AGRODEP Working Paper 0002

September 2013

Trade Reform and Quality Upgrading in South Africa:

A Product-Level Analysis

Marko Kwaramba

About the Author

Marko Kwaramba is a part-time Lecturer and PhD student at the University of Witwatersrand, South Africa.

Acknowledgements

The author would like to thank the AGRODEP Modeling Consortium for the financial support from the AGRODEP innovative research grants program and two anonymous referees for the extensive comments on an earlier draft of this paper.

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Abstract

The relationship between trade liberalization and product quality is both empirically and theoretically ambiguous. This paper empirically investigates the impact of tariff liberalization on product quality upgrading in the South African manufacturing sector using highly disaggregated product-level data. The study employs panel data techniques exploiting variation at the product level using HS8 product-level data from 1988 to 2009. Tariff liberalization affects product quality through various channels such as pro-competitive, variety, or input channel effects. The results show a positive relationship between tariff changes and product quality, with tariff liberalization associated with a decline in quality upgrading when exploiting variation at the HS8 digit product-level. The results are robust to many specifications and subsample analyses (1988 -2000 and 2001-2009) and therefore suggest that tariff liberalization hurts quality upgrading. My findings imply that since tariff liberalization has not brought an increase in product quality, such liberalization should be engaged in cautiously in conjunction with assessments of the international competitiveness of South African producers. The South African government should consider a case-by-case evaluation for future changes in tariffs, while simultaneously targeting liberalization of those products that can be easily upgraded.

Résumé

La relation entre la libéralisation du commerce et la qualité des produits est ambiguë tant au plan empirique que théorique. Cet article examine empiriquement l'impact de la réduction des droits de douane sur l'amélioration de la qualité des produits dans le secteur manufacturier en Afrique du Sud en utilisant des données sur les produits au niveau très désagrégé. L'étude utilise des techniques de données de panel exploitant les variations au niveau des produits en utilisant le système harmonisé HS8 de 1988 à 2009. La libéralisation tarifaire affecte la qualité des produits à travers différents canaux tels que les effets pro-compétitifs, la variété, ou le canal des inputs. En exploitant les variations au niveau désagrégé a huit chiffres (HS8), les résultats montrent une relation positive entre les changements tarifaires et la qualité des produits, la libéralisation tarifaire étant associée à une baisse de la qualité des produits. Les résultats sont robustes à de nombreuses spécifications et avec différents sous-échantillons (1988 -2000 et 2001-2009) et suggèrent que la libéralisation tarifaire freine l'amélioration de la qualité des produits. Nos résultats impliquent qu'étant donné que la libéralisation tarifaire n'a pas apporté une augmentation de la qualité des produits, cette libéralisation devrait être engagée avec précaution en association avec des évaluations de la compétitivité internationale des producteurs sud-africains. Le gouvernement sud-africain devrait envisager une évaluation au cas par cas pour l'évolution future des tarifs, tout en ciblant la libéralisation des secteurs dont les produits peuvent être facilement améliorés.

1. Introduction

The link between trade liberalization and product quality is both empirically and theoretically ambiguous. While existing empirical studies show mixed results (Hummels and Skiba, 2004; Amiti and Khandelwal, 2012; Fan and Li, 2012), little research on the subject has been conducted in developing countries. Trade reform and tariff policies in particular, play a central role not only in determining trade performance but also in driving economic growth. For a country to remain competitive in the global market, it can either decrease the price of its products or increase the quality of its products. The latter strategy seems most viable for South Africa given that a decrease in prices might squeeze profit margins, which are already low, even further (Rodrik, 2008). It is therefore crucial to determine whether or not tariff policies are helpful in achieving product quality upgrading. This study empirically examines the relationship between trade reform, particularly tariff reform, and product quality upgrading of South African export products.

Tariff reform is an important industrial policy instrument (Department of Trade and Industry (DTI), 2010) that motivates firms to upgrade product quality. South Africa's average tariff has fallen from around 23% in the early 1990s to 8.2% in 2011 (DTI, 2010), and the continued importance of tariff reform in South Africa's industrial development is evidenced by the government's call for continuing trade policy debate (DTI, 2010). Distance-to-the-frontier models find that tariff reductions are associated with quality upgrading for products closer to the world quality frontier, whereas lower tariffs discourage quality upgrading for products more distant from the frontier (Amit and Khandelwal, 2012). Trade liberalization may result in fiercer competition in product marketing; hence, product quality enhancement becomes central for competiveness.

This paper is motivated by the current limited empirical evidence regarding how product quality is influenced by trade liberalization (see Hallak and Schott, 2011; Fan and Li, 2012). The few studies that have explored this relationship have focused mainly on developed countries. Fewer studies that focus on developing countries did not include African countries (see Ma and Dei, 2009; Bandyopadhyay and Acharyya, 2004; Fenandes and Paunov, 2011; Amit and Khandelwal, 2012). It is therefore crucial to ascertain how tariff liberalization may impact the quality of South African exports using highly disaggregated trade data at Harmonised System (HS) 8-digit level. The focus is on manufacturing goods at the trade flow product level and the study analyses the impact of the removal of tariff barriers on South African imports on the quality of South African exports. The assumption in this study is unilateral tariff liberalization in which tariffs on imports are reduced without a parallel change in export conditions (Aghion et al., 2013).

Trade liberalization can affect product quality upgrading in two ways: through competition (Lacovone, 2012; Ge, Lai and Zhu, 2011; Bustos, 2011; Teshima, 2010; Lileeva and Trefler, 2010) or through the

import of better quality inputs. The competition effect works through the final product/output channel; this raises the issue of horizontal product differentiation, which is a key input in models showing that trade liberalization induces welfare gains due to an increase of the variety of products available to consumers (Krugman, 1979, 1980). The increase in product variety can either lead to an increase in product quality, as firms will try to innovate to outdo their competition, or lead to a decline in product quality, as firms fail to compete. This is referred to in the literature as the variety effect[1], a horizontal differentiation-driven phenomenon.

The other way in which tariff liberalization can affect product quality is through the input channel. It can be assumed that as a country liberalizes, it will be able to import higher quality inputs and thus produce higher quality products. This is in line with the vertical linkage or product differentiation model, which states that richer countries will produce and export higher quality products/inputs (Hummels and Klenow, 2005; Schott, 2004; Flam and Helpman, 1987; Kugler and Verhoogen, 2012). The idea is that trade liberalization increases access to foreign intermediate inputs and capital goods, and that this access promotes international knowledge spillovers and product quality upgrading. Firms respond to trade liberalization, by increasing their imported inputs and capital goods from more advanced countries and "learning" from foreign technology incorporated in the imported intermediates – "the learning effect"(Coe and Helpman 1995; Keller, 2004; Mendoza,2010). This is also referred to as the quality effect[2] (Fan and Li 2012; Grossman and Helpman, 1991; Halpern, Koren and Szeidl, 2009).

The position of this paper in the current literature is quite clear. Firstly, it uses highly disaggregated trade data at the product level, which has not been used previously in such an analysis in an African context. Secondly, the paper is among the few studies that track the effects of the current wave of trade liberalization on export quality with a focus on product-level trade data using African data set.

The general lack of empirical studies focusing on the impact of tariff reform on product quality in South Africa necessitates this study, as most of the studies done previously are only descriptive (see Petersson, 2005; Ballard, 2002). More detailed studies have been conducted by Aghion et al., 2013 and Edward and van de Winkel, 2005; however, these focus on domestic markets and productivity rather than exports. Understanding the sensitivity of products to tariff liberalization can help fine-tune trade policy in order to bring greater benefits to the South African economy. Further, understanding how tariff reform might help emerging and developing countries sell higher priced products is important to these countries' own development. South Africa represents an emerging country which could provide lessons for other

[1] This variety effect is seen not only in final outputs but even in imported intermediate inputs, as firms might improve efficiency through access to a broader range of imported intermediates (or new product variety) – "the variety effect" as per Goldberg et al. (2010).

[2] Existing literature supporting the idea that imported input quality is higher than the quality of domestic inputs include Schott,2004; Amiti and Konings ,2007; Kasahara and Rodrigue,2008 and Muendler,2004)

developing African countries in their quest for product quality upgrading. This focus on an emerging country in Africa gives insight into how other African countries are responding to global competition, and the effects that producers in South Africa face as a result of tariff liberation could signal the growth path of the entire African continent.

This paper's other main contribution relates to the methodology, dimension, and variables used for analysis. A majority of recent studies focus on firm-level data (see Amit and Konings, 2007; Bastos and Silva, 2010; Fernandes and Paunov, 2011; Topalova and Khandelwal, 2011; Martin and Mejean, 2012; Lacovone, 2012) and few on product level analysis (Fantagne et al, 2008; Baldwin and Harrigan, 2011; Amit and Khandelwal, 2012); however, the focus of this study is on product-level data. This product-level view is necessitated by a lack of firm-level data that can be exploited to match the tariff data available in South Africa. This study follows Baldwin and Harrigan (2011) and Johnson (2012) but exploits variations in quality at the product level as tariffs change. This dimension has not been extensively exploited in the literature, let alone in the context of South Africa.

1.1 Research Problem

Trade reform has proven to be a crucial driver of not only import and export volumes (Rodrik, 1999; Edwards and Lawrence, 2008) but also of product quality upgrading in different economies (Amiti and Khandelwal, 2012). Trade reform is still on-going in South Africa, which highlights the need for a focused study to contribute to the country's trade policy debate. Empirical research is conclusive that, on the aggregate, trade liberalization has increased trade flows in South Africa (Edwards and Lawrence, 2008). However, what is lacking is an analysis that focuses on the impact of tariff liberalization on product quality. This lack mainly stems from evidence that tariff reductions have not induced the necessary structural changes in the South African economy to significantly alter the export basket beyond the range of products that reflect South Africa's static comparative advantage (DTI, 2010), thus, tariff liberalization has not brought the anticipated results in terms of diversification and specialization of exports. One explanation for this could be that trade liberalization has not been targeted to the specific products or sectors that may lead to greater international trade competitiveness.

Though tariff policies have the potential for either positive or negative impacts on both export and import volumes, there is also the potential for disproportional effects across products, especially when focusing on quality, due to differences in the composition and importance of certain products. For example, some products might require a higher level of innovation to reach their target market, while others might not require such a high level of differentiation. These realities can be explored either theoretically or empirically, as is done in this study.

Product quality is one of the key determinants for exports' success on the international market and thus for a country's economic development (Kremer, 1993, Grossman and Helpman, 1991). Theoretical models incorporating consumers' love for variety indicate the need for innovation in export products (Krugman 1980).

1.2 Objectives

The main objective of this study is to ascertain the impact of trade liberalization on product quality upgrading in South African exports. Specifically, the study assesses the impact of tariff liberalization on product quality and investigates whether tariff reform is associated with an increase in product quality.

The study seeks to determine whether lower import tariffs on HS8 products raises the export unit values of such products. The hypothesis is that tariff reduction in South Africa is associated with the escape-competition effect, a situation in which firms will try to innovate to out-compete other firms. This is the opposite of the discouragement effect, in which firms will not innovate if they believe that they cannot keep up with their competition.

The rest of the paper is organized as follows. Section 2 briefly describes the liberalization landscape of South Africa. Section 3 gives a literature review and section 4 outlines the empirical model. Section 5 presents the results and section 6 concludes.

2. Liberalization in South Africa

Trade liberalization in South Africa can be characterized by two periods: the pre-democratic era and the post-democratic era. In the pre-democratic era, South Africa's trade and industrialization strategy was based on protectionism and import substitution (Draper and Alves, 2009) and depended on a wide range of trade instruments inclined more toward quantitative restrictions than tariffs (Draper and Alves, 2009). Another important event during this period was the establishment of the Southern Africa Customs Union (SACU) in 1910. The following table summarizes some key trade policy changes that occurred between 1985 and 1994.

Post-apartheid era trade policy was marked by one important event: the accession of South Africa to the World Trade Organization (WTO) in January 1995. Upon its accession into the WTO, South Africa immediately committed to rationalize over 12, 000 tariff lines, reduce the number of tariff bands to six, and increase the number of tariff bindings for industrial products from 55% to 98% (Draper and Alves, 2009). The country also committed itself to tariff liberalization of its Most Favored Nation (MFN) applied rates until the year 2000 as it integrated into the world economy. Since 2000, regional trade agreements have become more important for liberalizing trade tariffs; in 2000, the Southern Africa Development Community (SADC) Protocol on Trade was implemented, which included an agreement to establish a

SADC Free Trade Area by 2008, a Customs Union by 2010, Common Market by 2015, a Monetary Union by 2016, and a single currency by 2018. SADC successfully launched its Free Trade Area in 2008 with 85% of trade being duty-free; the remaining 15% was expected to be fully liberalized by 2012, but due to the global financial crisis, some of the member states (Tanzania and Zimbabwe) have since applied for derogation, which has derailed the attainment of a fully-fledged Free Trade Area.

Table 1 : Trade Policy Changes (1985-1994)

Date	Policy change
1985-1992	Proportion of tariff items subject to Quantitative Restrictions (QRs) fell from 28% in 1985 to less than 15% in 1992.
September 1985	Introduction of 10% import surcharge on all imported goods not bound by GATT.
August 1988	Differential surcharge rates applied to luxury goods (60%), capital goods (10%), motor vehicles (20%), and intermediate goods (10%). Increased applications for *ad valorem* and formula duties by businesses (Bell, 1992)
	"Structural adjustment programmes" involving a system of duty free imports for exports implemented for motor vehicles and textiles and clothing.
1990	General Export Incentive Scheme (GEIS) introduced. Provided a *tax free* financial export subsidy to exporters based on the value of exports, degree of processing, and local content of the exported product.
1990-91	Reduction of import surcharges to 40%, 5%, 15% and 5% for luxury goods, capital goods, motor vehicles, and intermediate goods, respectively.
June 1994	Import surcharges abolished for capital goods and intermediate goods.

Source: Bell, T. "Should South Africa Further Liberalise Its Foreign Trade?" in Draper and Alves (2009) and Edwards (2005)

South Africa signed a Free Trade agreement with the European Community (EC) in 1999. The FTA agreement, also known as the Trade, Development and Co-operation Agreement (TDCA), came into force on May 1, 2004. This agreement stipulates liberalization of 95% of the EC's imports from South Africa within 10 years and 86% of South Africa's imports from the EC in 12 years. Protection of sensitive sectors for both parties has been granted, which has resulted in some sectors being excluded and others being partially liberalized. Agricultural products and industrial products (in particular, certain motor vehicle and textiles and clothing products) are included for EC and South Africa, respectively; to this point, South Africa has liberalized a total of 4205 tariff lines, which is 82% of its tariff lines with the EC.

South Africa and its SACU partners have also signed a free trade agreement with the European Union Free Trade Area (EFTA), consisting of Iceland, Liechtenstein, Norway, and Switzerland. The agreement includes a Free Trade Agreement (effective from May, 2008) between the two sides and three separate bilateral agricultural agreements between SACU and Iceland, Norway, and Switzerland/Liechtenstein. Due to the wide disparities in levels of economic development between SACU and EU countries, the agreement has asymmetrical commitments. The EFTA undertook to immediately liberalize all trade in HS chapters 25 to 99 (i.e. all non-agricultural trade) (Kalaba, 2010); the SACU is completely liberalizing the majority of its non-agricultural trade with EFTA, although in certain cases tariffs are being reduced over an extended nine-year period (Kalaba, 2010). Thus, South Africa and its SACU partners undertook a

commitment to progressively reduce their tariffs with the EU until 2014. Table 2 summarizes South Africa's trade liberalization reforms in the post-apartheid era in chronological order.

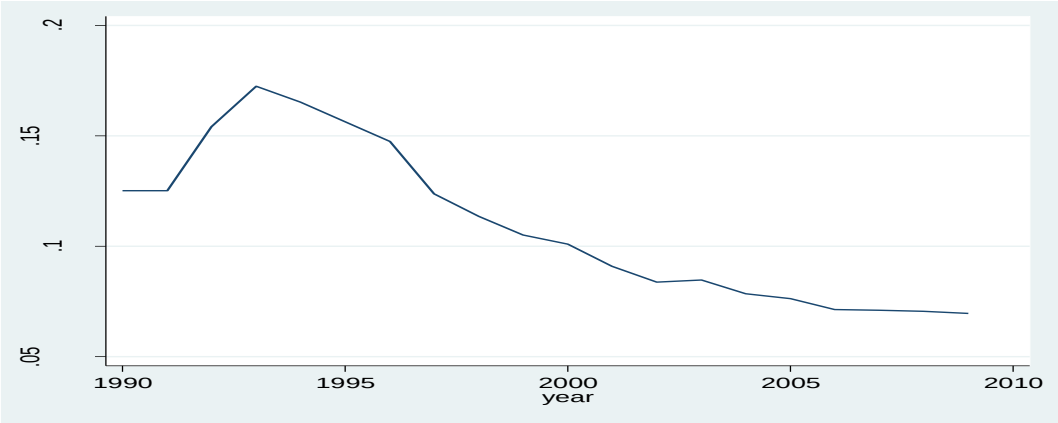
Table 2: Trade Liberalization, 1994 to 2011

Date	Trade liberalization
1994	SA's GATT offer during Uruguay Round: (1) bound about 98% of all tariff lines at the Harmonised System (HS) eight-digit level as against 18% before the round (2) Reduction in the number of tariff rates to six: 0%, 5%, 10%, 15%, 20%, and 30% (3) Rationalization of the over-12,000 tariff lines (4) Tariffication of QRs on agricultural products (5) Special provisions (extensions of the adjustment period and raised maximum tariff rates) for textile, clothing, and motor vehicle industries granted. (6) Decision taken to phase out GEIS. (7) Adoption of anti-dumping and countervailing duties legislation
1995	Payments under GEIS became taxable, range of eligible products reduced.
1 Oct 1995	Remaining import surcharges abolished
1994-97	Deregulation of agricultural marketing and control boards established under the Agricultural Marketing Act of 1968; import control on agricultural products removed.
1996	New Tariff Rationalization Process (TRP) formulated: Tariff lines and peaks to be reduced: formula and specific duties to be converted into *ad valorem* rates, imports that have no "suitable substitutes" to be duty free, *ad valorem* rates of 30% on final products, 20% on intermediate goods, and 10% on primary goods are generally not to be exceeded. GEIS limited to manufacturing goods.
Aug 1996	Signing of the SADC Free Trade Protocol (implemented in September 2000)
1 July 1997	Termination of export subsidies provided under GEIS.
1 Jan 2000	Implementation of SA-EU Trade, Development and Cooperation Agreement (TDCA)
2000	Preferential access to US for some products under African Growth and Opportunity Act (AGOA)
21 October 2002	2002 SACU Agreement introduces a new institutional structure; a dispute settlement mechanism; the requirement to have common policies on industrial development
December 2004	Preferential Trade Agreement signed between SACU and MERCOSUR
July 2006	Free trade agreement signed between SACU and the European Free Trade Area (EFTA) (implemented 1 May 2008)

Sources: Bell T. 'Should South Africa Further Liberalise Its Foreign Trade?', *op. cit*.; Bell ., 'Trade Policy', *op. cit*; Belli P, M Finger and A Ballivian, op. cit.; GATT, *op. cit*.; WTO, 1998; 2003, *op. cit.* (in Draper and Alves, 2009) and Edwards (2005)

As a result of these liberalization episodes, there has been a marked decline in tariffs at the South African border. Figure 1 shows that the average tariff has decreased since the late 1990s (it should be noted that this figure shows the average tariff for the manufacturing sector per year). In regressions analysis, tariffs at each product line are used instead of the average tariff for the all commodities depicted in the following figure.

Figure 1: Trend in Average Tariff of Manufacturing Sector



3. Literature Review

This section presents the theoretical models and empirical evidence used in this study.

3.1 Theoretical models

Many trade models (theories) explain trade between countries in terms of the price (quality) of products, with differing degrees of success. These models range from the traditional trade theories such as the comparative advantage theory of Eaton-Kortum (2002), to new trade theories such as the monopolistic competition theory of Dixit and Stiglitz (1977), to "new new" trade theories such as the heterogeneous firms trade model of Melitz (2003)[3]. These models did not introduce the quality component, although they did include some predictions regarding export prices; the introduction of quality in heterogeneous trade models has been done by Johnson (2012), Verhoogen (2008), Baldwin and Harrigan (2011), and and Kugler and Verhoogen (2011). These studies expanded the Melitz (2003) model of heterogeneous firms and constant mark-ups by considering how firms optimally choose quality and by producing quality sorting across firms; firms endowed with low marginal costs (higher productivity) produce high quality goods, while firms endowed with high costs (low productivity) produce low quality goods (Antoniades, 2012).

Eaton and Kortum's (2002) theory is a multi-country Ricardian model with trade cost. According to this theory, exporter countries should face competition in their destination markets. The more competitive a country is, the higher its chances of exporting a wide range of goods. This theory also predicts that most costly products are less likely to be exported over longer distances. Export prices decreases over bilateral distance, increase in the destination country's price index (remoteness), and are unrelated to size (Baldwin

[3] We only review these models because they try to give general guidelines regarding how other variables affect export prices.

and Harrigan, 2011). Eaton and Kortum also predict that the bigger the market of the importing country, the smaller the probability that the exporter will successfully ship its commodity to that market.

Models of monopolistic competition were introduced in the 1980s to explain intra- industry trade; consumers can buy some of every good with a finite price, and goods are exported to all nations. Basic tenets of these models include imperfect competition, increasing returns, and homogenous firms. The Dixit and Stiglitz'(1977) monopolistic competition model utilizes optimal mill pricing[4], implying that firms charge free on board (f.o.b) export prices regardless of the export's destination. Trade costs are passed fully to consumers; because of the assumption that products are sold in all markets, this model implies that f.o.b prices are identical for all destinations and that export prices are unrelated to distance, market size, or remoteness. Remoteness is defined by Baldwin and Harrigan (2011) as the relative location effect that the destination market will have if it faces high average trade costs; in this scenario, the destination market will experience high local prices and will thus be relatively easy for an exporting market to penetrate for any given bilateral trade cost. Unlike Eaton and Kortum's (2002) model, in this model, export price prediction with linear demand is driven by the reduction in mark-ups with distance. However, there are variants to this monopolistic competition model that imply a relationship between bigger markets and distance.

Melitz's (2003) heterogeneous firms' trade model explains trade at the firm level; however, it works with symmetric countries and thus requires modification to allow for the use of asymmetric countries and bilateral trade costs. It embraces all features of the baseline monopolistic competition model and adds elements of heterogeneous firm level marginal cost and beachhead costs (overhead fixed costs). Firms with lower marginal cost produce and export profitably. In general, the model directs that firms sell more in large countries than in small countries. After some manipulation, the model implies that the average price for any destination should decrease by markets distance, and increase by size and remoteness[5] of the destination market (Baldwin and Harrigan, 2011). Just like the monopolistic competition model, its basic tenets also include imperfect competition and increasing returns; however, it adds beachhead costs and heterogeneous marginal costs. This model may vary with market structure, source of scale economies, and source of heterogeneity.

These models suggest that gross domestic product, trade costs such as distance, and tariffs are all important factors associated with trade at the product level and must be accounted for by any empirical approach. In general, these models provide some prediction about the relationship between unit values and other variables, as shown in Table 3.

[4] Firms set a single price at the plant, and consumers bear the cost of transport.
[5] Remoteness generally points to the average price of goods sold in the destination market.

Table 3: Different Theoretical Models' Prediction for Key Variables

Models	Variables' Effect on Unit Prices		
	Distance[6]	Importer size	Remoteness
Eaton and Kortum	-	0	+
Monopolistic competition, linear demand	-	0	+
Heterogeneous firms, linear demand	-	-	+
Heterogeneous firms, CES, quality competition[7]	+	-	-
Heterogeneous firms, CES	-	+	+

There are a number of models that examine the relationship betweenproduct innovation and the product's distance from the world technological frontier (Aghion and Howitt, 2005; Aghion, Bloom, Blundell, Griffith and Howitt, 2005; and Aghion, Bloom, Griffith, Howitt and Prantil, 2009). These models show that theoretically, the relationship between the resultant competition from tariff liberalization and product quality is ambiguous and the relationship between competition and innovation is not linear. As in Schumpeter's (1942) argument, the lower the competition, the more innovation is expected since firms will have higher chances of getting higher returns from any innovation they undertake. But as firms approach the technological frontier, the higher the competition, the higher the innovation. These models show that intense competition is good for quality improving innovation (Aghion, 2005; Thoenig and Verdier, 2003) because firms will try to innovate in order to escape from competition. Along the same lines, Melitz (2003) suggests that average export quality could rise in response to trade liberalization because less productive firms are driven out of the market.

These models show two effects: firms either face discouragement (appropriability effect) or escape the competition effect. The discouragement effect entails that if firms see that they cannot match their competition due to trade liberalization, they will not innovate because they know that their products will not be able to compete with existing products that are close to or on technological frontier already. The escape competition effect entails that firms that are closer to the technological frontier will innovate as competition intensifies; the idea behind this is that firms will continue to innovate in order to maintain their leadership position. These firms view quality upgrading as a way to survive competition from potential new entrants. Therefore, product quality is influenced by competition or by the product's proximity to the technological frontier.

Various economists have introduced quality choice into heterogeneous firm models (Verhoogen, 2008; Bastos and Silva, 2010; Baldwin and Harrigan, 2011; Kugler and Verhoogen, 2011, Johnson, 2012,

[6] This is a proxy for trade cost, which is similar to tariffs

[7] This is a modification to Melitz model by Baldwin and Harrigan (2011) which accounts for spatial aspects on prices. Firms will compete on the basis of quality as well as prices. Their modification assumes that consumers care about quality and that firms produces different varieties of quality.

Antoniades, 2012 and Fan and Li, 2012). Table 4 provides a summary of trade models that modify Melitz's (2003) model of heterogeneous firms and constant marks to consider quality choices.

These models show that if firm production raises marginal costs substantially, there is a positive correlation between prices and productivity, as well as firm size and prices. The models produce quality sorting along the productivity axis, showing the positive correlation between prices and quality. This relationship shows that price is a good proxy for quality (Antoniades, 2012; Baldwin and Harrigan, 2011).

All of these models introduce the quality component at both the demand side and the supply side. The demand side shows the utility function, in which a consumer maximizes consumption of products of various quality levels. The consumer therefore prefers to maximize consumption of high quality products, and therefore quality in this case might be treated as exogenous (Foster, Haltiwanger, and Syverson, 2008). On the supply side, the firm maximizes profit by producing high quality goods; thus, quality is modelled as an endogenous sunk cost that firms have to pay (Shaked and Sutton, 1987, 1990; Antoniades, 2012 and Kugler and Verhoogen, 2011; Fan and Li, 2012). As this study contributes to the empirical side, it does not track the various equations involved in these models.

Table 4: Trade Models Incorporating Quality

	Baldwin and Harrigan (2011)	Johnson(2012)	Bastos and Silva (2010)	Verhoogen (2008)	Kugler and Verhoogen (2011)	Khandelwal[8] (2010)	Antoniadse (2012)[9]	Fan and Li(2012)
Melitz (2003) modification	QHFT-n-country version-consumers and producer care about quality	n-country version-consumers and producer care about quality	Tries to exploit uncharted- within firm product unit values	Features vertical product differentiation and differences in income across countries	Include endogenous choice of input and output quality. Added perfectly competitive but quality differentiated intermediate sector	Make explicit distinction between vertical and horizontal product differentiation	Full general equilibrium model-incorporates quality competition in Melitz-Ottaviaono model	Introduces endogenous quality[10] and number of imported varieties and fixed cost of importing
Unit value calculation level	Product country level	Product country level	Firm-product-country and product country level	Plant level	Plant-product level	Product level (exports to US)	Modelling- firm level.	Firm-product-country level

3.2 Empirical Evidence

The measurement of product quality is a major challenge in current quality and trade literature investigating the impact of trade reform on product quality (Amit and Khandelwal, 2012; Hallak and Schott, 2011).[11] Most empirical trade literature uses the unit value (prices) of products as a measure of product quality (Bastos and Silva, 2010; Fernandes and Paunov, 2009; Kiyota, 2008; Schott, 2004, 2008; Iacovone and Javorcik, 2008; Kugler and Verhoogen, 2008; Hallak, 2005, 2006). Akerlof's (1970) study of the market for lemons supports the notion that higher prices act as a signal for higher product quality in imperfect market conditions. However, the possibility of endogeneity between tariff and product quality upgrading needs to be taken into account. This possibility mainly stems from the fact that unit values

[8] This focuses on US imports, similar to Hallak (2006) and Schott (2004). Other studies that rely on the use of CES specification and rely on demand effects to identify quality include: Hallak and Schott, 2011; Feenstra and Romalis, 2012; Eslava, Fieler and Xu, 2012; Crozet, Head and Mayer, 2009 and Baldwin and Ito, 2008.

[9] This is a modification of Melitz- Ottaviano's (2008) model of linear demands systems and endogenous mark-ups that introduces endogenous quality.

[10] Assumption of exogenous quality invalidates their findings

[11] Hallak and Schott (2011) introduce a new method of measuring countries' product quality that involves decomposing observed export prices into quality- versus quality-adjusted-price components. Amit and Khandelwal (2012) use an approach developed in Khandelwal (2010), in which higher quality is assigned to products with higher market shares conditional on prices. However, this study has not exploited that approach.

might themselves reflect the incorporation of higher input costs resulting from the import tariffs faced by exporting countries. High production costs due to input cost increases may lead to increases in unit values that are unrelated to quality improvements. Thus, the causal effects of foreign competition on product quality upgrading might be bidirectional. Instrumental variables might therefore be needed to deal with endogeneity issues. Fernandes and Paunov (2009), building upon the measure used by Bernard et al. (2006), make use of transport costs as a measure of import competition, as this measure can be exogenous to quality upgrading. They estimate a product quality equation using plant level data:

$$\log unit\ values_{it} = f(Transport\cos t_{it-1}, other\ \text{var}iables_{it}) \quad (1)$$

where i denotes plant i and t is the time index. Transport cost (TC) was measured as $TC = \frac{freight_{ict}}{fob_{ict}}$

where $freight_{ict}$ is the 8-digit Harmonised System code i from exporting country c in year t (freight rates as the ratio of freight cost, provided by the Latin America Integration Association). They point out that the usual measure of trade barriers (that is, tariffs) is not informative in the Chilean context due to the uniform tariff structure across industries that have been in place since the 1980s. Our study differs by focusing on product trade-level data and use tariff as a trade barrier measure.

Ardelean (2011) implements a methodology developed by Bils and Klenow (2001) and consequently estimates product quality for 66 durable consumer goods. Bils and Klenow's study determine whether trade liberalization might explain the variation in product quality in the case of the U.S. Their paper identifies and estimates quality Engel curves using household-level data on purchases of durable goods. This study differs from Ardelean's paper both in the data used and in the focus; our study differs further by focusing not on goods consumed by South Africa, but rather on goods exported.

Hallak and Schott (2008) estimate export product quality both across countries and over time. They find that product quality is correlated with an exporter's level of development, but find a weaker relationship for growth rates; they also try to separate price and quality variation in unit value data. Fontagne et al, (2008), exploiting unit prices of HS6-digit products for 200 countries, find that the South is not competing with the North in terms of market share of high quality products. Hummels and Skiba (2004) show that export prices vary negatively with tariffs and positively with shipping costs, confirming the Alchian- Allen hypothesis. Hummels and Klenow (2005), like Schott (2004), find a positive relationship between exporter GDP per capita and product quality (unlike this study, however, they use import data). This study more closely mimics Baldwin and Harrigan (2011), who use bilateral product-level export data to show that the determinants of unit prices postulated by various leading trade theories fail to explain actual trade prices. They therefore suggest a quality-augmented Melitz model, which confirms their

findings that export unit values are positively related to distance; however, they fail to find a negative relationship between exporter GDP and unit values. Hallak (2006) looks at the importing country's demand and finds that there is a relationship between importer GDP per capita and quality.

Amit and Khandelwal (2012) use import tariffs to analyze the effect of import competition on quality upgrading using highly disaggregated export data (10,000 products) for the United States from 56 countries. They employ a nested logit demand framework based on Berry (1994) to estimate the quality variable and find that lower tariffs increase quality upgrading for products closer to the world quality frontier but discourage quality upgrading for products that are distant from the frontier. Their study defines a variety's proximity to the frontier as the ratio of its quality to the highest quality within each HS product. They rely on models by Aghion and Howitt (2005) and Aghion et al., (2005)[12], which argue that the degree of innovation resulting from import competition will depend on the distance of the product to the world technological frontier.[13] Our study differs from Amit and Khandelwal's study in that they focus on exports only to the US, while this study's focus is on South African exports to other countries. As in their study, however, we make use of tariffs as a measure of import competition and utilize their other product quality measure – unit prices.

Antoniade (2012), using a theoretical model, shows that an increase in competition raises the scope for quality differentiation and causes the quality ladder to pivot around some point. This study shows that for firms above the pivot point, the more productive firms escape competition by raising quality, mark-ups, and prices; firms below the point either lower quality, mark-ups, and prices or exit the market. The model predicts that average prices and mark-ups exhibit a U-shape response to competition (imports from developed countries are of higher quality and cost more than imports from developing countries.)

There are also various studies that track product quality at the firm-level (Bustos and Silva, 2011; Monova and Zhang, 2012; Martin, 2010; Gorg et.al, 2010; Verhoogen, 2008; and Kugler and Verhoogen, 2012). They compute unit values at the firm-product-country level, which differs from our dimension exploiting the product level alone and/or product- country level variations. Most of these studies find that competition results in firms upgrading the quality of their products. Moreover, the majority of these studies find that within firms, there is a positive correlation between export price and gross domestic product per capita of the destination country: markets that can afford high quality goods are supplied with

[12]Aghion et al. (2005) demonstrate the discouragement or appropriability effect and escape entry/competition effect.

[13] Amable, Demmou, and Ledezma (2008) use labor productivity (value added per hour worked) as the measure of efficiency, thus allowing them to identify the technological frontier. The latter is defined as the most productive available technology for each industry in a given time period. The individual (country-industry couple) having the maximum labor productivity among all countries in a given year is identified as the technological leader for that year. The closeness to the frontier is measured as the percentage of labor productivity relative to that of the frontier. (The distance to frontier is then the inverted ratio.) In order to smooth the series, they consider a three-year moving average.

high quality goods. Bloom et al. (2011) find that highly productive firms in the EU were more likely to respond to the increased competition bought by China's entry to the WTO by innovating than less productive firms. Lacovone (2012) also finds that liberalization boosts innovation efforts for more productive firms than it does for less productive firms. Lileeva and Trefler (2010) and Schor (2004) reveal that the impact of liberalization is heterogeneous across firms, while Bustos (2011) and Teshima (2010) use highly detailed plant level data from Argentina and Mexico, respectively, and find that firms respond to liberalization by investing in technology and innovation. Blundell et al. (1999), using a panel of British manufacturing firms, find that increased competition leads to innovation by more dominant firms.

4. Empirical Model

Our empirical methodology draws both from existing theoretical models and available data. The empirical equation follows specifications from existing studies (Amit and Khandelwal, 2012; Kneller and Yu, 2008; Ito, 2012; Baldwin and Harrigan, 2011). The paper estimate a model with unit values calculated at only the product level[14]. Unit values are calculated at the HS8-digit level, and the definition of a product means an HS8 product code. The use of HS8 helps in reducing the aggregation bias resulting from the use of the HS6-digit level. The model ignores country-level variations in unit values following existing international trade models, which implies that exporters charge the same free on board (f.o.b) to all destination countries (Krugman, 1980; Eaton and Kortum, 2002, Melitz, 2003); this is in contrast to those models that depict unit values as reduced for more distant countries (Brander and Krugman, 1983; Ottaviano et. al., 2002). Country-level variations are ignored because the tariff data only varies at the product level. We instead include product-year fixed effects to account for product-specific productivity shocks or changes in consumer demand. The focus is only on manufacturing products.

4.1 Model

The specification of the model is as follows:-

$$Luv_{it} = \beta_0 + \beta_1 Ltariff_{it} + \beta mc_{it} + \gamma_i + \lambda_t + \varepsilon_{it} \qquad (2)$$

where Luv_{it} is log of unit value of product i (here HS8 product code) at time t,

$Ltariff_{it}$ is log of tariff of product i at time t.

mc_{it} is the count of imported product i at time t. This is a proxy for import variety effect. It is a measure of extensive import trade margin and is a dummy variable with 1 if the product has been imported for a

[14] We also tried to estimate with unit values calculated at either country or preference and product level (HS6). The results were consistent.

particular year and 0 if otherwise. The other variable used to represent this variety effect is the log of the import value (Lmv_{it}) of product i at time t.

γ_i represents product fixed effects and controls for both products' unit values (for example, values for gold versus values for shirts) and difference in units of measurement (for example, kilograms versus a simple count) across HS8 codes.

λ_t represents year fixed effects (time trend).

ε_{it} represents the residuals.

As a robustness check, we re-specify the model with a lag of tariff ($lagLtariff_{it}$) to take into account the fact that a tariff might have a lag in its effect on quality upgrading.

In addition, the study adds other variables as control variables in line with the existing literature, such as gross domestic product per capita, foreign direct investment, world export, growth, and world gross domestic product growth (Baldwin and Harrigan, 2011; Hummels and Klenow, 2005; Caetano and Galego, 2006; Reganati and Pittiglio, 2005; Amiti and Khandelwal, 2012). The inclusion of these variables is justified below. The other model to be estimated therefore becomes:

$$Luv_{it} = \beta_0 + \beta_1 Ltariff_{it} + \beta_2 mc_{it} + \beta_3 Lgdpcap\_SA_t + \beta_4 w\exp\_g_t + \beta_5 wgdp\_g_t + \beta_6 Lfdi_t + \lambda_t + \varepsilon_{it} \qquad (3)$$

where $Lfdi_t$ is the log of foreign direct investment into South Africa at time t. However, the proxy used in this study is FDI inflows, which is taken as an aggregate figure, not at the product or sector level.

$Lgdpcap\_SA_t$ is the log of South Africa's gross domestic product per capita at time t ; this acts as a proxy for South Africa's ability to produce more (quality) export goods and also acts as demand pull factor from South African consumers.

$w\exp\_g$ is the world export growth at time t.

$wgdp\_g_t$ is world gross domestic product growth. Other variables are as defined above.

The coefficient of interest in equations 2 and 3 is β_1. A priori, it might be negative or positive; this depends on the channel that holds for South African products.

This model uses HS8-digit data. The tariff data from 2001 has been adjusted using trade weights to make it resemble MFN tariffs pre-2001. We also averaged tariffs without using trade weights; the results are not sensitive to this change. We estimate sub-sample periods from 1988-2000 and 2001-2009 to determine if our methodology masks the impact of a break in tariff reform that occurred in 2000. Unit values, gross domestic product per capita measure, foreign direct investment, and import value measure are all in US$ for the same base year.

Existing studies have shown that product quality is affected by many variables as listed in Table 5. The selection of variables used in this study is based on these studies.

Table 5: Variables Used in Existing studies

Variables	Expected sign	Previous Studies
GDP per Capita	+/-	Falvey and Kierzkowski, 1987; Schott, 2004; Hummels and Klenow, 2005, Baldwin and Harrigan, 2011, Hallak, 2006
Human capital	+	Schott, 2004
Technological innovation	+	Flam and Helpman, 1987, Aw et at. 2008, Faruq, 2011
FDI	+	Harding and Jovircik, 2009); Caetano and Galego, 2006, Reganati and Pittiglio, 2005, Faruq, 2011
Institutions	+	Faruq, 2011, Amiti and Khandelwal, 2012
Distance	+/-	Fontagne et al, 2008, Baldwin and Harrigan, 2011, Harrigan and Shlychkov, 2012
Tariffs	+/-	Amiti and Khandelwal, 2012, Hummels and Skiba, 2004
World Wide export growth	+/-	Proxy for productivity shocks. Amiti and Khandelwal, 2012

From our empirical models, it can be envisaged that the determinants of product quality can be grouped into exporting and importing country characteristics. For example, the larger or more sophisticated the domestic market, the higher the quality of products supplied to the local consumer (as in Motta et.al, 1997). This means that there are both demand-side determinants, like the importing country's GDP per capita, and supply-side determinants, like the exporting country's GDP per capita.

4.2 Definition of Variables

This section gives a brief description and definition of the variables used. The empirical equations estimated are at the product level, and the variables are modified to represent such specifications. For example, for unit value, we start with a calculation that assumes that f.o.b. prices for exports are same across countries; this is a calculation at the HS8 level.

Product Quality Measure - Why Use Unit Value

Unit values are the common proxy for quality in international trade (Schott, 2004; Hallak, 2006 and Johnson, 2012). In general, higher quality goods are expected to sell at higher prices. The reason for using unit values as an indicator of quality lies in the fact that trade data does not contain information on product characteristics (Faruq, 2011), which makes it hard to draw direct inferences about quality. Higher prices are therefore inferred as a depiction of higher quality (Schott 2004; Hallak, 2006). Furthermore, this strategy builds on the methodology used in several previous studies on trade and product quality[15]

[15] Existing empirical evidence even at the firm level reports a positive correlation between prices, supporting the use of unit values as a proxy for quality (Verhoogen, 2008; Kugler and Verhoogen; 2011, Hallak and Sivadasan; 2011, Manova and Zhang, 2012; Lacovone and Javorcik, 2012)

(Schott, 2004; Khandelwal, 2010; Faruq, 2011; Baldwin and Harrigan, 2011). The calculation of product unit values entails first aggregating the trade values and quantity at the product level across the country to remove variation. We then divide the value by the quantity to obtain the unit value.

The use of HS8-digit level aggregation is intended to reduce composition problems that might be associated with the calculation of unit values. This study relies on the Quantec data set, which contains both quantity and value for exports at the HS8-digit level; therefore by definition, a product is at the HS8-digit level[16]. The level at which unit prices are calculated and analysed varies in the literature. Existing studies either calculate unit value at trade flow product level (Rodrik, 1994; Schott, 2004; Hummels and Skiba, 2004; Hallak, 2006; Baldwin and Harrigan, 2011; Johnson, 2012) or at firm-level trade transaction data[17] (Bastos and Silva, 2010; Manova and Zhang, 2012; Gorg, Halpern and Murakozy, 2010; Martin, 2010, Verhoogen, 2008). The formula used to calculate unit values is as follows:[18]

$$uv_{it} = \frac{\sum_{i \in I_{jt}} hs8v_{ijt}}{\sum_{i \in I_{jt}} hs8q_{ijt}} = \frac{Value_{it}}{Quantity_{it}} \qquad (4)$$

where uv_{it} is the unit value of product i at time t. $hs8v_{ijt}$ is the HS8-digit level value of product i to country j at time t. $hs8q_{ijt}$ is the HS8-digit level quantity of product i to country j at time t. These are summed across countries in order to have a unit value of a product for all countries; this process is dictated by trade models that assume that export prices will not differ across countries (free-on-board)[19].

The advantage of this method is that unit values are easy to calculate from trade data. However, the weakness, as from Amiti and Khandelwal (2012), is that unit values are inappropriate proxies for quality if products possess both vertical and horizontal attributes. This weakness does not hold for this study, though, as it only focuses on South African exports with variation across products, not across countries. Using unit values as a proxy for quality is subject to criticism for other reasons as well. Unit values might be determined by factors other than quality, such as market power and production cost. Hallak and Schott (2005) further challenge the strong association of prices to quality, arguing that differences in unit values may reflect not only the quality of a product but also exchange rate misalignment or differences in production costs. Another weakness might arise from the fact that price differences could reflect quality

[16] This follows literature which has arbitrariness in the definition of a product. Schott (2004) connotes two different headings of the most detailed level of international trade classification as representing two different products at the HS6-digit level.

[17] The move to firm-level data has been necessitated by recent availability of this data in other countries. However, for the case of South Africa, such data is not readily available; hence we focus on the product level.

[18] However, this entails running a regression with products in different measurement units (for example, kgs, barrels, etc.). This is to an extent controlled by γ_i. Baldwin and Harrigan (2011) restrict their samples to only those in kilograms or only manufacturing products, as per this study.

[19] We neglect this assumption at theHS6-digit level and see if results hold.

perceptions influenced by advertising or reputation rather than intrinsic characteristics of the goods traded. Despite these weaknesses, using unit values as a proxy for quality is a generally accepted practice in existing trade literature.

Tariff Liberalization

The tariff data used in this study is at the product level and does not vary across countries because tariff does not vary at country level pre-2001. This limits the ability to analyze the impact of tariff liberalization on product quality using cross-country variation; due to this limitation, the analysis is carried out using variation across products. After 2000, South African tariffs changed to the regional level, at SADC, EU, and MFN levels. To make the data comparable, we take the trade-weighted average of tariff data after 2001 and then combine the calculated tariff with pre-2001 tariff data.

We construct weighted average tariffs for country j. The simple average is calculated by adding the tariffs on all lines of interest and dividing by the number of those tariff lines; a drawback of this process is that it gives the same weight to products that are not imported and to products that are imported in large amounts. Weighted average tariffs, on the other hand, tell us how much protection is applied by a country on average; the difference from a simple average is that weighted averages take into account the volume of imports in each product category. In other words, the weighted average tariff can be defined as the sum of the tariffs in a country's tariff schedule multiplied by a weighting factor that represents that product's importance to the country's trade. The disadvantage to this process is that, unlike simple averages, it tends to understate the degree of protection because high protection levels tend to restrict the volume of imports in a sector, leading to that sector being given a low weight. The formula for a weighted average tariff is:

$$\bar{t} = \sum_k w_k t_k \qquad (5)$$

where k indexes imported goods and w_k is the weight given to tariff k in the average. The most common approach is to weight goods with their share in the county's overall imports as shown below.

$$\bar{t} = \sum_{iSA} \frac{m_{iSAj}}{\sum_k M_{kSA}} t_{iSAj} \qquad (6)$$

where j is trading partner country, i is the set of products of interest, k is the set of source countries, t is the tariff of interest, m is product-level imports, and M is total imports by category. The weight used in this study is trade share in total South African imports for each product of EU, SADC, and MFN countries. The weightings differ by year, but for robustness purposes, we also try weightings that don't vary by year.

Foreign Direct Investment (FDI)

Foreign Direct Investment tries to measure the inflow of technology into the country. Several existing studies posit that FDI plays a role in quality as it provides a conduit for both direct technology transfer and indirect intra- industry knowledge spillovers (Damijan et al, 2003; Caetano and Galego, 2006, Regati and Pittiglio, 2005; Kokko, 1997; Javorcik, 2004). As South Africa receives more FDI, it can upgrade its product quality and hence be expected to export higher quality products. The FDI variable used in this study is net FDI inflows into South Africa as a percentage of GDP. This variable, like world export growth and GDP per capita, does not vary across products; thus, we also estimate time-specific and product-fixed effects.

World Export Growth and Import Value/Variety

World Export Growth represents a proxy for productivity shocks, as used in Amiti and Khandelwal (2012); the most appropriate measure for this study is the world export growth for each product. By tracing both the import value and variety, we can trace the impact that these have on product quality. In essence, the higher the quality of the varieties being imported, the higher the quality expected of South African products (the variety effect). This has been seen in existing literature by Fan and Li (2012), and also implies the input effect on product quality since most of the imports are intermediate commodities.

Market Size/Demand GDP per Capita

GDP per capita proxies market demand and development. The higher the GDP per capita for the exporting country, the higher the likelihood of that country exporting higher quality goods. However, the sign of GDP per capita for importing countries is ambiguous: it might present either a positive or a negative effect on unit values as indicated by the models reviewed previously. This follows Falm and Helpman's (1987) framework in which varieties of different qualities were produced at a cost reflected by higher prices for higher qualities. This model was extended by Choi et al. (2006) to form a multi-product, multi-country framework that allows for higher income countries buying higher unit value varieties. We use world GDP growth rates to proxy GDP for all other countries since we do not have variation at the country level.

4.3 Data

Data is accessed from different sources, as shown in Table 6. Tariff data is based on Edwards (2005). This is updated yearly and includes tariffs on final products. The time period for the study is dictated by data availability from 1988-2009.

Table 6: Data Sources

Variable	Description	Source
Unit values HS8	Calculated from HS8 digit level trade data	COMTRADE and Quantec. Both data sets start in 1988
Tariff rates	Calculated by Edwards at HS8 digit level For HS6 in trains	UNCTAD TRAINS Datase, Edwards(2005), and South African Revenue Services (SARS), Edwards, 2010
GDP	Gross Domestic product	World Bank
Distance	Distance among major cities	CEPII (Centre d'études prospectives et d'informations internationales, www.cepii.fr
World Exports growth	calculated	IMF
FDI	Foreign Direct Investment	World Bank

The descriptive statistics for HS8 data are as presented in Appendix Table A.1. As can be seen from this table, the data is not a balanced panel. The mean and standard deviation of the variables are not widely spread, and the remaining products are the result of data cleaning and merging of data sets. The various relationships of the variables used are as depicted in Appendix Figures A1 to A3. These graphs show a general decline of unit value until 2001, at which point it starts oscillating. There is also a clear positive relationship between unit values, tariffs, and gross domestic product.

5. Empirical Results

This section presents the results from our estimated models.

5.1 Model (Results at the HS8-Digit Level)

Our results exploit variation across both products and time. Table 7 shows nine regression results with different specifications. Columns 1-5 show the estimation of equation 2 above, while columns 6-9 show the estimation of equation 3 with different variables. Column 1 controls for the tariff and product fixed effects. Column 2 considers only the lagged tariff and product fixed effects. Column 3 controls for both the tariff and lagged tariff, while columns 4 and 5 take into account the two measures of extensive margins (variety). Columns 6-9 consider other variables that might affect product quality, such as GDP, export growth, world GDP growth, and foreign direct investment. The results consistently show the positive relationship between tariffs and the measure of product quality (unit values). The positive impact of tariffs is robust to the inclusion of different variables[20]. For example, column 4 shows that a 1% increase in tariffs leads to a 0.27% increase in product quality.

[20] Foreign Direct Investment is used for sensitivity analysis, and its inclusion in regression has not altered our results. However, an appropriate measure for FDI might be foreign direct investment per sector.

Given that tariffs have generally been falling from early 1990s to 2009 in South Africa, one interpretation could be that a reduction in tariffs is associated with a decline in product quality. The positive effect between tariffs and unit values (quality) shows that South African manufacturing products facing increased competition due to tariff reduction fail to experience an upgrade in quality. This suggests that South African manufacturers may have been concentrating on supplying the domestic market rather than the export market since they could potentially gain increased margins in the domestic economy. As the economy opens up, mark-ups are reduced.

Another interpretation is that South African products were not close to the technological frontier during the study period. This concurs with results found by Amiti and Khandelwal (2012) using the same measure as a proxy for product quality for products far away from the unit value frontier. These results seem logical, as they show that increasing tariffs will result in higher product quality because larger profits will be generated by the lack of competition. These profits will then be used to invest in improved product quality. The results support the discouragement effect as opposed to the escape-competition effect.

One implication of these results is that during the 1990s, South Africa was not competitive enough, and thus protection was the key to producing high quality exports. A more straightforward explanation suggests that a decrease in tariffs leads to decrease in product quality upgrading, meaning that the decrease in tariffs has not brought quality benefits to the South African manufactured products. This can be referred to as the market disciplining effect (as found by Edwards and Winkel, 2005) and shows that due to intense competition, South African exporters have been defensive in decreasing the unit prices of their commodities. This might be particularly the case for exports to other African markets, where South African exporters can decrease the quality of their products in order to sell their commodities. The results presented in Table 7 have used a weighted constructed tariff from 2001; this weighted tariff at the product level was calculated at the preferential trade data level using SADC, EU, EFTA, and MFN countries. The total imports of a HS product to South Africa were divided by total South African imports of that product from the whole world; this was then multiplied by the product's respective tariff. For sensitivity purposes, the results obtained from such a manipulation are compared to the results obtained using an average of the tariff data after 2000 without weighting; these results are generally in conformity with one another, which shows that the manipulation did not distort the tariff effect on product quality. The equations were estimated taking into account the product fixed effects (Prd.Fix. Ef) and year fixed effects (Year Fix Ef).

The lagged tariff also shows a positive sign. Appendix Table A.2 estimates equation 3 with a lagged tariff. The results are robust to the inclusion of the lagged tariff when including other variables. The positive impact of the tariff and the lagged tariff still stand in Columns 1-3 of Table A.2.

The positive relationship between South African GDP per capita and product quality shows that as the country becomes richer, it is able to produce higher quality goods. This points both to the country's ability to produce quality goods and to South Africa's domestic demand for quality products, showing that higher development is associated with shipping higher unit values. World GDP growth rate, however, carries mostly negative signs, which shows that as the world GDP increases, South African product quality decreases. This finding may be supported by the fact that as the world GDP increases, South Africa's competitors are able to produce and supply higher quality goods, dampening the potential quality upgrading of South Africa products. In other words, as global incomes increase, the world in general will not import more South African products shipped at higher unit values. This is the market size effect as envisaged by the heterogeneous firms linear demand models discussed previously. This concurs with Baldwin and Harrigan (2011) who postulate that lower quality firms will find it profitable to enter a larger destination market, thereby lowering the average export unit value to that market. On the other hand, Kneller and Yu (2008) show that a larger market implies fierce competition, resulting in higher export unit values. Bastos and Silva (2010) also finds a positive relationship between market size and unit values, but their results are derived from cross-sectional analysis for 2005 and include income per worker, suggesting that demand-side considerations do play a role in explaining export unit values. Hallak (2006) and Verhoogen (2008) find similar results.

World export growth carries a positive sign with the exception of column 9 (in Table 7). This shows that an increase in world exports acts as an increase of productivity, which might carry some spill-over effects to South African commodities. Thus, the increase in world exports is a proxy for productivity, implying that such an increase is good for South African manufacturers.

5.2 Sensitivity Analysis

Our study employs various methods: estimation using only time-specific effects and tariffs as independent variables, lagging tariff variable and using different sub-sample periods as shown in Tables 8 and 9. The results are robust, showing that tariffs have a positive effect on product quality for both sub-sample periods. We also selected products with a high initial tariff in 1988 and repeated the above regressions; the positive impact of tariffs is not sensitive to such selection.

5.3 Sub-Sample Analysis: Using HS8 Data, Product Level

The structural shift that occurred in 2001 in terms of tariff reform warrants sub-sample estimations using the pre-2001 sample and the post-2000 sample to see if our results remain consistent after preferential application of tariffs to some regional blocks. Tables 8 and 9 show the sub-sample estimations for 1988-2000 and 2001-2009, respectively.

Table 7: Full Sample Results (1988-2009): Using HS8 Data, Product Level

	1	2	3	4	5	6	7	8	9
ltariff	4.166 (114.88)**		4.139 (113.66)**	0.268 (4.60)**	0.630 (17.11)**	0.116 (2.37)*	0.528 (9.97)**	0.268 (4.60)**	0.454 (6.57)**
lagtariff		0.473 (18.31)**	0.211 (8.35)**						
lmv				0.040 (16.14)**		0.078 (35.46)**	0.043 (17.28)**	0.040 (16.14)**	0.051 (17.45)**
mc					1.623 (226.39)**				
lgdpcap_SA						0.164 (2.90)**	0.441 (7.66)**		1.204 (14.30)**
wexp_g						0.199 (3.26)**	0.134 (2.20)*		-0.415 (5.31)**
wgdp_g						-0.017 (4.15)**	-0.013 (3.18)**	-0.007 (1.78)	0.048 (7.55)**
lfdi									-0.058 (10.44)**
Constant	0.989 (281.21)**	1.21934 (382.71)**	0.979 (259.70)**	1.546 (44.72)**	0.1337 (77.80)**	-0.261 (0.57)	-2.042 (4.41)**	1.577 (44.85)**	-7.147 (11.69)**
Prd.Fix. Ef	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Year Fix Ef	No	No	No	Yes	No	No	No	Yes	No
R^2	0.04	0.00	0.04	0.01	0.19		0.00	0.01	0.01
N	300,146	300,145	300,145	161,142	300,146	161,142	161,142	161,142	111,663

*significance at 5% and **significance at 1%

As Table 8 shows, for the pre-2001 sub-sample, the results are not sensitive to sub-sample analysis. Columns 1-5 estimate equation 2, while columns 6-8 estimate equation 3. The tariff, GDP, world exports, and world growth all carry the same sign as in the full sample results, which shows that there is still a positive relationship between tariffs and product quality. The explanation for these consistent results might be the fact that pre-2001, South African producers were not very competitive; such an explanation could therefore support the idea that high tariffs during this pre-2001 period seem to have been beneficial to manufacturers. The lagged tariff variable still carries a positive and significant sign.

Table 8: Subsample Results (1988-2000); Using HS8 Data (Product Level)

	1	2	3	4	5	6	7	8
ltariff	3.311		3.302	0.357	0.662	0.478	0.357	0.212
	(74.57)**		(74.14)**	(5.14)**	(14.70)**	(7.49)**	(5.14)**	(2.18)*
lagtariff		0.249	0.084					
		(8.37)**	(2.84)**					
lmv				0.047		0.047	0.047	0.056
				(13.84)**		(13.89)**	(13.84)**	(12.66)**
mc					1.508			
					(156.92)**			
lgdpcap_SA						1.190		0.701
						(6.71)**		(1.97)*
wexp_g						-0.166		-0.784
						(1.88)		(6.88)**
wgdp_g						-0.075	-0.035	0.117
						(9.92)**	(4.97)**	(5.41)**
lfdid								-0.128
								(9.16)**
Constant	1.031	1.245	1.025	1.439	0.401	-7.854	1.605	-1.783
	(224.16)**	(309.74)**	(207.25)**	(32.81)**	(68.01)**	(5.57)**	(34.07)**	(0.62)
Prd.Fix. Ef	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fix Ef	No	No	No	Yes	No	No	Yes	No
R^2	0.03	0.00	0.03	0.01	0.14	0.00	0.01	0.01
N	204,111	204,110	204,110	110,342	204,111	110,342	110,342	66,129

*significance at 5% and **significance at 1%

Table 9 shows sub-sample results for the post-2000 period. The positive impact of tariffs on product quality still holds in these results, showing that even after the tariff reform of 2001, tariff reductions remain associated with a decline in product quality. This finding may signify that South African producers have failed to upgrade their products during this period; it may also suggest that South African producers are engaging in a defensive strategy in the domestic market by reducing mark-ups as they face higher competition These results show that the positive impact of tariffs is robust to sub-sample analysis. Columns 1-5 estimate equation 2, while columns 6-9 estimate equation 3. The measure for extensive margin or product variety carries a positive sign on all these regressions. GDP per capita for South Africa still carries a positive significant sign, as expected.

Table 9: Sub-Sample Results (2001-2009): Using HS8 Data (Product Level Data)

	1	2	3	4	5	6	7	8
ltariff	2.439		2.439	0.450	1.657	0.390	0.450	0.552
	(31.16)**		(31.10)**	(2.33)*	(20.25)**	(2.02)*	(2.33)*	(2.71)**
lagtariff		0.069	-0.00185					
		(1.90)	(0.05)					
lmv				0.018		0.023	0.018	0.017
				(4.34)**		(5.52)**	(4.34)**	(3.93)**
mc					0.42453			
					(31.01)**			
lgdpcap_SA						1.607		1.023
						(23.94)**		(7.22)**
wexp_g						0.379		2.287
						(5.01)**		(16.89)**
wgdp_g						0.004	-0.099	-0.126
						(0.69)	(20.47)**	(13.53)**
lfdid								0.086
								(7.96)**
Constant	1.108	1.214	1.108	1.531	0.918	-11.341	1.699	-8.270
	(249.28)**	(388.24)**	(239.26)**	(27.12)**	(121.88)**	(21.09)**	(29.84)**	(8.69)**
Prd.Fix. Ef	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fix Ef	No	No	No	Yes	No	No	Yes	No
R^2	0.01	0.00	0.01	0.03	0.02	0.02	0.03	0.03
N	96,035	96,035	96,035	50,800	96,035	50,800	50,800	45,534

*significance at 5% and **significance at 1%

6. Conclusion

This study investigates the impact of tariff liberalization on export product quality upgrading at the HS8-digit code from 1988 to 2009, looking at tariff changes across products. The study employs a panel data method that exploits variation across the product level. The results indicate that tariff liberalization is associated with a decline in the quality upgrading of South African products when considering variation at the product level only. Our results support the appropriability effect which discourages firms facing higher competition from upgrading the quality of their products.

The results found for other variables are consistent with existing theory; for example, for GDP per capita, the relationship with unit values is positive. This suggests that in order for manufacturing firms to engage in quality upgrading activities, GDP needs to continually increase. One policy recommendation stemming from these results is that future trade reforms need to address this failure of South African exporters to upgrade their products. Thus, there is a need for case-by-case consideration for further tariff liberalization, with proper consideration of the impact of such liberalization on international

competitiveness. However, our results may also suggest out that domestic mark-ups in South Africa have been high, so tariff liberalization may push them down.

While this study has attempted to unravel the impacts of tariff liberalization, there remains a need for further study to disentangle the competition and variety effects of tariff liberalization by computing input tariffs relying on Input-Output tables. In addition, while the methodology used in this study relies on unit values to measure product quality, unit values remain imperfect measures of product quality. Future research should therefore try to use alternative quality measures.

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Appendix

Figure A.1: GDP per capita and unit values

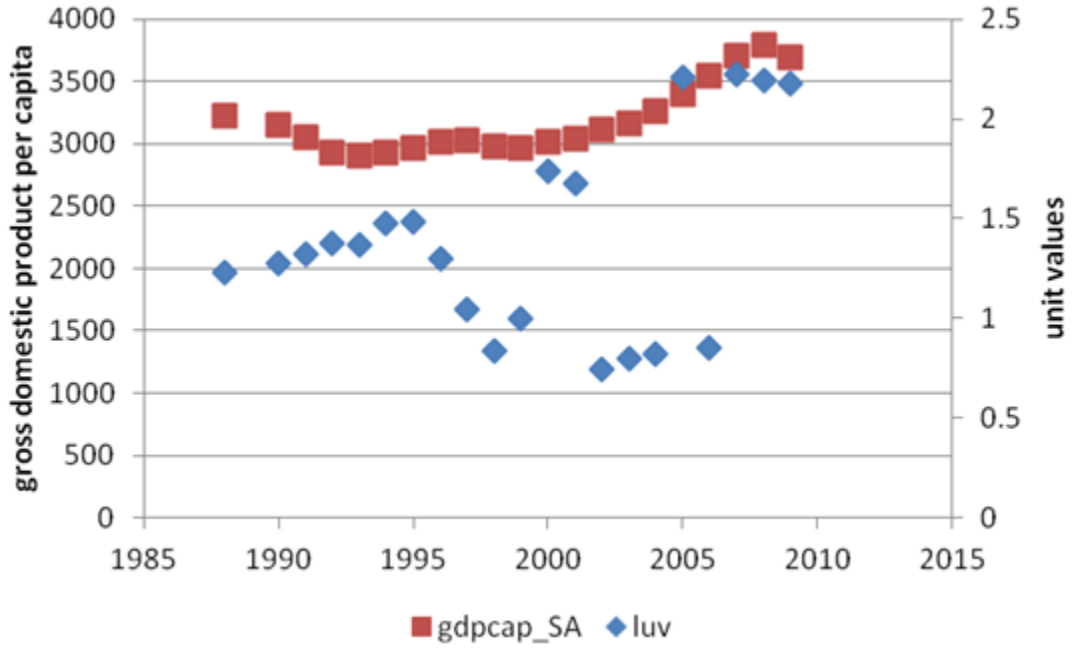

Figure A.2: Unit values (1988-2009)

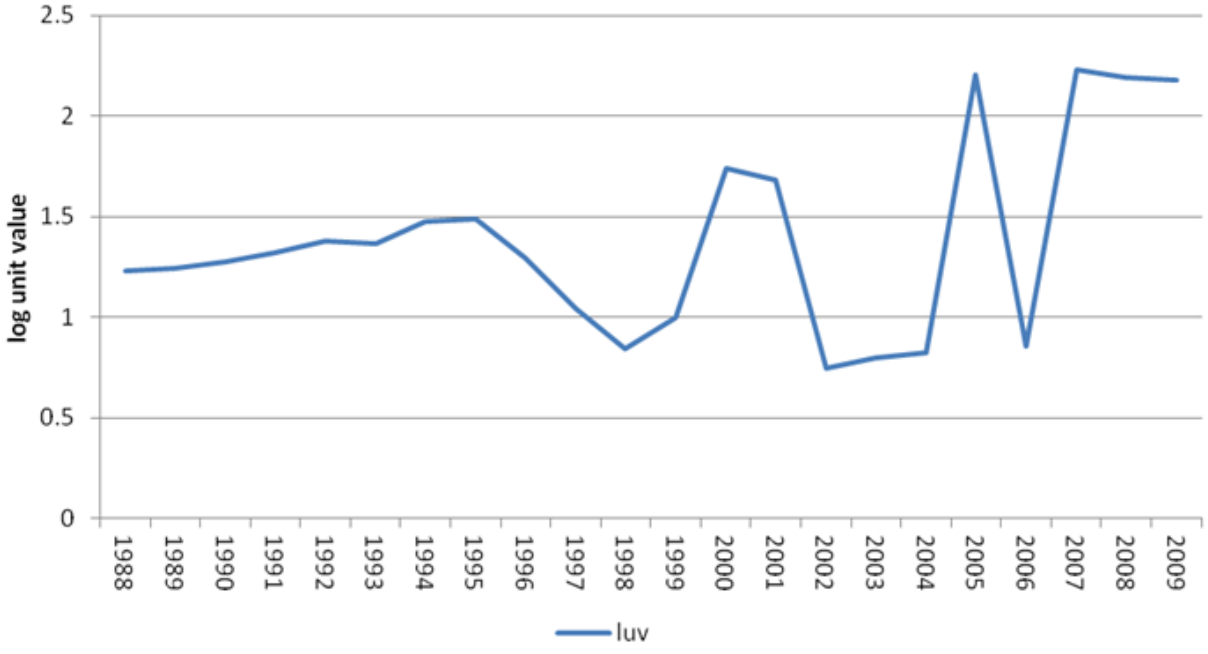

Figure A.3: Tariff and unit values (1988-2000)

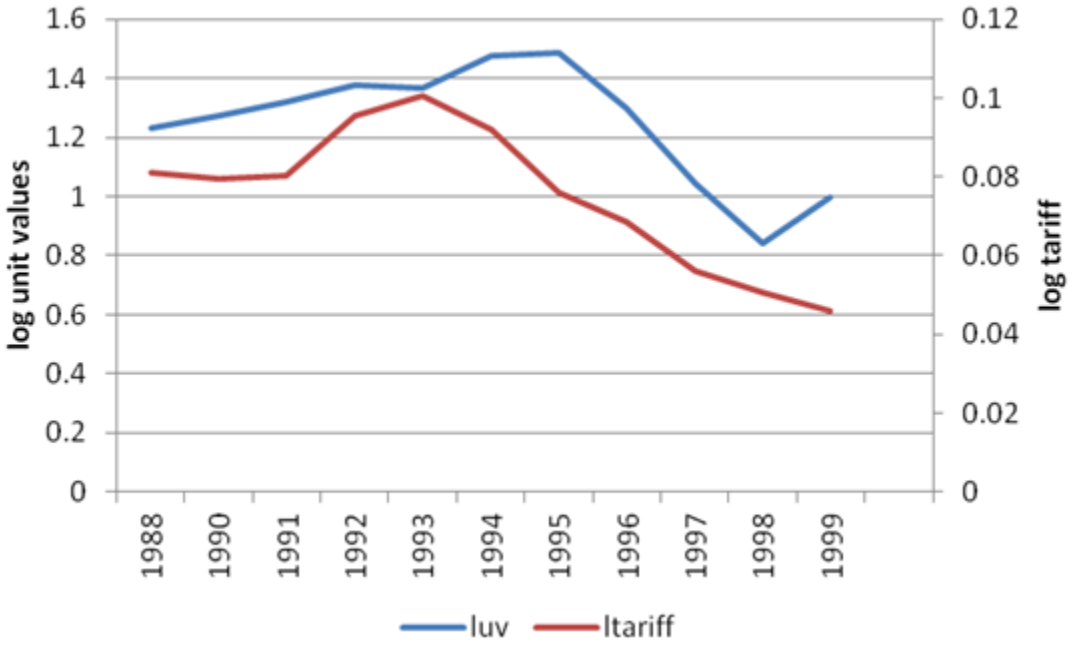

Table A.1: Descriptive statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
luv	overall	2.105862	2.431072	-10.31894	20.09742	N = 150952
	between		2.111398	-6.348139	17.85073	n = 16476
	within		1.265288	-8.916813	13.81292	T-bar = 9.16193
ltariff	overall	-1.911587	1.057306	-26.27602	1.981001	N = 103020
	between		.9759786	-12.04991	.6373217	n = 11005
	within		.5009033	-21.07978	5.403559	T-bar = 9.3612
lgd~2000	overall	8.047165	.0668836	7.973569	8.241478	N = 300146
	between		.0371813	8.024608	8.227623	n = 17408
	within		.0637229	7.95256	8.239168	T-bar = 17.2418
lmvd	overall	12.31847	2.91275	-.2150321	21.83599	N = 161153
	between		2.849393	.2056645	21.24055	n = 14885
	within		1.397925	-2.344102	21.13462	T-bar = 10.8265
wexp_g	overall	.0875994	.0841947	-.2164727	.2189627	N = 300146
	between		.0175238	-.2164727	.160171	n = 17408
	within		.0839351	-.2145103	.2761852	T-bar = 17.2418
wgdp_g	overall	2.917789	1.172452	-2.245053	4.720025	N = 300146
	between		.3514239	-2.245053	4.000198	n = 17408
	within		1.159882	-2.119152	5.848068	T-bar = 17.2418
lfdid	overall	21.68771	1.107971	19.63573	23.25962	N = 221509
	between		.380526	21.41901	23.25962	n = 17408
	within		1.088624	19.45014	23.37494	T-bar = 12.7246

Table A.2: Full Sample Results (1988-2009): Using HS8 Data: Product level: tariff lagged

	1	3	4
ltariff2	0.318	0.611	0.279
	(8.89)**	(16.16)**	(3.98)**
lagtariff21	0.146	0.129	0.025
	(6.20)**	(5.51)**	(0.69)
1.mc	1.655	1.623	
	(236.69)**	(224.60)**	
lgdpcap_SA	0.073	0.029	2.563
	(1.74)	(0.68)	(20.84)**
wexp_g	0.532	0.519	-0.132
	(12.22)**	(11.94)**	(1.64)
wgdp_g	-0.040	-0.035	0.020
	(12.90)**	(11.27)**	(3.10)**
lmvd			0.049
			(16.87)**
lfdid			1.564
			(14.55)**
laglfdi			-1.570
			(15.10)**
Constant	-0.186	0.155	-19.133
	(0.55)	(0.46)	(19.14)**
Prod Fix. Eff	No	Yes	Yes
N	300,145	300,145	111,661
R^2		0.19	0.01

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