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by
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Abstract

The rapid growth in imports from China over the past decade is seen as a key factor contributing towards the relatively slow growth in output and the decline in employment in South African manufacturing during this period. Yet the effects of Chinese trade may be complex and differentiated across sectors. To account for these differential effects, this analysis draws on a database of 44 manufacturing industries covering the period 1992-2010. Two approaches – a Chenery-type decomposition and econometric estimation – are used to evaluate the impact of Chinese trade on prices, production and employment in South African manufacturing. Chinese penetration of the South African market is shown to have increased rapidly over the past decade, in part due to displacement of imports from other countries, but more importantly at the expense of local production. Exports of manufactures to China did not add significantly to industrial growth in South Africa, whereas labour-intensive industries were particularly badly affected by Chinese imports implying that the negative impact on employment was more than proportional to the output displacement. However, we also find evidence that Chinese imports contributed towards lower producer price inflation in South Africa, which in turn will have moderated increases in consumer prices and helped to curtail production cost increases.

1. Introduction

The lack of dynamism of the manufacturing sector has been seen as a key factor explaining slow growth and high unemployment levels in South Africa since the ending of apartheid (Rodrik, 2008, DTI, 2010). Concerns have been expressed over the "deindustralization" of the economy (Maia, 2011) reflected in falling shares of manufacturing in GDP and employment. Although these trends have characterised the entire post-apartheid period, over the past decade they have coincided with the rapid growth of imports from China. This paper asks how trade with China in this period has affected the size and structure of South African manufacturing and its capacity to create jobs.

Since China joined the WTO in 2001, bilateral trade between South Africa and China has grown rapidly. In 2009, China became South Africa' s largest export market ahead of the United States and its largest supplier of imports ahead of Germany.[1] These imports are overwhelmingly of manufactured goods while South Africa's exports are mainly natural resources. The growth and composition of bilateral trade flows with China have fed concerns about deindustrialization of the economy, which has become a focus point of South Africa's engagement with China. This was highlighted by President Zuma's comment at the Forum on China-Africa Cooperation (FOCAC) in Beijing in July 2012 that an unequal trade relationship based on the supply of raw materials was unsustainable (*Mail and Guardian,* 19/7/12).

The common perception in South Africa is that the effects of the growth of trade with China has been negative for manufacturing, with several industries, most notably textiles and clothing, demanding increased protection from Chinese imports (Morris and Einhorn, 2008). The Free Trade Agreement between the South African Customs Union (SACU) and China first mooted in 2004, faced considerable opposition by business associations (SAIIA, 2005) and unions (Business Day, 3/11/2005) within South Africa. The current position of the Minister of Trade and Industry, Rob Davies, is that a conventional free trade agreement with China is not in the interest of the country (Business Day, 07/07/2010).

Despite this there have been no comprehensive studies which attempt to analyse the impacts of trade with China on the South African manufacturing sector. The growing relationship between South Africa and China is contributing to changes in the structure of the South African economy. This has implications for the growth and composition of manufacturing output and employment which this paper analyses. These effects may be complex and differentiated. To account for differential effects across sectors, this analysis draws on a database of 44 manufacturing industries covering the period 1992-2010 (see the Data Appendix for details)

The remainder of the paper is structured as follows. The next section outlines a framework for analysing the impact of the growth of China on the South African industrial sector and briefly introduces the methods that are used in the paper to estimate the impacts of trade with China on production and employment. Section 3 then describes the evolution of Chinese-South African trade flows at the product and industry level. Section 4

[1] DTI Economic Database at: http://www.dti.gov.za/econdb/raportt/rapcoun.html.

analyses the impact of trade with China on South African manufacturing production, while Section 5 looks at the impact on employment. Section 6 concludes.

2. A Framework for Analysing the Impact of China on Manufacturing

In analysing the impact of China on other developing countries a framework, presented in Table 1, has been developed which identifies direct and indirect effects and competitive and complementary effects (Jenkins and Edwards, 2006; Kaplinsky et al., 2006). Direct effects are associated with bilateral trade whereas indirect effects arise from China's global economic impact. Competitive effects occur when Chinese products are close substitutes for those produced by other developing countries, whereas complementary effects arise where the products concerned are complements.

Table 1: Examples of the Impact of Chinese Trade on Other Countries

	Competitive	Complementary
Direct	Chinese imports displacing domestic producers	Exports to China Imports of parts from China
Indirect	Loss of market share to China in third markets	Involvement in Global Production Networks with China

Much of the literature on the impact of China on other developing countries has focussed on the implications for exports to third markets, in other words on the indirect effects of China's growth. This has mainly been applied to Asia and Latin America where these effects are most significant (Santiso, 2007; Lall and Albaladejo, 2004; Lall and Weiss, 2005; Jenkins, 2010; Hanson and Robertson, 2009; Freund and Ozden, 2009; Gallagher et. al., 2008; Athukorala, 2009). The issue has received much less attention in Africa where exports of manufactures are less developed and Chinese competition is not regarded as such a threat.[2]

Although the threats and opportunities associated with bilateral trade with China receives considerable media attention, there have been far fewer academic studies which have analysed the direct impacts of Chinese trade on other countries and particularly the impacts on the manufacturing sector. Critics stress the negative effects of Chinese competition displacing local manufacturers (who are often the loudest voices calling for protection from "unfair" competition from China), while advocates of increased trade with China point to the gains not only to consumers from low cost Chinese products, but also to producers whose competitiveness is increased by access to cheaper inputs and capital equipment.

[2] Among the few exceptions to this generalization are Kaplinsky and Morris (2008) and Giovannetti and Sanfilippo, (2009).

There are no detailed studies of the impact of China on South African manufacturing. There are however a number of previous studies of South African manufacturing which have looked at the impact of trade liberalization or globalization more generally on production, trade and employment (Edwards, 2001a, 2001b, 2006; Dunne and Edwards, 2007 and Jenkins, 2008). These papers have used two approaches to analyse the impacts of increased import penetration on South African industry. The first approach involves using a Chenery-type decomposition of changes in local production between changes in domestic demand, imports and exports in order to estimate the effect of trade on the manufacturing sector. Employment coefficients at the industry level are then used to estimate the effects on jobs. The second approach involves econometric estimation of the impact of trade on production, productivity and employment (Jonsson and Subramanian, 2001; Fedderke, 2006)

Both these approaches can be extended to identify the effects of increased trade with China. In the case of the decomposition approach this involves separating out imports from China and the rest of the world and calculating the extent to which the growth of Chinese imports has reduced the market share of imports from other countries or that of local producers. With the econometric approach, again the impact of China can be estimated by constructing a separate variable for Chinese import penetration and that of the rest of the world.[3] Further elaboration of these two approaches is provided in the Appendix.

This paper is concerned only with the direct impacts of trade with China on South African manufacturing. A parallel study looks at the indirect effects of China on South African manufactured exports (Edwards and Jenkins, 2012). The next section therefore describes the main features of the growing bilateral trade relationship between the two countries.

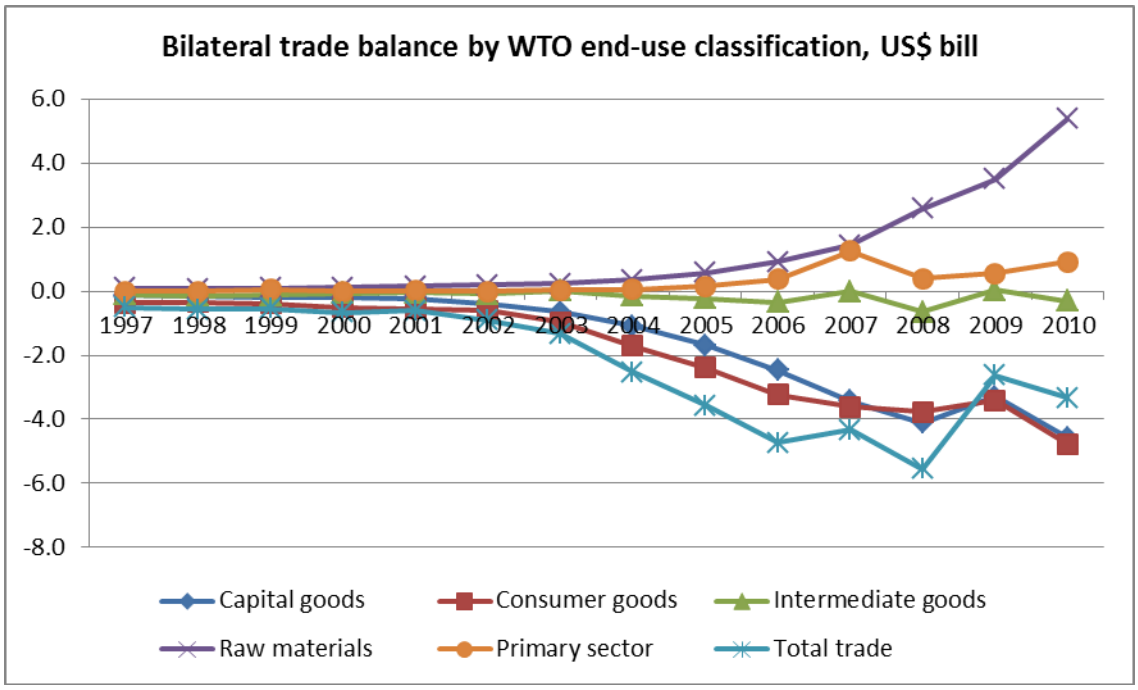
3. Chinese-South Africa Trade Flows

3.1 Growth and Structure of Chinese-South Africa Trade

Trade between South Africa and China has grown dramatically since China joined the WTO in 2001. South African imports from China increased from less than $1.1 billion in 2001 to $14.2 billion in 2011, while exports to China increased from less than $0.5 billion to $12.4 billion over the same period (UN Comtrade). Throughout the period, South Africa has run a trade deficit with China which tended to increase over time, as shown in Figure 1.

[3] A similar approach was used by Greenaway et. al. (1999) in a study of the UK and Castro et. al. (2009) for Argentina.

Figure 1: South Africa's Trade Balance with China



Source: own elaboration from UN Comtrade data. Categorization determined by World Trade Organization based classification system.

Although trade between South Africa and China is mainly in manufactured goods, broadly defined, South African exports are largely processed raw materials, whereas imports from China are mainly consumer products and increasingly capital goods (Table 2). This is reflected in the trade balances between the two countries with South African having surpluses in processed raw materials and primary products and large deficits in consumer and capital goods (Figure 1).

Table 2: South African Trade with China by Type of Product

	Exports		Imports	
	2000	**2010**	**2000**	**2010**
Primary	11%	15%	4%	3%
Manufacturing	89%	85%	96%	97%
Manufacturing by WTO Classification				
Capital goods	11%	2%	25%	42%
Consumer goods	2%	1%	55%	43%
Intermediate goods	45%	19%	20%	15%
Raw materials	41%	78%	0%	0%

Source: own elaboration from UN Comtrade data.

3.2 Product and Industry Analysis of South African Imports from China

Over the 15 year period from 1995 to 2010, China rose from South Africa's 10th largest import partner for manufactured goods with a share of 2.0 percent to its dominant source of imports with a share of 18.5 percent by 2010 ahead of Germany, the United States of America and Japan (UN Comtrade).

The growing Chinese presence in South Africa's total imports is also reflected in the scope and dominance of imports from China in specific products and manufacturing industries. Much of the growth in imports from China has been driven by the importation of new products (extensive margin). For example, the number of HS6-digit manufactured products imported from China more than doubled from 1995 (1 679 products) to 2010 (3 492 products).

China has also become the dominant supplier of many of these products. In 1995, China was the top source of imports for 203 HS 6-digit products, or 4.7 percent of all imported products. This rose to 528 in 2000 (12.2 percent of all imported product) and then close to tripled over the next 10 years to 1 423 products (35 percent of all imported products) in 2010. Germany, which initially dominated the number of top ranking products, is now distant second with only 525 top ranking products imported.

Similar trends are found in manufacturing industries classified at the 3-digit Standardized Industrial Classification level. Table 3 presents the country ranking of China as a source of imports and the share of China in total imports by manufacturing sector. In 1995, China was the principal source of imports in just three of the 45 manufacturing industries (clothing, footwear and other manufactures (toys)) (Table 3). By 2010, China was ranked as the principal source of imports to South Africa in 27 of the 45 manufacturing industries. In sectors including Knitted and Crocheted fabrics, Clothing, Leather and leather products, Footwear, Household appliances, Electrical lamps, Furniture and Other manufacturing, China made up between 48 percent and 77 percent of total South African imports of those products.

Table 3: China's ranking as a source of imports by sector and share of Chinese imports in total imports

		Country ranking of China as source of imports by sector				Share Chinese imports in total SA imports			
SIC		1995	2000	2005	2010	1995	2000	2005	2010
301	Meat, fish, fruit, vegetables, oils & fa	20	6	7	8	0.8	4.1	3.2	4.3
302	Dairy products	23	34	15	18	0.0	0.0	1.3	0.8
303	Grain milling & animal feeds	30	20	7	4	0.0	0.2	1.8	4.1
304	Other food products	36	28	19	11	0.2	0.5	1.8	3.9
305	Beverages	49	25	31	17	0.0	0.1	0.1	0.2
306	Tobacco	15	2	14	2	0.0	17.2	0.8	14.9
311	Spinning and weaving	3	2	1	1	6.4	10.1	36.9	43.5
312	Other textiles	6	1	1	1	4.8	12.1	25.0	38.2
313	Knitted ans crocheted fabrics	5	1	1	1	5.4	13.7	55.5	66.7
314/5	Clothing	1	1	1	1	29.0	51.9	74.2	75.1
316	Leather and leather products	4	1	1	1	10.2	17.7	38.4	49.0
317	Footwear	1	1	1	1	35.5	40.6	73.4	76.8
321	Sawmilling and planing of wood	41		9	4	0.0	0.0	1.9	5.8
322	Wood and wood products	9	5	1	1	3.1	5.2	13.2	24.6
323	Paper and paper products	29	25	16	3	0.2	0.4	1.9	8.6
324	Publishing	16	14	6	6	0.5	0.9	2.7	5.7
325/6	Printing and related services	6	2	1	1	5.7	10.2	19.4	43.0
331/2/3	Coke oven and petroleum products	4	4	8	11	11.7	10.6	4.1	2.8
334	Basic chemicals	13	8	6	1	1.4	3.5	5.9	12.6
335/6	Other chemicals	15	11	9	4	0.8	1.7	3.6	7.2
337	Rubber products	19	10	3	1	0.5	2.5	11.0	23.1
338	Plastic products	9	5	2	1	3.0	7.7	15.4	22.3
341	Glass and glass products	10	5	1	1	3.1	6.7	20.5	38.6
342	Non-metallic mineral products	8	6	1	1	5.1	7.3	15.4	25.0
351	Basic iron and steel	19	11	4	1	0.9	3.6	7.7	16.4
352	Non-ferrous metals	12	9	5	3	1.4	2.3	4.9	9.4
354	Structural steel products	21	13	8	3	0.4	1.5	4.5	13.4
355	Other fabricated metal products	6	4	1	1	4.3	9.9	22.4	32.2
356/59	General purpose machinery	15	6	1	1	1.1	5.1	16.9	23.8
357	Special purpose machinery	13	12	6	1	1.0	1.5	5.4	17.8
358	Household appliances	2	2	1	1	13.7	17.8	42.2	62.6
361	Electrical motors, generators and transf	13	6	1	1	1.2	6.2	16.3	23.4
362	Electricity distribution and control ap	21	10	5	2	0.5	1.8	5.5	12.8
363	Insulated wire and cable	17	9	1	1	1.1	4.2	13.8	24.1
364	Accumulators and batteries	12	5	1	1	1.7	5.9	22.4	28.0
365	Electric lamps and lighting equipment	2	1	1	1	9.4	21.1	47.9	59.9
366	Other electrical equipment	17	6	3	1	0.5	3.2	9.5	18.8
371/2/3	Television, radio and other electronic e	11	9	1	1	2.2	3.9	15.8	33.5
374/5/6	Medical appliances, measuring and contro	18	10	7	3	0.9	2.8	5.2	9.6
381	Motor vehicles	25	28	18	8	0.0	0.0	0.6	3.0
382	Bodies for motor vehicles	6	19	2	1	1.4	0.7	12.5	32.6
383	Parts and accessories for motor vehicles	25	16	4	4	0.1	0.8	5.3	8.6
384/5/6/7	Other transport equipment	11	8	8	7	1.2	1.1	1.9	3.8
391	Furniture	7	4	1	1	2.4	6.1	27.8	48.1
392	Other manufacturing	1	1	1	1	14.5	21.3	34.5	48.7
	Total Manufacturing	10	6	2	1	2.0	4.9	11.7	18.5

Source: Authors' calculations using UN Comtrade

The breadth of Chinese dominance is remarkable. In the mid-1990s, China dominated the traditional labour-intensive sectors, but by 2010 its dominance had also shifted to high-technology electronic and machinery sectors. It is only in the resource-based products (dairy products, other food products and beverages) that China remains outside of the top 10 sources of imports, but even in these industries China's ranking improved dramatically.

The extent of the impact of imports from China across manufacturing industries is also reflected in the rising share of these goods in domestic consumption (termed import penetration). Table 4 reports the share of Chinese imports in domestic consumption for 44 manufacturing industries[4] in 1995, 2000, 2005 and 2010. In aggregate, imports from China rose from a negligible 0.4% of domestic consumption in 1995 to 5.9% in 2010 with much of the increase occurring after 2000. Indeed during the past decade, China has accounted for over three quarters of the increase in import penetration in the South African market.

Looking across the sectors, all manufacturing industries in South Africa experienced increases in Chinese import penetration ratios between 1995 and 2010. There were, however, significant differences across industries in the level and change in import penetration by China over this period. The level and change in import penetration from China were smallest (less than 1 percentage point from 1995 to 2010) in agricultural and resource-based products (beverages; dairy products; other food products; printing and related services; grain milling and animal feeds; coke oven and petroleum products; meat, fish, fruit, vegetables, oils and fat; and sawmilling and planing of wood).

In contrast, large increases in the share of China in domestic consumption were recorded in the knitted and crocheted fabrics (42.8 percentage points); footwear (40.1 percentage points); television, radio and other electronic equipment (30.3 percentage points); electric lamps and lighting equipment (27.5 percentage points); clothing (27.2 percentage points); and general purpose machinery (22.1 percentage points) industries.

It is these strong increases, particularly in the labour intensive industries, that have given rise to major concerns amongst domestic manufacturers, and in the case of clothing products elicited the imposition of import quotas on Chinese imports in 2007 and 2008 (Morris and Reed, 2008; Edwards and Rankin, 2012; Edwards et al., 2011). Were it not for these quotas, the level and increase in import penetration in clothing may have been even higher.

[4] Statistics SA does not publish production data for the tobacco industry so that this has been dropped from the original 45 industries.

Table 4: South African Import Penetration from China, 1995-2010

		Import penetration from China (annual percentage)			
SIC	**Industry description**	**1995**	**2000**	**2005**	**2010**
301	Meat, fish, fruit, vegetables, oils & fat	0.13	0.61	0.50	0.87
302	Dairy products	0.00	0.00	0.05	0.03
303	Grain milling & animal feeds	0.00	0.01	0.15	0.42
304	Other food products	0.00	0.02	0.11	0.29
305	Beverages	0.00	0.01	0.00	0.01
311	Spinning and weaving	1.41	2.84	12.31	18.15
312	Other textiles	0.51	1.68	4.16	12.60
313	Knitted and crocheted fabrics	0.73	3.74	26.94	42.15
314/5	Clothing	1.08	5.94	18.34	28.29
316	Leather and leather products	2.26	5.95	10.88	19.13
317	Footwear	5.69	13.65	39.34	45.83
321	Sawmilling and planing of wood	0.00	0.00	0.34	0.76
322	Wood and wood products	0.19	0.49	1.23	2.06
323	Paper and paper products	0.02	0.05	0.23	1.31
324	Publishing	0.08	0.17	0.61	1.37
325/6	Printing and related services	0.04	0.10	0.19	0.44
331/2	Coke oven and petroleum products	0.24	0.77	0.61	0.73
334	Basic chemicals	0.45	1.39	2.52	5.35
335/6	Other chemicals	0.18	0.56	1.16	2.69
337	Rubber products	0.08	0.59	3.46	9.61
338	Plastic products	0.29	1.13	2.45	3.37
341	Glass and glass products	0.48	1.58	4.46	8.76
342	Non-metallic mineral products	0.46	1.06	2.05	4.04
351	Basic iron and steel	0.10	0.46	1.22	3.56
352	Non-ferrous metals	0.21	0.35	1.14	2.80
354	Structural steel products	0.00	0.03	0.13	1.13
355	Other fabricated metal products	0.56	1.68	4.15	7.11
356/59	General purpose machinery	0.49	3.20	12.46	22.63
357	Special purpose machinery	0.36	0.65	2.39	11.04
358	Household appliances	1.84	2.90	10.58	21.11
361	Electrical motors, generators and transformers	0.26	1.68	6.14	10.89
362	Electricity distribution and control apparatus	0.27	0.99	2.34	6.59
363	Insulated wire and cable	0.06	0.43	1.75	4.56
364	Accumulators and batteries	0.22	1.66	6.31	9.49
365	Electric lamps and lighting equipment	3.09	8.77	22.05	30.58
366	Other electrical equipment	0.12	0.81	3.13	5.86
371/2/3	TV, radio and other electronic equipment	1.36	3.19	13.96	31.69
374/5/6	Medical, measuring and controlling equipment	0.46	1.87	3.61	7.65
381	Motor vehicles	0.00	0.01	0.24	1.50
382	Bodies for motor vehicles	0.19	0.05	0.75	3.71
383	Parts and accessories for motor vehicles	0.02	0.09	0.70	1.52
384/5/6/7	Other transport equipment	0.42	0.62	1.42	1.87
391	Furniture	0.12	0.99	6.78	14.71
392	Other manufacturing	1.00	2.33	4.97	8.02
Total	Total	0.39	1.13	3.20	5.90

Source: Authors' calculations using UN Comtrade, Industrial Development Corporation (IDC) and Statistics South Africa data.

Notes: Total import penetration is calculated as the ratio of total imports to total consumption, with the latter calculated as total sales volume plus total imports minus total exports. Tobacco products are excluded as sales data are not provided by Statistics SA.

Yet, the fact that imports from China have increased their share of domestic consumption of manufactured goods in South Africa does not necessarily mean that they have displaced domestic production and employment. In some cases China may have replaced imports from other countries. Chinese imports of intermediate and capital goods – see the growth in imports of machinery and equipment, for example – may have enhanced productivity and stimulated output growth in downstream industries. In simple accounting

terms, Chinese imports still represent a small proportion of overall domestic consumption, suggesting that domestic factors (such as demand or domestic factor prices) may dominate output and employment levels as well as trade flows, including imports from China. The next section of the paper analyses the specific role played by Chinese imports in relation to manufacturing output.

4. The Impact of Chinese Competition on Production

The increasing penetration of the South African market by imports from China discussed in the previous section can have a number of different effects. It is likely to result in downward pressure on domestic prices which works through various channels. Low-cost exporting countries (such as China) depress prices in a domestic market by replacing more expensive imports from other trading partners, or by inducing a lowering of the prices of imports from these partners (Kamin et al., 2004: 5). Furthermore, in the face of growing competition from cheaper imports, domestic firms are forced to lower their price-cost mark-ups. For example, Edwards and Winkel (2005), Fedderke et al. (2007) and Riham (2007) find evidence, using industry level data during the 1990s and early 2000s that trade reform helped reduce mark-ups in South African manufacturing industries.[5] Finally, Broda and Weinstein (2006; 2008) argue that imports lower the price index through the introduction of new varieties. This effect is particularly relevant to the case of South African imports from China where much of the growth has taken the form of new products.

The impact that such price reductions have on domestic producers will depend on several factors: First, whether imports from China compete primarily with other exporters to South Africa or with local producers. Second, whether the affected industries in South Africa are import competing industries in which case they are likely to face falling profit margins and a reduced market share, or import-using industries, in which case cheaper Chinese inputs or capital goods would tend to lead to higher profitability and expanded output. Third, how domestic manufacturers respond to increased competition in terms of lowering mark-ups, defensive innovation, downsizing or upgrading.

4.1 Chinese Competition and Prices

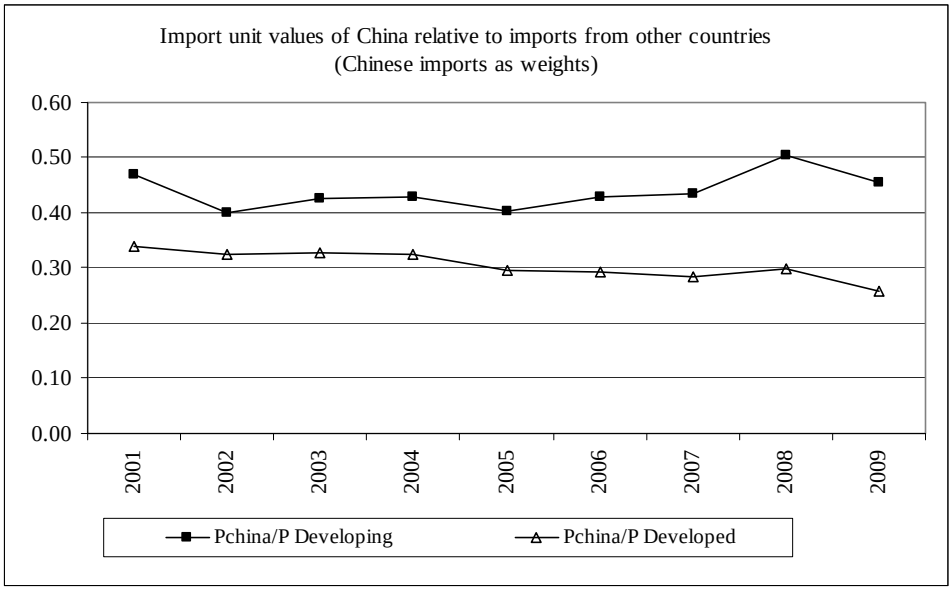
The impact of Chinese competition on prices is already present in South Africa. Morris and Einhorn (2008) show that Chinese imports reduced import prices and retail prices of clothing products in South Africa. Edwards and Rankin (2012) use highly disaggregated retail price data to show that the imposition of quotas on selected Chinese imports in 2007 and 2008 raised prices relative to unconstrained products by around 6 percent. Villoria (2009, Table 4) found that Chinese imports significantly reduced import prices in SACU, especially for garments, leather products and footwear. Finally, while Rangesamy and Swanepoel (2008) find no convincing association between aggregate inflation in China and domestic

[5] Given that these studies use industry level data, it is not possible to identify whether these industry level effects arise from changes in mark-ups within existing firms, or changes in the composition of firms within industries.

price changes, they find stronger sector-specific linkages between prices in China and South Africa at the disaggregated level.

Figure 2 presents the weighted average price of Chinese imports relative to imports from other countries. The relative price series are constructed using the HS6-digit import data and are weighted up using Chinese import values as weights (see notes to the figure for further details). Imports from China are less than half the price (unit value) of imports from other developing countries and only a third of the price of imports from developed countries. The price gap between Chinese and developed country imports has also increased and by 2009 unit values of South African imports from China were on average a quarter of those from developed countries.

Figure 2: Price per unit of Chinese imports relative to imports from other countries, 1992-2009



Source: Own calculations using UN Comtrade data.
Notes: Based on relative prices calculated at the 6-digit level of the Harmonized System, Revision 88/92. The denominator for each relative price is the weighted average price using each country's imports as weights. The average for all products is constructed using Chinese import values as weights.

For a product level comparison, Table 5 presents import unit values for the top 20 products imported by South Africa from China together with the average import unit values of these goods from other emerging economies and high-income economies. Digital Automatic Data Processing Machines (HS 847120), i.e. computers, made up the top (in value) imported product from China in 2010, but were similarly priced across all regions (558 US dollars from China to 582 US dollars from other emerging economies). In contrast, unit values of imports of Transmission Apparatus Incorporating Reception Apparatus (HS 852520), i.e. mobile phones – the second most important product – were substantially lower than alternative sources: 64 US dollars from China, 151 US dollars from other emerging economies and 226 US dollars from high income countries. Imports of Cotton Trousers (HS 620342 and HS 620462) from China were also substantially cheaper costing

around 3-4 US dollars per item compared to 16 to 22 US dollars from high-income countries. High price gaps exist for many of the other imported products presented in the table.

Table 5: Comparison of import unit values of top products imported from China in 2010 , US$

HS code and description	Unit	China	Emerging	High-income	Share total imports from China (percent)
270400 Coke, Semi-coke of Coal, Lignite, Peat; Retort Carbon	Kg	0.5	0.3	0.7	0.63
401120 New Pneumatic Tyres of Rubber for Buses or Lorries	Item	74.4	89.3	144.4	0.65
610910 Cotton T-shirts, Singlets, Other Vests, Knitted/Crocheted	Item	1.4	5.5	5.4	0.64
620342 Men's or Boys' Trousers, Overalls, Breeches, Cotton	Item	3.0	12.7	22.2	0.70
620462 Women's or Girls' Trousers, Breeches, Cotton	Item	3.4	9.9	16.5	0.65
640299 Other Footwear, Outer Soles and Uppers of Rubber/Plastics	Pair	3.0	5.2	5.3	2.31
640419 Other Footwear, Outer Soles of Rubber /Plastics	Pair	2.3	11.8	18.0	0.86
844350 Other Printing Machinery	Item	343.3	339.5	1009.7	2.03
844390 Parts, of Printing and Ancillary Machinery	Kg	40.5	41.3	43.0	1.35
847120 Digital Automatic Data Processing Machines	Item	558.6	582.3	576.1	4.99
847192 Input or Output Units	Item	46.6	121.8	219.2	1.06
847199 Other Data Processing Machines	Item	128.6	328.6	438.3	0.83
847330 Parts, Automatic Data Processing Machines	Kg	28.6	82.1	159.8	1.05
851730 Telephonic or Telegraphic Switching Apparatus	Item	171.1	499.8	542.6	2.01
851740 Other Apparatus, for Carrier-current Line Systems	Item	3498.6	869.2	827.2	0.83
852520 Transmission Apparatus Incorporating Reception Apparatus	Item	64.8	151.0	226.3	4.87
852530 Television Cameras	Item	68.9	389.3	596.8	0.59
852810 Colour Television Receivers	Item	83.4	206.5	295.1	1.63
950390 Other Toys	Kg	6.0	12.2	13.5	1.07
950490 Other Articles for Funfair, Table or Parlour Games	Item	4.1	36.3	26.9	0.75

Source: UN Comtrade. The development status of countries is determined using the World Bank classification of countries according to income levels. Emerging economies include low and middle income countries (excluding China).

The large differences in import unit values across countries even within the disaggregated HS 6-digit categories are suggestive of a high degree of within-product product specialisation. Similar heterogeneity in import prices within disaggregated product categories is found for the US (Schott, 2004 & 2008; Fontagné et al., 2008; Edwards and Lawrence, 2010). One implication of this finding is that industry level analyses such as this one may exaggerate the extent to which Chinese products compete with other imports and with domestically produced products. By specialising in different products, domestic firms can insulate themselves from the competitive effects of Chinese and other exports.

Nevertheless, the vast differences in relative prices imply that the shift in the composition of SA imports towards China will have contributed towards declining aggregate import prices at the product level. This in turn will have contributed towards lower producer

and consumer prices. This effect of imports on aggregate prices can be shown using the aggregate producer price indices for South Africa. For example, producer prices of imported manufactured goods rose by 3 percent per year from 2000 to 2011, which was less than half the 6.3 percent annual increase in the producer price of South African produced manufactured goods.[6]

An econometric estimate of a price equation was also conducted using 44 manufacturing industries (excluding tobacco) over the period 1993 to 2009. The estimates of a producer price equation specified in first differences are presented in Table 6.[7] Higher production costs, measured as increases in sectoral unit labour costs or falling total factor productivity (proxied by US total factor productivity) are found to raise domestic producer prices. Foreign prices, proxied by US producer prices, are also found to be an important and statistically significant determinant of South African producer prices.[8]

Table 6: Chinese competition and producer price inflation in South Africa

	Dependent variable: ∆ln(SA Producer Prices)
∆ln(US Producer Prices)	0.255*
	(0.102)
∆ln(1+tariff)	0.080
	(0.049)
∆ln(unit labour cost)	0.042**
	(0.014)
∆ln(US TFP)	-0.147*
	(0.062)
Import penetration, other	-0.019*
	(0.009)
Import penetration, China	-0.072*
	(0.031)
Constant	0.095**
	(0.007)
Observations	792
R-squared	0.327

Notes: US Total Factor Productivity (TFP) and producer price index data are obtained from the Bureau of Economic Analysis and the Bureau of Labor Statistics. US TFP is used as a proxy for global technological change. Tariff data are updated from Edwards (2005). South African producer price data are obtained from Statistics South Africa. Import penetration is calculated as imports/(sales-exports+imports) using sales data from Statistcs SA and trade data from UN Comtrade. Unit labour costs are calculated as the wage bill over sales value using data obtained from Statistics SA. Robust standard errors are presented in parentheses.
** p<0.01, * p<0.05, + p<0.1

[6] Calculations based on Producer Price Index data obtained from Statistics South Africa (P0142.1) (www. Statssa.gov.za). Consumer price indices for the 44 sectors are not available.

[7] See the Appendix for details of the technique used.

[8] Note that these equations do not adjust for the endogeneity of imports and unit labour costs (see Fedderke and Schaling, 2005), although the bias from the latter has been found to be small (Goldstein, 1974). Not accounting for the endogeneity of imports is likely to bias the estimates towards zero.

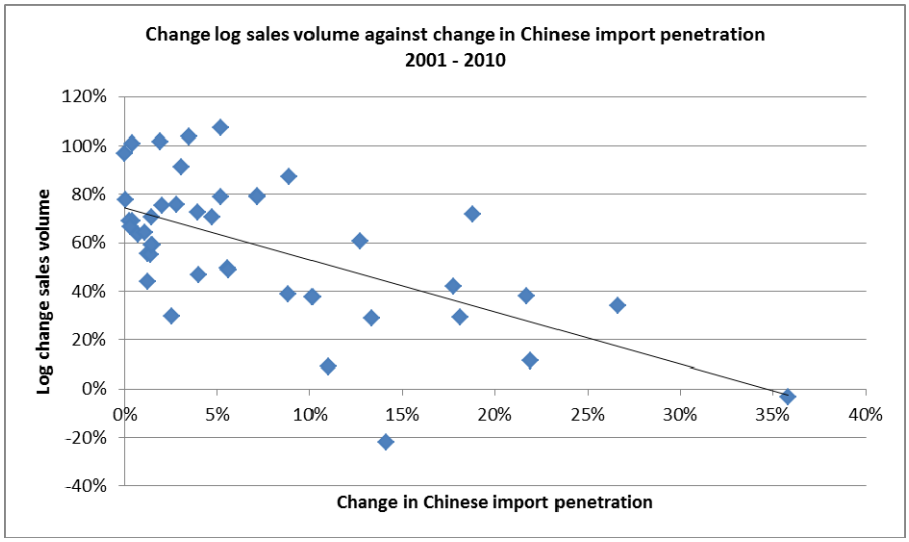
The estimates also include the share of imports (in levels) from China in domestic consumption as well as the share of imports from other countries in domestic consumption. Both variables are significant and negative, with the coefficient on Chinese import penetration more than three times the size of import penetration from other countries. Imports from China therefore appear to have had a particularly strong influence on price inflation in South Africa. The estimated coefficient suggests that Chinese import penetration reduced producer price inflation by around 0.3 percent per year from 2005 to 2010.[9]

Overall, these results suggest that increases in imports from China have contributed towards lower producer price inflation in South Africa, which in turn will have moderated increases in consumer prices and helped to curtail production cost increases.

4.2 Chinese Competition and Domestic Production

Figure 3 provides a first look at the relationship between Chinese competition and domestic production. Using data for the 2001 to 2010 period, it plots changes in import penetration from China against log changes in sales volume for 44 manufacturing industries (see Table A in the Appendix for the data). While there is significant variation across industries, the aggregate trend in Figure 3 suggests that the manufacturing industries that have been subject to greater competition from Chinese imports (reflected in larger changes in the level of Chinese import penetration) have generally registered smaller log changes (increases) in sales volumes over the 2000-2010 period.

Figure 3: Plot of log change in sales volume versus change in South African import penetration from China by manufacturing industry, 2001-2010



Source: Authors' own calculations using UN Comtrade data and Statistics SA data.

[9] Estimates were also conducted using an alternative measure of import competition, namely the change in the unit value index of South African imports from the world and from China, but none of the coefficients were significant. Estimates including the change in import penetration also yield insignificant coefficients for the import variables.

In order to explore the relationship between changes in import penetration and local production further, a Chenery-style decomposition was used to separate out the contributions of domestic demand, exports and changes in import penetration to changes in sales. [10] This was done for two main periods, 1992-2001 (the period prior to China's accession to the WTO) when imports from China remained relatively low and 2001-2010 when Chinese imports began to increase their penetration significantly.

Table 7 shows that in the 1990s changes in sales by South African manufacturers were equally divided between growing domestic demand and increased exports. The growth in exports exceeded the increase in total import penetration, despite the major import liberalization that occurred in this period. However, after 2001, this situation was reversed with import penetration increasing by more than exports, so that the change in total sales lagged behind the growth in domestic demand. The total increase in import penetration in constant Rand terms was roughly the same in the two periods, but the bulk of the increase in the later period came from China, whereas earlier its role had been marginal.

Table 7: Chenery Decomposition of Changes in South African Manufacturing Output, 1992-2001, 2001-2010 (million Rand)

	1992-2001	2001-2010
Growth of Domestic Demand	93,945	120,598
Exports to China	1,564	4,680
Exports to ROW	92,254	23,320
Increased import penetration	-60,339	-63,284
Change in Sales	127,423	85,315

Source: own elaboration from UN Comtrade and Statistics SA data.

As noted earlier, the fact that imports from China have increased their share of domestic consumption of manufactured goods in South Africa does not necessarily mean that they have displaced domestic production since in some cases they may have replaced imports from other countries. It is therefore necessary to divide the total increase in import penetration from China into that part which substituted for imports from other countries and that which reduced the market share of domestic producers.[11]

Table 8 shows that in the period before 2001, the increase in Chinese import penetration did not have a significant impact on imports from the rest of the world, but although the major effect was on domestic producers, this was of limited significance because Chinese imports remained relatively low. From 2001 onwards, displacement of imports from other countries accounted for around a quarter of the increased market penetration by China, but displacement of domestic production accounted for the bulk of the increase. In contrast to the earlier period, this loss of market by domestic producers to

[10] See the Appendix for details of the technique used.

[11] See the Appendix for an explanation of how the basic Chenery decomposition was extended to separate out the impact of Chinese imports on other imports and domestic production.

Chinese products between 2001 and 2010 was equivalent to about 5% of the value of sales in 2001. Although this may not seem particularly large, sales from the South African manufacturing industry only increased by 14% in real terms over the same period.[12]

Table 8: Loss of Market Share by Domestic Producers to China

	1992-2001	2001-2010
Total gain by China (R. mn.)	7242.1	41384.4
Gain from Domestic Producers (R mn.)	7161.2	30295.8
As % of Total Gain	98.9%	73.2%
As % of Domestic Sales in Base Year	1.50%	5.00%

Source: own elaboration from UN Comtrade and Statistics SA data.

The aggregate data also hides considerable variations between industries. As already noted, Chinese import penetration is particularly high in Textiles and Clothing, Footwear and Leather, Electrical and Electronic Products and some types of Machinery. These also tend to be the industries in which loss of market to Chinese competition has been most significant since 2001 (Table 9).

Table 9: Industries in which loss to Chinese imports between 2001-10 represented more than 10% of 2001 production

	Loss to China	Growth in Manufacturing Sales
Knitted and crocheted fabrics	60.5%	-23.5%
Footwear	45.3%	2.4%
Clothing	31.1%	-7.6%
General purpose machinery	28.5%	-19.1%
Household appliances	26.4%	16.9%
Television, radio and other electronic equipment	21.5%	11.0%
Special purpose machinery	18.7%	1.8%
Medical appliances, measuring and controlling equipment	18.0%	17.0%
Electric lamps and lighting equipment	13.3%	0.3%
Leather and leather products	12.9%	30.0%
Electrical motors, generators and transformers	12.3%	-7.3%
Other textiles	11.1%	-19.7%
Spinning and weaving	10.5%	-41.7%

Source: own elaboration from UN Comtrade and Statistics SA data.

Table 9 also shows the growth of sales by domestic producers (including exports) in real terms in each industry over the period 2001-2010. Of the thirteen worst affected

[12] A partial offset to increased import penetration from China was the increased exports to China between 2001 and 2010 which came to 4.6 billion Rand (see Table 5). This was substantially less than the 30.3 billion Rand displaced by increased Chinese imports.

industries, six showed an absolute decline in sales, while a further 3 showed minimal growth. Only four industries which had significantly lost market share to China still enjoyed significant growth in sales.

5. The Impact of Chinese Competition on Employment

A major issue of concern in relation to competition from Chinese imports is the effect that this has on employment in South Africa. This is particularly important in view of the significant impact found in the previous section on production in labour-intensive industries such as clothing and footwear. These were also sectors in which employment fell by large numbers.

Chinese competition may influence industry level employment in various ways. Increases in import competition can raise the derived labour demand elasticity, hence depressing wages and employment in those industries (Rodrik, 1997). Chinese competition may also depress output of existing domestic firms and lead to the exit of less efficient firms, both of which will reduce aggregate industry level employment and raise industry level productivity (Bernard et al., 2007). Further, domestic firms may 'defensively innovate' by upgrading capital stock and reducing employment in response to the competition (Wood, 1994).

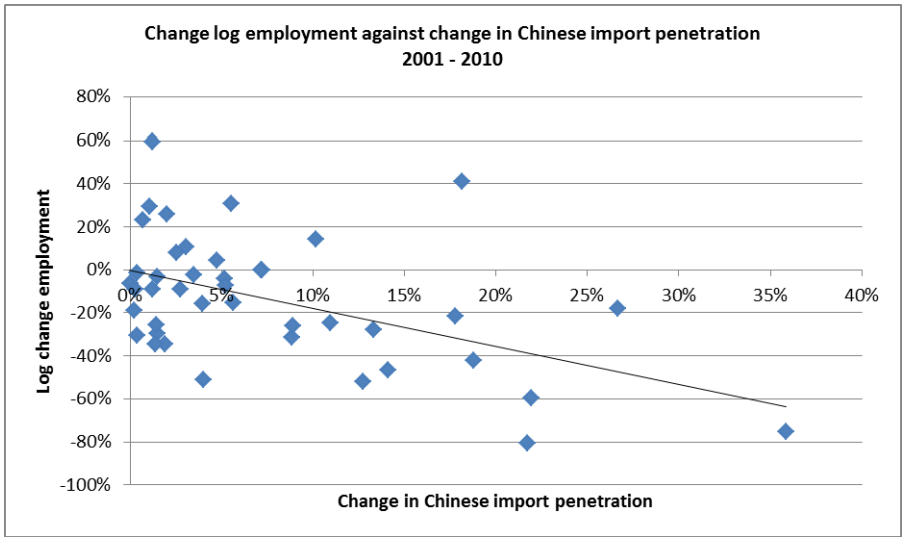
Contrary to these effects, imports of lower priced Chinese intermediate inputs and capital goods may enhance firm profitability leading to an increase in employment, although, as Feenstra and Hanson (1996) show this may also raise the wage premium of skilled labour within an industry. Employment gains may also accrue through growth in the export sector (or sectors retailing imported Chinese goods).

For a preliminary insight of the net employment impact across manufacturing industries, Figure 4 plots the change in Chinese import penetration against (log) changes in employment by manufacturing industry over the period 2000 to 2009. A negative relationship is found with relatively large increases in Chinese import penetration occurring in industries with relatively low (and mostly negative) changes in employment. The relationship is particularly strong amongst industries with below median wages such as Clothing, Footwear, Leather products and the various Textile industries.[13]

To evaluate this relationship further, the employment impact of changes in Chinese import penetration was also calculated using the Chenery decomposition technique. Average employment coefficients were calculated for each manufacturing industry from Statistics South Africa data on manufacturing sales (at 2000 prices) and number employed. Given the difference between the two periods before and after China joined the WTO, the impacts were estimated for both periods.

[13] High and low wage industries are distinguished on the basis of average wages for the 2000-2010 period. Industries recording an average wage below the median average wage for the period were classified as low wage industries.

Figure 4: Plot of log change in employment versus change in South African import penetration from China by manufacturing industry, 2001-2010



Source: Authors' own calculations using UN Comtrade and Statistics SA data.

Table 10 shows that the loss of jobs as a result of increased import penetration from China was relatively limited before 2001 at less than 25,000. The loss of employment as a result of increased imports from other countries was estimated to be five times higher than the impact of Chinese competition. In the later period however the situation was totally different with increased imports from China reducing employment by more than 75,000 jobs, which represented 70% of the total loss attributable to increased imports.

Table 10: Changes in Employment, 1992-2001 and 2001-2010

	1992-2001	2001-2010
Growth of Domestic Demand	140,569	208,944
Exports to China	2,585	4,080
Exports to ROW	174,741	9,951
Increased import penetration	-144,734	-110,318
(of which Chinese import penetration)	-24,117	-77,751
Productivity growth	-352,617	-226,124
Total Change in Employment	-179,457	-113,467

Source: own elaboration from UN Comtrade and Statistics SA data.

As a point of comparison, Table 10 also shows the loss of employment attributable to increased labour productivity in the two periods and the total change in manufacturing employment. In both periods, the loss of employment due to productivity growth is more than twice that attributable to increased import penetration. In the later period the negative effect of productivity growth on employment is almost matched by the positive impact of growing domestic demand. As a result the effect of increased import penetration, the bulk of which is attributable to China, is almost equal to the overall decline in manufacturing employment in South Africa between 2001 and 2010.

Exports to countries other than China made a significant contribution to maintaining employment in the period up to 2001, but declined dramatically after that. The impact of exports to China on manufacturing employment was minimal in both periods.

Table 11 shows those industries that account for the bulk of the job losses associated with Chinese import penetration. Between them they accounted for 85% of the total estimated loss of employment by domestic producers attributable to increased Chinese import penetration. Eight of the twelve industries saw an overall fall in total employment between 2001 and 2010. Of these, the fall was relatively small in Other Fabricated Metal Products, but in all the others it was substantial and well above the average decline in manufacturing employment of 9% over the period. The only sectors where employment increased in the period, despite Chinese competition were machinery, other chemicals and other electrical equipment.

Table 11: Estimated Job Losses as a result of increased Import Penetration from China, 2001-2010

	Employment Loss	Total decline in employment (%)
Clothing	22640	-45.0%
General purpose machinery	12717	50.9%
Special purpose machinery	7224	15.3%
Knitted and crocheted fabrics	3991	-52.9%
Other textiles	3053	-21.8%
Spinning and weaving	2851	-37.2%
Footwear	2521	-55.3%
TV, radio and other electronic equipment	2453	-16.6%
Other chemicals	2442	29.6%
Other electrical equipment	2059	4.5%
Other fabricated metal products	1983	-4.2%
Furniture	1895	-40.4%

Source: own elaboration from UN Comtrade and Statistics SA data.

Econometric estimates of the within-industry employment relationship were also conducted. Full details of the specification and estimation are presented in the Appendix. As shown in Table 12, the coefficients on the standard production function variables have the correct sign and are generally significant: wage (-) and sales volumes (+). Tariff rates are positively related to employment levels, but are not robust to different specification and estimators. Nevertheless, they suggest that tariff liberalisation may explain some of the decline in employment during the period.

Import penetration is also negatively correlated with employment levels, but only for Chinese imports. In the fixed effects results, a coefficient of -2.1 is estimated on Chinese import penetration in column 1, but the size of the relationship falls to -1.44 when Chinese import penetration is instrumented in column 2. This coefficient suggests that a 1 percentage point increase in Chinese import penetration is associated with a 1.44 percent decline in employment within the industry.

Table 12: Regression results for employment and wage models

	(1)	(2)	(3)	(4)
	Fixed Effects		GMM	
	Basic	Instrumented	1992-2009	2001-2009
Ln(employment)$_{t-1}$			0.729**	0.466**
			(0.096)	(0.129)
ln(real wage)	-0.038	-0.065+	-0.048	-0.341*
	(0.074)	(0.037)	(0.071)	(0.133)
ln(sales volume)	0.238+	0.312**	0.165**	0.150*
	(0.119)	(0.051)	(0.051)	(0.071)
ln(1+tariff)	0.347	0.396**	0.067	-0.101
	(0.230)	(0.153)	(0.117)	(0.510)
Import penetration, other	-0.344	-0.185	0.074	-0.259+
	(0.238)	(0.159)	(0.216)	(0.144)
Import penetration, China	-2.084**	-1.444**	-0.424	-0.623
	(0.494)	(0.276)	(0.304)	(0.429)
Export orientation	0.633**	0.535**	0.044	0.244+
	(0.217)	(0.103)	(0.114)	(0.135)
Constant	1.909**	1.357**		
	(0.604)	(0.294)		
Observations	792	792	748	308
R-squared (within)	0.399	0.387		
Sectors	44	44	44	44
m1			0.000	0.020
m2			0.274	0.591
Hansen			1.000	0.690

Notes: Estimates based on data from 2001 - 2009. Export orientation is measured as share of exports in sales using data from Statistics SA and UN Comtrade. Real wages are constructed by deflating industry wage data by SA producer prices, both obtained from Statistics SA. See Table 6 for a description of other variables.
In the GMM estimates, real wages and import penetration from China are modelled as endogenous. China's share in low and middle income country imports is used as an instrument for Chinese import penetration in the two-stage least square estimation of column (2).
Year dummies are included in all regressions. Industry fixed effects are included in column (1) and (2) estimates.
GMM results are one-step estimates with heteroskedasticity-consistent standard errors and test statistics. Hansen is a test of the overidentifying restrictions for the GMM estimators. The P-value is reported.
m1 and m2 are test for first-order and second-order serial correlation. Robust standard errors are presented in parentheses.
** p<0.01, * p<0.05, + p<0.1

The significance of the Chinese import penetration coefficient, however, declines once persistence in employment patterns are allowed for through the inclusion of lagged employment levels. In the GMM estimated results (column 3), for example, the coefficient on Chinese import penetration is no longer statistically significant. These GMM estimates however, should be treated with caution as the number of instruments is large even though the set of instruments for the lagged employment and endogenous variables (real wages and Chinese import penetration) is restricted to only include the second lagged level. To

reduce the number of instruments further, in column (4) the sample is restricted to the post 2000 period, but the coefficient on Chinese import penetration remains insignificant.[14]

The negative employment association is conditional on output, implying that Chinese import penetration is linked to increased labour productivity within sectors. This can originate from a combination of within-firm effects arising from increased competition and/or the importation of technology embodied in inputs (a high proportion of intermediate inputs are sourced from within each 3-digit SIC category) as well as across-firm composition effects driven by exit or slower output growth in low productivity firms in the industry. Firm level evidence in other emerging and developed economies, for example, suggests that both effects are likely (see Trefler, 2004 and Bernard et al., 2007).

There are nevertheless important cross-sector composition effects. The inclusion of interactions between the import penetration variables and a dummy for above median wage industries indicates that Chinese competition (and in some cases import competition from the rest of the world) had the strongest negative impact on employment (or positive impact on sector productivity) in low wage industries. This is also reflected in the cross sector relationship presented in the scatter plot diagram, Figure 4. This outcome corroborates the finding by Rodrik (2008) that increased openness (Chinese competition in this case) contributed towards shifts in the structure of manufacturing away from labour-intensive industries.

Interestingly, export growth as measured by share of exports in sales is positively related to employment. In the narrow theoretically specified labour model, the positive coefficient is indicative of declines in productivity associated with export growth. With firm heterogeneity, the results may also arise from shifts in the composition of firms within sectors towards relatively low wage labour-intensive exporters.

Table 13 uses the Chinese import penetration coefficient of -1.44 to decompose the impact of Chinese competition on manufacturing employment. The results for industries most adversely affected are also presented. These estimates are merely a guide as to the possible impact. Positive and negative indirect effects arising from import penetration in upstream or downstream industries are not included. The impact of Chinese imports on employment in the retail sector is also not included. Access to cheap Chinese clothing products, for example, is argued to have stimulated employment growth in the clothing retail sector (Morris and Einhorn, 2008). Finally, improvements in productivity induced by Chinese competition may also have had positive impacts on both employment and wage levels.

The simulations are nevertheless insightful. Chinese competition is estimated to have reduced employment levels (conditional on existing output) by 109 thousand, or 41 percent of the 266 thousand manufacturing jobs lost over the period 1992-2009. Close to 80 percent (or 86 thousand) of the jobs 'lost' through Chinese competition occurred over the period 2000 to 2009. Nevertheless, manufacturing employment would have declined over the full period even if the Chinese competition impact were not present. The relative and

[14] The Hansen test of overidentifying restrictions is weakened by many instruments. The shorter period reduces the number of instruments substantially, allowing for a stronger test of the validity of the instrumentation assumptions.

absolute decline in manufacturing employment cannot therefore be entirely attributed to Chinese competition, although its role is nevertheless substantive.

Table 13: Simulated impact of Chinese competition on employment, selected industries

Sector		Actual employment (1000)			log change jobs	Counterfactual employment (1000)		jobs 'lost' (000)
	SIC	1992	2000	2009	1992-2009	2000	2009	1992-2009
Total		1439.1	1287.5	1172.7	-0.20	1310.8	1281.7	109.1
Clothing	314/5	114.3	125.5	71.1	-0.48	133.8	97.5	26.5
General purpose machinery	356/59	26.6	23.3	35.2	0.29	24.4	47.1	11.8
TV, radio and other electronics	371/2/3	16.6	17.8	12.7	-0.27	18.4	19.4	6.8
Furniture	391	46.7	43.9	31.4	-0.40	44.6	37.1	5.7
Special purpose machinery	357	37.6	34.8	40.7	0.09	35.1	46.1	5.4
Footwear	317	27.2	15.7	5.9	-1.54	18.6	10.5	4.6
Other fabricated metal products	355	70.6	59.2	53.1	-0.28	60.5	57.6	4.5
Spinning and weaving	311	35.8	25.3	16.7	-0.76	26.0	20.9	4.2
Other electrical equipment	366	55.5	43.8	49.7	-0.11	44.3	53.9	4.2
Knitted and crocheted fabrics	313	15.5	10.9	5.3	-1.07	11.4	8.9	3.6

Source: Authors' own calculations using UN Comtrade and Statistics SA data. Employment calculations assume a coefficient of -1.44 on Chinese import penetration.

The set of sectors most affected by Chinese competition correspond closely to those found using the Chenery-style decomposition approach. The clothing sector is the most affected with a 'loss' of 26.5 thousand jobs reflecting a combination of relatively high employment levels and large increases in import penetration from the early 1990s. Other labour intensive sectors such as footwear, furniture, spinning and weaving and knitted and crocheted fabrics are also amongst the major sectors negatively affected. High technology sectors such as general purpose machinery, TV, radio and other electronics and Special purpose machinery are also affected, but these effects are likely to be upwardly biased as econometric estimates separating out high wage and low wage industries indicate lower impacts of Chinese competition on employment in these sectors.

6. Conclusion

The analysis presented here indicates that Chinese competition has had a significant impact on South African manufacturing in the period since China joined the WTO. Over the past decade, the bulk of the increase in import penetration of the South African market can be attributed to Chinese imports. It is now the largest source of imports to South Africa both in aggregate and in 27 out of 45 manufacturing industries. Its share of the domestic market has increased steadily over the period from less than ½% in 1995 to around 6% in 2010. The uneven nature of import penetration means that some industries face very significant competition from China.

Although increased imports from China have partly replaced imports from other countries, it was found that most of the increase in Chinese penetration of the market has been at the expense of local production. The paper estimates that the displacement of domestic production as a result of increased Chinese import penetration during the decade of the 2000s came to around R30 000 million, or close to 5 percent of the value of output in

2001. Given the modest growth of South African manufacturing during the period, this is not insignificant.

Exports of manufactures to China remained relatively limited and did not add significantly to industrial growth in South Africa. Even in 2010, the Chinese market only accounted for 1% of South African manufacturing sales. While exports to other countries are much more significant we did not analyse the impact of China on South Africa's exports to the Rest of the World here. However in a parallel paper (Edwards and Jenkins, 2012) we find that South Africa has lost market share to China in its major export markets.

This suggests that the overall impact of Chinese competition on manufacturing employment in South Africa was negative. First there was the loss of jobs associated with the displacement of local production by imported goods. Indeed, the fact that labour-intensive industries were particularly badly affected by Chinese imports meant that the negative impact on employment was more than proportional to the output displacement.

The econometric analysis also showed that, even controlling for changes in output, increases in Chinese import penetration tended to reduce employment at the industry level. A number of different factors could explain this. First the exit of the least productive firms would tend to increase the overall level of productivity in the industry. Second surviving firms may respond to increased competition through defensive innovation which raises productivity and/or moving out of the most labour-intensive segments of an industry. In the absence of firm level data and more disaggregated industrial sectors, it is impossible to say which of these effects have affected employment in South Africa, but all three may have played a part.

In concluding, some *caveats* are in order in relation to the interpretation of the impact of increased Chinese import penetration. First Chinese imports also reflect shifts in aggregate demand within South Africa. Hence they are an outcome of consumption, production and investment decisions elsewhere in the economy. We need therefore to be wary of assuming changes in Chinese import values are a consequence of exogenous (autonomous) effects, rather than endogenous outcomes of domestic influences. The estimates presented attempt to deal with some of these concerns by instrumenting Chinese imports with lagged values and the share of emerging economy imports sourced from China.

Second, we have not fully addressed the possible positive effects on domestic production of cheaper access to capital and intermediate inputs which now dominate imports from China. We also do not explore the consequent employment effects. Increases in output arising from cheaper intermediate inputs and capital would be expected to increase employment, but these gains may be offset by the substitution of cheaper capital for labour or the outsourcing of intermediate input production within each firm. These relationships require further investigation.

Thirdly, we have only addressed the impact of Chinese competition on the manufacturing sector and manufacturing employment and have not attempted to draw conclusions at the macro level which would involve considering the impacts on the primary and tertiary sectors as well. As far as services are concerned, imports of low priced clothing from China, for example, stimulated demand and employment within the retail sector. The losses in employment within clothing were therefore partly offset by increased employment in the retail sector (Morris and Einhorn, 2008). This focus on manufacturing is justified by

the key role that is seen by policy makers in South Africa for the industrial sector in bringing about a more dynamic economy in South Africa, and the need to achieve more rapid economic growth in order to tackle the country's serious employment problem.

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Appendix: Data

General

The database used in the paper was constructed from various sources. Employment, price and sales data (volume and value) are obtained for 45 manufacturing sectors (3-digit level of SIC) over the period 1992-2009 from various publications produced by Statistics South Africa. Disaggregated trade data for South Africa are obtained from UNcomtrade and aggregated to these 45 sectors using a concordance file based on a Harmonized System-ISIC concordance obtained from the World Integrated Trade System (WITS). Industry level foreign producer price indices (proxied by US PPI) and indices for foreign technology (proxied by US total factor productivity indices) are obtained from the US Bureau of Labor Statistics. South African producer price indices are obtained from Statistics South Africa (series P0142.1). Tariff data obtained from Edwards (2005) are updated to 2009 using published tariff schedules for South Africa. Finally real capital stock data for 2 to 3 digit SIC sectors are obtained from Quantec.

Employment

Evaluating manufacturing employment trends in South Africa is made difficult by the lack of consistently constructed data series. The enterprise based surveys (Survey of Employment and Earnings (P0271) and Quarterly Employment Statistics (P0277.1)) suffer from a number of survey sample breaks, whereas the household and labour force surveys (October Household Surveys from 1994 to 1999, Labour Force Survey from 2000 to 2007 and Quarterly Labour force Survey from 2008 to 2010) only provide employment data are relatively high levels of industry aggregation.

Figure A presents different estimates of manufacturing employment constructed using the various employment series sourced from Statistics South Africa. The variable "Statistics SA series" covers the raw data from the enterprise surveys and the "Constructed Series" adjusts this raw data for sample survey breaks using pre- and post-break quarterly growth rates. The remaining series draws on employment data from the various household and labour force surveys. [15]

The choice of series has a marked impact on the estimated level of employment in manufacturing. According to the enterprise surveys manufacturing sector employment declined throughout the 1990s. A brief recovery in employment followed in the early 2000s, but the downward trend continued from 2005. Over the entire period, manufacturing employment declined from more than 1.5 million workers in 1990 to fewer than 1.2 million workers in 2010 (a nearly 24% decline). This placed manufacturing employment at its lowest level in over 40 years.

[15] The Statistics South Africa data is characterised by a number of breaks when the sample of manufacturing firms is updated. The main breaks occur in 2002 quarter 3, 2004 quarter 4 and 2006 quarter 2. Quarterly growth rates were used to splice the different series together.

This picture contrasts somewhat with that presented using data on formal sector employment in the manufacturing sector drawn from the household and labour force surveys. The various data series are closely matched up to 1999, but then diverge with the household and labour force survey data showing an increase in employment in the manufacturing sector – rising from more than 1.4 million workers in 2000 to more than 1.5 million workers in 2010. Nevertheless, even in these data series, manufacturing declined as a proportion of overall employment in the post-2000 period when Chinese competition was at its strongest (share non-agricultural non-mining employment fell from 18.6 percent to 16.7 percent from 2001 to 2010).

Figure A: Employment in the South African manufacturing sector, 1990-2010

Source: Statistics SA and IDC data.

Table A: Change in import penetration from China against log changes in sales volumes and industry employment by manufacturing industry, 2001-2010

SIC	Industry description	Change in Chinese import penetration, (percentage point)	Log change in sales volume (percentage)	Log change in industry employment, 2001-2010 (percentage)
301	Meat, fish, fruit, vegetables, oils & fat	0.39	100.70	-1.51
302	Dairy products	0.03	77.76	-6.29
303	Grain milling & animal feeds	0.41	69.05	-30.58
304	Other food products	0.25	68.89	-18.83
305	Beverages	0.01	96.93	-6.41
311	Spinning and weaving	14.12	-22.03	-46.60
312	Other textiles	10.97	8.94	-24.54
313	Knitted and crocheted fabrics	35.85	-3.36	-75.20
314/5	Clothing	21.94	11.58	-59.70
316	Leather and leather products	13.35	28.89	-27.75
317	Footwear	21.71	38.23	-80.59
321	Sawmilling and planing of wood	0.73	63.54	23.20
322	Wood and wood products	1.47	70.75	-29.74
323	Paper and paper products	1.26	55.38	-9.02
324	Publishing	1.23	44.03	59.44
325/6	Printing and related services	0.31	66.62	-8.96
331/2	Coke oven and petroleum products	-0.06	77.46	6.88
334	Basic chemicals	3.95	72.69	-15.75
335/6	Other chemicals	2.01	75.26	25.95
337	Rubber products	8.85	38.76	-31.34
338	Plastic products	1.92	101.45	-34.63
341	Glass and glass products	7.21	79.45	0.03
342	Non-metallic mineral products	2.78	75.76	-9.02
351	Basic iron and steel	3.08	91.38	10.56
352	Non-ferrous metals	2.52	29.54	7.99
354	Structural steel products	1.09	64.42	29.25
355	Other fabricated metal products	5.18	78.88	-4.26
356/59	General purpose machinery	18.15	29.51	41.16
357	Special purpose machinery	10.14	37.67	14.21
358	Household appliances	17.77	41.86	-21.78
361	Electrical motors, generators and transformers	8.90	87.50	-25.98
362	Electricity distribution and control apparatus	5.23	107.20	-7.46
363	Insulated wire and cable	4.00	46.89	-51.20
364	Accumulators and batteries	7.19	79.11	0.04
365	Electric lamps and lighting equipment	18.78	71.99	-42.04
366	Other electrical equipment	4.73	70.55	4.43
371/2/3	TV, radio and other electronic equipment	26.65	34.08	-18.20
374/5/6	Medical, measuring and controlling equipment	5.57	49.57	30.79
381	Motor vehicles	1.49	59.23	-3.20
382	Bodies for motor vehicles	3.50	103.48	-2.46
383	Parts and accessories for motor vehicles	1.41	54.97	-34.60
384/5/6/7	Other transport equipment	1.43	58.97	-25.49
391	Furniture	12.73	60.68	-51.81
392	Other manufacturing	5.64	48.73	-15.40

Source: Authors' calculations using UN comtrade, IDC and Statistics SA data.
Notes: Total import penetration is calculated as the ratio of total imports to total consumption, with the latter calculated as total sales volume plus total imports minus total exports.

Appendix: Empirical Methods

Chenery Decomposition

The Chenery (1979) style decomposition technique disaggregates changes in the gross value of manufacturing production into demand effects arising from changes in domestic consumption, exports and import penetration. While similar decomposition techniques have been applied to South African data (Edwards (2001a, 2001b, 2006); Dunne and Edwards (2007) and Jenkins (2008)), these studies focus on displacement effects arising from total trade and not bilateral trade flows. The evaluation of displacement effects arising from Chinese trade requires minor modifications to the standard Chenery-style decomposition.

The decomposition starts from the basic accounting identity that

$$Q_{it} = D_{it} + X_{it} - M_{it} \qquad (1)$$

where

D_{it} is domestic absorption of industry i at time t
Q_{it} is domestic production of industry i at time t
X_{it} is exports of industry i at time t
M_{it} is imports of industry i at time t

Defining import penetration in industry i at time t as:

$$m_{it} = M_{it}/D_{it} \qquad (2)$$

then a change in production in industry i between base year (0) and current year (1) can be decomposed as:

$$\Delta Q_i = (1- m_{i0})\Delta D_i + \Delta X_i + (m_{i0} - m_{i1})D_{i1} \quad (3)$$

Since we are interested in the impact of imports from China on domestic production, then it is necessary to disaggregate the trade data between imports from China and imports from the Rest of the World.

$$\Delta Q_i = (1- m_{i0})\Delta D_i + \Delta X_i + (m_{Ci0} - m_{Ci1} + m_{Ri0} - m_{Ri1})D_{i1} \quad (4)$$

where m_{Ci} is the share of Chinese imports in total domestic absorption and m_{Ri} is the share of the Rest of the World.

An increase in Chinese import penetration can come at the expense of either domestic production or imports from other countries (or both). To estimate the displacement of domestic production by Chinese imports, it is assumed that in those industries where import penetration from the Rest of the World has risen, then the entire increase in Chinese import penetration has come at the expense of domestic producers. If, however, the share of other importers in the South African market has fallen, then part of the increase in Chinese import penetration has been at the expense of the Rest of the World. If the share of local production in domestic demand has increased, then it is assumed that the growth of Chinese import penetration has been entirely at the expense of other importers.

On this basis it is possible to estimate the extent to which China has displaced both other imports and local producers over specific periods of time. The estimated impact on domestic producers is as follows: If Δm_{Ci} and Δm_{Ri} in industry i are both positive (or negative), the loss (gain) by domestic producers to (from) China is $\Delta m_{Ci} * D_{i1}$. If, however, import penetration by China and the Rest of the World change in opposite directions then the impact of China on domestic producers depends on whether or not the total share of imports increases or falls, as set out in the following matrix.

	$\Delta m_{Ci} > 0; \Delta m_{Ri} < 0$	$\Delta m_{Ci} < 0; \Delta m_{Ri} > 0$
$\Delta m_{Ci} + \Delta m_{Ri} > 0$	$(\Delta m_{Ci} - \Delta m_{Ri})\ D_{i1}$	0
$\Delta m_{Ci} + \Delta m_{Ri} < 0$	0	$(\Delta m_{Ci} - \Delta m_{Ri})\ D_{i1}$

The impact of Chinese competition on employment in South Africa can then be estimated by applying employment coefficients, derived from manufacturing sales and employment data to the estimates of market losses by domestic producers to Chinese imports.[16]

Employment changes are a result of changes in output and changes in labour productivity, where labour productivity is defined as Employment (Lit) per unit output (Qit). This relationship is represented as:

$$\Delta L_i = l_{i1}\Delta Q_i + (\Delta l_i)\ Q_{i0} \qquad (5)$$

Substituting Equation (3) into Equation (5) gives:

$$\Delta L_i = l_{i1}(1 - m_{i0})\Delta D_i + l_{i1}\Delta X_i + l_{i1}\ (m_{i0} - m_{i1})D_{i1} + (\Delta l_i)\ Q_{i0} \qquad (6)$$

The first term on the right hand side measures the impact of changes in domestic demand on employment, the second the effect of changes in exports, the third the impact of the total change in import penetration and the final term indicates the effect of productivity changes. Since we are interested in the effect of Chinese imports on domestic employment, this can be calculated by replacing the third term by the calculation of the loss by domestic producers to China, as estimated above.

There are several limitations to the method used here, particularly in relation to the estimation of the employment impacts of Chinese competition. First, it only relates to the direct effects of Chinese imports and does not take into account the indirect impacts on suppliers of a reduction in domestic production. Thus calculated changes in employment in spinning and weaving, for example, only relate to the imports of Chinese yarns and woven fabrics and do not take into account indirect or upstream effects arising from displacement

[16] Displacement of imports from other countries by Chinese goods is not included since this has no effect on employment in South Africa.

of domestic clothing production, which affect the domestic market for South African textile manufacturers. This would require estimation of total employment coefficients and not just the direct coefficients that have been used here.

A second limitation of the decomposition analysis is that it assumes that the various components are independent of each other. In practice it is quite likely that changes in labour productivity are related to changes in import penetration. This can occur because firms need to increase their productivity to remain competitive in the face of import competition. Wood (1994) refers to this as "defensive innovation" and the relationship has been formalized in theoretical models developed by Acemoglu (2002) and Thoenig and Verdier (2003). [17]

Finally, no account is taken of the impact of Chinese competition on prices and hence on the profitability of domestic producers. If domestic firms maintain their market share through reduced prices and profitability in the short term, this may in the long run lead to lower levels of investment and loss of competitiveness.

These issues cannot be analysed within the decomposition framework used here and need to be explored using different approaches. One such approach is the application of econometric techniques to estimate the conditional relationship between Chinese imports and output or employment in South African manufacturing industries. This is the second approach followed in the paper.

Econometric Estimation

The availability of industry level data over time lends itself to the use of econometric methods for panel data models. These techniques are used to estimate the conditional impacts of trade with China on manufacturing employment and prices in South Africa.

Following Milner and Wright (1998), the impact of trade on labour is estimated using a labour demand function derived from a standard Cobb-Douglas production function.[18] The basic labour demand relationship is specified as:

$$\ln L_{it} = \delta_0 - \delta_1 \ln A_{it} - \delta_2 \ln\left(\frac{w}{r}\right)_{it} + \delta_3 \ln Q_{it} + \upsilon_{it} \ , \quad \delta_1, \delta_2, \delta_3 > 0 \qquad (7)$$

where *w* is wage rate, *r* is rental, *Q* is output, *L* is labour, *A* is total factor productivity and the subscripts *i* and *t* denote industry and time respectively. To include trade effects Greenaway *et al.* (1999) assume technical efficiency to be dependent on trade and therefore the parameter *A* is taken to equal:

$$A_{it} = e^{\lambda_0 T_i} M_{it}^{\lambda_1} X_{it}^{\lambda_2} \ , \quad \lambda_0, \lambda_1, \lambda_2 > 0 \qquad (8)$$

where *T* is a time trend, *M* is import penetration and *X* is export orientation. Substituting Equation (8) into Equation (7) yields

[17] The theoretical foundations of factor content analyses used to calculate the impact of trade on labour are also weak (Leamer, 2000).

[18] See the applications by Dunne and Edwards (2007) on South Africa using 28 industrial sectors between 1970 and 2002 and Castro et al. (2009) on Argentina over the period 1991 to 2003.

$$\ln L_{it} = \alpha_0 - \alpha_1 \ln M_{it} - \alpha_2 \ln X_{it} - \alpha_3 \ln\left(\frac{w}{r}\right)_{it} + \alpha_4 \ln Q_{it} - \alpha_5 T + \upsilon_{it} \qquad (9)$$

This equation forms the basis of the labour demand estimations conducted in this paper. Demand for labour is a negatively related to relative wages and is positively related to output. Negative coefficients on the trade variables, indicate that trade has induced a reduction in the amount of labour per unit of output (improved labour productivity) through its impact on technological change. To test the sensitivity of labour demand to competition from China, import penetration is split into the component attributed to China and the component attributed to imports from the rest of the world.

To evaluate the impact of Chinese import competition on domestic prices, a simple price model based on Feenstra (2004: 236) is estimated

$$\ln P_{it} = \eta_i - \delta_1 \ln M_{it} + \delta_2 \ln P_{it}^{*} + \delta_3 \ln ulc_{it} + \delta_4 \ln(1 + tariff_{it}) + \lambda_t + \upsilon_{it} \qquad (10)$$

where *P** denotes foreign prices (proxied by US Producer Prices converted to South African local currency); *tariff* a measure of import protection; *ulc* unit labour costs and *M* an indicator of Chinese import competition. Increases in unit labour costs, a proxy for marginal production costs, are expected to raise domestic prices. Increased international competition, measured either through lower foreign prices, lower tariffs and increases in import penetration reduce domestic prices by lowering mark-ups, and in the case where these variables refer to intermediate inputs used by that sector, through lower production costs. [19]

In estimating the employment and price relationships, a number of problems needed to be dealt with. Firstly, the data used is relatively aggregated (44 manufacturing industries) with the consequence that the results are influenced by changes occurring within firms as well as changes in composition of firms within industries. For example, it is also possible, particularly where competition from low wage countries is concerned, that the most labour-intensive parts of each industry will contract or disappear, thus raising the average level of productivity in the surviving industry. Part of what is attributed to productivity in the econometric analysis (and the decomposition analysis) can therefore be an indirect consequence of increased import penetration.[20]

A second concern relates to potential biases associated with the estimated relationships above. Labour demand and prices are likely to show persistence. The inclusion of lagged dependent variables in the econometric estimates can account for this inertia, but lead to biased coefficients in a panel setting where industry fixed effects are included and the time dimension is short (Bond, 2002). A further concern is the potential endogeneity of wages and output in the labour demand equation. An additional consideration is the potential endogeneity of import penetration. Import penetration is an outcome of various influences including protection, foreign and domestic demand and supply conditions.

[19] According to the input-output tables for South Africa, many industries source 40 percent or more of their intermediate inputs from other firms within the same industrial sector.

[20] See Melitz (2003) and Bernard et al. (2007).

Domestic shocks may therefore affect employment, output, wages and imports simultaneous. Some of these effects can be captured through the inclusion of industry and time fixed effects, but endogeneity problems may nevertheless persist.

The approach followed in this paper is to use a variety of estimators and model specifications to identify the influence of China on the variables of interest. These include a simple static fixed effect model with industry and time fixed effects, a two-stage least square estimation of a static fixed effect model with import penetration from China instrumented using China's share of low and middle income imports (excluding South Africa), and a dynamic fixed effects model (specified as a partial adjustments model) estimated using the first-differenced generalized methods of moment (GMM) estimator of Arellano and Bond (1991). In the GMM estimator, the variables are differenced to transform out the fixed effects and lagged levels are then used as instruments for the (now differenced) lagged dependent variable. In the GMM employment estimates import penetration and wages are assumed to be endogenous and instrumented accordingly (Bond 2002; Roodman, 2009).

southern africa labour and development research unit

The Southern Africa Labour and Development Research Unit (SALDRU) conducts research directed at improving the well-being of South Africa's poor. It was established in 1975. Over the next two decades the unit's research played a central role in documenting the human costs of apartheid. Key projects from this period included the Farm Labour Conference (1976), the Economics of Health Care Conference (1978), and the Second Carnegie Enquiry into Poverty and Development in South Africa (1983-86). At the urging of the African National Congress, from 1992-1994 SALDRU and the World Bank coordinated the Project for Statistics on Living Standards and Development (PSLSD). This project provide baseline data for the implementation of post-apartheid socio-economic policies through South Africa's first non-racial national sample survey.

In the post-apartheid period, SALDRU has continued to gather data and conduct research directed at informing and assessing anti-poverty policy. In line with its historical contribution, SALDRU's researchers continue to conduct research detailing changing patterns of well-being in South Africa and assessing the impact of government policy on the poor. Current research work falls into the following research themes: post-apartheid poverty; employment and migration dynamics; family support structures in an era of rapid social change; public works and public infrastructure programmes, financial strategies of the poor; common property resources and the poor. Key survey projects include the Langeberg Integrated Family Survey (1999), the Khayelitsha/Mitchell's Plain Survey (2000), the ongoing Cape Area Panel Study (2001-) and the Financial Diaries Project.

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