the period 1948-2003, he shows that relative to the baseline case of neither country within a bilateral pair being a WTO member, a country pair with two-members, and a country-pair with one member, trade 60 and 23 percent more, respectively.

Evidence regarding the relative magnitude of the intensive and extensive margins in response to changes in trade policy has been mixed. With respect to the GATT/WTO debate, Dutt, Mihov & Van Zandt (2013) show that the effect of WTO membership is mainly along the extensive margin. Analysing bilateral exports at the Standard Industrial Trade Classification (SITC) 4-digit level for approximately 150 countries over the period 1962 to 1999, their estimates show that the WTO raises the extensive margin by 25 percent, while it reduces the intensive margin by 7 percent.

In contrast, Disdier, Fontagné & Mimouni (2015) find the intensive margin effects resulting from tariff liberalisation to be greater than the extensive margin effects. They examine the impact of tariff liberalisation resulting from the Uruguay Round negotiations on emerging economies’ export flows. They analyse trade and tariff data at the Harmonised System (HS) 6-digit level across 18 emerging economy exporters and 25 importing partners over the period 1996 to 2006. Their results point to the trade creation effects being driven by growth in existing trade relationships. For example, on average, a one percent reduction in the applied tariff,

[22] For example, see Felbermayr & Kohler (2006), Liu (2009) and Helpman et al. (2008). In fact, Rose (2009) concedes that the GATT/WTO may have played an important role in developing trade linkages that may not have otherwise existed (i.e. the extensive margin).

results in a 2.09 percent increase along the intensive margin, a 0.1 percent increase in the probability of entry, and a 0.25 percent decrease in the probability of exit. Similarly, Liu (2009) attributes 30 percent of world trade created by the WTO to the extensive margin, while the remaining 70 percent is explained by the intensive margin.

Strong intensive margin effects are echoed in Buono & Lalanne (2012), who extend the WTO discussion to the firm-level. They examine whether the tariff liberalisation resulting from the Uruguay Round of WTO negotiations impacted on the export patterns of French firms. Using firm-level export data for 57 sectors to 147 destinations over the period 1993 to 2002 and product-level tariff data, they observe intensified export shipments by incumbents (i.e. intensive margin), while no substantial entry of new exporters in response to lower tariffs (i.e. extensive margin).

When considering trade agreements more generally the evidence regarding the relative magnitude of the intensive and extensive margins effects in response to tariff liberalisation, continues to be mixed. Foster, Poeschl & Stehrer (2010) estimate the impact of Preferential Trade Agreement (PTA) membership on the margins of trade for 174 countries over the period 1962 to 2000. Their results indicate that PTA formation is trade creating and that much of the trade creation is driven by growth along the extensive margin. Similarly, Persson & Wilhelmsson (2016) examine the impact of unilateral preference regimes offered by the EU on diversification patterns among beneficiary nations over the period 1962-2007. They find strong diversification effects among developing countries benefiting from the Generalised System of Preference (GSP) programme, and additional preferences offered within the GSP framework, such as the GSP Plus and the Least Developed Country (LDC) programmes. However, the beneficiaries of the African, Caribbean & Pacific (ACP) preferences show increased concentration rather than diversification, suggesting strong intensive margin effects.

Trade effects resulting from tariff liberalisation vary along the intensive and extensive margins across product type. Disdier et al. (2015) find strong trade effects along the extensive margin for differentiated products, and similarly in the case of non-differentiated products along the intensive margin. Their results correspond with the predictions made in Chaney (2008) regarding the manner in which the trade effects vary across the dual margins depending on the elasticity of substitution of the product concerned. Analysing the response of South African exports to the TDCA, Kwaramba et al. (2015) find a similar set of results.

The preceding discussion indicates that trade policy, in the form of tariff liberalisation, influences export growth along the extensive margin. Although the evidence is mixed regarding the relative magnitude of the trade effects across the intensive and extensive margins, there is enough evidence to suggest that trade policy can be actively used to facilitate export diversification. However, the literature also shows that the effects of tariff liberalisation on export diversification vary by product type and thus policy needs to be cogniscent of this.

2.5 Conclusion

Although no singular unified policy exists, the broad thrust of South African economic policy is to diversify its export structure toward manufacturing, targeting emerging economies and regional markets, and using trade policy as an instrument to facilitate the transformation of its export structure. Drawing on the theoretical and empirical literature, this chapter sets out to critically appraise this broad policy stance and the assumptions behind it. By drawing on lessons from the literature, this chapter also looks to provide policy guidance regarding South Africa’s export strategy.

South Africa’s policy emphasis on export diversification is sound. Countries that diversify their export structures experience higher levels of economic growth. Higher levels of economic development are associated with more diverse export structures, and this linkage exists in the middle-income country case. Regardless of the empirical validity of the resource curse, which is a concern for resource-rich countries such as South Africa, diversification away from an export structure concentrated in commodities is likely to be economically advantageous. Therefore, the realisation of this policy objective has the potential to generate favourable outcomes.

However, the policy challenge lies in how to go about this process of diversification. What sectors should a country diversify into? What factors inform this process? South Africa adopts an active industrial policy approach, where the Industrial Policy Action Plan targets fourteen sectors (DTI, 2017). Identification of a targeted sector is based on a sectors potential to generate growth and employment, potential for export diversification and growth, and research and self-discovery processes (DTI, 2007). There is no further detailing on what factors inform the choice of sector targeted.

Current economic policy does not sufficiently emphasise the extent to which endowments constrain and shape the composition of a country’s export structure. The work by Cadot et al.

(2011) suggests that countries diversify in accordance with their endowment structure, and that it is difficult to diversify into products at odds with your endowment structure. South African policy advances diversification toward non-commodity manufactures, which implies that policy makers are proposing diversification out of comparative advantage. There is thus a tension between the desire to diversify and the constraints imposed by a country's endowments. Therefore, the following question emerges: how should a resource-rich middle-income country, such as South Africa, diversify its export structure?

One possible approach emerging from the literature, is for a country to leverage off its current productive know-how or capabilities and diversify toward 'proximate' or related sectors. This approach acknowledges that structural transformation is a path dependent process, whereby the capabilities embodied in a country's current productive structure shape subsequent paths of diversification. In South Africa's case, this would involve leveraging off the capabilities developed in natural resource-based sectors, such as mining and agriculture. For example, many of the processes in mining and agriculture involve specialised machinery, for which a number of South African firms have developed the requisite capabilities to design and manufacture. Drawing on lessons from the Scandinavian experience, this process of leveraging off natural resource-intensive sectors has the potential to yield positive externalities. However, it is best realised if pursued in a knowledge- and technology-intensive manner that promotes learning and innovation.

Although policy aimed at diversifying into new geographic markets seems sound, the choice of market warrants caution. Diversification across geographic markets acts as a buffer against the volatility associated with concentrated traded flow structures and is thus a sound policy approach. In South Africa's case, the targeting of emerging and African markets is potentially problematic. The literature exploring whether certain export destinations yield positive externalities provides evidence that exporting to high-income markets yields benefits relative to other markets. The realization of South Africa's current policy approach would forgo the benefits of exporting to firms in high-income markets.

A further concern relates to the targeting of regional or African markets. The Southern African Development Community Free Trade Agreement, and the future African Continental Free Trade Area, show that South Africa has used (and is using) trade policy to promote free trade across the region and continent. The policy embodied in these free trade agreements primarily involves the reduction and removal of tariff barriers. However, it is important to note that firms looking to export into the region and the rest of Africa face a range of other costs and non-tariff barriers that act as considerable impediments to trade. The extent to which these non-tariff barriers dissuade firms from entering these markets dampens the effectiveness of the policy approach targeting these markets. Certainly, there is room for policy intervention that enables firms to negate the high barriers to entry into these markets.

Nevertheless, the literature provides the basis for trade policy to be used as a tool to facilitate export diversification. There are significant extensive margin effects associated with trade liberalisation policies. Furthermore, the theoretical and empirical literature show that the extensive margin effect, or diversification effect, of tariff liberalisation is felt strongest in differentiated products. Differentiated products are manufactured products, typically with a low commodity content. Trade policy can thus facilitate the broader policy aim of diversifying into non-commodity manufactures. However, for trade policy to be effective in promoting export diversification into the regional market, it will have to extend beyond tariff liberalisation and deal with the challenges of non-tariff barriers.

Proceeding chapters: Applying lessons learnt from the literature

The empirical chapters to follow are influenced by the literature alluded to in this chapter. It is worth briefly noting how the rest of the chapters take the lessons from this chapter forward.

The literature shows that growing and diversifying a country's exports is good for economic growth and development. However, the composition in terms of 'what' and 'where' a country exports is key to this developmental link. Chapter 3 provides an in-depth analysis of South Africa's product-level export dynamics along these important dimensions of export growth. Drawing on the learnings from this chapter, the analysis in Chapter 3 provides insight into the growth implications associated with South Africa's evolving export structure.

Chapter 4 further explores the link between endowments and evolving export patterns, particularly whether endowments shape changes along the extensive margin. The analysis focuses on South Africa, and thus provides insight into the middle-income country case. As a middle-income country, these adjustments along the extensive margin may vary according to the relative factor endowments of its trading partners. It is evident in South African policy that the role of endowments is not sufficiently emphasised, and the analysis in Chapter 4 provides and empirical basis for contesting this policy assumption.

Chapter 5 provides further insight into the link between trade policy and export diversification. The chapter analyses the response of South African exports to tariff liberalisation emerging from the Trade Development and Cooperation Agreement between South Africa and the EU. If this tariff liberalisation drives the diversification of South Africa's export mix, then it would suggest that the use of trade policy as a tool to drive diversification is sound.

CHAPTER 3: PRODUCT-DESTINATION LEVEL DECOMPOSITION OF SOUTH AFRICA'S EXPORT GROWTH

3.1 Introduction

The South African economy suffers from an inability to generate economic growth without running into balance of payments constraints. In order to counter this 'external constraint', South African economic policy in the post-apartheid period promotes the growth and diversification of exports. Aggregate trends describing South Africa's post-apartheid export performance do reveal growth and diversification.[23] However, these aggregate trends do not provide insight into the dynamics driving export growth and diversification over this period. For instance, the extent to which export growth has been driven by the intensification of established export relationships, or the creation of new export relationships, is unclear. It is also unclear whether export diversification has been driven by entry into new product or new destination markets.

Therefore, this chapter examines the dynamics driving the evolution of South Africa's exports in the post-apartheid period. In so doing, the analysis provides a detailed picture of the sources of export growth and the dynamics driving changes in the composition of South Africa's export structure, particularly along the product and destination dimensions.

This chapter applies an extended version of Zahler's (2011) product variety style decomposition approach to evaluate the evolution of South Africa's exports along the intensive and extensive margins for the period 1995 to 2012. In so doing it completes the following: firstly, it measures the extent to which South Africa's export growth is driven by the intensive and extensive margins. Secondly, it measures the extent to which the extensive margin is driven by entry into new product markets – the 'what' – and entry into new destination markets – the 'where'. Thirdly, it measures the extent to which the intensive margin is driven by the price and quantity margins. Fourthly, it analyses whether growth along these margins vary by product and destination characteristics. Finally, drawing on the economic development insights discussed in Chapter 2, it assesses South Africa's export performance.

[23] Evidence pointing to export diversification is shown in Petersson (2005), Naude & Russouw (2011), and Edwards & Alves (2006). Evidence showing export growth is shown in Edwards (2001b), Petersson (2005), Edwards & Alves (2006), Edwards & Lawrence (2008), and Edwards, Rankin & Schoer (2008).

Examining the dynamics driving the evolution of South Africa's exports in the post-apartheid period provides insight into a number of interesting issues: firstly, the post-apartheid period is marked by the removal of international trade sanctions, and the opening of the economy through a variety of trade liberalisation reforms. Given this period of re-integration into the global economy, it is interesting to examine the extent to which entry into new product and destination markets has driven export growth.

Secondly, the post-apartheid period is also marked by changes to the global economic environment. In relation to developed economies, emerging economies, such as China and India, have grown in economic importance. By analysing export dynamics along the destination extensive margin, this chapter provides insight into whether the destination composition of South Africa's export structure has responded to the changing global economic environment.

Thirdly, although the intensive margin typically accounts for the majority share of export growth across countries, in the case of developing economies, the extensive margin is shown to be a relatively important driver of export growth.[24] Drawing on previous research, this chapter provides insight into whether South Africa's export growth dynamics is consistent with that of other developing and middle-income economies.

Fourthly, in pursuit of higher levels of economic growth, export diversification is an important element of South African economic policy. As advanced in Chapter 2, diversification in itself is not enough. The product and destination composition of a diversifying export structure is of key importance for economic growth. Analysis of the product and destination components of the extensive margin provides insight into the growth implications associated with South Africa's evolving export structure.

Finally, the early- to mid-2000s is characterised by the commodities super cycle, and it is interesting to consider the dynamics of South Africa's export response. Given its substantial natural resource endowment, it is expected that this response is driven by the intensive margin. Of key interest is whether this response is driven by the quantity or price margins. If the price effect dominates, then export growth is simply driven by favourable terms of trade. This in

[24] For example, see Amurgo-Pacheco & Pierola (2008) and Zahler (2011).

conjunction with a weak quantity effect, points to supply-side constraints. However, if the quantity effect is strong, then export growth is driven by a strong supply-side response.

The benefit of Zahler's (2011) product variety style decomposition approach is that it decomposes export growth at the product-destination level. This compares favourably to other decomposition studies, where only the product or destination dimension of export growth is decomposed. The Zahler (2011) approach allows one to decompose the extensive margin into entry into new product markets, and entry into new destination markets, thus allowing one to interrogate the 'what' and 'where' of South Africa's extensive margin growth.

A limitation of the above approach is that it does not decompose intensive margin growth, and thus abstracts from the price and quantity dynamics driving growth in established export relationships. Price and quantity dynamics provide insight into the possible demand and supply factors driving growth along the intensive margin. For example, being able to distinguish between the price and quantity dynamics driving South Africa's export growth during the commodities super cycle, provides insight into exporters' supply-side response. Consequently, this chapter extends the Zahler (2011) approach to decompose the intensive margin into price and quantity margins. This extension of the Zahler (2011) decomposition approach serves as a methodological contribution to the literature.

It is worth noting that the static decomposition approach, which decomposes export growth between two points in time, limits the analysis by not accounting for the dynamic interaction between the intensive and extensive margins. The duration of trade literature shows that new trade relationships are characterised by frailty and thus mostly short-lived (Besedeš & Prusa, 2006a; Nitsch, 2009; Besedeš & Prusa, 2011). It is only once entries (extensive margin) into new export relationships survive (intensive margin) and the duration of these relationships rise, that long-term export growth is generated. The decomposition analysis employed in this chapter measures the entry, exit and survival of export relationships in the static sense, and thus alludes to the issue of churning. However, the estimation of survival and hazard functions – as is the norm in the duration of trade literature – falls outside the focus of this chapter.

The analysis in this chapter looks to extend existing work decomposing South Africa's export growth by, firstly, considering a longer time period to existing work, secondly, by focusing on the product-destination level of analysis, and thirdly, by decomposing intensive margin growth into price and quantity margins. Using data at the firm-level, Matthee, Farole, Naughtin &

Rankin (2015) and Matthee, Rankin, Naughtin & Bezuidenhout (2016), focus on the periods 2002 to 2012, and 2010 to 2013, respectively. By considering a longer time period, 1995 to 2012, this chapter examines export dynamics pertaining to South Africa's entire post-apartheid period, at the most detailed level possible – the product-destination level. Furthermore, despite showing evidence that the intensive margin constitutes the dominant share of export growth, neither of these studies consider the role that the price and quantity margins play in driving this important margin of growth.

This chapter uses product-destination level trade data at 6-digit level of the Harmonised System, for the period 1995 to 2012. Applying decomposition analysis to product-destination level data best reveals the heterogeneity present in trade flows, and thus gives the clearest and most detailed picture of the dimensions and dynamics driving export growth.

The rest of the chapter proceeds as follows: Section 3.2 examines the key insights of the trade decomposition literature and how these insights can inform the analysis in this chapter. The extended *product variety style decomposition approach*, and the product-destination level trade data employed in the analysis, are described in Sections 3.3 and 3.4, respectively. The results of the analysis are presented in Section 3.5, and some concluding remarks are presented in Section 3.6.

3.2 The decomposition literature

This section reviews the trade decomposition literature and is divided into two parts: firstly, it provides a brief discussion on what a decomposition is, what is meant by margins, and what influences the measurement of these margins. Secondly, it looks at key empirical themes in the literature.

3.2.1 Decomposition analysis – measuring the margins of trade

Decomposition analysis typically divides trade growth into components, called margins. The two primary margins of trade are the intensive and extensive margins. The former measures the growth of existing trade relationships, while the latter measures growth of new trade relationships. The extensive margin can be further decomposed into product and destination components, which measure growth into new product and destinations markets, respectively.[25] The intensive margin can be further decomposed into price and quantity margins.[26]

The decomposition methods upon which studies base their respective analyses differ along a number of dimensions. Therefore, one needs to apply caution when interpreting and comparing results across studies. There are two key considerations that influence the measurement of the margins of growth.

The most important of these methodological considerations is the *unit of analysis* that determines the level at which the intensive and extensive margins are defined. For instance, depending on data availability, studies define the intensive and extensive margins at the destination level (Helpman et al., 2008), the product level (Amiti & Freund, 2010), the product-destination level (Brenton & Newfarmer, 2009), or the firm-product-destination level (Bernard, Jensen, Redding & Schott, 2009). The more narrowly one defines the data in terms of product, destination and firm, the more detailed the measure of the extensive margin. A study with more narrowly defined data may measure a trade transaction as extensive margin growth whereas a study with more broadly defined data will define the same transaction as intensive margin growth.

The second consideration is the type of decomposition. Trade decomposition analyses also differ in terms of whether they decompose the level of trade at a point in time or the value of trade growth over time. The level decomposition approach, as advanced by Hummels & Klenow (2005), measures the intensive margin as a country's market share in world trade, for the products pertaining to its export structure. The extensive margin measures the breadth of a country's export structure relative to all exports that exist in the world. The time decomposition approach decomposes the value of export growth into intensive and extensive margins between two points in time.[27] The analysis in this chapter follows the latter approach.

3.2.2 Key empirical findings in the trade decomposition literature

The basis of the trade decomposition literature arose from the notion that trade evolves along two margins. The initial convention when studying bilateral trade flows was to only focus on

[25] For example, see Brenton & Newfarmer (2009) and Zahler (2011)
[26] For example, see Haddad, Harrison & Hausman (2011) and Bingzhan (2011)
[27] Most trade growth decomposition analyses decompose growth between an initial period and end period. Besedeš & Prusa (2011) refer to such approach as static. They adopt an alternative approach that they label as a dynamic decomposition approach, which decomposes trade growth between two points using an iterative process that decomposes growth annually and sums the margins of growth for each iteration.

positive trade flows.[28] Subsequent research reveals that not all countries trade with one another, hence the presence of 'zeros'.[29] By ignoring the 'zeros', these initial studies could only ever consider what would later be termed the intensive margin. The presence of 'zeros' in international trade flows has declined over time, thus indicating the creation of new trade relationships and the evolution of trade along the extensive margin. Amongst other things, the decomposition literature has looked to measure the relative importance of these two margins.

It is generally observed that the share of export growth accounted for by the intensive margin exceeds that accounted for by the extensive margin, while the destination extensive margin exceeds the product extensive margin. Evenett & Venables (2002), one of the earliest cross-country decomposition studies, use bilateral trade data at the SITC 3-digit level, to decompose export growth for 23 countries over the period 1970 to 1997. On average, 60 percent of this growth is due to increased exports to existing trading partners, 30 percent is due to growth in existing product lines to new destination markets, and 10 percent is due to entry into new product markets. This aggregate pattern of export growth dynamics is observed in other more recent cross-country trade decomposition studies (Amurgo-Pacheco & Pierola, 2008; Brenton & Newfarmer, 2009; Zahler, 2011). The importance of the intensive margin relative to the extensive margin is also observed in country case studies, such as those for China (Amiti & Freund, 2010; Bingzhan, 2011) and South Africa (Matthee et al., 2016).

The extensive margin plays a relatively more important role in driving export growth in developing countries than it does in developed countries. Using SITC 4-digit trade data for 112 countries, Zahler (2011) decomposes export growth for the period 1984 to 2000. He shows that for developed countries, the intensive, destination extensive and product extensive margins, account for 82.9, 16.7 and 0.3 percent of export growth, respectively. The corresponding results for developing countries are 55.3, 37.4 and 7.4 percent, respectively. Qualitatively similar results are observed in Amurgo-Pacheco & Pierola (2008) who analyse more disaggregated 6-digit level trade data for a more recent period, 1990 to 2005, but for a smaller number of developed and developing countries (24).

The level decomposition applied in Hummels & Klenow (2005) provides insight into why larger economies export more in absolute terms than smaller economies. Using HS 6-digit level

[28] For example, see Anderson & van Wincoop (2003) and Rose (2004).
[29] 'Zeros' refer to instances where there is no existing trade relationship between two countries, and hence, zero trade flows. For example, see Felbermayr & Kohler (2006) and Helpman et al. (2008).

trade data for 126 exporters to 76 importing countries in 1995, they find that 60 percent of the greater exports by larger economies is explained by a wider set of products, or the extensive margin.[30] Within product categories, they find that larger economies export greater quantities at higher prices, which is indicative of higher levels of quality.

In terms of export growth, the key factors differentiating top performing export economies from poor performers is, firstly, the relatively higher export death rates experienced by the latter, and secondly, the ability of the former to sustain new export relationships. Zahler (2011) shows that export relationship deaths account for a 1 percent decrease in export growth for top performing economies, while for poor performing economies this value is 33 percent. Decomposing the export growth of 46 countries between 1975 and 2003 using SITC 4-digit data, Besedeš & Prusa (2011) shows that entry into new export relationships plays a relatively minor role in the success of top performing export economies. Rather it is their ability to maintain newly generated export relationships, and thus overcome the frailty of export relationships, that explains their success.[31]

Studies have looked at the differential trade response of the intensive and extensive margins to economic shocks, such as trade liberalisation episodes, or periods of rapid economic growth. Kehoe & Ruhl (2013) use SITC 4-digit data to study changes in the extensive margin for countries that have undergone periods of structural change resulting from shocks such as these. They find that these shocks that are characterised by permanent structural change, are associated with increased activity along the extensive margin. The strong extensive margin effect resulting from a trade liberalisation shock, is confirmed in Foster, Poeschl & Stehrer (2010) who consider the impact of PTA membership on the margins of trade for 174 countries over the period 1962 to 2000.

Kehoe & Ruhl (2013) also show that periods of temporary change, such as business cycle episodes, exhibit less activity along the extensive margin. This is corroborated in studies examining adjustment of trade along the intensive and extensive margins during a trade

[30] The Hummels & Klenow (2005) level decomposition approach typically finds a larger role for the extensive margin than the intensive margin compared to analysis using the time decomposition approach. This does not mean that their respective results contradict one another. The former measures the margins of export levels while the latter measures the margins of export growth. Hummels & Klenow (2005) ask, at a point in time, what share of a larger country's greater level of exports is explained by the number of (extensive margin), by the quantity of (intensive margin), and by the price of (intensive margin) unique products exported. Growth decomposition analyses decompose export growth between two time periods. These studies ask what share of export growth between the base period and the final period is accounted for by existing trade relationships and new trade relationships.

[31] The duration of trade literature identifies a key stylized fact concerning the dynamics of international trade: export relationships are characterized by frailty and short duration (Besedeš & Prusa, 2006a; Nitsch, 2009; Hess & Persson, 2011).

collapse resulting from an adverse macroeconomic shock (Bernard et al, 2009; Haddad, Harrison & Hausman, 2011). Using 10-digit firm level trade data for the US, Bernard et al. (2009) show that the response of firms exporting to East Asian countries during the 1997 Asian financial crisis. Although there is some adjustment along the extensive margin, they find that, in value terms, export declines are dominated by the intensive margin. Similarly, using firm-level data for South Africa, Matthee et al. (2015) show that approximately three-quarters of the export value response, during and after the 2009 global financial crisis, is along the intensive margin.

Haddad, Harrison & Hausman (2011) extend the analysis of the response of trade to macroeconomic shocks by further decomposing adjustments along the intensive margin into price and quantity adjustments. Using HS 6-digit level data on imports to the USA, Brazil, Indonesia, and each member country of the European Union during the 2009 global financial crisis, they find that on aggregate, there is increased exit from product markets, decreased entry into product markets, and decreases in both the quantity and price margins. The intensive margin response across manufacturing and non-manufacturing products differs, with a fall in quantity and increase in price in the former, and a fall in both quantity and price in the latter.

Outside the study by Haddad et al. (2011), analyses decomposing intensive margin growth into price and quantity margins are limited and typically applied in country case-study analyses. Using 6-digit level trade data, Bingzhan (2011) decomposes China's export growth for the period 2001 to 2007. He finds that China's export growth is mainly driven by the quantity component of the intensive margin and that this result is robust to different markets, products and methods. Using the same method as Bingzhan (2011), Türkcan (2014) finds the same pattern evident in Austrian exports over the period 1998 to 2001.

This chapter adds to the small body of work examining the price and quantity components of the intensive margin at a country-level. The next section discusses the decomposition methodology that enables such analysis.

3.3 Methodology: The extended product variety style decomposition

This paper employs a product variety style decomposition approach based on the technique used by Zahler (2011). The technique is extended to further decompose the intensive margin into price and quantity components, as in Haddad, Harrison & Hausman (2011). The extended product variety style decomposition approach allows one to examine the price and quantity components of the intensive margin, and the product and destination extensive margins. The logic behind this decomposition approach is presented and formalised in this section.

3.3.1 Conceptualising the decomposition approach

3.3.1.1 Decomposing the intensive and extensive margins at the product-destination level

The product variety style decomposition approach developed by Zahler (2011) is suitable for decomposing export growth between two points in time using product-destination level trade data. Applying the product-destination pair as the unit of analysis allows the decomposition to measure growth in export relationships along various dimensions – surviving export relationships, dying export relationships (negative growth), entry into new product markets, and entry into new destination markets.

The logic behind the decomposition of export growth into intensive and extensive margins is explained using Figure 3.1, which is adapted from Zahler (2011). Panel A of Figure 3.1 shows exports for a hypothetical country in base period t_0. Exports are shown across three dimensions, with the x-axis showing the number of potential products that can be exported, the y-axis showing the number of potential destinations that can be exported to, and the z-axis measuring the value of each product-destination pair.

Each bar represents a product-destination pair and hence a variety that the country exports in the base period (Panel A). This country does not export every product to every destination, but rather four products to a subset of three countries. Each of these product-destination pairs represents a variety, of which this country exports seven. The labels on the bars represent the value of these exports, with the total export value in base period t_0 being the sum of all these product-destination pairs (R19).

The dashed lines divide the product-destination space into quadrants with the lower left quadrant being what Zahler (2011) terms a country's "potential product-destination space". This space represents potential product-destination pairs of existing products and destinations. The remaining three quadrants in panel A represent export markets yet to be 'colonised'.

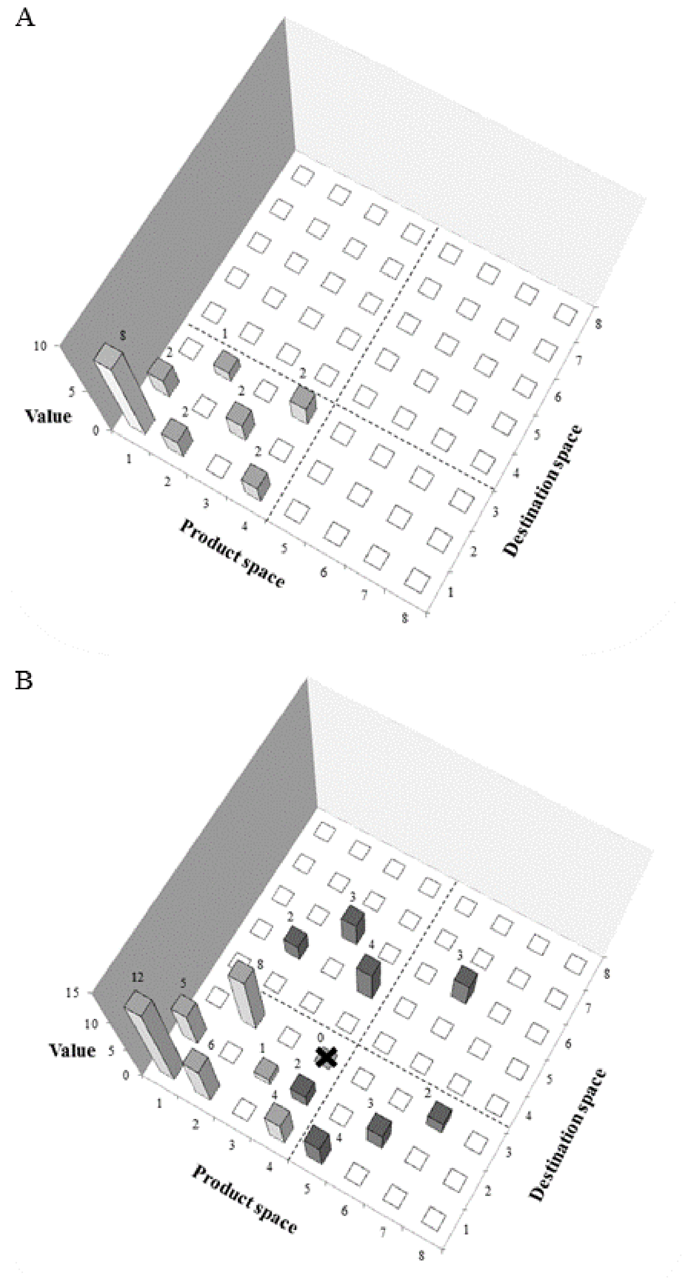

Figure 3.1: Extended product variety style decomposition approach – intensive and extensive margins by value

Source: Adapted from Zahler (2011).
Notes: 1. Dying export varieties are marked by an 'X' and new varieties marked by dark bars.

By comparing Panel A to Panel B in Figure 3.1, one can see how exports have grown between the base period and final period. By summing the export values for each period and subtracting the former from the later, it is evident that exports have grown by R40 (i.e. 59-19). Looking at Panel B, one can see that export growth can be divided into two components. Firstly, net growth in surviving varieties, which are either higher (e.g. product 1 to destination 1) or lower (e.g.

product 3 to destination 2) – intensive margin growth. Secondly, net growth of new and dying varieties – extensive margin growth.

Looking at Panel B, the extensive margin can be divided into five components. First, the bottom left quadrant represents expansion of existing products to new destination markets for the product, but a known destination market for the country (e.g. product 4 to country 2). Second, the top left quadrant represents expansion of existing products to new destinations. These two left quadrants represent expansion into new destination markets. Third, the bottom right quadrant represents expansion of new products into existing markets. Fourth, the top right quadrant represents expansion of new products to new destinations. These two right quadrants represent expansion into new product markets.[32] Finally, in the bottom left quadrant, dying export relationships, which constitute a decline in the extensive margin, are depicted by an 'X'.[33] The first four components less the fifth component represent net extensive margin growth.

3.3.1.2 Decomposing the intensive margin into the price and quantity margins

Drawing on Haddad, Harisson & Hausman (2011), this chapter extends the product variety style decomposition approach by decomposing growth in surviving export relationships into price and quantity margins. For each surviving product-destination pair, such as product 1 to destination 1 in Figure 3.1, the change in value is decomposed into price and quantity margins. Price and quantity margins can increase or decrease in tandem, which results in increasing or decreasing intensive margin growth, respectively. These margins can also move in opposite directions, resulting in either a negative or positive net effect. The price and quantity margins for each surviving product-destination pair are then summed to capture the aggregate price and quantity margins.

[32] Zahler (2011) acknowledges that the top right quadrant could also be classified as new destinations. He argues for it being classified as new products because it is the defining feature of this element of export growth.
[33] Zahler (2011) included 'dying export relationships' in his measure of the intensive margin. He defines the intensive margin as net growth in base year varieties. However, as far as I can tell, in every other study in the literature dying (exiting) export relationships are included in the extensive margin. Remaining consistent with the literature, I include dying (exiting) export relationships in the extensive margin.

3.3.2 Formalisation of the extended product variety style decomposition approach

The total value of exports in base period t_0 is represented in equation (3.1):

$$v_{t_0} = \sum_{pd \in PD_{t_0}} p_{pd,t_0} q_{pd,t_0} \tag{3.1}$$

PD_{t_0} is the set of product-destination pairs, or varieties, with positive export flows in period t_0. The total value of exports is the sum of all product-destination export flows in that period. The value of each product-destination export flow is the product of the price, p_{pd,t_0}, and the quantity, q_{pd,t_0}. Analogously, in the case of final period t_1.

Export growth is taken as the difference in export value between the final period, t_1, and the base period, t_0, and is written as follows:

$$dv_t = v_{t_1} - v_{t_0} = \sum_{pd \in PD_{t_1}} p_{pd,t_1} q_{pd,t_1} - \sum_{pd \in PD_{t_0}} p_{pd,t_0} q_{pd,t_0} \tag{3.2}$$

The growth in value of total exports is decomposed into net growth in surviving varieties (S), growth due to new (N) export relationships, less dying (D) export relationships, which is defined below:

$$\begin{aligned} dv_t = \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} p_{pd,t_1} q_{pd,t_1} - \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} p_{pd,t_0} q_{pd,t_0} + \sum^{N} p_{pd,t_1} q_{pd,t_1} \\ - \sum_{pd \in PD_{t_0} \wedge pd \notin PD_{t_1}}^{D} p_{pd,t_0} q_{pd,t_0} \end{aligned} \tag{3.3}$$

Net growth in surviving varieties (first two terms of the equation), or intensive margin growth, is restricted to a subset of product-destination pairs that are positive in both periods ($pd \in PD_{t_0} \wedge PD_{t_1}$). It is measured as the summation of the differences in export value for these product-destination pairs across the two periods. Dying export relationships (fourth term of the equation) is defined as product-destination pairs for which there is a positive trade value in the base period, and a zero trade value in the final period ($pd \in PD_{t_0} \wedge pd \notin PD_{t_1}$).

New export relationships (third term of the equation) are defined as entirely new product-destination pairs that emerge in the final period. As per Zahler (2011), the growth in exports due to the formation of new export relationships can be divided into four components that comprise the measures for the product and destination extensive margins. This is written in equation (3.4) as follows: [34]

$$\sum^{N} p_{pd,t_1} q_{pd,t_1} = \sum^{N}_{\substack{p\in P_{t_0\wedge t_1}, d\in D_{t_0\wedge t_1},\\ pd\notin PD_{t_0} \wedge pd\in PD_{t_1}}} p_{pd,t_1} q_{pd,t_1} + \sum^{N}_{\substack{p\notin P_{t_0} \wedge p\in P_{t_1},\\ d\in D_{t_0} \wedge d\in D_{t_1}}} p_{pd,t_1} q_{pd,t_1} + \sum^{N}_{\substack{p\in P_{t_0} \wedge P_{t_1},\\ d\notin D_{t_0} \wedge d\in D_{t_1}}} p_{pd,t_1} q_{pd,t_1} + \sum^{N}_{\substack{p\notin P_{t_0} \wedge p\in P_{t_1},\\ d\notin D_{t_0} \wedge d\in D_{t_1}}} p_{pd,t_1} q_{pd,t_1} \tag{3.4}$$

The first term on the right-hand side of equation (3.4) represents the value of production-destination pairs exported in t_1 where the country of interest exported the product and exported to the destination in t_0 but not in that new combination (depicted by the black bar in the bottom left quadrant in Figure 3.1). The second term represents the value of exports of new products to existing destinations (depicted by the black bars in the bottom right quadrant in Figure 3.1). The third term refers to the value of exports of existing products to new destinations (depicted by the black bars in the top left quadrant of Figure 3.1). The final term captures the value of new products exported to new destinations (depicted by the black bars in the top right quadrant in Figure 3.1). The combination of the first and third terms of equation (3.4) represents the destination extensive margin. Similarly, the second and fourth terms of equation (3.4) represent the product extensive margin.

Following Haddad, Harrison & Hausman (2011), the intensive margin is further decomposed into price and quantity margins. The derivation of the price and quantity components of the intensive margin is shown in Appendix A.1. The final price-quantity decomposition equation, which shows the change in trade for surviving export relationships, is presented below:

$$dv_t^S = \sum^{S}_{pd\in PD_{t_0} \wedge PD_{t_1}} \frac{p_{pd,t_0} + p_{pd,t_1}}{2} \Delta q_{pd,t_1} + \sum^{S}_{pd\in PD_{t_0} \wedge PD_{t_1}} \frac{q_{pd,t_0} + q_{pd,t_1}}{2} \Delta p_{pd,t_1} \tag{3.5}$$

The first and second terms of equation (3.5) measure the quantity and price margins, respectively. The combination of equations (3.3) and (3.5) allows for the measure of the total change in value of exports between period t_0 and t_1. This change in value is split into net

34 The notation for this equation can be read as follows: for the first term, the new product-destination pair is an element of a product-destination that exists in the final period, but does not exist in the base period, for products that are an element of products that exist in both periods, and destinations that are an element of destinations that exist in both periods. In the case of the second term, the new product-destination pair is an element of products that did not exist in the base period but exist in the final period, and destinations that exist in both periods. A similar logic can be applied to the remaining terms of the equation.

growth arising from surviving export relationships, which is further split into quantity and price margins, and export growth due to new export relationships net of dying export relationships. The percentage change in the initial value of exports attributable to these margins can be calculated by dividing the components of equations (3.3) and (3.5) by the total value of exports in the base period.

3.3.3 Advantages of the extended product variety style decomposition approach

There are three reasons why the application of the extended version of the *product variety style decomposition* technique is advantageous for the purposes of this thesis: firstly, the use of the product-destination as the unit of analysis allows for the most detailed measurement of the margins of export growth. Easterly, Reshef & Schwenkenberg (2009) advocate for the use of the product-destination unit of analysis. They initially examine country export concentration patterns using the product unit of analysis. However, after shifting to the product-destination unit of analysis, they find that exports within a product category are not uniform across destinations and that concentration patterns play out at the product-destination level. Analysis at the product-destination level thus reveals more of the heterogeneity present in international trade flows. Therefore, the product variety style decomposition approach enables a better understanding of the heterogeneity present in South African export flows.

Secondly, the approach allows for a detailed split of extensive margin growth into product and destination segments. This aligns with the objective of aiming to get a better understanding of the ‘what’ and the ‘where’ of South Africa’s export dynamics.

Finally, the advantage of being able to measure price and quantity effects driving intensive margin growth, is that one can identify the importance of demand and supply factors driving the trade effect. For example, negative price and quantity effects suggest a negative demand shock. Alternatively, a positive demand shock accompanied by a large price effect and a small quantity effect, may suggest a supply-side constraint. The price and quantity effects offer additional insights into the factors driving export dynamics. This is especially important because the literature shows the intensive margin to be a key driver of export growth.

3.4 Data

This chapter employs South African export data at the 6-digit level of the HS classification for the period 1995 to 2012. Data is accessed from the UN COMTRADE database.[35] The 1988/1992 revision of the HS6 classification is chosen so that a consistent set of product categories is analysed over the longest possible period of time.

A number of amendments were made to the data during the data cleaning process. Product categories for gold exports were dropped because of unspecified destination information for a large proportion of these export trade flows. Mirror data did not offer a solution to this problem. Mirror data were used for platinum and platinum group products due to missing export data for these product categories prior to 2000. Botswana, Lesotho, Namibia and Swaziland were dropped from the dataset because of incomplete export data and corresponding mirror data being inconsistent and incomplete. A detailed explanation of the construction and cleaning of the dataset is provided in Appendix A.2.

Conducting a decomposition analysis at the product-destination level provides a clearer view of the scope for extensive margin growth. The 6-digit level of the HS classification is highly disaggregated, comprising 5,017 product categories, of which South Africa exports 4,376 in 2012 (see Table 3.1). Similarly, the dataset contains 215 potential destination markets, of which 210 feature in South Africa's 2012 export structure. This shows that South Africa exports a wide range of products and exports to a wide range of destinations. However, when considering the product-destination level, positive exports flows only account for 10.5 percent of potential export relationships (i.e. there are a lot of zeros). Further, the mean number of products that South Africa exports to each destination is only 460 – well below the potential 4,376. The equivalent measure at the median is substantially lower – 139. The mean being higher than the median indicates that a disproportionately high number of products are exported to a relatively small number of destination markets. A similar line of argument pertains to the mean/median number of destinations per product. It is thus evident that export flows are concentrated in a relatively small number of product-destination pairs, and that this level of analysis better indicates the substantial scope for extensive margin growth.

Despite the highly disaggregated nature of the data at the 6-digit level, it is possible that some extensive margin growth in terms of new products may be omitted. The 1988/1992 revision of

[35] Available on the World Integrated Trade Solutions (WITS) database (http://wits.worldbank.org/wits/)

the HS6 classification details products specific to that time period and does not contain updates for recently innovated products. It is possible that some new products that start entering trade during the period of analysis may fall within an existing 6-digit product grouping, and thus get measured in the intensive margin. Nevertheless, this is the most disaggregated trade data available for South Africa and using the 1988/1992 revision allows for a long period of analysis of a consistent set of products.[36] Therefore, the benefit of a longer period of analysis capturing more variation along the extensive margin needs to be weighed against missing newly innovated products.

Table 3.1: Summary Statistics, 2012

Number of products	4 376
Number of destinations	210
Number of product-destination pairs with positive export flows	96 553
Number of zeros	822 407
Number of potential product-destination pairs	918 960
Mean number of products per destination	460
Median number of products per destination	139
Mean number of destinations per product	22
Median number of destinations per product	16

Source: UN COMTRADE – own calculations by author.
Notes: 1. The number of potential product-destination pairs is measured by multiplying the number of products by the number of destinations. 2. The number of zeros is measured as the number of potential product-destination pairs less the number of product-destination pairs with positive export values.

3.5 Results

The empirical analysis is divided into three sections. The first section presents an aggregate picture of South Africa's export performance in the post-apartheid period, 1995 to 2012, particularly focusing on changes in the composition of the export structure. Section two presents the results drawn from the *product variety style decomposition* analysis. The estimates of the price-quantity decomposition are examined in the final section.

3.5.1 The changing composition of South Africa's exports

The evolution of South Africa's aggregate export flows, is depicted in Figure 3.2, which presents export value and volume indices for the period 1995 to 2012.[37] A number of points

[36] It must be noted that 8-digit data is available, but there is no concordance available to convert the data to a common revision.
[37] These indices are taken from the World Bank's World Development Indicators (2019), which obtains the data from the United Nations Conference of Trade and Development (UNCTAD) export volume and export value index series. It is noted in WDI (2019) that export values are the current value of exports converted to U.S. dollars and expressed as a percentage of the average for the base period. The base period is 2000, and this is shifted to 1995 in order to align with the period of analysis in this chapter. The index is inflation adjusted in so far as the conversion to constant US dollars accounts for this.

emerge from this diagram, which are interrogated in the proceeding sections: firstly, although exports grow at an average annualised rate of 7.53 percent, the value and the volume indices depict two distinct sub-periods of growth. The initial post-apartheid period is marked by sluggish growth, while the period 2002 onward, exhibits faster growth. In order to further interrogate the dynamics driving this two-period pattern of export growth, the next section analyses the decomposition of growth in these two periods.

Secondly, from the mid-2000s, growth in export value outstrips growth in volumes, which suggests that export prices may be driving export growth. The decomposition of intensive margin growth into price and quantity margins allows for further insight into this growth dynamic. This period does coincide with the commodities super cycle, and thus depending on the composition of South Africa's export structure, it may be high global commodity demand that is driving this growth. Therefore, the analysis in this section starts by looking at changes in the composition of exports.

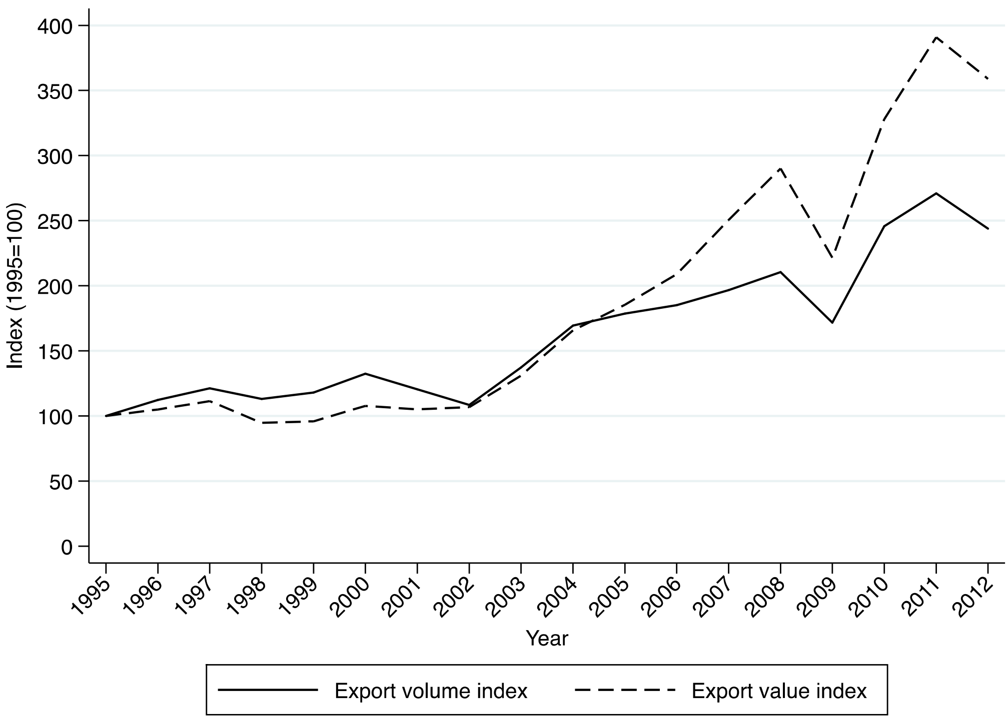

Figure 3.2: Exports by volume and value indices, 1995-2012

Source: Own calculations using data from World Bank World Development Indicators (World Bank, 2019b; 2019c).

In order to get a sense of how South Africa's export portfolio has evolved along the product dimension – the 'what' – the Lall (2000) technology classification is used to examine compositional changes. The Lall (2000) technology classification provides insight into a country's ability to undergo structural transformation and thereby achieve a higher level of economic development. Lall (2000) argues that a country's ability to successfully incorporate new technologies into its production activities is key to its potential to diversify and develop further.

Table 3.2 presents the value of exports by Lall (2000) classification and shows that changes in the composition of South Africa's exports over the seventeen-year period since democratisation run contrary to policy prescription over that period. Instead of diversification toward 'pure' manufacturing exports, the share of these products in South Africa's export structure has remained constant at approximately 37 percent.[38] Consequently, the composition of South Africa's exports remains relatively concentrated in natural resource-intensive products.[39] The combined share of primary product and resource-based manufacturing exports accounts for close to two-thirds of South Africa's export structure. The extent to which the share structure of resource-intensive and 'pure' manufacturing exports in 1995 closely match their corresponding contribution to export growth, further illustrates the static nature of South Africa's export structure over the period.

There is evidence of compositional shifts within 'pure manufacturing' exports, with a shift in composition away from low-technology manufactures (12.32% to 5.49%) toward medium-technology manufactures (22.50% to 28.81%). The Motor Industry Development Plan (MIDP) is a key driving force behind this growth, since much of this growth is achieved by increased exports of motor vehicles.[40] Table 3.2 shows that medium-technology manufactures comprise the majority share of 'pure' manufacturing exports and account for 31.14 percent of South Africa's total export growth. The decomposition analysis in the next section provides insight into the dynamics driving the growth of medium-technology manufactures.

Drawing on the discussion in Chapter 2, export diversification, particularly diversification away from resource-based products and toward manufacturing products, is growth-inducing. The evidence indicates that the product composition of South Africa's export structure remains

38 Using the Lall (2000) classification, 'pure' manufactures or non-commodity manufactures comprise low-, medium- and high-technology products. Commodity manufactures – resource-based manufactures as per Lall (2000) – are distinguished from 'pure' manufactures because the final products of the former have a high share of primary products inputs in their value.
39 Furthermore, the estimates in Table 3.2 understate the magnitude of primary product exports because gold exports have been dropped from the analysis. For more information, see Appendix A.2.
40 Approximately 93 percent of the increase in medium-technology exports arises from increased exports of automotive products.

resource-based, and there is little evidence of diversification into new manufacturing products. A number of implications for economic growth and development arise.

Table 3.2: South Africa's export structure by Lall (2000) classification, 1995-2012

	Exports ($m) 1995	Exports ($m) 2012	Share structure of SA exports (%)		Contribution to change (%) 1995-2012
			1995	2012	
	(1)	(2)	(3)	(4)	(5)
Primary products	6 030	24 688	28.07	31.09	32.21
Resource-based	7 286	24 617	33.92	31.00	29.92
Pure manufacturing, of which:	8 099	29 716	37.71	37.43	37.32
Low-technology	2 646	4 359	12.32	5.49	2.96
Medium-technology	4 833	22 872	22.50	28.81	31.14
High-technology	620	2 486	2.89	3.13	3.22
Total exports	21 480	79 400	100	100	100

Source: UN COMTRADE – own calculations by author.
Note: 1. Export values in $US millions. 2. Sectors defined by Lall (2000) classification – see Appendix Table A. 1 for details. 3. Under the Lall classification, the share structure does not sum to 100 percent and total exports does not exactly match its component parts because products not allocated in the Lall classification have been left out – these comprise between 0.3 and 0.4 percent of total South African exports.

The prominence of natural resource-intensive products in South Africa's export structure does not offer favourable growth and industrial development prospects. The 'resource curse' literature postulates that, on average, natural resource dependence adversely effects economic growth (Sachs & Warner, 1995b; 1997). Lall (2000) argues that less skill- and technology-intensive products, such as resource-based products, are associated with slower growing markets, limited learning potential, and less scope for positive spillover effects into other activities.

The compositional shift away from low-technology manufactures toward medium-technology manufactures offers favourable growth and industrial development prospects. Technology- and skill-intensive products tend to experience higher trade growth rates, they tend to be highly income elastic, they create new demand, and they offer positive spillover effects in terms of the creation of new skills and the generation of knowledge that can be applied to other activities (Lall, 2000).

The growth of medium-technology manufactures is encouraging because it points to an existing industrial base from which to expand and diversify South Africa's export structure. Drawing on Hidalgo et al. (2007), it could be argued that the production of these manufacturing products in the core of the product space, positions South Africa well in terms of future diversification.

This is because the productive capabilities embedded in these medium-technology manufactures overlap with many of the productive capabilities needed in order to produce a variety of other manufacturing products.

The evolution of South Africa's export structure along the destination dimension – the 'where' – shows evidence of geographical diversification. Table 3.3 presents the value of exports by World Bank regional classification and shows the increasing importance of the Asian and Sub-Saharan African markets. This is evident in the share of exports to the East Asia & Pacific, and Sub-Saharan Africa regions rising over the period from 20.29 and 15.35 percent to 31.76 and 19.10 percent, respectively. The East Asia & Pacific region is now the largest regional market for South African exports.

Table 3.3: South Africa's export structure by regional classification, 1995-2012

	Exports ($m) 1995	Exports ($m) 2012	Share structure of exports (%)		Contribution to change (%) 1995-2012
			1995	2012	
	(1)	(2)	(3)	(4)	(5)
North America	2 408	8 412	11.21	10.56	10.32
Rest of Americas	578	2 048	2.69	2.57	2.53
East Asia & Pacific	4 358	25 302	20.29	31.76	36.00
Rest of Asia & Eastern Europe	493	5 312	2.30	6.67	8.28
Europe	8 821	18 221	41.06	22.87	16.16
Middle East & North Africa	701	3 195	3.26	4.01	4.29
Sub-Saharan Africa	3 298	15 216	15.35	19.10	20.48
Total exports	21 480	79 400	100	100	100

Source: UN COMTRADE – own calculations by author.
Note: Export values in $US millions. Regions classified according to World Bank regional classification. Ad hoc approach applied to countries, territories and islands not classified by the World Bank. Under the Regional classification, the share structure does not sum to 100 percent and total exports does not exactly match its component parts because a percentage of exports are shipped to a trade category named "not elsewhere specified. This category comprises trade transactions to small island territories, errors in partner assignment, or non-disclosure of partner information. This category comprises between 2 and 4 percent of total South African exports.

Conversely, the shift toward Asian and Sub-Saharan African markets has been matched by the declining importance of developed country markets. The share of exports to the European market has declined from 41.06 to 22.87 percent over the period, and as a result it has been displaced as the number one destination market for South African exports. However, despite this decline, the importance of the European market must not be understated as it is the second largest regional export market. Similarly, the North American regional market has also experienced a small decline in share of South African exports yet remains an important regional destination for exports.

The changing destination composition of South Africa's export structure, particularly the shift toward East Asia, indicates a response to the changing global economic environment. South African exporters are increasingly looking to developing and emerging country markets as a source of export growth. This is consistent with South Africa's policy stance calling for diversification into proximate and fast-growing destination markets. However, this shift away from developed country markets stands at odds with the literature discussed in Chapter 2, which points to growth-inducing effects associated with exports to high-income markets.

3.5.2 Extended product variety style decomposition analysis

The evolving composition of South Africa's export structure is shaped by the dynamics of export growth. To get a clearer picture of the dynamics behind the aggregate trade flows, and how they're driving compositional changes in the export structure, the extended product variety style decomposition approach is employed.

3.5.2.1 Decomposition by time period

The decomposition estimates shown in Table 3.4 indicate that the intensification of established export relationships account for 70.24 percent of export growth over the period 1995 to 2012 and is thus the main channel of export growth (column (3)). This result is consistent with the literature where the intensive margin is typically found to be the main source of export growth across both developed and developing countries.[41]

As shown in columns (5) and (6), close to 40 percent of export growth over the entire period can be attributed to entry into new export markets. This expansion into new export markets is dominated by entry into new destination markets as opposed to entry into new product markets, which only accounts for 4.27 percent of export growth. This result is consistent with the literature, which finds that, on average, the destination extensive margin is greater in magnitude than the product extensive margin.

However, the overall contribution of the extensive margin to total export growth is net of dying export relationships. Due to an 8.34 percent decline in export growth resulting from the death

41 However, this result runs contrary to the individual decomposition analyses applied by Zahler (2011) for South Africa, where the extensive margin is estimated to be a larger source of export growth than the intensive margin (See Table A.7 in Zahler (2011)). Initially, similar results were achieved in the analysis for this chapter. However, closer inspection of data for gold, platinum and platinum group products revealed that estimates for the extensive margin were incorrectly inflated. For more on the treatment of gold, platinum and platinum group product lines, see Appendix A.2.

of old export relationships, net extensive margin growth accounts for 29.76 percent of growth over the full period of analysis.

The dynamics of South Africa's export growth, specifically along the extensive margin, is broadly consistent with that of other developing and middle-income economies. Using similar decomposition methodologies, Amurgo-Pacheco & Pierola (2008), Brenton & Newfarmer (2009) and Zahler (2011) find that the extensive margin accounts for 17, 20 and 42 percent of export growth in developing economies, respectively. Brenton & Newfarmer (2009) show that the extensive margin accounts for 23 percent of export growth in middle-income economies. The corresponding measure for South Africa – 29.76 percent – sits within the range of values listed above.

Table 3.4: Decomposition of export growth into intensive and extensive margins

	Annual export growth	Export growth	Growth of surviving varieties	Dying varieties	New destinations	New products
	% p.a.	%	share of (2)	share of (2)	share of (2)	share of (2)
	(1)	(2)	(3)	(4)	(5)	(6)
1995-2012	7.53	269.64	70.24	-8.34	33.83	4.27
1995-2001	3.00	23.03	67.40	-72.22	77.58	27.25
2002-2012	10.64	203.98	88.08	-7.74	20.47	0.03

Source: UN COMTRADE – own calculations by author.
Notes: 1. Column (1) shows average annual growth for the period. 2. Column (2) shows percentage growth for the period. 3. Columns (3) to (6) measure each margins percentage contribution to total growth, as presented in column (2).

The extent to which the various margins are driving export growth, provides insight into changes in the composition of South Africa's export structure. The dominance of the intensive margin, and hence the intensification of existing export relationships, helps explain the relatively static nature of South Africa's export structure. The limited extent to which there has been structural transformation along the product dimension, and the evidence pointing toward destination diversification, is consistent with the relative size of the product and destination extensive margins.

A more detailed breakdown of the components of extensive margin growth indicates that the majority share of extensive margin growth is accounted for by 'new products to known destinations' (11 percent of extensive margin growth) and 'new destinations of known products and destinations' (89 percent of extensive margin growth).[42] Therefore, entry into new markets,

[42] See Appendix Table A. 2 for a more detailed version of the decomposition.

be it from the product or destination side, is into product or destination markets in which other South African firms have already entered.

The possibility of firms benefiting from information and network externalities, in terms of the costs and profitability associated with a market, may explain this pattern of extensive margin growth.[43] Heterogeneous firm trade theory, such as Helpman et al. (2008), state that the ability of a firm to profitably enter a market depends upon the fixed and variable costs associated with that market, relative to the productivity of the firm. Therefore, the more information a firm has on the fixed and variables costs associated with that market, the more likely it is to enter that market relative to markets for which it has relatively little information.

As shown in Table 3.4, export performance in the post-apartheid period can be separated into two distinct periods: firstly, the period 1995 to 2001, which is marked by sluggish average annual growth of 3 percent.[44] Secondly, the period 2002 to 2012, which is characterised by relatively more rapid average annual growth of 10.64 percent. An examination of the intensive and extensive margins provides insight into the dynamics driving export patterns over these two periods.

Firstly, it is evident that there is a great deal of churning – exit and entry – in the first period. The large contributions to total export growth resulting from entry into new destination markets (77.58%) and new product markets (27.25%), is substantially reduced by dying export relationships (72.22%).

Secondly, the rapid expansion of exports in the second period is largely driven by growth along the intensive margin. The intensive margin grew by 179.67 percent over this period and accounted for 88.08 percent of export growth.[45] The next section advances the analysis by examining the extent to which the price and quantity margins drive the intensive margin during this period.

[43] However, one cannot discount the nature of the data employed in this paper. There is a limit to the number of classified product categories (5017), and the number of countries in the world. If a country is exporting nearly all possible products and exporting to nearly all of the destinations, there is little room for growth into entirely new product or destination markets.
[44] The recession in the Unites States in 2001 is not driving this period of slow export growth. It is evident in Figure 3.2 that export growth between 1995 and 2001 was relatively modest and only started to accelerate in the period 2002 to 2012.
[45] This period is marked by the 2009 global financial crisis. Recent firm-level studies by Matthee et al. (2015) and Purfield, Farole & Fernando (2014) find that the expansionary export growth prior to the recession, declining export growth during the recession, and the post-recession export recovery, occurred mainly along the intensive margin. This is consistent with this section’s overall finding for this period.

The duration of trade literature offers insight into the dynamics of export growth across these two periods. Besedeš & Prusa (2006a; 2011) show that for developing countries, a key element to generating faster aggregate export growth is higher survival rates for existing trade flows. The relatively rapid export growth in the second period, marked by the intensification (survival) of existing export relationships, is consistent with their assertion. Brenton, Pierola & von Uexkull (2009) find that what distinguishes poorly performing countries relative to stronger performers is not so much entry into new trade relationships, but rather the ability of the latter to extend the survival (duration) of its export relationships. Further, both Brenton & Newfarmer (2009) and Zahler (2011) find that export failure is linked to high hazard rates (deaths of export relationships). The sluggish first period, marked by churning and very high levels of 'export deaths', is consistent with the poorer performance

A plausible explanation for the different patterns of export growth over the two periods may be found in the opening of the economy through a variety of trade liberalisation reforms. The post-94 period is characterised by the establishment of various trade agreements and an extensive effort to liberalise the trade regime (Edwards, 2005).[46] The significant degree of exit and entry in the period 1995 to 2001, may be due to firms adjusting to a more liberalised trade environment and the uncertainty associated with this new business environment (Besedeš & Prusa, 2006b). Liberalisation adjusts the relative costs and profitability of exporting, which may explain the adjustments along the extensive margin over the first period (Persson, 2012; Kehoe & Ruhl, 2013). The relatively more stable second period may be a result of firms having already adjusted to the changing trade regime and are now able to intensify trade relationships. The analysis in Chapter 5 further explores the role of trade policy in driving variation along the extensive margin, by focusing on the impact of TDCA driven tariff liberalisation on South African exports into the EU.

A potential explanation for the relatively rapid export growth that characterised the second period, certainly for the sub-period prior to the financial crisis in 2008, is the effect of the global commodities super cycle. The increased demand for commodities over this period is likely to have had a substantial effect on export growth since the composition of South Africa's exports is skewed toward natural resource-intensive products. Further, the strong intensive margin

[46] Edwards (2005) documents trade liberalisation actions in South Africa since the 1970s. The major liberalisation actions took place post-94. In particular, South Africa's GATT offering during the Uruguay Round (1994), SADC Free Trade Protocol (signed in 1996, implemented in 2000), termination of export subsidies under GEIS (1997), implementation of SA-EU Trade, Development and Cooperation Agreement, and preferential access to the USA for some products under the African Growth and Opportunity Act.

growth is to be expected since export relationships involving commodities are likely to be well established. The decomposition analysis in Section 3.5.2.4. investigates the extent to which this intensive margin growth is driven by the price and quantity margins.

3.5.2.2 Decomposition by product characteristics

In this section, South Africa's export growth over the period 1995 to 2012 is decomposed by Lall (2000) product classification.[47] The results presented in Table 3.5, show how the dynamics of export growth drive changes in the product composition of South Africa's export structure.

The dynamics driving export growth within low- and medium-technology manufactures, provides insight into the compositional shift of exports from the former to the latter. The rising share of medium-technology manufactures is not driven by diversification into new product markets within this product grouping. Rather, it is driven by the intensification of established export relationships (68.9%), and by diversification into new destination markets (35.53%).[48]

The impact of the changing global economic environment, particularly the increased prominence of China in global trade, is evident in the export dynamics of low-technology manufactures. The large share of declining growth due to dying export relationships (53.23%) is key to understanding the declining importance of low-technology manufactures. One possible explanation for this decline, is the increased competition from Chinese manufacturing exports in these products markets that are characterised by low labour costs. This explanation is consistent with Edwards & Jenkins (2013) who argue that South African manufacturing exports to Sub-Saharan Africa, particularly low- and medium-technology manufactures, have been crowded-out by Chinese manufacturing exports.

Furthermore, one could infer from the margins of growth in Table 3.5, the response of low-technology manufacturing exporters to this increased competition. The large share of growth emerging from growth in surviving varieties (78.3%) points to firms shifting up the quality ladder to insulate themselves from the increased competition. The analysis of the price and quantity margins in the next section provides further support for this explanation. The expansion into new destination markets (74.71%) may be indicative of firms exiting geographic

[47] See Appendix Table A. 3 for more detail on the decomposition of export growth by Lall (2000) classification.
[48] The expansion into new destination markets is mainly due to entry into new destination markets of known products and known destinations. Appendix Table A. 3 shows that 35.4 percent of growth within medium-technology manufacturing exports is due to entry into new destination markets of known products and known destinations.

markets in which they cannot compete and moving into geographic markets where they are better positioned to compete or face less competition.

Table 3.5: The margins of South Africa's export growth by Lall (2000) product classification, 1995-2012

	Export growth	Growth of surviving varieties	Dying varieties	New destinations	New products	
	(% p.a.)	(% share)	(% share)	(% share)	(% share)	%
	(1)	(2)	(3)	(4)	(5)	(6)
Primary products	8.15	75.57	-6.10	30.64	0.04	100
Resource-based manufactures	6.99	66.60	-9.06	30.95	11.43	100
Pure manufacturing, of which	7.49	69.35	-9.76	39.27	1.14	100
Low-tech manufactures	2.81	78.30	-53.23	74.71	0.23	100
Medium-tech manufactures	9.02	68.90	-5.77	35.53	1.34	100
High-tech manufactures	8.02	65.49	-8.48	42.99	0.00	100
Total	7.53	70.24	-8.34	33.83	4.27	100

Source: UN COMTRADE – own calculations by author.
Notes: 1. The values for the growth margins represent the share of each margin within each Lall (2000) category. Columns (2) to (5) sum to 100 percent (i.e. column (6)) 2. Export growth is decomposed by product (HS 6-digit) in a manner that indicates what portion of export growth in each product is due to each of the growth margins as per the product variety style decomposition methodology. 3. Column (1) shows average percentage growth per annum.

A closer look at the product extensive margin provides further evidence of the marginal nature of product diversification in the post-apartheid period. Approximately 4.27 percent of export growth is a result of entry into new product markets, of which approximately three-quarters is accounted for by one resource-based manufacturing product.[49] This further illustrates that although there has been a degree of structural transformation in terms of a shift of production away from low-technology manufactures toward medium-technology manufactures, the extent to which South African firms have entered new and dynamic export markets, as prescribed by the likes of Hausmann et al. (2007), is limited.

3.5.2.3 Decomposition by destination characteristics

In this section, export growth is decomposed by World Bank regional classification. The analysis of the margins of growth by regional market is interesting in the middle-income country context because trade patterns may differ across regions. The results in this section inform the analysis in Chapter 4, where South Africa’s revealed factor abundance across high-

[49] 271000 - Petroleum oils, etc, (excl. crude).

, middle- and low-income trading partners is analysed. Table 3.6 presents the margins of growth within each of the regional markets.

The intensive margin is a key source of growth into the regional markets where South African firms have a more established presence. It is evident in Table 3.6 that growth in surviving varieties constitutes 91.08, 75.53, 67.37 and 70.08 percent of growth in the North America, East Asian and Pacific, Europe, and Sub-Saharan Africa regions, respectively. The product lifecycle explanation of export growth detailed in Brenton & Newfarmer (2009) provides insight into this pattern of growth in established export markets. They argue that once firms have passed the first phase of successfully discovering and entering a market, the next phase is an acceleration phase where they intensify exports into this market and expand into new destination markets. The 'acceleration phase' pattern is especially evident in the two established developing country regional markets, which may explain their growing importance as regional destinations and the relatively rapid pace at which this is occurring.

Export growth into the other regional markets, which are developing country markets and comprise a relatively smaller share of South African exports, is more dynamic. Table 3.6 shows that the destination extensive margin comprises 90.45, 51.37 and 66.35 percent of export growth within the Rest of the Americas, the Rest of Asia and Eastern Europe, and the Middle East and North Africa regions, respectively. The majority of the destination extensive margin is driven by entry into new destination markets of known products and destinations.[50] The relative importance of the destination extensive margin coupled with comparatively high 'export relationship deaths' shows a significant degree of export churning within these regional markets. This entry and exit of exports, presents a picture of firms, in the face of uncertainty, testing the profitability of exporting to markets within these regions (Besedeš & Prusa, 2006b).

Export growth to South Africa's second most important regional market, Europe, exhibits a pattern of churning. The significant share of 'dying' export relationships (-17.11%) within this region is key to explaining the slow growth of exports to this region and its declining importance as a regional destination for South African exports. The exiting out of export relationships within this market has been accompanied by growth due to entry into new destination markets (46.98%), which is surprising since the European market is a relatively

[50] See Appendix Table A. 4 for detailed decomposition results. Entry into new destination markets of known products and destinations means that a firm may start to export a product, which other firms have exported to countries within the region before, to a destination that other firms (and this firm) have exported other products to before.

established market for South African firms. This suggests that South African exporters who have experienced export relationship deaths or reductions along the intensive margin with more established European partner countries, have shifted to other European markets. This may be partly explained by the expansion of the EU and the imposition of existing EU trade agreements with South Africa onto new member countries. This very issue is explored in greater detail in Chapter 5.

Table 3.6: The margins of South Africa's export growth by World Bank regional classification, 1995-2012

	Export growth (% p.a.) (1)	Growth of surviving varieties (% share) (2)	Dying varieties (% share) (3)	New destinations (% share) (4)	New products (% share) (5)	% (6)
North America	7.20	91.08	-4.66	13.49	6.47	100
Rest of Americas	7.29	32.14	-23.81	90.45	1.22	100
East Asia & Pacific	10.27	75.53	-6.23	27.23	3.47	100
Rest of Asia & Eastern Europe	14.12	53.84	-5.65	51.37	0.43	100
Europe	4.11	67.37	-17.11	46.98	2.75	100
Middle East & North Africa	8.79	44.58	-12.88	66.35	1.95	100
Sub-Saharan Africa	8.87	70.80	-3.23	25.89	6.54	100
Total	7.53	70.24	-8.34	33.83	4.27	100

Source: UN COMTRADE – own calculations by author.
Notes: 1. The values for the growth margins represent the share of each margin within each regional destination category. Columns (2) to (5) sum to 100 percent (i.e. column (6)) 2. Export growth is decomposed by destination (country) in a manner that indicates what portion of export growth to each destination is due to each of the growth margins as per the product variety style decomposition methodology. 3. Column (1) shows average percentage growth per annum.

The analysis in Table 3.3 above provides aggregate evidence pointing to geographical diversification, while the decomposition analysis indicates that there are cross-country growth dynamics driving this diversification. As mentioned above, compositional changes in South Africa's export structure along the destination dimension show a shift from developed country markets toward developing country markets. In addition to this geographic diversification across regional markets, the importance of the destination extensive margin within a number of regional markets indicates that there has also been diversification within these regional markets. As such, the composition and growth of exports differs across destinations. Chapter 4 provides a theoretical view on the cross-country variation in South African exports.

3.5.2.4 *Price-quantity decomposition*

In order to analyse the extent to which the price and quantity margins are driving the intensive margin, this section applies an extended product variety style decomposition. The decomposition methodology from Haddad, Harrison & Hausman (2011) is assimilated into the Zahler (2011) product variety style decomposition. The analysis covers the period 2002 to 2012. There are two reasons for the choice of period. Firstly, the quantity data is limited in its coverage in earlier years.[51] Secondly, this period is marked by relatively rapid export growth that is primarily driven by the intensive margin (88.01%). The commodities super cycle occurs during this period and given the prominence of resource-based products in South Africa's export structure, it's interesting to disentangle the price and quantity response of South African exporters.

It is clear from Table 3.7 that, on aggregate, the price margin is driving the intensification of existing trade relationships, for the period 2002 to 2012. Approximately 93 percent of growth in surviving export relationships is along the price margin, while only 7 percent is along the quantity margin. This stands in stark contrast to China's export performance over a comparable period, 2001 to 2007, where quantity growth accounted for approximately 70 percent of total export growth (Bingzhan, 2011). This confirms the conclusions regarding Figure 3.2, where growth in export values, driven by price growth, outstrips growth in export volumes.

The extent to which the price margin is driving export growth in primary products and resource-based manufactures substantiates the view that the commodities super cycle was largely responsible for the relatively rapid export growth in the post-2002 period. It is evident in Table 3.7 that the price margin accounts for 97.1 and 82.2 percent of growth in surviving export relationships for primary products and resource-based manufactures, respectively. Findings in the preceding sections show that growth over this period is primarily along the intensive margin and that South Africa's export structure is skewed toward commodities and commodity-based products. Thus, commodity price growth resulting from the commodities super cycle accounted for much of the export growth that emerged in the post-2002 period.

The minor contribution of quantity growth relative to price growth during the commodities super cycle does suggest that supply-side constraints prevented South African firms from responding to a favourable global market. The commodities super cycle marks a period of

[51] See Appendix A.2 for details on the construction of the dataset used in the analysis.

increased global demand for commodities, which pushed up the price of commodities. The dominance of the price margin in primary products and resource-based manufactures indicates that growth was simply driven by favourable terms of trade, and not a supply-side response in the form of increased volumes. The notion of South African export growth being constrained by supply-side factors is consistent with Edwards & Alves (2006). They argue that factors such as the real effective exchange rate, infrastructure costs, tariff rates, and a scarcity of skilled labour, negatively affect the profitability of export supply. The implication is that South Africa failed to fully exploit the most recent commodities super cycle by reaping the benefits of rapidly increasing export volumes.

Table 3.7: Price and quantity margins of export growth by Lall (2000) classification, 2002-2012

	Price growth (% share) (1)	Quantity growth (% share) (2)	% (3)
Primary products	97.1	2.9	100
Resource-based manufactures	82.2	17.8	100
Low-tech manufactures	186.0	-86.0	100
Medium-tech manufactures	89.1	10.9	100
High-tech manufactures	60.9	39.1	100
Total	92.81	7.19	100

Source: UN COMTRADE – own calculations by author.
Notes: 1. Values represent percentage share of surviving export relationship growth within Lall (2000) category.

The positive price margin and the negative quantity margin for low-technology manufactures is consistent with the contention of quality upgrading in the face of competition. The analysis in Section 3.5.2.2 addressed the declining importance of low-technology manufactures. Referring to Edwards & Jenkins (2013), it was stated that this may be a result of increased competition from Chinese exporters. The importance of the destination extensive margin in low-technology manufactures suggested that exporters of these products responded by moving into new geographic markets where they might face less competition. The growth pattern characterised by positive price growth and negative quantity growth suggests quality upgrading. This implies that South African exporters that remain in established markets respond to increased competition by moving up the quality ladder in order to differentiate their products from their competitors.

Table 3.8 reveals an interesting pattern of growth along the price and quantity margins within developed and developing country regional markets. On average, rising prices are driving intensive margin growth into developed country regional markets, while declining volumes are contributing negatively to growth in these regions. Conversely, intensive margin growth to developing country regions is, on average, being driven by both rising prices and volumes.

Table 3.8: Price and quantity margins of export growth by World Bank regional classification, 2002-2012

	Price growth (% share) (1)	Quantity growth (% share) (2)	% (3)
North America	141.7	-41.7	100
Rest of Americas	40.6	59.4	100
East Asia & Pacific	62.5	37.5	100
Rest of Asia & Eastern Europe	41.7	58.3	100
Europe	161.3	-61.3	100
Middle East & North Africa	76.5	23.5	100
Sub-Saharan Africa	98.4	1.6	100
Total	92.81	7.19	100

Source: UN COMTRADE – own calculations by author.
Notes: 1. Values represent percentage share of surviving export relationship growth within regional destination category.

Focusing on the quantity margin, it is evident that, on average, growth in export volumes is small. This indicates that there has not been a major increase in the aggregate supply of South African exports. Rather the decline in export volumes to developed country markets and the rise in export volumes to developing country markets suggests a shift in supply across regional markets. It is likely that this shift has contributed to the geographical diversification of South Africa's export structure.

3.6 Conclusion

This chapter examines the dynamics driving the evolution of South Africa's exports in the post-apartheid period. The Zahler (2011) product variety style decomposition approach is used to decompose export growth into intensive, product extensive, and destination extensive margins. This methodological approach is extended in order to further decompose the intensive margin into price and quantity margins. A number of interesting insights emerge.

South Africa's export dynamics, particularly the share of growth accounted for by the extensive margin, is consistent with the export dynamics of other developing and middle-income economies. Export growth in the post-apartheid period is driven by the intensification of existing export relationships (70.24%), while the extensive margin plays a lesser role (29.76%). Extensive margin growth is driven by entry into new destination markets (33.83%), while entry into new product markets is limited (4.27%). Intensive margin growth is driven predominantly by the price margin (93%).

Export dynamics in the initial post-apartheid period, 1995 to 2001, which involved re-integration into the global economy and trade liberalisation reforms, is characterised by churning. Entry into new product and destination markets accounted for 27.25 and 77.58 percent of export growth, respectively, while the exiting out of export relationships accounted for 72.22 percent of growth. Liberalisation adjusts the relative costs and profitability of exporting, which suggests that this pattern of entry and exit may be due to firms adjusting to a more liberalised trade environment.

Another interesting export dynamic linked to South Africa's trade liberalisation reforms, involves export growth into Europe. The share of exports to Europe has declined over the period, and this is reflected in a substantial share of negative growth arising from dying export relationships. However, the destination extensive margin within the region is relatively high, accounting for close to half the growth of exports into the region. This diversification within the region may be driven by, firstly, the establishment of the TDCA between the EU and South African, and secondly, the enlargement of the EU, and the imposition of the TDCA on new member countries. The impact of this tariff liberalisation on the margins of South Africa's export growth into the EU, is examined in Chapter 5.

In addition to re-integrating into the global economy, South African exporters faced a changing global economic order, where emerging economies, such as China and India, have grown in economic importance. South Africa's export response is reflected in the destination composition of its export structure shifting away from developed country markets, toward developing country markets in Africa and Asia. This is consistent with the destination extensive margin accounting for a third of export growth over the period. As a middle-income country, South Africa's export dynamics are likely to vary across destination markets. Chapter 4 provides a theoretical view on why the evolving composition of South Africa's export structure varies across destination markets.

The changing global economic order is further evident in the evolution of South Africa's low-technology manufacturing exports. The exit out of old export relationships associated with these low-wage manufacturing products, may be explained by increased competition from low-wage economies, such as China. In response to this competition, as reflected in the destination extensive margin, it seems that South African exporters have shifted to new destination markets where they face less competition. A further response is evident in the intensive margin growth that is characterised by large price growth and negative quantity growth. This may point to exporters shifting up the quality ladder in order to insulate themselves from increased competition.

The export dynamics for resource-based products during the period marked by the commodities super cycle plays a key role in explaining the relatively rapid export growth over this period. Export growth in this period is driven by growth in surviving export relationships, many of which are associated with commodities or commodity-based products. Growth in these surviving export relationships is almost completely driving by the price margin. Thus, much of the relatively rapid growth that emerged during the post-2002 period, certainly up until the financial crisis, is driven by price growth linked to the commodities super cycle. Further, the marginal contribution of the quantity margin to intensive margin growth suggests supply-side constraints. This suggests that South African exporters were not able to exploit the commodities super cycle by generating volume growth.

The decomposition analysis also provides insight into South Africa's export performance in relation to policy prescription. Policy calls for the diversification of exports along the product and destination dimensions. Along the product dimension, the goal of shifting away from resource-based products and toward manufacturing products has not been met. South Africa's post-apartheid export structure remains strongly skewed toward resource-based products. There is, however, a compositional shift within manufacturing away from low-technology products toward medium-technology products. Much of this growth has been driven by the growth in automotives under the MIDP programme. Along the destination dimension, the goal of diversifying toward proximate and fast growing emerging markets has been met. This is evident in a compositional shift away from developed country markets toward developing country markets in Africa and Asia.

Drawing on Chapter 2, the continued dominance of resource-based exports, is concerning in light of the negative growth predictions found in the 'resource curse' literature. The compositional shift from low-technology manufactures toward medium-technology manufactures, offers more favourable economic growth prospects. The path dependent nature of structural transformation, advanced by Hidalgo et al. (2007), suggests that producing these manufacturing products places South Africa in a position for easier diversification into other manufacturing products.

The diversification of South Africa's export structure along the destination dimension is a favourable development since it reduces a country's risk exposure to country-specific shocks, and the resultant declines in export revenues (Bacchetta, Jansen, Lennon & Piermartini, 2009). However, the 'where you export matters' literature discussed in Chapter 2, points to the growth inducing effects associated with exports to high-income economies. The compositional shift away from developed country markets suggests that South African exporters may enjoy less of the positive externalities and spillovers effects associated with exporting to these destinations.

To conclude, South Africa's post-apartheid export pattern is one of continued natural-resource dominance. Despite a rising share of medium-technology manufacturing exports, the degree to which the economy has undergone structural transformation has been minor. Nevertheless, the extensive margin, particularly entry into new destination markets, plays a significant role in driving export growth. Therefore, both Chapters 4 and 5 takes the analysis forward by investigating two factors – endowments and trade policy – that may be driving this extensive margin growth.

CHAPTER 4: THE EXTENSIVE MARGIN AND REVEALED FACTOR ENDOWMENTS

4.1 Introduction

The analysis in Chapter 3 reveals the importance of the extensive margin in driving export growth. Over the period 1995 to 2012, approximately 38.1 and 29.8 percent of South Africa's export growth results from gross and net entry into new export markets, respectively. This is consistent with recent empirical research, which shows the extensive margin to be an important channel of export growth, especially in the case of developing countries (Evenett & Venables, 2002; Bernard et al, 2009; Zahler, 2011).

This chapter examines what South Africa's export structure reveals about its endowments. This in turn informs one whether endowments shape the country's export pattern. Further, given the importance of the extensive margin, this chapter also analyses the role of endowments in driving South Africa's evolving export structure. In so doing, the chapter determines what South Africa's evolving export structure reveals about its factor abundance and comparative advantage.

This analysis is of interest and importance for the following reasons: firstly, theory points to the importance of endowments in shaping trade patterns. International trade theory, specifically the Heckscher-Ohlin model, predicts how endowments drive trade patterns across countries. As a natural resource and unskilled labour abundant country, theory would predict that South Africa's export structure reflects this. This chapter assesses whether the predictions emerging from this model are consistent with South Africa's export outcomes.

Secondly, the notion that endowments play a role in driving the evolution of a country's export structure is advanced in recent empirical analysis by Cadot et al. (2011). Investigating export diversification patterns along the economic development path, they find that the initial diversification at low levels of economic development, and the re-concentration at high levels of economic development, is driven primarily by changes along the extensive margin. This adjustment along the extensive margin is akin to countries travelling across diversification cones, as per Schott (2003; 2004). Cadot et al. (2011) also claim that as middle-income economies advance from low-income status, they accumulate capital and produce an increasing variety of capital-intensive products. This chapter assesses whether this claim of increased capital-intensity in production is consistent with South Africa's experience as a middle-income country. More broadly, this chapter considers whether endowments play a role in shaping South Africa's evolving export structure.

Thirdly, the empirical literature points to a paradox regarding the factor content of South Africa's trade and its endowment structure. South African exports in the post-apartheid period are shown to be increasingly capital- (Edwards, 2001b) and skills-intensive (Edwards, 2001a), while its factor content of trade reveals it to be capital abundant (Alleyne & Subramanian, 2001). This stands in contrast to South Africa being characterised by an abundance of unskilled labour and high unemployment. These existing analyses use aggregated industry-level data, and it is thus interesting to consider whether the paradox remains when using disaggregated product-level data. This chapter also examines whether the paradox is evident in South Africa's evolving export structure.

Fourthly, to the extent that endowments shape South Africa's export structure, there is scope for policy makers to change the country's export structure by altering the accumulation of endowments. South Africa's economic policy aims for the diversification of its export structure away from resource-based products and toward manufacturing. As a resource abundant country, this implies changing its comparative advantage and diversifying out of traditional comparative advantage products. Therefore, this chapter provides insight into whether altering South Africa's endowment structure can facilitate policy targeting export diversification toward manufacturing.

Finally, as a middle-income country, South Africa does not fit within the neat developed-developing country framework put forth by international trade theory. Smet (2007) argues that South Africa occupies a 'middle position' between industrialised trading partners and emerging economies on the one hand, and its African neighbours on the other. Certainly, there is evidence in Chapter 3 indicating that both the composition and the evolving composition of South Africa's export structure, varies across destination markets. This chapter analyses whether South Africa occupies this 'middle position', where relative endowments shape its export structure across trade partners. The role of endowments in shaping South Africa's evolving export structure across trade partners is also considered.

This chapter employs the Baldwin (1971) cross-commodity regression approach. It involves regressing product-level trade flows on associated factor intensities to yield coefficients that are indicative of factor abundance. This provides insight into the role of endowments in shaping a country's export structure, as well as driving the evolution of its export structure.

The Baldwin (1971) cross-commodity regression approach, and hence the empirical literature, is extended in the following ways: firstly, the cross-commodity regression approach is extended from a static to a dynamic analysis. Typically, this regression approach is used to test what a country's export pattern reveals about its factor abundance at a point in time (for example, see Alleyne & Subramanian, 2001). This chapter extends this empirical approach by examining what changes in a country's export pattern over time reveal about its factor abundance.

Secondly, this chapter benefits from the use of highly disaggregated product-level trade data and matching revealed factor intensity data. In previous studies, the cross-commodity regression approach is applied at an aggregated industry-level (for example, see: Baldwin, 1979; Harkness & Kyle, 1975; Wright, 1990; Romalis, 2004). The availability of product-level data allows for a disaggregated product-level application of this approach. For instance, the highly disaggregated product-level trade data allows for detailed measurement of the extensive margin, which allows for a more nuanced analysis of what South Africa's evolving trade pattern reveals about its factor abundance. Furthermore, Schott (2003) shows that within aggregate industry categories there is substantial variation in factor intensity and posits that this is a result of intra-industry product heterogeneity. Using product-level factor intensity data allows one to account for this heterogeneity.

The rest of the chapter is organised as follows. Section 4.2 investigates the relevant theoretical and empirical literature concerned with the link between factor endowments and trade. Section 4.3 explains the Baldwin (1971) cross-commodity regression approach and details the extensions of the approach applied in this chapter. Section 4.4 describes the data employed in the analysis. Section 4.5 provides both the descriptive and econometric results, while Section 4.6 concludes.

4.2 Literature review

Key to addressing the research objective in this chapter, is understanding the link between endowments and trade. This section starts by consulting the theoretical literature, which provides a set of hypotheses on the link between endowments and trade. The relevant model is the Heckscher-Ohlin-Vanek (HOV) model. The second part of this section considers the associated empirical literature.

4.2.1 The link between trade and endowments: The Heckscher-Ohlin-Vanek model[52]

In predicting trade patterns across countries, the Heckscher-Ohlin (HO) model places emphasis on differences in factor endowment across countries (Feenstra, 2003). As such, the HO model is clear: endowments drive trade patterns. A multi-product, multi-factor extension of the HO model, the Heckscher-Ohlin-Vanek (HOV) model, provides predictions on how trade, technology (i.e. factor intensities embodied in production) and endowments are linked.

The higher dimensionality of the HOV model is reflected in many countries, indexed by $i = 1, \dots, C$, many industries (or products), indexed by $j = 1, \dots, N$, and many factors, indexed by $k = 1, \dots, M$. The standard HO model assumptions, such as, identical technologies across countries, factor-price equalisation prevailing under free trade, no barriers to trade, zero transport costs, and identical and homothetic tastes across countries, apply to the HOV model.

Factor intensity in the model is represented in the $(M \times N)$ matrix $A = [a_{jk}]$, which denotes the amounts of primary factors k, such as labour, capital and land, needed to produce one unit of production in each industry (product) j. The assumption of identical technologies across countries ensures that this matrix applies across all countries.

The $(N \times 1)$ vector of outputs in each industry (product) in country i is denoted by Y^i, and the $(N \times 1)$ vector of demands for each industry (product) is denoted by D^i. As such, the vector of net exports for country i equals $T^i = Y^i - D^i$. The factor content of trade is then defined as $F^i \equiv AT^i$, which is an $(M \times 1)$ vector. Individual components of the factor content vector are denoted as, F_k^i, where a positive value indicates that the factor is exported, and a negative value indicates that a factor is imported.

Feenstra (2003) states that the goal of the HOV model is to relate the factor content of trade AT^i to the endowments of a country. To do so, one computes AY^i and AD^i. AY^i equals the demand for factors in country i, and assuming full employment, equals the endowments in country i, $AY^i = V^i$.

The computation of AD^i is simplified by using the assumption of identical and homothetic tastes. Since product prices are equalised across countries by free trade, the consumption

[52] The description of the HOV model in this section is informed by Chapter 2 of the Feenstra (2003) book, titled *Advanced International Trade: Theory and Evidence*.

vectors of all countries must be proportional to one another, which is written as $D^i = s^i D^W$. D^W denotes the world consumption vector and s^i is the share of country i in world consumption. It follows that $AD^i = s^i AD^W$. If trade is balanced, then s^i also equals country i's share of world GDP. World consumption must equal world production and thus $AD^i = s^i AD^W = s^i AY^W = s^i V^W$. This implies that country i consumes a constant fraction, s^i, of world endowments.

The factor content of net exports is $AT^i = AY^i - AD^i$, and thus making use of the expressions for AY^i and AD^i, Feenstra (2003) shows that:

$$F^i \equiv AT^i = V^i - s^i V^W \qquad (4.1)$$

which is the statement of the HOV theorem. Country i is considered abundant in factor k if its endowment of this factor relative to the world endowment exceeds its share of world GDP, $V_k^i / V_k^W > s^i$. With respect to equation (4.1), this implies that the factor content of trade in factor k is positive $F_k^i > 0$. Conversely, factor k is scarce if its respective factor content of trade is negative $F_k^i < 0$. Therefore, equation (4.1) encapsulates the prediction of the HOV model, which states that a country will export the services of the abundant factors and import the services of the scarce factors.

Using the Baldwin (1971) cross-commodity regression approach, discussed below, one uses information on a country's trade and factor intensities to infer its factor abundance, assuming the theoretical prediction of the HOV model holds.

4.2.2 The link between trade and endowments: Empirical literature

This section refers to two strands within the relevant empirical literature: first, literature examining whether country-level trade patterns align with the predictions of the Heckscher-Ohlin model. Second, existing research exploring the link between endowments and trade in the South African context.[53]

[53] Chapter 2 provides a discussion on the literature examining the link between a country's changing export structure, as evidenced by adjustment along the extensive margin, and its endowments.

4.2.2.1 *Empirical analyses on the link between trade and endowments: Early tests of the Heckscher-Ohlin model*[54]

The empirical literature exploring the link between endowments and trade is informed by the predictions of the Heckscher-Ohlin model, and as such, much of it is driven by methodological concerns regarding the testing of the model. There are two dominant approaches to testing the Heckscher-Ohlin model: firstly, the factor content approach, which compares the factor ratios of exports versus imports. Leontief (1953) applied this approach to the capital abundant USA, and paradoxically found that US imports were more capital-intensive than US exports, suggesting labour abundance. This paradoxical result spurred a literature focusing on the validity of the empirical approach used to test the Heckscher-Ohlin model.[55] Leamer (1980) argued that the correct application of the factor content approach, in an unbalanced trade context, is to compare the factor ratios of consumption versus production. Application of this approach yielded the predicted result of capital abundance in the US case.

The second approach to testing the Heckscher-Ohlin model is the cross-commodity regression approach. The Heckscher-Ohlin model describes a three-way relationship between factor abundance, factor intensity, and trade. Assuming the Heckscher-Ohlin-Vanek theorem holds, the cross-commodity regression approach, as applied by Baldwin (1971), regresses trade flows on associated factor intensities to reveal factor abundance. Net exports biased toward capital-intensive products is interpreted to imply capital abundance. The analysis to follow employs this approach, and thus this section focuses closely on the application and evolution of this approach.

The cross-commodity regression approach has been used in a number of studies, typically focusing on the US, and has evolved in its application over time. Initial analysis by Keesing (1966), estimates simple correlations between US export performance and skill intensities. The methodology is advanced in Baldwin (1971), who adopts a multiple regression approach by regressing net exports across commodities on associated factor intensities and additional control variables. Using 1962 trade data for sixty US industries and factor intensity data from the 1958 US Input-Output table, Baldwin (1971) finds a negative coefficient on the capital-to-labour ratio variable. This aligns with the paradoxical results found earlier by Leontief (1953).

[54] Deardorff (1984) and Leamer & Levinsohn (1995) provide detailed reviews of this literature.
[55] For example, see Baldwin (1971), Harkness & Kyle (1975), Leamer (1980), Stern & Maskus (1981) and Leamer (1984).

Harkness & Kyle (1975) critique Baldwin (1971) and argue for a multi-factor model, as opposed to the two-factor Heckscher-Ohlin model used in Leontief (1953). Using the Baldwin (1971) dataset, they employ a logit estimation technique with a binary dependent variable equal to one if an industry is a net exporter and zero if a net importer. They argue for the logit estimation technique, because in a multifactor world the HOV model can only determine the direction of trade and not the volume. Contrary to the 'Leontief paradox', they find that the US has a comparative advantage in capital-intensive manufacturing industries as well as skill-intensive industries.

Subsequent studies advance the approach by applying the cross-commodity regression approach to multiple periods in order to unpack long-term linkages between endowments and trade (Stern & Maskus, 1981; Wright, 1990). Others extend the analysis beyond the US focus. Stern (1976) and Baldwin (1979) find negative coefficients on the capital intensity variable for other capital abundant economies, such as Germany, Japan and the United Kingdom.

More recently Romalis (2004) has applied the cross-commodity regression approach to test the '*quasi-Heckscher-Ohlin*' predictions of a modified factor proportions model that he developed. The model predicts that countries constitute larger shares of world production and trade in commodities that intensively use their abundant factors. Using 1998 US import data from 123 countries across 370 4-digit SIC industries, and associated US factor intensity data from 1992, Romalis (2004) regresses each country's share of US imports for each commodity against the factor intensity associated with each commodity. The results of the regressions confirm the predictions of the model, and Romalis (2004) concludes that factor proportions appear to be an important determinant of the structure of production and international trade.

Given paradoxical results showing revealed labour abundance in capital abundant countries, studies by Leamer & Bowen (1981), Anderson (1981) and Leamer (1984), present a critique of the cross-commodity regression approach. These studies argue that the theoretical basis of this empirical approach is unclear (Leamer & Levinsohn, 1995). For instance, Leamer (1984) argues that the 'Leontief paradox' confirming result reached by Baldwin (1971) is problematic, because it is based on the false theoretical proposition that the sign pattern of the estimated coefficients are the same as the sign pattern of the excess factor supplies. Feenstra (2003:18) posits that it is not a tight test of theory, and thus states:

"…even if the U.S. was capital-abundant and the HOV Theorem held, it would still be possible for the Baldwin regression to find a negative coefficient on capital: this does not contradict the HOV Theorem, because like the original Leontief approach, it is the wrong test."

An additional consideration posed by both Leamer (1984) and Deardorff (1984), is that although the regression analysis has substantial explanatory power, the need for theory becomes apparent when posed with questions concerning the specification of the regression. For instance, what is the appropriate form of the trade variable, gross exports or net exports, scaled or unscaled? What is the appropriate form of the explanatory variables, factor shares or factor ratios?

Nevertheless, Bowen & Sveikauskas (1992) argue that in practice the theoretical concern raised above is not very important. They run cross-commodity regressions for 35 countries and compare the estimates indicating factor abundance with the actual abundance in these countries. Their results lead them to conclude that reversals in the sign patterns are unlikely to occur in practice. Furthermore, in a review of this literature, Feenstra (2003) states that using the cross-commodity regression approach as a descriptive tool to indicate how trade is related to industry factor requirements has merit, but as a test of the Heckscher-Ohlin-Vanek theorem it is inadequate.

Therefore, the cross-commodity regression approach remains a useful empirical tool and is thus employed in the analysis to follow.

4.2.2.2 Examination of the link between trade and endowments in South Africa

Existing empirical work indicates that South Africa's export structure is characterised by inter-industry trade (Isemonger, 2000; Parr, 2000; Smet, 2007; Smet, 2013). Using measures of Revealed Comparative Advantage, the Grubel-Lloyd Index, and the Marginal Grubel-Lloyd Index, these studies reveal that South Africa's export structure over the 1990s (Isemonger, 2000; Parr, 2000) and early 2000s (Smet, 2007; Smet, 2013) is one largely characterised by inter-industry trade, although with increasing levels of intra-industry trade. The importance of inter-industry trade as a driver of South Africa's trade structure validates the use of comparative-advantage based trade theory, such as the Heckscher-Ohlin model, in this chapter.

Smet (2007) advances the literature by analysing South Africa's trade structure and changing trade patterns through the middle-income country lens. He uses measures of inter- and intra-industry trade to analyse the structure and dynamics of South Africa's trade with its main trading partners, the North Atlantic Free Trade Area (NAFTA), the European Union, CHINAS (China and its territories), and Japan, over the period 1992 to 2006. Using 4-digit HS trade data, Smet (2007) argues that South Africa holds a 'middle position' between its industrialised trading partners (EU, Japan, NAFTA) and emerging economies (CHINAS) on the one hand, and its African neighbours on the other. South Africa is revealed to be competitive with respect to Africa in manufacturing, and competitive with regards to CHINAS, NAFTA and the EU in primary products – hence the 'middle position'. In light of South Africa's 'middle position', Smet (2013) develops a 3-dimension HO framework to aid the understanding of a middle-income country's trade patterns.

A further issue worth considering with respect to the South African context, is that the productive structure of the economy is found to be capital-intensive. Edwards (2001b) analyses the impact of South Africa's post-apartheid trade liberalisation episode on the structure of trade and production in South Africa. Analysing data from Input-Output tables covering 29 industrial sectors over the period 1984 to 1997, Edwards (2001b) argues that this period is characterised by structural change in production toward capital-intensive exports. Paradoxically, this finding stands in contrast to the South African economy being characterised by high levels of unemployment and an abundance of unskilled labour.

However, Edwards (2001b) notes that the extent to which trade liberalisation is responsible for this shift is limited. A variety of other factors, such as supply-side policies promoting capital-intensive sectors, and competitive problems associated with labour-intensive sectors, may be affecting production and trade.

The paradoxical capital-intensive nature of South Africa's export structure is confirmed by Alleyne & Subramanian (2001). Applying both the factor content and cross-commodity regression approaches, they analyse data for 32 non-service sectors in 1989 and 1997, in order to explore the factor content of South Africa's trade. They account for the middle-income country context by examining the factor content of South Africa's trade structure across its low-, middle-, and high-income trading partners. They find that South Africa's trade pattern reveals it to be capital abundant, and thus a net exporter of capital-intensive goods. Interestingly, this result still holds when the analysis is restricted to trade with capital abundant high-income countries. The analysis to follow examines whether this paradox is evident in South Africa's evolving export structure.

4.2.3 Gaps in the literature

In light of the discussion in this and the previous sections, key research gaps are identified: firstly, it is evident in both older studies (Baldwin, 1971; Bowen & Sveikauskas, 1992), and more recent studies (Alleyne & Subramanian, 2001; Romalis, 2004), that relatively aggregated industry-level trade data are used when estimating cross-commodity regressions. In order to account for product-level heterogeneity in export flows and factor intensities, disaggregated product-level data is required.

Secondly, it is evident that the cross-commodity regression approach is a static analysis. The structure of trade is regressed against the factor intensity associated with the production of traded goods for a given year. Using the static approach, one is unable to get a sense of what changes in a country's export structure reveal about its factor abundance.

Thirdly, the middle-income country case does not fit neatly within the developed-developing country framework put forth by endowment-driven trade models, such as the Heckscher-Ohlin model. As such, there is a scarcity of studies analysing the middle-income country case in the empirical literature.

This chapter applies the Baldwin (1971) cross-commodity regression approach in order to provide insight into the role that endowments play in driving a middle-income country's export structure and changes to this structure. The analysis benefits from the use of highly disaggregated product-level trade data and associated revealed factor intensity data. Insight into the link between a country's endowments and its evolving export structure, is gained from the application of a dynamic version of the cross-commodity regression approach.

4.3 Methodology

The section starts by introducing the static cross-commodity regression approach, or the Baldwin (1971) approach, which allows one to analyse the role that endowments play in shaping a country's export structure. This is followed by a discussion on the dynamic cross-commodity regression approach, an extension of the Baldwin (1971) approach, which allows one to analyse the role that endowments play in shaping a country's evolving export structure.

The application of which serves as an empirical contribution. The section concludes by detailing how the middle-income country context is examined through the use of both these regression approaches.

4.3.1 The static cross-commodity regression approach

The specification of the static cross-commodity regression, or the Baldwin (1971) cross-commodity regression, takes the following form:

$$T_i = \alpha_i + \beta_1 ln(rci_i) + \beta_2 ln(rhci_i) + \beta_3 ln(rnri_i) + \mu_i, \quad (4.2)$$

where the dependent variable, T_i, represents a measure of gross exports of product i scaled by world market size for product i.[56,57] The explanatory variables, rci_i, $rhci_i$, and $rnri_i$, represent the revealed physical capital, revealed human capital, and revealed natural resource intensity measures associated with the production of product i.[58] The natural logarithm of the revealed factor intensity variables is used in the estimations. The β's are the associated coefficients, and μ_i is the stochastic error term.

Consistent with the literature, the objective of the regression is to generate correlates that allow one to observe revealed factor abundance.[59] The estimated coefficient for each explanatory variable measuring the factor intensity embodied in the production of each traded product is indicative of factor abundance. For example, a positive coefficient for an explanatory variable measuring the capital per worker (rci_i) embodied in the production of various traded products, points to capital abundance. The advantage of the regression approach is that one is able to examine the linkage between exports and each factor intensity measure, while holding the others constant.

It is important to note what the cross-commodity regression approach is not doing. First, the regression approach is not used as a test of the HOV model. Rather, assuming that the HOV model holds, the estimates provide insight into what a country's trade structure reveals about

56 Leamer & Levinsohn (1995) note that simply using the absolute level of trade is problematic since some commodity groups form larger shares of total output and others smaller shares. If the scale of a commodity group is not controlled for, any explanatory variable that is correlated with the size of the commodity group will pick up the scale effect. This scale effect is typically controlled for by dividing the dependent variable by a measure of world market size.

57 To test robustness, regressions are also estimated using net exports scaled by world market size as the dependent variable.

58 To measure factor intensities, Baldwin (1971) uses factor shares, which is more consistent with the Heckscher-Ohlin model. I follow the more recent studies by Alleyne & Subramanian (2001) and Romalis (2004) that use factor ratios. Further, product-level factor intensity data is only available as factor ratios.

59 For example, see Baldwin (1971; 1979), Stern (1976), Stern & Maskus (1981) and Wright (1990).

its factor abundance. Second, this is not a causal model, but rather a descriptive tool used to indicate revealed factor abundance. Thus, one is not concerned with the broader explanatory power of the estimates.

The specification defined in equation 4.2 is adjusted to allow one to examine whether South Africa's trade structure has changed over time. This is achieved by pooling the data for the initial and end periods and controlling for year with interaction effects. This specification takes the following form:

$$\begin{aligned} T_{it} = \alpha_i + \beta_1 ln(rci_{i,t}) + \beta_2 ln(rhci_{i,t}) + \beta_3 ln(rnri_{i,t}) \\ + \beta_4 (ln(rci_{i,t}) \times time_{t+1}) + \beta_5 (ln(rhci_{i,t}) \times time_{t+1}) \\ + \beta_6 (ln(rnri_{i,t}) \times time_{t+1}) + \mu_{it} \end{aligned} \quad (4.3)$$

where each of the factor intensity measures is interacted with the end period dummy variable, $time_{t+1}$. The initial period is the base category, t. In the estimations, the initial and end periods are defined as 1995 and 2012, respectively. The statistical significance of the coefficient estimates for the interaction terms indicate whether there has been a change in trade structure. Wald tests are performed to test for joint statistical significance of the interaction terms.

In the preferred specification, the initial period values (1995) for the revealed factor intensity measures are employed in the regressions. This allows one to analyse the structure of trade while holding factor intensities constant over time. The rationale for such approach is as follows: First, the regressions are concerned with the correlations between the factor intensities and trade. If both are moving, then it is hard to determine what is driving the results. Second, the variables are not interdependent since the revealed factor intensities are generated using international trade data, which suggests that changes in South Africa's trade may influence subsequent factor intensity measures.[60] However, given the concern that revealed factor intensities may change drastically over time, the robustness of the estimates are tested by running the regressions using alternative variations of these measures. These include taking the mean revealed factor intensities for the three initial period years (1995, 1996 and 1997), and the mean for the initial and end period years (1995 and 2007).

Consistent with the literature, the various regressions are estimated using the ordinary least squares estimator (Baldwin, 1971; Alleyne & Subramanian, 2001).

60 Details concerning the generation of the revealed factor intensity measures are provided in Appendix B.3.

4.3.2 The dynamic cross-commodity regression approach

This chapter extends the Baldwin (1971) approach by applying a dynamic version of the cross-commodity regression approach. The dynamic approach provides insight into the role that endowments play in shaping a country's evolving export structure. Apart from the specification of the dependent variable, the specification of the dynamic cross commodity regression is identical to that shown in equation 4.2. To provide insight into South Africa's evolving export structure, focus is placed on the extensive margin, and thus an alternative measurement of the dependent variable is used. The trade variable, T_i, is a count of all new product-destination combinations within product category i.

The dynamic cross-commodity regression shifts away from a value measure of trade toward a count measure. The use of count data is partly motivated by empirical difficulties relating to the scaling of the dependent variable. Leamer & Levinsohn (1995) state that if the scale of a product is not controlled for, any explanatory variable that is correlated with the size of the product will pick up the scale effect. The scale effect is controlled for by dividing the dependent variable by a measure of world market size (Deardorff, 1984; Leamer & Levinsohn, 1995).

However, certain problems arise when scaling measures of export growth along the extensive margin. First, if one is interested in the dynamics of export patterns, then one would scale by the change in world export growth by commodity. The problem is that the dependent variable for each commodity could indicate the following four scenarios: growth in a growing world market, growth in a declining world market, declining growth in a growing world market, and declining growth in a declining world market. Given this, it is unclear what the signs of the estimated coefficients imply about relative factor abundance. Second, even after scaling by world market size, it seems that the scale effects still influence the results. If one examines the distribution of the value data for extensive margin growth, there is a long right tail, with a small number of products experiencing high absolute levels of growth, and a large number of products experiencing relatively low absolute levels of growth. This distribution persists after scaling. Given these problems with scaling the extensive margin, this chapter uses count data to measure the extensive margin.[61]

[61] This is also consistent with other studies that have used count data to measure the extensive margin, such as Cadot et al. (2011) and Klinger & Lederman (2011).

Since the dependent variable is a count variable, the Poisson Pseudo-Maximum Likelihood (PPML) estimation technique is employed. Separate estimations are run for the entry and exit of product-destination combinations, and thus capture export growth dynamics into and out of export markets.

4.3.3 Exploring the middle-income country context

To analyse whether South Africa occupies a 'middle position', and thus whether relative endowments shape its export structure across trading partners, a destination dimension is incorporated into the regressions. As opposed to being specified individually, destinations are grouped. They are grouped according to the World Bank income classification, which acts, although imperfectly, as a proxy for factor abundance.[62] Destinations are grouped into low-, middle-, and high-income categories.[63] Applying the static cross-commodity regression approach, the specification takes the following form:

$$
\begin{aligned}
T_i = \alpha_i &+ \beta_1 \text{low} + \beta_2 \text{middle} + \beta_3 ln(rci_i) + \beta_4 ln(rhci_i) + \beta_5 ln(rnri_i) \\
&+ \beta_6 (ln(rci_i) \times low) + \beta_7 (ln(rhci_i) \times low) \\
&+ \beta_8 (ln(rnri_i) \times \ low) \beta_6 (ln(rci_i) \times middle) \\
&+ \beta_7 (ln(rhci_i) \times middle) + \beta_8 (ln(rnri_i) \times middle) + \mu_i
\end{aligned}
\tag{4.4}
$$

where each of the factor intensity measures is interacted with the low- and middle-income country dummy variables. The high-income group is the base category. The statistical significance of the coefficient estimates for the interaction terms indicate whether there is a statistically significant difference in the structure of trade between the country groupings. Wald tests are performed to test for joint statistical significance of the interaction terms. The dependent variable captures the value of gross exports of product i scaled by world market size for product i, by country grouping.

An analogous specification is applied for the dynamic cross-commodity regression. Again, in the case of the static cross-commodity regression, the ordinary least squares estimator is employed, while in the case of the dynamic cross-commodity regression the Poisson Pseudo-Maximum Likelihood (PPML) estimation technique is employed.

[62] While physical and human capital abundance increase with income levels, the link between natural resource abundance and income is less clear. Further insight into factor abundance by county income grouping and South Africa's relative factor abundance is provided in Section 3.5.1.

[63] The lower and upper middle-income categories are merged.

One potential concern is the presence of non-OECD countries in the high-income country grouping. This concern stems from the notion that these countries are predominantly oil-rich countries, such as Saudi Arabia, Qatar and the United Arab Emirates, and that their income levels are driven by oil revenues. As such, their endowment structure, with respect to human capital, physical capital and natural resources, may differ substantially from that of other high-income countries. To the extent that endowments shape trade patterns, this would alter South Africa's trade structure with these countries in relation to other high-income countries, which in turn influences the estimates in the cross-commodity regressions.

To address this concern, the regressions specified in the sub-sections above are estimated with two further specifications of the high-income country grouping. The baseline regressions reported in Section 4.5 pool the OECD and non-OECD countries within the high-income group. Additional estimations, reported in the Appendix, include estimations for, firstly, a high-income group that excludes non-OECD countries, and secondly, a high-income group that excludes natural resource-rich countries.[64]

4.4 Data

This section details the two datasets employed: firstly, product-level trade data, and secondly, revealed factor intensity data.

4.4.1 Product-level trade data[65]

The trade data are obtained from the UN COMTRADE database.[66] This chapter employs South African export and import data at the 6-digit level of the HS classification for the period 1995 to 2012. The 1988/1992 revision of the HS6 classification is employed for two reasons: firstly, it allows for a consistent set of product categories to be analysed over the longest possible period of time. Secondly, it maps easily with the revealed factor intensity data, which is provided by UNCTAD in the same revision of the HS nomenclature.

The 6-digit level of the HS classification is highly disaggregated, comprising 5 017 product categories. Over the period of analysis, South Africa exports between 4 375 and 4 739 products.

[64] Defining a country as natural resource-rich is based on the World Bank definition, which states that a country is rich in natural resources if natural resource rents as a share of GDP exceeds 5 percent. Data from the World Bank Development Indicators is used to apply this definition and thus identify natural resource-rich countries within the high-income grouping (World Bank, 2019a).

[65] A detailed explanation of the construction and cleaning of the dataset is provided in Appendix B.1 and Appendix A.2.

[66] Available on the World Integrated Trade Solutions (WITS) database (http://wits.worldbank.org/wits/)

The COMTRADE data details the destination for each product-level export flow, which allows for the calculation of a detailed product-destination measure of the extensive margin. A further benefit of using product-level trade data is that it allows one to control for the product heterogeneity present in trade flows. Therefore, the analysis in this chapter benefits from the rich detail contained in product-level trade data.

4.4.2 Revealed factor intensity data[67]

A key contribution of the empirical analysis is the use of product-level factor intensities as opposed to the industry-level intensities used in other studies. The product-level factor intensity data are developed by Shirotori, Tumurchudur & Cadot (2010), and can be obtained from the UNCTAD Revealed Factor Intensity Database.[68] The revealed factor intensity data are provided at the HS 6-digit level, 1988/1992 revision, for the period 1988 to 2007. The database contains three indices of revealed factor intensity, namely, revealed physical capital intensity index, revealed human capital intensity index, and revealed natural resource intensity index, for each product. These indices measure average years of schooling per worker, physical capital per worker, and arable land per worker, respectively.

It is important to note that the revealed factor intensity indices are indirect measures, and not actual factor intensity data extracted from country input-output tables. The revealed factor intensity measures are constructed from a combination of country-level factor endowment data and product-level export data. These indices are constructed using the same method applied by Hausmann et al. (2007), when calculating the revealed technology content of traded products (i.e. PRODY). The revealed physical capital intensity, human capital intensity, and natural resource intensity of a product is measured as the weighted average of the physical capital, human capital, and natural resource abundance of countries that export the product, respectively, where the weights are the exporters' RCA indices for that product.[69]

The intuition behind the measure is that a product exported by countries that are capital abundant, is produced in a capital-intensive manner. For instance, if a product is typically exported by Germany and Japan, production of that product is revealed to be capital-intensive. Conversely, if a product is typically exported by Vietnam and Lesotho, production of that

[67] A description of the database treatment for the revealed factor intensity data is provided in Appendix B.2.
[68] Available on the UNCTAD website (http://www.unctad.info/en/Trade-Analysis-Branch/Data-And-Statistics/Other-Databases/).
[69] A detailed explanation on the coverage and construction of the revealed factor intensity indices is presented in Appendix B.3.

product is revealed to be labour-intensive. Herein lies a key advantage to using the revealed factor intensity data as opposed to industry data. The revealed factor intensity indices are generated using cross-country data, and thus these measures abstract from the domestic distortions specific to industries within a country.

These product-level measures also allow for a more thorough and precise analysis, since they account for the substantial product heterogeneity. Testing the Heckscher-Ohlin model, Schott (2003) critiques the use of industry-level data. He argues that trade classification nomenclature does not aggregate products into industry categories according to factor intensity groupings. He thus shows that within aggregate industry categories there is substantial variation in factor intensity and posits that this is a result of intra-industry product heterogeneity.

This intra-industry product heterogeneity is evident in the data employed in this chapter. For example, when looking at the product-level (HS6) revealed capital intensity indices within the *Textiles* Standard Industrial Classification (SIC) industry grouping, the mean revealed capital intensity for the 497 products within this grouping is US $62 639 of capital stock per worker, with a standard deviation of US $33 503. The minimum revealed capital intensity value is US $4 405 for *Multiple folded or cabled yarn of jute*, and the maximum is US $168 098 for *Bolting cloth*. Within Basic Chemicals, the mean revealed capital intensity for the 573 products within this grouping is US $98 668 of capital stock per worker, with a standard deviation of US $33 413. The minimum revealed capital intensity value is US $7 828 for *Wattle extract*, and the maximum is US $182 350 for *1-cyanoguanidine (dicyandiamide)*.

Therefore, the use of aggregate industry-level data, such as that used in Alleyne & Subramanian (2001), masks substantial product-level variation in factor intensities. In using product-level factor intensity measures, this chapter is able to account for this product heterogeneity.

4.5 Results

This section starts by providing a description of South Africa's relative endowment structure, which informs the analyses of the static and dynamic cross-commodity regressions that follow. The section concludes by examining the estimates for the static and dynamic cross-commodity regressions, when estimated by country group.

4.5.1 South Africa's relative endowment structure

This section characterises South Africa's relative endowment structure. It thus provides a reference point for the cross-commodity regression analysis to follow. The regression analysis allows one to observe what a country's trade structure reveals about its endowments. It is thus important to detail South Africa's endowment structure before examining what its trade structure reveals about its endowments. In the literature it is claimed that South Africa is natural resource and unskilled labour abundant (Alleyne & Subramanian, 2001; Edwards & Lawrence, 2008; Hausmann & Klinger, 2008; Smet, 2013). This section discusses this claim in context of the cross-commodity regression analysis to follow.

Using endowment data from Shirotori, Tumurchudur & Cadot (2010), the analysis below plots the cross-country distribution of each of the three endowment measures – physical capital per worker, human capital per worker, and land per worker – and positions South Africa within each distribution, for the period 1995.[70] In each of the kernel density plots, South Africa's endowment level is represented by a dashed vertical line. One is thus able to pinpoint South Africa's factor abundance in relation to other sets of countries. Countries are grouped according to income-level, as this provides insight into South Africa occupying a 'middle position' in relation to other economies.

South Africa's physical capital endowment positions it as capital and labour abundant relative to low- and high-income countries, respectively. In Figure 4.1, South Africa's physical capital endowment (10.1 log points or $24,822 per worker) lies above the mean for low-income economies (8.1 log points or $4,140 per worker) and below the mean for high-income economies (11.6 log points or $121,811 per worker). Further, this endowment level for physical capital lies above that for all low-income economies and below that of all high-income economies. South Africa fits within the middle-income space, with its physical capital

[70] Given earlier mentioned motivations for using initial period endowment measures, this section uses data for the year 1995. It is worth stating that the same endowment patterns were observed when using the most recent period, 2007.

endowment almost equal to the mean for the middle-income group (10.0 log points or $29,422 per worker). It is thus difficult to determine South Africa's relative factor abundance in relation to this country grouping.

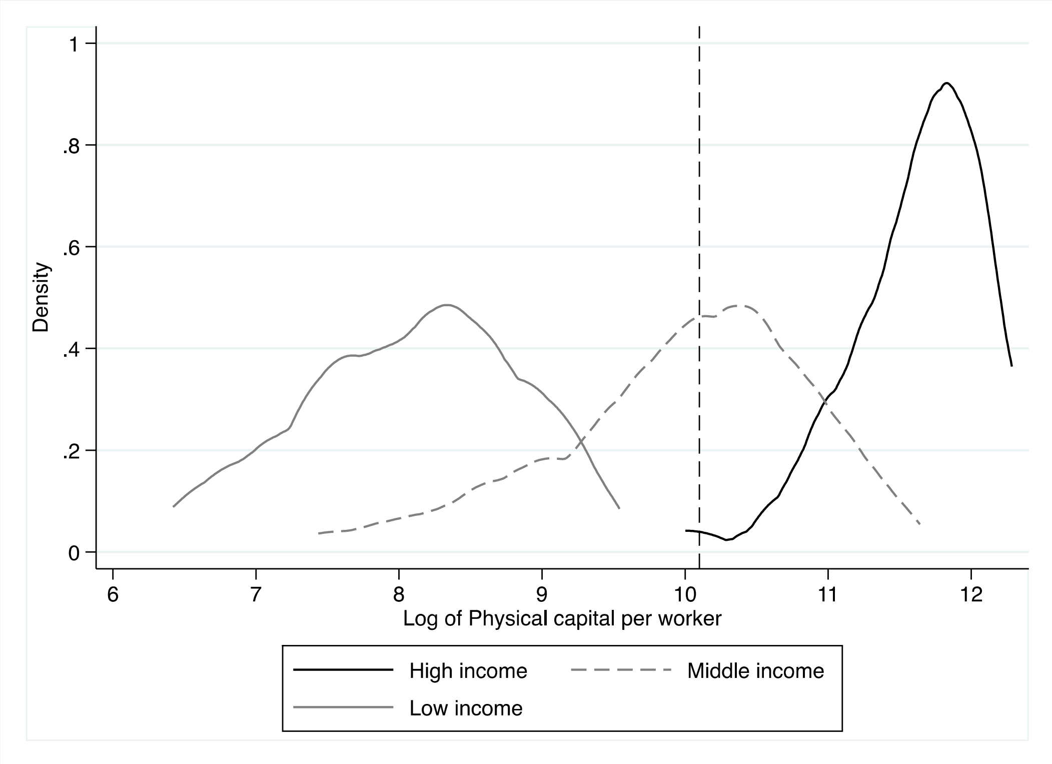

Figure 4.1: Kernel density for natural log of physical capital per worker by income group, 1995

Source: Own calculations using UNCTAD Revealed Factor Intensity and Endowment data (Shirotori, Tumurchudur & Cadot, 2010).
Notes: 1. Physical capital stock per worker defined in real US dollar terms. 2 Middle-income is comprised of lower and upper middle-income. 3. South Africa's endowment level represented by vertical dashed line.

With respect to human capital endowment, South Africa's relative endowment is less clear as there is a high degree of overlay across the distributions. In relation to low-income economies, it is evident in Figure 4.2 that South Africa's human capital endowment (8.1 years of schooling) lies above that for the majority of low-income economies (mean human capital per worker of 3.6) and is thus human capital abundant in relation to this group of countries. However, with respect to middle- and high-income economies, South Africa's relative human capital endowment is less clear. In relation to middle-income economies (mean human capital per worker of 6.0) South Africa lies at the top end of the distribution, while concurrently being positioned at the bottom of the high-income distribution (mean human capital per worker of 9.1).

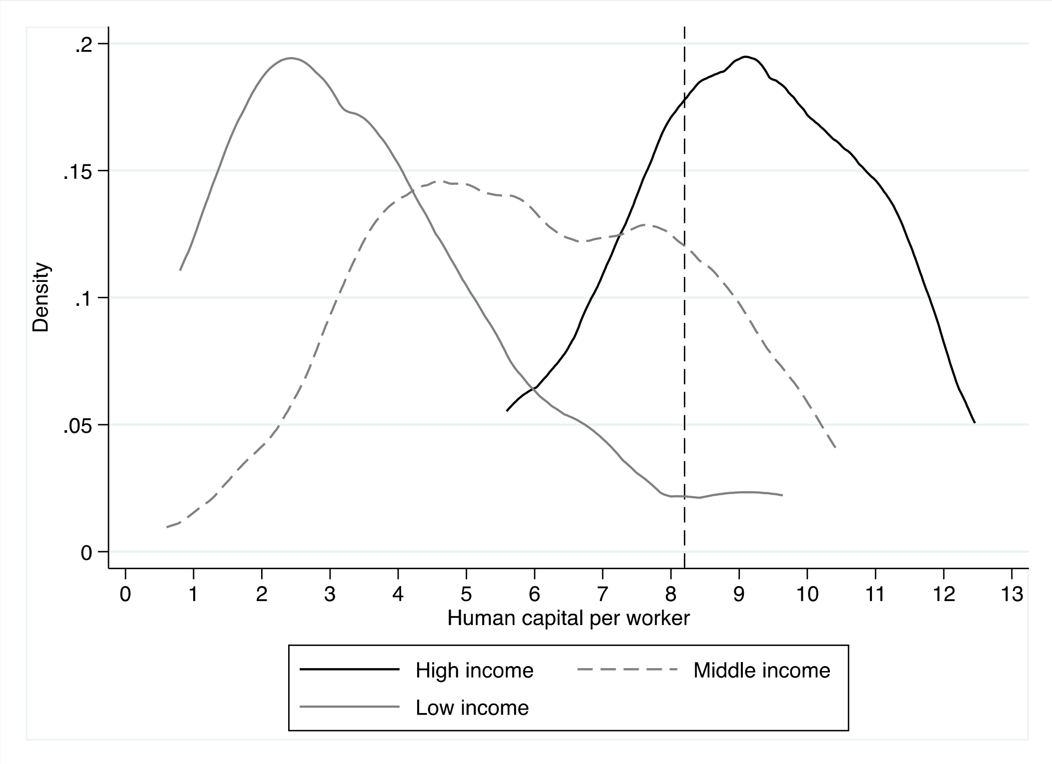

Figure 4.2: Kernel density for human capital per worker by income group, 1995

Source: Own calculations using UNCTAD Revealed Factor Intensity and Endowment data (Shirotori, Tumurchudur & Cadot, 2010).
Notes: 1. Human capital measured as average years of schooling. 2. Middle-income is comprised of lower and upper middle-income. 3. South Africa's endowment level represented by vertical dashed line.

South Africa's natural resource endowment – measured as arable land per worker – locates it as natural resource abundant relative to most countries. In Figure 4.3 it is evident that South Africa's natural resource endowment (1100 hectares per worker) lies above the mean endowment for low (760 hectares per worker), middle (760 hectares per worker) and high-income (596 hectares per worker) countries. Consistent with similar mean natural resource endowment levels across the three country groupings, the bulk share of countries are clustered toward the lower-end of the distribution, with outliers present across all three groupings. There is no clear discernible link between natural resource endowment levels and income in Figure 4.3.[71]

[71] However, Shirotori, Tumurchudur & Cadot (2010) show, using a variety of natural capital measures, that per capita natural resource endowment levels rise with income levels.

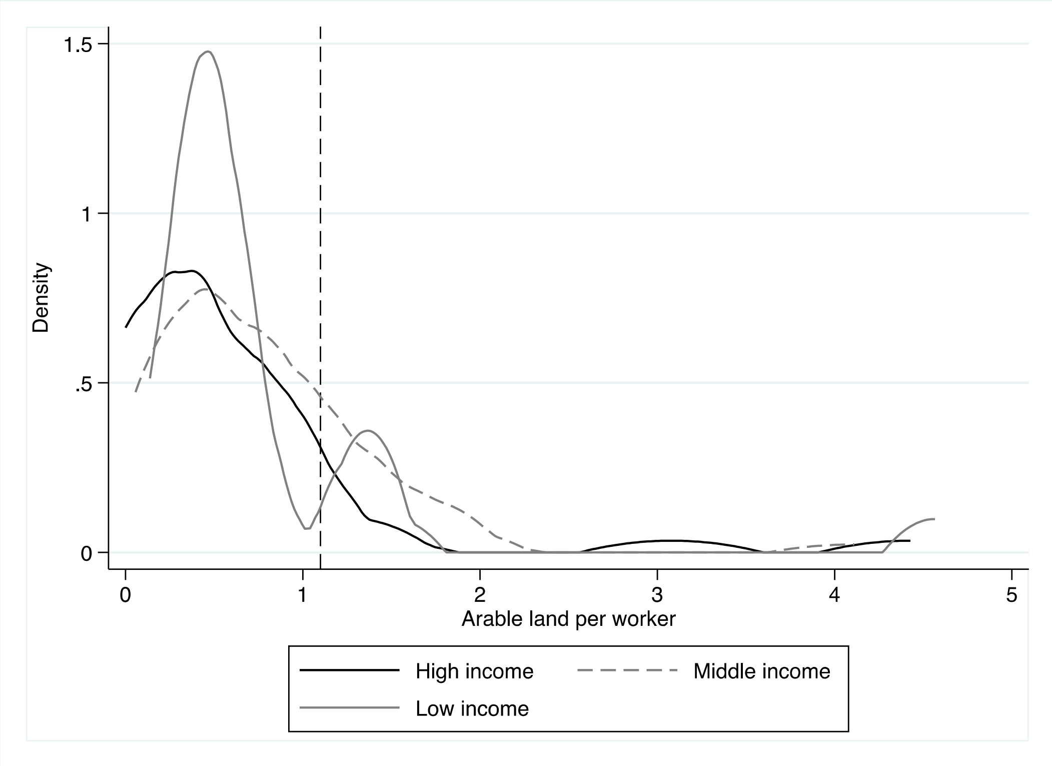

Figure 4.3: Kernel density for arable land per worker by income group, 1995

Source: Own calculations using UNCTAD Revealed Factor Intensity and Endowment data (Shirotori, Tumurchudur & Cadot, 2010).
Notes: 1. Natural resource endowment measured as arable land per worker (1000s hectares per worker). 2. Middle-income is comprised of lower and upper middle-income. 3. South Africa's endowment level represented by vertical dashed line.

The cross-commodity regression analysis to follow shows what South Africa's trade structure reveals about its relative endowments. The discussion above, detailing South Africa's relative endowment structure, provides a basis for analysing the regression results. Consistent with the literature, South Africa's relative endowment levels indicate that it is natural resource abundant in relation to the majority of countries across income groups. As one would expect, it is capital abundant in relation to low-income countries and labour abundant in relation to high-income countries. However, contrary to the literatures claim of unskilled labour abundance, the human capital endowment measure provides a less clearly defined picture, with human capital abundance in relation to low-income countries, but a mixed picture in relation to middle- and high-income countries.

4.5.2 Econometric analysis: Static and dynamic cross-commodity regressions

This section provides an analysis of the results from the static and dynamic cross-commodity regressions.

4.5.2.1 Static cross-commodity regression

The static cross-commodity regression estimates show how endowments shape South Africa's export structure. Since the methodological approach applied in Alleyne & Subramanian (2001) is similar to that applied in this chapter, their estimates act as a reference point. There are two key differences between their analysis and the analysis in this chapter: firstly, they perform an industry-level analysis (45 industry sectors), whereas this chapter provides a product-level analysis (4611 products). As such, the analysis in this chapter accounts for product-level heterogeneity within broad industry groupings. Secondly, their factor intensity measures are derived from industry data and are thus subject to domestic distortions specific to industries within South Africa. The revealed factor intensity indices are based on cross-country data and thus reflect a global production function.

Simple correlations between gross exports and each of the revealed factor intensity variables, align with what one would expect given South Africa's endowment structure. South Africa is labour, unskilled labour, and natural resource abundant, and thus it is expected that export values are likely to be higher for products that intensively use these factor endowments. The coefficient estimates in columns (1) to (3) of Table 4.1 confirm this. Higher gross export levels are associated with products characterised by lower levels of revealed human capital intensity, lower levels of revealed physical capital intensity, and higher levels of revealed natural resource intensity. However, this pattern changes once one shifts from simple correlations to the cross-commodity regressions, where all the revealed factor intensities are controlled for in the estimations.

South Africa is revealed through its trade to be natural resource abundant. The estimated coefficient for revealed natural resource intensity presented in column (4) of Table 4.1 is positive and statistically significant. Given the evidence pointing to South Africa's natural resource abundance presented in Section 4.5.1, this result is expected. It stands in contrast to estimates in Alleyne & Subramanian (2001), where the natural resource intensity control is not statistically significant.

Table 4.1: Static cross-commodity regression estimates

	(1)	(2)	(3)	(4)	(5)
Log of Revealed human capital intensity	-0.005**			0.029***	0.034***
	[0.002]			[0.006]	[0.009]
Log of Revealed natural resource intensity		0.015***		0.013***	0.014***
		[0.002]		[0.001]	[0.002]
Log of Revealed physical capital intensity			-0.006***	-0.016***	-0.018***
			[0.001]	[0.003]	[0.004]
Log of Revealed human capital intensity * 2012					-0.010
					[0.012]
Log of Revealed natural resource intensity * 2012					-0.001
					[0.003]
Log of Revealed physical capital intensity * 2012					0.005
					[0.005]
Constant	0.018***	-0.085***	0.079***	0.044***	0.055**
	[0.004]	[0.009]	[0.011]	[0.016]	[0.023]
Observations	9,448	9,448	9,448	9,448	9,448
R-squared	0.001	0.021	0.010	0.039	0.040

Source: Own calculations using UN Comtrade data and UNCTAD Revealed Factor Intensity data (Shirotori et al., 2010).
Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Dependent variable is the value of gross exports for each HS 6-digit product scaled by world exports of each product. 4. The 1995 values for the revealed factor intensity measures are employed. 5. Initial (1995) and end (2012) period data are pooled in the estimations. 6. Columns (1) to (3) represent correlations between each of the explanatory variables and gross exports. The OLS estimates for the cross-commodity regression are reported in column (4). Column (5) includes a set of interactions between each of the revealed factor intensity variables and the final period (2012). The reference period is the initial period (1995) and the reference period dummy (not reported) is not statistically significant.

South Africa is paradoxically revealed through its trade to be skill abundant. This stands in contrast to the findings in Alleyne & Subramanian (2001) that reveal South Africa to be unskilled labour abundant.[72] The positive and statistically significant coefficient for revealed human capital intensity, presented in column (4) of Table 4.1, indicates that products requiring labour inputs with higher levels of human capital tend to have higher gross export values. This result, using disaggregated product-level data, is consistent with Edwards (2001a), who paradoxically finds that despite South Africa being abundant in unskilled labour, manufacturing firms have become increasingly skill-intensive.

Consistent with South Africa's endowment structure being characterised as labour abundant, the regression estimates indicate that South Africa is revealed through its trade to be labour abundant. The coefficient estimate for the revealed physical capital intensity variable presented in column (4) of Table 4.1, is negative and statistically significant. Products associated with higher capital to labour ratios tend to have lower gross export levels. This result is at odds with

[72] Alleyne & Subramanian (2001) find that the higher the skilled-to-unskilled labour ratio associated with production in an industry, the lower the probability of South Africa being a net exporter of commodities from that industry.

Alleyne & Subramanian (2001), who paradoxically find that South Africa's trade pattern reveals it to be capital abundant.[73]

In terms of structural change over time, the estimated coefficients for the interaction terms in column (5) of Table 4.1 point to no major change over the period 1995 to 2012. The coefficient estimates for the variables interacting each of the revealed factor intensities with the final period are not statistically significant.[74] This suggests that shifts in exports along the extensive margin is occurring within the existing export structure. This is not surprising since the major share of extensive margin growth is occurring along the destination dimension, with little occurring along the product dimension. This is explored further in the dynamic cross-commodity regressions.

The coefficient estimate for the revealed human capital intensity variable may be driven by an underlying relationship between revealed physical capital intensity and revealed human capital intensity. This is evident in the following: firstly, the pairwise correlation value between revealed physical capital intensity and revealed human capital intensity is 0.85. Secondly, by iteratively including the revealed factor intensity variables into the regression equation, one is able to further unpack the relationships between these variables. In Table 4.2 it is evident that the estimated coefficient for revealed human capital intensity is negative and statistically significant when the regression does not control for revealed physical capital intensity, but then becomes positive and statistically significant when the revealed physical capital intensity variable is included in the estimation.[75]

These results are picking out the effect of omitted variable bias. The pairwise correlation indicates that there is a strong positive correlation between revealed physical capital intensity and revealed human capital intensity. When estimating the cross-commodity regression, the exclusion of the physical capital intensity measure results in a downward bias of the coefficient estimate for the human capital intensity measure.

[73] It is argued in Alleyne & Subramanian (2001) that the estimate for capital intensity may be affected by the inclusion or exclusion of the natural resource intensity control, because resource-based industries tend to be capital-intensive. Exploring this avenue, it was found that the coefficient for revealed physical capital intensity remains negative and statistically significant irrespective of the inclusion of the revealed natural resource intensity measure.

[74] The Wald test was used to test for joint statistical significance of the three interaction terms. Testing the null hypothesis that the three interaction terms are jointly equal to zero, the Wald test results ($F(3,9440) = 0.32$; $Prob > F = 0.8082$), indicate that the null hypothesis cannot be rejected.

[75] This pattern is robust to the measure of dependent variable employed (i.e. gross and net exports).

Table 4.2: Static cross-commodity regression estimates using an iterative approach

	(1)	(2)	(3)
Log of Revealed human capital intensity	-0.005**	-0.006***	0.029***
	[0.002]	[0.002]	[0.006]
Log of Revealed natural resource intensity		0.015***	0.013***
		[0.002]	[0.001]
Log of Revealed physical capital intensity			-0.016***
			[0.003]
Constant	0.018***	-0.074***	0.044***
	[0.004]	[0.010]	[0.016]
Observations	9,448	9,448	9,448
R-squared	0.001	0.022	0.039

Source: Own calculations using UN Comtrade data and UNCTAD Revealed Factor Intensity data (Shirotori et al., 2010). Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Dependent variable is the value of gross exports for each HS 6-digit product scaled by world exports of each product. 4. The 1995 values for the revealed factor intensity measures are employed. 5. Initial (1995) and end (2012) period data pooled in the estimations.

These results pertaining to human capital intensity, while controlling for physical capital intensity, indicate that South Africa specialises in a skill-intensive subset of labour-intensive products. This conclusion is supported by the results in Chapter 3. These results show a decreasing share of exports in low-technology manufactures, characterised by unskilled labour intensity and low-wages. They also show a rising share of exports in medium-technology manufactures, characterised by greater skill-intensity. This export pattern aligns with the middle-income country context, where a middle-income country is competed out of unskilled labour-intensive products by low-wage economies, and thus has to shift emphasis toward skill-intensive products. This does motivate for running these estimations by country grouping in order to further unpack the middle-income country story.

4.5.2.2 Testing the robustness of the static cross-commodity regression estimates

To motivate for the robustness of the static cross-commodity regression estimates, the following checks are carried out: firstly, the regressions are estimated for the manufacturing subset of products. Secondly, the regressions are estimated with the dependent variable being specified as net exports.

One concern with the estimates, particularly those pertaining to the revealed human capital intensity variable, is that they may be biased by trade distortions arising from agricultural subsidies in human capital abundant developed countries. The subsidies may result in developed countries having a revealed comparative advantage (RCA) in agricultural goods, which may bias both the revealed physical capital and human capital intensity indices upwards for these products.[76] Shirotori et al. (2011) note this issue, and when generating the dataset, they eliminate observations where RCAs are obviously driven by policy. Nevertheless, when ranking the top twenty products by revealed human capital intensity, a small number of these products were agricultural products. Therefore, in order to ensure that the results are not being affected by any possible bias associated with agricultural products, the regressions are estimated for the manufacturing subset of products.

A second concerns relates to the specification of the dependent variable. The Heckscher-Ohlin model bases its predictions on the factor content of net exports. Although this chapter is not testing the Heckscher-Ohlin model, to further substantiate the results, the cross-commodity regression is estimated using net exports by product i as the dependent variable. These regressions are run for both the full sample of products and the manufacturing subset.

Regardless of whether one restricts the sample to manufacturing products or employs net exports as the dependent variable, the estimates in Table 4.3 are consistent with those discussed earlier. The static cross-commodity regressions are also estimated with alternative specifications of the revealed factor intensity measures, and different samples of the high-income country group. The estimates for these regressions are consistent with those reported in Table 4.1.[77]

[76] See Appendix B.3 for details on the construction of the revealed factor intensity indices.

[77] As detailed in Section 4.3.1, the regressions are estimated using two additional specifications of the revealed factor intensity variables: first, the mean revealed factor intensities for the three initial period years (1995, 1996 and 1997), and second, the mean for the initial and end period years (1995 and 2007). As detailed in Section 4.3.3, the regressions are also estimated where the destination country sample is adjusted by, firstly, excluding high-income non-OECD countries, and secondly, excluding high-income natural resource abundant countries. These estimates are reported in Table B. 1 in Appendix B. The estimates are robust to these alternative specifications.

Table 4.3: Static cross-commodity regression using net exports as the dependent variable and estimates for the manufacturing sub-set of products

	Gross Exports		Net Exports			
	Manufacturing		Total		Manufacturing	
	(1)	(2)	(3)	(4)	(5)	(6)
Log of Revealed human capital intensity	0.018***	0.024***	0.033***	0.040***	0.022***	0.030**
	[0.007]	[0.009]	[0.007]	[0.010]	[0.008]	[0.012]
Log of Revealed natural resource intensity	0.013***	0.014***	0.012***	0.013***	0.012***	0.013***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]
Log of Revealed physical capital intensity	-0.013***	-0.016***	-0.017***	-0.020***	-0.015***	-0.018***
	[0.003]	[0.004]	[0.003]	[0.004]	[0.003]	[0.004]
Log of Revealed human capital intensity * 2012		-0.014		-0.014		-0.017
		[0.013]		[0.014]		[0.015]
Log of Revealed natural resource intensity * 2012		-0.002		-0.002		-0.003
		[0.003]		[0.003]		[0.004]
Log of Revealed physical capital intensity * 2012		0.006		0.006		0.008
		[0.005]		[0.005]		[0.006]
Constant	0.030	0.043	0.052***	0.064**	0.043**	0.060*
	[0.018]	[0.027]	[0.018]	[0.026]	[0.021]	[0.031]
Observations	8,066	8,066	9,448	9,448	8,066	8,066
R-squared	0.036	0.037	0.033	0.034	0.028	0.029

Source: Own calculations using UN Comtrade data and UNCTAD Revealed Factor Intensity data (Shirotori et al., 2010).

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. In columns (1) and (2), the dependent variable is the value of gross exports for each HS 6-digit product scaled by world exports of each product. In columns (3) to (6), the dependent variable is the value of net exports for each HS 6-digit product scaled by world exports of each product. 4. The 1995 values for the revealed factor intensity measures are employed. 5. Initial (1995) and end (2012) period data are pooled in the estimations. 6. Columns (2), (4) and (6) include a set of interactions between each of the revealed factor intensity variables and the final period (2012). The reference period is the initial period (1995), and the reference period dummy (not reported) is not statistically significant.

4.5.2.3 Dynamic cross-commodity regression

Shifting the cross-commodity regression analysis to a dynamic analysis allows one to examine whether endowments play a role in shaping South Africa's evolving export structure. Assuming the HOV model holds, one can hypothesise that export growth, particularly extensive margin growth, is greater in products that intensively use South Africa's abundant factor.

Table 4.4 presents the results for the dynamic cross-commodity regression. In columns (1) and (2), the dependent variable measures a count of entry into new export markets and exit out of old export markets, by HS product, respectively.

It is worth noting that the variation in the extensive margin measured in the entry and exit of production-destinations by product, is primarily capturing geographic diversification. There are two reasons for this: firstly, referring back to Chapter 3, it is evident that the majority of extensive margin growth is occurring along the destination margin, and that entry into new product markets is minimal and concentrated in one product. Secondly, even in the case of the product extensive margin, entry into new products is occurring in new destinations for that product.

Despite labour abundance, South Africa's evolving export structure is being driven by growth in capital-intensive products. The positive and statistically significant coefficient for the revealed physical capital intensity variable in column (1) of Table 4.4, reveals that extensive margin growth, in terms of entry into new markets, is occurring in products characterised as capital-intensive. Finding a similar paradoxical trend, Edwards (2001b) asserts that this increasing capital intensity in production is driven by supply-side policies and labour market constraints.

Consistent with South Africa's natural resource abundance, its evolving export structure is being driven by growth in natural resource-intensive products. This is supported by the positive and statistically significant coefficient estimate for the *Entry* specification in column (1). The positive and statistically significant coefficient estimates for the *Entry* and *Exit* specifications reported in columns (1) and (2), respectively, point to churning. This indicates that the export dynamics of resource-intensive products is characterised by entry into new export markets and exit out of old export markets. Given that the variation along the extensive margin is driven primarily by geographic diversification, this shows that exporters of resource-intensive products are shifting from old to new geographic markets. The estimates for the dynamic cross-commodity regressions by income group, discussed in the next section, provide further insight into this pattern of churning.

Table 4.4: Dynamic cross-commodity regression estimates, 1995 to 2012

	Entry (1)	Exit (2)
Log of Revealed human capital intensity	0.008	0.060
	[0.118]	[0.115]
Log of Revealed natural resource intensity	0.174***	0.233***
	[0.037]	[0.040]
Log of Revealed physical capital intensity	0.229***	0.004
	[0.045]	[0.046]
Constant	-1.488***	-0.358
	[0.450]	[0.450]
Observations	4,837	4,837
R-squared	0.017	0.005

Source: Own calculations using UN Comtrade data and UNCTAD Revealed Factor Intensity data (Shirotori et al., 2010). Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. The dependent variable for each specification in columns (1) and (2), is a count measure of entry into new product-destination combinations, and exit out of old product-destination combinations, by HS product, respectively. 4. The 1995 values of the revealed factor intensity measures are employed. 5. A cut-off value of US $1,000 is applied in order to remove the noise from very small exports and measurement error. 6. Regressions estimated using the poisson pseudo maximum likelihood estimator.

Across the two specifications, the estimates for revealed human capital intensity are not statistically significant. The interpretation is that there is no statistically significant link between South Africa's evolving export structure – measured along the extensive margin – and the human-capital intensity of production associated with the products driving this growth.

The dynamic cross-commodity regression estimates advance the notion that endowments play a role in shaping South Africa's evolving export structure.[78] South Africa's natural resource abundance drives both the composition of its export structure, which Chapter 3 shows to be concentrated in resource-based products, and the evolving composition of its export structure. Consistent with Edwards (2001b), South Africa's evolving export structure is driven by the entry into new export markets associated with capital-intensive products. This pattern affirms the claim made by Cadot et al. (2011), that as middle-income economies progress to higher

78 The dynamic cross-commodity regressions are also estimated using alternative specifications of the revealed factor intensity measures and alternative specifications of the high-income country grouping. These estimates are reported in Table B. 2 in Appendix B. Consistent with the preferred method of using the initial period revealed factor intensity measures, the same general pattern of entry in capital-intensive products and churning of natural resource-intensive products is observed across the different specifications. There is some noise when measuring the revealed factor intensity measures using the mean of the initial and end period. The coefficient estimates for the revealed human capital intensity variable in the entry specification remain positive but become statistically significant. This aligns with the initial concern of allowing the factor intensity measures to fluctuate.

levels of economic development, they accumulate capital and produce an increasing variety of capital-intensive products. The next section considers the middle-income context in more detail, by examining whether the linkages between South Africa's evolving export structure and endowments varies by trading partner.

4.5.3 The middle-income country context

This section investigates whether a middle-income country, such as South Africa, occupies a 'middle position', where the composition of its exports across trading partners is a function of its relative factor endowments. As detailed in Section 4.3.3, this is enabled through the inclusion of interaction terms, which interact the revealed factor intensity variables with income group dummies.[79] This is applied in both the static and dynamic cross-commodity regressions, which are reported in Table 4.5 and Table 4.6, respectively.

4.5.3.1 Static cross-commodity regression

South Africa occupies a 'middle position' between advanced high-income economies on the one side and developing low- and middle-income economies on the other. This is evident across the three sets of factor intensity variables and their interactions reported in Table 4.5, where both the sign of the estimated coefficients and their statistical significance, corroborate this finding. For example, in the case of revealed physical capital intensity, the sign of the estimated coefficient for the base category (i.e. high-income countries) is negative, while the marginal effect for the low- and middle-income interaction terms is positive (the net effect is discussed below). Further, the coefficient estimates for the interaction terms are statistically significant indicating that the composition of exports differs across these trading partners. An analogous pattern is evident in the case of the other two revealed factor intensity measures.

However, while the composition of exports as a function of relative factor endowments differs across the country groupings, the association is not as stark as would be expected. Across all three factor intensity measures one observes a strong association between factor intensity and the composition of exports to high-income countries (i.e. the base category). When looking at the corresponding middle- and low-income country interactions, the net effect indicates that

[79] In the regressions, the high-income country group acts as the base category. Thus, the coefficient estimates for each revealed factor intensity variable capture the high-income group effect. The low- and middle-income country interaction terms for each revealed factor intensity variable need to be interpreted in relation to the base category. This is done by adding the coefficient of the base category with that of each interaction term.

there is no association between factor intensity and export composition.[80] It is worth noting that the statistical significance of the interaction terms indicates that the difference between the associations between export composition and factor intensity across the country groupings is distinct, while the net effects for the interactions indicate that it is not stark.

Table 4.5: Static cross-commodity regression estimates – income group specification

	(1)
Log of Revealed human capital intensity	0.027***
	[0.005]
Log of Revealed human capital intensity * middle-income	-0.024***
	[0.006]
Log of Revealed human capital intensity * low-income	-0.027***
	[0.005]
Log of Revealed natural resource intensity	0.010***
	[0.001]
Log of Revealed natural resource intensity * middle-income	-0.008***
	[0.001]
Log of Revealed natural resource intensity * low-income	-0.009***
	[0.001]
Log of Revealed physical capital intensity	-0.013***
	[0.002]
Log of Revealed physical capital intensity * middle-income	0.011***
	[0.002]
Log of Revealed physical capital intensity * low-income	0.013***
	[0.002]
Constant	0.039***
	[0.013]
Observations	28,344
R-squared	0.038

Source: Own calculations using UN Comtrade data and UNCTAD Revealed Factor Intensity data (Shirotori et al., 2010). Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Dependent variable is the value of gross exports to countries within each income group for each HS 6-digit product scaled by world exports of each product. 4. The 1995 values for the revealed factor intensity measures are employed. 5. Initial (1995) and end (2012) period data are pooled in the estimations. 6. Each of the revealed factor intensity measures are interacted with income groupings, which include: low-income, middle-income (lower and upper combined) and high-income. The latter grouping is the reference group. 7. The estimates for the low- and middle-income group dummies (not reported) are negative and statistically significant.

An explanation for the pattern discussed, resides in South Africa's trade structure being dominated by a north-south trade pattern.[81] High-income country destination markets

[80] For example, the statistically significant association between exports and the revealed physical capital intensity of the exported products is -0.013 in the case of high-income countries. The corresponding statistically significant marginal effect for middle- and low-income countries are 0.011 and 0.013, respectively. The corresponding net effects, after summing the base category and the marginal effect, are -0.002 and 0, respectively, effectively zero. An analogous pattern is observed for revealed human capital intensity and revealed natural resource intensity.

[81] Smet (2013) and Rankin (2013) note that the EU is South Africa's most important export destination. Further, South Africa has three major trade agreements with high-income destination markets: The Trade, Development and Cooperation Agreement with the European Union, the African Growth and Opportunity Act (AGOA) with the United States, and the European Free Trade Association Agreement with Iceland, Norway, Lichtenstein and Switzerland.

constitute the majority share of South Africa's exports – 71 and 51 percent in 1995 and 2012, respectively. As such, South Africa's trade pattern has been structured around trade with advanced economies. This is reflected in the pattern of trade to high-income destinations, observed in Table 4.5, being consistent with the aggregate trade pattern observed in Table 4.1.

Relative to its high-income trading partners, South Africa is revealed to be labour and natural resource abundant. Referring back to the discussion on South Africa's relative endowment structure, in Section 4.5.1, this pattern of revealed factor abundance is as expected. In relation to developing low- and middle-income trading partners, the pattern of trade is distinct from that with high-income trading partners, but there is no stark difference with respect to revealed relative factor abundance – i.e. the north-south trade pattern drives the composition of exports. Put differently, one needs to distinguish between South Africa not exporting resource- and labour-intensive products to developing countries (i.e. a stark difference) versus South Africa exporting less resource- and labour-intensive products to these countries (what the estimates are indicating).

In line with the estimates generated in the aggregate static cross-commodity regression, the estimates for the revealed human capital intensity variable in Table 4.5 point to revealed human capital abundance in relation to high-income countries.[82] This is contrary to expectation since higher levels of education, and thus larger human capital endowment, is associated with higher levels of income (Shirotori, Tumurchudur & Cadot, 2010). Omitted variable bias may be driving these results, since human capital is correlated with factors such as productivity and product differentiation. Thus, what may be driving the composition of exports with respect to the human capital intensity of exports are intra-industry trade factors, and not revealed comparative advantage factors.[83] Further, in the discussion on South Africa's relative endowment structure in Section 4.5.1, it is evident that there is a high degree of overlay of the human capital endowment measure across country groupings. This may cloud the estimates.

82 Analogously to the discussion above regarding natural resource and labour abundance, South Africa exports less human capital-intensive products to its low- and middle-income trading partners.

83 Although Smet (2007; 2013) show that South Africa's export structure is characterised by inter-industry trade flows, they also find evidence showing increasing levels of intra-industry trade. Evidence of increasing intra-industry trade is also found in Isemonger (2000) and Parr (2000).

In summary, the results indicate that South Africa's export structure differs across income groups.[84] Such a conclusion aligns with the hypothesis advanced by Smet (2007; 2013), which states that South Africa holds a 'middle position' in relation to its trading partners.

4.5.3.2 Dynamic cross-commodity regression

The dynamic cross-commodity regression estimates focusing on aggregate trade, advance the notion that endowments play a role in shaping South Africa's evolving export structure. This section considers whether endowments shape South Africa's evolving export structure across trading partners.

The paradoxical pattern of entry in capital-intensive product markets, observed in the aggregate dynamic cross-commodity regression, is being driven by entry into high-income country markets. This is confirmed by the positive and statistically significant coefficient estimate for the base category of the revealed physical capital intensity variable in the *Entry* specification in Table 4.6. The middle- and low-income interaction terms for the *Entry* specification are not statistically significant.

When considering both the *Entry* and *Exit* specifications for the revealed physical capital intensity measure, South Africa's 'middle position' becomes evident. While entry in capital-intensive products is occurring in high-income markets, the positive and statistically significant coefficient estimates for the middle- and low-income group interactions indicate that exit from capital-intensive products is occurring in middle- and low-income country markets. Thus, the pattern of extensive margin growth in capital-intensive products, and hence South Africa's evolving export structure, points to it occupying a 'middle-position'.

South Africa's evolving export structure, with respect to natural resource intensive products, provides support to it occupying a 'middle position' between trading partners. This is evident in the pattern of churning alluded to in the aggregate dynamic cross-commodity regressions. Consistent with a pattern of churning, the estimates in the *Entry* and *Exit* specifications in Table 4.6 show both the entry and exit of natural resource intensive products in high- and low-income country markets. In the case of entry, the coefficient estimate for the low-income revealed natural resource intensity interaction is negative and statistically significant, with the net effect

[84] The estimates reported in Table 4.5 are robust to alternative specifications of the revealed factor intensity measures and alternative samples of the high-income country grouping. These estimates are reported in Table B. 3 in Appendix B.

being positive.[85] This suggests that the pattern of entry into low-income country markets, while being distinctly different from that occurring in high-income country markets, is not starkly different. An analogous pattern is observed in the exit from natural resource intensive products, where the pattern of exit from low- and middle-income country markets is distinctly different from the pattern of exit from high-income country markets.

Table 4.6: Dynamic cross-commodity regression estimates – income group specification

	Entry	Exit
	(1)	(2)
Log of Revealed human capital intensity	-0.058	0.143
	[0.158]	[0.142]
Log of Revealed human capital intensity * middle-income	0.068	-0.039
	[0.212]	[0.215]
Log of Revealed human capital intensity * low-income	0.108	-0.361*
	[0.189]	[0.213]
Log of Revealed natural resource intensity	0.222***	0.187***
	[0.049]	[0.047]
Log of Revealed natural resource intensity * middle-income	0.060	0.297***
	[0.067]	[0.073]
Log of Revealed natural resource intensity * low-income	-0.180***	-0.162**
	[0.059]	[0.070]
Log of Revealed physical capital intensity	0.185***	-0.089
	[0.059]	[0.055]
Log of Revealed physical capital intensity * middle-income	0.127	0.217**
	[0.082]	[0.087]
Log of Revealed physical capital intensity * low-income	0.007	0.179**
	[0.072]	[0.080]
Constant	-2.433***	0.127
	[0.600]	[0.529]
Observations	14,511	14,511
R-squared	0.023	0.056

Source: Own calculations using UN Comtrade data and UNCTAD Revealed Factor Intensity data (Shirotori et al., 2010).
Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. The dependent variable for each specification in columns (1) and (2), is a count measure of entry into new product-destination combinations, and exit out of old product-destination combinations, by HS product, respectively. 4. The 1995 values of the revealed factor intensity measures are employed. 5. A cut-off value of US $1,000 is applied in order to remove the noise from very small exports and measurement error. 6. Each of the revealed factor intensity measures are interacted with income groupings, which include: low-income, middle-income (lower and upper combined) and high-income. The latter grouping is the reference group. 7. Regressions estimated using the poisson pseudo maximum likelihood estimator.

Thus, the pattern of extensive margin growth, in terms of entry and exit, across trading partners provides evidence that endowments are playing a role in shaping South Africa's evolving

[85] The sum of the coefficient estimates for the base category (0.222) and the coefficient estimate for the low-income country interaction (-0.180) is positive (0.042).

export structure. Further, this evolving pattern is consistent with South Africa occupying a 'middle position'.[86]

4.6 Conclusion

This chapter examines what South Africa's export structure reveals about its endowments. This in turn informs one whether endowments shape the country's export pattern. Given the importance of the extensive margin, this chapter also analyses the role of endowments in driving South Africa's evolving export structure. The analysis is focused on the link between trade and endowments, and thus draws on the theoretical predictions of the Heckscher-Ohlin-Vanek model. To address the research question, the chapter employs an empirical approach linked to this theoretical model – the Baldwin (1971) cross-commodity regression approach.

The cross-commodity regression approach is extended along two dimensions, which serve as empirical contributions. Firstly, to deal with product heterogeneity present in both export data and factor intensity data, the analysis is extended from the aggregate industry-level to the product-level. Secondly, to analyse the role of endowments in shaping South Africa's evolving export structure, the analysis is extended from the static to the dynamic.

The results from the static cross-commodity regressions indicate that endowments play a role in shaping South Africa's export structure. However, the extent to which South Africa's export outcomes align with the predictions of the Heckscher-Ohlin-Vanek model is mixed. Applying the static cross-commodity regressions, South Africa is revealed through its trade to be natural resource abundant. This is consistent with South Africa's abundance of natural resources, and thus aligns with the theoretical predictions. At odds with the paradoxical finding of revealed physical capital abundance found by Alleyne & Subramanian (2001), the estimates pertaining to physical capital intensity indicate revealed labour abundance, which is consistent with South Africa's endowment structure being characterised as labour abundant. However, and paradoxically, the static cross-commodity regression reveals South Africa to be human capital abundant, which is at odds with its abundance of unskilled labour and high unemployment rate.

[86] The estimates reported in Table 4.6 are robust to alternative specifications of the high-income country grouping. While the general pattern is qualitatively consistent with the results generated from the preferred specification, the estimates do exhibit a degree of noise when using alternative specifications of the revealed factor intensity measure. Particularly, when measuring revealed factor intensities using the mean of the initial and end periods. This does align with the concern, expressed in Section 4.3, of allowing the factor intensity measures to fluctuate over time. The estimates for these alternative specifications can be observed in Table B. 4 in Appendix B.

It is worth noting that the product-level estimates are picking up an interesting relationship between human capital intensity and physical capital intensity. Human capital abundance is only revealed once the cross-commodity regression controls for physical capital (or labour) intensity. The estimates suggest that South Africa specialises in a skill-intensive subset of labour-intensive products. Arguably, this is a response by exporters to being competed out of unskilled labour-intensive product markets, and thus shifting to skill-intensive alternatives. It is unlikely that this effect would be picked up using aggregated industry-level data, which validates the use of product-level data.

The results from the dynamic cross-commodity regressions indicate that endowments play a role in shaping South Africa's evolving export structure. Extensive margin growth, in terms of entry into new export markets, is being driven by the growth of physical capital-intensive products. This is consistent with Cadot et al. (2011), who argue that the progression to higher levels of economic development, particularly for middle-income countries, is marked by the accumulation of capital and the production of an increased variety of capital-intensive products.

The extensive margin growth associated with capital-intensive products also shows that the paradox regarding the factor content of South Africa's export structure, as alluded to by Alleyne & Subramanian (2001) and Edwards (2001b), is evident in its evolving export structure. This growth in capital-intensive products is occurring despite an abundance of labour and a high unemployment rate.

Consistent with South Africa's natural resource abundance, its evolving export structure is being driven by growth in natural resource-intensive products. There is evidence of churning across export markets characterised by natural resource-intensive products. Given that the variation along the extensive margin is driven primarily by geographic diversification, this shows that exporters of resource-intensive products are shifting from old to new geographic markets. The dynamic cross-commodity regressions that include income group effects, show that this pattern of churning is evident in both high- and low-income country markets, with exit from middle-income country markets.

The static cross-commodity regressions also indicate that South Africa occupies a 'middle position' between its advanced high-income trading partners on one side and its developing country trading partners on the other side. While the composition of exports as a function of relative factor endowments is distinctly different across these country groupings, the association is not as stark as would be expected. The findings suggest that the north-south trade pattern between South Africa and its advanced country trading partners drives the overall composition of South Africa's export structure. This shows that the relative endowments of a middle-income country, such as South Africa, play a role in shaping its export structure across its trading partners.

The evidence presented indicates that both South Africa's static export structure and its evolving export structure, reveal it to be a natural resource abundant country. Furthermore, the evidence suggests that endowments play a role in shaping its export structure. Therefore, as proposed in policy, if South Africa is to diversify toward increased manufacturing activity, then the accumulation of capital and human capital, particularly the latter, may facilitate this process. It's worth noting that the revealed skill abundance evident in the static cross-commodity regressions, points to an export response to increased competition from low-wage labour abundant economies, as opposed to South Africa being a skill abundant country. This is corroborated by the large pool of unskilled workers without employment. The accumulation of human capital is increasingly important given the increased technology intensity associated with global manufacturing activities.

CHAPTER 5: THE IMPACT OF THE TDCA TARIFF LIBERALISATION ON THE MARGINS OF SOUTH AFRICAN EXPORTS TO THE EUROPEAN UNION

5.1 Introduction

While the relative importance of regional trade agreements (RTA) in world trade has grown over time, the precise measurement of the trade effects associated with these agreements is limited. The 2011 World Trade Report, and more recently, Bureau, Guimbard & Jean (2016), show that the number of RTAs and their share of world trade has expanded rapidly since the 1990s. Despite the growing importance of RTAs in world trade, it is widely expressed in the literature examining the trade effects of these agreements that there is a paucity of reliable and robust estimates (Baier & Bergstrand, 2007; Cipollina & Salvatici, 2010; Kohl, 2014; Jean & Bureau, 2016). As such, the more recent literature is focused on measuring these trade effects more precisely (Kohl, 2014; Jean & Bureau, 2016).

This chapter contributes to this literature by precisely measuring the trade effect of an RTA – the Trade Development and Cooperation Agreement – between the European Union and South Africa. In doing so, the following questions are addressed: firstly, how does tariff liberalisation linked to the TDCA affect trade flows? The chapter investigates the extent to which lower tariffs impact South Africa's manufacturing exports into the EU, specifically exports into the EU10 countries.[87] The EU10 constitutes a group of European countries that joined the EU in 2003 and were subsequently party to the TDCA in 2004. Secondly, this chapter asks whether the trade effect is felt more strongly along the intensive or extensive margin. Thirdly, the analysis considers whether the trade effect varies by product characteristic. More specifically, does the trade effect along the intensive and extensive margins vary according to the degree of differentiation of the traded product?

The Besedeš & Cole (2017) heterogeneous firm model provides a theoretical basis from which to address these questions. The following testable hypotheses emerge: firstly, TDCA tariff liberalisation is expected to increase South African exports along the intensive and extensive margins. Secondly, the trade effect is relatively stronger in differentiated products markets

[87] In this chapter, EU15 countries refer to Belgium, France, Germany, Italy, Luxembourg, Netherlands, Denmark, Ireland, United Kingdom, Greece, Portugal, Spain, Austria, Finland and Sweden. EU10 countries refer to Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia.

along the extensive margin, and in homogeneous product markets along the intensive margin. Thirdly, tariff liberalisation is predicted to have a larger trade effect on differentiated product markets relative to homogeneous product markets. This chapter tests whether the revealed trade effects are consistent with these theoretical predictions.

The analysis in Chapter 3 pointed to strong extensive margin growth into European countries over the period 1995 to 2012, particularly for manufactured products. The data point to the geographic diversification of South African exports into the European regional market. This extensive margin growth has coincided with the establishment of the TDCA, and the expansion of EU membership. Therefore, this chapter examines the role of TDCA tariff liberalisation in driving the diversification of South Africa's export structure into the EU.

The diversification of a country's export structure toward differentiated products, especially manufactures, is a key policy aim among developing countries. Rauch (1999) and Besedeš & Prusa (2006b) provide evidence suggesting that search costs are higher and matching more difficult for differentiated products, relative to homogenous products that are traded on organised international exchanges. In other words, it is harder to establish a trade relationship when dealing with differentiated products, which are typically manufactured products. If tariff liberalisation linked to an FTA drives diversification into differentiated product export markets, then arguably, this trade policy helps exporters overcome these search costs and difficulties in matching with importers. Therefore, this chapter examines the effectiveness of the TDCA in driving diversification into differentiated product export markets.

To measure the trade effect of the TDCA tariff liberalisation on South African export flows into the EU, specifically the EU10 countries, a difference-in-differences methodology is applied. In particular, the triple difference-in-differences estimator from Frazer & Van Biesebroeck (2010) and Van Biesebroeck & Yi (2012) is adapted and employed.

In the applied empirical literature, Kohl (2014) and Jean & Bureau (2016) identify two key problems in studies measuring the impact of tariff liberalisation on trade. Firstly, they mention that trade policy variables are not strictly exogeneous – the endogeneity concern.[88] It is assumed that trade agreements bring about trade liberalisation that positively impacts on cross-border trade between the signatories. However, it is possible that the reverse is true, where

88 Concern regarding the exogeneity of the trade policy variable is not new. For example, both Trefler (1993) and Lee & Swagel (1997) used an instrumental variable approach to account for the potential endogeneity of the trade policy variable, while Baier & Bergstrand (2007) use panel regression techniques.

countries that trade a lot with one another also tend to enter into trade agreements with one another. The endogeneity bias arises from the fact that the establishment of the trade agreement is motivated by missing variables, contained in the error term, which also affect the intensity of trade (Baier & Bergstrand, 2007; Kohl, 2014).

Secondly, Jean & Bureau (2016) identify the heterogeneity concern. Typically, econometric analyses control for tariff liberalisation emerging from the agreement by simply including a binary dummy variable defining whether or not a bilateral trading pair are party to an agreement. Jean & Bureau (2016) argue that such an approach is unable to deal with the heterogeneity both within and across trade agreements. Trade agreements are heterogeneous across a variety of dimensions. For example, there are one-way preferential trade agreements, two-way preferential trade agreements, free trade agreements, common markets and economic unions, all of which differ in the depth and breadth of their tariff liberalisation. Furthermore, within a trade agreement, the degree of tariff liberalisation is heterogeneous across traded products due to negotiating parties bargaining for less drastic tariff liberalisation in sensitive industries. Accounting for this heterogeneity allows for more precise estimates of the impact of tariff liberalisation on trade.

This chapter contributes to the applied empirical literature by addressing the empirical issues listed above. In doing so, the analysis provides a precise estimate of the impact of tariff liberalisation on trade, in the context of a developing middle-income country entering into a free trade agreement with a set of developed countries. This chapter also advances an existing study by Kwaramba et al. (2015) that investigates the impact of TDCA tariff liberalisation on South Africa's exports into the EU, along the intensive and extensive margins. While dealing with the heterogeneity concern, their study fails to deal with the endogeneity concern, potentially biasing their estimates.

This chapter deals with the endogeneity concern by exploiting a natural experiment, whereby the extension of EU membership acts as an exogenous shock to identify the causal effect of trade preferences on South African exports. The TDCA was negotiated between the original EU15 members and South Africa and was implemented in 2000. Upon entry into the EU, the TDCA was extended to the EU10 countries in 2004. Thus, the expansion of the EU provides a unique event whereby a trade agreement negotiated between two parties (the EU15 countries and South Africa) is extended unilaterally and exogenously to another party (the EU10 countries).

This addresses the endogeneity concern along two dimensions: first, the critique that trade agreements are often signed between countries that already have strong trade relationships, is negated by the TDCA being imposed exogenously onto the EU10 countries upon entry into the EU. Secondly, tariff phase-downs are typically negotiated for non-sensitive products while protection remains in sensitive products. However, the TDCA negotiations were negotiated for the trade structure pertaining to EU15 countries and not that of the EU10 countries. Therefore, tariff liberalisation at the product-level is imposed exogenously onto EU10 countries, and is thus not influenced by trade negotiations, nor their industry structure. This element of exogeneity allows one to identify the causal effect of the TDCA tariff liberalisation on South African exports.

The chapter deals with the heterogeneity concern by adopting what Kohl (2014) refers to as a ‘specialist’ approach and focuses on a single trade agreement and the specifics pertaining to this agreement. Furthermore, the analysis exploits the variation in preferential access within the agreement by applying a product-level analysis, and thus capturing the unevenness of the trade response across products.

The next section discusses specific details of the TDCA that influence the applied methodological approach. Section 5.3 provides a review of the empirical literature focused on measuring the impact of regional trade agreements on trade. Section 5.4 provides a theoretical background for the expected link between tariff liberalisation and trade. The methodological approach is discussed in Section 5.5. Details on the data used is provided in Section 5.6. The results of the empirical analysis are discussed in Section 5.7. Section 5.8 concludes.

5.2 The Trade, Development and Cooperation Agreement

Following a ‘specialist’ approach, this chapter focuses on measuring whether tariff liberalisation initiated by the TDCA has impacted on South African exports to the EU, specifically the EU10 countries. This section provides a description of the agreement, focused on details relevant to the analysis. In particular, this section highlights key features of the agreement that allow one to generate an econometrically precise estimate of the trade effect associated with the tariff liberalisation. These features strongly influence the methodology applied in this chapter.

The TDCA is a reciprocal free trade agreement signed between South Africa and the EU in October 1999 – then comprising the EU15 countries. Implementation was initiated on 1

January 2000. Tariff liberalisation is asymmetric across industrial and agricultural products and phased over time.[89] Prior to implementation of the TDCA, 10 percent of industrial products entered into the EU duty-free. Upon implementation in 2000, 60 percent of industrial products entered duty free. By 2003 the share of duty-free industrial products is 87 percent and by 2006 almost all (99%) industrial products entered the EU duty free. This phase-down of EU tariffs benefits the econometric analysis by providing an additional source of variation across time and products.

A key feature of the TDCA is the imposition of the agreement on new EU members – defined as the EU10. In 2003, 10 additional countries joined the EU – Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. Subsequent to joining the EU, the EU10 countries adopted the TDCA and all aspects of the agreement, as of May 2004.[90]

The imposition of the TDCA on the EU10 countries provides a natural experiment that enables the analysis in this chapter to deal with the endogeneity concern. The expansion of the EU provides a unique event whereby a trade agreement negotiated between two parties (the EU15 countries and South Africa) is extended exogenously to another party (the EU10 countries). This is interesting because it presents a case whereby the terms of a trade agreement that was negotiated between the two initial parties, and hence all the lobbying and bargaining associated with this agreement, are imposed exogenously on the third party, which was not involved in the negotiating process. This feature of the TDCA acts as an exogenous shock, thus allowing for the identification of the trade effect. The methodology applied in this chapter, detailed in Section 5.5, exploits this feature.

5.3 Literature review: Measuring the impact of regional trade agreements

The empirical literature focused on measuring the impact of trade agreements has evolved along three dimensions. These dimensions speak to an evolving empirical approach. Firstly, the empirical approach has evolved to account for the dual margins of trade growth. Secondly,

[89] In the case of agricultural products, by the end of the phasing-in period, only 48 percent of South African agricultural products entered the EU duty free.

[90] In Article 1 of the Additional Protocol accounting for the accession of the EU10 countries into the EU, the following is stated: "*The Czech Republic, the Republic of Estonia, the Republic of Cyprus, the Republic of Latvia, the Republic of Lithuania, the Republic of Hungary, the Republic of Malta, the Republic of Poland, the Republic of Slovenia, and the Slovak Republic (hereinafter referred to as 'the new Member States') hereby become Contracting Parties to the TDCA and shall respectively adopt and take note, in the same manner as the other Member States of the Community, of the texts of the Agreement, as well as of the Annexes, Protocols and Declarations attached thereto*." (European Commission of Communities, 2005).

it has evolved to account for the heterogeneous nature of trade liberalisation. Finally, it has evolved to deal with the inherent endogeneity associated with trade agreements.

5.3.1 Methodological issues

In the applied international trade literature examining the trade effects of RTAs, it is noted that there is a lack of precision and robustness in the measurement of these trade effects (Ghosh & Yamarik, 2004; Baier & Bergstrand, 2007; Cipollina & Salvatici, 2010; Kohl, 2014; Jean & Bureau, 2016). Cipollina & Salvatici (2010) conduct a meta-analysis of the literature and provide evidence of substantial variation in the estimated trade effect across studies. As such, Jean & Bureau (2016) state that while RTAs are likely to have had a profound impact on the structure of global trade, there is uncertainty over their real impact on trade flows.

While there are several methodological issues that impact on the precision of the estimated trade effect associated with RTAs, two receive particular focus in the literature: first, the endogeneity concern, and second, the heterogeneity concern (Head & Meyer, 2014; Kohl, 2014; Kohl, Brakman & Garretsen, 2016; Jean & Bureau, 2016).

5.3.1.1 The endogeneity of trade agreements

A major critique of the applied empirical literature focusing on the impact of RTAs on trade is that trade policy is not strictly exogenous (Head & Meyer, 2014; Kohl, 2014). Baier & Bergstrand (2007) contend that there may be unobserved country characteristics that influence trade between members, while at the same time being correlated with agreement membership.[91] In other words, there may be factors that naturally lead country pairs to trade with one another, and thus make them more likely to self-select into a trade agreement with one another. Both Baier & Bergstrand (2007) and Kohl (2014) show that by not dealing with the endogeneity bias present in trade agreements, econometric estimates underestimate the trade effect arising from trade agreements.

Panel regression techniques and panel data are best suited to dealing with the endogeneity concern (Baier & Bergstrand, 2007).[92] Baier & Bergstrand (2007) apply two gravity equation

[91] In cross-sectional econometric analysis, the endogeneity concern refers to one or more of the right-hand-side variables being correlated with the error term. In such instances, the econometrically endogenous variable leads to biased and inconsistent coefficient estimates (Baier & Bergstrand, 2007).

[92] In light of the endogeneity of the trade policy variable, Head & Meyer (2014) note that cross-section or pooled panel estimates are not reliable. They also note that an instrumental variable approach suffers from a lack of plausible instruments. Most of the variables that cause RTAs, such as distance and colonial history, also explain the level of trade between members.

specifications that allow them to deal with endogeneity bias: firstly, a fixed-effects specification which includes country-pair or dyadic fixed effects that control for time-invariant unobservable bilateral factors influencing trade. This specification also includes exporter-time and importer-time fixed effects, which capture observable time-varying exporter and importer characteristics, such as GDP, as well as unobservable country specific time-varying factors influencing trade (e.g. multilateral resistance terms). Secondly, a first-differencing specification, which applies a first-difference over five-year periods and includes exporter-time and importer-time fixed effects. They find that the traditional gravity equation approach underestimates the trade effect of FTAs by between 75 and 85 percent.[93] Studies by Egger, Larch, Staub & Winkelmann (2011) and Kohl (2014) also find evidence of endogeneity bias.

Frazer & Van Biesebroeck (2010) apply the triple difference-in-differences estimation technique to deal with additional sources of endogeneity in the context of the AGOA agreement between the USA and Africa. They provide an example where a country is granted AGOA eligibility just as its economy is experiencing a strong period of growth after emerging from a period of civil war. The increase in exports, which coincides with eligibility, may merely reflect a growing economy, and not strictly the trade effect resulting from AGOA.[94] The triple difference-in-differences estimation technique uses three sets of interacted fixed effects – country-time, product time and country-product – that control for unobserved heterogeneity along the product, country and time dimensions, and is thus able to deal with this endogeneity.[95]

Another approach to dealing with the endogeneity concern is the use of a natural experiment study design (Head & Mayer, 2014). Exploring the broader trade effects associated with the formation of the European Union, Frankel (2010a) exploits the conversion of the French Franc to the Euro in 1999, to estimate the trade response of African Financial Community (CFA) countries. This acts as an exogeneous shock impacting CFA countries whose common currency – the CFA Franc – was tied to the French Franc and subsequently the Euro. After the formation of the EU, the switch to a common currency with other members of the EU can be considered

[93] Subsequently, the use of the Baier & Bergstrand (2007) fixed-effects gravity specifications has become commonplace in the literature. For example, see Kohl (2014), Baier, Bergstrand & Feng (2014) and Kohl, Brakman & Garretsen (2016).

[94] At the product-level, AGOA status may be granted to products that are expected to experience growing global demand. Thus, growing exports of these products, which coincides with AGOA, may simply reflect growing global demand and not a true AGOA trade effect.

[95] This approach has been employed by Van Biesebroeck & Yi (2012) to analyse imports into China post-WTO accession, and by Thelle, Jeppesen, Gjodesen-Lund & Van Biesebroeck (2015) (henceforth TJGV, 2015) to examine developing country imports into the EU.

as exogeneous for the CFA countries, and hence the trade effect resulting from this change can be declared as causal.

This chapter deals with the endogeneity concern by using a natural experiment. The extension of EU membership acts as an exogenous shock to identify the causal effect of the TDCA on South African exports into EU10 countries.

5.3.1.2 The heterogeneous design of trade agreements

A further methodological critique of the applied empirical literature is its inability to account for the heterogeneous design of trade agreements. This critique concerns the use of a binary dummy variable accounting for the presence of a trade agreement between country pairs. The dummy variable captures the existence of the agreement but ignores the heterogeneous details of the agreement. This is important in a multi-agreement analysis, where the specifics of agreements may explain the differences in trade effects across the agreements. Similarly, in an agreement specific case-study, the specifics within an agreement, such as varying tariff levels across products, may explain the impact in a more precise and nuanced manner.

In light of this, researchers have adjusted their empirical approach to better account for these sources of heterogeneity. Studies have explored this heterogeneity of trade effect by generating estimates by agreement type (Magee, 2008; Roy, 2010; Baier, Bergstrand & Feng, 2014; Persson & Wilhelmsson, 2016). The heterogeneity of the trade effect has also been explored across time (Baier & Bergstrand, 2007; Magee, 2008; Frankel, 2010a; Frazer & Van Biesebroeck, 2010). Further, product-level heterogeneity, in terms of product-level tariff-cuts and associated preference margins, has been interrogated (Van Biesebroeck & Yi, 2012; Kwaramba et al., 2015; Cirera, Foliano & Gasiorek, 2016). Product-level heterogeneity is unaccounted for when simply applying a dummy-variable approach. This is problematic in instances where negotiated tariff reductions are substantial, but only for product lines that do not comprise a significant share of aggregate trade between the negotiating partners. As such, what may look like substantial *de jure* liberalisation is limited in the *de facto* sense.

5.3.2 The trade effects of regional trade agreements

When estimating the trade effects of regional trade agreements at the aggregate – what Kohl (2014) refers to as a ‘generalist’ approach – the effects are largely trade creating (Baier & Bergstrand, 2007; Magee, 2008; Roy, 2010). However, when estimating the trade effects at the agreement level – what Kohl (2014) refers to as a ‘specialist’ approach – the effects vary. Baier & Bergstrand (2007) estimate the trade effects of free trade agreements (FTA) across 96 countries for the period 1960 to 2000 and find that, on average, bilateral trade between FTA partners doubles after 10 years. Focusing on 166 trade agreements across 150 countries for the period 1950 to 2010, Kohl (2014) adopts the ‘generalist’ approach and finds that these agreements foster trade by at most 50 percent. However, when applying a ‘specialist’ approach and estimating the individual trade effects for each trade agreement, he finds that of the 166 trade agreements in the sample, 106 (64%) have no statistically significant effect on trade flows. Only 44 (27%) have a trade-promoting effect, while 16 (10%) have the opposite effect.[96].

Consistent with the discussion regarding the heterogeneity concern, the effects of regional trade agreements vary by agreement type. Examining the trade effects of RTAs across 133 countries for the period 1980 to 1998, Magee (2008) finds that the estimated trade effects decline in order of magnitude, as one shifts from customs unions, to free trade agreements, to preferential trade agreements. Similarly, using the gravity model and data from Baier & Bergstrand (2007), Roy (2010) finds that customs unions, and not free trade agreements, are driving the trade effect observed in Baier & Bergstrand (2007). Baier, Bergstrand & Feng (2014) examine the impact of trade agreements on the dual margins of trade for a panel of 149 countries over the period 1962 to 2000. To account for varying depths of integration and liberalisation across agreements, they measure the trade effect for each margin of trade on the different types of agreements. The results point to a hierarchy, where trade agreements with deeper levels of integration and liberalisation, such as customs unions, common markets and economic unions, have larger effects than FTAs, which in turn have larger effects than two- and one-way PTAs.

The response of trade to trade agreements also varies across time. Baier & Bergstrand (2007) argue that there may be a lagged impact associated with the implementation of a trade agreement, because it is often the case that trade agreements are ‘phased-in’ over time. The use of panel data becomes very important when dealing with this heterogeneity of trade effect over time. Frazer & Van Biesebroeck (2010) assess the effectiveness of the African Growth and Opportunity Act (AGOA) in stimulating African exports into the USA for the period 1998 to 2006. They show that the impact of AGOA grows over time. For example, in apparel and non-

[96] For comparative purposes with this chapter, when estimating the effects of the TDCA, Kohl (2014) finds a positive but not statistically significant trade effect. This stands in direct contrast to the results in this paper and Kwaramba et al. (2015).

apparel products, trade grows by 21.9 and 6.4 percent, and 44.4 and 23.7 percent, in the first and last years of the analysis, respectively. Baier, Bergstrand & Feng (2014) find that heterogeneity of trade effect across time varies according to the margins of trade, with the intensive margin effect stronger in the short-run, and the extensive margin effect stronger in the long-run.

There is also evidence of pre-emptive trade effects. McLaren (1997) notes that trade may increase in anticipation of a trade agreement as industries gear up and invest in delivery systems and infrastructure. Magee (2008) finds evidence of anticipatory effects, whereby there is a significant increase in trade during the four years leading to the inception of an RTA. Frankel (2010a) estimates the trade effect associated with the formation of the European Monetary Union and also finds pre-emptive trade effects. A potential explanation, offered by Frankel (2010a), states that these agreements are typically discussed for many years in advance, and once it is clear that the agreement is going to take place, firms quickly try to establish "first mover advantage".

The dummy variable approach, applied in most of the studies discussed above, assumes that trade liberalisation is homogeneous across products. However, product-level tariff cuts agreed to during negotiations vary, and this product-level heterogeneity needs to be taken into account. Cirera et al. (2016) examine the impact of the EUs unilateral preference regimes on developing country exports using a bilateral gravity model at the product-level. Their analysis benefits from product-level data at the 10-digit level (Combined Nomenclature), where each trade flow between a developing country and an EU country is matched to the appropriate tariff, as per the EU preference regime pertaining to that developing country. They find that lower tariffs and larger preference margins increase trade. Similarly, Jean & Bureau (2016) examine the impact of RTAs on agricultural exports across 74 country pairs for the period 1998 to 2009, and find that a 1 percent preference margin increases trade flows by 4 percent and increases the probability of exporting by 0.05 percent.

Analysing trade agreements at the product-level also allows one to estimate the trade effect by product characteristic. Kwaramba et al. (2015) estimate the impact of the TDCA on South African exports to the EU15 countries and find that the effects are strongest for capital products and raw materials along both the intensive and extensive margins. Using the Rauch classification, they show that differentiated product exports respond strongest to tariff cuts along both the extensive and intensive margins. Homogeneous and reference priced product exports do not respond to tariff cuts in a significant manner along the extensive margin, but they do so along the intensive margin, although to a lesser degree than differentiated product exports. The positive trade effect along the extensive margin for differentiated product exports is confirmed by Van Biesebroeck & Yi (2012), when analyzing imports into China post-WTO accession.

Not only do RTAs drive up bilateral trade volumes between partners, they also expand the range of products traded – i.e. extensive margin growth. Using data for 174 countries over the period 1962 to 2000, Foster, Poeschl & Stehrer (2011) examine the trade effect of PTA membership along the intensive and extensive margins. They find that a positive trade effect is largely driven by increases in exports along the extensive margin. This is echoed in more recent studies by Kehoe & Ruhl (2013) and Persson & Wilhelmsson (2016). Persson & Wilhelmsson (2016) show that unilateral trade preferences granted by the EU to developing countries increase the range of products exported by these countries to the EU.

The analysis in this chapter fits within the applied empirical literature examining the impact of RTAs on trade. It is evident that as the literature has evolved, the empirical approach to this question has become more important in order to accurately measure the trade effect. Product-level tariff data is employed in order to account for product-level heterogeneity in preferential access as well as allowing for estimations of the trade effect by product type. The endogeneity concern is especially important in the case of measuring the trade effect associated with trade agreements. The analysis in this chapter addresses this concern by applying the triple difference-in-differences approach and exploiting the implementation of the TDCA and the accession of the EU10 countries into the EU. The extension of the EU and the accession of the EU10 countries into the TDCA acts as an exogenous shock, thus allowing for the identification of the trade effect resulting from TDCA tariff liberalisation.

5.4 Theoretical framework

This chapter draws on the Besedeš & Cole (2017) heterogeneous firm model, since it provides a theoretical basis for predicting: firstly, the response of exports to tariff liberalisation. Secondly, whether the responsiveness of exports to tariff liberalisation is felt more strongly along the intensive or extensive margin. Thirdly, whether this responsiveness to tariff liberalisation varies according to the degree of differentiation of the exported product.[97] It thus aligns with the research objectives of this chapter and allows for the generation of testable hypotheses.

Besedeš & Cole (2017) extend the Chaney (2008) heterogeneous firm model by distinguishing between two types of variable trade costs: transport and tariff costs.[98] They argue that the two costs affect the level of firm profit differently, which in turn impacts on firm entry and exit – the extensive margin.[99] The model thus allows one to generate hypotheses specific to changes in tariffs.

The model follows Chaney (2008) and generalises the Melitz (2003) model to a world with many asymmetric countries. It is thus able to predict the structure of bilateral trade flows. The combination of heterogeneous firm productivity and fixed costs of entry into export markets, results in the endogenous selection of firms into export markets. Entry into an export market is determined by the productivity threshold, $\bar{\varphi}_{ij}$, defined as the productivity of the least productive firm in country i able to export to country j. Firms with productivity levels above the threshold are able to enter the foreign market (and service the domestic market), while firms with productivity levels below the threshold are only able to service the domestic market. The productivity threshold is defined as follows:

$$\bar{\varphi}_{ij} = \lambda_1 \left(\frac{f_{ij} t_{ij}^{\sigma}}{Y_j} \right)^{1/(\sigma-1)} \frac{w_i \tau_{ij}}{P_j} \qquad (5.1)$$

where $\lambda_1 = \left(\frac{\sigma}{\sigma-1} \right) \left(\frac{\sigma}{\mu} \right)^{1/(\sigma-1)}$ is a constant, f_{ij} is the fixed cost of trading between country i and country j, t_{ij}^{σ} is the tariff cost of trade between country i and country j, Y_j is the income level in country j, w_i is the wage in country i, τ_{ij} is the variable cost of trade between country i and country j, P_j is the price level in country j, and σ is the elasticity of substitution.

It is evident in equation (5.1) that the costs of trade are directly related to the productivity threshold, and thus a decline in these costs, either fixed, transport or tariff, lowers the productivity threshold. A lower threshold means that some firms with low productivity levels,

97 The elasticity of substitution is used to measure the degree of differentiation of a product. Differentiated products are associated with low elasticities of substitution, and homogenous products are associated with high elasticities of substitution.
98 Besedeš & Cole (2017) follow Chaney (2008) closely and maintain the same notation and setup.
99 The difference in firm profit arising from transport and tariff costs, emerges from a firm being able to recoup a portion of the former due to its monopolistic power, whereas the former is completely captured by the domestic government (Besedeš & Cole, 2017).

previously unable to enter the foreign market, are now able to profitably enter the foreign market. Therefore, a change in the costs of trade adjusts the set of firms exporting to a foreign market, and this is referred to as an adjustment along the extensive margin. The model also predicts an increase in exports from existing firms, and thus adjustment along the intensive margin.[100]

The adjustment in the set of exporting firms resulting from a change in the costs of trade is an additional margin of adjustment relative to representative firm models, and it changes the behaviour of aggregate trade.[101] Aggregate bilateral trade is represented in the following equation, which purposefully aligns with the gravity model of trade:

$$X_{ij} = \lambda \frac{Y_i Y_j}{Y} \left(\frac{w_i \tau_{ij} t_{ij}^{\frac{\sigma}{\sigma-1} - \frac{1}{\gamma}}}{\theta_j} \right)^{-\gamma} f_{ij}^{-\left(\frac{\gamma}{\sigma-1} - 1\right)} \tag{5.2}$$

where exports from country i to country j are a function of country sizes (Y_i and Y_j), the wage in country i (w_i), the fixed (f_{ij}), transport (τ_{ij}) and tariff (t_{ij}) trade costs between country i and country j, and a measure of country $j's$ remoteness from the rest of the world (θ_j).

The gravity structure of trade is substantially adjusted when accounting for the presence of firm heterogeneity (Chaney, 2008). This is because a reduction in trade costs, not only increases the exports of existing firms, but also encourages more firms to enter the export market. Therefore, a change in the costs of trade results in adjustment along the intensive margin, which is amplified by adjustment along the extensive margin.

Two key predictions, regarding the impact of tariffs on exports, emerge from this model. These are observed when considering the elasticity of exports to changes in tariffs, (t_{ij}), by trade margin. Taking equation (5.2), this can be expressed as follows:

$$\vartheta \equiv -\frac{dlnX_{ij}}{dlnt_{ij}} = (\sigma - 1) + \frac{\sigma\big(\gamma - (\sigma - 1)\big)}{\sigma - 1} = \frac{\sigma\gamma}{\sigma - 1} - 1 \tag{5.3}$$

100 Since this chapter is focused on the impact of tariff reform on trade, the remainder of this section focuses on the predictions of the Besedeš & Cole (2017) model regarding adjustments in tariff costs.

101 This is in comparison to the Krugman (1980) model where aggregate trade is represented in the following equation: $X_{ij} = \lambda \frac{Y_i Y_j}{Y} \left(\frac{w_i \tau_{ij}}{\theta_j} \right)^{-(\sigma-1)}$. The absence of the fixed costs of exporting in this model shows that the inclusion of these costs is one of the key extensions of heterogeneous firm models from representative firm models. The fixed costs of entry into an export market, in combination with heterogeneity in firm productivity, allow for adjustment in terms of firm entry and exit (i.e. adjustment along the extensive margin).

where $(\sigma - 1)$ is the intensive margin elasticity, and $\left(\frac{\sigma(\gamma-(\sigma-1))}{\sigma-1}\right)$ is the extensive margin elasticity with respect to tariff trade costs (t_{ij}).

The first prediction states that the response of exports to a change in tariffs, varies along each margin in opposing directions according to the elasticity of substitution. In homogeneous product markets where the elasticity of substitution is high, the impact of tariffs is strong on the intensive margin and mild on the extensive margin. In the case of differentiated product markets where the elasticity of substitution is low, the opposite applies.

The intuition behind these opposing effects is as follows: In the case of differentiated product markets where the elasticity of substitution (σ) is low, the demand for each individual variety is relatively insensitive to changes in trade costs, and thus trade barriers have relatively little impact on the intensive margin. Conversely, in the case of homogeneous product markets where the elasticity of substitution (σ) is high, the demand for each individual variety is more sensitive to changes in trade costs, and thus the impact along the intensive margin is felt more strongly.

Focusing on the extensive margin, the following intuition applies: In differentiated product markets (low σ), less productive firms are able to capture a relatively large market share, since the link between market share and productivity in these less competitive markets is relatively weak. As trade barriers fall, low productivity firms are able to enter the market and capture relatively large shares of the market in relation to existing exporters. This implies that the extensive margin is more strongly affected by trade barriers in less competitive differentiated product markets. The opposite applies in relatively more competitive homogeneous product markets where the elasticity of substitution (σ) is high.[102]

The second prediction states that the response of exports to a decrease in tariffs is predicted to have a larger effect in differentiated product markets than in homogeneous product markets. Taking equation (5.3) it is evident that the elasticity of substitution (σ) does impact on the elasticity of exports with respect to changes in tariffs. Besedeš & Cole (2017) posit that the

102 This is evident in equation (5.1), where $\frac{dln(\varphi_{ij})}{dln(t_{ij})} = \frac{1}{\sigma-1}$ shows that the higher the elasticity of substitution, σ, the lower the responsiveness along the extensive margin.

elasticity of exports with respect to ad valorem tariffs is decreasing in elasticity of substitution, $\frac{d\vartheta}{d\sigma} = \frac{-\gamma}{(\sigma-1)^2} < 0$.

Drawing on the Besedeš & Cole (2017) heterogeneous firm model, the following testable hypotheses arise: firstly, TDCA tariff liberalisation is expected to increase South African exports along both the intensive and extensive margins.[103] Secondly, the impact of tariff liberalisation is felt more strongly in differentiated products markets along the extensive margin, and in homogeneous product markets along the intensive margin. Thirdly, tariff liberalisation is predicted to have a larger impact on differentiated product markets compared to homogeneous product markets.

5.5 Methodology

The methodological approached used to measure the effect of TDCA tariff liberalisation on South African exports is detailed below. This section motivates the use of the difference-in-differences regression approach.

This chapter adopts a triple difference-in-differences estimation technique that is grounded in the gravity model. The gravity equation model embodies the standard empirical approach to measuring the determinants of world trade (Kohl, 2014; Baier, Bergstrand & Feng, 2014; Jean & Bureau, 2016). The fixed effects version of the gravity equation, developed by Baier & Bergstrand (2007), represents the standard gravity model specification applied in the empirical literature measuring the trade effects associated trade agreements.[104] The Baier & Bergstrand (2007) gravity equation includes importer-time and exporter-time fixed effects, which control for both observed (e.g. GDP) and unobserved (e.g. multilateral resistance terms) time varying country characteristics. It also includes country-pair fixed effects that control for time-invariant unobservable bilateral factors influencing trade. These sets of interacted fixed effects remove the standard gravity equation controls (e.g. distance, GDP, contiguity) from the estimation (Kohl, 2014). The fixed effects gravity equation is consistent with the triple difference-in-

[103] While the theoretical model details adjustment along the extensive margin at the firm-level, it can be used to understand adjustment along the extensive margin at the product-destination level. For example, Besedeš & Cole (2017) use product-destination level data to test the various hypotheses that emerge from their model. The empirical analysis in this chapter follows this approach since appropriate firm-level data is not available.

[104] For example, see Roy (2010), Fugazza & Nicita (2013), Kohl (2014), Baier et al. (2014), Disdier, Fontagné & Mimouni (2015) and Kohl et al. (2016).

differences approach, detailed below, where the three sets of interacted fixed effects control for standard gravity model variables.[105]

5.5.1 Specification 1: Difference-in-differences model

The analysis starts by estimating the standard difference-in-differences estimator applied to the country dimension. Exports to the EU15 countries acts as the control, and the entry of EU10 countries into the EU in 2004 acts as the shock (treatment). The differences-in-differences estimator examines whether the mean export outcomes from before to after the treatment is different across the EU15 and EU10 country groupings. This is summarised in equation (5.4):

$$ln(1 + X_{pjt}) = \alpha_1 + \beta_1 DPost_t + \beta_2 DPref_j + \beta_3(DPost_t * DPref_j) + \varepsilon_{pjt} \quad (5.4)$$

where the dependent variable is the natural logarithm of South African exports of product p to destination j in period t. To deal with the zero trade flows, 1 is added to all export values before transforming the dependent variable to natural log form.[106] Exports of product p are classified at the 6-digit level of the Harmonised System (HS) Revision 1996. Destinations j are comprised of control and treatment countries from the EU15 and EU10 groupings, respectively. $DPref_j = 1$ if destination j is a EU10 treatment country, and $DPref_j = 0$ if destination j is a EU15 control country. $DPost_t = 1$ in the period when the EU10 countries joined the EU (i.e. 2004 to 2008), and $DPost_t = 0$ in the period prior to EU10 countries joining the EU (i.e. 2000 to 2003).

Equation (5.4) is estimated using ordinary least squares (OLS), and standard errors are clustered at the product-destination level.[107] The estimations include various combinations of

[105] To test the robustness of the estimates in this chapter, a country-level fixed effects gravity equation, along the lines of Baier & Bergstrand (2007), is estimated. The estimates are reported in Appendix Table C. 4.

[106] Another approach to dealing with observations with zero values is to apply the inverse hyperbolic sine (or arcsinh) transformation. The arcsinh transformation is defined as $log\left[y_i + \sqrt{(y_i^2 + 1)}\right]$. The transformation approximates the natural logarithm of the variable and allows for the retaining of zero-valued observations (Bellemare & Wichman, 2019). The arcsinh transformation has been applied in the international trade literature (Kristjánsdóttir, 2012, 2013; Bahar & Rapoport, 2018), as well as in the broader development literature (McKenzie, 2017; Clemens & Tiongson, 2017). To test the robustness of estimates for the aggregate difference-in-differences specifications, estimations applying the arcsinh transformation to the dependent variable are included in Appendix Table C. 7.

[107] Standard-errors are clustered at the product-destination level, since it is believed that both the regressors (tariff preferences) and the errors are potentially correlated within this cluster. Studies of a similar type, such as those by Frazer & Van Biesebroeck (2010), Disdier et al. (2015), and Jean & Bureau (2016), also cluster standard-errors at the product-destination level. These studies also control for product-destination fixed effects. Cameron & Miller (2015:13) note that controlling for fixed effects and clustering standard-errors at the same level is acceptable. They note that *"…while cluster-specific effects control for part of the within-cluster correlation of the error, in general they will not completely control for within-cluster error correlation (not to mention heteroscedasticity). So the CRVE (cluster robust variance estimation) should still be used.*".

fixed effects, with the most restricted, and preferred, specification including product-destination and industry-time fixed effects.

The interaction term is the difference-in-differences term. The estimated coefficient β_3 indicates whether the expected mean change in exports from before to after the EU10 countries joined the EU in 2004, is different across the control and treatment countries. The term is measuring whether, relative to EU15 countries, South African exports to EU10 countries change in response to these countries joining the EU (and applying TDCA tariff rates on South African exports). Drawing on Besedeš & Cole (2017), it is expected that $\beta_3 > 0$.

It is important to note that the extent to which the difference-in-differences approach allows one to identify the trade effect resulting from tariff liberalisation depends on whether the parallel trends assumption holds. The parallel trends assumption states that the control group provides information on how the treatment group would have evolved in the absence of treatment. In the case of this analysis, it is a question on the validity of the EU15 countries as a control group. To substantiate the validity of the EU15 control group, two formal tests of the parallel trends assumption are presented in Section 5.7.2.1: firstly, the placebo test, and secondly, the Autor (2003) pre-treatment trends test.

However, this standard difference-in-differences approach, applied at the country dimension, does not take into account product-level heterogeneity. This approach is akin to the dummy variable approach critiqued in Section 5.3. It assumes that the tariff liberalisation applied on South African exports into the EU is identical across all products. However, there is substantial heterogeneity in tariff liberalisation across products. There is an additional source of heterogeneity at the country-level, with the pre-EU accession tariffs varying across EU10 countries. Therefore, there is both country- and product-level heterogeneity that is not controlled for in specification 1.

5.5.2 Specification 2: Triple difference-in-differences model

To more accurately identify the impact of TDCA tariff liberalisation on South African exports, the triple difference-in-differences approach of Frazer & Van Biesebroeck (2010) and Van Biesebroeck & Yi (2012) is employed. The methodology requires that the dependent variable and the preferential market access control varies along three dimensions: time, countries and products. The generalised form of the triple difference-in-differences approach is expressed as follows:

$$\begin{aligned} ln(1+X_{pjt}) = \alpha_1 &+ \beta_1 DPost_t + \beta_2 DPref_j \\ &+ \beta_3(DPost_t * DPref_j) + \beta_4(DPost_t * DPref_j * lnTP_{pjt}) + \gamma_{pj} + \gamma_{jt} \\ &+ \gamma_{pt} + \varepsilon_{pjt} \end{aligned} \quad (5.5)$$

There are two main differences between specification 1 and 2: firstly, to account for heterogeneity at the product-destination level, the standard difference-in-differences equation is modified by interacting the difference-in-differences term with a tariff preference measure. This measure accounts for the preference associated with a change in tariff regime at the product-destination level over time. It is measured as the difference between the reference and applied tariff. In the baseline specification, the reference tariff is measured as the mean tariff for the period prior to the treatment: $\overline{trf}_{pj,pre} = \sum trf_{pjt}/n$. The natural log of the tariff preference variable is calculated as follows: $lnTP_{pjt} = ln(1+\overline{trf}_{pj,pre}) - ln(1+trf_{pjt})$.[108] This tariff preference measure accounts for the preferential access specifically afforded to South African exporters, and captures the phasing of tariffs under the TDCA over time. It is predicted that $\beta_4 > 0$.

Secondly, the triple difference-in-differences approach requires the inclusion of three sets of interacted fixed effects (TJGV, 2015). The country-year fixed effects, γ_{jt}, control for import demand, level of development, and changes in the business cycle for each EU country over time.[109] These may also control for time-varying factors that influence the formation of a preferential trade agreement between South Africa and the EU country. The product-year fixed effects, γ_{pt}, control for product specific changes in demand, quality and production technology that are at a global level.[110] These may also control for product specific time varying factors

108 By construction the interaction between the tariff preference variable and the difference-in-differences term is zero in the pre-treatment period and non-zero in the post-treatment period for EU10 countries.

109 For example, increased exports to an EU country may not be entirely due to lower tariffs but also due to strong economic growth driving import demand.

110 For example, it may be the case that China has entered the market at a certain point in time for a certain set of products and this impacts on South African exporters' ability to make use of the tariff preferences in the face of Chinese competition.

that may influence the coverage and magnitude of trade preferences. The country-product fixed effects, γ_{pj}, allow for heterogeneity in the base level of exports of any product to any of the EU countries.[111] Therefore, the triple difference-in-differences approach, through the inclusion of the three sets of interacted fixed effects, allows one to isolate the tariff effect from other sources of variation in exports.

The intuition behind the approach can be expressed as follows: Assuming just two periods, (pre- and post-tariff liberalisation), two products (1 and 2) and two destinations (treatment and control), the triple difference-in-differences estimator calculates the relative increase in exports of product 1 versus product 2 into the treatment country. This is normalised by the corresponding relative increase in exports to the control country. This is in response to the treatment, which is a change in tariffs imposed by the treatment country for product 1 versus product two, normalised by the change in tariffs imposed by the control country.[112]

Frazer & Van Biesebroeck (2010) state that the triple difference-in-differences methodology is robust to policy endogeneity. A key contribution in this chapter, is an additional means of dealing with the endogeneity concern. The EU10 countries joined the EU in May 2004, and their tariff schedule aligned to that of existing EU15 members. Their accession into the EU afforded South African exporters TDCA-aligned tariff rates into EU10 countries. Therefore, the analysis deals with the policy endogeneity concern, since preferential access into the EU10 was granted unilaterally and exogenously by very nature of this accession process. The exogenous imposition of the TDCA tariff schedule upon EU10 countries also means that the typical pattern whereby tariff phase-downs are negotiated for non-sensitive products, while protection remains in sensitive products, is also negated. Therefore, this form of product-level endogeneity is also dealt with by virtue of preferential access into the EU10 being granted unilaterally and exogenously.

The triple difference-in-differences methodology and the exploitation of the EU10 accession into the EU, allows for a determination of the causal impact of TDCA tariff liberalisation on South African exports. This stands in contrast to a recent study by Kwaramba et al. (2015), which in examining this very question, does not deal with the endogeneity concern. As such,

111 For example, South African firms may have a comparative advantage in a certain product or group of products, and thus the trade-tariff link may be stronger for these products.

112 Ideally, the change in tariffs for the control country should be zero because there is no treatment. In the case of the EU15 control countries there is still a small amount of phasing down of tariffs as per the rules of the TDCA. According to these rules, by the start of the treatment period, when the EU10 joins the EU, 87 percent of industrial tariffs are duty-free. Therefore, EU15 countries have already undergone much of the tariff reform by the time the EU10 countries join the EU.

the presence of endogeneity potentially biases their estimates, and prevents them from estimating a causal relationship.

5.5.3 Intensive and extensive margin responses to tariff liberalisation

For the baseline results, equation (5.4) and (5.5) are estimated for aggregate South African exports to EU15 and EU10 countries. These results measure the impact of tariff liberalisation on aggregate trade.

To distinguish between the impact of tariff liberalisation along the intensive and extensive margins, this chapter follows the two-period approach used in Van Biesebroeck & Yi (2012) and Disdier et al. (2015). This two-period approach involves constructing the dependent variable for the periods prior and post the accession of the EU10 countries into the EU. For the intensive margin, only trade relationships that are positive in both periods are considered ($X_{pjt-1} > 0 \; and \; X_{pjt} > 0$). Equation (5.5) is then estimated for this reduced sample of surviving export relationships.[113]

For the extensive margin, a linear probability model is employed in order to estimate the probability of a new export relationship emerging as a result of the TDCA tariff liberalisation imposed on the EU10 countries.[114] In this case the dependent variable is a dummy variable equal to unity if there is a positive export flow for product p to destination j in period t, and zero otherwise ($X_{pjt} = \begin{cases} 1 \; if \; X_{pjt} > 0 \\ 0 \; if \; X_{pjt} = 0 \end{cases}$). This adjusted dependent variable is then applied in the equation (5.5) specification.

A key advantage for using the linear probability model, as noted by Frazer & Van Biesebroeck (2010), is that it allows one to keep a very general set of fixed effects. This is important when applying the triple difference-in-differences approach, which includes three sets of interacted fixed effects. For this reason, a number of studies in the applied empirical literature, focused on the effects of RTAs on trade, use the linear probability model to estimate trade effects along the extensive margin.[115] However, a disadvantage of the linear probability model is that the

113 The restriction of the sample to surviving export relationships is performed on export levels (zero and positive trade levels) prior to log transformation. Once the sample is identified, the dependent variable is log transformed.

114 It is worth noting that the extensive margin can include entry as well as 'negative entry' (exit). Firms can respond to a change in trade costs by entering a new market or by halting exports to a given market. In the case of declining tariffs, the propensity for entry rises while the propensity for negative entry declines.

115 For example, see Head, Meyer & Reis (2010), Frazer & Van Biesebroeck (2010), Disdier et al. (2015), Jean & Bureau (2016) and Cirera et al. (2016). Notably, all these studies include multiple sets of fixed effects.

predicted values are not restricted to lie between 0 and 1. Frazer & Van Biesebroeck (2010) note that this is unlikely to be an issue when using the triple difference-in-differences approach, because the coefficient estimates are identified off time variation across product-destination categories. They add that, conditional on the product-destination controls, the trade effect in terms of export probability is likely to be relatively small.[116]

To test whether the effects of tariff liberalisation on the intensive and extensive margins vary according to the elasticity of substitution of the traded product, equation (5.4) and (5.5) are estimated for products grouped according to the Rauch (1999) classification.[117] Rauch (1999) divides internationally traded commodities into three groups, in order of decreasing elasticity of substitution: homogeneous, reference-priced and differentiated products. Homogeneous products are those that have a reference price quoted on an organised exchange. Reference-priced products are homogeneous products that have a reference-price quoted only in trade publications. Differentiated products do not have a reference-price. In the analysis below, the two homogeneous product groupings are combined into a single homogeneous product group.[118] Marginal effects are estimated by Rauch (1999) product category by interacting the key explanatory variable with a dummy variable for the homogenous product grouping. The base category picks up the marginal effect for differentiated products.

5.6 Data

To conduct the empirical analysis, a product-destination level panel comprising trade and tariff data for the period 2000 to 2008 is generated. The trade data comprise South African manufacturing exports, recorded at the 6-digit level of the HS classification, to EU15 and EU10 countries, for the period 2000 to 2008. The 1996 revision of the HS classification is used since it best aligns with the period of analysis. The export data are rectangularised in order to form a balanced panel where there is a combination of zero and positive trade flows. These data are used to construct the dependent variable specified in the previous section. The data are taken from UN COMTRADE, accessed from the World Integrated Trade Solutions (WITS) database.

116 Given this concern, the predicted values for the linear probability model estimation are inspected and reported in Section 5.7.2.3.

117 Using a concordance developed by Jon Haveman these classifications are mapped to the trade data used in the analysis. (see https://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeData.html#Rauch).

118 The analysis focuses on manufacturing products, of which 81 and 19 percent are differentiated and homogeneous (homogenous and reference-priced) products, respectively. The relative share of homogenous products is smaller since many of these products are located within the agricultural and mining sectors.

A detailed discussion on the construction and cleaning of the export data is provided in Appendix C.1.

The tariff data are obtained from the WITS database, where the analysis primarily uses the Trade Analysis Information System (TRAINS) Raw Data, but in some instances, draws from the Integrated Data Base (IDB) dataset. The tariff data are used to generate the key explanatory variable specified in the previous section. The dataset is restricted to the trade regime applicable to South African imports to each destination country. A hierarchy of trade regime is applied in order to ensure the minimum applied tariff for each product-level trade flow. If multiple regimes apply to a tariff line in the raw data, the regime offering the lowest tariff is applied. This follows the hierarchy starting with TDCA, followed by Generalised System of Preferences (GSP), and then Most Favoured Nation (MFN). Tariff data are recorded at the prevailing HS revision, and thus the tariffs for each year need to be converted to the 1996 revision of the HS classification. The raw tariff data are recorded at the 8- or 10-digit level and are aggregated to the 6-digit level by taking the simple average tariff of the 8/10-digit tariffs within each 6-digit grouping. The tariff data include *ad valorem* as well and *ad valorem* equivalent (AVE) tariffs. A detailed discussion on the construction and cleaning of the tariff data is provided in Appendix C.2.

The trade and tariff data are merged in order to form a balanced panel. The panel comprises product-level export flows for 4 052 manufacturing products and the corresponding tariff, for the 15 EU15 and 10 EU10 countries, over the period 2000 to 2008.

5.7 The impact of TDCA tariff liberalisation on exports to the EU

The analysis comprises three parts: first, a descriptive analysis of the trends in exports and tariffs, pre and post the imposition of the TDCA on EU10 countries, is provided. Second, the regression estimates are analysed. Third, a series of robustness checks are reported.

5.7.1 Descriptive analysis of the structural break in trade and tariffs

This section provides initial evidence of tariff liberalisation and the response of exports.[119] The purpose of this is twofold: firstly, to show the structural change in tariffs imposed on South African exports into EU10 countries resulting from the implementation of the TDCA.

119 In this section, tariff reform refers to the implementation of the TDCA by EU10 countries, and thus an adjustment of their tariffs on South African exports.

Secondly, to relate this structural break in tariff levels to changes in South African export flows into these countries. Analysis of these trends in tariffs and trade provides motivation for the difference-in-differences approach applied in the next sub-section.

Figure 5.1 depicts clear structural breaks in the mean tariff applied on South African manufacturing exports when the TDCA was implemented by the EU15 countries in 2000, and when the EU10 countries joined the EU in 2004. The pre-TDCA tariff and the corresponding drop in the mean tariff level across these EU country groupings varies substantially. The mean tariff for the EU15 group was 5.3 percent (0.048 log points) in 1999 and dropped to 2.7 percent (0.025 log points) in 2000. The mean tariff for the EU10 group averaged 6.1 percent (0.056 log points) in the pre-TDCA period between 1999 and 2003 and dropped to 1.4 percent (0.012 log points) in 2004. It is evident that the drop in mean tariff applied by the EU10 country group is much larger and from a higher base than the EU15 country group.

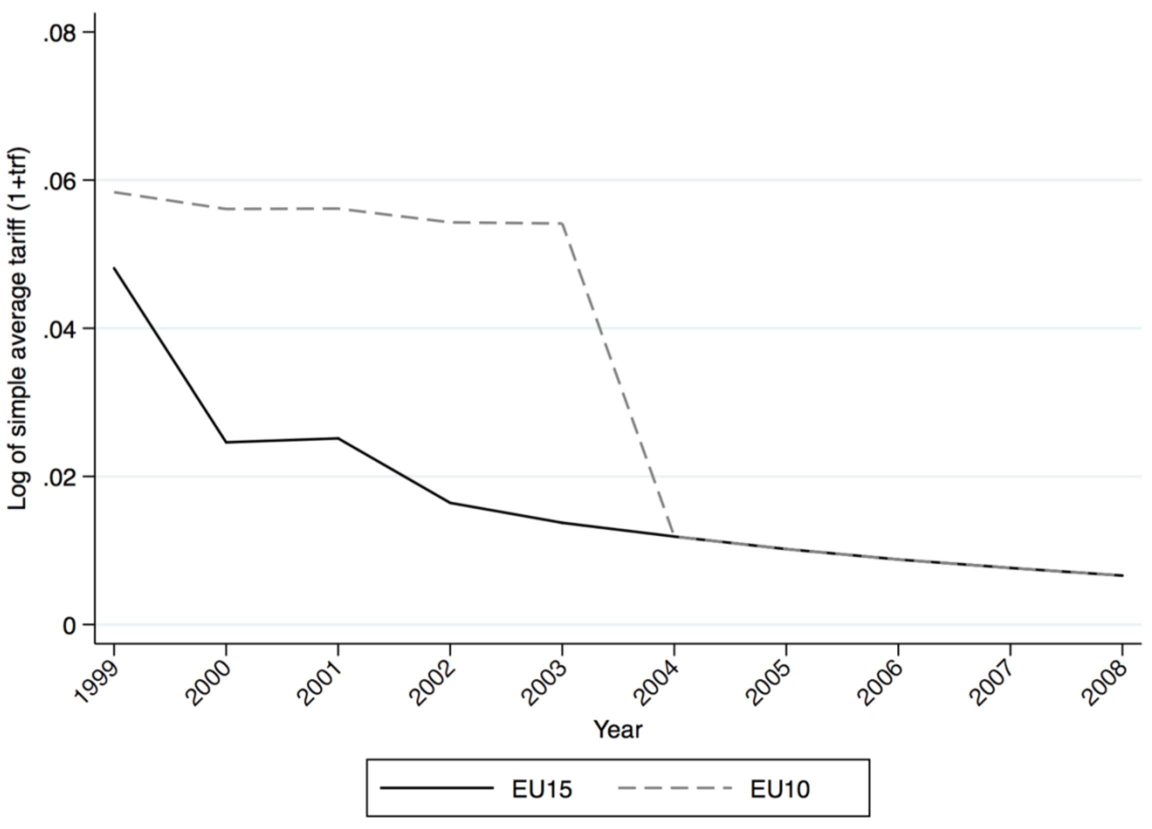

Figure 5.1: Simple average tariff for manufacturing products by EU grouping, 1999-2008

Source: Own calculations using data from TRAINS and the IDB accessed from the WITS database.
Notes: 1. Tariff value by EU group calculated as the natural logarithm of the simple average tariff (plus unity), applied across all products and countries within each group.

Figure 5.1 offers motivation for using the EU10 and EU15 country groupings as treatment and control groups in the difference-in-differences setting, respectively. First, since the drop in mean tariff for the EU10 group is substantial, 0.04 log points or 4.5 percentage points, there is sufficient variation to work with in the regression analysis. Second, the EU15 group acts as a good control since most of the trade effects relating to the EU15 group are likely to have occurred as a result of the initial structural change in tariffs in 2000. After the initial structural break, the mean tariff applied by EU15 countries continues to be phased-down. However, this phasing is small in magnitude and adjusting from a relatively low base.

There is substantial cross-country heterogeneity in TDCA tariff liberalisation among EU10 countries. Table 5.1 shows the pre- and post-TDCA simple average tariff imposed on South African manufacturing exports by each EU10 country. The absolute and percentage change is provided in columns (3) and (4), respectively. The pre-TDCA average tariff varies substantially across the individual countries within the EU10 country group (see column (1)). The pre-TDCA average tariff is relatively low in the case of Estonia, Latvia and Lithuania, thus resulting in a relatively minor drop in average tariff levels upon joining the EU (columns (3) and (4)). In contrast, the average pre-TDCA tariff was relatively high in Cyprus, Hungary, Malta, Poland and Slovenia. Thus, upon joining the EU, the decline in the average tariff on South African manufacturing exports is relatively substantial in the case of these EU10 countries.

Table 5.1: Simple average tariff for manufacturing products by EU10 country and EU country group, 2002 and 2008

	2002 (1)	2008 (2)	Absolute change (3)	Percentage change (4)
EU15	1.90	0.78	-1.12	-58.89
EU10	5.91	0.78	-5.13	-86.82
Cyprus	6.55	0.78	-5.77	-88.10
Czech Republic	4.97	0.78	-4.19	-84.32
Estonia	0.94	0.78	-0.16	-17.10
Hungary	6.22	0.78	-5.44	-87.48
Latvia	2.61	0.78	-1.83	-70.11
Lithuania	3.29	0.78	-2.51	-76.33
Malta	6.25	0.78	-5.47	-87.54
Poland	12.86	0.78	-1208	-93.94
Slovak Republic	5.09	0.78	-4.31	-84.68
Slovenia	10.33	0.78	-9.55	-92.45

Source: Own calculations using data from TRAINS and IDB accessed from WITS database.
Notes: 1. Column (1) shows the simple average tariffs in a year (2002) prior to EU10 country accession into the EU. Column (2) shows the simple average tariffs in a year post (2008) EU10 country accession into the EU. 2. Values reported in percentage terms.

There is cross-product heterogeneity in average tariff levels pre and post the imposition of the TDCA, as well as in the magnitude of TDCA tariff liberalisation. Table 5.2 shows the average tariff levels according to the Rauch (1999) product classification. The pre- and post-TDCA average tariff levels are highest for homogeneous products. Average tariff levels are lowest for differentiated products, except in the pre-TDCA period for the EU10 grouping where the average tariff for reference-priced goods is marginally lower.

The comparative absolute change in average tariff levels by product grouping among the EU15 and EU10 country groups, advances the claim that the methodological approach deals with policy endogeneity at the product-level. The EU15 were party to the trade negotiations and would have influenced the cross-product structure of tariff liberalisation. In contrast, the structure of tariff liberalisation was exogenously imposed on the EU10 countries. The difference in the absolute change in tariffs across product type between the EU15 and EU10 groups provides evidence of this. In column (3) of Table 5.2, the absolute change in average tariffs by product grouping among the EU15 is greater in magnitude for homogeneous, followed by reference-priced, and then differentiated products. This pattern is reversed for the EU10 country grouping, thus indicating that the TDCA determined tariff liberalisation presents an adjustment away from its initial tariff structure.

Table 5.2: Simple average tariff for manufacturing products for EU group by Rauch category, 2002 and 2008

	2002 (1)	2008 (2)	Absolute change (3)	% change (4)
<u>EU15</u>				
Differentiated	1.40	0.44	-0.97	-68.95
Reference-priced	2.60	1.23	-1.37	-52.66
Homogeneous	5.44	3.92	-1.53	-28.05
<u>EU10</u>				
Differentiated	5.90	0.44	-5.47	-92.62
Reference-priced	5.87	1.23	-4.64	-79.05
Homogeneous	7.61	3.92	-3.69	-48.55

Source: Own calculations using data from TRAINS and IDB accessed from WITS database.
Notes: 1. Column (1) shows the simple average tariffs in a year (2002) prior to EU10 country accession into the EU. Column (2) shows the simple average tariffs in a year post (2008) EU10 country accession into the EU. 2. Values reported in percentage terms. 3. Conservative version of Rauch (1999) classification is used.

In conjunction with the structural break in applied tariffs on South African manufacturing exports to EU10 countries, there is a corresponding structural break in export flows to these destinations. Figure 5.2 depicts trends in South African manufacturing exports to EU10 countries, in relation to its exports to EU15 countries, and its exports to the rest of the world. These relative trends are presented as export ratios. Aligning with accession into the EU in

2004, the ratios show a clear upward trend in exports flows to EU10 countries in relation to export flows to both EU15 countries (the control group), and the rest of the world. Thus, the structural break in export flows aligns with the structural break in tariffs.

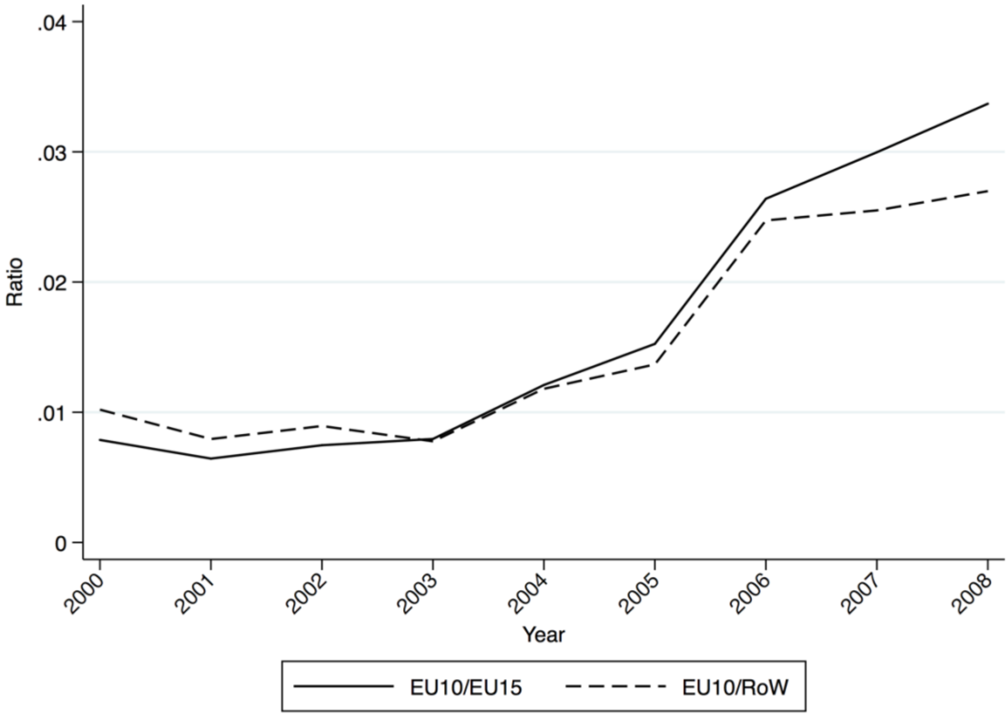

Figure 5.2: Ratios of exports to EU10 relative to exports to EU15, and exports to EU10 relative to exports to rest of world, 2000-2008

Source: Own calculations using data from UN COMTRADE accessed from WITS database.
Notes: 1. Export ratios calculated as total manufacturing exports to EU10 divided by, firstly, total manufacturing exports to the EU15, and secondly, total manufacturing exports to the rest of the world (RoW). 2. "RoW" refers to South African exports to the rest of the world. This group comprises all non-European destinations for which South Africa is not party to a trade agreement, for the period 2000 to 2008.

Given initial evidence pointing to a trade effect associated with the TDCA tariff liberalisation, it is also worth considering the margins of export growth to these EU groups.[120] In Figure 5.3, export growth for the period 1997 to 2008 is decomposed into the intensive margin, product and destination extensive margins, and dying export relationships.[121] The extensive margin is an important channel of export growth across both EU country groupings. The sum of the product and destination extensive margins account for 55 and 70 percent of export growth into the EU15 and EU10 groups, respectively. This is substantially higher than extensive margin

120 It is important to note that manufacturing exports to the EU10 countries constitutes a relatively small share of manufacturing exports to the EU – 0.78 and 3.24 percent in 2000 and 2008, respectively. Thus, the pattern of export growth along the intensive and extensive margins needs to be viewed in light of growth being off a small base.
121 The period 1997 to 2008 is considered because it captures the TDCA effect for both EU groupings and allows one to see whether the trade effect linked to tariff liberalisation materialized differently across these two country groupings.

growth to the rest of the world (41%). This stands in contrast to the standard trade decomposition findings that show the intensive margin as the main driver of trade growth.[122]

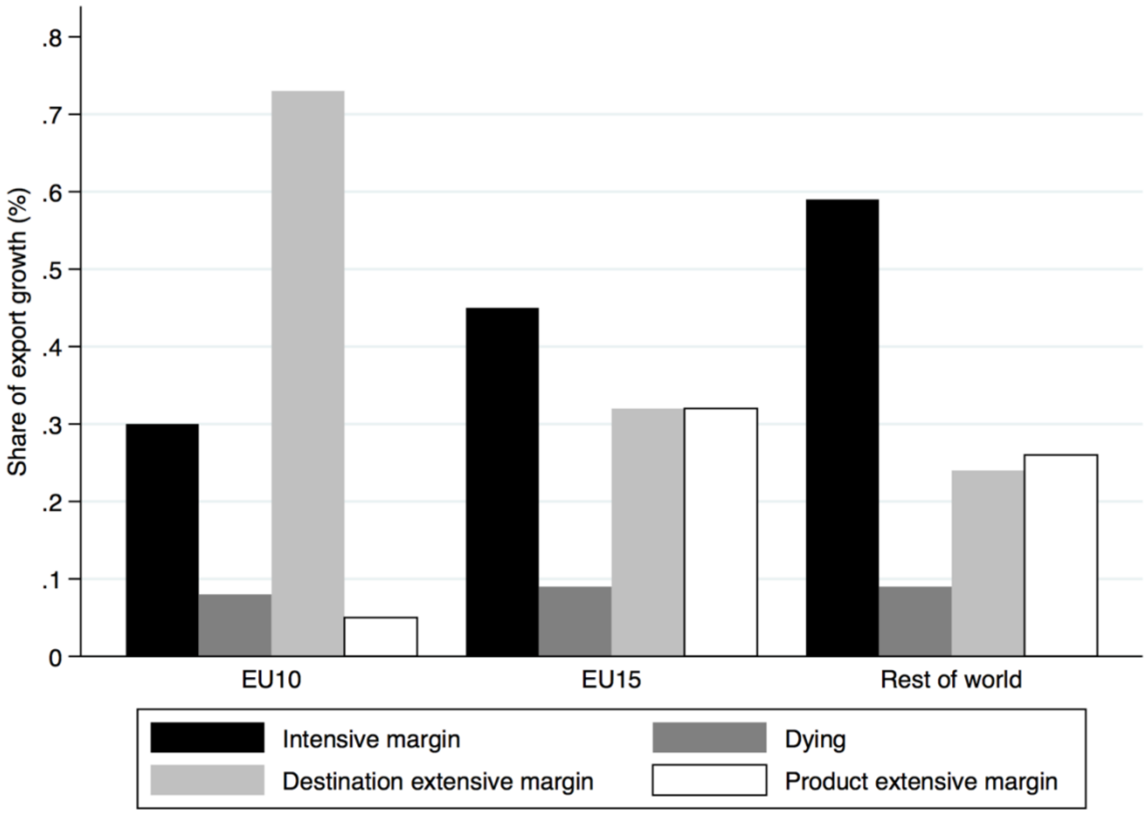

Figure 5.3: Decomposition of South Africa's manufacturing export growth by EU group and rest of world, 1997-2008

Source: Own calculations using data from UN COMTRADE accessed from WITS database.
Notes: 1. Intensive margin plus Destination extensive margin plus Product extensive margin less Dying equals 100 percent.

Therefore, export growth into the EU, particularly into the EU10 countries, is driven by diversification into new export relationships. Specifically, the export of products that are already a part of the South African export basket, but to new destinations. This suggests that the tariff effect is working through lowering the cost of entry into these countries, thus allowing for growth along the extensive margin. Using the triple difference-in-differences approach, the regression analysis to follow isolates this tariff effect by controlling for other factors that may be driving export growth.

122 For example, see Evenett & Venables (2002), Besedeš & Prusa (2011), and Zahler (2011).

5.7.2 Econometric results

This section starts by testing the parallel trends assumption. Thereafter, using specifications 1 and 2, the analysis considers the impact of tariff liberalisation on aggregate exports. This is followed by determining whether the trade effect varies by export growth margin. Finally, estimates showing whether the trade effect varies by product type is examined with reference to the theoretical predictions of the Besedeš & Cole (2017) model.

5.7.2.1 Testing the parallel trends assumption

The analysis in this section tests whether the parallel trends assumption holds and thus the validity of the EU15 countries as a control group.[123] Two formal tests of the parallel trends assumption are presented below: firstly, the placebo test, and secondly, the Autor (2003) pre-treatment trends test.[124]

Before formally substantiating the validity of the EU15 country control group, it is worth providing two intuitive motivations for the specification of this control group: first, EU15 and EU10 countries are geographically proximate, and thus South African exports follow similar trade and transport routes when being shipped to these destinations. Second, the process of EU10 country integration into the EU has resulted in monetary and fiscal policy convergence, whereby, prior to accession, EU10 countries have had to align their macroeconomic policy to that of the EU. The main point being that the adoption of tariffs did not coincide with large changes in macroeconomic policy, thus allowing one to identify the relationship between tariffs and trade.

The placebo test is used to determine whether the pre-treatment trends are the same. This involves estimating the difference-in-differences regression for the pre-treatment period only and defining fictitious treatment periods within the actual pre-treatment period (i.e. placebo policy). A common pre-treatment trend can be rejected, and hence the validity of the

[123] There are two possible critiques regarding the specification of the EU15 countries as the control group. Firstly, the TDCA comes into effect for the EU15 in 2000, and thus overlaps both the pre- and post-treatment periods of the EU10 group. Baier & Bergstrand (2007) show that the effect of trade agreements can be felt 10 to 15 years after implementation. Therefore, the effect of the TDCA tariff specific to the EU15 may be playing out during the period of analysis, and this may impact on the validity of the EU15 control group. Secondly, there are possible trade diverting effects linked to EU10 tariff liberalisation, where trade is diverted from the EU15 to the EU10 countries. In such a case, the estimated trade effect for the EU10 group is magnified.

[124] To deal with the potential limitations of the EU15 control group, the author created an alternative control group consisting of non-EU European countries (e.g. Moldova, Macedonia, Croatia, Turkey and Albania). Despite some evidence aligning with the results to follow, which can be provided, the estimates suffer from the relative paucity of South African exports being shipped to these destinations. Thus, the EU15 country grouping offers the best control group option.

difference-in-differences design brought into question, if the placebo policy has a statistically significant impact. The estimates for the placebo test are presented in Table 5.3 where specification 1 is estimated. Using four years of pre-treatment data, three fictitious treatment periods can be created – see columns (1)-(3).

Table 5.3: Testing for pre-TDCA tariff liberalisation trends

	Pre = 2000 Post = 2001-2003 (1)	Pre = 2000-2001 Post = 2002-2003 (2)	Pre = 2000-2002 Post = 2003 (3)
Post*Preference$_{jt}$	0.012	0.054**	0.019
	[0.029]	[0.027]	[0.031]
Observations	94 396	94 396	94 396
R-squared	0.728	0.728	0.728
F-test	0.179	3.941	0.395
Product-Destination FE	YES	YES	YES
Industry-time FE	YES	YES	YES

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the country-product level. 4. The sample is restricted to EU15 and EU10 countries over the pre-TDCA tariff liberalisation period, 2000 to 2003. 5. The EU15 and EU10 constitute the control and treatment countries, respectively. The treatment period is defined as 2001-2003, 2002-2003, and 2003 in the column (1), (2) and (3) estimations, respectively. 6. Product-destination combinations for which there is not a single positive trade flow over the full period (2000-2004) are dropped from the sample.

The placebo tests provide reasonably strong evidence validating the use of the EU15 countries as the control group. When the fictitious treatment period is defined as either 2001-2003 or 2003 (see columns (1) and (3)), the coefficient estimate for the difference-in-differences estimator is not statistically significant. This means that a common pre-treatment trend cannot be rejected. However, when the fictitious treatment period is defined as 2002-2003 (column (2)), the statistically significant coefficient estimate indicates rejection of the common pre-treatment trend.

Pre-emptive trade effects may provide an explanation for the failed placebo test. As mentioned earlier, trade may increase in anticipation of a trade agreement as industries gear up and invest in delivery systems and infrastructure (McLaren, 1997), or as firms try and establish "first mover advantage" (Frankel, 2010a). In the case of EU10 country accession into the EU, negotiations started in the 1990s, ended 13 December 2002, the treaty was signed 16 April 2003, and accession took place in May 2004. By the end of 2002, and certainly by 2003, there must have been a high degree of certainty of the impending accession, and the terms of the accession (such as being party to EU trade agreements). Drawing on McLaren (1997) and Frankel (2010a), it is plausible that exporting firms may have responded pre-emptively to the ensuing accession. It is thus possible that the placebo test is capturing these pre-emptive trade effects, which would be consistent with similar findings in Baier & Bergstrand (2007), Magee (2008) and Frankel (2010a). This argument is investigated further in Section 5.7.3.2, where the robustness of the relationship to the exclusion of the 2002-2003 period, is tested.

To strengthen the case for the choice of control group, a further test of the parallel trends assumption is implemented – the pre-treatment trends test by Autor (2003). The test involves interacting the difference-in-differences estimator with leads (year dummies for the pre-treatment period) and lags (year dummies for the post-treatment period) of the treatment, and thus allowing for time varying treatment effects. The parallel trends assumption is upheld if the estimates for the leads are close to zero, and the estimates for the lags are different from zero. These estimates are then presented graphically, as shown in Figure 5.4.

The estimates for the pre-treatment trends test, presented graphically in Figure 5.4, suggest that the parallel trends assumption holds. The estimates for the leads (1-3 years prior) are close to zero and not statistically significant, suggesting that the parallel trends assumption holds.[125] The estimates for the lags confirm the trade effect, but are irregular. The coefficient for the lags pertaining to the year of accession (2004) and 4 years after (2008) are positive and statistically significant. The estimates for the lag one year after accession (2005) is negative and statistically significant. The estimates for the lags two and three years after accession are negative and positive but not statistically significant. Nevertheless, there appears to be an upward trend after the initial positive trade effect occurring on the year of accession. These post-treatment export dynamics may be explained by an initial sudden inflow of exports upon accession in 2004, with the negative estimates in 2005 and 2006 pointing to the more difficult task of establishing trade relationships after initial entry. The positive estimates in 2007 and 2008, suggests that once established, these export relationships start to grow substantially. As such, this provides strong motivation for not only considering the aggregate trade effect of the tariff liberalisation but also the intensive and extensive margin effects.

[125] Testing whether the estimates for the leads are jointly equal to zero cannot be rejected at the 10 percent level ($F(3, 33052) = 2.08$; Prob. > F = 0.1008).

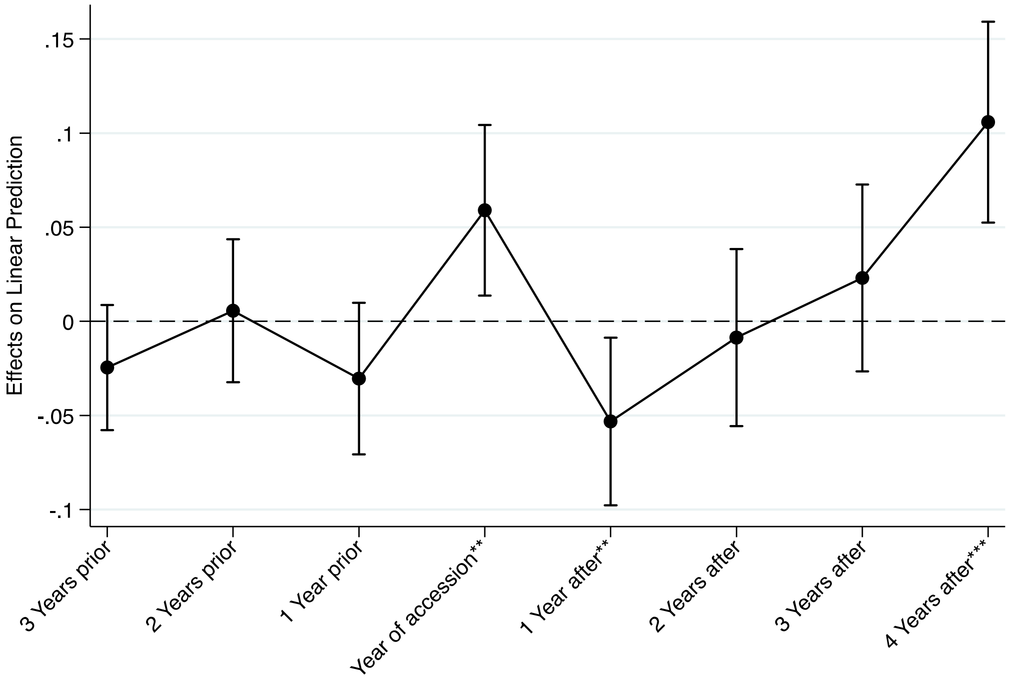

Figure 5.4: Estimated impact of TDCA tariff liberalisation on exports to EU10 countries before and after implementation

Notes: 1. The asterisk next to the horizontal axis labels represents the statistical significance of the difference-in-differences variable in that period (*** p<0.01, ** p<0.05, * p<0.1). 2. Standard errors are clustered at the country-product level. 3. The sample is restricted to EU15 and EU10 countries over the period 2000 to 2008. 5. Product-destination combinations for which there is not a single positive trade flow over the full period (2000-2008) are dropped from the sample. 6. Year of accession is 2004.

Both the ‘placebo’ and the pre-treatment trends tests validate the use of the EU15 countries as a control group. This indicates that the difference-in-differences specification, specified above, is valid.

5.7.2.2 The aggregate trade effect of TDCA tariff liberalisation on exports into EU10 countries

In Table 5.4 the estimates for the effect of tariff liberalisation on aggregate exports are reported. The estimates for specification 1 are reported in columns (1) and (2), with the former not controlling for fixed effects, and the latter controlling for a full set of interacted fixed effects (the most restricted model). The setup for specification 2 in columns (3) and (4) is analogous.[126]

[126] Estimations where the various fixed effects are iteratively included in each of the specifications are reported in Appendix Table C. 5 and Appendix Table C. 6.

The estimates for the standard difference-in-differences specification, not controlling for fixed effects, shown in column (1), points to a positive trade effect. The positive and statistically significant coefficient estimate for the difference-in-differences estimator ($Post*Preference_{jt}$) indicates that the mean change in aggregate trade, from before to after the TDCA tariff liberalisation, was 4.9 percent higher for the EU10 countries in relation to the EU15 countries.[127] The treatment dummy ($Preference_j$) indicates the baseline difference in aggregate trade between the EU10 (treatment) and EU15 (control) countries prior to treatment. The negative and statistically significant coefficient estimate indicates higher aggregate exports to EU15 countries prior to treatment. The trend dummy ($Post_t$) shows the expected mean change in aggregate trade from before to after the treatment among the control group countries. The positive and statistically significant coefficient on this variable shows a positive trend in aggregate exports to EU15 countries. The overall treatment effect is a combination of the effect shown in the difference-in-differences estimator plus the trend effect.

It is evident in column (2) that the positive trade effect remains after controlling for various sources of unobserved heterogeneity.[128] The inclusion of the interacted fixed effects allows the regression estimation to isolate the tariff effect from these alternative sources of variation in exports, thereby identifying the tariff effect. For example, the industry-time fixed effects control for demand shocks that could be correlated with the type of products exported to EU10 countries.[129] The product-destination fixed effects control for the comparative advantage determined base level of exports of each product to each EU country. The positive and statistically significant estimate for the difference-in-differences estimator indicates that the mean change in aggregate trade for EU10 countries is 3.8 percent higher relative to EU15 countries. After controlling for alternative sources of variation in exports, the trade effect is slightly lower.

The standard difference-in-differences approach applied in specification 1 does not take into account product-level variation in preferences associated with the tariff liberalisation. For example, one would expect a stronger export response in those products experiencing large

127 Percentage change calculated using: $100 \times (e^{\beta} - 1)$

128 In order to control for the high-dimensionality interacted fixed effects in this large dataset, the *reghdfe* Stata package developed by Sergio Correia (Correia, 2016) is applied. This estimator has been applied in the estimation of gravity models, which include importer-time, exporter-time and importer-exporter fixed effects. For example, see Head & Meyer (2014), Kohl (2014), and Mayer & Thoenig (2016).

129 Instead of including product-year fixed effects, industry-year fixed effects are included. This is because in the post-treatment period, tariffs at the product level all shift to the same level across all EU countries (EU10 and EU15). Due to no variation at the country level, the product-year fixed effects may possibly wipe out all the variation. This is especially important in the specification 2 estimations. Industry is defined at the 2-digit level of the HS classification.

reductions in tariffs. To explore this relationship, specification 2 includes an interaction between the difference-in-differences term and the preference margin ($Post*Preference*ln(TP)_{pjt}$).

Table 5.4: The effect of TDCA tariff liberalisation on aggregate trade

	Specification 1		Specification 2	
	(1)	(2)	(3)	(4)
$Post_t$	0.111***		0.111***	
	[0.007]		[0.007]	
$Preference_j$	-0.689***		-0.689***	
	[0.015]		[0.015]	
$Post*Preference_{jt}$	0.048***	0.038**	0.035**	
	[0.015]	[0.015]	[0.017]	
$Post*Preference*ln(TP)_{pjt}$			0.231	0.317*
			[0.155]	[0.162]
Observations	297 477	297 477	297 477	297 477
R-squared	0.015	0.661	0.015	0.662
F-test	918.9	6.284	691	3.811
Product-Destination FE	NO	YES	NO	YES
Destination-time FE	N/A	N/A	NO	YES
Industry-time FE	NO	YES	NO	YES

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the country-product level. 4. The sample is restricted to EU15 and EU10 countries over the period 2000 to 2008. 5. Product-destination combinations for which there is not a single positive trade flow over the full period (2000-2008) are dropped from the sample. 6. The EU15 and EU10 constitute the control and treatment countries, respectively. The treatment period is defined as the period 2004 to 2008. 7. One is not able to control for destination-time fixed effects in Specification 1 since this wipes out all the variation in the key explanatory variable. Hence, the estimation is a standard difference-in-differences estimation.

While there is strong evidence of a positive aggregate trade effect in specification 1, the evidence for a positive aggregate trade effect in specification 2 – when taking into account product-level heterogeneity in tariff preferences – is weaker. When including the full set of interacted fixed effects, the coefficient estimate for the tariff preference interaction term is positive, as expected, but only statistically significant at the 10 percent level (p-value of 0.051). Given the number of observations in the estimation, the trade effect is not as strong as expected.

However, it is worth noting at this stage, that there is evidence below showing a stronger positive trade effect for the tariff preference interaction term. The corresponding coefficient is positive and statistically significant at the 5 percent level. This is evident when, firstly, periods that may be influenced by pre-emptive trade effects are excluded from the estimation (see Section 5.7.3.2). Secondly, when the data is collapsed into single pre- and post-intervention periods (see Section 5.7.3.3). Thirdly, when the analysis is restricted to products that have undergone full trade liberalisation prior to the intervention – i.e. when the EU10 countries accede to the EU (see Section 5.7.3.4).

Therefore, the estimates reported in Table 5.4 point to a positive aggregate trade effect.[130] However, it is important to note that the aggregate effect confounds two export growth dynamics. The results reflect an 'average' of both the extensive and intensive margins. This is because the specification of the dependent variable adds one to the export value for missing exports (i.e. zeros).[131] This is a shortcoming of the estimation approach.[132] The next sub-section distinguishes between the impact of tariff liberalisation on the extensive and intensive margins.

5.7.2.3 The effect of tariffs on the margins of trade

Table 5.5 presents estimates measuring the impact of the tariff liberalisation on South African exports to the EU10 countries along the intensive and extensive margins. Columns (1) and (2) present the estimates for the intensive and extensive margins, respectively.[133]

The estimates suggest that the impact of the tariff liberalisation does not intensify existing export relationships with EU10 countries. The coefficient estimate for the intensive margin estimation in column (1) is not statistically significant. The intensive margin estimates run contrary to the hypothesised outcome.

The estimates pertaining to the extensive margin indicate that the trade effect is driven by adjustments along the extensive margin. This is consistent with the hypothesised outcome. The linear probability model estimate in column (2) measures the propensity for the creation of a new export relationship with a EU10 country, given a change in preferential access into the market.[134] The positive and statistically significant coefficient estimate shows that a 1 percent

130 To test the robustness of these estimates, a country-level fixed effects gravity equation is estimated. The gravity equation estimates are reported in Appendix Table C. 3, and confirm a positive aggregate trade effect.

131 Of the 297,477 observations present in specifications 1 and 2, 179,147 are zero trade flows, the remaining 118,330 observations are positive trade flows.

132 In order to produce unbiased estimates of the intensive and extensive margins of trade, the standard approach in the gravity equation literature, is to employ the PPML estimator developed by Silva & Tenreyro (2006). However, the PPML estimator does not allow one to include the three sets of interacted fixed effects needed to estimate the triple difference-in-differences estimator. Another approach to dealing with observations with zero trade values in the dependent variable, is to apply the inverse hyperbolic sine transformation. To test the robustness of the estimates of the aggregate trade effects, this transformation is applied to the dependent variable in specifications 1 and 2. The estimates reported in Appendix Table C. 7 show that the positive trade effect holds and that the results are thus robust.

133 A two-period application of specification 2, with the full set of interacted fixed effects, is applied in these estimations. The mean value for exports and tariff preferences, at the product-destination level, is calculated for the pre-period, which comprises years 2000 to 2001, and the post-period, which comprises years 2006 to 2008. The choice of years used to construct the mean values of the dependent and key explanatory variables, excludes those that are two periods pre or post the policy intervention. This is done so as to avoid including the years 2002 and 2003 in the pre-period, since it is possible that pre-emptive trade emerges in these years. This is discussed further in Section 5.7.3.2. Using latter years in the post-period allows for the trade effects to materialise.

134 Majority of the predicted values generated from the linear probability model estimation sit within the 0 to 1 bound. Only 12 out of the 53,544 observations have a predicted value in excess of 1. The majority sit around the mean predicted value of 0.72, falling within the middle band of the distribution, and thus driving the estimates. This provides support for the use of the linear probability model.

increase in preferential access is associated with an increased likelihood of entry of 0.57 percent.

Table 5.5: The effect of TDCA tariff liberalisation on the intensive and extensive margins

	Intensive Margin (1)	Extensive Margin (2)
Post*Preference*ln(TP)$_{pjt}$	1.238	0.565***
	[1.451]	[0.174]
Observations	23,118	53,554
R-squared	0.823	0.384
F-test	0.729	10.56
Product-Destination FE	YES	YES
Destination-time FE	YES	YES
Industry-time FE	YES	YES

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the country-product level. 4. The sample is restricted to EU15 and EU10 countries for the pre and post periods. The mean values of the dependent and explanatory variables are calculated for the pre-period, using the years 2000 to 2001, and for the post-period, using years 2006 to 2008. 5. Product-destination combinations for which there is not a single positive trade flow over both periods are dropped from the sample. 6. For the intensive margin estimations, the sample is restricted to product-destination combinations that are positive in both the pre and post periods. In the intensive margin estimations, the dependent variable is measured as the natural log of the export value for each product-destination combination. 7. For the extensive margin estimations, the sample is restricted to product-destination combinations that are positive across both periods, zero in the initial period and positive in the final period, and positive in the initial period and zero in the final period. In the extensive margin estimations, the dependent variable is measured as zero or unity.

These results indicate that TDCA tariff liberalisation is driving the diversification of South Africa's export structure into the EU10 markets. Drawing on Figure 5.3, which shows that 70 percent of export growth is due to the destination extensive margin, it is likely that the majority of this diversification is occurring along the destination extensive margin.[135] In other words, the tariff liberalisation is driving South African firms to extend the export of existing products to new destination markets.[136] The analysis now focuses on whether these trade effects vary according to product type, particularly, the degree to which a product is differentiated.

5.7.2.4 The effect of tariffs by product type

The estimations reported above impose a common coefficient across products. However, as predicted in Besedeš & Cole (2017), different products respond differently to changes in the costs of trade, such as tariff liberalisation. Therefore, this section reports the estimations for specifications 1 and 2, which measure the marginal effects by Rauch (1999) product category.

[135] This strong extensive margin trade effect needs to be viewed in context of EU10 countries constituting a relatively small share of South African manufacturing exports into the EU – 1.19 and 3.24 percent in 1997 and 2008, respectively. Thus, these large gains on the extensive margin have occurred off a relatively low base, where strong extensive margin effects are more likely.

[136] Future analyses could test whether the probability of entry of a product into EU10 markets is greater if the product was initially exported to an EU15 market.

This is done by interacting the key explanatory variable with a dummy variable controlling for the homogenous product grouping. The base category picks up the marginal effect for differentiated products, and the sum of the base category and the homogenous product grouping interaction term picks up the marginal effect for homogenous products.

Drawing on the predictions of the Besedeš & Cole (2017) heterogeneous firm model, tariff liberalisation emerging from the TDCA is expected to have a larger impact on differentiated product markets. Howveer, the estimates in Table 5.6 provide weak evidence for this trade response to tariff liberalisation. The coefficient estimate for the base category (Post*Preference$_{jt}$) in specification 1 (column (1)), which picks up the marginal effect for differentiated products, is positive but only statistically significant at the 10 percent level. Given the number of observations in the estimation, this trade effect is not as strong as expected. The estimate picking up the marginal effects for homogeneous products is not statistically significant (Post*Preference$_{jt}$*Homogenous). Further, neither of these coefficient estimates in specification 2 are statistically significant.

Table 5.6: The effect of TDCA tariff liberalisation on aggregate trade by Rauch classification

	Specification 1 (1)	Specification 2 (2)
Post*Preference$_{jt}$	0.029*	
	[0.015]	
Post*Preference$_{jt}$*Homogenous	0.058	
	[0.054]	
Post*Preference*ln(TP)$_{pjt}$		0.314
		[0.266]
Post*Preference*ln(TP)$_{pjt}$*Homogenous		-0.006
		[0.308]
Observations	277,983	277,983
R-squared	0.663	0.664
F-test	2.967	1.892
Product-Destination FE	YES	YES
Destination-time FE	N/A	YES
Industry-time FE	YES	YES

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the destination-product level. 4. The sample is restricted to EU15 and EU10 countries over the period 2000 to 2008. 5. Product-destination combinations for which there is not a single positive trade flow over the full period (2000-2008) are dropped from the sample. 6. The homogenous product group dummy is interacted with the key explanatory variable in each specification. The sum of the base category, which measures the marginal effect for differentiated products, and the homogeneous product group interaction term, provides the marginal effect for homogeneous products. 7. Specification 1 and 2 are estimated using the conservative version of the Rauch (1999) classification. See Appendix Table C. 8 for the estimations using the liberal version of the classification. The estimates are qualitatively consistent across the two versions of the classification. 8. The EU15 and EU10 countries constitute the control and treatment groups, respectively. The treatment period is defined as the period 2004 to 2008.

The strong extensive margin trade effect reported in Table 5.5, is driven by entry in differentiated product markets. This is evident in column (2) of Table 5.7, where the coefficient estimates for the extensive margin specification are statistically significant for both the base category (Post*Preference*ln$(TP)_{pjt}$) and the homogenous product interaction term (Post*Preference*ln$(TP)_{pjt}$*Homogenous). Consistent with earlier estimates showing no intensive margin effect, the coefficient estimates in the intensive margin specification are not statistically significant.

Table 5.7: The effect of TDCA tariff liberalisation on the margins of trade by Rauch classification

	Specification 2	
	Intensive margin (1)	**Extensive margin (2)**
Post*Preference*ln$(TP)_{pjt}$	1.162	0.899***
	[1.549]	[0.242]
Post*Preference*ln$(TP)_{pjt}$*Homogenous	-0.340	-0.626**
	[2.705]	[0.301]
Observations	21,336	49,902
R-squared	0.824	0.383
F-test	0.284	7.185
Product-Destination FE	YES	YES
Destination-time FE	YES	YES
Industry-time FE	YES	YES

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the country-product level. 4. The sample is restricted to EU15 and EU10 countries for the pre and post periods. The mean values of the dependent and explanatory variables are calculated for the pre-period, using the years 2000 to 2001, and for the post-period, using years 2006 to 2008. 5. Product-destination combinations for which there is not a single positive trade flow over both periods are dropped from the sample. 6. For the intensive margin estimations, the sample is restricted to product-destination combinations that are positive in both the pre and post periods. In the intensive margin estimations, the dependent variable is measured as the natural log of the export value for each product-destination combination. 7. For the extensive margin estimations, the sample is restricted to product-destination combinations that are positive across both periods, zero in the initial period and positive in the final period, and positive in the initial period and zero in the final period. In the extensive margin estimations, the dependent variable is measured as zero or unity. 8. The homogenous product group dummy is interacted with the key explanatory variable in each specification. The sum of the base category, which measures the marginal effect for differentiated products, and the homogeneous product group interaction term, provides the marginal effect for homogeneous products. 9. Specification 2 is estimated using the conservative version of the Rauch (1999) classification. See Table C. 9 for the estimations using the liberal version of the classification. The estimates are qualitatively consistent across the two versions of the classification. 10. The EU15 and EU10 countries constitute the control and treatment groups, respectively. The treatment period is defined as the period 2004 to 2008.

Consistent with the predictions of the Besedeš & Cole (2017) model, the magnitude of the extensive margin trade effect is larger in the case of differentiated products relative to homogenous products.[137] The marginal effect for the base category shows that a 1 percent increase in preferential access for differentiated products is associated with an increased likelihood of entry of 0.9 percent. In the case of homogenous products, the increased likelihood

[137] The expectation is not that there is no effect for homogeneous products, but rather that the effect is stronger for differentiated products.

of entry, given a 1 percent increase in preferential access, is lower at 0.27 percent (0.899 less 0.626).

The estimates indicate that TDCA tariff liberalisation has enabled firms to overcome market entry costs, thus allowing diversification into EU10 markets. In particular, TDCA tariff liberalisation has been effective in driving the diversification of South Africa's export structure in differentiated product markets. It is noted in Rauch (1999) that export market search costs are higher and matching more difficult in differentiated products markets. Therefore, this trade policy intervention has been effective in driving the diversification of South Africa's export structure in products markets that are typically associated with higher search and entry costs.

5.7.3 Robustness checks

To check the robustness of the baseline estimates reported above, the following tests are carried out: firstly, the estimations are run using an alternative key explanatory variable. Secondly, the estimations are run excluding data for two years in the pre-treatment period, which were identified as problematic in the parallel trends tests above (2002 and 2003), and which may be associated with pre-emptive trade effects. Thirdly, the estimations are run after collapsing export and tariff data for the pre- and post-treatment years into single pre- and post-treatment periods. Fourth, the regressions are estimated for a subset of products that have undergone full liberalisation prior to EU10 country entry into the EU.

5.7.3.1 Alternative key explanatory variable

In this first set of robustness checks, the regressions are estimated using an alternative specification of the key explanatory variable. Following Van Biesebroeck & Yi (2012) and TJGV (2015), the natural log of tariffs plus unity for product p to destination j in period t is employed as the key explanatory variable. The full specification – specification 3 – is detailed in equation (5.6):

$$ln(1 + X_{pjt}) = \alpha_1 + \beta_1 ln(1 + trf_{pjt}) + \gamma_{pj} + \gamma_{jt} + \gamma_{pt} + \varepsilon_{pjt} \quad (5.6)$$

Following the triple difference-in-differences approach applied in Van Biesebroeck & Yi (2012) and TJGV (2015), the full set of interacted fixed effects are included. Analogously to specification 2 above, the dependent variable measures aggregate exports, or alternatively the intensive or extensive margins of exports. The expected sign of the estimated coefficient is negative, since exports are expected to increase as tariffs fall.

The estimates using an alternative measure of tariff liberalisation show that the manner in which TDCA tariff liberalisation impacts on South African exports to EU10 countries is consistent with that evident in the baseline estimates reported above. The negative and statistically significant coefficient estimates in columns (1) and (2) of Table 5.8 show that declining tariff levels lead to higher export levels. These higher aggregate export levels are driven by the trade response in differentiated products. Consistent with earlier estimates, there is no statistically significant trade effect along the intensive margin (columns (3) to (4)). The negative and statistically significant coefficient estimates in columns (5) and (6), show that the trade effect is driven by the creation of new export relationships in differentiated product markets. Contrary to the estimates in Table 5.7 the extensive margin effect on homogeneous products does not hold when using this alternative measure of tariff liberalisation. The overall pattern evident in Table 5.8 indicates that the estimates are robust to an alternative specification of tariff liberalisation.

Table 5.8: Estimations with alternative specification of key explanatory variable

	Specification 3					
	Aggregate		Intensive margin		Extensive margin	
	Total	Rauch	Total	Rauch	Total	Rauch
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(1+trf_{pjt})$	-0.357***	-0.566**	-1.235	-1.017	-0.687***	-0.714***
	[0.136]	[0.235]	[0.843]	[0.936]	[0.144]	[0.179]
$\ln(1+trf_{pjt})$*Homogenous		0.314		-0.069		-0.412
		[0.269]		[2.584]		[0.258]
Observations	297 477	277,983	23,118	21,336	53,554	49,902
R-squared	0.662	0.664	0.823	0.824	0.384	0.383
F-test	6.924	3.773	2.148	0.595	22.66	8.146
Product-Destination FE	YES	YES	YES	YES	YES	YES
Destination-time FE	YES	YES	YES	YES	YES	YES
Industry-time FE	YES	YES	YES	YES	YES	YES

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the country-product level. 4. For the aggregate estimations in columns (1) and (2), the sample is restricted to EU15 and EU10 countries over the period 2000 to 2008. For the intensive and extensive margin estimations in columns (3) to (6), the sample is restricted to EU15 and EU10 countries for the pre and post periods. The mean values of the dependent and explanatory variables are calculated for the pre-period, using the years 2000 to 2001, and for the post-period, using years 2006 to 2008. 5. Product-destination combinations for which there is not a single positive trade flow over the full period are dropped from the sample. 6. For the intensive margin estimations, the sample is restricted to product-destination combinations that are positive in both the pre and post periods. In the intensive margin estimations, the dependent variable is measured as the natural log of the export value for each product-destination combination. 7. For the extensive margin estimations, the sample is restricted to product-destination combinations that are positive across both periods, zero in the initial period and positive in the final period, and positive in the initial period and zero in the final period. In the extensive margin estimations, the dependent variable is measured as zero or unity. 8. The homogenous product group dummy is interacted with the key explanatory variable in each specification – columns (2), (4) and (6). The sum of the base category, which measures the marginal effect for differentiated products, and the homogeneous product group interaction term, provides the marginal effect for homogeneous products. 9. The conservative version of the Rauch (1999) classification is used in these estimations.

5.7.3.2 Excluding the years 2002 and 2003

In Section 5.7.2.1, the placebo test, where the years 2002 and 2003 are defined as the placebo treatment periods, failed to uphold the parallel trends assumption. As discussed earlier, pre-emptive trade effects provide a potential explanation for this. Drawing on McLaren (1997) and Frankel (2010a), it is plausible that exporting firms, seeking 'first mover advantage', may have responded pre-emptively to the ensuing accession and the impending TDCA driven tariff liberalisation imposed on EU10 countries. If this were the case, the results for the baseline set of estimates are likely to be biased downward. To test this, specifications 1 and 2 are estimated excluding data for the years 2002 and 2003 in the pre-treatment period. If these estimations yield higher coefficient estimates, then this provides support for the above assertion. These estimates are presented in Panel A of Table 5.9, which also includes the main set of results taken from Table 5.4 and Table 5.6 (Panel B) for comparative purposes.

When comparing the coefficient estimates for Panel A with the corresponding estimates in Panel B, support is found for the assertion of pre-emptive trade effects. Not only are the estimates for the regressions that exclude 2002 and 2003 (panel A) qualitatively consistent with the baseline set of results (Panel B), these estimates are also greater in magnitude. Further, the coefficient estimate for the tariff preference interaction term in specification 2 is marked by greater statistical significance – at the 5 percent level (column (3)). Thus, the inclusion of 2002 and 2003 biases the main results downward, suggesting the presence of pre-emptive trade effects, and in turn, offers an explanation for one of the three placebo tests failing to uphold the parallel trends assumption.

Table 5.9: Estimates for specifications 1 and 2, excluding 2002 and 2003

	Specification 1		Specification 2	
	Total	Rauch	Total	Rauch
	(1)	(2)	(3)	(4)
Panel A: Estimates excluding 2002 and 2003 from the pre-treatment period				
Post*Preference$_{jt}$	0.054***	0.043**		
	[0.020]	[0.020]		
Post*Preference$_{jt}$*Homogenous		0.052		
		[0.074]		
Post*Preference*ln(TP)$_{pjt}$			0.405**	0.411
			[0.194]	[0.352]
Post*Preference*ln(TP)$_{pjt}$*Homogenous				-0.016
				[0.388]
Panel B: Estimates repeated from Table 5.4 and Table 5.6				
Post*Preference$_{jt}$	0.038**	0.029*		
	[0.015]	[0.015]		
Post*Preference$_{jt}$*Homogenous		0.058		
		[0.054]		
Post*Preference*ln(TP)$_{pjt}$			0.317*	0.314
			[0.162]	[0.266]
Post*Preference*ln(TP)$_{pjt}$*Homogenous				-0.006
				[0.308]
Observations	211,946	197,785	211,946	197,785
R-squared	0.662	0.663	0.663	0.665
F-test	7.585	3.032	4.372	2.341
Product-Destination FE	YES	YES	YES	YES
Destination-time FE	N/A	N/A	YES	YES
Industry-time FE	YES	YES	YES	YES

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the country-product level. 4. The sample is restricted to EU15 and EU10 countries over the period 2000 to 2008, with data for the pre-treatment years, 2002 and 2003, excluded from the sample. 5. Product-destination combinations for which there is not a single positive trade flow over the full period (2000-2008) are dropped from the sample. 6. The EU15 and EU10 constitute the control and treatment countries, respectively. The treatment period is defined as the period 2004 to 2008. 7. One is not able to control for destination-time fixed effects in Specification 1 since this wipes out all the variation in the key explanatory variable. Hence, the estimation is a standard difference-in-differences estimation. 8. The homogenous product group dummy is interacted with the key explanatory variable in each specification – columns (2) and (4). The sum of the base category, which measures the marginal effect for differentiated products, and the homogeneous product group interaction term, provides the marginal effect for homogeneous products. 9. The conservative version of the Rauch (1999) classification is used in these estimations.

5.7.3.3 Two-period analysis – aggregating data into a pre and post period

Bertrand, Duflo & Mullainathan (2004) critique the application of the difference-in-differences approach when using long time series. They argue that there is potentially serial correlation of the error term since it is typically the case that the dependent variable is highly positively correlated. As such, the presence of multiple pre and post periods may artificially inflate the estimated relationship. One solution is to aggregate data into two periods (pre and post) and then apply the difference-in-differences estimation.

To address this critique, specification 1, specification 2, and the intensive and extensive margin estimations, are estimated using data aggregated into pre and post periods. The data is aggregated by measuring the mean value of exports and tariffs for each product-destination combination in the two periods. Panels A and B of Table 5.10 present estimates that are comparable to those reported in the baseline set of estimates above. In Panel A, data for the full set of years is collapsed into pre and post periods. Panel B excludes data for the years 2002 and 2003, since the estimates in Section 5.7.3.2 indicate that the inclusion of these years may bias the estimates downwards.

The estimates in Panel A and B provide evidence that the results are robust to the critique posed by Bertrand, Duflo & Mullainathan (2004) when dealing with a long time series in a difference-in-differences setting. The estimates in Panel A pertaining to aggregate exports are in line with corresponding estimates in the baseline set of results above. The positive and statistically significant estimates for both specification 1 (column (1)) and 2 (column (2)) point to a positive trade effect. It is worth noting that the statistical significance of the tariff preference interaction term in specification 2 (column (2)) increases when the data is collapsed into single pre- and post-intervention periods. As evident in the main set of results, the impact of the tariff liberalisation is not felt along the intensive margin (columns (4) and (5)). The two-period coefficient estimates pertaining to the extensive margin in Panel A, although positive, are not statistically significant, and thus diverge from the baseline estimates.

Table 5.10: Estimates after collapsing data into single pre and post periods

	Specification 1	Specification 2					
	Aggregate	Aggregate		IM		EM	
	Total	Total	Rauch	Total	Rauch	Total	Rauch
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Collapsing data into single pre and post periods							
Post*Preference$_{jt}$	0.122***						
	[0.025]						
Post*Preference$_{jt}$*Homogenous							
Post*Preference*ln(TP)$_{pjt}$		0.597**	0.380	-0.015	0.633	0.225	0.345
		[0.302]	[0.451]	[0.490]	[0.833]	[0.152]	[0.227]
Post*Preference*ln(TP)$_{pjt}$*Homogenous			0.260		-0.937		-0.192
			[0.562]		[0.853]		[0.273]
Panel B: Collapsed data into single pre and post periods and excluding 2002 and 2003							
Post*Preference$_{jt}$	0.091***						
	[0.029]						
Post*Preference$_{jt}$*Homogenous							
Post*Preference*ln(TP)$_{pjt}$		0.691**	0.293	0.332	0.633	0.402***	0.734***
		[0.317]	[0.531]	[1.301]	[1.352]	[0.136]	[0.204]
Post*Preference*ln(TP)$_{pjt}$*Homogenous			0.510		0.244		-0.577**
			[0.611]		[2.690]		[0.249]

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the country-product level. 4. The sample is restricted to EU15 and EU10 countries over the period 2000 to 2008. In Panel B data for the pre-treatment years, 2002 and 2003, are excluded from the sample. 5. Product-destination combinations for which there is not a single positive trade flow over the full period are dropped from the sample. 6. The EU15 and EU10 constitute the control and treatment countries, respectively. The treatment period is defined as the period 2004 to 2008. 7. In Specification 1, product-destination and industry-time fixed effects are controlled for. One is not able to control for destination-time fixed effects in Specification 1 since this wipes out all the variation in the key explanatory variable. In Specification 2, product-destination, industry-time and destination-time fixed effects are controlled for. 8. For the intensive margin estimations, the sample is restricted to product-destination combinations that are positive in both the pre and post periods. In the intensive margin estimations, the dependent variable is measured as the natural log of the export value for each product-destination combination. 9. For the extensive margin estimations, the sample is restricted to product-destination combinations that are positive across both periods, zero in the initial period and positive in the final period, and positive in the initial period and zero in the final period. In the extensive margin estimations, the dependent variable is measured as zero or unity. 10. The homogenous product group dummy is interacted with the key explanatory variable in each specification – columns (3), (5) and (7). The sum of the base category, which measures the marginal effect for differentiated products, and the homogeneous product group interaction term, provides the marginal effect for homogeneous products. 11. The conservative version of the Rauch (1999) classification is used in these estimations.

Section 5.7.3.2 indicates that the inclusion of the pre-treatment years, 2002 and 2003, bias the estimates downwards. The estimates in Panel B, especially with respect to the extensive margin, provide further evidence for this pre-emptive trade effect. After excluding these years, the extensive margin trade effect, driven by growth in differentiated product markets, returns (columns (6) and (7) of Panel B). Looking at specification 2, the aggregate trade effect, remains, is stronger, and is characterised by greater statistical significance, relative to the baseline estimates.

5.7.3.4 Isolating products that have undergone full liberalisation prior to EU10 accession

One potential problem with the EU15 country control group, is the fact that not all products had been phased down to duty free by the start of the treatment period, 2004. By 2004, when the EU10 countries joins the EU, 87 percent of industrial tariffs are duty-free. Thus, the tariff levels for a small share of products are still being phased down at this stage. To further test the robustness of the baseline set of results, the regressions are estimated for a reduced subset of products, which have undergone full tariff liberalisation by 2004 (i.e. duty free by 2004). These estimates are reported in Table 5.11.

The estimates using a fully liberalised subset of products show that the manner in which TDCA tariff liberalisation impacts on South African exports to EU10 countries is consistent with that evident in the baseline estimates. The positive aggregate trade effects estimated using specification 1 (column (1)) and specification 2 (column (2)) are greater in magnitude relative to the baseline set of estimates reported in Table 5.4. Further, in the case of specification 2, the positive aggregate trade effect, evident in the coefficient estimate for tariff preference interaction term, is marked by greater statistical significance. Consistent with the main set of results, there is no evidence of an intensive margin effect, while the extensive margin effect is driven by entry into differentiated product markets.

Table 5.11: Estimates for fully liberalised set of products

	Specification 1		Specification 2					
	Aggregate		Aggregate		Intensive margin		Extensive margin	
	Total	Rauch	Total	Rauch	Total	Rauch	Total	Rauch
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post*Preference$_{jt}$	0.044***	0.033**						
	[0.016]	[0.016]						
Post*Preference$_{jt}$*Homogenous		0.063						
		[0.062]						
Post*Preference*ln(TP)$_{pjt}$			0.669**	0.404	0.657	1.278	0.793***	1.029***
			[0.331]	[0.449]	[2.204]	[2.225]	[0.242]	[0.391]
Post*Preference*ln(TP)$_{pjt}$*Homogenous				0.616		-4.687		-0.436
				[0.556]		[3.166]		[0.419]
Observations	260,685	241,929	260,685	241,929	20,402	18,656	46,930	43,408
R-squared	0.651	0.652	0.652	0.653	0.818	0.818	0.379	0.378
F-test	7.885	3.338	4.088	2.465	0.0890	1.112	10.74	5.400
Product-Destination FE	YES	YES	YES	YES	YES	YES	YES	YES
Destination-time FE	N/A	N/A	YES	YES	YES	YES	YES	YES
Industry-time FE	YES	YES	YES	YES	YES	YES	YES	YES

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the country-product level. 4. For the aggregate estimations in columns (1) to (4), the sample is restricted to EU15 and EU10 countries over the period 2000 to 2008. For the intensive and extensive margin estimations in columns (5) to (6), the sample is restricted to EU15 and EU10 countries for the pre and post periods. The mean values of the dependent and explanatory variables are calculated for the pre-period, using the years 2000 to 2001, and for the post-period, using years 2006 to 2008. 5. The Product-destination combinations for which there is not a single positive trade flow over the full period are dropped from the sample. 6. The EU15 and EU10 constitute the control and treatment countries, respectively. The treatment period is defined as the period 2004 to 2008. 7. In Specification 1, product-destination and industry-time fixed effects are controlled for. One is not able to control for destination-time fixed effects in Specification 1 since this wipes out all the variation in the key explanatory variable. In Specification 2, product-destination, industry-time and destination-time fixed effects are controlled for. 8. For the intensive margin estimations, the sample is restricted to product-destination combinations that are positive in both the pre and post periods. In the intensive margin estimations, the dependent variable is measured as the natural log of the export value for each product-destination combination. 9. For the extensive margin estimations, the sample is restricted to product-destination combinations that are positive across both periods, zero in the initial period and positive in the final period, and positive in the initial period and zero in the final period. In the extensive margin estimations, the dependent variable is measured as zero or unity. 10. The homogenous product group dummy is interacted with the key explanatory variable in each specification – columns (3), (5) and (7). The sum of the base category, which measures the marginal effect for differentiated products, and the homogeneous product group interaction term, provides the marginal effect for homogeneous products. 11. The conservative version of the Rauch (1999) classification is used in these estimations.

5.8 Conclusion

This chapter considers the impact of TDCA tariff liberalisation on South African exports to EU10 countries. The analysis distinguishes between the effect of tariff liberalisation on the intensive and extensive margins, and whether these effects are felt differently in homogeneous and differentiated product markets. The analysis draws on and tests the theoretical predictions of the Besedeš & Cole (2017) heterogeneous firm model.

As discussed by Jean & Bureau (2016), studies measuring the impact of trade agreements on trade suffer from the endogeneity and heterogeneity concerns. This chapter deals with the endogeneity concern by exploiting a unique event whereby a trade agreement negotiated between two parties (the EU15 countries and South Africa) is extended exogenously to another party (the EU10 countries). The terms of the TDCA that were negotiated between the EU15 and South Africa, and hence the lobbying and bargaining associated with this agreement, are imposed exogenously on the EU10 countries that were not involved in the negotiations. This feature of the TDCA acts as an exogenous shock, thus allowing for the identification of the trade effect associated with TDCA tariff liberalisation adopted by EU10 countries. The triple difference-in-differences estimator further exploits this feature. Using product-level tariff data to measure preferential access resulting from the agreement, as opposed to a dummy variable approach, allows the analysis to deal with the heterogeneity concern. These methodological features allow for a more precise measure of the trade effect resulting from the preferential access afforded to South African exporters.

There is sufficient evidence showing that in response to TDCA tariff liberalisation, there is a positive aggregate trade effect on South African manufacturing exports into EU10 countries. This is evident in the baseline estimates for specification 1. Contrary to expectations, the statistical significance of the specification 2 baseline estimates is weak. However, this statistical significance improves once the specification is adjusted to take into account pre-emptive trade effects, once it is shifted to a two-period analysis, and when the analysis is focused on products that have undergone full liberalisation. Consistent with the predictions from the Besedeš & Cole (2017) heterogeneous firm model, tariff liberalisation emerging from the TDCA has a larger impact on differentiated product markets than homogeneous product markets.

TDCA tariff liberalisation imposed on EU10 countries has driven the diversification of South Africa's export structure into the EU. The estimates show no statistically significant impact along the intensive margin. The positive trade effect is being driven by increased entry into EU10 destination markets. This extensive margin effect is strong, with a 1 percent increase in preferential access being associated with an 0.57 percent increase in the likelihood of entry. The intensive and extensive margin estimates run contrary to the Besedeš & Cole (2017) model, which predicts a positive trade effect along both these margins.

TDCA tariff liberalisation has been effective in driving the diversification of South African exports into EU10 countries in differentiated product markets. Rauch (1999) provides evidence suggesting that it is harder to establish a trade relationship when dealing with differentiated products. If this is the case, then the TDCA tariff liberalisation has helped exporters overcome these search costs and difficulties in matching with importers. The trade effect along the extensive margin is felt in both differentiated and homogeneous product markets. Consistent with Besedeš & Cole (2017), the extensive margin trade effect is felt more strongly in differentiated as opposed to homogeneous product markets.

The estimates have policy relevance. More broadly, the precise measurement of the trade effect is vital from the perspective of driving policy design and adaptation through evidence-based research. The estimates suggest that tariff liberalisation emerging from negotiated trade agreements can drive developing country export growth into new markets, thereby facilitating the adjustment towards a more diverse export structure along both the product and destination dimensions. As discussed in Chapter 2, export diversification has positive economic development implications. Further, the strong extensive margin trade effect for differentiated products, which are characterised by higher search costs and greater difficulty in matching with importers, indicates that the trade policy has been an effective tool in driving diversification into these 'harder to enter' product markets. Finally, the magnitude of the aggregate trade effect depends upon the extent of liberalisation. The greater the reduction in tariff levels, the greater the preference margin, and the greater the trade effect. In the case of the EU10 countries there is a great deal of cross-country and -product heterogeneity, because the levels of protection prior to the intervention varied substantially across these dimensions. As such, it is vital for the policy maker o take into account these sources of heterogeneity when designing policy. Drawing on the results in this chapter and the preceding chapters, the final chapter of this thesis provides a more detailed policy discussion.

CHAPTER 6: CONCLUSION AND POLICY IMPLICATIONS

The external constraint is a developmental challenge facing developing countries, especially middle-income countries looking to graduate to high-income status. The broad solution to this challenge involves the growth and diversification of exports. If it is the case that the growth and diversification of exports is key to overcoming the external constraint, then it is important to gain an understanding of the nature of the relationship between exports and development. This is gained in Chapter 2, which examines the complexity of this relationship through the lens of South Africa's economic policy. Given the importance of the link between exports and economic development, Chapter 3 examines the dynamics driving a middle-income country's – South Africa – evolving export structure. Chapters 4 and 5 consider two key factors that shape export patterns, endowments and trade policy, respectively. In particular, focus is placed on their impact on extensive margin growth dynamics.

The decomposition analysis in Chapter 3 shows that the extensive margin, particularly entry into new destination markets, is a relatively important source of export growth driving South Africa's evolving export structure. Drawing on the literature, this pattern of export growth is consistent with that of other developing middle-income countries (Amurgo-Pacheco & Pierola, 2008; Brenton & Newfarmer, 2009; Zahler, 2011). The strong response along the destination extensive margin may be partially explained by South Africa embarking on a liberalisation plan in the post-apartheid period, and thus reintegrating into the global economy. Chapter 5 provides partial evidence of this, by showing that South Africa's export response to the TDCA was driven by entry into new markets within the EU10 country grouping. Relatedly, the destination composition of South Africa's export structure has shifted away from developed country markets, toward developing country markets. This indicates that South African firms have responded to the changing global economic order, which is characterised by the increased economic importance of emerging economies, such as China and India.

Despite this pattern of growth along the extensive margin, the intensive margin is South Africa's most important source of export growth. This growth is driven largely by the intensification of existing export relationships in natural resource-based products. This is consistent with South Africa being a natural resource abundant middle-income country, and thus the composition of its export structure has remained resource-intensive. Relatedly, South Africa has been unable to diversify into more sophisticated manufacturing products, hence limited growth along the product extensive margin.

Intensive margin growth was particularly strong over the 2000s, a period characterised by the global commodities super cycle. The extended product variety style decomposition approach shows that this strong period of export growth, driven by the intensive margin, is almost entirely accounted for by price growth as opposed to quantity growth. One explanation for this result is the presence of supply constraints, that have limited exporters' ability to generate volume growth, and thus exploit a favourable global economic environment (Edwards & Alves, 2006).

The thesis also considers what factors may be shaping South Africa's evolving export pattern. Chapter 3 shows that extensive margin growth varies by destination. This pattern of export growth alters the destination composition of South Africa's export structure. As such, Chapter 4 examines whether relative endowments have shaped South Africa's evolving export structure. Consistent with Smet (2007; 2013), the analysis in Chapter 4 provides evidence of South Africa occupying a 'middle position' between its trading partners. This evidence indicates that relative endowments play a role in shaping middle-income country export patterns.

Chapter 4 also provides evidence of South Africa's evolving export structure becoming increasingly capital-intensive. The dynamic cross-commodity regressions, estimated at the product-level, show that extensive margin growth is being driven by entry into capital-intensive product markets. This is in line with Cadot et al. (2011) who argue that as middle-income countries develop, they transition across diversification cones toward increasingly capital-intensive products. Arguably, this presents an economic development challenge to middle-income economies with high levels of unemployment, such as South Africa. If shifts toward higher levels of economic development involve diversification toward capital-intensive products, then the ability of these countries to address unemployment is potentially curtailed.

From a policy perspective, there are two key findings that emerge from Chapter 4: first, the analysis shows that endowments play a role in shaping a country's export structure. Current policy aims to diversify out of traditional comparative advantage products. There is thus a tension between the desire to diversify and the endowment constraint, which policy does not sufficiently emphasise. Changing comparative advantage is hard. One possible policy approach is for a country to leverage off its current productive know-how or capabilities and diversify toward 'proximate' sectors. This approach acknowledges that structural transformation is a path dependent process, whereby the capabilities embodied in a country's current productive structure shape subsequent paths of diversification. In South Africa's case, this would involve leveraging off the capabilities developed in natural resource-based sectors. Drawing on lessons from the Scandinavian experience, this process of leveraging off natural resource-intensive sectors has the potential to yield positive externalities. However, it is best realised if pursued in a knowledge- and technology-intensive manner that promotes learning and innovation.

Second, the increasingly capital-intensive nature of South Africa's evolving export pattern is consistent with the Cadot et al. (2011) 'diversification-development' pattern. This pattern involves countries changing comparative advantage and diversifying away from traditional comparative advantage products over time. These findings suggest that a country's endowment structure, although difficult, can be altered so as to affect its export patterns. Edwards (2001a) argues that South African economic policy in the early 1990s promoted capital-intensive industries, thereby biasing the country's productive structure toward such industries. This suggests that countries could alter the relative prices of capital and labour in order to adjust production patterns toward a desired outcome. In south Africa's case, lowering the price of labour relative to capital may incentivise more labour-intensive industries or labour-intensive means of production within industries.

Strong extensive margin growth into Europe, evident from the decomposition analysis in Chapter 3, provides motivation for considering whether trade policy influenced this trade pattern. Chapter 5 considered the role of TDCA tariff liberalisation in driving export growth into the European regional market, specifically EU10 countries. The analysis in this chapter is informative since it deals with the endogeneity concern by using the extension of EU membership as an exogenous shock to identify the effect of tariff liberalisation on South African exports. TDCA tariff liberalisation at the product-level is imposed exogenously onto EU10 countries, and thus not influenced by trade negotiations, nor EU10 country industry structure. This allows for the identification of the trade effect resulting from the tariff liberalisation.

The estimates in Chapter 5 point to a positive trade effect that is driven by extensive margin growth in differentiated product markets for manufactured goods. A number of policy insights emerge from these findings: first, trade policy can be used as a tool to drive export diversification. This is especially advantageous for resource abundant middle-income countries that are typically dependent on export revenues from resource-based exports. Export diversification limits their exposure to shocks (Bacchetta, Jansen, Lennon & Piermartini, 2009). Second, trade policy can be used as a tool to drive diversification into differentiated product markets, which are typically manufactured products. Evidence from Rauch (1999) suggests that it is harder to establish a trade relationship when dealing with differentiated products as opposed to non-differentiated products, since the search and matching costs are relatively higher. The results imply that the tariff liberalisation lowers the cost of entry into new export markets, thereby lowering the relatively higher search and matching costs associated with differentiated product markets. This is especially important, since middle-income countries looking to graduate to high-income status need to diversify their export structure, particularly with respect to manufacturing.

APPENDIX

APPENDIX A. CHAPTER 3

A.1 Decomposition of the intensive margin into price and quantity components

Haddad, Harrison & Hausman (2011) employ a decomposition method that separates the intensive margin into price and quantity effects. This method is incorporated into the product variety style decomposition approach developed by Zahler (2011). This section details how the price-quantity component in equation (3.5) is derived. In order to decompose intensive margin growth into price and quantity effects, one starts with equation (A1) below:

$$dv_t = \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} p_{pd,t_1} q_{pd,t_1} - \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} p_{pd,t_0} q_{pd,t_0} + \sum^{N} p_{pd,t_1} q_{pd,t_1} - \sum_{pd \in PD_{t_0} \wedge pd \notin PD_{t_1}}^{D} p_{pd,t_0} q_{pd,t_0} \quad \text{(A1)}$$

and add and subtract

$$\sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} p_{pd,t_1} q_{pd,t_0} \quad \text{(A2)}$$

for the surviving export relationships

$$dv_t = \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} p_{pd,t_1} q_{pd,t_1} - \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} p_{pd,t_0} q_{pd,t_0} + \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} p_{pd,t_1} q_{pd,t_0} - \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} p_{pd,t_1} q_{pd,t_0} + \sum^{N} p_{pd,t_1} q_{pd,t_1} - \sum_{pd \in PD_{t_0} \wedge pd \notin PD_{t_1}}^{D} p_{pd,t_0} q_{pd,t_0} \quad \text{(A3)}$$

Rearranging, one gets:

$$dv_t = \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} p_{pd,t_1} \Delta q_{pd,t_1} - \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} \Delta p_{pd,t_1} q_{pd,t_0} + \sum^{N} p_{pd,t_1} q_{pd,t_1} - \sum_{pd \in PD_{t_0} \wedge pd \notin PD_{t_1}}^{D} p_{pd,t_0} q_{pd,t_0} \quad \text{(A4)}$$

Or one could add and subtract

$$\sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} p_{pd,t_0} q_{pd,t_1} \tag{A5}$$

and get

$$dv_t = \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} p_{pd,t_0} \Delta q_{pd,t_1} - \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} \Delta p_{pd,t_1} q_{pd,t_1} + \sum^{N} p_{pd,t_1} q_{pd,t_1} - \sum_{pd \in PD_{t_0} \wedge pd \notin PD_{t_1}}^{D} p_{pd,t_0} q_{pd,t_0} \tag{A6}$$

Or one could use the average of the two

$$dv_t = \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} \frac{p_{pd,t_0} + p_{pd,t_1}}{2} \Delta q_{pd,t_1} + \sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} \frac{q_{pd,t_0} + q_{pd,t_1}}{2} \Delta p_{pd,t_1} + \sum^{N} p_{pd,t_1} q_{pd,t_1} - \sum_{pd \in PD_{t_0} \wedge pd \notin PD_{t_1}}^{D} p_{pd,t_0} q_{pd,t_0} \tag{A7}$$

The percentage change can be found as follows:

$$\frac{dv_t}{v_{t_0}} = \frac{\sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} \frac{p_{pd,t_0} + p_{pd,t_1}}{2} \Delta q_{pd,t_1}}{v_{t_0}} + \frac{\sum_{pd \in PD_{t_0} \wedge PD_{t_1}}^{S} \frac{q_{pd,t_0} + q_{pd,t_1}}{2} \Delta p_{pd,t_1}}{v_{t_0}} + \frac{\sum^{N} p_{pd,t_1} q_{pd,t_1}}{v_{t_0}} + \frac{\sum_{pd \in PD_{t_0} \wedge pd \notin PD_{t_1}}^{D} p_{pd,t_0} q_{pd,t_0}}{v_{t_0}} \tag{A8}$$

A.2 Database treatment for trade data

Chapter 3 uses South African export data at the 6-digit level of the Harmonised System (HS) classification from the UN COMTRADE database. The period of analysis for this chapter is 1995 to 2012 and export data for these two years is appended and cleaned. The 1988/1992 revision of the HS6 classification is chosen so that a consistent set of product categories is analysed over the longest possible period of time. The raw dataset is adjusted as follows:

1. There are a number of countries that are initially classified as one country and then become two separate countries at a later stage during the period of analysis. In these instances, it is impossible to separate the earlier data for each separate country. Therefore, the trade values for the two separate countries in the later stages of the period of analysis are merged and thus treated as one country throughout the entire period of analysis. There are four such instances in the data. Belgium and Luxembourg, Italy and The Holy See, Czech Republic and the Slovak Republic, and South Sudan and Sudan are country pairs that are treated as one economic entity. This is done so as not to confuse what Felbermayr & Kohler (2006) call a 'psuedo extensive margin' with the real extensive margin. The 'psuedo extensive margin' is extensive margin growth resulting from a country separating into two new nation states, whereas real extensive margin growth is exporting to a destination market that has not been serviced before.
2. Observations recording gold exports (710813: Gold in semi manufactured forms) are dropped from the dataset. There are a number of reasons for doing so. Firstly, initial analysis indicates that one of the largest items contributing to export growth along the destination extensive margin is 'Gold in semi manufactured forms". However, all observations for this product recorded the destination for the exports of this product as 'Unspecified'. Consequently, the product variety style decomposition measured export growth for this product solely along the new destination extensive margin. In reality, growth in exports for this product would more likely be a mixture of intensive (historically South Africa is an exporter of gold) and destination extensive margin growth (expansion of gold exports into new markets). Therefore, it is likely that the decomposition results for the intensive margin and destination extensive margin would be biased downwards and upwards, respectively. Secondly, there are substantial differences between the mirror data and export data for this product line that are irreconcilable. A third reason is that traditionally data on gold exports are problematic. Information on such trade transactions

are of a sensitive nature internationally and are typically not reported or reported under general headings.

3. Observations for platinum and platinum group product exports are replaced by mirror values.[138] The UN COMTRADE data for South African exports of platinum and platinum group products is only reported from 1999 onwards. Therefore, the product variety style decomposition calculation identifies growth in exports of these products as product extensive margin growth. This is incorrect because South Africa has been exporting platinum and platinum group products at least as early as the 1980s. Thus, growth in exports of these products should be either in the form of intensive margin growth or destination extensive margin growth. Subsequently, a comparison between export values and mirror values over corresponding years and product lines was conducted. At the product- and country-level they differ substantially but at the aggregate level they are nearer in magnitude. A number of patterns are evident when comparing the export data to the mirror data: 1) the unwrought product lines exhibit higher mirror values while the semi-manufactured product lines exhibit higher export values. This may be because on the importer side, the tariffs and duties are lower on unwrought platinum and platinum group products in comparison to semi-manufactured platinum and platinum group products – there may be an incentive to report the one as opposed to the other. 2) At the aggregate level the difference between the export values and the mirror data is between 10 and 20 percent, which is expected because export data is reported FOB and import data is reported CIF (See UN COMTRADE WITS user manual).
4. Export data for Southern African Customs Union (SACU) member countries – Botswana, Lesotho, Namibia and Swaziland – are dropped from the dataset. Export data to these countries is largely missing and the corresponding mirror data is questionable in terms of quality.
5. The decomposition of the intensive margin into price and quantity margins uses a reduced sample of surviving product-destination combinations. There are two reasons for this reduced sample. Firstly, a number of product-destination combinations for surviving export relationships have different units of measurement for the quantity variable in different periods. Secondly, there are a number of product-destination combinations for surviving export relationships, which have zero values for the quantity variable. The result of the

[138] "Platinum in other semi manufactured forms" (711019); "Platinum unwrought or in powder form" (711011); "Palladium unwrought or in powder form" (711021); "Palladium in other semi manufactured forms" (711029)"); "Rhodium unwrought or in powder form" (711031); "Rhodium in other semi manufactured forms" (711039)"); "Iridium, osmium and ruthenium unwrought or in powder form" (711041); "Iridium, osmium and ruthenium in other semi manufactured forms" (711049)".

above is an inability to measure changes in quantity and price over time for these export relationships. Therefore, these are dropped from the sample. As a result, approximately 7 and 4 percent of the value of exports in 2002 and 2012 is lost, respectively.

The estimates for the price and quantity decomposition are sensitive to outliers in the price data. Analysis of the data showed that an observation recording exports of Titanium Oxide (282300) to the USA had an unrealistic price value, which was biasing the data to such an extent that the results were spurious. The price of this product was adjusted to the average price for this product in that period. It’s likely that the quantity data was incorrectly recorded.

Table A. 1: Technological classification of exports

Lall (2000) technology classification	Examples
Primary products	Fresh fruit, meat, rice, cocoa, tea, coffee, wood, coal, crude petroleum, gas
Resource based manufactures	
RB1: Agro/forest-based products	Prepared meats/fruits, beverages, wood products, vegetable oils
RB2: Other resource-based products	Ore concentrates, petroleum/rubber products, cement, cut gems, glass
Low technology manufactures	
LT1: 'Fashion cluster'	Textile fabrics, clothing, headgear, footwear, leather manufactures, travel goods
LT2: Other low technology	Pottery, simple metal parts/structures, furniture, jewellery, toys, plastic products
Medium technology manufactures	
MT1: Automotive products	Passenger vehicles and parts, commercial vehicles, motorcycles and parts
MT2: Process industries	Synthetic fibres, chemicals and paints, fertilisers, plastics, iron, pipes/tubes
MT3: Engineering industries	Engines, motors, industrial machinery, pumps, switchgear, ships, watches
High technology manufactures	
HT1: Electronics and electrical products	Office/data processing/telecommunications equip, TVs, transistors, turbines, power generating equipment
HT2: Other high technology	Pharmaceuticals, aerospace, optical/measuring instruments, cameras
Other transactions:	
Other	Electricity, cinema film, printed matter, 'special' transactions, gold, art, coins, pets

Source: Lall (2000) and extracted from Edwards & Alves (2006)

Table A. 2: Decomposition of export growth into intensive and extensive margins

	Annual export growth	Export growth	Growth of surviving varieties	Dying varieties	New destination of known countries and products	New destination, existing products	New products, known destination	New product and destination
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1995-2012	7.53	269.64	189.39	-22.49	91.01	0.22	11.51	0.01
Contribution to (2)			70.24	-8.34	33.75	0.08	4.27	0.00
1995-2001	3.00	23.03	15.52	-16.63	17.84	0.02	6.25	0.03
Contribution to (2)			67.40	-72.22	77.48	0.10	27.12	0.12
2002-2012	10.6	203.98	179.67	-15.78	41.75	0.00	0.06	0.00
Contribution to (2)			88.08	-7.74	20.47	0.00	0.03	0.00

Source: UN COMTRADE – own calculations by author.

Notes: 1. Column (1) shows average annual growth for the period. 2. Column (2) shows percentage growth for the period. 3. The top row for each period in columns (3) to (8) measure percentage growth by margin. 4. The bottom row for each period in columns (3) to (8) measure each margins percentage contribution to total growth, as presented in column (2).

Table A. 3: The margins of South Africa's export growth by Lall (2000) classification, 1995-2012

	Export growth	Growth of surviving varieties	Dying varieties	New destination of known countries and products	New destination, existing products	New products, known destination	New product and destination
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intensive and extensive margin share of export growth within Lall classification grouping							
Primary products		75.57	-6.10	30.61	0.03	0.04	0.00
Resource-based manufactures		66.60	-9.06	30.92	0.04	11.42	0.01
Low tech manufactures		78.30	-53.23	74.49	0.22	0.23	0.00
Medium tech manufactures		68.90	-5.77	35.40	0.12	1.34	0.00
High tech manufactures		65.49	-8.48	42.56	0.43	0.00	0.00
Other		17.54	-4.84	8.98	0.25	78.06	0.00
Intensive and extensive margin share of total export growth by Lall classification grouping							
Primary products	32.23	24.36	-1.97	9.87	0.01	0.01	0.00
Resource-based manufactures	29.87	19.90	-2.71	9.24	0.01	3.41	0.00
Low tech manufactures	2.96	2.31	-1.57	2.20	0.01	0.01	0.00
Medium tech manufactures	31.14	21.46	-1.80	11.03	0.04	0.42	0.00
High tech manufactures	3.22	2.11	-0.27	1.37	0.01	0.00	0.00
Other	0.54	0.09	-0.03	0.05	0.00	0.42	0.00
Total	100.00	70.24	-8.34	33.75	0.08	4.27	0.00

Source: UN COMTRADE – own calculations by author.

Notes: 1. The top panel provides the estimates for the contribution of each margin to export growth within each Lall (2000) classification category. Rows sum to 100 percent. 2. The bottom panel provides the estimates for the contribution of each margin by each Lall (2000) classification category to total export growth. The rows for columns (2) to (7) sum to 100 percent. 3. Contributions to total export growth do not sum to 100 percent because product codes not assigned a Lall (2000) classification have been left out – they comprise between 0.3 and 0.4 percent of total exports. 4. Column (1) provides the contribution of each Lall (2000) category to export growth over the period.

Table A. 4: The margins of South Africa's export growth by World Bank regional classification, 1995-2012

	Export growth	Growth of surviving varieties	Dying varieties	New destination of known countries and products	New destination, existing products	New products, known destination	New product and destination
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intensive and extensive margin share of export growth within WB regional classification							
North America		91.08	-4.66	13.48	0.01	0.10	0.00
Rest of Americas		32.14	-23.81	90.37	0.07	1.22	0.00
East Asia & Pacific		75.53	-6.23	27.22	0.01	3.47	0.00
Rest of Asia & Eastern Europe		53.84	-5.65	51.18	0.19	0.43	0.00
Europe		67.37	-17.11	46.98	0.00	2.75	0.00
Middle East & North Africa		44.58	-12.88	66.35	0.00	1.95	0.00
Sub-Saharan Africa		70.80	-3.23	25.62	0.27	6.54	0.00
Intensive and extensive margin share of total export growth by WB regional classification							
North America	10.37	9.44	-0.48	1.40	0.00	0.01	0.00
Rest of Americas	2.54	0.82	-0.60	2.29	0.00	0.03	0.00
East Asia & Pacific	36.16	27.31	-2.25	9.84	0.00	1.25	0.00
Rest of Asia & Eastern Europe	8.32	4.48	-0.47	4.26	0.02	0.04	0.00
Europe	16.23	10.93	-2.78	7.63	0.00	0.45	0.00
Middle East & North Africa	4.31	1.92	-0.55	2.86	0.00	0.08	0.00
Sub-Saharan Africa	20.58	14.57	-0.66	5.27	0.06	1.35	0.00
Total	100.00	70.24	-8.34	33.75	0.08	4.27	0.00

Source: UN COMTRADE – own calculations by author.

Notes: 1. The top panel provides the estimates for the contribution of each margin to export growth within each regional category. Rows sum to 100 percent. 2. The bottom panel provides the estimates for the contribution of each margin by each regional category to total export growth. The rows for columns (2) to (7) sum to 100 percent. 3. Under the regional classification, the share structure does not sum to 100 percent and total exports does not exactly match its component parts because a percentage of exports are shipped to a trade category named "not elsewhere specified. This category comprises trade transactions to small island territories, errors in partner assignment, or non-disclosure of partner information. 4. Column (1) provides the contribution of each regional classification category to export growth over the period.

APPENDIX B. CHAPTER 4

B.1 Database treatment for trade data

The analysis in Chapter 4 employs the same trade dataset used in Chapter 3. Thus, the database treatment is consistent across the two chapters – see Appendix A.2.

B.2 Database treatment for revealed factor intensity data

Chapter 4 uses revealed factor intensity data developed by Shirotori, Tumurchudur & Cadot (2010), which is available from the UNCTAD Revealed Factor Intensity Database. Revealed factor intensity indices are available by product category at the 6-digit level of the Harmonised System (HS) classification, 1988/1992 revision. The data cover the period 1988 to 2007. The raw dataset is adjusted as follows:

1. The revealed factor intensity data for each period are merged in order to create a complete dataset in wide format. However, a number of product codes that are present in the earlier periods (e.g. 1995) are missing in later periods (e.g. 2007). This may be due to revisions in the HS classification. As countries shift to the latest revision of the HS classification, product codes that have been revised (e.g. a single product code split into two or more codes) come into disuse. Therefore, there is little or no reported trade data for these product codes and revealed factor intensity indices cannot be created for these product codes. These product codes are dropped from the merged dataset. The impact is evident in the 'dying' extensive margin where product-destinations cease to be exported. These products comprise approximately 10 percent of the dying extensive margin.
2. The revealed factor intensity dataset covering the period 1995 to 2007 is merged with the product-level trade data by product code. A number of product codes with export value information do not have matching revealed factor intensity data (e.g. product codes 284410, 140291, 380993, and 440334). These comprise a negligible share of the total export value and are dropped from the dataset.

B.3 Construction of the revealed factor intensity indices

The revealed factor intensity indices estimate the 'revealed' factor intensities of traded products applying a similar methodology to that used by Hausmann et al. (2007) when constructing the 'revealed' technology content of traded products (i.e. the PRODY index).

Shirotori et al. (2010) construct the indices as follows: first, they collected the raw data on national factor endowments of physical capital, human capital and natural resources for countries from which the data is available.

Using aggregate investment data from the Penn World Table (PWT) and the perpetual inventory method approach of Easterly & Levine (2001), the authors construct cross-country capital stock levels over time. They then estimate the annual stock of workers per country indirectly by inferring this estimate from real GDP per worker, GDP per capita and population data from the PWT. They are then able to construct a series of real capital stock per worker for 137 countries over the period 1961 to 2007.

Human capital stock data is measured using a proxy. The authors use Barro & Lee's (2001) yearly data on average years of schooling as the proxy. The dataset from Barro & Lee (2001) only gives values for every five years. However, the authors use a technique of interpolation to obtain yearly measures of human capital for 147 countries from 1950 to 2010.

The natural resource endowment is constructed using data on arable land taken from the World Bank's World Development Indicators (WDI). The authors construct a yearly series of arable land per worker, measured as arable land hectares per person (presented as 1000 hectares per person), which covers 205 countries for the period 1961 to 2007.

Second, using the raw data on national factor endowments, the authors calculate a 'revealed' factor intensity for each product. Products categories are classified according to either the Standard International Trade Classification (SITC) at the 5-digit level, or the Harmonised System at the 6-digit level.

The thinking behind the revealed factor intensity indices is that a product exported predominantly by countries that are richly endowed with physical capital is 'revealed' to be intensive in physical capital. The revealed factor intensity for each traded product is calculated as a weighted average of the factor abundance of the countries exporting the product. The weight is a variant of Balassa's revealed comparative advantage (RCA) indices. This is the methodology employed by Hausmann et al. (2007) when constructing the 'revealed' technology content of traded products – i.e. the PRODY index. The rationale for using a variant of RCA indices as opposed to straight export shares is to ensure that country size does not distort the ranking of products.

The revealed capital intensity of product j is calculated as

$$k_j = \sum_i \omega_j^i \frac{K^i}{L^i}$$

where K^i is country $i's$ capital stock, L^i is its labour force, and the weights are given by

$$\omega_j^i = \frac{X_j^i / X^i}{\sum_i \left(X_j^i / X^i \right)}$$

where X_j^i is country $i's$ exports of product j, $X^i = \sum_j X_j^i$ is country $i's$ aggregate exports and $\sum_i \left(X_j^i / X^i \right)$ is the sum of product shares across countries. ω_j^i is a variant of the Balassa (1965) RCA measure for country i in product j and is adjusted, as per Hausmann et al. (2007), to sum to one:

$$\sum_i \omega_j^i = \sum_i \frac{X_j^i / X^i}{\sum_i \left(X_j^i / X^i \right)} = \frac{1}{\sum_i \left(X_j^i / X^i \right)} \sum_i \left(X_j^i / X^i \right) = 1$$

Similarly, the revealed human capital intensity index is given by

$$h_j = \sum_i \omega_j^i h^i$$

where h^i is the average years of schooling achieved by the average person. The revealed land intensity index is calculated using arable land per person,

$$l_j = \sum_i \omega_j^i l^i$$

where l^i is the arable land (in hectares) per person.

There are two issues of concern with the RFI indices. Firstly, the weighted average RFI indices are sensitive to the country coverage in the endowments database. Shirotori et al. (2010) state that there is a trade-off between RFI estimations with a large sample size and one which is smaller but without any missing values. They thus propose two versions of the RFI dataset: firstly, a 'wide' one, based on the widest annual country coverage, and secondly, a 'consistent' one, based on a balanced panel of data. Secondly, the authors are careful to weed out the effect of subsidies and trade distortions, which are prevalent in agriculture. The authors use the World Bank's new Agricultural Distortions database (Anderson & Valenzuela, 2008) to eliminate observations where RCAs were obviously driven by policy. Without this correction, there would be high 'revealed' human capital intensities for agricultural products whose exports are subsidised by rich countries.

Table B. 1: Static cross-commodity regressions using different specifications of revealed factor intensity measures and sampling of high-income countries

	Revealed factor intensity (Initial period)		Revealed factor intensity (Mean initial three periods)			Revealed factor intensity (mean initial and final periods)		
	All countries less high-income non-OECD	All countries less high-income resource-rich	All countries	All countries less high-income non-OECD	All countries less high-income resource-rich	All countries	All countries less high-income non-OECD	All countries less high-income resource-rich
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log of Revealed human capital intensity	0.033***	0.033***	0.044***	0.043***	0.042***	0.037***	0.037***	0.034***
	[0.009]	[0.008]	[0.009]	[0.009]	[0.009]	[0.011]	[0.011]	[0.010]
Log of Revealed natural resource intensity	0.013***	0.013***	0.013***	0.013***	0.013***	0.015***	0.014***	0.014***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Log of Revealed physical capital intensity	-0.018***	-0.017***	-0.021***	-0.021***	-0.020***	-0.018***	-0.018***	-0.017***
	[0.004]	[0.003]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
Log of Revealed human capital intensity * 2012	-0.010	-0.008	-0.008	-0.008	-0.008	-0.004	-0.004	0.001
	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]	[0.015]	[0.015]	[0.014]
Log of Revealed natural resource intensity * 2012	-0.001	-0.002	-0.001	-0.001	-0.002	-0.001	-0.000	-0.001
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Log of Revealed physical capital intensity * 2012	0.005	0.004	0.003	0.003	0.003	0.002	0.002	0.001
	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]
Constant	0.056**	0.053**	0.070***	0.070***	0.069***	0.049**	0.051**	0.046**
	[0.023]	[0.022]	[0.024]	[0.024]	[0.023]	[0.023]	[0.022]	[0.021]
Observations	9,448	9,448	9,448	9,448	9,448	9,448	9,448	9,448
R-squared	0.039	0.040	0.043	0.043	0.042	0.038	0.039	0.038

Source: Own calculations using UN Comtrade data and UNCTAD Revealed Factor Intensity data (Shirotori et al., 2010).

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Dependent variable is the value of gross exports for each HS 6-digit product scaled by world exports of each product. 4. In columns (1) and (2) the 1995 values for the RFI measures are employed. In columns (3) to (5) the mean RFI values of the initial three periods (1995-1997) are employed. In columns (6) to (8) the mean RFI values for the initial (1995) and final (2007) periods are employed. 5. The sample of countries vary across the estimations. All countries (export destinations) are included in estimations (3) and (6). All countries less high-income non-OECD countries are included in estimations (1), (4) and (7). All countries less high-income resource-rich countries are included in estimations (2), (5) and (8). 6. Initial (1995) and end (2012) period trade data are pooled in the estimations. 7. The reference period is the initial period (1995) and the reference period dummy (not reported) is not statistically significant. 8. Each of the estimations are performed for a manufacturing subset of products, with the results being consistent to those with the full set of traded products.

Table B. 2: Dynamic cross-commodity regressions using different specifications of revealed factor intensity measures and sampling of high-income countries

	Revealed factor intensity (Initial period)				Revealed factor intensity (Mean initial three periods)						Revealed factor intensity (mean initial and final periods)					
	Less non-OECD		Less NR-rich		All Countries		Less non-OECD		Less NR-rich		All Countries		Less non-OECD		Less NR-rich	
	Entry	Exit	Entry	Exit	Entry	Exit	Entry	Exit	Entry	Exit	Entry	Exit	Entry	Exit	Entry	Exit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Log of Revealed human capital	0.004	0.068	0.006	0.082	0.110	0.095	0.096	0.098	0.102	0.118	0.328**	0.106	0.321**	0.098	0.328**	0.126
intensity	[0.114]	[0.116]	[0.116]	[0.117]	[0.136]	[0.132]	[0.132]	[0.133]	[0.134]	[0.133]	[0.146]	[0.156]	[0.142]	[0.157]	[0.144]	[0.157]
Log of Revealed natural resource	0.161***	0.230***	0.167***	0.237***	0.156***	0.214***	0.144***	0.214***	0.149***	0.220***	0.205***	0.195***	0.188***	0.194***	0.195***	0.201***
intensity	[0.036]	[0.040]	[0.037]	[0.040]	[0.040]	[0.041]	[0.039]	[0.040]	[0.039]	[0.041]	[0.041]	[0.045]	[0.041]	[0.045]	[0.041]	[0.045]
Log of Revealed physical capital	0.234***	0.012	0.237***	0.010	0.191***	-0.019	0.199***	-0.009	0.201***	-0.012	0.125**	-0.029	0.130***	-0.014	0.132***	-0.019
intensity	[0.044]	[0.046]	[0.044]	[0.046]	[0.049]	[0.050]	[0.047]	[0.051]	[0.048]	[0.051]	[0.048]	[0.053]	[0.047]	[0.054]	[0.048]	[0.054]
	-1.531***	-0.534	-1.610***	-0.560	-1.163**	-0.043	-1.220***	-0.263	-1.289***	-0.277	-1.170***	0.185	-1.193***	-0.065	-1.264***	-0.073
Constant	[0.440]	[0.456]	[0.445]	[0.453]	[0.472]	[0.471]	[0.462]	[0.480]	[0.466]	[0.476]	[0.453]	[0.484]	[0.442]	[0.490]	[0.448]	[0.485]
Observations	4,837	4,837	4,837	4,837	4,837	4,837	4,837	4,837	4,837	4,837	4,837	4,837	4,837	4,837	4,837	4,837
R-squared	0.018	0.006	0.018	0.006	0.015	0.004	0.016	0.005	0.016	0.005	0.016	0.003	0.017	0.003	0.017	0.004

Source: Own calculations using UN Comtrade data and UNCTAD Revealed Factor Intensity data (Shirotori et al., 2010).
Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. The dependent variable for each specification in columns (1), (3), (5), (7), (9), (11), (13) and (15), is a count measure of entry into new product-destination combinations, by HS product. The dependent variable for each specification in columns (2), (4), (6), (8), (10), (12), (14) and (16), is a count measure of exit out of old product-destination combinations, by HS product. 4. In columns (1) to (4) the 1995 values for the RFI measures are employed. In columns (5) to (10) the mean RFI values of the initial three periods (1995-1997) are employed. In columns (11) to (16) the mean RFI values for the initial (1995) and final (2007) periods are employed.. 5. A cut-off value of US $1,000 is applied in order to remove the noise from very small exports and measurement error. 6. Regressions estimated using the poisson pseudo maximum likelihood estimator.

Table B. 3: Static cross-commodity regressions using different specifications of revealed factor intensity measures and sampling of high-income countries – income group specification

	Revealed factor intensity (Initial period)		Revealed factor intensity (Mean initial three periods)			Revealed factor intensity (mean initial and final periods)		
	All countries less high-income non-OECD	All countries less high-income resource-rich	All countries	All countries less high-income non-OECD	All countries less high-income resource-rich	All countries	All countries less high-income non-OECD	All countries less high-income resource-rich
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log of Revealed human capital intensity	0.026***	0.026***	0.035***	0.034***	0.034***	0.030***	0.030***	0.031***
	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.006]	[0.006]	[0.006]
Log of Revealed human capital intensity * middle-income	-0.023***	-0.023***	-0.029***	-0.028***	-0.028***	-0.024***	-0.023***	-0.024***
	[0.005]	[0.005]	[0.006]	[0.006]	[0.005]	[0.007]	[0.007]	[0.006]
Log of Revealed human capital intensity * low-income	-0.026***	-0.027***	-0.037***	-0.035***	-0.035***	-0.032***	-0.032***	-0.033***
	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.007]	[0.006]	[0.006]
Log of Revealed natural resource intensity	0.009***	0.009***	0.010***	0.009***	0.009***	0.011***	0.010***	0.010***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Log of Revealed natural resource intensity * middle-income	-0.007***	-0.007***	-0.007***	-0.007***	-0.006***	-0.008***	-0.008***	-0.007***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Log of Revealed natural resource intensity * low-income	-0.008***	-0.008***	-0.009***	-0.008***	-0.008***	-0.010***	-0.009***	-0.009***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Log of Revealed physical capital intensity	-0.013***	-0.013***	-0.016***	-0.016***	-0.015***	-0.014***	-0.014***	-0.014***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Log of Revealed physical capital intensity * middle-income	0.010***	0.011***	0.013***	0.012***	0.012***	0.010***	0.010***	0.010***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Log of Revealed physical capital intensity * low-income	0.013***	0.013***	0.016***	0.016***	0.016***	0.014***	0.014***	0.014***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Constant	0.039***	0.041***	0.053***	0.053***	0.055***	0.033***	0.034***	0.033***
	[0.013]	[0.012]	[0.013]	[0.013]	[0.013]	[0.012]	[0.012]	[0.011]
Observations	28,344	28,344	28,344	28,344	28,344	28,344	28,344	28,344
R-squared	0.036	0.036	0.041	0.039	0.039	0.036	0.034	0.034

Source: Own calculations using UN Comtrade data and UNCTAD Revealed Factor Intensity data (Shirotori et al., 2010).

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Dependent variable is the value of gross exports to countries within each income group for each HS 6-digit product scaled by world exports of each product. 4. In columns (1) and (2) the 1995 values for the RFI measures are employed. In columns (3) to (5) the mean RFI values of the initial three periods (1995-1997) are employed. In columns (6) to (8) the mean RFI values for the initial (1995) and final (2007) periods are employed. 5. The sample of countries vary across the estimations. All countries (export destinations) are included in estimations (3) and (6). All countries less high-income non-OECD countries are included in estimations (1), (4) and (7). All countries less high-income resource-rich countries are included in estimations (2), (5) and (8). 6. Initial (1995) and end (2012) period data are pooled in the estimations. 7. Each of the revealed factor intensity measures are interacted with income groupings, which include: low-income, middle-income (lower and upper combined) and high-income. The latter grouping is the reference group.

Table B. 4: Dynamic cross-commodity regressions using different specifications of revealed factor intensity measures and sampling of high-income countries – income group specification

	Revealed factor intensity (Initial period)				Revealed factor intensity (Mean initial three periods)						Revealed factor intensity (mean initial and final periods)					
	Less non-OECD		Less NR-rich		All Countries		Less non-OECD		Less NR-rich		All Countries		Less non-OECD		Less NR-rich	
	Entry	Exit	Entry	Exit	Entry	Exit	Entry	Exit	Entry	Exit	Entry	Exit	Entry	Exit	Entry	Exit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Log of Revealed human capital intensity	-0.098	0.180	-0.088	0.204	0.071	0.218	-0.000	0.256	0.024	0.288*	0.218	0.363*	0.148	0.409**	0.181	0.449**
	[0.163]	[0.150]	[0.166]	[0.149]	[0.183]	[0.165]	[0.188]	[0.176]	[0.193]	[0.173]	[0.191]	[0.189]	[0.194]	[0.201]	[0.198]	[0.197]
Log of Revealed human capital intensity * middle-income	0.109	-0.076	0.099	-0.100	0.017	0.025	0.088	-0.013	0.064	-0.045	0.138	-0.444	0.208	-0.489	0.175	-0.529*
	[0.216]	[0.221]	[0.218]	[0.220]	[0.246]	[0.246]	[0.250]	[0.254]	[0.253]	[0.252]	[0.260]	[0.297]	[0.262]	[0.305]	[0.265]	[0.302]
Log of Revealed human capital intensity * low-income	0.148	-0.398*	0.139	-0.422*	0.080	-0.627***	0.151	-0.665***	0.127	-0.697***	0.160	-0.678**	0.231	-0.724**	0.198	-0.764***
	[0.193]	[0.218]	[0.195]	[0.217]	[0.218]	[0.234]	[0.222]	[0.242]	[0.226]	[0.240]	[0.233]	[0.278]	[0.235]	[0.286]	[0.239]	[0.284]
Log of Revealed natural resource intensity	0.180***	0.169***	0.206***	0.188***	0.190***	0.171***	0.148***	0.161***	0.170***	0.177***	0.258***	0.152***	0.204***	0.139**	0.232***	0.158***
	[0.051]	[0.048]	[0.053]	[0.048]	[0.053]	[0.048]	[0.055]	[0.050]	[0.056]	[0.050]	[0.054]	[0.052]	[0.055]	[0.054]	[0.057]	[0.054]
Log of Revealed natural resource intensity * middle-income	0.101	0.315***	0.075	0.296***	0.083	0.294***	0.124*	0.303***	0.103	0.288***	0.067	0.312***	0.121	0.324***	0.093	0.305***
	[0.068]	[0.073]	[0.069]	[0.073]	[0.072]	[0.074]	[0.073]	[0.075]	[0.074]	[0.075]	[0.074]	[0.081]	[0.075]	[0.083]	[0.076]	[0.082]
Log of Revealed natural resource intensity * low-income	-0.138**	-0.144**	-0.164***	-0.163**	-0.163***	-0.171**	-0.121*	-0.161**	-0.142**	-0.177**	-0.203***	-0.192**	-0.149**	-0.180**	-0.176***	-0.198**
	[0.061]	[0.070]	[0.062]	[0.070]	[0.062]	[0.071]	[0.064]	[0.072]	[0.066]	[0.072]	[0.065]	[0.078]	[0.066]	[0.079]	[0.067]	[0.079]
Log of Revealed physical capital intensity	0.192***	-0.096	0.208***	-0.093	0.133**	-0.127**	0.145**	-0.131**	0.158**	-0.129**	0.084	-0.169***	0.095	-0.171**	0.104	-0.172***
	[0.061]	[0.059]	[0.061]	[0.058]	[0.063]	[0.061]	[0.065]	[0.066]	[0.065]	[0.064]	[0.064]	[0.063]	[0.065]	[0.067]	[0.066]	[0.065]
Log of Revealed physical capital intensity * middle-income	0.120	0.224**	0.104	0.221**	0.154*	0.202**	0.142	0.207**	0.129	0.205**	0.115	0.336***	0.104	0.338***	0.095	0.339***
	[0.083]	[0.090]	[0.084]	[0.089]	[0.088]	[0.095]	[0.089]	[0.098]	[0.089]	[0.097]	[0.087]	[0.103]	[0.088]	[0.106]	[0.089]	[0.104]
Log of Revealed physical capital intensity * low-income	-0.000	0.186**	-0.016	0.183**	0.023	0.263***	0.011	0.267***	-0.002	0.266***	0.009	0.253***	-0.002	0.255***	-0.011	0.256***
	[0.074]	[0.082]	[0.074]	[0.081]	[0.077]	[0.086]	[0.079]	[0.089]	[0.079]	[0.088]	[0.077]	[0.091]	[0.078]	[0.094]	[0.079]	[0.093]
Constant	-2.467***	0.031	-2.813***	-0.107	-1.907***	0.497	-1.933***	0.321	-2.239***	0.207	-2.091***	0.818	-2.030***	0.604	-2.345***	0.493
	[0.631]	[0.563]	[0.633]	[0.549]	[0.626]	[0.560]	[0.658]	[0.605]	[0.660]	[0.585]	[0.601]	[0.552]	[0.624]	[0.589]	[0.632]	[0.569]
Observations	14,511	14,511	14,511	14,511	14,511	14,511	14,511	14,511	14,511	14,511	14,511	14,511	14,511	14,511	14,511	14,511
R-squared	0.049	0.031	0.046	0.039	0.022	0.056	0.048	0.031	0.045	0.038	0.023	0.055	0.048	0.030	0.045	0.038

Source: Own calculations using UN Comtrade data and UNCTAD Revealed Factor Intensity data (Shirotori et al., 2010).

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. The dependent variable for each specification in columns (1), (3), (5), (7), (9), (11), (13) and (15), is a count measure of entry into new product-destination combinations, by HS product. The dependent variable for each specification in columns (2), (4), (6), (8), (10), (12), (14) and (16), is a count measure of exit out of old product-destination combinations, by HS product. 4. In columns (1) to (4) the 1995 values for the RFI measures are employed. In columns (5) to (10) the mean RFI values of the initial three periods (1995-1997) are employed. In columns (11) to (16) the mean RFI values for the initial (1995) and final (2007) periods are employed.. 5. A cut-off value of US $1,000 is applied in order to remove the noise from very small exports and measurement error. 6. Regressions estimated using the poisson pseudo maximum likelihood estimator.

APPENDIX C. CHAPTER 5

C.1 Database treatment for trade data

The analysis in Chapter 5 employs a similar dataset to that used in Chapters 3 and 4 – see Appendix A.2. The trade data is constructed in the same manner except for the following:

1. The dataset is restricted to the period 1997 to 2008 and the 1996 revision of the Harmonised System is used.
2. Since the analysis focuses on a later period, 2000 to 2008, Belgium and Luxembourg, and the Czech Republic and Slovakia, are treated as separate entities in the data. Italy and the Holy See are treated as a single economic entity.
3. Since the analysis is focused on manufacturing exports, the issues regarding gold and platinum exports are no longer a concern.

C.2 Database treatment for tariff data

The aim of the data cleaning process is to create a panel of applied tariffs on manufacturing products imported by the EU from South Africa. Data is obtained from the World Integrated Trade Solutions (WITS) database, where the analysis primarily uses the TRAINS Raw Data (*TRAINS-Total (Incl. AVE)*), but in some instances, it draws from the IDB dataset. The period under consideration is 1997 to 2008, and tariffs are aggregated to the 6-digit level of the 1996 Revision of the Harmonised System. The set of destinations comprising the panel include EU15 and EU10 countries. The discussion below details the construction of the tariff panel for each of these groupings.

European Union tariff data

When constructing a dataset on tariffs applied by the EU, one needs to take note of the changing composition of the EU over time. Looking at Table C. 1, it is evident that the EU tariff schedule applies to EU15 countries over the full period, 1997 to 2008. In the case of the EU10 countries, the EU tariff schedule applies for the period, 2004 to 2008. Therefore, when constructing the tariff panel, the EU tariff schedule applies identically to all countries within each EU groupings according to the periods specified.

Table C. 1: Identification of EU tariff schedule by country group

	EU15	EU10
1997-1999	EU	Country specific
2000-2003	EU	Country specific
2004-2008	EU	EU

The TRAINS Database is used to construct the part of the tariff panel pertaining to the EU countries. When constructing this part of the panel, the following steps are followed:

- One starts by identifying the trade regime applicable to South African exports into the EU over time. In the pre-TDCA period the Generalised System of Preferences (GSP) and the Most Favoured Nation (MFN) tariff rates apply. From 2000 onward, the TDCA, GSP, and MFN rates apply.
- In determining the tariff rate pertaining to an individual trade flow, the WITS method is applied (see WITS User Manual)[139]. In determining the tariff rate applied to a trade flow, the method assumes the effectively applied tariff, which is defined as the lowest available tariff rate. This suggests a trade regime hierarchy, where in the pre-TDCA period, the GSP regime supersedes the MFN regime. Similarly, from 2000 onward, the TDCA regime supersedes the GSP and MFN regimes.
- The tariff panel includes *ad valorem* equivalent (AVE) measures generated by WITS for non-*ad valorem* tariffs. WITS estimate AVEs using the UNCTAD Method 2.
- There is no tariff data for the TDCA regime in 2001. The solution applied to the tariff panel is to copy the 2000 tariff regime to 2001. This assumes that the tariff regime in 2000 would be close to, if not identical to, that applied in 2001. This is a fairly safe assumption, since the second phase of the TDCA phasing schedule only applies in 2003, suggesting that the TDCA tariff levels remain constant over the period 2000 to 2002 (see Table 1 in Kwaramba et al., 2015).
- The tariff data is restricted along a number of dimensions: firstly, the sample is restricted to HS6 products that South Africa exported at least once, to at least one destination, over the period 1997 to 2012. This is done in order to ensure that when the combined trade-tariff dataset is rectangularised, only products that South Africa is able to produce and export are included in the analysis. Secondly, using the Lall (2000) classification, the sample is restricted to resource-based and non-resource-based manufacturing products (i.e. low- medium- and high-technology products). Thirdly,

139 http://wits.worldbank.org/data/public/WITS_User_Manual.pdf.

product lines with missing tariff data are dropped from the sample. These are typically product lines where mixed or specific tariffs apply, but for which there is no measured *ad valorem* equivalent (AVE).

- The tariff panel is mapped to the 1996 Revision of the HS classification. Therefore, in the years 2002 to 2006 and 2007 to 2008, one maps tariff data reported using the 2000 Revision and the 2007 Revision, to the 1996 Revision of the HS classification, respectively.
- Tariff data from TRAINS is reported at the 8 or 10-digit level. In order to merge the tariff data to South African export data, the tariff data must be aggregated to the 6-digit level. During the aggregation process a simple average tariff is applied.

EU10 country tariff data prior to accession into the EU

The EU10 countries had pre-existing tariff schedules that applied to South African exports prior to their accession into the EU. In constructing the tariff panel specific to these countries, the following steps are followed:

- The same process applied in generating the EU tariff schedule is followed when constructing the pre-accession tariff schedule for the EU10 countries.
- For some of the EU10 countries, the TRAINS data is recorded for a limited number of years in the dataset. Following Disdier et al. (2015), the TRAINS data is supplemented with the Integrated Data Base (IDB) data, in order to generate a more complete dataset. Table C. 2 details, firstly, the data sources used to construct the pre-accession tariff schedule for each country, and secondly, the years in which there is no recorded data in WITS. TRAINS data is employed for every country, except for Hungary, Latvia and Slovakia. The decision to supplement the TRAINS data with IDB data is based on the following rule: if there are no *ad valorem* equivalent tariff lines in the TRAINS dataset, or if these AVE lines disappear once the sample is restricted to manufacturing products, then the IDB is used. In order to make sure that the two datasets are consistent, a comparison was made between the IDB and TRAINS data for a given country in a given year. In the case of Slovakia, the TRAINS and IDB data for 2002 were compared. Out of 4 176 HS6 products, two tariff lines differed and the mean tariff across the two datasets is almost identical. In the case of Latvia, the TRAINS and IDB data for 2001 were compared. Out of 4 363 HS6 product lines, 52 tariff lines differed, and the mean tariff using the TRAINS data is 2.94, while the mean tariff using the IDB data is 2.92.

In the case of Hungary, the TRAINS and IDB data for 1997 is compared. The TRAINS data does not report a full list of tariff lines and thus only 2 810 HS6 lines are comparable between the IDB and TRAINS data. Of these 2 810 tariff lines, 330 differ, and the mean GSP tariff for the IDB data is 4.2, and the mean tariff for the GSP data is 3.9. It can be argued that the differences between the two datasets are not substantial, and thus in the interest of a more complete tariff panel, the IDB data can be used for these three countries.

- With regard to the missing years it was assumed that tariffs at the product level, outside of major changes in trade policy, remain fairly stable over the short- to medium-term. Based on this assumption, one could apply the following rules: firstly, the tariff regime for the earliest period for which there is data is applied until there is a new data entry. For example, in the case of Malta, the 2000 tariff regime applies in the missing 2001 period. Secondly, in the case of 1997, the 1998 or the next periods tariff regime is applied, since there is no data collected for 1996.

Table C. 2: Tariff data source and data availability for EU10 countries

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cyprus	TR	TR	TR	TR	TR	TR	..				
Czech Republic	TR	TR	TR	TR	TR	TR	TR				
Estonia	TR	TR	TR	TR	TR	TR	TR				
Hungary	IDB	..	..	..	..	IDB	..				
Latvia	..	IDB	IDB	IDB	IDB	IDB	..				
Lithuania	TR	..	..	..	..	TR	TR				
Malta	TR	..	..	TR	..	TR	TR				
Poland	TR	TR	TR	TR	TR	TR	TR				
Slovakia	..	IDB	IDB	IDB	IDB	IDB	IDB				
Slovenia	..	..	TR	..	TR	TR	TR				

Source: World Integrated Trade Solutions Database
Notes: 1. TR = Trade Analysis and Information System (TRAINS); IDB = Integrated Data Base; .. = missing data. 2. The shaded section of the table represents the period when EU10 countries joined the EU and thus applied the EU tariff regime.

Merging the tariff and trade data

In order to estimate the impact of the TDCA tariff liberalisation on South African exports, a product-destination level panel is created for the period 2000 to 2008. The panel merges data on South African export flows into EU countries with data on the tariffs imposed by these countries, all at the HS6 product level.

A key issue when merging the trade and tariff panels, is that there are a number of missing values where there is trade data but no tariff data. For example, for a given product exported to a given destination, there is tariff data for 2000 to 2002 and 2004 to 2008 but missing tariff data for 2003. There are 658 out of 4 365 products for which there is incomplete tariff data.

In light of this, two datasets are created: firstly, a trade-tariff panel – Dataset A – where products with at least one missing value are dropped from the sample. A total of 658 products are dropped. The sample comprises a fully populated balanced panel, with 3 707 products exported to 25 destinations over the period of nine years. However, looking at Table C. 3, the dropped products account for a fairly substantial share of EU trade (14 to 24 percent). The bulk of which are accounted for by exports to Poland in which there are no pre-EU accession tariffs for 128 of the 658 products.

The second trade-tariff panel – Dataset B – is created in order to reduce the share of exports to the EU accounted for by dropped products. To reduce the number of dropped products, missing tariff values are inferred and thus manually filled in. For example, if the *ad valorem* tariff applied on shoes by Malta in 2000 and 2002 is 10 percent, then it is fairly safe to assume that the missing value in 2001 is also 10 percent. This process assumes that tariffs do not change substantially over the short- to medium-term.

Using this approach, one is able to deal with the 128 Polish tariff lines. The TRAINS dataset has tariff data for these products in 2000. One can infer that these tariff levels did not change until Poland joined the EU in 2004. There are still some products that are dropped, which are detailed in Table C. 3 under Dataset B. The share of exports to the EU that these dropped products comprise is a lot smaller and thus less likely to bias the results. The resulting dataset contains 4 052 products, exported to 25 countries over a 9-year period. This dataset is used in the baseline analysis.

Table C. 3: Share of South African exports to the EU accounted for by dropped products

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Dataset A:									
Products with missing data (658)	0.22	0.24	0.22	0.16	0.14	0.15	0.14	0.14	0.16
Dataset B:									
2007 HS Revision (250)	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
2002 HS Revision (52)	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Malta & Cyprus (2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total share of exports to EU	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.00	0.00

Source: Own workings using WITS (2017)

Notes: 1. Brackets represent number of products dropped. 2. '2007 HS Revision' and '2002 HS Revision' refer to products where there is no tariff data across all countries in 2007-2008 and 2002-2008, respectively. Presumably this is linked to the changing of the HS revisions in 2002 and 2007. 3. 'Malta & Cyprus' refers to products in which these two countries have no data across the full period.

C.3 Gravity equation estimation

To further test the robustness of the estimates generated by the triple difference-in-differences estimations, a gravity equation estimation, following Baier & Bergstrand (2007) is applied. Baier & Bergstrand (2007) estimate a fixed effects gravity equation, which takes the following form:

$$lnX_{ijt} = \beta_0 + \beta_1(FTA_{ijt}) + \eta_{ij} + \delta_{it} + \psi_{jt} + \epsilon_{ijt}$$

where lnX_{ijt} is the natural log of exports from country i to country j in time period t. FTA_{ijt} is a dummy variable equal to unity if there is a free trade agreement between country i and country j in time period t. The exporter-time, δ_{it}, and importer-time, ψ_{jt}, fixed effects capture time varying importer and exporter characteristics, such as GDP, and unobservable country-specific time varying factors influencing trade (e.g. multilateral resistance terms). The country-pair fixed effects control for time invariant unobservable bilateral factors influencing trade.

Since the estimation is focused on South African exports to EU15 and EU10 countries, and not bilateral trade, the subscript i falls away, and the equation is left with importer, time and importer-time fixed effects. Further, in the estimations below, the importer-time fixed effects are excluded because there is only one observation per importer-year grouping. Thus, only the time and importer fixed effects are included in the estimations. Consistent with the standard gravity equation specification, the natural log of GDP and the natural log of population – time varying country observables – are included in the estimations.

The same sample of countries (15 EU15 countries and 10 EU10 countries) and years (2000 to 2008), as used in the main set of estimations, is used in the gravity equation estimations below. South African exports to each of the EU importers is aggregated from the product-level to the country-level. Thus, the estimations do not account for product-level heterogeneity in tariff liberalisation. In addition to the fixed effects gravity equation estimation (column 1 of Table C. 4), a poisson pseudo maximum likelihood (PPML) estimation is included (column 2 of Table C. 4). The PPML estimation technique is widely used in the gravity equation literature (for example, see Silva & Tenreyro, 2006; Egger et al., 2011; Yotov, Piermartini, Monteiro & Larch, 2016).

The estimates in Table C. 4 indicate that the positive trade effect generated in the main set of results is robust to this alternative specification. The positive and statistically significant coefficient estimate for the free trade agreement dummy variable shows, that at the aggregate level, the TDCA has a positivetrade effect on South African exports to EU10 countries.

Table C. 4: Fixed effects gravity equation

	Fixed effects	PPML
	(1)	(2)
Free trade agreement (TDCA)	0.414**	0.462***
	[0.169]	[0.137]
Natural of GDP	1.164	2.949***
	[0.721]	[0.355]
Natural log of population	-3.923	-4.932**
	[2.765]	[2.332]
Observations	225	225
R-squared	0.968	0.984
F-test	28.31	
Year FE	YES	YES
Destination FE	YES	YES

Source: GDP and population data from CEPII (Head, Meyer & Reis, 2010)
Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the country level. 4. The sample is restricted to EU15 and EU10 countries over the period 2000 to 2008. 5. The dependent variable in the fixed effects estimation in column (1) is the natural log of exports. The dependent variable in the Poisson Psuedo Maximum Likelihood estimation in column (2) is the level of exports.

Table C. 5: Specification 1 detailed – The effect of TDCA tariff liberalisation on aggregate trade

	(1)	(2)	(3)	(4)	(5)
$Post_t$	0.111***				
	[0.007]				
$Preference_j$	-0.689***	-1.172***			
	[0.015]	[0.020]			
$Post*Preference_{jt}$	0.048***	0.048***	0.048***	0.048***	0.038**
	[0.015]	[0.015]	[0.015]	[0.016]	[0.015]
Observations	297 477	297 477	297 477	297 477	297 477
R-squared	0.015	0.258	0.360	0.659	0.661
F-test	918.9	423.3	10.29	56.13	6.284
Product FE	NO	YES	YES	NO	NO
Year FE	NO	YES	YES	YES	NO
Destination FE	NO	NO	YES	NO	NO
Product-Destination FE	NO	NO	NO	YES	YES
Industry-time FE	NO	NO	NO	NO	YES

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the country-product level. 4. The sample is restricted to EU15 and EU10 countries over the period 2000 to 2008. 5. Product-destination combinations for which there is not a single positive trade flow over the full period (2000-2008) are dropped from the sample. 6. The EU15 and EU10 constitute the control and treatment countries, respectively. The treatment period is defined as the period 2004 to 2008. 7. One is not able to control for destination-time fixed effects in Specification 1 since this wipes out all the variation in the key explanatory variable. Hence, the estimation is a standard difference-in-differences estimation.

Table C. 6: Specification 2 detailed – The effect of TDCA tariff liberalisation on aggregate trade

	(1)	(2)	(3)	(4)	(5)	(1)
$Post_t$	0.111***					
	[0.007]					
$Preference_j$	-0.689***	-1.172***				
	[0.015]	[0.020]				
$Post*Preference_{jt}$	0.035**	0.007	0.032	0.031*		
	[0.017]	[0.020]	[0.020]	[0.018]		
$Post*Preference*ln(TP)_{pjt}$	0.231	0.707***	0.274	0.291*	0.386**	0.317*
	[0.155]	[0.227]	[0.213]	[0.157]	[0.156]	[0.162]
Observations	297 477	297 477	297 477	297 477	297 477	297 477
R-squared	0.015	0.258	0.360	0.659	0.660	0.662
F-test	691	385.1	6.006	50.80	6.144	3.811
Product FE	NO	YES	YES	NO	NO	NO
Year FE	NO	YES	YES	YES	NO	NO
Destination FE	NO	NO	YES	NO	NO	NO
Product-Destination FE	NO	NO	NO	YES	YES	YES
Destination-time FE	NO	NO	NO	NO	YES	YES
Industry-time FE	NO	NO	NO	NO	NO	YES

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the country-product level. 4. The sample is restricted to EU15 and EU10 countries over the period 2000 to 2008. 5. Product-destination combinations for which there is not a single positive trade flow over the full period (2000-2008) are dropped from the sample. 6. The EU15 and EU10 constitute the control and treatment countries, respectively. The treatment period is defined as the period 2004 to 2008.

Table C. 7: The effect of TDCA tariff reform on aggregate trade, using inverse hyperbolic sine transformation of dependent variable

	Specification 1		Specification 2	
	Total	Rauch	Total	Rauch
	(1)	(2)	(3)	(4)
Post*Preference$_{jt}$	0.047***	0.036**		
	[0.017]	[0.018]		
Post*Preference$_{jt}$*Homogenous		0.072		
		[0.061]		
Post*Preference*ln(TP)$_{pjt}$			0.356*	0.322
			[0.185]	[0.303]
Post*Preference*ln(TP)$_{pjt}$*Homogenous				0.052
				[0.352]
Observations	297,477	277,983	297,477	277,983
R-squared	0.650	0.651	0.651	0.652
F-test	7.539	3.536	3.688	1.909
Product-Destination FE	YES	YES	YES	YES
Destination-time FE	N/A	N/A	YES	YES
Industry-time FE	YES	YES	YES	YES

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the country-product level. 4. The sample is restricted to EU15 and EU10 countries over the period 2000 to 2008. 5. Product-destination combinations for which there is not a single positive trade flow over the full period (2000-2008) are dropped from the sample. 6. The EU15 and EU10 constitute the control and treatment countries, respectively. The treatment period is defined as the period 2004 to 2008. 7. One is not able to control for destination-time fixed effects in Specification 1 since this wipes out all the variation in the key explanatory variable. Hence, the estimation is a standard difference-in-differences estimation. 8. The dependent variable, measuring export levels, is transformed using the inverse hyperbolic sine transformation. 9. The number of observations for the 'Total' estimations does not equal that of the 'Rauch' estimations since some products do not have a Rauch (1999) classification.

Table C. 8: The effect of TDCA tariff liberalisation on aggregate trade by Rauch classification (liberal)

	Specification 1 (1)	Specification 2 (2)
Post*Preference$_{jt}$	0.039**	
	[0.016]	
Post*Preference$_{jt}$*Homogenous	-0.010	
	[0.045]	
Post*Preference*ln(TP)$_{pjt}$		0.510
		[0.317]
Post*Preference*ln(TP)$_{pjt}$*Homogenous		-0.301
		[0.331]
Observations	277,983	277,983
R-squared	0.663	0.664
F-test	3.209	1.835
Product-Destination FE	YES	YES
Destination-time FE	N/A	YES
Industry-time FE	YES	YES

Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the destination-product level. 4. The sample is restricted to EU15 and EU10 countries over the period 2000 to 2008. 5. Product-destination combinations for which there is not a single positive trade flow over the full period (2000-2008) are dropped from the sample. 6. The homogenous product group dummy is interacted with the key explanatory variable in each specification. The sum of the base category, which measures the marginal effect for differentiated products, and the homogeneous product group interaction term, provides the marginal effect for homogeneous products. 7. The EU15 and EU10 countries constitute the control and treatment groups, respectively. The treatment period is defined as the period 2004 to 2008.

Table C. 9: The effect of TDCA tariff liberalisation on the margins of trade by Rauch classification (liberal)

	Intensive margin	Extensive margin
	(1)	(2)
Post*Preference*ln(TP)$_{pjt}$	1.795	1.149***
	[2.269]	[0.311]
Post*Preference*ln(TP)$_{pjt}$*Homogenous	-1.129	-0.861***
	[2.215]	[0.327]
Observations	21,336	49,902
R-squared	0.824	0.383
F-test	0.329	7.121
Product-Destination FE	YES	YES
Destination-time FE	YES	YES
Industry-time FE	YES	YES

Notes: Notes: 1. Robust standard errors in brackets. 2. *** p<0.01, ** p<0.05, * p<0.1. 3. Standard errors clustered at the country-product level. 4. The sample is restricted to EU15 and EU10 countries for the pre and post periods. The mean values of the dependent and explanatory variables are calculated for the pre-period, using the years 2000 to 2001, and for the post-period, using years 2006 to 2008. 5. Product-destination combinations for which there is not a single positive trade flow over both periods are dropped from the sample. 6. For the intensive margin estimations, the sample is restricted to product-destination combinations that are positive in both the pre and post periods. In the intensive margin estimations, the dependent variable is measured as the natural log of the export value for each product-destination combination. 7. For the extensive margin estimations, the sample is restricted to product-destination combinations that are positive across both periods, zero in the initial period and positive in the final period, and positive in the initial period and zero in the final period. In the extensive margin estimations, the dependent variable is measured as zero or unity. 8. The homogenous product group dummy is interacted with the key explanatory variable in each specification. The sum of the base category, which measures the marginal effect for differentiated products, and the homogeneous product group interaction term, provides the marginal effect for homogeneous products. 9. Specification 2 is estimated using the liberal version of the Rauch (1999) classification. 10. The EU15 and EU10 countries constitute the control and treatment groups, respectively. The treatment period is defined as the period 2004 to 2008.

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