

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

Have falling tariffs raised wage inequality in South Africa?*

Duncan E. Pieterse

School of Economics, University of Cape Town

Abstract: This paper comments on a possible relationship between wage inequality and trade liberalisation in South Africa. Several unique contributions are made here: first, the above-mentioned relationship is tested using mandated-wage regressions that were based on the zero-profit condition; second, the impact of falling tariffs on factor returns is analysed directly; and third, the indirect impact of trade liberalisation on factor returns, through its effect on technology, is examined. This paper finds that the sector bias mandated by regressions between tariffs and product prices did not increase the skill premium, as it mandated negative returns to skilled labour that was higher than the negative returns mandated to unskilled labour. Despite this evidence, the price changes induced by tariffs mandate a decline in the skill premium that is mostly statistically insignificant.

* I would like to thank TIPS for making available the data that made this paper possible. The National Research Foundation and MESP provided financial assistance for this paper. Views expressed in the paper are mine and should not be taken to reflect the views of the institutions that provided data and financial assistance. I am indebted to Lawrence Edwards for guidance, helpful comments and assistance with gathering the data. The usual disclaimer applies.

1. Introduction

In recent years, the production side of the South African economy has been characterised by a rise in skill intensity. This has translated into increasing unemployment among unskilled workers and possibly contributed to a rise in wage inequality.¹

This study examines a possible relationship between rising wage inequality and trade liberalisation. Two factors have motivated research on this relationship: (a) an international debate around the causes of rising wage inequality in industrialised countries;² and (b) South Africa's recent programme of trade liberalisation. Unfortunately, South African research on the topic focus either on the impact of trade flows on the labour market or explains employment trends after freer trade. Therefore, current South African current research fails to examine, directly, the impact of trade liberalisation on wage inequality. This study addresses the above-mentioned shortcoming through an analysis of the impact of tariff cuts on returns to skilled and unskilled labour and capital.

Three significant contributions to South African literature on the topic are made here: first, mandated-wage regressions that are based on the zero-profit condition are used. Second, the impact of tariff cuts on factor returns are analysed directly. Third, the indirect impact of trade liberalisation on factor returns, through its effect on technology, is examined.

¹ This statement is qualified in the Section 3.

² South African literature on the topic is discussed in Section 3. For a detailed discussion of the international debate, the reader is referred to Slaughter (1999). Fedderke, Shin and Vaze (1999) neatly summarise the international debate.

The empirical framework used in this paper is based on one of the most popular analytical frameworks used to discuss the general-equilibrium linkages between changes in tariffs, product price changes, technological change and factor returns: the Stolper-Samuelson Theorem (Stolper and Samuelson, 1941). The Stolper-Samuelson Theorem (SST) is complemented by ideas developed by Wood (1994) and formalised by Thoenig and Verdier (2003), which allows one to discuss the linkages between changes in tariffs and product prices, based on the relationship between tariffs and technological change. Thus, the empirical framework employed here is based on the popular SST, but incorporates the impact of trade liberalisation through technological change, as identified by Wood. This empirical framework is used to examine how product prices in skill-intensive sectors have changed relative to product prices in unskill-intensive sectors.

The structure of the paper is as follows. The next section draws on the SST and Wood (1994) frameworks to provide a theoretical overview of the relationship between trade, prices technology and factor returns. Section 3 reviews South African literature and data on the relationship between trade and labour, while section 4 introduces the mandated wage methodology and discusses other approaches used to examine the relationships considered here. Section 5 discusses the methodological framework, data used and econometric methodology applied. This is followed by section 6, which contains an analysis of the results. The paper ends with a few concluding remarks and notes possible avenues for future research.

2. Theoretical Overview

The theoretical overview covers the relationship between tariffs and wage inequality derived from two analytical viewpoints: Stolper-Samuelson Theorem (SST) and Wood (1994). This section also contains a discussion on limitations of the SST.

2.1 Stolper-Samuelson Theorem (SST)

The SST relates relative price shocks to relative factor returns. Since this identity has been articulated in different ways, it is important to decide which interpretation most accurately describes the relationship examined here. Alternative interpretations of the SST are neatly articulated in Deardorff (1994) and this study employs what he calls the *essential version*. The *essential version* of the SST states that, under certain assumptions, a rise in the relative price of a good raises the real return to the factor used intensively in the production of that good and lowers the real return to the other factor (Deardorff, 1994).

While other versions of the SST make reference to the relationship between international trade and factor abundance, the *essential version* merely relates changes in product prices to those in factor returns. Since South Africa has characteristics of both developed and developing economies, one should be wary of applying a version of the SST that makes assumptions about factor abundance. South Africa, unlike other developing countries, is relatively less well endowed with unskilled labour – especially since the entry of large unskill-abundant countries like China and India (see Wood, 1997). And, South Africa's capital-labour ratios are uncharacteristically

skewed in favour of capital, as revealed by high capital-labour ratios for some of its industries (Beverages, Paper, Glass, Iron and Steel and Non-Ferrous Metals – own calculations). Therefore, the *essential version* of the SST is deliberately used to avoid any specification problems associated with South Africa's relative factor abundance.

The relationship between changes in prices and factor price changes established by the *essential version* can be described as follows. An increase in the relative price of a product will increase the incentive to produce it (relative to other products). As a result, resources will shift to this product, as it becomes more attractive to produce relative to other products. Once resources shift in favour of this product, its industry will expand in response to higher profitability and absorb factors of production from other sectors. This represents a change in relative factor demand in favour of this product. In other words, this product will demand factors of production from other products (and sectors) within the economy. If this product is unskilled intensive; that is, if its production relies mostly on the efforts of unskilled workers as opposed to skilled workers, the shift in the balance of production will increase the net demand for unskilled workers and reduce it for skilled workers (Winters, 1999). Changes in relative factor demand cause changes in relative factor returns – an increase in the demand for a factor increases its real return.³ If the product experiencing a relative price increase is unskilled intensive, the real return to unskilled labour will increase and the real return to skilled labour will decrease. The same line of reasoning can be applied to work out the effect of price changes on products (or sectors) where skilled labour is used intensively. The SST therefore allows for the possibility of either rising or declining wage inequality in response to trade liberalisation. If the real return to

³ As pointed out by Winters (1999), the one exception to this rule is if the factor is available in perfectly elastic supply. If this is the case, any amounts of this product will be supplied at constant prices. In other words, price is determined by supply and output is determined by demand.

unskilled labour rises while the real return to skilled labour declines for a product (or in a sector), one can conclude that the price change has reduced wage inequality for that product (or sector).

Thus, the SST describes a relationship between price changes and factor price changes. More formally, this relationship can be illustrated using zero-profit conditions, which equate prices with average cost. Zero-profit conditions are used to imply a systematic relationship between the entire set of product prices facing domestic producers and the entire set of factor prices paid by these producers (Slaughter, 1998). Following Slaughter (1998), the zero-profit conditions for the entire economy can be written as follows:

Eq. 1
$$P = \theta * W$$

where P is an $(N \times 1)$ vector of N domestic product price changes, W is an $(M \times 1)$ vector of M domestic factor-price changes, and θ is an $(N \times M)$ initial cost-share matrix (which depends on technology and perhaps W) whose θ_{ij} element tells the share of factor i in the average costs incurred in producing one unit of product j . This equation describes how changes in product prices faced by domestic firms generate changes in domestic factor prices paid by firms. Changes in product prices, whether induced by trade, technology or another variable, drives factor movements between sectors. As described earlier, these factor movements in turn cause relative changes in labour demand for skilled and unskilled labour, which is ultimately cancelled out by changes in factor returns. These changes in factor returns will ensure zero profits in a perfectly competitive economy.⁴ According to equation 1, price changes will prompt changes to the share of a particular factor in the average costs of a specific product.

⁴ Helpman and Krugman (1985) have extended the basic HO model by illustrating how imperfect competition could also yield zero profits in all sectors.

Applying the *essential version* to equation 1 suggests that a change in relative product prices will generate changes in factor prices based on which factor is used intensively in producing one unit of product j . According to θ , factor intensity is measured by the share of a particular factor in average costs incurred in producing one unit of product j . Thus, the zero-profit conditions illustrate how price changes drive factor changes. To restore zero profit to all competitive sectors, changes in product prices must cause changes in factor returns. When factor changes cause changes in real returns, these are used to illustrate the impact on wage inequality.

The issue here is to determine what portion of observed product price changes is attributable to trade liberalisation. The SST contains no prescriptions on the type of factors that may influence product prices. Slaughter (1998) notes that a change in domestic and foreign political barriers to trade, international trade barriers and changes in foreign tastes, technology and/or endowments can all change domestic product prices. As a result, it is essential to examine the relationship between product prices and tariffs before commenting on the relationship between tariffs and factor returns.

2.2 Defensive skill-biased technology (Wood, 1994)

Another relationship between tariffs and wage inequality can be derived using Wood's thesis of defensive skill-biased technological innovation. This allows one to analyse the impact of trade liberalisation on factor returns through its impact on technology. According to Wood (1994), production technology in developed countries became increasingly skill-intensive in recent decades in order to compete

with low-wage production overseas. Since unskill-intensive sectors in industrialised countries face competition from developing economies, they develop skill-demanding technology to raise their productivity. This thesis was formalised by Thoenig and Verdier (2003) who introduced a theory of defensive skill-biased innovation. In their paper, Thoenig and Verdier (2003) present a dynamic general-equilibrium model of trade and innovation, which illustrates how firms in industrial countries bias the direction of their innovations in favour of skilled workers when faced with the threat of technological leapfrogging or imitation by less-industrialised countries.⁵ These developments are based on the idea that innovations in favour of skilled workers are not only harder to imitate, but also more expensive to operate. Thus, according to Thoenig and Verdier (2003), the process of defensive skill-biased innovation generates an increase in wage inequalities in both industrialised and less-industrialised countries. Most importantly, however, the process of defensive skill-biased innovation may be driven by trade liberalisation. In other words, the driving force behind changing wage inequalities may not be technology (in the form of defensive skill-biased innovation), but the trade liberalisation that prompted firms to innovate in response to competition from international low-wage producers.

The increasingly important role of technological change is based on the incorporation of information technology and microelectronic processes into the production cycle, which has the ability to change product prices and influence relative wages as a result. Broadly speaking, technological change can be driven by global skill-biased technology (as in Haskel and Slaughter, 2000), sector-biased technology (see Finlay and Grubert, 1959), defensive innovation (see discussion above) or trade-induced

⁵ The interested reader is referred to Acemoglu (2003) for a conceptually distinct formalisation of the implications of the Wood (1994) thesis that yields similar empirical implications.

technological transfers (Pissarides, 1997), but the details of these won't be considered here.⁶

The ability of this study to examine the impact of technological change is significant since many South African studies completed on the relationship between trade and wage inequality (Bell and Cattaneo, 1997, Borat and Hodge, 1999 and Edwards, 2001), have found technology, not trade, to be the dominant force behind changes in wages and employment. International evidence on those factors influencing the skill structure of wages have been mixed. Lawrence and Slaughter (1993), Baldwin and Cain (1997) and Gregory and Greenhalgh (1997) favour a technology and domestic demand explanation. Bhagwati (1995) agrees, but adds union behaviour as an additional explanatory factor. Abrego and Whalley (2000) agree to some extent, but stress the importance of demand-side substitution in cancelling out possible trade effects. On the other side of the debate, Wood (1994) and Feenstra and Hanson (1997) find trade to be more significant than technical change in explaining wage movements and Haskel and Slaughter (1999) discount the role of technology in accounting for changes in relative wages.

2.3 Limitations of the SST

Since the argument of this paper rests largely on the SST relationship, it is important to consider limitations of this approach. A major weakness of this study concerns the various restrictive assumptions needed to operationalise the SST – this clearly reduces

⁶ The interested reader is referred to Edwards (2002) for a discussion of how various types of technological change impact industries and firms.

its value as a relevant theory when applied to real world data.⁷ For example, the SST requires perfectly competitive goods and factor markets for the direct and simple transmission of product price changes to factor price changes. A few market participants dominate major sub-sectors in South Africa. For example: Anglo American (mining), South African Pulp and Paper Industries (SAPPI) (paper) and Amalgamated Beverage Industries (ABI) (beverages). In these industries, the transmission of product price changes into factor price changes becomes much more complicated to predict.

There are several other factors that may impact the relationship between trade liberalisation and wage inequality. As a result, these factors affect an application of the SST.

First, while the SST and Wood (1994) analytical frameworks allow one to relate product prices and technology to factor returns, these cannot take account of other factors that may impact the relationship between trade liberalisation and wage inequality. These include labour market inflexibilities (union behaviour and labour legislation), domestic demand fluctuations that cause changes in skilled and unskilled labour within particular sub-sectors, changes in market power, industry size, industry concentration, reaction time of firms and the initial structure of protection. For example, how well the effects of trade reform are translated in wage changes will depend on the flexibility of labour markets and union behaviour. If firms are heavily restricted from adjusting their work force by labour legislation or a well-organised union, it cannot make the factor changes needed to respond to changes in product prices as articulated by the SST.

⁷ These assumptions are reviewed in “Box 1: Why the Stolper-Samuelson Theorem is not Sufficient to Analyse Poverty,” in Winters (2000).

Second, the SST relationship between trade liberalisation and wage inequality depends on the speed with which firms react to trade liberalization (Bannister and Thugge, 2001). The SST dynamics are affected if firms are slow to respond to changes in product prices.

Third, the SST relationship depends on the initial pattern of protection; if it favoured unskilled workers, then freer trade should increase wage inequality (Bannister and Thugge, 2001).

Fourth, as argued before, changes in market power, industry size and concentration also impact the relationship between trade liberalisation and wage inequality. The dominance of major sub-sectors within an economy by a few large firms with monopoly power that allows them access to economic rents complicates the transmission of product price shocks into factor price changes. Firms with monopoly power can decide not to pass advantages resulting from trade liberalisation to their workers and use it to drive higher profit margins.

University of Cape Town

3. Trade and Labour: An overview of the South African Debate

This section contains three discussions: first, South Africa's pattern of trade liberalisation as summarised by overall and sub-sector specific changes to its tariff structure; second, a summary of South African literature on changes in the skill structure of employment; and third, a summary of the South African literature on a possible relationship between trade liberalisation and wage inequality.

3.1 Changes in Tariff Structure

The impact of trade liberalisation on South Africa's skill premium depends on the extent to which tariffs have actually been reduced. This section analyses the extent of South Africa's trade liberalisation on two levels: the macro level and a more detailed, sub-sector specific micro level. As a result of South Africa's recent programme of trade liberalisation, one would expect an overall reduction in tariffs in the economy as a whole. More importantly, this section will assess the sector bias of tariff reductions to give insight into possible impacts on wage inequality.

Changes in South Africa's tariff structure are well-documented in the literature and can be described as a result of the determination of a post-1994 government to push into the global arena, a country that was politically, economically and culturally ostracized from the rest of the world.⁸ This process included becoming a signatory to the GATT and establishing a Free Trade Arrangement (FTA) with the EU. These required significant reductions in trade restrictions in the form of South Africa's

⁸ Detailed evidence of South Africa's trade liberalisation process can be found in Holden and Casale (2000), Lewis (2001) and TIPS (2002).

GATT offer during the Uruguay Round and reductions resulting from the EU FTA. In fact, according to Bell (1997), the tariff reductions proposed by South Africa, exceeded those actually required by its commitments during the Uruguay Round.

Table 1: Macro-level Tariff Statistics

Data Description	1992	1997	2000
Number of tariff lines	13000	7814	7824
Unweighted mean (including ad valorem equivalents)	20.6	15.1	10.6
Unweighted mean (including surcharges)	26.8	15.1	10.6
Mean collection rate	5.7	4.8	3.5
Mean collection rate (including surcharges)	8.6	4.8	3.5

Source: Edwards (2004)

Although estimating South Africa's trade liberalization is made difficult by the numerous protection measures used and the high number of tariff rates and lines, broadly speaking, significant trade liberalization has taken place. The table reveals that between 1992-2000, average scheduled tariffs fell by more than half from 26.8% to 10.6%. Collection rates (including surcharges) have decreased to 3.5% and the number of tariff lines reduced to 7824. As non-tariff barriers were prevalent up to 1992, tariff data before 1993 is likely to underestimate protection. This concern is addressed in the data used in the estimations of section 5. Despite these overall reductions and South Africa's WTO and EU FTA commitments, there remain sectors within the South African economy in which protection may have increased (whether measured nominally or using effective rates of protection) and other areas, such as simplifying the tariff structure, where South Africa has not yet met its WTO obligations.

According to TIPS (2002), tariff peaks still exist for the following sectors: food, vehicles and parts, tobacco, rubber and clothing and textiles. For the purpose of this paper, it is interesting to note that these sectors are mostly unskill-intensive. Also, relatively high effective rates of protection are currently found in these sectors. The tariff peaks data and the data on effective rates of protection, suggest that unskilled workers are still protected by South African trade policy.

Consider the following table of micro-level tariff statistics.⁹ It contains the top six sub-sectors within the South African economy with the highest tariff cuts.

Table 2: Micro-level Tariff Statistics

Sector	Year				Level Tariff Cut (between 1988 and 2003)
	1988	1993	1997	2003	
Tobacco	94.9	85.0	35.6	35.6	59.3
Clothing	76.1	78.9	59.0	30.5	45.6
Beverages	48.5	32.4	15.2	17.0	31.5
Textiles	50.6	46.0	34.9	20.7	29.9
Footwear	51.2	44.2	29.6	22.6	28.6
Plastic Products	37.5	22.7	13.1	9.8	27.7

Source: TIPS. Own calculations.

Two messages can be drawn from this table. First, the sub-sectors in this table have seen substantial cuts, partly because the initial tariff rates were quite high. Second, all of these sectors are relatively unskill-intensive. Incidentally, the tobacco, clothing and textiles sectors also have tariff peaks.

⁹ The years used in these two tables were chosen specifically for their value in illustrating South Africa's trade liberalisation programme. 1993 is the last year before South Africa intensified its programme of trade liberalisation and 1997 saw the termination of export subsidies provided under GEIS and other tariff cuts.

The message of Table 2 is given credence by related results drawn from Edwards (2004). He finds that the plastic (-24%), textiles (-18%), chemicals (-13% to -15%) and wearing apparel (-11%) sectors experienced the largest reductions in product prices due to declining protection.

A valuable addition to this discussion is the scatter plots found in Appendix B. These figures, which exclude the mining sub-sectors, plot tariffs (y-axis) against skill intensity (x-axis). Figure 1 plots average tariff levels between 1988-1994 against average skills ratio between 1988-1994. This figure highlights which sub-sectors were most protected from 1988-1994 based on skill ratios for that period. Figure 1 illustrates that the tobacco, clothing, textiles and footwear sub-sectors had the highest average tariff rates between 1988-1994. Three of these sub-sectors (clothing, textiles and footwear) also had some of the lowest skill ratios – indicating that these sub-sectors are highly unskill-intensive. Therefore, based on skill ratios between 1988-1994, unskill-intensive sectors were highly protected between 1988-1994. Figure 2 plots average tariff levels between 1995 and 2001 against average skills ratio between 1995-2001, with the same result. This highlights that when post-1994 tariff reductions are taken into account, unskill-intensive sectors still remained highly protected between 1995-2001.

Figure 3 plots the percentage reduction in tariff levels between 1988-1994 against the average skills ratio between 1988-1994. This figure shows the sector bias of tariff reductions between 1988-1994. Interestingly, the clothing sub-sector has seen a very small percentage reduction in tariff rates relative to the other unskill-intensive sub-sectors discussed above. The leather, textiles and footwear sub-sectors had significant

percentage tariff reductions. However, the largest percentage tariff reductions were not in unskill-intensive sectors. This conclusion is consistent with that of Figure 4, which plots the percentage reduction in tariff levels between 1995-2001 against the average skills ratio between 1995-2001. The largest percentage reductions were not in unskill-intensive sectors. Percentage tariff reductions were largest in skill-intensive sectors such as professional equipment, other transport, radio, television and communications equipment, chemicals, other chemicals and non-ferrous metals. Interestingly, the agriculture sub-sector had the largest percentage tariff reductions between 1988-1994 and the lowest between 1995-2001. This is probably because non-tariff barriers, which were lowered after 1994 while tariff reductions were kept to a minimum, protected the agriculture sub-sector.

Two general messages can be drawn from the scatter plots. First, figures 1 and 2 illustrate that the most unskill-intensive sub-sectors remained protected throughout the period under examination. Therefore, high tariff levels between 1988-1994 protected unskilled workers. After 1994, when trade liberalisation started, unskilled workers remained protected. Second, the sector bias of percentage tariff reductions was concentrated in the skill-intensive sectors. Therefore, skilled workers were most-disadvantaged by percentage tariff reductions during both periods.

3.2 Changes in the skill structure of employment

This section contains an indirect analysis of the relationship between trade liberalisation and wage inequality. Research on changes in the skill structure of employment allows one to make inferences about the impact of trade liberalisation on

wage inequality through the SST relationship. The SST relationship between changes in factor intensities and factor returns was discussed in section 2. One can use this relationship to infer the impact of trade liberalisation on wage inequality based on the impact of increased openness on factor intensities.

Changes in South Africa's skill structure of employment have generally reflected capital deepening and a shift towards more skilled labour – a trend that is consistent throughout most of the sub-sectors. In one of the latest and most comprehensive studies on wage inequality, Borat (1999a) addresses some of the shortcomings of previous work by directly accounting for wages in his discussion of the South African labour market.¹⁰ This study uses census data from 1995 and cannot therefore fully account for the effects of the trade liberalization programme initiated after the 1994. However, it is able to break down the broad manufacturing sector into its sub-sectors (unlike many other similar studies) and provides valuable insight into the structure of and changes in relative wages in the South African labour market. The results of this study highlighted the regular race, skills and education differentials and its main conclusion was that skilled labour is being paid a premium due to its shortage in the labour market. Its other results can be summarized as follows: first, the levels of wage inequality among African and Coloured workers of both genders were much lower than the inequality found amongst Asians and Whites of both genders. Second, the education wage differentials suggested that the level of wage inequality increased as one moved into higher education cohorts. Third, sectoral data was largely consistent with these results since it revealed that, particularly in the manufacturing sub-sectors, skill- and capital-intensive sub-sectors exhibited the highest levels of wage inequality.

¹⁰ An earlier study, Borat and Leibbrandt (1999), focus only on African workers, which limits its relevancy and application to this paper.

In another study, Borat and Hodge (1999) use decomposition techniques to identify the impact of structural changes on the South African labour market. Their study found that the South African labour market has been characterized by a dramatic increase in the demand for high skilled individuals coupled with a shift away from elementary occupations towards machinery. More specifically, their analysis found that skilled, Asian and White workers benefited from positive employment effects, which is likely to increase wage inequality. In their study, they ascribe these labour market changes to two trends: rapid growth in the service industry, which has caused higher rates of adoption of technology in most sectors; and a rise in capital-labour ratios by firms in an attempt to improve productivity in response to trade liberalisation related pressures. The latter suggests the presence of a relationship similar to that identified by Wood (1994).

3.3 Is there a relationship between trade liberalization and wage inequality: A review of the research.

Research on the relationship between trade liberalisation and wage inequality has shown how increased openness can contribute to changes in wage inequality. This section contains a review of South African research analysing the impact of trade liberalization on wage inequality through its impact on factor returns. The research papers discussed in this section will be grouped according to two broad categories: Price Effect Studies and Factor Content Studies. As this section will highlight, none of the research discussed here tests, directly, the relationship between trade liberalisation and wage inequality.

3.3.1 Price Effect Studies

Price studies are based on either direct (Leamer (1996) specification) or indirect (consistency-check analyses) applications of the zero-profit condition. The Leamer (1996) specification uses the zero-profit condition to relate product prices to factor returns. Consistency-check analyses use the zero-profit condition to examine whether the sector bias of product price changes is consistent with changes in relative factor returns.

While many price studies have been carried out for developed countries, only one such study's use and interpretation of South African data is complete in a way that makes it relevant to this paper. Fedderke, Shin and Vase (1999) employ both the Leamer (1996) specification and consistency-check analyses to investigate the impact of trade liberalization on labour markets between 1970 and 1997 through heterogeneous panel estimation techniques. Their application of the Leamer (1996) specification (assuming a zero pass-through of technology) yields three major results. First, they find that, to the extent that output prices change as a result of trade liberalisation, trade in manufacturing has led to positive effects on the earnings of labour and capital (with labour gaining disproportionately more than capital). Second, when technological change mandates negative growth in labour and capital earnings, the impact on capital is stronger than that on labour. Third, when they assume perfect technology pass-through, any negative impact of trade on labour and capital earnings

is much weaker than the change mandated by technology.¹¹ From these results they draw the conclusion that trade has had a positive impact on labour earnings, with the magnitude of this impact exceeding that on capital.

Their consistency-check analyses yield a negative long-run coefficient for the ratio of skilled to unskilled labour and between price changes and the capital-labour ratio. This forms the basis of two of their conclusions: freer trade benefited the earnings of unskilled workers relatively more than that of skilled workers, especially in the manufacturing sector. And trade liberalisation had the effect of strengthening the demand for labour relative to capital in South Africa through the price effect (Fedderke *et al*, 1999).

However, their analysis suffers from a methodological shortcoming in that they do not estimate the relationship between trade and product prices directly. As highlighted in the section 2.1, SST linkages allow product prices to be influenced by a range of factors. This includes, but is not limited to, trade. Their assumption that South Africa is a small, open and developing economy with competitive markets allows them to assume that changes in tariffs are translated perfectly into changes in product prices. As a result, they use a proxy for product prices, the value added deflator, instead of actual trade prices. Thus, their relationship between factor returns and trade liberalisation is tenuous. Edwards (2004) suggests several reasons why their assumption may be misleading and inaccurate. A discussion in section 2.1 already illustrated why it may be misleading to assume South Africa is a developing country.

Also, as Edwards (2004) suggests, the small, price-taking country with competitive

¹¹ Fedderke, *et al* (1999) note that results based on the assumption of perfect technology pass-through are unlikely to hold for South Africa as a result of their assumption that South Africa is a small open economy.

markets assumption does not hold in cases where quotas preserve the market power of monopolistic firms. A huge segment of South Africa's protection for their period under analysis (1970-97) was marked by the extensive use of quotas. In addition, their research is limited to the manufacturing sector while this study extends the analysis to include the agriculture and mining sub-sectors (excluding gold mining). Their research does, however, have the statistical advantage of allowing for both dynamics across time periods and a reasonable amount of heterogeneity across cross-section units.

3.3.2 Decomposition Studies

The papers discussed in this section are less rigorous in their examination of the relationship between trade liberalisation and wage inequality. Instead, the research discussed here mostly infers this relationship based on the analyses of trade flows and changes in labour demand. However, due to a possible relationship between trade flows and trade liberalisation on the one hand, and changes in labour demand and wage inequality on the other, these discussions merit inclusion.

In the first study dealing with the impact of freer trade on employment in South Africa, Bell and Cattaneo (1997) used a factor-content approach to estimate the employment impact of South Africa's changing export structure between 1972 and 1993. This study finds *prima facie* evidence that trade liberalization has had adverse effects on employment by concluding that there have been accelerated structural shifts towards capital intensive exports and ultra-labour intensive imports.

This paper, however, fails to explain why these shifts have occurred and only focus on the direct impact of trade flows while ignoring the indirect effects changes in trade have on the intermediate sectors (Edwards, 2001).

In one of the first studies to infer a relationship between trade liberalization and the labour market, Borat (1999b) uses census and time series data to determine the effects tariff liberalization and trade flows may have on labour demand. His analysis has two main findings. First, while all workers gained from the flows of exports and imports between 1970 and 1997, the labour demand gains were higher for those individuals who had high educational qualifications or were non-African. In short, these gains were not skills, race and education neutral (Bhorat, 1999b). Second, within the manufacturing sector, labour demand data suggests that not only has trade liberalization favoured skilled and highly skilled workers at the expense of those with low skills, but it has also resulted in significant disemployment at the bottom-end of the job-ladder. Although Borat (1999b) is unable to explain how much of these labour demand changes are a result of trade liberalisation, these results suggest that changing trade flows have affected labour demand.

The next relevant piece of research was carried out by Borat (2000) and again used both survey and time-series data for the South African economy between 1970-1995 to derive the impact of trade liberalization on employment. Although it could not capture the post-1995 trade reforms, this study is valuable as it used a decomposition technique to estimate the impact of trade on labour demand for various skill levels. The results of this study suggest that while trade led to an overall decline in manufacturing employment between 1993-1997, freer trade in manufacturing

benefited highly skilled workers at the expense unskilled employees. This study, however, fails to address the same two critiques levelled at the two papers discussed earlier: it cannot account for the indirect effects resulting from freer trade and does not discuss exactly which factors led to these changes in the labour market. While this study does not comment on relative wages, it does point out that increased trade may have had adverse effects on the bottom end of the employment ladder, which implies a possible change in relative wages through negative labour demand effects for unskilled labour.

Edwards (2001) deals with these shortcomings by using an input-output decomposition technique that allows him to conduct a demand side analysis of trade liberalization and employment from 1993-1997. This type of analysis allows one to isolate those factors (domestic final demand, export expansion, import substitution or technology) responsible for labour market changes. This study contains some results relevant to this paper. Firstly, while it found that employment changes in the whole economy mainly originated from changes in final demand and technology, not trade, this conclusion was less robust in the manufacturing sector. Secondly, the study found that there has been an increase in the capital intensity of exports, while a rise in import penetration has occurred in the labour intensive sectors. The result that employment changes were biased against low-skilled workers is consistent with all the studies quoted in this section, but unlike those papers, the Edwards (2001) study concluded that the employment changes were mainly driven by domestic demand and technology, not trade.

All the South African research discussed in this section studies confirm the difficulty of separating the effect of trade on wages from other effects and clearly illustrate how the use of different econometric techniques often yields very different results. Most importantly, however, these studies fail to test, directly, the relationship between trade liberalisation and wage inequality.

University of Cape Town

4. Sector Bias and the Mandated Wage Methodology

The estimations carried out in section five rely on the effective functioning of two theoretical relationships: a relationship between changes in product prices and tariff changes and the SST relationship between product prices and factor returns based on the zero-profit condition. The methodology developed here will enable a direct test of the relationship between trade liberalisation and wage inequality. In addition, this section mentions other approaches one could use to relate prices and technological change to factor returns.

4.1 Mandated Wage Methodology

Following Haskel and Slaughter (2000), the zero-profit condition for each sector where production occurs is:

$$\text{Eq. 2} \quad p_i^G = \sum a_{ji} w_j + \sum b_{ii} p_i^G \quad i = 1 \dots I$$

where p_i^G is the domestic gross output price in sector i , w_j is the unit cost of the j th input, a_{ji} is the (endogenously determined) employment of input j per unit of output in sector i ; and b_{ii} is the amount of intermediate input i required to produce a unit of good i . Completely differentiating equation 2 with respect to time yields:

$$\text{Eq. 3} \quad \Delta \log p_{it} + \Delta \log TFP_{it} = \sum (V_{jit} \Delta \log w_{jt})$$

where $\Delta \log p_{it} = [\Delta \log p_{it}^G - \sum (V_{iit} \Delta \log p_{it}^G)]$ is the change in value added prices, V_{jit} is the share of factor j in total costs in sector i at time t , $\Delta \log TFP_{it}$ is the growth in total factor productivity for sector i ; and $\Delta \log w_{jt}$ is the economy-wide wage change for factor j . Equation 3 will serve as the foundation for estimating the impact of tariff

changes on factor returns, since it relates changes in product prices and TFP to factor cost changes while ensuring zero-profit in all sectors where production occurs.

In line with the objective of this study, a regression of $\Delta \log p_{it}$ on the factor shares, V_{jit} will yield the estimates of economy-wide factor return changes consistent with zero-profits in the face of product price changes (Haskel and Slaughter, 2000). If one recalls the *essential version* of the SST presented in the introduction and relate it to equation 3, it follows that if changes in the tariff structure translate into decreases in product prices in a certain sector, this should reduce the relative wages of factors employed relatively intensively in that sector. V_{jit} defines factor intensity in equation 3. This highlights the relationship between changes in factor returns and product prices, which forms the basis of the SST.

Following Haskel and Slaughter (2000), the estimations proceed in two stages: first product price changes are regressed on a set of factors, which explain price changes in a given period:

$$\text{Eq. 4} \quad \Delta \log p_{it} = \sum Z_{pri,it} \delta_{pri,t} + \epsilon_{it}$$

where $\delta_{pri,t}$ is the estimated coefficients, and ϵ_{it} is the random error. Since tariff rates are used as the factor that explains price changes in a given period, $Z_{pri,it}$ will be different specifications of the tariff variable.

In the second stage, the contribution of each underlying variable is regressed on factor returns:

$$\text{Eq. 5} \quad \delta_{pri} Z_{pri,it} = \sum V_{jit} \gamma_{jt,pri} + \epsilon_{it}$$

where $\gamma_{it,pri}$ yield the factor returns mandated by the sector bias of each explanatory factor included in $Z_{pri,it}$, which exercises its influence through $\Delta \log p_{it}$. If $Z_{pri,it}$ primarily includes tariff changes, then equation 4 will determine the product price variation mandated by tariff changes and equation 5 will determine the wage changes mandated by the sector bias of tariff changes working through product prices.

This methodology relies on several strong assumptions (such as complete factor mobility and perfect competition), but it has been used in various studies as an informative way of estimating the SST dynamics.¹² There are three additional qualifications one should bear in mind before estimating these relationships. First, Slaughter (1998) points out that the results are likely to be sensitive to the selection and weighting of industries included in the sample, the decade considered, the extent of data aggregation and the measurement of skills. In this study, the time period considered was based on the availability of data. Industries were not weighted and skills were measured using the most popular available method (also used by both Haskel and Slaughter (2000) and Fedderke *et al* (1999)).

Second, the SST assumes that causality runs from tariff changes to corresponding changes in product prices. However, it is quite possible that effective lobbying could force the causality to reverse if decreasing product prices lead to increasing tariff rates. As Deardorff and Haikura (1994) point out: trade liberalisation and product prices are simultaneously caused by things; trade does not cause product price changes. Not only does this possibility complicate the theoretical relationship, it has the effect of reducing the strength of the relationship between tariff cuts and changes in product prices.

¹² The assumptions (such as zero abnormal profits and differing skill intensities across sectors) are neatly summarised in Leamer (1996).

Third, as pointed out by Edwards (2004) in all mandated wage regressions, it is assumed that the product mix does not change during the period under analysis. That is, the country does not shift into a new cone of diversification. A quick look at the composition of South African exports and imports should reveal quite significant changes in South Africa's product mix. Borat and Hodge (1999) look at changes in the structure of the South African economy through changes in the share of GDP of various economic activities. They find that from the mid eighties to late nineties, the share of GDP of agriculture and mining fell from 5.7 to 4.4 and 14.9 to 7.5, respectively. At the same, the finance and services industries saw their shares of GDP increase from 13.5 to 17.2 and 16.2 to 18.6, respectively. A changing product mix would complicate the relationship between changes in prices and factor price it may yield inaccurate information about product prices and its relationship between factor prices as a result.

4.2 Other Empirical Approaches

The product price methodology employed in this study is especially significant as it addresses the shortcomings embedded in other ways of estimating the relationship between trade liberalisation and the labour market. Wood (1994 and 1995) argues that conventional decomposition studies (discussed in section 3.2.2) fail to account for the impact of defensive innovation, a factor this paper includes.¹³ In addition, the methodology employed here shares an advantage of decomposition studies – its ability to separate the contribution of changes in tariffs and technology to changes in product prices.

¹³ Decomposition studies, however, have the advantage of being able to separate the contribution of various factors that could drive labour market changes better than mandated wage regressions.

Another method used to estimate the tariff-wage relationship is the factor content studies approach. This approach involves the estimation of the implicit change in factor endowments that arise through exports and imports. However, since it often underestimates the labour content of imports, this approach is criticised for understating the full impact of trade on factor markets (Wood, 1994 and 1995). Another more serious critique of the factor content studies approach is its lack of theoretical underpinning since it is not a strict application of the SST, or any other, framework (Leamer, 1996). This approach is more accurately described as an application of the Heckscher-Ohlin-Vanek theorem, which estimates the ambiguous relationship between relative factor returns and the factor content of trade.

Consistency-check analyses provide one with an alternative to mandated wage regressions. These analyses determine the sector bias of product price changes (through a simple correlation) and then infer whether this bias is consistent with changes in relative factor returns during a specific period (Edwards, 2004). However, as pointed out by Slaughter (1998), studies of this kind do not give insight into how much product price changes may have contributed to actual changes in factor returns. Slaughter (1998) suggests that the product price methodology improves upon the consistency check analyses in many ways, is the best estimate of the SST relationship and thus most applicable to estimating wage inequality.

5. Data, Specification and Econometric Methodology

The empirical framework used here is based on the work of Haskel and Slaughter (2000) with certain adjustments to accommodate the relationship identified by Wood (1994). The analysis carried out through equations 6 and 7 require industry year-on-year data on tariffs, product prices, factor payment shares and TFP from 1988-2001. Two different tariff measures are employed. The first set of tariff data is simple ad valorem tariffs using schedules plus surcharges (*TAR*). The second set of tariff data consists of the above-mentioned dataset with data points from 1988-1993 adjusted upwards with ad valorem equivalents from various WTO Trade Reports (*TARadj*). The log growth rates of these two tariff measures are used as the two indicators of protection. More details on the data employed, how these datasets were calculated and the sectors included are provided in the data appendix.

Based on the discussion in section 3, the following two equations are estimated for 1988-2002. In the first-stage regression, various forms of the following equation are estimated:

$$\text{Eq. 6} \quad \Delta \log p_{it} = \delta_1 \Delta \text{TAR}_{it} + \epsilon_{it}$$

where $\Delta \log p_{it}$ is the price deflator and ΔTAR_{it} is the log growth rate of the tariff variable.

$\delta_1 \Delta \text{TAR}_{it}$ determines the amount of product prices variation accounted for by tariff changes (Haskel and Slaughter, 2000). Certain additional explanatory variables were added to equation 6. *TAR_KL* is an interaction term based on tariffs and the capital-

labour ratio. Following Haskel and Slaughter (2000), this variable is used to test whether tariff pass-through depends on market structure. In particular, it is expected that sectors with higher capital-labour ratios, would show less pass-through from tariff decreases to product prices. *TFP* is added as a proxy for technological change to account for its potential impact on product prices. *TAR_TFP* is included as a measure of the defensive skill-biased technological innovation relationship introduced in section 2.2. As mentioned before, this variable allows one to analyse the impact of trade liberalisation on factor returns through its impact on technology.

In the second-stage regression, the following equation is estimated:

$$\text{Eq. 7} \quad \delta_1 \Delta \text{TAR}_{it} = \gamma_s V_{sit} + \gamma_u V_{uit} + \gamma_k V_{kit} + \gamma_i V_{iit} + \epsilon_{it}$$

where the coefficients γ_s , γ_u , γ_k and γ_i yield the economy-wide changes in skilled and unskilled labour, capital prices and the intermediate sector needed to restore zero profits in the face of tariff-induced price changes. As mentioned before, $\delta_1 \Delta \text{TAR}_{it}$ determines the wage changes mandated by the sector bias of the part of product price variation explained by tariff changes.

Equation 6 was estimated using the between effects panel data estimator, while equation 7 was estimated using standard least squares. The between effects model estimates a long run relationship using sectoral variation in the variables. This approach computes long run coefficients as averages of the individual sector coefficients (Pesaran and Smith, 1995). Since the SST is based on factor movement between sectors, which causes changes in relative factor demand and ultimately changes relative wages, the between effects estimator may be the best approach.

The Hausman test compares fixed effects to random effects by testing the null hypothesis that the coefficients estimated by the efficient random estimator are the same as the ones estimated by the consistent fixed effects estimator.¹⁴ The Hausman test was completed for equations 1 and 3 of Table 3. In both cases (0.21 for specification 1 and 0.25 for specification 2), the p-value was larger than 0.05. Therefore, since both the p-values are both insignificant it is safe to use the random effects estimator. The first-stage regressions were also estimated using random effects (Table 5) and fixed effects (Table 6); these are found in Appendix C. The coefficients in the two tables are clearly consistent with each other and with results from the between effects estimator.

However, since coefficients from the random and fixed effects estimations were smaller and in some cases insignificant, the between effects estimator was chosen. Coefficients generated by the between effects estimator answers the question about the effect of an explanatory variable when it changes between sub-sectors. The first-stage regressions rely on differences between sub-sectors; in particular differences between skilled and unskilled sub-sectors, to test the impact of tariffs, via relative price differences on factor returns. Thus, it is essential to capture the differences between sub-sectors for a particular explanatory variable. This is achieved by using the between effects estimator as it uses cross-section variation to estimate the coefficients.

In both stages, the gold sub-sector was dropped because it is likely to bias the second-stage regressions against unskill-intensive labour more than it should. Included sub-

¹⁴ Information on the Hausman Test was obtained from the Data and Statistical Services (DSS) of Princeton University Library (Available: http://dss.princeton.edu/online_help/analysis/panel.htm).

sectors are indicated in the data appendix. Tariffs in the gold sub-sector fell from 10.11% in 1988 to 0% in 1999, where it has remained since. Since South Africa imports very little gold and the sub-sector is fairly unskill-intensive, these tariff changes should not be allowed to impact product prices; it is therefore best to remove this sub-sector completely from our analysis.

The robustness of the results was checked in a number of ways. The first-stage regressions were limited to two additional time frames: 1989-1994 and 1995-2001. The estimations between 1989-1994 yield significant results for *TAR_{adj}*, but insignificant results for *TAR*. Whereas estimations between 1995-2001 yield insignificant regression results for both tariff measures. Also, it may be worthwhile to note that effective rates of protection were used as an alternative tariff measure but yields neither significant nor correctly signed coefficients. In addition, the second stage regressions were estimated for factor returns to labour, capital and the intermediate sector as a separate regression for all specifications. These results were consistent with included second-stage results, but insignificant at the 5% level and therefore not included in this discussion.

6. Results

The section looks at results of the two-stage analysis of changes in South Africa's tariff structure and the skill premium. The results of these two stages, equations 6 and 7, are contained in tables 3 and 4, respectively. These tables are illustrated as they are discussed. The results of various estimations of equation 6 are illustrated below:

Table 3: Stage 1 Price Regressions¹⁵

(Dependent Variable indicated in first row)

	(1)	(2)	(3)	(4)	(5)	(6)
	PP	PP	PP	PP	PP	PP
TAR	0.117 (0.038)	0.175 (0.001)				
TARadj			0.142 (0.016)		0.121 (0.026)	0.206 (0.000)
TAR_KL		-0.794 (0.032)				
TARadj_KL					-0.609 (0.042)	-0.751 (0.008)
TARadj_TFP				2.110 (0.008)	1.850 (0.013)	
TFP		-0.433 (0.002)				-0.423 (0.001)
Δ PP	-0.01	-0.01	-0.01	-	-0.01	-0.02
R-Squared	0.03	0.07	0.04	0.02	0.05	0.09
Prob > F	0.039	0.001	0.016	0.008	0.002	0.000
Observations	434	434	434	434	434	434

The first column of table 3 estimates equation 6 with the standard tariff measure, *TAR* (0.117), which is correctly signed and significant at the 5% level. This suggests a

¹⁵ This table contains the coefficients (with p-values in brackets) for estimations of equation 6. The R-Squared and Prob > F values gives an indication of overall significance of each estimated equation. Prob > F tests the null hypothesis that the explanatory variables are jointly or simultaneously equal to zero. To reject this null hypothesis at the 5% level, Prob > F must be less than 0.05.

significant correlation between decreases in standard tariffs and corresponding decreases in product prices. This can be interpreted as the amount of *PP* variation explained by *TAR*. In other words, for every 1% decrease in *TAR*, the mean value of product prices will decrease by 11.7% on average per year for the entire period under consideration. That is, the direct effect of a unit change in *TAR* on the mean value of product prices is 11.7%. Column 3 estimates the same relationship, but with the adjusted tariff variable, *TARadj*. Although the coefficient is slightly higher at 0.142, the result is the same. For every unit decrease in *TARadj*, the mean value of product prices will decrease by 14.2%. This improved correlation between tariffs and product prices is probably due to the fact that *TARadj* is higher since it was adjusted upwards to account for under-protection between 1988-1992.

Column 2 adds variables *TAR_KL* and *TFP* to the relationship estimated in column 1. Both these additional variables are signed as expected and significant at the 5% level. A large negative relationship between market structure (*TAR_KL*) and *TAR* suggests that, when market structure is taken into account, the pass-through of tariffs is much lower for capital-intensive sectors. This is consistent with the view that less-competitive sub-sectors, with high capital-labour ratios, may show less pass-through from tariff cuts to product prices as highlighted in section 4. Therefore, the pass-through from *TAR* to *PP* is affected by market structure. A significant negative relationship between technological change (*TFP*) and product prices suggests that the increasing adoption of technology is possibly correlated with decreasing product prices. Therefore, technological change may be passed through to consumers in the form of lower prices.

Column 6 estimates the same relationship as column 2, but with the adjusted tariff variable. Although the coefficients are slightly higher, for reasons mentioned earlier, the results are the same. Column 4 estimates “Wood (1994) relationship”, which was explained in section 2.2. The size of this coefficient implies a strong relationship between changing product prices and technological change. This significant result is consistent with the argument made in section 2.2: decreases in TAR_{adj} may be correlated with decreases in PP via a negative relationship between TAR_{adj} and technological change. Column 5 estimates the same relationship as column 6, but substitutes Wood’s interaction term for TFP . The positive coefficient for Wood’s interaction term in column 5 suggests that the pass-through of tariff reductions to product prices may be higher in sectors with strong TFP growth. Or, sectors with high TFP growth are possibly more competitive. Again, the results are significant and signed as expected.

Also included in table 3 is a measure of the change in product prices induced by tariffs. That is, the change in price due to changing tariffs. This was calculated as the product of the tariff coefficient in each regression and average tariffs between 1989-2001. For column 1, changing tariffs caused a decrease in product prices of 1% on average per year between 1989-2001. As mentioned before, due to the measure of tariffs used, the tariff effect was highest for column 6 at 2%. The overall message of table 3 should be clear: tariff cuts are correlated with declining product prices (as expected and predicted by the discussions of section 2).

The results of various estimations of equation 7 are illustrated below:

Table 4: Stage 2 Sector Bias Regressions (Between Effects)¹⁶(Dependent variable: part of $\Delta \log p_{it}$ induced by ΔTAR_{it} calculated from Table 3)

	(1)	(2)	(3)	(4)	(5)	(6)
VS	-0.072 (0.013)	-0.107 (0.013)	-0.073 (0.027)	-1.1 (0.027)	-0.063 (0.027)	-0.107 (0.027)
VU	-0.007 (0.735)	-0.01 (0.735)	-0.001 (0.873)	-0.06 (0.873)	-0.003 (0.873)	-0.006 (0.873)
VK	-0.011 (0.266)	-0.017 (0.266)	-0.016 (0.181)	-0.241 (0.181)	-0.014 (0.181)	-0.023 (0.181)
VI	0.002 (0.791)	0.002 (0.791)	-0.004 (0.565)	-0.057 (0.565)	-0.003 (0.565)	-0.007 (0.565)
ΔPP	-0.01	-0.01	-0.01	-	-0.01	-0.02
Test 1 (VS and VU)	0.09	0.09	0.11	0.11	0.11	0.11
Test 2 (VS and VK)	0.04	0.04	0.09	0.09	0.09	0.09
Test 3 (VU and VK)	0.85	0.85	0.67	0.67	0.67	0.67
R-Squared	0.72	0.72	0.79	0.79	0.79	0.79
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
Observations	32	32	32	32	32	32

In table 4, the tariff coefficients of table 3 are multiplied by actual tariff rates to determine the wage changes mandated by the sector bias of the part of product price variation explained by tariff changes. The measure of the change in product prices induced by tariffs was included in table 4 for easy reference. The results of table 4 are largely insignificant and can be interpreted together. Factor share for the intermediate sector (*VI*) is included at the expense of the constant term. Thus, the explanatory variables are interpreted relative to each other. Although largely insignificant, the second-stage results show that tariff cuts may have mandated relatively larger negative returns to skilled labour than unskilled labour. In particular, column 1 of table 4 can be interpreted as follows: the changes in *TAR* between 1989-2001,

¹⁶ This table contains the coefficients (with p-values in brackets) for estimations of equation 7. The R-Squared and Prob > F values gives an indication of overall significance of each estimated equation. Prob > F tests the null hypothesis that the explanatory variables are jointly or simultaneously equal to zero. To reject this null hypothesis at the 5% level, Prob > F must be less than 0.05.

working through product prices as estimated by column 1 of table 3, may have mandated a 7.2% decline in the skilled wage and a 0.7% decline in the unskilled wage on average per year between 1989-2001. This implies a mandated fall in the skill premium of 6.5% on average per year between 1989-2001. As indicated in table 4 (ΔPP), 1% of these changes in wages were caused directly by tariff cuts. Although the VS coefficient is significant, the VU coefficient is not – this implies that one should not attach too much importance to its value as an explanatory variable. This may also explain the relatively high average mandated fall in the skill premium. The capital factor share, VK in column 1 of table 4, can be interpreted as follows: changes in TAR between 1989-2001, working through product prices as estimated by column 1 of table 3, may have mandated a 1% decline in returns to capital on average per year between 1989 and 2001. Again, 1% of this decline was caused directly by tariff cuts. In all instances, the decline in returns to capital is lower than the decline in returns to skilled labour, but higher than the decline in returns to unskilled labour. Therefore, tariff cuts may have decreased returns to capital relatively more than decreasing returns to unskilled workers and relatively less than decreasing returns to skilled workers. Again all columns, except 4 can be read in a similar manner and yield the same insignificant results. Also included in table 4 are the p-values from the tests that examine whether the explanatory variables are significantly different from each other (at the 5% level). These results indicate that none of the three explanatory variables (VS , VU and VK) are significantly different from each other, except VS and VK for columns 1 and 2. This suggests that only specifications 1 and 2 yield coefficients for VS and VK that have statistically different relationships with the dependent variable. Interestingly, if one relaxes the significance level to approximately 10%, VU and VK

are the only variables that do not have statistically different coefficients for all specifications.

Table 4 illustrates that the sector bias mandated by regressions between tariffs and product prices did not increase the skill premium, as it may not have mandated negative returns to skilled labour that was higher than the negative returns mandated to unskilled labour. Despite this evidence, the price changes induced by tariffs mandate a fall in the skill premium that is mostly statistically insignificant. Thus, there is no strong evidence that tariffs cuts, working through price changes, mandated a decline in wage in inequality. Unfortunately, there exists very little data on relative wages. Thus, one cannot observe whether these mandated wage changes are correlated with actual wage changes.

The results recorded here are consistent with that of the scatter plots discussed in section 2. The scatter plots suggest that high tariff levels between 1988-1994 protected unskilled workers relative to skilled workers. After 1994, when trade liberalisation started, unskilled workers remained relatively more protected. Also, it highlighted that the sector bias of percentage tariff reductions was concentrated in the skill-intensive sectors. Therefore, skilled workers were relatively most-disadvantaged by percentage tariff reductions during both periods.

7. Concluding Remarks

This paper comments on a possible relationship between a rise in skill intensity in the South African economy, the concomitant widening of wage inequality and South Africa's trade liberalisation programme. In particular, this study analyses, directly, the impact of lower tariffs on returns to skilled and unskilled labour and capital.

Several unique contributions to South African literature on the topic were made here: First, the above-mentioned relationship was tested using mandated-wage regressions that were based on the zero profit condition. Second, the impact of falling tariffs on factor returns was analysed directly. Third, the indirect impact of trade liberalisation on factor returns, through its effect on technology, was examined. In addition, this study addressed several questionable aspects of similar research; most notably its direct analysis of the tariff and factor returns relationship and its examination of a possible relationship between tariffs and factor returns via technology.

The main results can be summarised as follows: first, changes in South Africa's tariff structure are significantly and consistently related to changes in product prices. Second, the sector bias mandated by stage-one regressions may not have increased the skill premium since it may have mandated negative returns to skilled labour that was higher than negative returns to unskilled labour. In fact, one could conclude that tariff cuts may have reduced the skill premium. Tariff cuts may have decreased capital rents relatively less than the decreases to skilled wages and relatively more than decreases to unskilled workers. Therefore, tariff cuts may not have mandated rising wage inequality across skill categories.

Many possible avenues for future work exist. The results obtained here can be re-evaluated with new tariff data, data on non-tariff barriers and relative wage data. Also, these regressions can be re-estimated by extending the time period to 2004. In addition, these equations can be estimated using dynamic heterogeneous panel data techniques and compared to the static estimations of this paper.

University of Cape Town

8. References

Abrego, L. and Whalley, J. (2000). Demand side considerations and the trade and wages debate, NBER Working Paper Series, Working Paper No. 7674. [online] Available: <http://papers.nber.org>

Acemoglu, D. (2003). Patterns of skill premia, *Review of Economic Studies*, 70, 199-230.

Baldwin, R. and Cain, G. (1997). Shifts in U.S relative wages: The role of trade, technology and factor endowments, NBER Working Paper Series, Working Paper No. 5934. [online] Available: <http://papers.nber.org>

Bannister, G. and Thugge, K. (2001). International Trade and Poverty, IMF Working Paper, WP/01/54, Policy Development and Review and African Departments

Bell, T. and Cattaneo, N. (1997). Foreign trade and employment in South African manufacturing industry. Occasional Report no. 4, Employment and Training Department, International Labour Office, Geneva

Berndt, E. and Wood, D. (1982). The Specification and Measurement of Technical Change in U.S Manufacturing, in *Advances in the Economics of Energy and Resources*, Volume 4, JAI Press, pp.199-221.

Bhagwati, J. (1995). Trade and Wages: Choosing among alternative explanations. Federal Reserve Bank of New York Economic Policy Review, January 1995.

Bhorat, H. (1999a). Wage Premia and Wage Differentials in the South African Labour Market. Paper presented at the 2000 TIPS Annual Forum at Glenburn Lodge, Muldersdrift, 18-20 September, 2000. [online] Available: www.tips.org.za.

Bhorat, H. (1999b). Decomposing Sectoral Employment Trends in South Africa. Paper presented at the TIPS 1999 Annual Forum at Glenburn Lodge, Muldersdrift, 19-22 September, 1999. [online] Available: www.tips.org.za.

Bhorat, H. (2000). The Impact of Trade and Structural Changes on Sectoral Employment in South Africa. TIPS Working Paper 8_2000. [online] Available: www.tips.org.za

Bhorat, H. and Hodge, J. (1999). Decomposing sectoral employment trends in South Africa. South African Journal of Economics, vol. 67, no. 3.

Bhorat, H. and Leibbrandt, M. (1999). Modelling Vulnerability and Low Earnings in the South African Labour Market, Development Policy Research Unit Working Paper No. 99/32.

Deardorff, A. (1994). Overview of the Stolper-Samuelson Theorem in Deardorff, A. V. and Stern, R. M. (eds) *The Stolper-Samuelson Theorem: A Golden Jubilee*, Ann Arbor: University of Michigan Press, pp 7-34.

Edwards, L. (1999). Trade liberalization, structural change and occupational employment in South Africa. Paper presented at the TIPS Annual Forum, Muldersdrift, 19-22 September.

Edwards, L. (2001). Globalisation and the occupational structure of employment in South Africa. *South African Journal of Economics*, vol. 69, no. 1, pp. 40-71.

Edwards, L. (2002). A Firm-level Analysis of Trade, Technology and Employment in South Africa, Paper presented at the 2002 Annual TIPS Forum at Glenburn Lodge, Muldersdrift.

Edwards, L. (2004). Trade Liberalisation, Technological Change and the Skill Structure of Employment in South Africa, Unpublished PhD thesis, University of Cape Town, South Africa.

Edwards, L. and Abidi, T. (2001) Trade, technology and wage inequality in South Africa. Development Policy Research Unit Working Paper No. 02/60

Fedderke, J., Shin, Y. and Vase, P. (1999). Trade and Labour usage: An examination of the South African manufacturing industry, *Econometric Research Southern Africa Working Paper*, No. 15.

Feenstra, R. C. (1996). U.S. Imports: Data and Concordances, NBER Working Paper Series, Working Paper No. 5515. [online] Available: <http://papers.nber.org>

Feenstra, R.C. and Hanson, G (1999). The impact of outsourcing and high technology capital on wages: estimates for the United States, 1979-1990, *Quarterly Journal of Economics* 114 (3), 907-940.

Finlay, R. and Grubert, H., (1959). Factor intensities, technological progress and terms of trade. *Oxford Economic Papers*, February.

Gregory, M. and Greenhalgh, C. (1997). International trade, deindustrialisation and labour demand: An input-output study for the UK (1979-1990), In Borkakoti, J. and C. Milner (eds), *International Trade and Labour Markets*. London: Macmillan Press.

Hanson, G. and Harrison, A. (1999). Trade and Wage Inequality in Mexico, *Industrial and Labour Relations Review*, Vol. 52, No. 2: 271-288.

Haskel, J. and Slaughter, M. (2000). Have Falling Tariffs and Transportation Costs raised U.S. Wage Inequality?, NBER Working Paper Series, Working Paper No. 7539. [online] Available: <http://papers.nber.org>

Haskel, J. and Slaughter, M (2001). Trade, technology and UK wage Inequality, *The Economic Journal* 111, 163-187.

Helpman, E. and Krugman, P. (1985). *Market Share and Foreign Trade*, Cambridge: Cambridge. MIT Press.

Holden, M. and Casale, D. (2000). Endogenous Protection in a Trade Liberalising Economy: The Case of South Africa. TIPS Working Paper 11_2000. [online] Available: www.tips.org.za.

Lawrence, R. and Slaughter, M. (1993). International trade and American wages in the 1980s: Giant sucking sounds or small hiccup?, *Brookings Papers: Macroeconomics*, No. 2:161-226.

Leamer, E. (1996). In Search of Stolper-Samuelson Effects on U.S. Wages, National Bureau of Economic Research Working Paper, No. 5427. [online] Available: <http://papers.nber.org>

Learner, E. (1998). In Search of Stolper-Samuelson Linkages between International Trade and Lower Wages, in Sharon M. Collins, ed., *Imports, Exports, and the American Worker*. Washington, D.C.: Brookings Institution Press, pp. 141-203.

Leibbrandt, M., Borat, H. and Woolard, I. (1999). Understanding Contemporary Household Inequality in South Africa, Development Policy Research Unit Working Paper, No. 99/25.

Lewis, J. (2001). Reform and Opportunity: The Changing Role and Patterns of Trade in South Africa and SADC. Africa Region Working Paper Series No. 14

Pesaran, M. and Smith, R. (1995) Estimating long run relationships from dynamic heterogeneous panels. *Journal of Econometrics*, 68,79-113

Pissarides, C., (1997). Learning by trading and the returns to human capital in developing countries. *The World Bank Economic Review*, Vol. 11, No. 1:17-32

Slaughter, M. (1998). What are the results of Product-Price Studies and what can we learn from their differences?, National Bureau of Economic Research Working Paper, No. 6591. [online] Available: <http://papers.nber.org>

Stolper, W. and Samuelson, P. (1941). Protection and Real Wages, *Review of Economic Studies* 9 (1): 51-68.

TIPS (2002). The State of Trade Policy in South Africa, *TIPS Review* [online]. Available: www.tips.org.za.

Thoenig, M. and Verdier, T. (2003). A Theory of Defensive Skill-Biased Innovation and Globalisation, *American Economic Review*, 93, 709-28

Winters, A. 1999. Trade and Poverty: Is there a connection? Chapter 3 of Ben-David, D., Nordstrom, H. and Winters, A., *Trade, Income Disparity and Poverty*, WTO Special Studies 5 [online]. Available: www.wto.org

Wood, A. (1994). *North-South Trade, Employment, and Inequality*. Oxford: Clarendon.

Wood, A. (1997). Openness and Wage Inequality in Developing Countries: The Latin American Challenge to East Asian Conventional Wisdom. *The World Bank Economic Review*, vol. 11, no. 1

University of Cape Town

Appendix A: Data Description

Sub-sectors

Sub-sectors of South African economy included in the analysis		
Agriculture	Paper	Fabricated Metals
Coal Mining*	Publishing and Printing	Machinery and Apparatus
Other Mining*	Petroleum Refining	Electrical Machinery
Food	Basic Chemicals	Radio, TV and Communications Equipment
Beverages	Other Chemicals	Professional Equipment
Tobacco	Rubber	Motor Vehicles and Accessories
Textiles	Plastics	Other Transport
Clothing	Glass and Glass Products	Furniture
Leather	Other Non-metallic Minerals	Other Manufacturing
Footwear	Basic Iron and Steel	
Wood	Basic Non-Ferrous Metals	

* These sub-sectors were excluded from the scatter plots

Product prices (Code: *PP*)

The log growth rate of the price deflator was used as an indicator for product prices. The price deflator was calculated as the total value of output in current prices divided by the total value of output in constant prices from 1988-2002. These figures were used to calculate log growth rates from 1989-2002 using the formula, $\ln(t1)-\ln(t0)$. Data used in this calculation were obtained from the South African Standardised Industrial Database (Available: www.tips.org.za).

Tariffs (Codes: *TAR* and *TARadj*)

Two different tariff measures were employed. As a result, there are two different codes based on the particular tariff measure and how it was calculated. The first set of tariff data is simple ad valorem tariffs plus surcharges (*TAR*). This dataset was formed by combining data from the World Integrated Trade Statistics (WITS) and Industrial

Development Corporation (IDC) tariff databases. The second set of tariff data consists of the above-mentioned dataset with data points from 1988 to 1993 adjusted upwards with ad valorem equivalents (*TARadj*) from the following sources:

WTO (1993), Trade Policy Review, WTO, Geneva

WTO (1998), Trade Policy Review, WTO, Geneva

This was done in order to account for the apparent under-representation of protection during this period as South Africa, like other countries, relied on quotas instead of tariffs. The log growth rates of these two datasets were used as indicators of protection.

Technology (Code: *TFP*)

TFP was used as an indicator for technology. This measure was calculated using the standard *TFP* computation:

$$TFP = \Delta \log (Y_{it}) - l_{it} \Delta \log (L_{it}) - k \Delta \log (K_{it})$$

where Y_{it} is the value added output for every sub-sector, L_{it} is the labour employed in every sub-sector and K_{it} is the constant prices value of capital; and l_{it} and k_{it} are the labour and capital value added shares for sector i , respectively. Data used in this calculation were obtained from TIPS.

Capital-Labour Ratio (Code: *KL*)

The capital-labour ratio was calculated as the natural log of the value of machinery and equipment to labour remuneration at constant prices. Data used in this calculation were obtained from TIPS.

Skill Intensity (Code: *SR*)

The natural log of the number of skilled and highly skilled workers divided by the number of unskilled workers. Data used in this calculation were obtained from TIPS.

Factor Payment Shares (Code: Various)

The factor payment shares were calculated as follows:

The factor payment to capital was calculated as the capital remuneration share of value added divided by total output (**Code: VK**). The following two equations were used to calculate the factor returns to skilled (**Code: VS**) and unskilled (**Code: VU**) labour:

$$VU = Wu*U/(Output) \quad (1)$$

$$Ws/Wu = x \quad (2)$$

$$Ws*S + Wu*U = LY \quad (3)$$

where LY = labour remuneration, Ws = skilled wage, Wu = unskilled wage, S = number of skilled workers, and U = number of unskilled workers.

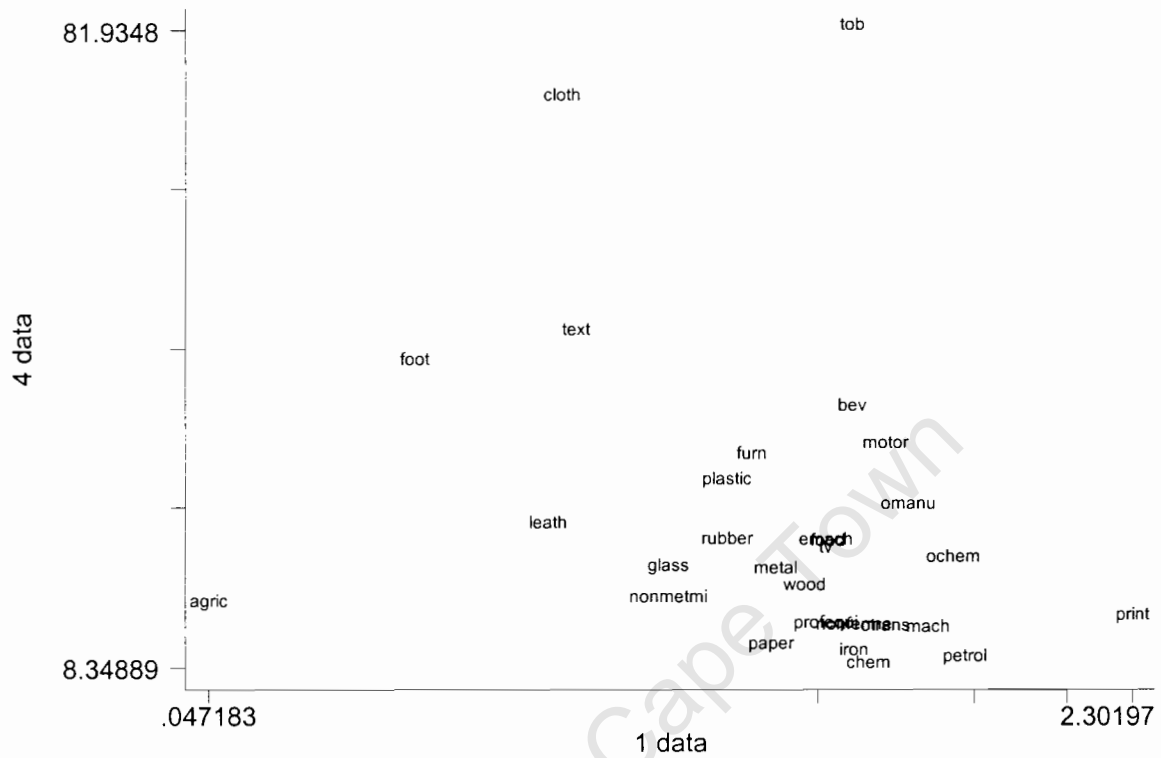
The factor payment to the intermediate sector (**Code: VI**) was calculated as:

$$VI = 1 - VS - VU - VK.$$

Sub-sector-specific data for relative wages were obtained from a 1997 SAM.

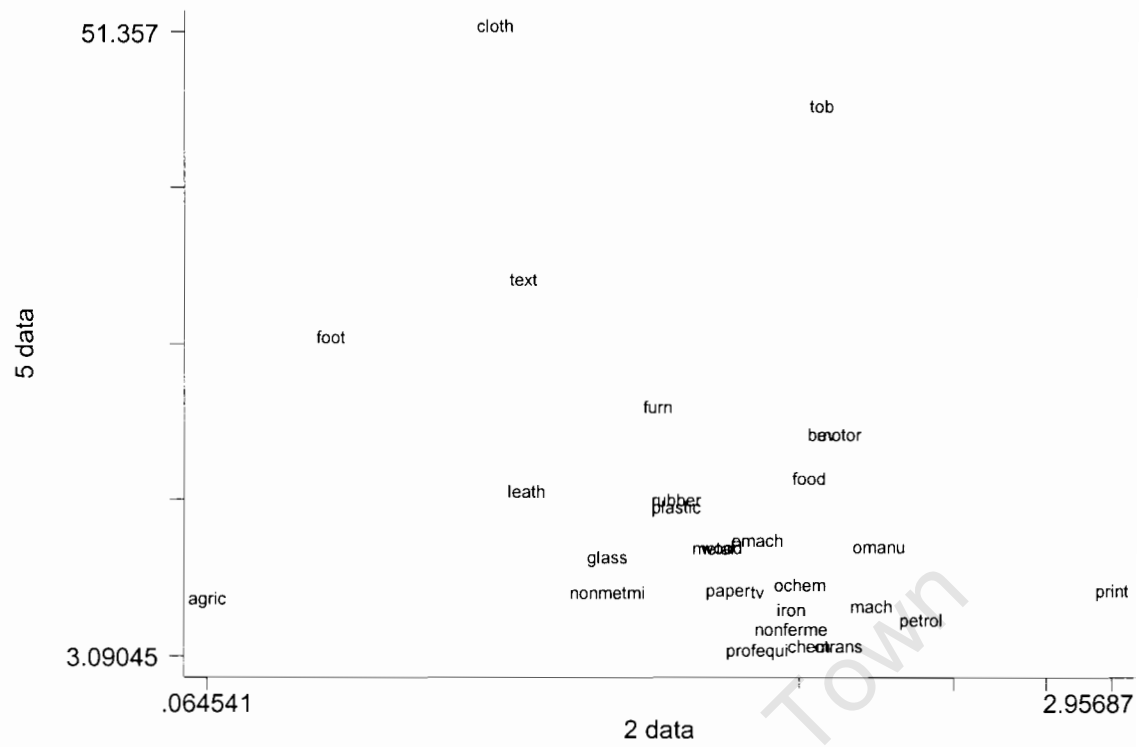
Appendix B: Scatter plots (excludes mining sub-sectors)

Figure 1



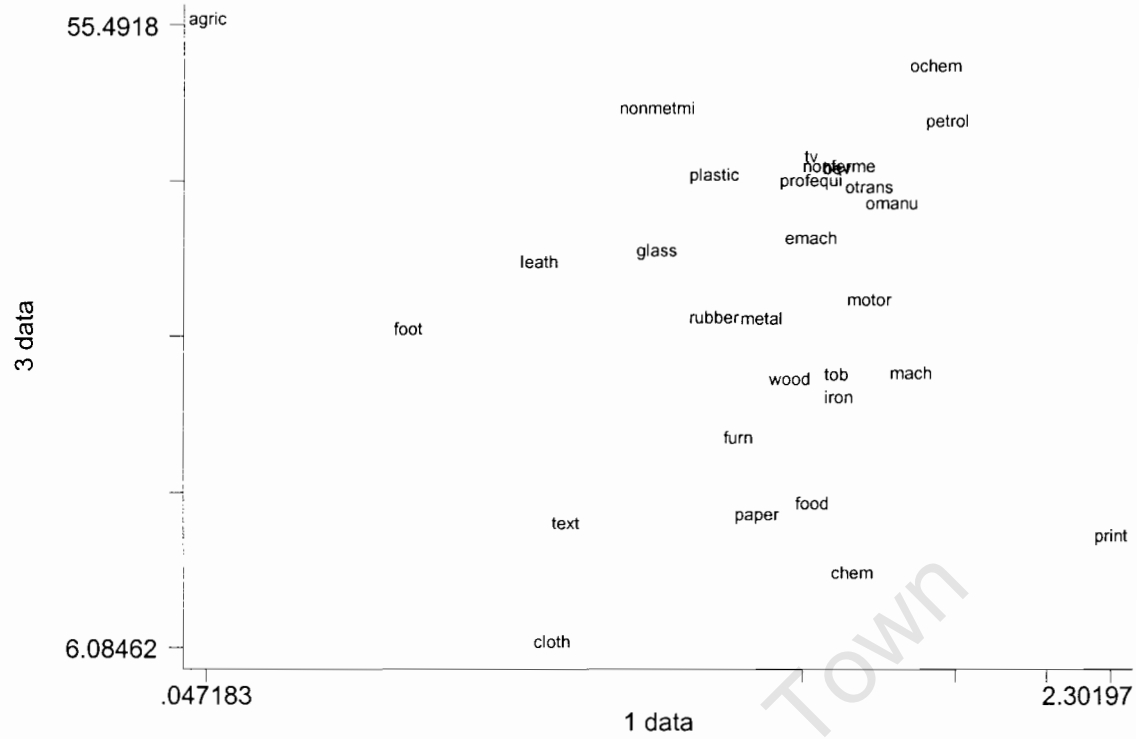
Notes: Figure 1 plots industry tariffs (average levels between 1988-1994 on the y-axis) against skill intensity (average levels between 1988-1994 on the x-axis). The WTO adjusted tariffs (including surcharges) were used for these figures. Skill intensity is calculated as the sum of highly skilled and skilled workers divided by the number of unskilled workers in a sub-sector. Each observation represents a sub-sector. Sources: TIPS Industry Database.

Figure 2



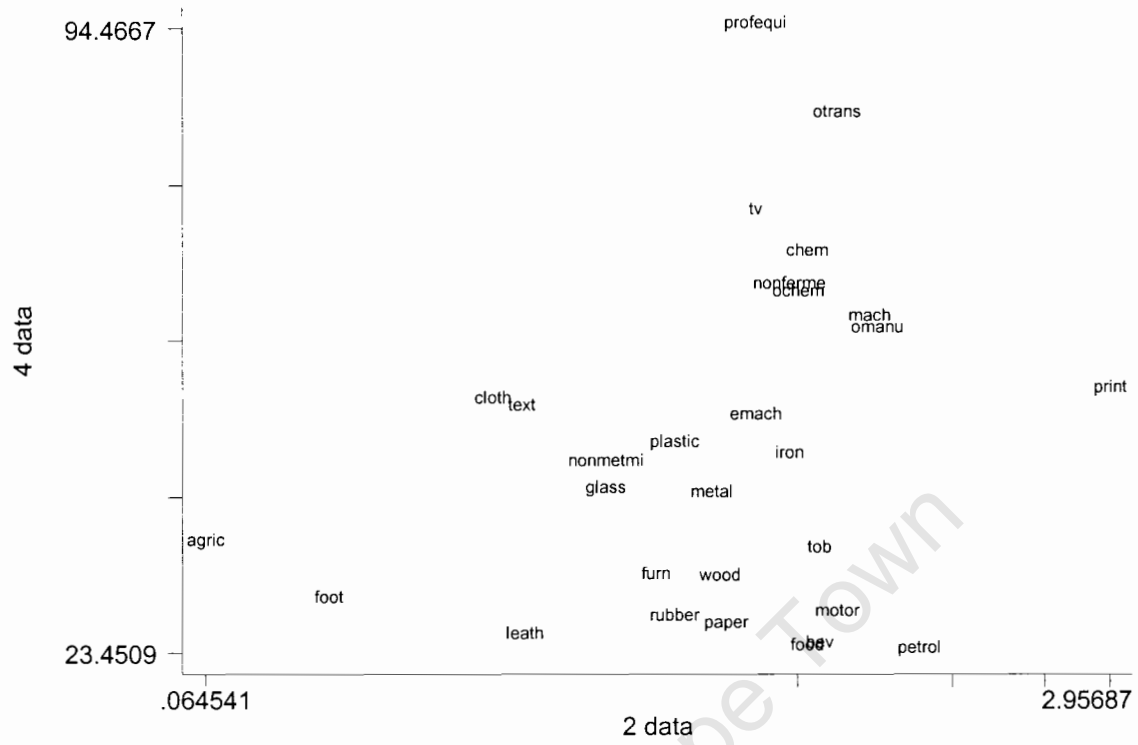
Notes: Figure 2 plots industry tariffs (average levels between 1995-2001 on the y-axis) against skill intensity (average levels between 1995-2001 on the x-axis). The WTO adjusted tariffs (including surcharges) were used for these figures. Skill intensity is calculated as the sum of highly skilled and skilled workers divided by the number of unskilled workers in a sub-sector. Each observation represents a sub-sector. Sources: TIPS Industry Database.

Figure 3



Notes: Figure 3 plots industry tariffs (percentage reduction between 1988-1994 on the y-axis) against skill intensity (average levels between 1988-1994 on the x-axis). The WTO adjusted tariffs (including surcharges) were used for these figures. Skill intensity is calculated as the sum of highly skilled and skilled workers divided by the number of unskilled workers in a sub-sector. Each observation represents a sub-sector. Sources: TIPS Industry Database.

Figure 4



Notes: Figure 4 plots industry tariffs (percentage reduction between 1995-2001 on the y-axis) against skill intensity (average levels between 1995-2001 on the x-axis). The WTO adjusted tariffs (including surcharges) were used for these figures. Skill intensity is calculated as the sum of highly skilled and skilled workers divided by the number of unskilled workers in a sub-sector. Each observation represents a sub-sector. Sources: TIPS Industry Database.

Appendix C: Results

Table 5

Stage 1 Price Regressions (Random Effects)

(Dependent Variable indicated in first row)

	(1)	(2)	(3)	(4)	(5)	(6)
	PP	PP	PP	PP	PP	PP
TAR	0.052 (0.001)	0.06 (0.731)				
TARadj			0.083 (0.000)		0.092 (0.000)	0.098 (0.000)
TAR_KL		-0.16 (0.000)				
TARadj_KL					-0.348 (0.058)	-0.416 (0.022)
TARadj_TFP				0.479 (0.003)	0.386 (0.016)	
TFP		-0.087 (0.000)				-0.16 (0.000)
R-Squared	0.03	0.05	0.04	0.02	0.06	0.07
Prob > F	0.001	0.000	0.000	0.003	0.000	0.000
Observations	434	434	434	434	434	434

Table 6

Stage 1 Price Regressions (Fixed Effects)

(Dependent Variable indicated in first row)

	(1)	(2)	(3)	(4)	(5)	(6)
	PP	PP	PP	PP	PP	PP
TAR	0.047 (0.005)	0.041 (0.025)				
TARadj			0.075 (0.000)		0.08 (0.001)	0.082 (0.000)
TAR_KL		-0.046 (0.834)				
TARadj_KL					-0.234 (0.304)	-0.29 (0.196)
TARadj_TFP				0.4 (0.016)	0.323 (0.051)	
TFP		-0.144 (0.000)				-0.147 (0.000)
R-Squared	0.03	0.07	0.04	0.02	0.06	0.09
Prob > F	0.005	0.000	0.000	0.016	0.000	0.000
Observations	434	434	434	434	434	434