

**The Impact of Import Competition from China on the Skill-Bias of
Manufacturing Employment across South African Regions
between 2001 and 2011**



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Abstract

South Africa and China established their first official diplomatic ties in 1998. A decade later in 2008 China had become South Africa's largest bilateral trade partner which presents both complementary and competitive outcomes for the South African labour market. This study explores the competitive outcomes, particularly the impact that China has had on the skill bias of manufacturing employment within South Africa's local municipalities between 2001 and 2011. The study follows on from two theories of trade: the Heckscher-Ohlin theory with its Stolper-Samuelson theorem, and specific factor theories. The identification method employed in this study was developed by Autor, Dorn and Hansen (2013) and seeks to exploit variation across South African municipalities which stems from initial differences in industry specialisation and instrumenting for South African imports using changes in Chinese imports by other low- and middle-income countries. The data used in the current study is from the UN Comtrade as well as South African population census data from 1996, 2001 and 2011. This study makes two main contributions to the literature by looking at the impact that import competition has on manufacturing employment in local labour markets, and how this impact varies by skill set and gender. The main finding of the study was that Chinese import exposure was biased against low-skilled workers as it resulted loss of employment for the low-skilled workers, and had a minimal effect on the employment of high-skilled workers.

Keywords: International trade, Skill bias, South Africa, China, Local labour market.

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1. Introduction

This study looks at the bilateral trade partnership between one of Africa's leading economies, South Africa, and the world's largest developing economy, China. The two nations established their first official diplomatic ties in 1998 and by a decade later in 2008 China had become South Africa's largest bilateral trade partner (Comtrade, 2010). This trade partnership presents both complementary and competitive outcomes for the South African labour market. One of the competitive outcomes is an increase in import competition from China. This study relates the changes import exposure from China to changes in the skill bias of manufacturing employment within the 234 municipalities of South Africa between 2001 and 2011.

This study will present empirical evidence based on the identification method of Autor, Dorn and Hansen (2013) at local labour market level to establish the effects that import competition from China has on the South African local labour markets. Autor et al. (2013) investigated the heterogeneous effects that trade liberalisation has on different geographical regions, and their main finding was that the initial concentration of industry within each region means that these regions are affected differently by import competition. This study will investigate how manufacturing workers of varied skill sets are impacted by import competition, resulting in skill bias. Skill can be defined both in terms of occupation and educational attainment; this study focuses primarily on skill based on occupation. Furthermore, this study will analyse the gender effects of the skill bias.

While a breadth of South African literature has looked at the labour market impacts of Chinese importation on the manufacturing sector at a macro-economic level; this study focuses on the regional outcomes.

1.1. Background and motivation

China has seen spectacular growth over the past three decades with its growth in gross domestic product (GDP) averaging 9.8 per cent per year from 1978 to 2007 (Zhu & Kotz, 2011). This rapid growth has been attributed to the increase in productivity which came about post-1978 after China's

market-oriented reform policy. The reforms introduced profit incentives to rural enterprises and freed many of these enterprises from State intervention, which resulted in a productivity boom in China (Hu & Khan, 1997). The focus of this study is motivated by the observation that import competition from China has risen over the past two decades, and that China became South Africa's largest trading partner in 2008 when it surpassed both Germany and the United States of America (USA) (Comtrade, 2010).

Figure 1 below shows the growth in South African imports from China relative to total South African imports from the rest of the world. In the years between 1996 and 2011, South African manufacturing imports from the rest of the world rose from 243 894 56 to 958 660 19 (both amounts in US\$ '000). In the same period imports from China increased from 57 470 in 1996 to 1 060 297 in 2001; and after China's ascension into the WTO manufacturing imports increased by 12 per cent to a total of 141 31 951 (all amounts in US\$ '000) (UN Comtrade, 2012).

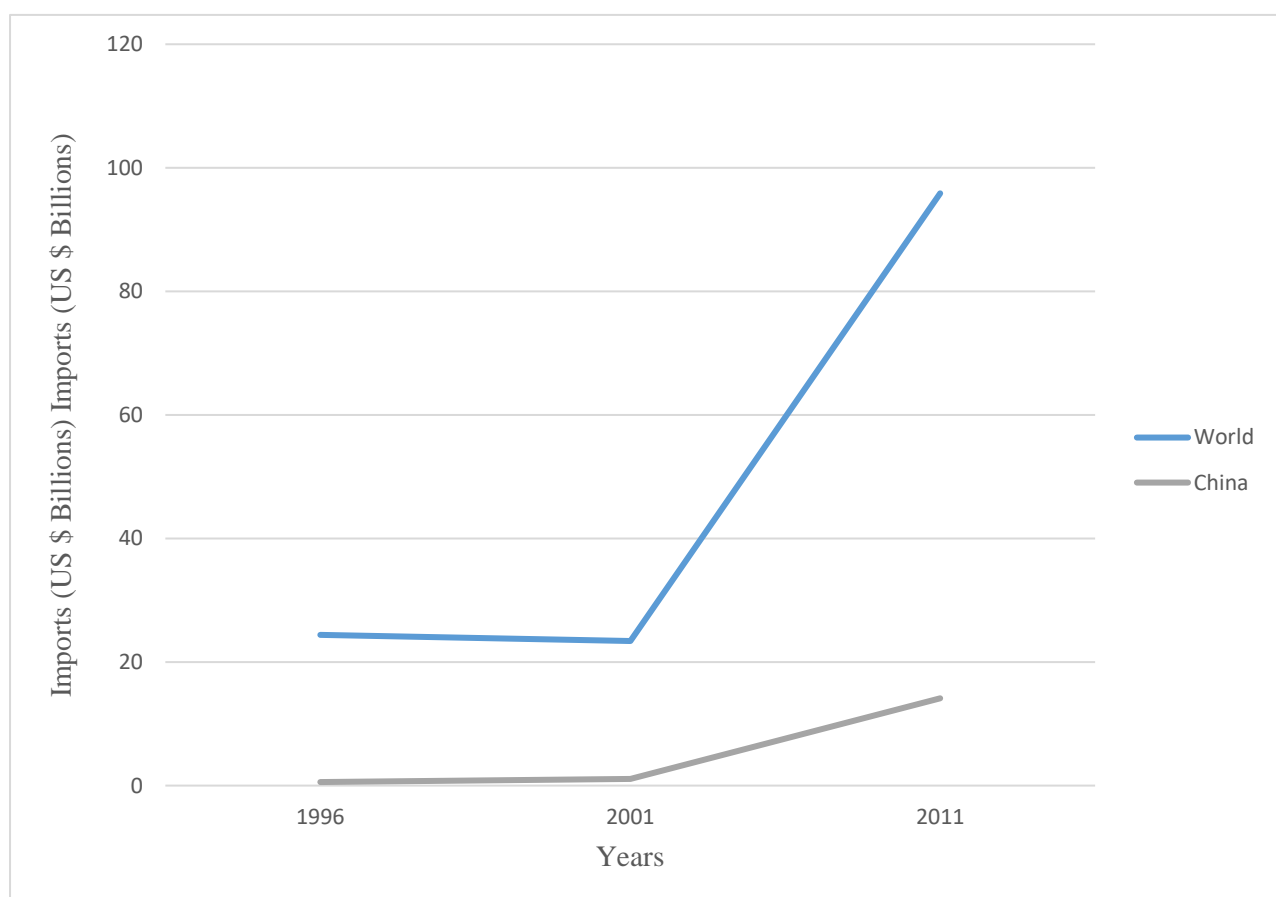


Figure 1: Increase in South African imports from China.

Source: Author's calculations using UN Comtrade (2012) data

This study seeks to provide insight into the effect of increased trade relations with China on employment levels within the manufacturing industry, and how these outcomes vary primarily by skill and by gender. The partnership between South Africa and China is of importance because apart from the investment that China has made into South Africa's economy, China is also a competitor in sectors considered strategic to South Africa according to Alden and Wu (2014). Previous literature on the impact of Chinese import competition found that China's accession into the World Trade Organization (WTO) had a negative impact on manufacturing.

China's accession into the WTO in 2001 was a shock to the world trading economy. This shock resulted in rising exports of manufactured goods and subsequently declining world prices of these products. According to traditional trade theory, openness to trade would benefit two trading partners, as it encourages them to specialise in the goods that they have a comparative advantage in. According to Krugman (2008) owners of the country's abundant factors may gain from trade, while owners of the country's scarce factors lose. Relative to its trading partner China, South Africa is abundantly endowed with highly skilled labour; a characteristic of East Asian countries is they are abundantly endowed with unskilled labour (Jenkins, 2008). As such, the Heckscher-Ohlin model predicts that trade would shift employment towards the abundant factor, which is high skilled labour. The Heckscher-Ohlin presents challenges in that it assumes labour is fully mobile between regions, and between industries. However, workers may not easily move between regions nor to other industries. For this reason, this paper will also consider the specific factor model, which describes the case where the unskilled worker has skills specific to an industry whilst the skilled labour may have skills that are transferable across the industry. Another alternative would be skill-biased technological change, whereby firms introduce new technology which is easier for skilled workers to adopt than it is for unskilled workers to do so.

The identification method used in this study comes from the study by Autor et al. (2013) which looked at how local labour markets in the USA adjusted to the shock of increased imports from China. According to their study, the initial shock would occur at the product market where the competition is most intense. The shock will then transfer to the local markets where competing firms and industries are concentrated. Finally, these shocks will affect the labour market outcomes in these regions; a result of which is significant declines in employment; particularly relating to low-skilled or non-college educated workers. South Africa's colonial and apartheid era was characterised by racial discrimination, which brought about the homeland policies and Group Areas Act, both of which restricted movement of labour and led to unequal development of the regions which are still discernible today. Different

regions in South Africa had different industrial compositions before the trade liberalisation which took place in the 1990s. Furthermore, varying import tariffs were put in place based on the different industries in the regions, to minimise the impact of import penetration on the industry in each region. The insights provided by this study will allow for the effective restructuring of the local labour markets. The data for this study is panel data from the South African Census survey conducted by Statistics South Africa, which has observations for all 234 local municipalities in South Africa for the years 2001–2011 and trade data from UN Comtrade.

1.2. Problem statement

There has been no comprehensive study on the direct impact of bilateral trade with China, particularly insofar as how imports would affect employment in South Africa’s manufacturing sector at a regional level. Much of the literature¹ on the impact of Chinese import competition on the South African labour market (as well as that of other developing countries) has focused on the impact of China on the manufacturing industry at large; and on the impact of trade liberalisation on production, trade and employment on the country as a unit. Thus, this study seeks to fill that gap by analysing how trade with China has affected the demand for skilled labour relative to unskilled labour in the local regions of South Africa.

1.3. Objectives of the study

The major objective of the study is to determine the effect of import competition from China on the demand for skills in South Africa’s local labour market. To this end, this study will:

1. Present an overview of the trade partnership between South Africa and China at an aggregate level and at a sector level.
2. Identify the trade theory that predicts the impact that import competition would have on low and high skilled manufacturing workers within the South African municipalities, also referred

¹ Including Edwards (2001), Dunne and Edwards (2007) and Jenkins (2008)

to in the current paper as local labour markets.

3. Estimate empirically the impact that import competition has had on manufacturing employment and unemployment of skilled and unskilled labour within South Africa's local labour markets.

4. Estimate empirically the gender effects of Chinese import competition on manufacturing employment within South Africa's local labour markets.

1.4. Overview of the dissertation

The remainder of this study is structured as follows: Section 2 provides context regarding the South Africa and China trade partnership; while Section 3 will look at the Heckscher-Ohlin and specific factors theory and other theoretical insights which may affect the skill bias of manufacturing employment. Section 4 analyses the empirical literature from previous studies. Thereafter Section 5 looks at the empirical model that is employed, while Section 6 will look at the data used in the present study. Section 7 provides the results and discussion thereof and Section 8 provides the conclusion.

2. South African municipalities and Chinese import competition

This section sets the context for the current study by firstly discussing the process of trade liberalisation in South Africa. Secondly, the section presents factors specific to China, particularly its rapid economic growth, which has led to it becoming South Africa's largest trading partner. Lastly, the section presents data on the local labour regions in South Africa, the manufacturing industry composition of these and how trade liberalisation affected them.

2.1. South African trade history

Before the 1990s South Africa's trade policy was more focused on import substitution, and the imports comprised mostly labour-intensive products such as clothing and textiles. This period was characterised by various tariffs; towards the late 1980s South Africa still had the most tariff rates, as well as the widest range of tariffs, when compared to other developing countries (Edwards, 2005).

South Africa's liberalisation accelerated from 1990 with the removal of surcharges and reduction of tariffs which came when South Africa's offer in the Uruguay round of the General Agreement on Tariffs and Trade (GATT). The liberalisation was further fuelled by South Africa's formal offer to the WTO where it agreed to reduce the number of tariff rates and replace the restrictions on agricultural products. Not only did this result in reduced tariffs, quotas and surcharges; it was also the beginning of what would become a more open economy which accelerated South Africa into the global economy. From the 2000s trade was further increased through free trade agreements with the European Union (EU) and the Southern Africa Development Community (Edwards and Lawrence, 2008).

South Africa's process of trade liberalisation coincided with the end of the apartheid era in the early 1990s. The apartheid period policies such as the homeland policies and Group Areas Act restricted the movement of labour and resulted in unequal development of areas. These policies caused a great disparity in economic activity, growth and employment across the local labour markets. Consequently, this led to unequal spatial growth which continued post-independence, with the continued development of major cities at the expense of the homelands and other remote areas. During that time South Africa maintained a comparative advantage in the production of mineral and agricultural resource-intensive products, mainly because of its natural resource endowments. However, the system encouraged the development of inefficient industries coupled with inefficient use of the

land, low investment in transportation infrastructure and high transport costs in the homelands (Bosker & Krugell, 2008). One of the effects of the discrimination stemming from apartheid exists as inequitable distribution of opportunities for education levels, as well as types of employment available to the poor in rural areas (Edwards & Lawrence, 2008). The Apartheid era left a majority of South Africans lives in rural areas, which are former 'homelands' where they were confined under the apartheid Bantustan policy, and this has impacted their integration into the labour market. Of the poorer South Africans, a high majority are employed either in low-skill occupations or subsistence farming, and only a few are employed in high-skilled occupations.

2.2. China's rise as South Africa's trading partner

China's growth story starts in 1978 with its market-oriented reform policy and opening up to world markets. The policy was aimed at increasing the real income of those who lived in rural areas by increasing the prices of agricultural produce (Zhu & Kotz, 2011). In 1992 China established itself as a market economy, which resulted in the growth of the private sector. The growth was further accelerated by China's accession to the WTO on December 11, 2001, which encouraged international trade. Up to that point domestic demand had been the main driver of China's rising GDP. In the year following the entry into the WTO, foreign demand for China's output accounted for much more of the GDP growth, and thus China's manufacturing sector became more export-oriented. The rise in demand for more capital-intensive products saw a mass rural-to-urban migration of over 150 million workers further fuelling the growth (Chen, Jin & Yue, 2006). Between 2001 and 2007 the export share of GDP rose from 22.7 per cent to 39.6 per cent. Chinese exports grew at an average rate of 20.9 per cent per year from 2001 to 2007 (Zhu & Kotz, 2011).

Formal diplomatic ties between South Africa and China started in January 1998. What followed was a series of bilateral declarations and agreements which have, over time, strengthened the formal partnership. In April 2000 the Pretoria Declaration was signed to establish a binational commission which would result in expanded trade, among other commitments. When China joined the WTO in 2001 the trade relations further escalated, with a move toward a strategic partnership in June 2004. This strategic partnership meant that South Africa had now granted China market status, which meant that the parameters that were in place to pursue trade disputes in terms of WTO criteria had been narrowed. A year later in 2005 negotiations for a free trade agreement with the Southern

African Customs Union started. A decade after formal diplomatic ties were established, China was already South Africa's primary import and export partner. Imports from China were one-fifth of South Africa's total imports, surpassing those from Germany, the USA and Japan (Comtrade, 2010). By August 2010, ties between the two nations were further elevated, with the signing of the comprehensive strategic partnership which became known as the Beijing Declaration. By 2015, South Africa had signed 26 trade agreements with China (Alden & Wu, 2014).

The depth of these diplomatic ties has now gone beyond the State and currently includes provincial links. The provinces of Gauteng, Western Cape and KwaZulu-Natal have their own partnerships with China (Alden & Wu, 2014). Gauteng is the only inland province among these, and while it boasts mainly a mining industry, it now has various others including metal products and machinery, particularly vehicle parts and accessories, electrical machinery and other electronic products. Prominent regions here are the cities of Tshwane, Ekurhuleni and Johannesburg. In the Western Cape the largest industry is in the City of Cape Town where the specialisation is textiles, clothing, steel production, food and beverages, fuel, petroleum, and chemical and rubber products. In KwaZulu-Natal eThekweni has similar industry to the Western Cape, with the addition of automotive manufacturing, which is also predominant in the Eastern Cape, in Buffalo city and Nelson Mandela Bay.

2.3. Import competition and the manufacturing sector in South Africa

The following section provides an overview of the trade partnership between South Africa and China on an aggregate level. Figure 2 below shows the growth in South African imports from China from 1996 to 2011. In 1996, only 2 per cent of South Africa's imports were from China, and the figure rose to 5 per cent in 2001. However, a substantial increase was seen in 2011, when China accounted for 15 per cent of South Africa's imports.

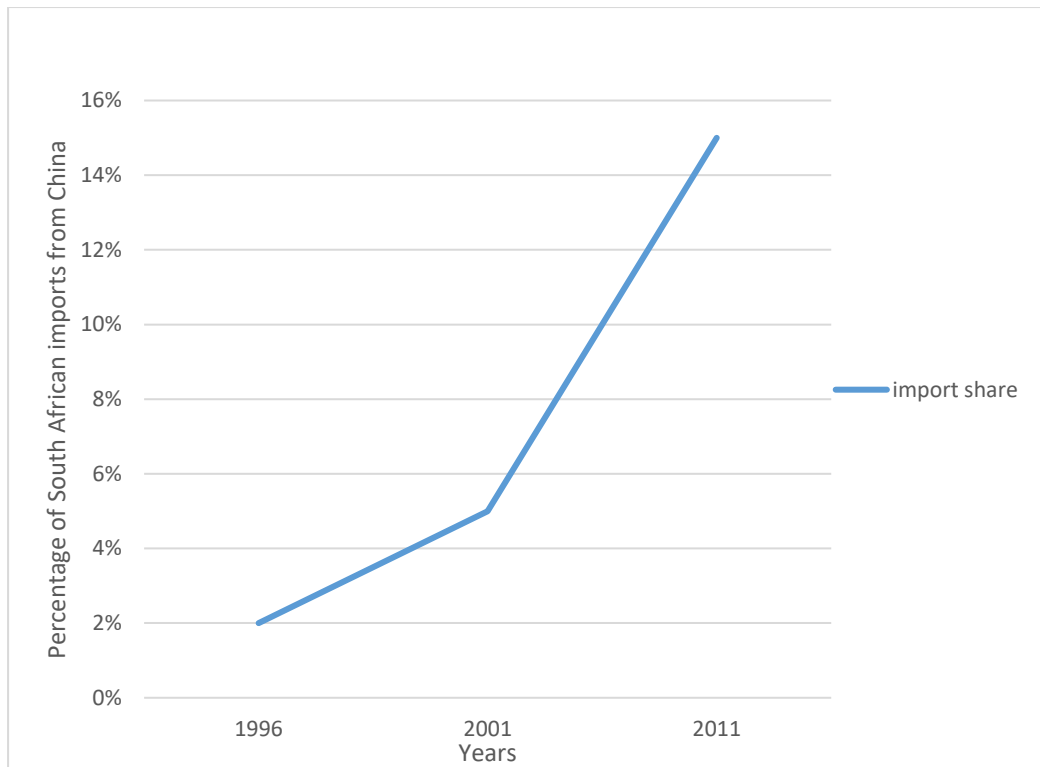


Figure 2: The percentage share of South African imports from China by year.

Source: Authors' calculations using UN Comtrade (2012) data.

According to the World Integrated Trade Statistics² (WITS), imports from South Africa into China were 1 064 431 (US \$ '000) in 2001 and up to 14 207 815 (US \$ '000) in 2011, with the bulk of these imports being consumer and capital goods (UN Comtrade, 2012). Figure 3 shows the share of South African manufacturing imports by product type. The industries with the highest share of imports from China are machinery and electrical products; clothing and textiles; footwear; chemical and metals. This result is complementary with Edwards et al. (2013) study on aggregate impact of imports from China on the various industries in South Africa. They found that Chinese imports rose by 5.5 per cent in the 15-year period between 1995 and 2010. In that period Chinese imports accounted for more than three-quarters of the increase in import penetration into the South African market Edwards et al. (2013). While the change in imports in agricultural and resource-based products was less than 1 per cent in knitted and crocheted fabrics it was 42.8 per cent. According to Morris and Einhorn (2008) and Edwards and Rankin (2012) this percentage would have been even more had it not been for the

² The World Integrated Trade Solution (WITS) is software developed by the World Bank which offers access the major trade and tariff data compilations including the UN Comtrade database.

imposition of trade quotas in 2008 and 2009.

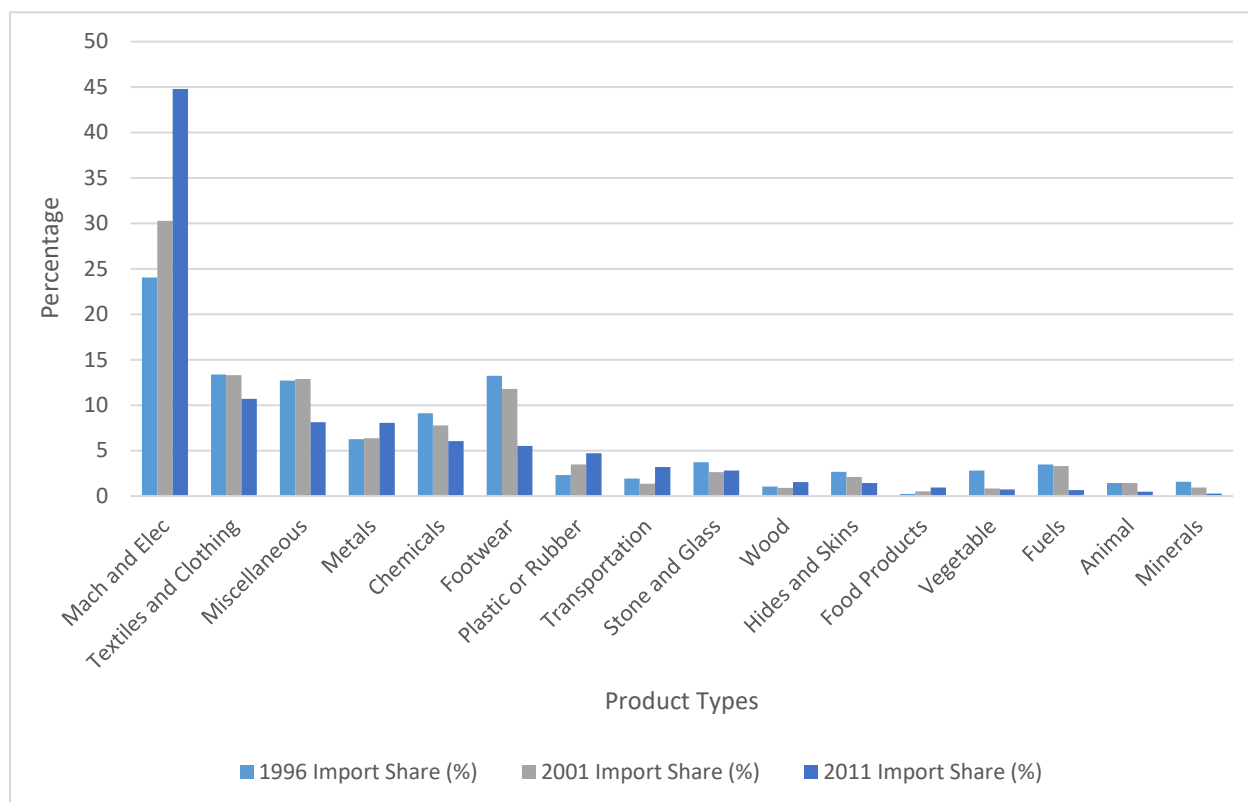


Figure 3: Percentage of South African imports from China by product type between 1996, 2001 and 2011.

Source: Author’s calculations using UN Comtrade (2012) data.

Pertinent to this study is the change in levels of employment between 1996 and 2011. According to the World Bank, South Africa’s unemployment rate was 21 per cent in 1996, rose to 25.4 per cent in 2001 and was slightly lower at 24.7 per cent in 2011, however, this still remains one of the highest unemployment rates in the world (World Bank, 2012). Unemployment by the narrow definition refers to the share of the labour force that is actively looking for employment but has been without work for the last week. The broader definition of employment includes the narrowly unemployed, as well as those without work, who are not actively looking but would accept a suitable job if one were offered to them (Fields G.S, 2000). For the remainder of this paper, unemployment will refer to the narrow definition. Banerjee et al. (2008) used a nationally representative panel study of employment before and after South Africa transitioned into a democratic country. They found that in the ten years between 1995 and 2001, unemployment almost doubled from 13 per cent to almost 30 per cent. On the other hand, they found that labour force participation had increased since the end of apartheid. The primary sector in South Africa, mainly agriculture and mining sectors, was thriving in the 1990s; towards the 2000s there was a decline in those sectors while finance, wholesale and retail sales and community,

social and personal services saw increases in employment. The workers who were displaced from the agriculture and mining sectors would have been unable to relocate to other regions where jobs might be available, owing to specific skills that had in the particular sector that they were previously employed in.

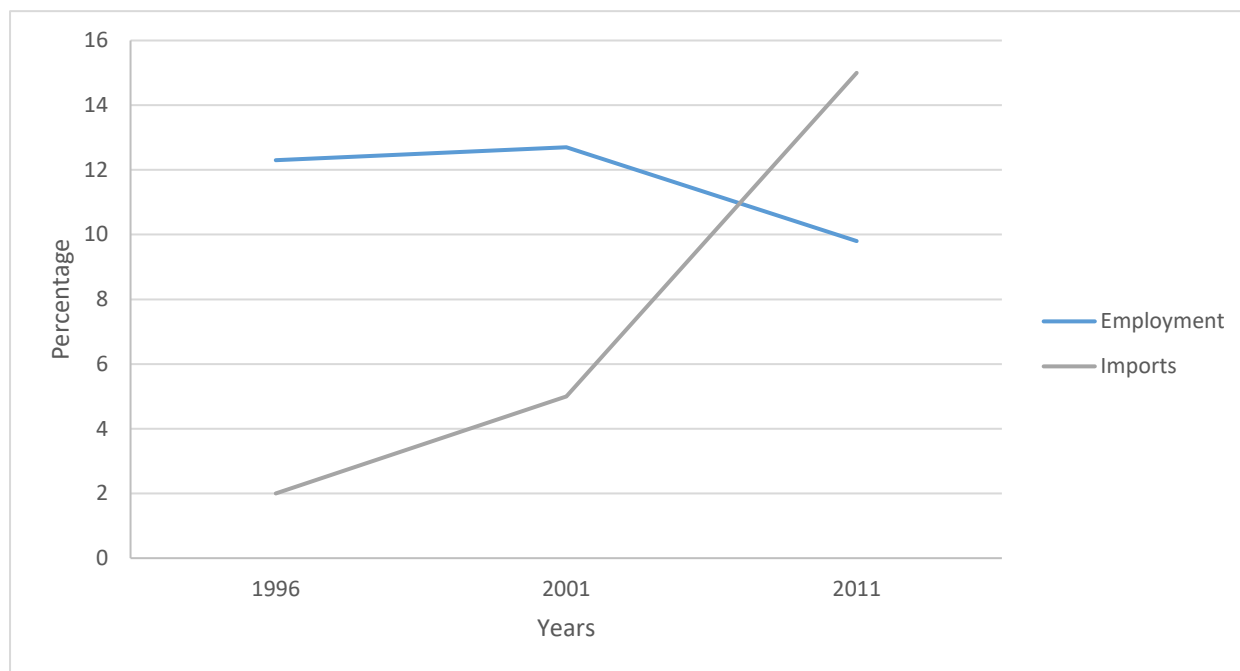


Figure 4: The relationship between manufacturing employment and South African imports from China

Source: Author's calculations using Statistics South Africa (2011) data and UN Comtrade (2011) data.

Figure 4 shows the relationship between the percentage share of manufacturing employment and the percentage share of South African imports from China. Between the years 1996 and 2001, there is a marginal increase in share of South African imports from China, which coincides with a marginal increase in the share of manufacturing employment. Between 2001 and 2011, however, the large increase in the share of South African imports from China coincides with a sharp decline in the share of manufacturing employment. This suggests an inverse relationship between South African imports from China and manufacturing employment.

The remainder of this study seeks to analyse theoretically and empirically the relationship between the increase in import competition from China and the decline in the employment of unskilled labour within the manufacturing sector in South Africa.

Theoretical Framework

3.1. Theoretical models seeking to explain the ‘China shock’

When China, a large export-oriented labour-abundant country, joined the WTO in 2001 this was a shock to the world trading economy. This shock resulted in rising exports of manufactured goods and subsequently declining prices of these products. This section looks to what international trade theory would predict as an outcome of increasing Chinese exports on the demand for skilled labour relative to unskilled labour within South Africa’s local regions. This study considers three main mechanisms through which trade affects the relative demand for skills. The two main theories used in this paper to frame the key questions of this investigation on how international trade affects the South African local labour market are the Heckscher-Ohlin Stolper-Samuelson model (Heckscher et al., 1991) and the specific factors model. To further analyse the impact this study also looks at the recent skill-biased technological change theory.

The earliest work on international trade was recorded in Adam Smith’s *Wealth of the Nations* (1776), which states that free and unrestricted trade benefits the trading nations, which offset the losses of trade. Openness to trade would encourage countries to produce the goods for which they have lower costs and absolute advantage, and to import the goods which had a higher cost and absolute disadvantage. This would lead to an increased market for goods produced by each country, which would encourage firms to increase their productivity in order to meet this increasing demand.

This theory of absolute advantage was challenged by Ricardo (1817), who argued that advantage should be seen not in absolute terms but rather in comparative terms. If there is a country which had an absolute disadvantage in producing traded goods A and B, it would still benefit from trade by producing good A if it had a lower relative cost of producing good A compared to good B in comparison to the other countries. This in turn leads to growth in the sector of good A with the comparative advantage, and hence a higher demand for workers to produce good A. The negative effect of trade would be the reduction in the sector with the comparative disadvantage, which produces good B. China had a comparative advantage in low-wage and low-productivity industries. According to the Ricardian theory (Ricardo, 1817), this would have led to the restructuring of South African production away from the low-wage, low-productivity goods to higher-wage, higher-productivity goods. Under the

assumption of full mobility of homogenous labour between industries, the model predicts a rise in real wages while unemployment remains constant. However, supposing there are adjustment costs and wage rigidities, the model predicts that there will be loss of employment in the low-wage, low-productivity industries within South Africa. The limitation with Ricardian theory is that it assumes that labour is homogenous; thus, this model cannot be used to explain the effects for workers across skills.

Following on from the theory of comparative advantage is the Heckscher-Ohlin model (Heckscher et al, 1991). Unlike in the Ricardian model, a country's comparative advantage is a result of relative factor endowments as opposed to the relative costs of producing goods. In a simple Heckscher-Ohlin model with two countries, the theory predicts that countries will export goods that intensively use the factors of production that they are relatively abundantly endowed with and will import goods that intensively use factors that are relatively scarce. The Heckscher-Ohlin model assumes a competitive market, constant returns to scale, homothetic preferences, and common production technologies. Furthermore, this model assumes that factors of production are perfectly mobile, and factor returns are assumed to be equalised across all regions.

China has a relative comparative abundance of unskilled labour and consequently a comparative advantage in unskilled labour-intensive products. South Africa, on the other hand, has a comparative abundance of skilled labour and as such has a comparative advantage in skilled labour-intensive goods. According to the theory, when China entered the WTO this would have led to a reduction in the world price of the unskilled labour-intensive goods relative to the skilled labour-intensive goods. This would have resulted in a decline in the number of unskilled labour-intensive firms in South Africa when faced with competition from China. The Heckscher-Ohlin theory predicts that the skill-intensive industry would grow in response to access to the Chinese market, and a rise in the relative price of the skilled labour-intensive goods. The Stolper-Samuelson effect of the Heckscher-Ohlin model predicts that a rise in the skilled labour-intensive industry would in turn lead to a rise in the demand for skilled workers, which would in turn raise the relative and real wages of skilled labour. Consequently, this would cause the unskilled labour-intensive industry in South Africa to shrink.

There are a few challenges with employing the Heckscher-Ohlin model. Firstly, the model assumes full mobility of factors across regions. This assumption does not hold true for many countries, at least not in the short run. Furthermore, South Africa is likely to have higher rigidities in movement across regions than other countries, as a result of the homeland policies and Group Areas Act which

restricted the movement of labour during the apartheid period. The application of the aggregate Heckscher-Ohlin model in the analysis of South African regional market would need to consider each local region as its own 'country', because relative endowments differ enormously across regions; hence it is expected that the effect of Chinese import competition will differ across these regions. The second challenge with the Heckscher-Ohlin model is that it assumes factor markets clear; as such the effect of import competition is predicted to be revealed through increasing wages of the skilled workers relative to the unskilled workers, as opposed to the effect being evident in aggregate employment. By allowing for downward wage rigidities into the model, which are expected in South African labour laws, then the effect would play out in the form of employment and not through wage changes; this is particularly true for unskilled workers in South Africa, whose bargained wages are binding. The consequence of this is it would lead to a decline in aggregate employment of unskilled relative to skilled workers. The third challenge of the Heckscher-Ohlin model is that it assumes that workers are fully mobile across industries; however, in practice workers accumulate skills specific to a sector and this constrains their ability to move across industries.

This leads the discussion on to the specific factors model, where labour is specific to the manufacturing sector. The key feature of this theory is that one factor of production is assumed to be 'specific' to an industry. The 'specific' factor is considered immobile between industries in response to changes in market conditions. Labour could be regarded as immobile in that the worker is specifically trained for the specific production process. Thus, it would be difficult and costly to move these factors across industries. With regard to skilled and unskilled labour, unskilled manufacturing workers tend to be more specific to the sector they work in, as compared to skilled manufacturing workers. Those in managerial or professional occupations, for example, would be able to find a job in a different sector much more easily.

In the specific factors model, a decline in the price of the unskilled labour-intensive goods on the aggregate level would mean an unskilled worker specific to that industry would see substantial reductions in wages, relative to the skilled worker who would be more mobile across industries. Where wage rigidities exist, this effect would be revealed in declines in employment of unskilled workers in absolute terms and declines in employment relative to skilled labour.

3.2. Other theoretical insights

Since its liberalisation South Africa finds itself ‘competing against low-wage countries like India and China, as well as highly productive developed countries’ (Edwards, 2005: 754). Firms that are less efficient may be forced to either exit the market, which will further lower the demand for unskilled labour, or defensively innovate in order to compete with rising import competition. Firms achieve this by adopting new technologies, which results in a skill-biased technological change. In this phenomenon there is a change in the production technology that a firm is using; the new technology employed tends to favour high-skilled over low-skilled labour, as it increases the relative productivity of high-skilled labour and that in turn increases the relative demand for skilled labour. This is contrary to the Heckscher-Ohlin model which assumes that technology is exogenous. The skill-bias technological change provides an alternative theory explaining the outcomes for skilled and unskilled workers where technology changes. This hypothesis works on the assumption that the new technology is complementary with skilled workers and not with unskilled. Some arguments for this hypothesis have been the ‘learning by doing’ notion, which is that experience in using a specific technology would increase the productivity of the user. This assumes that the skilled worker would be able to learn to use the new technology much faster than the unskilled worker. A consequence of the technological change is that it may lead to even larger losses in employment than what was predicted in the above models, particularly more losses in unskilled employment.

There are various possible outcomes to trade liberalisation. While the above models focus on the competitive effects of trade, there are some complementary effects to consider which could positively affect employment within the local regions. One complementary effect is the growth in exports that would increase employment in the export goods industry. The second complementary effect is the decrease in the cost of capital and intermediate goods. If the skilled labour is complementary with the increase in capital, there will be a relative increase in the relative demand for skilled labour employment.

3. Literature Review

Trade liberalisation and openness are regarded as a way of increasing developing countries' living standards and enhancing their economic development. This section will review empirical literature on the relationship that trade has had on the demand for skilled and unskilled workers. The first section looks at the impact of import competition on skill bias at a national level. Thereafter, the international literature which focuses on regional labour markets is reviewed, highlighting the paper by Autor et al. (2013) upon which this study is based. Thereafter the impact of trade on other developing markets is examined.

4.1. Effect of import competition on skill bias at national level

One of the earliest studies that investigated skill bias as a result of international trade is Wood (1995) *North-South trade, employment, and inequality*. Wood (1995) presented the argument that international trade between developed countries 'North' and developing countries 'South' hurt the unskilled manufacturing workers in the developed countries by lowering their wages and pushing them out of their jobs. While South Africa may not be a developed country, it has relatively more skilled workers compared to China and thus would be subject to the same outcome as the 'North' in Wood, A. (1995) work. The argument supports the Heckscher- Ohlin theory where trade will take place as the developed country has a large supply of skilled labour and the developing country a large supply of unskilled labour. Thus, the developed country will export skilled labour-intensive products in exchange for unskilled labour-intensive products from the developing country. Wood, A. (1995) further considers the case where relative wages in the developed country are rigid; in which case there will be a rise in the relative demand of skilled labour in the developing country and surpluses in unskilled labour resulting in an increased gap in the employment rates of the skilled and unskilled workers.

Sachs et al. (1994) investigated the impact that international trade had on manufacturing jobs in the United States. They found that in the face of international competition between 1978 and 1990, not only did the manufacturing sector shrink by 7.2 per cent; but there was also a decline in the levels of employment of unskilled manufacturing workers. In particular, they found that the textiles, apparel and footwear sectors were most affected.

On the other hand, there are studies that did not find a significant impact of trade on skilled and unskilled workers. Krugman and Lawrence (1994) acknowledged that rising imports from developing countries coincided with the decline in the employment of unskilled manufacturing workers in the United States. They argued, however, that the impact of rising imports was too small and concluded that the rising demand for skilled workers in manufacturing industry may be due to changes in demand rather than as a response to international trade. A similar conclusion was reached by Lee and Schluter (1999) who looked at the effect of trade on the demand for skilled and unskilled workers in the USA between 1972 and 1992 and found that trade was not a major contributor. Their analysis looked at various sectors, including mining, manufacturing, agriculture and the service industry. However, the issue with this analysis is that it looked at employment in certain sectors that were not directly competing with imports such as the service industry.

Most studies find a negative relationship between trade liberalisation and net aggregate employment in South Africa. Bell and Cattaneo (1997) conducted one of the studies on trade and employment in South Africa. Their study focused on how imports and exports impacted on employment between the years 1972 and 1993. Using a factor-content approach they found that rising import penetration negatively affected labour intensive sectors. They found that import penetration between 1985 and 1993 reduced employment levels by 10.4 per cent. As Bell and Cattaneo (1997) study period was up to 1993, it did not capture the impact of South Africa's tariff liberalisation process which began in 1994. To capture this effect, Edwards (1999) extended this study to the period after 1994 using the same factor-content approach and the net impact of trade. He also found that the decline in employment was felt mostly by the labour-intensive sectors. The limitation with both these studies is that the impact of the trade flows is interpreted independently from changes in domestic demand.

The consensus within South African literature including Bell and Cattaneo (1997), Tshikata (1999) and Borat (2000) suggests that trade flows have become more skill intensive. Borat (2000) shows that the skill bias concept is not a recent phenomenon by investigating trends in formal employment between 1970 and 1995 and found that there was a significant rise in the demand for highly skilled workers, and this came at the expense of unskilled workers. Feenstra and Hanson (1997) found that openness to trade allows goods that require a higher level of skill to be outsourced from high-skilled economies to low-skilled economies, raising the demand for skill and thus favouring skilled workers everywhere. In another argument on why openness to trade would favour skilled workers, Leonardi

(2003) argues that wealthier and higher-skilled workers tend to consume more skill-intensive goods, so if trade increases their income it could favour skilled workers.

Falling employment within the manufacturing sector coincided with China's rapid growth. Edwards and Jenkins (2015) used the Chenery-type decomposition to evaluate the impact of Chinese trade on the employment of South African manufacturing from 1992 to 2010. Overall they found that import competition from China had a negative effect on South Africa's manufacturing sector. It resulted in a loss of approximately 102,000 jobs through displacement of local manufacturing and a further loss of 43,000 jobs due to raising labour productivity. According to their estimations, employment in the manufacturing sector in South Africa was 8.2 per cent lower in 2010 than it would have been had it not been for import competition from China (Edwards and Jenkins, 2015).

4.2. Import competition from China at regional level

While the above studies focused on import competition on a net aggregate level, the section below motivates for a study at a regional level, presenting a section on import competition from China on developed markets followed by an analysis of developing markets.

4.2.1. Evidence of skill bias in developed markets

The main study that this paper is based on is by Autor et al. (2013), who measured how import competition as a result of international trade impacts the local labour markets by focusing on the 722 commuting zones in the USA between 1980 and 2007. The industry level shocks were projected onto the labour market by causing them to interact with the variation in the commuting zones industry mix before the rise of China's productivity. They found a strong spatial variation in the industry specialisation in the different zones, as manufactures within an industry tend to cluster together geographically. This affected the manner in which these zones were affected by exposures to trade. They looked at the effects of import competition on overall employment, unemployment and non-participation in manufacturing as well as non-manufacturing sectors.

Autor et al. (2013) found that import competition led to large declines in local manufacturing employment and rises in local labour market unemployment. Workers with less than a college education were most affected by trade. The study found that the decline was not limited to production jobs; instead, it was consistent across managerial, professional and technical jobs. The study also found that the adjustment in local labour markets has been slow and that wages and labour-force participation rates remained depressed and unemployment rates remained elevated for at least a full decade after the China trade shock commenced. In order to isolate the effects of Chinese import competition they used an identification strategy that uses the growth of Chinese exports to other high-income countries as an instrument for imports by the USA from China. The reasoning was that the growth in Chinese imports within a particular industry in the USA and other high-income countries is driven by the growth in China's productivity, which came about as China transitioned into a more open economy and when they joined the WTO.

The importance of looking at the spatial and initial industry composition when analysing the impact of trade on labour market outcomes was also documented by Caliendo and Parro (2015). They developed a dynamic trade model where production and consumption occur in distinct labour markets with varying exposures to international competition. They used this model to study the impact of import competition from China on the USA and found that while there was a decline in the manufacturing sector, states that were focused more on retail, wholesale and construction saw a rise in employment. This suggests that in those states that had a comparative advantage, industries experiencing high trade exposure had significant employment losses. In contrast, states that had a comparative advantage in sectors that were less exposed benefitted from relatively cheap intermediate goods imports, and overall experienced a reduced impact on employment. Therefore, it can be said that labour markets respond differently to the same trade shock across industry specialisation and time.

Lu and Ng (2013: 1404) defined skill in terms of the *Dictionary of Occupational Titles* (DOT) measure. Their study uses instrumentation to control for endogeneity which are United Kingdom import penetration ratios of corresponding industries to instrument those of industries in the USA. Their results found that import exposure favoured employment for “non-routine skill sets, including cognitive, interactive, and manual non-routine skills” (Lu & Ng, 2013: 1416) and less so for workers with routine skills.

In Austria, Onaran (2011) found evidence that inter-industry imports from low-wage countries

and intra-industry imports from developed countries can lead to job and income losses for workers in import-competing industries. He found that unskilled labour was affected more by these job losses. Those who were negatively affected were mostly blue-collar workers – more so than white collar workers, who were found to be positively affected by imports.

Chinese import competition led to skill upgrading in Belgium. Mion and Zhu (2013) found that China accounted for 27% of the total observed increase in the share of non-production (highly educated) workers in low-tech Belgian manufacturing between 1996 and 2007. Norwegian manufacturing firms also experienced reductions in employment as a result of increased import competition from China at local labour market level. Balsvik, Jensen & Salvanes (2015) found that the Chinese import shock primarily affected the unskilled workers (those without a college degree). These workers were left unemployed, while some were able to find employment in other private sectors.

4.2.2. Evidence of skill bias in developing markets

There are fewer studies which address the demand for skill in developing countries as opposed to developed countries. This section of the study will look at the impacts of import competition from China on local labour regions, specifically focusing on empirical data from other developing countries.

Mexico had a trade reform in 1985 and Feenstra and Hanson (1997) found an increase in the wages of skilled workers relative to unskilled workers. In a further study on Mexico, Harrison and Hanson (1999) specifically looked at whether the costs of adjustment to trade had fallen more on the unskilled than the skilled workers. They found that in the years following trade reform the ratio of skilled to unskilled wages increased. This result corroborates the findings of Robbins (1994), who looked at the wages of skilled and unskilled workers in Chile between 1980 and 1990. His main finding was that workers with a university degree saw wage increases of 56 per cent relative to those with only high school education.

In a later region level study Mendez (2015) looked at the impact of import penetration exposure on regions across Mexico that stemmed from differences in their initial industry specialisation. He observed the effect of Chinese import exposure on the Mexican local labour market and found that a one standard deviation increase in import penetration led to a 0.45 per cent decrease in manufacturing

employment and a 2 per cent decrease in a region's working age population. Overall the paper suggested that these trade shocks had a negative effect on employment in the manufacturing sector.

Studies in Brazil have found that there are growing returns to skilled workers, which coincided with the time this country went through trade liberalisation (Blom et al., 2003). The Heckscher-Ohlin model would predict substitution of skilled workers with the unskilled. This was not the case in Brazil, where skilled workers' employment rose with the rise in skill premium. In Turkey Meschi, Taymaz and Vivarelli (2008) investigated the impact of trade openness and adoption of technology on the relative demand for skilled workers within manufacturing firms. They looked at the period after Turkey's liberalisation that took place from 1980 to 2001. Over this period, they found that the relative demand for skilled labour increased substantially. This contradicted the prediction of the Heckscher-Ohlin theorem as Turkey has more unskilled labour relative to its trading partners in the EU, and the theory predicted an increase in demand for unskilled workers.

Tunisia implemented trade reforms in the 1980s and moved away from protecting infant industries. Mouelhi (2007) investigated the impact that the process had on skilled and unskilled employment using data from 1983 and 1994. Their analysis looked at various firms and particularly at how they fared when there was a change in this trade protection. The study found that unskilled labour was more sensitive to changes in trade protection than skilled labour. They also found that import-competing firms suffered more than export-oriented firms when it came to the reduction of labour demand.

Topalova (2010) looked at the impact that liberalisation in India had on the 450 Indian districts when trade protection was removed in 1991. She found that regions in India that were exposed to liberalisation, particularly the more rural areas, experienced a slower decline in poverty. The study also found that the lack of mobility of labour led to higher levels of import penetration, resulting in higher poverty levels. An interesting observation from her study was that there was an inability of labour to reallocate from sectors that were most affected by opening up to trade, a result that is consistent with predictions of the specific factors model of trade.

4.3. Further empirical literature considerations

4.3.1. Gender bias of skill bias

An additional dimension to consider with regards to the skill bias of employment is the impact that it has on the different genders within South Africa's local labour markets. Manufacturing employment is equally important for men and women, and as such, both males and females would be affected by trade liberalisation. In his study on the effect of trade liberalisation on gender, Thurlow (2006) finds that trade liberalisation in South Africa benefitted skilled male and females and had negative effect on unskilled women particularly those employed in the food and textiles sector. This was largely due to higher-skilled women and men having greater sectoral mobility while unskilled females were forced into lower wage agricultural and services sectors. In their study Cockburn et al. (2007) found a strong gender bias against women as a result of trade liberalisation which resulted in a decrease in their labour market participation, while men's labour participation increased.

4.3.2. Effect of technological change on labour markets

Various scholars have attributed the demand for skilled labour to technological change. International evidence from Berman et al. (1994) estimated that international trade displaced approximately 9 per cent of the unskilled workers in the United States of America (USA), however skill biased technological change displaced more than 70 per cent of unskilled workers. This result was consistent with findings by Wood (1995) and Brauer and Hickok (1995) who both concluded that as the USA adopted new technology it increased the relative demand for more skilled labour, thus reducing the demand for unskilled labour. In their study, Sachs et al. (1994) also attributed some of the increase in skill bias to changes in technology. The reason this may occur is because an industry that is advancing its technology would favour skilled workers over the unskilled, as the skilled workers would have higher potential to learn the new technology (Wolff, 2006). Skilled workers are also more likely to evaluate and adapt innovations than unskilled workers.

In a study into the skill bias of occupational employment in South Africa, Edwards (2001) used the input output methodology. His study was based on years 1984, 1988, 1993 and 1997; and he found that trade had a positive effect on employment overall, however, he highlighted a significant shift away

from low skilled employment that came about as a result of technological change. Employment of skilled labour rose for all periods in the study, and rose most between 1993 and 1997 which was a period of tariff reform in South Africa. In this 1993 - 1997 period, employment of semi and low skilled workers declined by 1.84 and 3.31 per cent respectively. When investigating trends in sectoral employment, Borat (2000) also found that a large shift towards highly skilled workers was due to technological change.

While the impact of technological change cannot be denied, Jenkins (2008) presents an alternative way of thinking of the impact of technology. He argues that technology only explains part of the low employment levels between 1970 and 2001; he presents other factors such as microeconomic conditions, economic institutions and social norms which may contribute to the demand for employment. In South Africa these could be the ending of apartheid, the growth of trade unions and other legislative changes that have taken place. In his study, (Jenkins, 2008) proxied these out by using time dummies.

The breadth of the literature on the impact of international trade in South Africa is at an aggregate level. To the best of the authors knowledge, there are no comprehensive studies on the impact of import competition on local labour markets in South Africa. Hence the current study will analyse the demand for skills in the regional labour market and how this has been affected by import competition from China.

5. Methodology

This section presents the methodology used to determine the impact that increased imports from China by South Africa has had on the demand for skilled and unskilled labour in the manufacturing sector within local labour markets. The empirical approach used in the present study draws from the work of Autor et al. (2013). The model specifications are discussed first, followed by a discussion on endogeneity of the import exposure and the instrumental variable used to deal with this problem.

5.1. Model specifications

The empirical model used in this current study is based on the work of Autor et al. (2013) that focused on the impact of exogenous increases in Chinese import competition on local labour markets in the USA. Autor et al. (2013) define each local labour market as a small open economy that operates under monopolistic competition.

The basic model estimates the effect that import exposure has on the levels of employment (total and by skill) within the manufacturing industry:

$$E_{rt} = \alpha + \beta_1 IPW_{rt} + \varepsilon_{rt} \quad (1),$$

where E_{rt} refers to the levels of manufacturing employment (defined as total employment, skilled employment or unskilled employment) in municipality r at time t . The variable α represents the constant and IPW_{rt} is a measure of exposure to imports from China in municipality r at time t . The variable ε_{rt} is the standard error.

The coefficient for import exposure β_1 is expected to be negative, implying that an increase in imports from China leads to lower demand for manufacturing workers. Furthermore, the coefficient is expected to be more negative for unskilled manufacturing workers than for skilled manufacturing workers. This would imply stronger negative effects of Chinese competition on employment of unskilled workers relative to employment of skilled workers.

A limitation of the above specification is that it does not control for other characteristics that could

bias estimates of β_1 . To account for the possibility of omitted variable bias, an extended specification includes a set of control variables. To specification (1) a municipality fixed effect (γ_r) is added and it captures all time-invariant effects that could affect the skilled and unskilled levels of employment specific to the municipality r . Other controls included are the size of the working age population, the net migration in and out of the region, the level of skills of the working age population, the unemployment rate in the region, the level of infrastructure and the initial share of employment in the manufacturing industry. Further, time fixed effects (γ_t) are included to account for macro forces that affect employment across all regions in each year. The resultant extended specification is:

$$E_{rt} = \alpha_0 + \beta_1 IPW_{rt} + \theta C + \gamma_r + \gamma_t + \varepsilon_{rt} \quad (2),$$

where in addition to those variables already explained, θ denotes the row vector of coefficients for the set of controls (C).

Turning to the expected signs of the control variables, a positive coefficient is expected on the size of the working age population (between 15 and 64 years) in the region. A region with a higher number of persons of working age (between 15 and 64 years) would be more likely to have higher levels of employment. If more workers are moving into a region, it is more likely that this will result in greater employment within that region. The level of skill that the working age population has within a region would affect the levels of employment. A region with more skilled workers would have more employment than a region with less skilled workers. The overall unemployment rate in that region will affect the employment in manufacturing; if a region has a higher unemployment rate it is more likely that the manufacturing employment is lower, and this would imply a lower level of employment for both skilled and unskilled workers.

The level of infrastructure within a region will also influence the level of skilled and unskilled workers; a better infrastructure would favour the skilled workers more than the unskilled workers. The share of manufacturing in that region would also affect the employment in the region. A region which has a larger share of manufacturing industry would be expected to have more workers employed than a region which primarily focuses on other non-manufacturing industry.

5.1.1. Constructing the measure of import exposure

Following on from the methodology of Autor et al. (2013), the measure of import competition is constructed, calculated as the weighted value of imports per worker in each local labour market. This is designated as the import exposure per worker (IPW) and is specified as follows:

$$IPW_{rt} = \sum_x \frac{L_{rt} M_{rt}}{L_t L_{rt}} \quad (3),$$

where r and t are the region or municipality and period respectively. The above model is simplified to account for an increase in imports from China and how that affects the manufacturing industry in the region r where the industry is located. An increase in manufacturing industry imports from China over a period t to a region r is based on the region's share of total national employment in the industry at the beginning of the period. This total increase in import value is then scaled by the total employment in region i at the beginning of period t , denoted as L_{rt} , and this is weighted by the share of region r in the South African manufacturing employment, expressed as L_{rt}/L_t . The resultant expression is the IPW.

5.2. Instrument variable

A concern with the above estimation is that the changes in demand for skilled and unskilled manufacturing labour in South Africa's local labour markets may also come about due to industry demand and not due to changes in Chinese import competition. For this reason, an instrument variable will be used to account for this. The instrument used is Chinese imports to other developing countries. The Autor et al. (2013) paper uses this instrument variable strategy to identify the Chinese productivity and trade-shock component of a nation's import growth. If the common within-industry component of rising Chinese imports to South Africa and other developing countries stems from China's rising comparative advantage and declining trade costs in these sectors. A potential threat to this model is if there is some correlation in import demand between these countries. In this instance, OLS estimates would underestimate the impact because both exports and imports may be correlated with unobserved shocks to South African producer demand. A second threat to the IV identification strategy is that South Africa's productivity shock and not China's is driving the growth in imports. The third threat is that

the growth in imports could be a result of South Africa own technological shocks, as they move towards automation, which affects the more labour-intensive industries.

The instrument variable which is the measure of import penetration in other developing markets is as follows:

$$IPW^i_{rt} = \sum_x \frac{L_{rt}}{L_t} \frac{M^i_{rt}}{L_{rt}} \quad (4),$$

where IPW_{rt} and M_{rt} from equation (3) has been substituted with IPW^i_{rt} and M^i_{rt} respectively, denoting the use of imports from other developing countries.

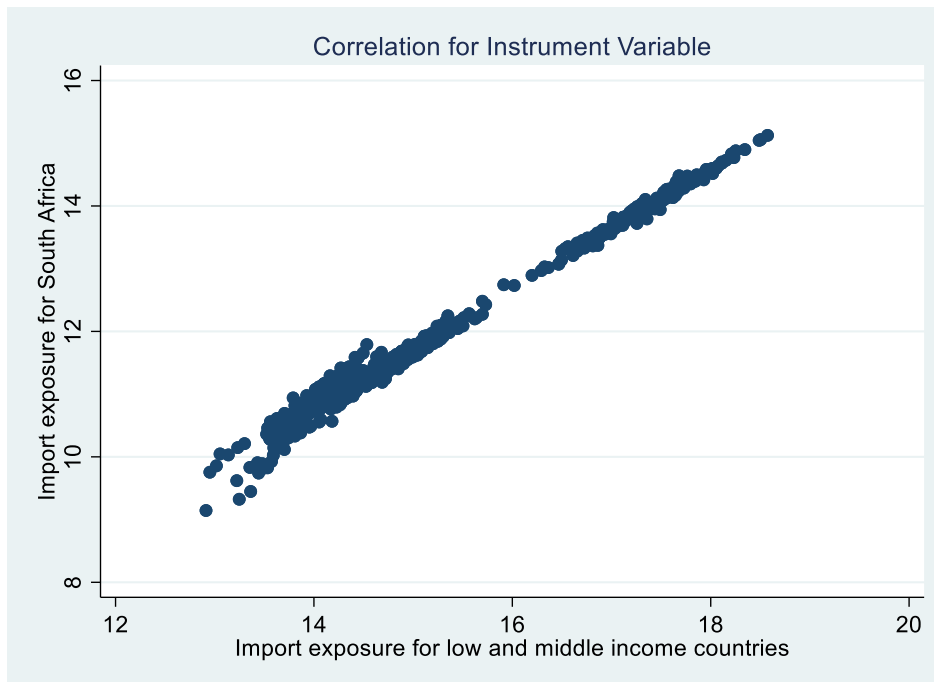


Figure 5: The relationship between the observed IPW from China to South Africa and the instrumental variable, and IPW from China to other low- and middle-income countries.

Source: Author’s calculations using UN Comtrade (2012) data.

A strong instrument variable would need to meet two criteria. Firstly, there should be a strong correlation between IPW from China to South Africa and the IPW from China to other developing countries. The correlation between the import competition measure in South Africa and other low- and middle-income countries is shown in Figure 5 above.

6. Presentation of Data

In this section the two sources of the data used for this study are first described, which are the South African Population Census and UN Comtrade data (2012). Thereafter the two main measures of skill are discussed, which are skill by occupation and skill by education. Then a few preliminary statistics based on the data are presented, which gives an overview of the changes in both employment within manufacturing as well as in skills within manufacturing. Finally, how our measure of import exposure has changed over the period is explored.

6.1. Sources of data

The data for this study are drawn from two sources. The South African import data are derived from United Nations Comtrade 2012 and aggregated into three-digit industry codes. The employment data are derived from nationally representative South African Population Census conducted by Statistics South Africa. The dataset has observations for all 234 local municipalities in South Africa for the years 1996, 2001 and 2011. It is particularly useful as it provides data on employment, unemployment, and education across the municipalities. The two periods are of interest as they capture the changes from 2001 when the partnership between South Africa and China deepened due to South Africa's accession into the WTO; and the impact a decade afterwards in 2011. The limitation with the South African Population Census is that there have been changes in local municipal borders over the period of study.

6.2. Employment

Growth in employment within the manufacturing industry has been increasing at a slower rate over the period between 1996 and 2011. Moreover, the share of unskilled workers has been decreasing while the share of skilled workers increased. The sub-section below discusses the distinction between skilled and unskilled workers before presenting the data.

6.2.1. Defining skill

Skill can be defined either in terms of levels of attainment of education or in terms of type of occupation. The current study focusses on the levels of employment in the manufacturing industry and how import exposure from China affects the skilled relative to the unskilled workforce. It is therefore necessary to describe the distinction between the two.

The South African Standard Classification of Occupations (SASCO) provides us with a basis for classifying the occupations as obtained in the population Census data. Occupations within this classification are classified in major groups (1–10):

1. Legislators;
2. Senior officials and managers;
3. Professionals and technicians;
4. Associate professionals;
5. Clerks;
6. Service workers and shop and market sales workers;
7. Skilled agricultural and fishery workers;
8. Craft and related trades workers;
9. Plant and machinery operators and assemblers;
10. Elementary occupations and domestic workers.

For this study, unskilled workers are defined as craft and related trades workers as well as plant and machine operators and assemblers employed in the manufacturing sector. All other occupations within the manufacturing sector are defined as skilled. This is the same skill classification method used by Sachs et al. (1994)³ who identified non-production workers as skilled and production workers as unskilled.

Skill can also be defined in terms of the level of academic attainment. Kraak (2008) provided a relationship between the National Qualification Framework (NQF) levels and skill level. They defined

³ Sachs et al. (1994) followed on the skill classification method by Berman, Bound, and Griliches (1994) and Lawrence and Slaughter (1993)

low skilled as any person who has less than matric; semi-skilled as a person with a matric or matric and diploma; and high skilled as persons with a higher education degree and postgraduate courses.

Banerjee et al. (2008) classified the population into four education groups: less than matric, matric, some post-matric education, and tertiary education completed. Their main finding was that higher education was correlated with better employment outcomes and higher labour market participation. The employment rate for workers with a matric or less declined from 54 per cent to 49.7 per cent between 1995 and 2005. Consequently, their unemployment rate almost doubled, from 15.2 per cent to 28.2 per cent. Workers with a university degree were the only group found to have the lowest unemployment rates.

In their study Docquier and Rapoport (2004) collected census data from several countries, most of which had three levels of educational attainment. Low-skilled workers were those with primary education (or with 0–8 years of schooling in countries where the highest diploma is not provided); medium-skilled workers were those with secondary education (9–12 years of schooling); and high-skilled workers those with tertiary education (13 years and above).

In this study, individuals are split into two education groups: the skilled (those that have at least completed high school, that is, 12 years of education) and the unskilled (those with less than complete high school education). This is the same distinction made by Wood (1994), who defined unskilled workers as those with a basic general education, and the skilled as those with further education and training.

6.2.2. Manufacturing employment in South Africa by skill

The analysis of regional manufacturing employment begins with an overview of the aggregate changes in the share of manufacturing employment in South Africa between 1996 and 2011. Figure 6 depicts the change in percentage of South Africans employed in manufacturing, by skill. Between 1996 and 2001 there was a marginal increase in the manufacturing share of employment in South Africa from 12.3 to 12.7 per cent of total employment in South Africa. Between 2001 and 2011, there is a decrease in manufacturing share of employment to 9.8 per cent. More pertinent to the current study is the change in the manufacturing employment share, where in 1996 6.5 per cent of manufacturing share of employment was unskilled workers and 5.7 per cent were skilled workers. The consecutive years,

2001 and 2011, the share of skilled workers in manufacturing exceeded the share of unskilled workers. Of all workers employed in South Africa in 2001, 6.1 per cent were unskilled manufacturing workers while 6.6 per cent were skilled. In 2011, the share of unskilled fell to 4.0 with the skilled share increasing to 5.7 per cent.

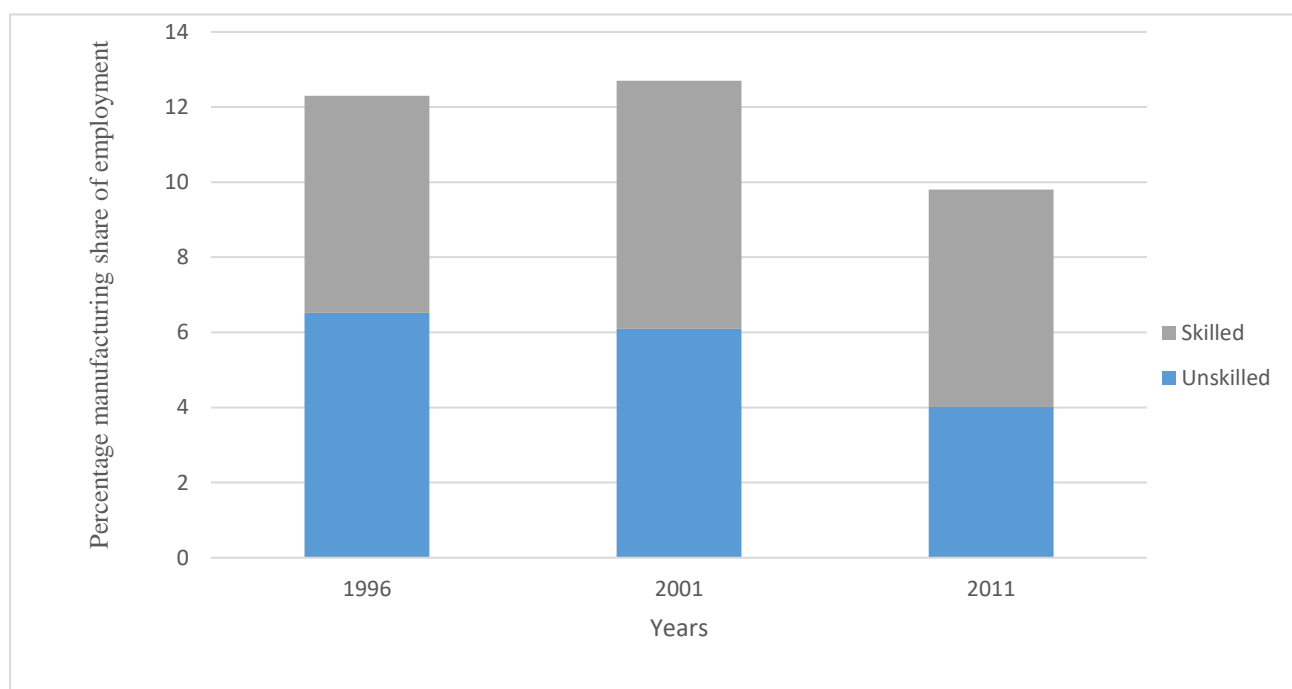


Figure 4: South African manufacturing share of employment by skill.

Source: Author's calculations using Statistics South Africa (2011) data.

Note: Skilled and unskilled are calculated according to occupational category.

Table 1 shows the share composition of employment in manufacturing across the municipalities by skill. The change in the share of employment by skills shows that in 1996, 53% of all manufacturing workers were unskilled; this decreased to 48 per cent by 2001 and was down to 41 per cent by 2011. Similarly, the share of skilled workers in 1996 was 47 per cent and this increased to 52 per cent in 2001 and by 2011 had risen by 12 per cent to 59 per cent. Table 1 suggests that there has been a change in the composition of skilled and unskilled workers in the manufacturing industry and this change is biased against unskilled workers.

Table 1: Share composition of employment in manufacturing by skill, mean across regions

	Share	
	Unskilled	Skilled
1996	53%	47%
2001	48%	52%
2011	41%	59%

Source: Author's calculations using Statistics South Africa (2011) data.

To further analyse the variation in employment by region, Figure 7 presents a kernel density diagram to assess how the levels of manufacturing employment across the municipalities vary by skill and how this has changed over the period. The plot shows the distribution of skilled manufacturing employment across the municipalities for the period between 1996 and 2011, and this shows a wide variation in skills between the municipalities. Over time there is a movement of manufacturing employment away from unskilled to skilled. There is a slight shift to the right between 1996 and 2001; however, the shift by 2011 was much greater. The resultant image shows that the bulk of municipalities had approximately 0.6 per cent share of skilled workers by 2011.

In 1996 the average share of skilled workers employed in manufacturing was centred around 42 per cent with a wider variation in skills amongst the municipalities. In 2001 a slight shift resulted in an average of approximately 47 per cent of skilled workers employed in manufacturing, and by 2011 there was an average of 60 per cent skilled workers across the municipalities. In 2011 the municipality with the lowest share of skilled workers had a level of around 40 per cent.

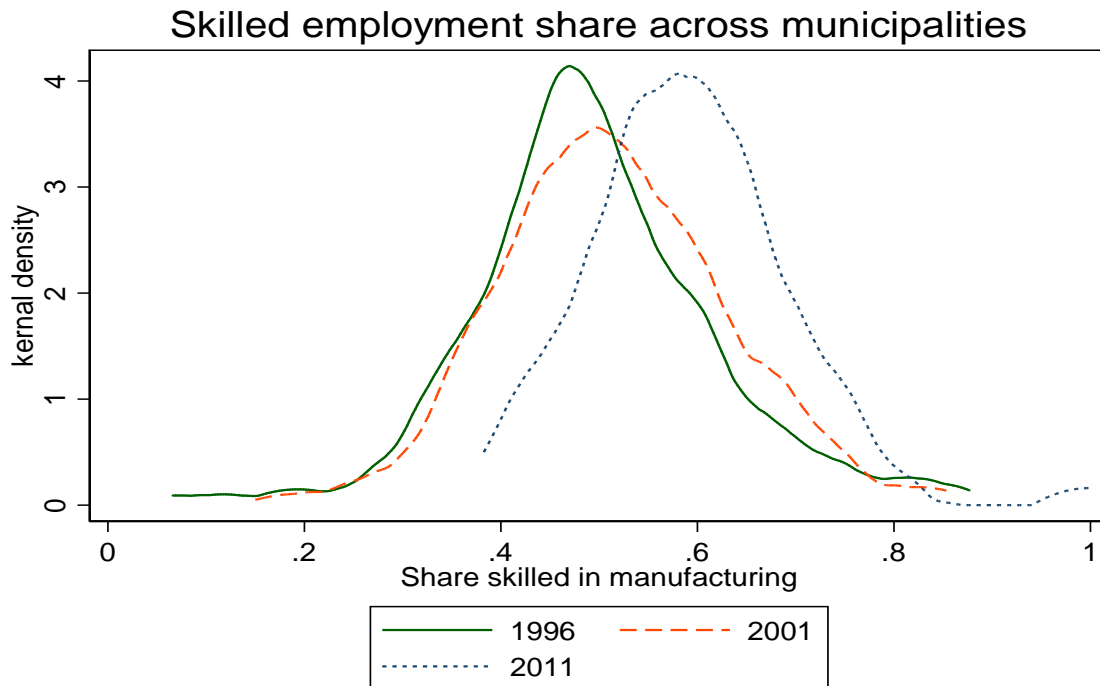


Figure 7: Share composition of employment in manufacturing by skill.

Source: Author’s calculations using Statistics South Africa (2011) data.

6.3. Import exposure

Table 2 provides an overview of South Africa’s manufacturing industry imports. The first section looks at South Africa’s imports by industry from the world. South Africa’s largest imports in the years 1996 to 2011 were in the mining, fuel, petroleum and chemical products; metal products and machinery and transport equipment industry. As South Africa is abundantly endowed with natural resources, it is not surprising to see the agriculture, forestry and fishing and wood product imports having the lowest amounts of import value at 2183 (\$ US mill) and 1839 (\$ US mill) respectively.

The second section looks at South Africa’s imports by industry from China. South Africa was importing 575 (\$ US mill) manufacturing goods from China in 1996, this number almost doubled in 2001 with imports from China at 1060 (\$ US mill); the largest increase was seen with the increase in 2011 where South Africa was importing 14 132 (\$ US mill) manufacturing products from China. The industries with the highest share of South Africa’s imports from China in 1996 and 2001 were textiles, clothing and footwear; fuel, petroleum and chemical products and metal products and machinery. The textiles, clothing and footwear industry in particular grew from 145 (\$ US mill) in 1996 to 2012 (\$ US

mill) in 2011.

The third section presents an alternative way of looking at the imports by taking the share of imports from China imports relative to imports from the world. Overall, the share of South African imports from China grew from approximately 2.4 per cent in 1996 up to 4.5 per cent in 2001 and by 2011, a decade after accession into the WTO; the imports had risen to 14.7 per cent. The largest change was in the textiles; clothing and footwear industries; South Africa was importing only 12.4 per cent of textiles, clothing and footwear from China in 1996 and by 2011, 50.1 of its total textiles, clothing and footwear imports were from China. The electrical machinery and furniture industries rose from 3.1 per cent to 31.9 per cent and 4.1 per cent to 32.8 per cent respectively. There were increases seen in non-metallic products; metal products & machinery; and electronic products which all had low single digit share in 1996 and 2001 and rose to double digits in 2011.

The final section shows the change in the share of South African imports from China. While the textiles, clothing and footwear industry had the largest proportion of overall industry imports in 1996 at 25.2 per cent, it has fallen to 14.9 per cent. This suggests that South Africa has grown its import share in other industries for example metal products & machinery and electrical machinery.

Table 2: Manufacturing industry imports from China

Industry	World (USD mill)			China (USD mill)			Percentage of imports from China			Growth of imports from China		Proportion of imports from China		
	1996	2001	2011	1996	2001	2011	1996	2001	2011	China	Total	1996	2001	2011
Agriculture; Forestry; Fishing	741	381	2183	15	9	109	2.1	2.3	5.0	196.3	108.0	2.7	0.8	0.8
Mining	2355	3416	15 256	9	10	37	0.4	0.3	0.2	142.2	186.9	1.6	1.0	0.3
Food; beverages & tobacco products	1263	923	5516	11	21	199	0.8	2.3	3.6	293.8	147.4	1.8	2.0	1.4
Textiles; clothing & footwear	1171	927	4214	145	228	2112	12.4	24.6	50.1	268.1	128.1	25.2	21.5	14.9
Wood products	869	626	1839	5	8	219	0.6	1.3	11.9	377.5	75.0	0.9	0.7	1.6
Fuel; petroleum & chemical products	4214	4231	19 967	111	215	1965	2.6	5.1	9.8	287.4	155.6	19.3	20.3	13.9
Non-metallic products	412	372	1259	22	26	362	5.4	6.9	28.7	279.6	111.6	3.8	2.4	2.6
Metal products & machinery	7175	5165	20 330	114	258	4718	1.6	5.0	23.2	372.3	104.1	19.8	24.3	33.4
Electrical machinery	2615	2746	8913	80	165	2842	3.1	6.0	31.9	357.2	122.6	13.9	15.6	20.1
Electronic products	889	803	2461	12	26	256	1.4	3.3	10.4	305.7	101.8	2.1	2.5	1.8
Transport equipment	1691	2901	11 312	10	16	455	0.6	0.5	4.0	377.0	190.0	1.8	1.5	3.2
Furniture & recycling	994	912	2616	41	78	858	4.1	8.5	32.8	304.4	96.7	7.1	7.3	6.1
Grand Total	24 389	23 403	95 866	575	1060	14 132	2.4	4.5	14.7	320.2	136.9	100.0	100.0	100.0

Source: Author's calculations using UN Comtrade (2012) data.

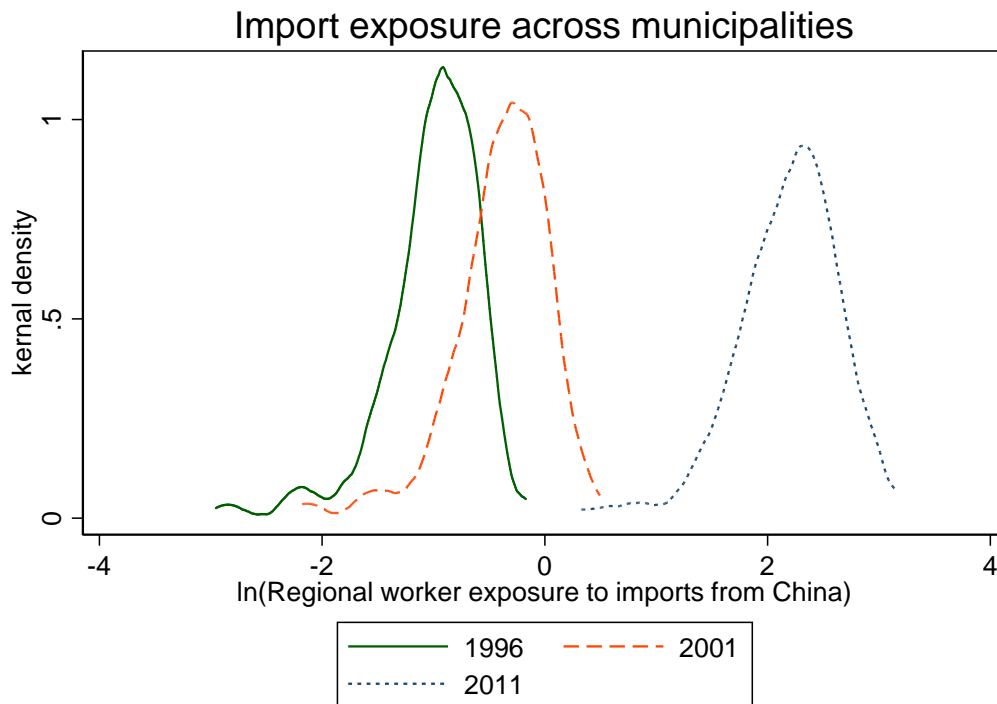


Figure 8: Regional import exposure across municipalities.

Source: Author’s calculations using UN Comtrade (2012) data.

Figure 8 presents a kernel density diagram to assess the regional exposure to imports from China and how this has changed over time. The first observation is that there is indeed a substantial variation in exposure of workers to imports from China across regions. These differences are driven entirely by differences in the industry composition of employment in manufacturing across regions. Over time there is a shift to the right, indicating rising IPW within local municipalities, with the largest shift occurring after the entry of China into the WTO in 2001.

Table 3 shows the median, mean and standard deviation of import exposure facing manufacturing workers in each region. On average each manufacturing worker’s exposure to imports from China increased from 0.39 in 1996 to 0.73 in 2001 and then very dramatically to 9.75 in 2011 (all amounts in US\$ ’000).

Table 3: Summary of IPW (US\$ '000 per worker)

Year	Median	Mean	SD
1996	0.39	0.39	0.14
2001	0.72	0.73	0.27
2011	9.48	9.75	4.09

Source: Author's calculations using UN Comtrade (2012) data.

Table 4 shows the 15 municipalities with the highest Chinese import exposure in 2011 and in 2001, along with the province in which these municipalities are located. The first observation is that there is variation in the provinces with the highest Chinese import exposure. This would support the hypothesis that there are spatial differences between provinces.

Secondly, a majority of the municipalities that had the highest Chinese import exposure in 2001 also had the highest import exposure in 2011. This would suggest that the initial industry concentrated itself within that area and may not have changed much over the period as industry tends to be specific to an area. An example of industry concentration that would remain constant over time is one of the municipalities with the highest level of import exposure in 2011: Emfuleni in Gauteng. This is a single-sector municipality which produces most of the South Africa's steel and has been a part of the steel industry value chain since 1943 (South African Cities Network, 2015).

Table 4: Municipalities with the highest value of import exposure in 2001 and 2011

2001			2011		
Municipality	Province	Import exposure	Municipality	Province	Import exposure
Govan Mbeki	Mpumalanga	0.49	Emalahleni	Mpumalanga	3.15
Metsimaholo	Free State	0.49	Letsemeng	Free State	3.15
Letsemeng	Free State	0.41	Emfuleni	Gauteng	3.08
Emalahleni	Mpumalanga	0.32	Steve Tshwete	Mpumalanga	3.04
Makana	Eastern Cape	0.31	Makana	Eastern Cape	3.01
Mbhashe	Eastern Cape	0.30	Westonaria	Gauteng	3.01
Emfuleni	Gauteng	0.26	Victor Khanye	Mpumalanga	2.94
Victor Khanye	Mpumalanga	0.24	Mbhashe	Eastern Cape	2.92
Steve Tshwete	Mpumalanga	0.22	Fetakgomo	Limpopo	2.90
Westonaria	Gauteng	0.22	Ekurhuleni	Gauteng	2.85
Fetakgomo	Limpopo	0.20	Metsimaholo	Free State	2.83
Nkandla	Kwa-Zulu Natal	0.19	Nkandla	Kwa-Zulu Natal	2.82
Mohokare	Free State	0.18	Mohokare	Free State	2.81
Newcastle	Kwa-Zulu Natal	0.16	Newcastle	Kwa-Zulu Natal	2.80
Ekurhuleni	Gauteng	0.16	Elias Motsoaledi	Limpopo	2.80

Notes: The log of import exposure

Source: Author's calculations using UN Comtrade (2012) data.

A more interesting result is observed in Figure 9, which shows the local municipalities which had the largest overall change in Chinese import exposure between 2001 and 2011. Many of the municipalities with the most change between 2001 and 2011 are based in KwaZulu-Natal province. KwaZulu-Natal is one of the provinces in South Africa which specialises in manufacturing, particularly in textiles, clothing, steel production, food and beverages, fuel, petroleum and automotive manufacturing. A high change in the import exposure measure implies that the manufacturing industry in those municipalities was most adversely affected by Chinese trade.

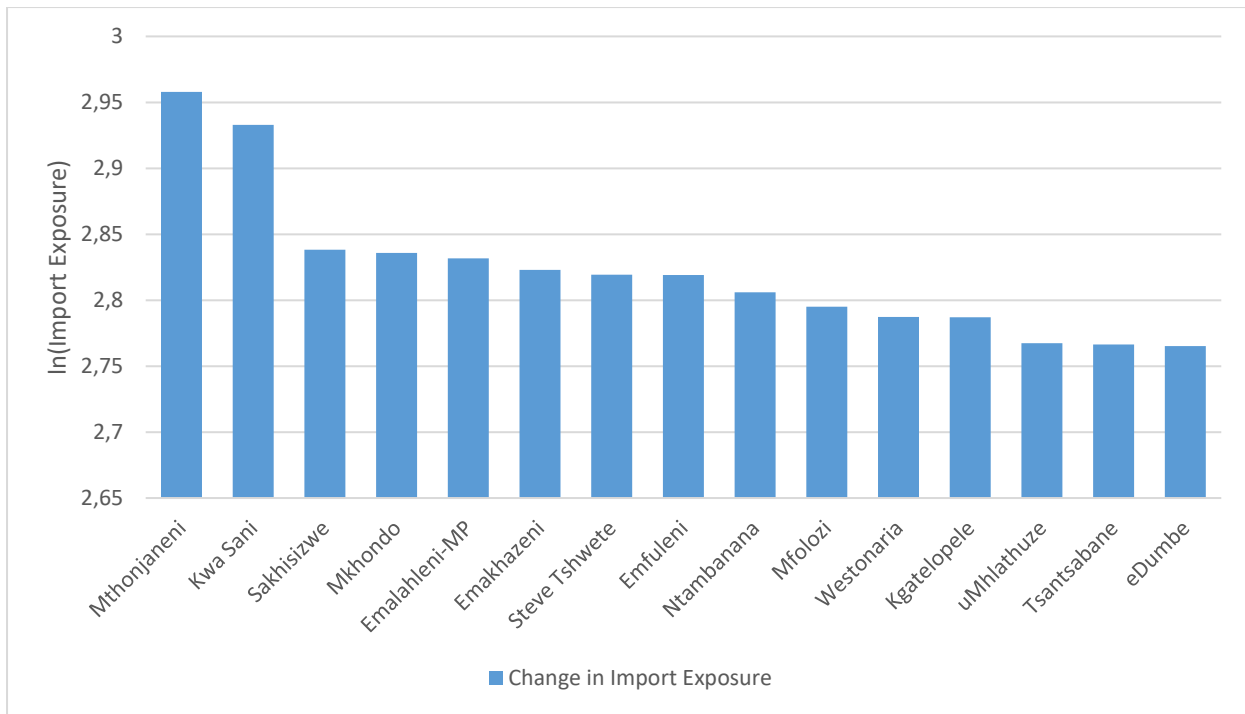


Figure 9: Local municipalities with highest change in levels of log of IPW between 2001 and 2011.

Source: Author’s calculations using UN Comtrade (2012) data

6.4. Gender effects of skill bias

This section extends the analysis to investigate the effect that import competition from China had on the employment of males relative to females, and how these vary by skill. Figure 10 shows the change in the percentage of skilled and unskilled manufacturing employment by gender. For both unskilled males and females, there is a decrease in the share employed within manufacturing from 1996 to 2011. What is interesting in this result is the small increase in share of employed skilled females. The share of skilled males, on the other hand, remained fairly constant between 1996 and 2001 and decreased slightly in 2011.

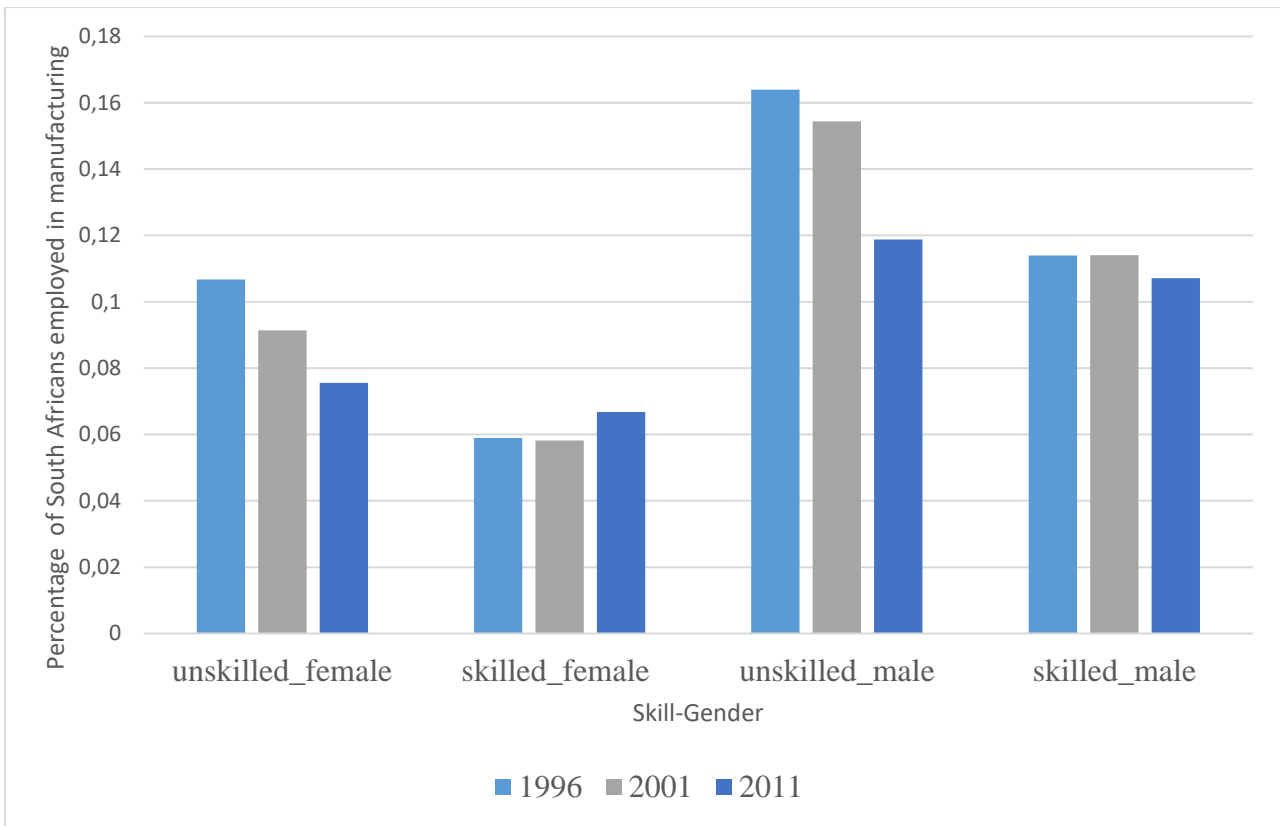


Figure 10: Average share of skilled and unskilled manufacturing employment by gender.

Source: Author's calculations using Statistics South Africa (2011) data.

This would support our above hypothesis that import competition is skill biased and allows us to determine whether the bias affects females or males more. The remainder of this study will be aimed at exploiting the regional variation to identify relationships with regional employment within manufacturing.

7. Results: Effect of import exposure on the skill bias of manufacturing employment at municipal level

This section presents the empirical results for the effect that import exposure had on the skill bias of manufacturing employment at a municipal level. The analysis commences with a basic regression for total manufacturing employment over the period 2001–2011 with and without instrumentation. It then looks at the effects by skill. To test for the robustness of the model, the section presents sets of results over the longer period 1996–2011 and using education- as opposed to occupation-based measures of skill. Thereafter, the analysis is extended to investigate whether the skill bias was also gender biased. The overall results and implications are discussed in the final subsection.

7.1. Regression results

In the previous section, the main concern with assessing the effect of import exposure on the local labour markets was that there could be some endogeneity as a result of omitted variables, which could lead to biased results. For this reason, South African imports from China are instrumented with other low- and middle-income countries' imports from China. To assess the level of bias, Table 5 shows the results with and without instrumentation: in Model 1 import exposure is not instrumented, while in Model 2 the variable is instrumented using Chinese exports to other low- and middle-income countries or emerging economies.

Model 1 in Table 5 shows the ordinary least squares estimation without instrumentation. Looking first at the control variables, most variables are not significant. An exception is that of working age population. As expected, regions with larger working age populations have higher levels of manufacturing employment. The estimates show that a one per cent increase in the working age population is associated with a 1.205 per cent increase in manufacturing employment (significant at a 5 per cent level). The initial share of manufacturing in total employment is also positively correlated with manufacturing employment levels. This variable is significant at the one per cent level with a positive value of 6.136. This is expected, as a municipality with a large share of manufacturing industry initially would employ more workers within that industry and this would result in a higher level of employment within the manufacturing industry in that region. Consequently, a one per cent increase

in the share of manufacturing employment within a region is associated with a 6.136 per cent increase in manufacturing employment.

Turning to the key variable of interest, the coefficient on import exposure is a positive 0.221 and implies that a one per cent increase in Chinese import exposure would increase manufacturing employment in the region by 0.221 per cent, although the coefficient is not significantly different from zero. One potential explanation is endogeneity of imports. Rising imports could reflect relatively strong demand effects in the region that raise both employment and imports. Further, firms may adopt new labour-saving and/or skill-biased technology, offsetting rises in imports from China.

In Model 2, the South African imports from China are instrumented with imports by other low- and middle-income countries from China. The coefficient on the import exposure measure becomes negative, as expected, but remains insignificantly different from zero. The direction of the import exposure variable, however, is consistent with expectations of an upward bias on the estimated coefficient for the non-instrumented variable. The non-significant result is surprising, and contrasts with the aggregate findings by Edwards and Jenkins (2015) and the regional analysis by Autor et al. (2013). One possible explanation is that the results are picking up the combined effect of two offsetting outcomes: a decline in employment of unskilled labour, and a rise in employment of skilled labour as firms adopt new technology in response to increased competition. To assess the skill bias effect, it is necessary to run separate estimations for skilled and unskilled employment in manufacturing as shown in Table 6.

Table 5: Impact of import exposure on the local labour regions (with and without instrumentation)

	(1) Manufacturing employment No Instrumentation	(2) Manufacturing employment Instrumentation
ln(import exposure)	0.221 (0.466)	-0.134 (0.546)
ln(working age)	1.205** (0.468)	1.265*** (0.471)
ln(migration)	-0.818* (0.429)	-0.815* (0.429)
ln(skill rate)	-0.548 (1.710)	-0.310 (1.723)
ln(unemployment rate)	-0.759 (1.284)	-0.672 (1.288)
ln(infrastructure)	-0.00305 (0.0190)	-0.000121 (0.0192)
ln(manufacturing share)	6.136*** (1.143)	6.265*** (1.149)
2001 year dummy	-0.119 (1.226)	-1.012 (1.421)
Constant	-6.297 (5.326)	-6.276 (5.333)
Observations	466	466
R-squared	0.215	
Number of municipalities	234	234

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

Table 6: Impact of import exposure on the local labour regions by skill

	(1) Unskilled	(2) Skilled	(3) Gap
ln(import exposure)	-1.277** (0.613)	0.0122 (0.544)	-1.169*** (0.373)
ln(working age)	0.985* (0.518)	1.289*** (0.468)	-0.0804 (0.316)
ln(migration)	-1.055** (0.473)	-0.880** (0.427)	-0.168 (0.288)
ln(skill rate)	-0.964 (1.887)	0.00282 (1.715)	-0.754 (1.150)
ln(unemployment rate)	1.342 (1.446)	-1.464 (1.282)	1.479* (0.881)
ln(infrastructure)	-0.000413 (0.0211)	0.0124 (0.0191)	-0.0201 (0.0128)
ln(manufacturing share)	5.449*** (1.264)	6.508*** (1.144)	-0.546 (0.770)
2001 year dummy	-4.204*** (1.605)	-0.768 (1.414)	-2.973*** (0.978)
Constant	-1.408 (5.881)	-7.343 (5.307)	3.269 (3.586)
Observations	463	466	463
Number of municipalities	234	234	234

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

To estimate skill bias, three main regression models which assess the effect of import exposure from China on the local regions are presented in Table 6. This table presents three models: Model 1 looks at the level of unskilled manufacturing employment in the local region; Model 2 looks at the level of skilled manufacturing employment; and Model 3 analyses the effect of import competition on the employment gap between unskilled and skilled (measured as the log ratio of unskilled to skilled employment). The import exposure measure is instrumented in all results presented.

The results provide evidence of a strong skill bias in the employment effects of competition from China. Model 1 in Table 6 shows a negative sign for β_1 that suggests that an increase in import exposure from China decreases the level of unskilled manufacturing employment. The coefficient is significant at the 5% level and indicates that a 1 per cent rise in IPW is associated with a 1.277 per cent decline in employment of workers in low skilled occupations. This is an economically significant relationship, given that workers' exposure to Chinese goods rose by over 250 log points during this period.

Model 2 considers employment for the skilled manufacturing workers. The coefficient on import exposure is not significant and is close to zero. To assess whether workers' exposure to imports from China affected the skill composition of employment, Model 3 regresses the log ratio of unskilled to skilled workers in each local region on the Chinese import exposure measure. The coefficient is negative and significant at the 1 per cent level. The results imply that a one per cent increase in worker exposure to imports from China is associated with a 1.169 per cent decrease in employment of unskilled relative to the skilled workers in manufacturing.

7.2. Checks for robustness

The results of the previous section suggest that import competition from China raised the skill composition of employment in the South African manufacturing sector. To test the robustness of the results two additional sets of models are estimated. The first set analyses the increase the sample size to include data for the year 1996, and second uses skill measured by education attainment. The data from 1996 are a particularly interesting dimension as they capture the effect of import exposure for the period shortly after South Africa gained independence yet prior to strengthening of the trade partnership between China, and China's accession into the WTO.

7.2.1. Including data from 1996

In the following set of models in Table 7, the sample size is increased by including data from the 1996 South African Population Census, which adds a third wave of data to our study. Table 7 has four different models: Model 1 looks at the overall level of manufacturing employment within a local region; Model 2 looks at the level of unskilled manufacturing employment in a local region; Model 3 looks at the level of skilled manufacturing employment in a local region; and Model 4 looks at the gap between the skilled and unskilled manufacturing employment.

Model 1 shows the total level of manufacturing employment within a local region. This model shows that import exposure has a negative impact on manufacturing employment; although this is not significant, this suggests that a one per cent increase in import exposure would lead to a 0.273 per cent decrease in overall manufacturing employment within that region.

The controls for working age population, movement into a region and share of manufacturing are all significant at a one per cent level. The working age population has a positive effect on the manufacturing employment, this can be interpreted as a one per cent increase in the working age population would lead to a 1.253 per cent increase in the level of manufacturing employment. Likewise, a one per cent increase in the share of manufacturing industry within a region would increase the level of manufacturing employment by 6.122 per cent. Moving into a region is found to have an unexpected sign as it shows a negative impact on the manufacturing employment. For every one per cent increase in workers in a region, manufacturing employment decreases by 0.637 per cent. The rest of the controls, working age skill rate, unemployment rate and infrastructure, and the dummy variables are non-significant.

Model 2 shows the level of unskilled manufacturing employment; this can be interpreted as a one percent increase in import exposure will result in a 1.084 per cent decrease in the employment levels of unskilled manufacturing. This is significant at a 5 per cent level and supports our hypothesis of the impact of import exposure on unskilled manufacturing employment. Model 3 shows the level of skilled manufacturing employment. While the sign on the coefficient for import exposure is expected to be positive, it is a small negative, although non-significant. This implies that a one percent increase in import exposure leads to a 0.364 per cent decrease in skilled manufacturing employment level. This is contrary to the previous models, which had a positive coefficient. A potential reason for this is the

expansion of the data set to include 1996, which is prior to China's accession into the WTO.

Model 4 presents the skills bias of manufacturing employment, and the main variable of interest is significant at the 10 per cent level. This strongly suggests that there is a skill bias as a result of Chinese import exposure and can be interpreted as a 1 per cent increase in import exposure will result in a 0.676 per cent decrease in the skill gap of manufacturing employment within a region.

The primary result is that the findings for the 2001–2011 period hold, but the coefficients are smaller. Rising exposure to imports from China is still associated with a decline in employment of less-skilled employment in total and relative to skilled labour. There is no significant effect on total employment and skilled labour. Overall the results do not support the argument that imports from China have reduced manufacturing employment. However, the results do suggest that the effects of import competition from China have been felt very differently across the skilled and the unskilled, with the latter experiencing declining employment.

Table 7: Impact of import exposure on the local labour regions (including 1996)

	(1)	(2)	(3)	(4)
	Overall	Unskilled	Skilled	Gap
ln(import exposure)	-0.273 (0.379)	-1.084** (0.451)	-0.364 (0.404)	-0.676* (0.366)
ln(working age)	1.253*** (0.171)	1.212*** (0.206)	1.078*** (0.183)	0.347** (0.167)
ln(migration)	-0.637** (0.286)	-0.784** (0.334)	-0.681** (0.305)	-0.0640 (0.271)
ln(skill rate)	1.086 (0.966)	0.0533 (1.124)	2.312** (1.030)	-2.010** (0.912)
ln(unemployment rate)	-0.0609 (0.674)	1.215 (0.796)	-0.384 (0.719)	0.808 (0.646)
ln(infrastructure)	-0.0113 (0.0122)	-0.0173 (0.0142)	-0.00112 (0.0130)	-0.0184 (0.0115)
ln(manufacturing share)	6.122*** (0.587)	5.441*** (0.682)	6.583*** (0.625)	-0.882 (0.553)
2001 year dummy	0.305 (0.233)	0.778*** (0.278)	0.395 (0.248)	0.355 (0.226)
	1.440 (1.199)	4.128*** (1.436)	1.855 (1.278)	2.000* (1.165)
2011 year dummy				
Constant	-7.905*** (1.971)	-8.979*** (2.359)	-7.023*** (2.101)	-4.149** (1.913)
Observations	700	697	700	697
Number of municipalities	234	234	234	234

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

7.2.2. Educational attainment as a measure of skill

The previous models estimated the skill bias of manufacturing employment using occupation as a measure of skill. The next set of models estimates skill by educational attainment. In this section, unskilled workers refers to those who have less than a matric education, while the skilled are those who have a higher than matric education. Table 8 presents the impact of IPW on the levels of skilled and unskilled manufacturing employment in Models 1 and 2 respectively, and the skill gap of manufacturing employment using educational attainment as a measure of skill in Model 3 for 2001–2011.

The initial observation from the set of Models using educational attainment over the period 2001–2011 is that none of the values for the main variable of interest β_1 , are significant. Therefore, it can be concluded that educational attainment would not fare well as a measure of skill.

For Model 1, while a positive sign for the import exposure measure β_1 is expected for both the skilled and the unskilled manufacturing workers, these were not significant. This implies that an increase in import exposure from China would increase the level of unskilled and skilled manufacturing employment. A one per cent increase in IPW would increase the level of employment by 0.316 per cent and 0.368 per cent for the unskilled and skilled respectively. This is potentially as a result of the classification of skilled and unskilled using educational attainment. The cut-off point for unskilled workers in this study was Grade 12 or matric equivalent. The bulk of workers in South Africa have a matric equivalent and placing these workers as skilled would skew the results.

Finally, Model 3 considers the skill gap by educational attainment. The measure of import exposure in this model is non-significant. Overall this would imply that Chinese import exposure decreased the unskilled / skilled gap by 0.0798 per cent.

Table 8: Impact of import exposure on the local labour regions (educational attainment)

	2001–2011			1996–2011			
	Unskilled	Skilled	Gap	Overall	Unskilled	Skilled	Gap
ln(import exposure)	0.316 (0.229)	0.368 (0.297)	-0.0798 (0.328)	0.310* (0.174)	0.363* (0.197)	-0.117 (0.261)	0.465* (0.275)
ln(working age)	0.500** (0.197)	0.482* (0.255)	-0.00535 (0.282)	1.075*** (0.0786)	1.006*** (0.0921)	0.961*** (0.118)	0.0197 (0.129)
ln(migration)	0.0769 (0.180)	0.761*** (0.233)	-0.693*** (0.257)	0.290** (0.131)	0.304** (0.149)	0.938*** (0.197)	-0.642*** (0.208)
ln(skill rate)	-2.853*** (0.720)	3.379*** (0.935)	-6.232*** (1.030)	-0.197 (0.443)	-2.504*** (0.501)	3.871*** (0.666)	-6.363*** (0.701)
ln(unemployment rate)	0.274 (0.546)	1.662** (0.699)	-1.261 (0.781)	0.397 (0.309)	0.359 (0.355)	0.781* (0.465)	-0.355 (0.497)
ln(infrastructure)	-0.00279 (0.00804)	0.00708 (0.0104)	-0.00894 (0.0115)	-0.00327 (0.00560)	-0.00409 (0.00634)	0.00121 (0.00843)	-0.00507 (0.00886)
ln(manufacturing share)	8.782*** (0.481)	8.075*** (0.624)	0.665 (0.688)	8.491*** (0.269)	8.775*** (0.305)	8.200*** (0.405)	0.556 (0.426)
2001 year dummy	0.206 (0.598)	0.790 (0.771)	-0.676 (0.855)	-0.297*** (0.107)	-0.311** (0.121)	0.0719 (0.161)	-0.373** (0.169)
2011 year dummy				-0.831 (0.549)	-0.891 (0.623)	0.230 (0.827)	-1.059 (0.871)
Constant	0.359 (2.241)	-2.575 (2.894)	3.244 (3.206)	-5.602*** (0.903)	-4.760*** (1.051)	-7.229*** (1.360)	2.713* (1.469)
Observations	465	466	465	700	699	700	699
No. of municipalities	234	234	234	234	234	234	234

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

The final set of regressions looks at is the effect of import exposure on the local labour regions using education as a measure of skill and including 1996. Four models are considered: Model 1 looks at the overall level of manufacturing employment in a local region; Model 2 at the level of unskilled manufacturing employment in a local region; Model 3 at the level of skilled manufacturing employment in a local region; and Model 4 at the gap between skilled and unskilled manufacturing employment.

Considering the period 1996–2011, increasing the sample size by including the year 1996 had some weak significance for the Chinese import exposure measure. The sign of Model 1 is negative 0.0386, which would suggest that a one per cent increase in import exposure would decrease overall manufacturing employment within the region by 0.0386 per cent. However, the unskilled and skilled manufacturing employment coefficients are both positive – although a one per cent increase in import exposure would increase the unskilled manufacturing by 0.283 per cent and the skilled by only 0.122 per cent. This in itself does suggest that there is some skill bias; however, it is not a significant result. The skill gap measure has a negative sign, which suggests that the import exposure would decrease the unskilled / skilled gap, which favours skilled employment – although this too is not significant. Based on the above results, it can be concluded that educational attainment is not a good measure of skill as it yields non-significant results.

Possible reasons why educational attainment as a skill measure wasn't significant could be similar to those found in the Borat et al. (2001) study, where those with only primary or incomplete secondary education faced more job losses than those who completed matric or had tertiary education. Dias and Posel (2007) also investigated the role of education in affecting the probability of finding employment and found that while being educated does better one's chances of gaining employment, a discontinuity exists at matric education. This is because education serves more as a signaling device for the prospective employer than an indication of productivity.

The above analysis shows that there are no significant associations (at 5% or below) between import exposure and employment defined according to educational categories. There is some suggestion that import competition could actually have raised employment of the unskilled over the full 1996–2011 period. Thus, Chinese import competition has revealed itself through its impact on low-skill, production worker occupational categories.

7.3. Further analysis

This section investigates whether the skill bias had any gender effects using the data from 1996 to 2011.

7.3.1. Gender effects

The results in Table 9 below suggest that import competition led to reductions in both skilled and unskilled females, while for men, only unskilled men are adversely affected. The import exposure measure is strongly significant for the skilled and unskilled females. A one per cent increase in Import exposure will cause a 1.850 per cent decrease in unskilled manufacturing employment and 1.357 per cent decrease in skilled manufacturing employment. This is significant at the 1 per cent level. For men, one per cent increase in import exposure will cause a 1.368 per cent decrease in unskilled manufacturing employment. This too was significant at a 1 per cent level. The result for the skilled males was not significant.

The result is most likely a result of the manufacturing industries that males and females find themselves in. Females tend to be employed intensively within the clothing and textile industry, which faced more intense competition from imports from China than most other sectors.

Table 9: Impact of import exposure on the local labour regions (gender)

	Female		Male	
	Unskilled	Skilled	Unskilled	Skilled
ln(import exposure)	-1.850*** (0.689)	-1.357** (0.537)	-1.368*** (0.469)	-0.0773 (0.459)
ln(working age)	1.225*** (0.320)	1.071*** (0.234)	1.254*** (0.214)	0.783*** (0.215)
ln(migration)	-1.721*** (0.520)	-1.073*** (0.390)	-0.543 (0.347)	-0.628* (0.347)
ln(skill rate)	-0.544 (1.742)	3.542*** (1.314)	0.577 (1.169)	1.435 (1.170)
ln(unemployment rate)	2.178* (1.244)	-0.124 (0.921)	0.895 (0.828)	0.118 (0.829)
ln(infrastructure)	-0.0270 (0.0226)	0.00561 (0.0171)	-0.0183 (0.0147)	-0.0115 (0.0148)
ln(manufacturing share)	5.602*** (1.052)	6.168*** (0.809)	5.622*** (0.709)	6.369*** (0.712)
2001 year dummy	1.242*** (0.428)	1.019*** (0.332)	0.930*** (0.289)	0.229 (0.282)
Constant	7.519*** (2.199)	5.112*** (1.710)	4.758*** (1.493)	1.151 (1.455)
Constant	-11.39*** (3.658)	-9.146*** (2.700)	-10.14*** (2.452)	-3.987 (2.453)
Observations	687	693	697	699
Number of municipalities	234	234	234	234

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

Conclusion

This paper sought to estimate empirically the impact that the increase in manufacturing imports from China had on the employment of manufacturing workers in the local municipalities of South Africa, and how this differed by skill levels. Since China joined the World Trade Organisation and diplomatic ties between South Africa and China strengthened, there has been an increase in imports from China. This increase coincided with a period of declining manufacturing employment, a relationship which had been established in previous literature including Edwards and Jenkins (2014).

While previous literature investigated the relationship between Chinese import competition and manufacturing employment, this study investigated the effects at a local labour market level. Using insights from the Heckscher Ohlin Stolper-Samuelson model (Heckscher et al., 1991) and the specific factors models, the hypothesis would be that Chinese import competition does not affect all workers the same; the models predict that unskilled workers are more adversely affected than skilled workers.

The paper uses the import exposure measure derived from Autor et al. (2013) to exploit the variation in industry composition of employment at the regional level. The analysis made use of the 1996, 2001 and 2011 Population Census data with regions defined at the local municipality level. To control for potential endogeneity of imports from China, Chinese exports to low- and other middle-income countries are used as instrument variables.

Contrary to previous literature, including aggregate studies in South Africa, this study finds no significant effect on aggregate employment in manufacturing. The reason for this is that imports from China have differential effects on employment according to skills. For low-skilled workers imports exposure led to job losses, but for high-skilled workers the effect was zero, or even potentially positive. A potential explanation for the latter is that in the face of import competition firms may have adopted skill-biased technology. The effect of import competition was stronger when skill bias by gender is considered, where import competition resulted in reductions in both skilled and unskilled females, while only unskilled men are affected.

The implications of the findings play a key role in policy making in South Africa's manufacturing sector to bring about growth both in production and employment statistics. For as long as South Africa continues to increase imports from China, the unskilled workers in the manufacturing industry, more especially labour-intensive sectors such as textiles, clothing, and footwear will continue to suffer from a loss of employment. The same is not true for skilled workers who tend to hold managerial posts and are less likely to suffer from Chinese import competition. It would be recommended that South Africa upskill as the manufacturing industry is moving towards a skill biased technological change and to continue to compete in the global markets would need to automate processes within manufacturing.

The current study is limited to panel data of employment in South African municipalities between 1996 and 2011 as studies variables relating to employment, gender and education levels. The effects that Chinese import competition has on wages of workers within manufacturing industry have not been investigated. Future research could include wages as well as prices of manufactured goods in South Africa. Further research could also extend this study to the include years beyond 2011 in order to understand the full scope and impact that Chinese import competition has had on South Africa's manufacturing industry.

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