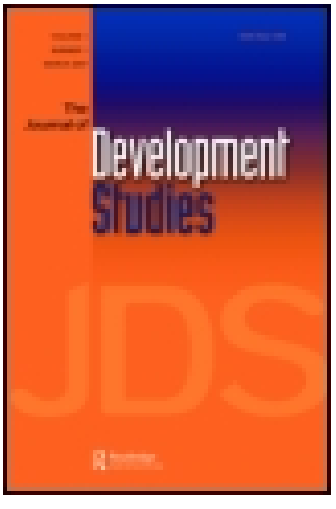

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The Impact of Chinese Import Penetration on the South African Manufacturing Sector

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ABSTRACT *This article uses a Chenery-type decomposition and econometric estimation to evaluate the impact of Chinese trade on production and employment in South African manufacturing from 1992 to 2010. The results suggest that increased import penetration from China caused South African manufacturing output to be 5 per cent lower in 2010 than it otherwise would have been. The estimated reduction of total employment in manufacturing as a result of trade with China is larger – in 2010 about 8 per cent – because the declines in output were concentrated on labour-intensive industries and because the increase in imports raised labour productivity within industries.*

1. Introduction

The lack of dynamism of the manufacturing sector has been seen as a key factor explaining slow growth and high unemployment in South Africa since the ending of apartheid (DTI, 2010; Rodrik, 2008). Concerns have been expressed over the 'deindustrialisation' of the economy (Maia, 2011) reflected in falling shares of manufacturing in GDP and employment, which over the past decade 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 World Trade Organisation (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 deindustrialisation and become an issue in South Africa's engagement with China. President Zuma commented 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*, 2012).

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 imports from China (Morris & Einhorn, 2008). The Free Trade Agreement between the South African Customs Union (SACU) and China first mooted in 2004

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faced considerable opposition by business associations (Lennox, 2008) and unions (Mde, 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 (Langeni, 2012).

Despite these concerns, there have been no comprehensive studies that attempt to analyse the impacts of trade with China on the South African manufacturing sector. This article seeks to fill that gap, drawing on a database of 44 manufacturing industries covering the period 1992–2010 (see the Online Appendix for details). Two approaches – a Chenery-type decomposition and econometric estimation – are used to evaluate the impact of Chinese trade on production and employment in South African manufacturing.

The analysis reveals that Chinese penetration of the South African market 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, and labour-intensive industries were particularly badly affected by imports from China, implying that the negative impact on employment in manufacturing was more than proportional to the output displacement. In addition, Chinese import penetration tended to reduce the employment intensity of production, raising productivity within industries. There is also evidence that imports from China contributed towards lower producer price inflation in South Africa, which moderated increases in consumer prices and helped to curtail production cost increases.

The remainder of the article is structured as follows. The next section describes the evolution of Chinese-South African trade flows at the product and industry level and discusses the impact that these have had on producer prices in South Africa. Section 3 looks at the impact on South African manufacturing production, while section 4 focuses on the impact of Chinese import penetration on manufacturing employment. Section 5 concludes.

2. South Africa Trade Flows

2.1 Growth and Structure of South Africa Trade

Trade between South Africa and China has grown dramatically since China joined the WTO in 2001. Based on UN Comtrade (2012) data, 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. This places China as the dominant source of South Africa's imports, with a share of 18.5 per cent in 2010 (up from 5% in 2000), ahead of Germany, the United States of America and Japan (UN Comtrade, 2012). While China has also become the dominant destination for South African exports (with a share of 11% in 2010), the country has run a trade deficit with China throughout the period, which has tended to increase over time.

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 1). This is reflected in the trade balances

Table 1. South African trade with China by type of product (per cent total)

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

between the two countries, with South African having surpluses in processed raw materials and primary products and large deficits in consumer and capital goods.

2.2 Industry Analysis of South African Imports from China

The growing Chinese presence in South Africa's total imports is reflected in the scope and dominance of imports from China in specific products and manufacturing industries. Table 2 reports the share of China in total South African imports and total domestic consumption for 44 manufacturing industries in 2000 and 2010. In the mid-1990s, China dominated as a source of imports in the traditional labour-intensive sectors such as clothing, footwear and other manufactures (toys), but by 2010 its dominance had also shifted to high-technology electronic and machinery sectors. For example, China accounted for between 48 per cent and 77 per cent of total South African imports of knitted and crocheted fabrics, clothing, leather and leather products, footwear, household appliances, electrical lamps, furniture and other manufacturing in 2010. 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 and share of total imports rose dramatically over the period.[2]

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, and with 'consumption' defined in this article as domestic absorption, including intermediate input use as well as all final demand). On aggregate, imports from China rose from a negligible 0.4 per cent of domestic consumption in 1995 to 5.9 per cent 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 of the South African market.

Looking across the sectors, all manufacturing industries in South Africa experienced increases in Chinese import penetration ratios between 2000 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 one percentage point from 2000 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 imports from China in domestic consumption were recorded from 2000 to 2010 in knitted and crocheted fabrics (38.4 percentage points); footwear (32.2 percentage points); television, radio and other electronic equipment (28.5 percentage points); clothing (22.4 percentage points); electric lamps and lighting equipment (21.8 percentage points); and general purpose machinery (19.4 percentage points).

2.3 Imports from China and Domestic Prices

These imports from China have been associated with downward price pressure on South African producers. Figure 1 presents the weighted average price of South African imports of manufactured goods from China relative to imports from other countries, based on unit values at the HS six-digit level. Imports from China are around 63 per cent of the price (unit value) of imports from other developing countries and only a third of the price of imports from developed countries.

The large differences in import unit values across countries within the disaggregated HS six-digit categories are suggestive of a high degree of within-product product specialisation.[3] Similar heterogeneity in import prices within disaggregated product categories is found for the US (Fontagné, Gaulier, & Zignago, 2008; Schott, 2008). 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 import competition.

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

Table 2. Share of imports from China in total South African imports and domestic consumption, 2000–2010

SIC	Industry description	Share of China in total SA imports (percentage)		Chinese import penetration (per cent of consumption)	
		2000	2010	2000	2010
301	Meat, fish, fruit, vegetables, oils & fat	4.1	4.3	0.6	0.9
302	Dairy products	0.0	0.8	0.0	0.0
303	Grain milling & animal feeds	0.2	4.1	0.0	0.4
304	Other food products	0.5	4.0	0.0	0.3
305	Beverages	0.1	0.2	0.0	0.0
311	Spinning and weaving	10.1	43.5	2.8	18.2
312	Other textiles	12.1	38.2	1.7	12.6
313	Knitted and crocheted fabrics	13.8	66.7	3.7	42.2
314/5	Clothing	51.9	75.1	5.9	28.3
316	Leather and leather products	17.7	49.0	6.0	19.1
317	Footwear	40.6	76.8	13.7	45.8
321	Sawmilling and planing of wood	0.0	5.8	0.0	0.8
322	Wood and wood products	5.2	24.6	0.5	2.1
323	Paper and paper products	0.4	8.6	0.1	1.3
324	Publishing	0.9	5.7	0.2	1.4
325/6	Printing and related services	10.2	43.0	0.1	0.4
331/2	Coke oven and petroleum products	10.6	2.8	0.8	0.7
334	Basic chemicals	3.5	12.6	1.4	5.4
335/6	Other chemicals	1.7	7.2	0.6	2.7
337	Rubber products	2.5	23.1	0.6	9.6
338	Plastic products	7.7	22.3	1.1	3.4
341	Glass and glass products	6.7	38.6	1.6	8.8
342	Non-metallic mineral products	7.3	25.0	1.1	4.0
351	Basic iron and steel	3.6	16.4	0.5	3.6
352	Non-ferrous metals	2.3	9.4	0.4	2.8
354	Structural steel products	1.5	13.4	0.0	1.1
355	Other fabricated metal products	9.9	32.2	1.7	7.1
356/59	General purpose machinery	5.1	23.8	3.2	22.6
357	Special purpose machinery	1.5	17.8	0.7	11.0
358	Household appliances	17.8	62.6	2.9	21.1
361	Electrical motors, generators and transformers	6.2	23.4	1.7	10.9
362	Electricity distribution and control apparatus	1.8	12.8	1.0	6.6
363	Insulated wire and cable	4.2	24.1	0.4	4.6
364	Accumulators and batteries	5.9	28.0	1.7	9.5
365	Electric lamps and lighting equipment	21.2	59.9	8.8	30.6
366	Other electrical equipment	3.2	18.8	0.8	5.9
371/2/3	TV, radio and other electronic equipment	3.9	33.5	3.2	31.7
374/5/6	Medical, measuring and controlling equipment	2.8	9.6	1.9	7.7
381	Motor vehicles	0.1	3.0	0.0	1.5
382	Bodies for motor vehicles	0.7	32.6	0.1	3.7
383	Parts and accessories for motor vehicles	0.8	8.6	0.1	1.5
384/5/6/7	Other transport equipment	1.1	3.8	0.6	1.9
391	Furniture	6.1	48.1	1.0	14.7
392	Other manufacturing	21.3	48.7	2.3	8.0
	Total	4.9	18.5	1.1	5.9

Source: Authors' calculations using UN Comtrade (2012), Industrial Development Corporation (IDC) and Statistics South Africa (2011a, b, c, d) data.

Notes: Chinese import penetration is calculated as the ratio of imports from China to total consumption, with the latter calculated as total domestic sales plus total imports minus total exports. Consumption here includes intermediate inputs and final demand. Tobacco products are excluded as sales data are not provided by Statistics South Africa.

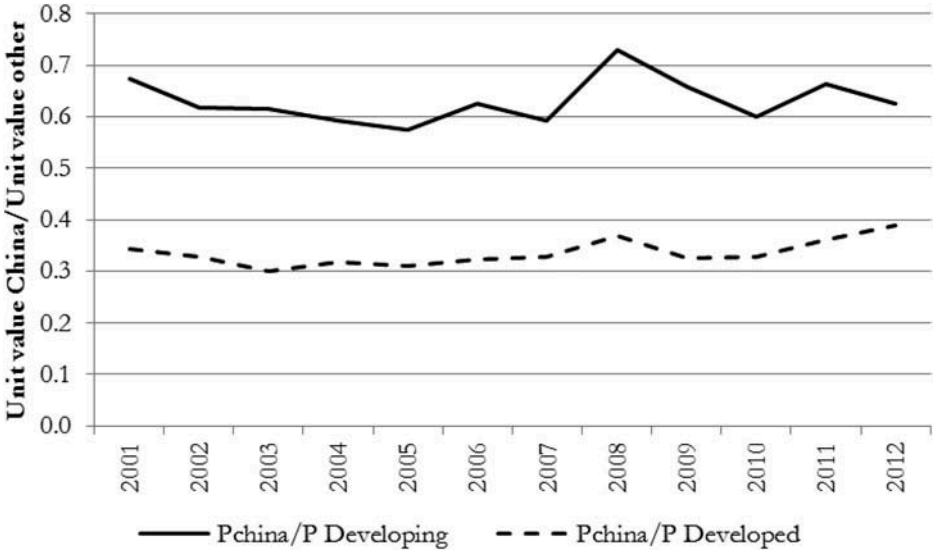

Figure 1. Price per unit of imports of manufactured goods from China relative to imports from other countries, 1992–2009.

Source: Own calculations using UN Comtrade (2012) data.

Notes: Developing countries include low- and middle-income economies, excluding China. Developed countries include high-income OECD countries. Relative unit values of South African imports of manufactured goods are calculated using six-digit level of the Harmonised System, Revision 88/92. The aggregate price per unit import for each of the developed and developing country groups is first calculated by dividing total South African import values by quantity at the HS six-digit level for each of these country groupings. The price per unit of imports (at the HS six-digit level) from China relative to imports from the country groupings is then constructed. The figure presents the weighted average relative unit value calculated using annual Chinese import values as weights.

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 per cent per year from 2000 to 2011, which was less than half the 6.3 per cent annual increase in the producer price of South African produced manufactured goods.[4]

It is these price pressures and strong increases in import penetration, 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 imports from China in 2007 and 2008 (Edwards, Naughtin, & Rankin, 2011; Edwards & Rankin, 2012; Morris & Reed, 2008). Were it not for these quotas, the level and increase in import penetration in clothing may have been even higher.

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. Imports of intermediate and capital goods from China may have enhanced productivity and stimulated output growth in downstream industries. In simple accounting terms, imports from China 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.

Although the threats and opportunities associated with bilateral trade with China receive considerable media attention, there are no detailed studies of the direct impact of China on South African manufacturing output and employment.

There is some evidence that Chinese competition reduced prices of products in South Africa, particularly of clothing, leather products and footwear (Edwards & Jenkins, 2013a; Edwards &

Rankin, 2012; Morris & Einhorn, 2008; Rangasamy & Swanepoel, 2011; Villoria, 2009). For example, Edwards and Jenkins (2013a) present econometric estimates of a producer price equation using 44 manufacturing industries (excluding tobacco) over the period 1993 to 2009. They estimate that Chinese import penetration reduced producer price inflation by around 0.3 per cent per year from 2005 to 2010. Imports from China therefore moderated increases in consumer prices and helped to curtail production cost increases. However, the downward pressure on producer prices from imports from China will also have increased pressures on competing South African producers. The implications of these price decreases for production and employment in South African manufacturing industries have not been comprehensively explored.

There are, however, a number of previous studies of South African manufacturing which have looked at the impact of trade liberalisation or globalisation more generally on production, trade and employment (Dunne & Edwards, 2007; Edwards, 2001a, 2001b; Fedderke, 2006; Jenkins, 2008; Jonsson & Subramanian, 2001). In this article we extend this type of analysis to identify the effects of increased imports from China on production (Section 3) and employment (Section 4) in South African manufacturing industries from the early 1990s to 2010. Details on the empirical methods used are presented in the relevant sections.

3. The Direct Impact of Chinese Competition on Production

The impact that price reductions from Chinese competition 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 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.

In order to explore the relationship between changes in import penetration and local production, a Chenery (1979) style decomposition was used to separate out the direct contributions of domestic demand, exports and changes in import penetration to changes in sales.

The decomposition starts from the basic accounting identity that:

$$Q_{it} = D_{it} + X_{it} - M_{it} \tag{1}$$

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, and M_{it} is imports of industry i at time t.

Defining import penetration in industry i at time t as:

$$m_{it} = M_{it}/D_{it} \tag{2}$$

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

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

The first term on the right-hand side denotes the contribution of changes in domestic demand for intermediate and final goods to domestic output. The second term measures the contribution of changes in exports, while the third term captures the contribution of changes in import penetration on domestic output.

There are two important limitations to the Chenery decomposition technique applied here to estimate the impact of Chinese import competition on domestic output. The decomposition is an accounting identity that ignores the inter-dependency between exports, import penetration and final

demand. For example, lower-priced imports of consumer goods may boost domestic absorption. Lower-priced imported inputs may reduce costs and thus increase domestic production and exports. Hence, imports may account for some of the growth in domestic output attributed to the first two terms of the decomposition equation.

The second limitation is that imports are assumed to be perfect substitutes for domestic output. The final term in the decomposition, which shows how output is affected by the rise in import penetration, given the level of demand in the final period, is only if imports and domestic output are perfect substitutes.[5] In reality, and as suggested by the vast variation in imported prices of similar products shown earlier, we expect imports and domestic goods to be partial substitutes. Consequently, the decomposition exaggerates the effect of import penetration on domestic output.

Bearing these limitations in mind, we use the decomposition Equation (3) to calculate the displacement of domestic product by imports. The decomposition 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 imports from China began to increase their penetration significantly.

Table 3 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 liberalisation 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.

While similar decomposition techniques have been applied to South African data (Dunne & Edwards, 2007; Edwards, 2001a, 2001b; Jenkins, 2008), these studies focus on displacement effects arising from total trade and not bilateral trade flows. Since we are interested in the impact of imports from China on domestic production, it is necessary to carry out a further decomposition to separate out the effects of imports from China and imports from the rest of the world:

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

where m_{Ci} is the share of imports from China in total domestic absorption and m_{Ri} is the share of the rest of the world. This disaggregation is useful as it illustrates that an increase in Chinese import penetration can come at the expense of domestic production or imports from other countries (or both). For example, if imports from China only displace foreign imports, there will be no net increase in import penetration and the third term will be reduced to zero.[6]

The question of how to divide gains and losses in market shares between different countries has been addressed in constant market share (CMS) analysis of international trade (Batista & Azevedo, 2002). Although CMS analysis is usually applied only to shares of a country's imports, there is no reason in principle that it cannot be applied to total market shares including domestically produced goods. The simplest approach to this problem is to assume that countries that gained market share in a

Table 3. Chenery decomposition of changes in South African manufacturing output, 1992–2001, 2001–2010 (billion rand)

	1992–2001	2001–2010
Growth of domestic demand	93.9	120.6
Exports to China	1.6	4.7
Exports to ROW	92.3	23.3
Increased import penetration	−60.3	−63.2
Change in sales	127.4	85.3

Source: Authors' calculations using UN Comtrade (2012) and Statistics South Africa (2011c, d) data.

Table 4. Loss of market share by domestic producers to China

	1992–2001	2001–2010
Total gain by China (R. bill)	7.24	41.38
Gain from domestic producers (R bill)	7.16	30.30
As % of total gain (%)	98.90	73.19
As % of domestic sales in base year (%)	1.50	5.00

Source: Authors' calculations using UN Comtrade (2012) and Statistics South Africa (2011c, d) data.

particular product would have only gained from those that lost market share in the same product. The gain of any country that gained market share can then be distributed between those countries that lost market share according to the latter's share in the total loss by product.

This is the approach used here to estimate the displacement of domestic production by imports from China. 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. If, however, the share of local production in domestic demand has fallen along with a fall in the share of imports from the rest of the world, the entire loss of market share by local producers is attributed to increased import penetration from China. On this basis it is possible to calculate the extent to which China has displaced both other imports and local production over specific periods of time.[7]

Table 4 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 imports from China 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.[8]

The results suggest that increased import penetration from China from 1992 to 2010 caused manufacturing output in 2010 to be about 5 per cent lower than it otherwise would have been.[9] To put it in another way, in the absence of trade with China, the sales of South Africa's manufacturing industry would have risen in real terms between 1992 and 2010 by 52 per cent rather than the actual rise of 45 per cent (or 19% as opposed to 14% from 2001 to 2010).

The aggregate data also hide considerable variations between industries. Table 5 shows the loss in sales due to Chinese import penetration and the corresponding growth of total sales by domestic producers (including exports) in real terms for the 13 industries most affected by Chinese import penetration over the period 2001–2010.

Losses in sales were particularly high in textiles and clothing, footwear and leather, electrical and electronic products and some types of machinery. Of the 13 industries, six showed an absolute decline in sales, while a further three showed minimal growth. Only four industries (leather and leather products, medical appliances, household appliances and television, radio and other electronic equipment) that had significantly lost market share to China still enjoyed significant growth in sales.

4. The Impact of Chinese Competition on Employment

A major issue of concern in relation to import competition from China 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.

Table 5. Industries in which loss to Chinese imports between 2001 and 2010 represented more than 10 per cent of 2001 production

	Loss to China (per cent)	Growth in manufacturing sales (per cent)
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: Authors' calculations using UN Comtrade (2012) and Statistics South Africa (2011c, d) data.

To evaluate the employment impact of changes in Chinese import penetration, we extend the Chenery decomposition technique developed earlier. Employment changes are a result of changes in output and changes in labour productivity, where labour productivity is defined as Employment (L_{it}) per unit output (Q_{it}). This relationship is represented as:

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

Substituting the Chenery decomposition Equation (3) into Equation (5) gives:

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

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 labour productivity changes.

To estimate the impact of trade with China on manufacturing employment, we first replace the $(m_{i0}–m_{i1})D_{i1}$ part of the third term with the estimates from the previous section of the effect of Chinese import penetration on manufacturing output. We then apply econometric techniques to identify the contribution of Chinese import penetration to increases in industrial labour productivity (the fourth term)

4.1 Chenery Decomposition

To apply the decomposition, average employment coefficients for each manufacturing industry are required. Obtaining these coefficients for South Africa is made difficult by the lack of consistently constructed employment series at the industry level. According to the enterprise-based surveys provided by Statistics South Africa (Survey of Employment and Earnings [P0271] and Quarterly Employment Statistics [P0277.1]), manufacturing employment declined from more than 1.5 million workers in 1990 to fewer than 1.2 million workers in 2010. In contrast, the household and labour force surveys suggest manufacturing employment levels of slightly more than 1.5 million in 2010 (See the Online Appendix for further details). Nevertheless, in all data sources, manufacturing declined as a proportion of overall employment in the post-2000 period when Chinese competition was at its strongest.

We calculate employment coefficients for each manufacturing industry using the Statistics South Africa (2011c) enterprise-based survey data on manufacturing sales (at 2000 prices) and numbers

employed. Given the difference between the two periods before and after China joined the WTO, the impacts were estimated for both periods.

Table 6 shows that the loss of jobs as a result of output reductions due to 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 is estimated to be five times higher than the impact of Chinese competition. In the later period, however, the situation was totally different, with output reductions as a result of increased imports from China reducing employment by more than 77,000 jobs, which represented 70 per cent of the total loss attributable to output reductions as a result of increased imports.

Looking at the other sources of employment change, 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. The main positive contribution to employment after 2001 came from the growth of domestic demand.

Table 6 also shows the loss of employment attributable to increased labour productivity in the two periods. In both periods, the loss of employment due to productivity growth is more than twice that attributable to increased import penetration. The primacy of labour productivity in driving employment changes in South African manufacturing is also found by Edwards (2001a), Dunne and Edwards (2007) and Jenkins (2008).

Table 7 shows the 12 industries that account for the bulk of the job losses associated with output reductions due to Chinese import penetration (85% of the total in Table 6). Eight of the 12 industries experienced a fall in 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

Table 6. Changes in employment, 1992–2001 and 2001–2010 (thousand)

	1992–2001	2001–2010
Growth of domestic demand	140.6	208.9
Exports to China	2.6	4.1
Exports to ROW	174.7	10.0
Increased import penetration	−144.7	−110.3
(of which Chinese import penetration)	−24.1	−77.8
Productivity growth	−352.6	−226.1
Total change in employment	−179.5	−113.5

Source: Authors' calculations using UN Comtrade (2012) and Statistics South Africa (2011a, b, c, d) data.

Table 7. Estimated job losses as a result of increased import penetration from China, 2001–2010

	Employment loss (thousand)	Total change in employment (per cent)
Clothing	22.6	−45.0
General purpose machinery	12.7	50.9
Special purpose machinery	7.2	15.3
Knitted and crocheted fabrics	4.0	−52.9
Other textiles	3.1	−21.8
Spinning and weaving	2.9	−37.2
Footwear	2.5	−55.3
TV, radio and other electronic equipment	2.5	−16.6
Other chemicals	2.4	29.6
Other electrical equipment	2.1	4.5
Other fabricated metal products	2.0	−4.2
Furniture	1.9	−40.4

Source: Authors' calculations using UN Comtrade (2012) and Statistics South Africa (2011a, b, c, d) data.

decline in manufacturing employment of 9 per cent over the period. The only sectors where employment increased during the period, despite Chinese competition, were machinery, other chemicals and other electrical equipment.

There are several factors which could potentially lead to over- or under-estimation of the impact of imports from China on South African employment. Following on from our earlier caveats regarding the effect of import penetration on output, the assumption that Chinese and South African products are perfect substitutes is likely to bias upwards our estimates of employment losses attributed to rising import penetration.[10]

The estimates of the employment effects also depend on the method used to attribute the gains in China's market share to losses by domestic producers and by other exporters. Using the alternative Batista (2008) method to separate out the effects of imports from China gives lower estimates of the negative effect on employment of around 21,000 between 1992 and 2001 and 64,000 between 2001 and 2010.

4.2 Trade and Technology

In contrast, the assumption that changes in labour productivity are independent of trade with China tends to lead to an underestimation of the employment effects of increased imports and is unlikely to hold in practice. In the face of increased competition from imports, domestic firms may 'defensively innovate' by upgrading capital stock, upgrading skills and reducing employment (Acemoglu, 2002; Bloom, Draca, Reenen, 2011; Mion & Zhu, 2013; Thoenig & Verdier, 2003; Wood, 1994;). Aggregate industry productivity is also expected to rise as less efficient firms exit or experience relatively large declines in output in the face of import competition (Bernard, Jensen, & Schott, 2006; Melitz, 2003; Pavcnik, 2002).[11]

Job losses from rising labour productivity in Equation (6) can therefore in part be attributed to increased competition from imports. To isolate the contribution of Chinese import penetration to rising labour productivity, econometric estimates were made of the within-industry labour productivity relationship from 1992 to 2009 for the 44 manufacturing sectors. The approach followed is to regress the real volume of sales per worker on various explanatory factors including Chinese import penetration.[12] Industry and time fixed effects are included to account for unobserved industry effects and common trends in labour productivity across all sectors.

The first column of Table 8 presents the results of the most basic model that separately includes import penetration by China and the rest of the world. Import penetration is positively correlated with output per worker, but only for China. A coefficient of 0.733 is estimated on Chinese import penetration in column 1, but it falls to 0.486 in column 2 once additional control variables such as the ratio of capital to labour, US total factor productivity and export orientation are included in the regression. The coefficient on the capital–labour ratio is positive and highly significant, as is expected, although increases in the capital–labour ratio could themselves be a consequence of firm responses to import competition. The inclusion of the capital–labour variable may bias downward the true effect of import competition.

Interestingly, the coefficient on import penetration by the rest of the world is significant and negative, suggesting that rising import penetration reduces labour productivity. One explanation is that the coefficient is spurious and reflects the coincidence of falling rest of world import penetration from 2001 to 2010 in the face of imports from China and rising labour productivity. The coefficient on Chinese import penetration is robust to the exclusion of import by the rest of the world, whereupon it rises by approximately 10 percentage points.

One concern with these estimates is that unobserved demand and supply shocks may simultaneously affect employment, output and imports, leading to biased estimates of the import penetration coefficient. In addition, we anticipate reverse causation effects that will also bias the estimates. For example, rising firm productivity in response to competition raises the competitiveness of domestic producers, which in turn reduces imports. To address these problems with respect to our variable of interest, we instrument Chinese import penetration using China's share in low- and middle-income country

Table 8. Regression results for labour productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Extended		High-wage sectors	Low-wage sectors	Imported inputs	Imported inputs by source
Variables	Basic		(IV)	(IV)	(IV)	(IV)	(IV)
Import penetration, China	0.733**	0.486**	0.504*	−0.357	1.035**	0.394+	0.274
	(0.173)	(0.135)	(0.235)	(0.617)	(0.281)	(0.230)	(0.327)
Import penetration, other	−0.838**	−0.529**	−0.526**	−0.758**	−0.395	−0.611**	−0.670**
	(0.136)	(0.154)	(0.158)	(0.225)	(0.302)	(0.159)	(0.162)
ln(Capital/Labour)		0.498**	0.498**	0.667**	0.275**	0.494**	0.499**
		(0.045)	(0.044)	(0.064)	(0.050)	(0.043)	(0.042)
Ln(US TFP)		−0.002	−0.002	−0.318	0.288*	0.023	0.085
		(0.114)	(0.114)	(0.218)	(0.123)	(0.111)	(0.117)
Export orientation		−0.186+	−0.189+	0.202	−0.652**	−0.173+	−0.139
		(0.103)	(0.106)	(0.162)	(0.188)	(0.105)	(0.106)
Import penetration in inputs						0.743*	
						(0.312)	
Import penetration in inputs, other							0.652+
							(0.360)
Import penetration in inputs, China							2.054*
							(0.853)
Constant	0.408**	−2.557**	−2.554**	−2.709**	−2.506**	−2.651**	−2.961**
	(0.045)	(0.515)	(0.512)	(0.855)	(0.583)	(0.504)	(0.528)
Observations	792	792	792	396	396	792	792
R-squared	0.963	0.975	0.975	0.968	0.983	0.975	0.975

Notes: Estimates based on annual data for 44 industries from 1992–2009. The dependent variable is the volume of sales per worker. US total factor productivity (TFP) data are obtained from the US Bureau of Labor Statistics (2011). Capital stock (in 2005 prices) are obtained from Quantec Ltd. (2012). Export orientation is measured as share of exports in sales and import penetration is calculated as imports/(sales–exports + imports). Both trade measures are calculated using sales data from Statistics South Africa and trade data from UN Comtrade (2012). The variable *Import penetration in inputs* measures the weighted average import penetration in intermediate inputs used in each sector. Input cost shares, excluding own industry, are obtained from the 2000 Supply-Use tables produced by Statistics South Africa and used as weights. IV refers to two-stage least square estimation results where China's share in low and middle income country imports is used to instrument Chinese import penetration. Year dummies and industry fixed effects are included in all regressions. Robust standard errors are presented in parentheses. $^{**}p < 0.01$, $^{*}p < 0.05$, + p < 0.1

(excluding South Africa) imports. Our results presented in column 3, reveal a slightly stronger positive impact of Chinese import penetration on labour productivity. The results suggests that a 1 percentage point increase in Chinese import penetration is associated with a 0.5 per cent increase in output per worker within the industry.[13]

There are important cross-sector composition effects. In columns 4 and 5, we split the sample into above and below median wage industries and re-estimate the relationship using instrumental variable (IV) estimation. Chinese import competition has the strongest positive impact on output per worker in low-wage industries where a coefficient of 1.04 is estimated. No significant association is found for high-wage industries.

What is missing from the analysis is the effect on labour productivity of increases in import penetration in intermediate inputs. As shown by Amiti and Konings (2007) access to cheaper imported inputs can raise productivity via learning, variety and quality effects. Access to new input varieties can also stimulate output growth and the introduction of new products (Goldberg, Khandelwal, Pavcnik, & Topalova, 2010). These effects may be considerable in the case of Chinese competition. A high proportion of South African imports from China are made up of intermediate inputs and capital goods (Table 1).

To explore this further, column 6 includes the weighted average import penetration in intermediate inputs used in each industry. Input cost shares, excluding own industry, obtained from the 2000 Supply-Use tables produced by Statistics South Africa are used as weights. Column 7 splits import penetration in inputs into that attributable to China and the rest of the world.

The results reveal that a rising share of imports in intermediate inputs is an important factor contributing towards the increase in output per worker. This may arise from the outsourcing of production process to foreign firms, as well as the importation of labour saving technology embodied in inputs. In column 7, we note that the coefficient on Chinese import penetration in consumption loses significance once Chinese import penetration in intermediate inputs used by each sector has been included. The dominant channel through which China has affected labour productivity may therefore be through its indirect effect on production costs rather than the direct competitive impact.

A final limitation of these estimates is that we are unable to disaggregate the industry level effects into within-firm and between-firm effects. Rising industry productivity associated with Chinese import penetration may originate from increases in productivity within-firms, as well as across-firm composition effects driven by exit of low productivity firms. Firm-level data are required to disentangle these effects.

4.3. Total Employment Impact

Bearing in mind the various caveats noted earlier and differences in the effect of import penetration across industries, we can use the estimated coefficients to isolate the aggregate contribution of Chinese import penetration to the loss of employment through increased labour productivity. Drawing on the Chinese import penetration coefficient of –0.5 from column 3 in Table 8, we calculate that improvements in aggregate labour productivity associated with Chinese competition reduced employment in manufacturing by 43,000 over the period 1992–2010. This makes up 7.5 per cent of the 578,000 jobs lost due to improvements in labour productivity according to the Chenery decompositions (see Table 6).

These results combined with the employment losses from lower output calculated in the decomposition analysis suggest that Chinese import penetration from 1992 to 2010 may have contributed to a reduction in South African manufacturing employment opportunities of up to 145,000 manufacturing jobs (102,000 directly and 43,000 indirectly through labour productivity). This is equivalent to 45 per cent of the total loss in manufacturing jobs over the period. Alternatively, import penetration from China from 1992 is estimated to have caused employment in South African manufacturing in 2010 to be 8.2 per cent lower than it otherwise would have been. The effect on employment is larger than on output because the effects of Chinese import penetration on output and labour productivity were concentrated in labour-intensive industries.

5. 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 China. It is now the largest source of imports to South Africa both in aggregate and in 27 out of 45 manufacturing industries.

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 article 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 billion. The displacement of South African manufacturing over the full 1992 to 2010 period caused output in 2010 to be about 5 per cent lower than it otherwise would have been.

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 per cent 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, Edwards and Jenkins (2013b, 2014) find that South Africa has also lost market share to China in its major export markets.

We also find a negative overall impact of Chinese competition on manufacturing employment in South Africa. First, there was the loss of approximately 102,000 jobs associated with the displacement of local production by imported goods from 1992 to 2010. Second, Chinese import penetration raised labour productivity within industries, leading to a further decline in employment of 43,000 jobs. Together, these effects caused employment in South African manufacturing in 2010 to be 8.2 per cent lower than it otherwise would have been.

The effect of trade with China on output and employment in South African manufacturing is significant, but on aggregate still makes up a relatively small share of total output and employment. However, some industries, particularly the labour-intensive clothing, footwear and textile industries, have experienced disproportionate and rapid reductions in output and employment, leading to considerable adjustment costs for employees and firm owners in these industries.

Our analysis has also focused mainly on the 'threats' associated with Chinese competition. 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. In addition, the shrinkage of uncompetitive firms and the elimination of inefficient firms may have left the South African manufacturing industry better placed for expansion in future.

Further, we have only addressed the impact of Chinese competition on the manufacturing sector 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 (Morris & Einhorn, 2008). Lower-priced imports benefited consumers in the form of lower prices of many manufactured goods. These lower prices will also have contributed, through South Africa's inflation-targeting framework that governs monetary policy, to lower interest rates.

The focus on manufacturing in this article 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. Nevertheless, for an economy-wide perspective, these additional aspects require consideration.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes

1. South African Department of Trade and Industry Economic Database, available online at http://www.dti.gov.za/econdb/raportt/rapcoun.html.
2. Table A1 in the Online Appendix presents the country ranking of China as a source of South African imports by manufacturing sector classified at the three-digit standardised industrial classification (SIC) level. In 1995, China was the

principal source of imports in just three of the 45 manufacturing industries, but by 2010 this had risen to 27. All data used in this paper are available from the authors upon request.

3. A detailed analysis of import unit values of the top 20 products imported from China corroborates our finding of vast price differences in import values across countries. For example, unit values of imports of transmission apparatus incorporating reception apparatus (HS 852520), that is mobile phones – the second most important product imported from China – were substantially lower from China (64 US dollars) than from other emerging economies (151 US dollars) and from high-income countries (226 US dollars). Imports of cotton trousers (HS 620342 and HS 620462) from China were also substantially cheaper costing around 3 to 4 US dollars per item compared to 16 to 22 US dollars from high-income countries.
4. Calculations based on Producer Price Index data obtained from Statistics South Africa (P0142.1) (http://www. Statssa.gov.za). Consumer price indices for the 44 sectors are not available.
5. For example, assume an increase in imports from China of a good for which there are no domestic substitutes. The direct impact on domestic output and employment would be zero (there may be indirect effects as consumers shift expenditure from domestic goods to the imported good). A rise in M will raise import penetration $M/(Q + M - X)$, with no change in Q at all (and hence no change in employment). However, in the Chenery decomposition $(m_0 - m_1) < 0$, and the calculation will erroneously give rise to an estimated loss of domestic output and consequently employment.
6. Calculating the impact of imports from China on domestic production simply by taking the change in the share of Chinese goods in domestic absorption $(m_{Ci0} - m_{Ci1})D_{i1}$ would tend to overestimate the impact because it ignores the possibility that imports from China substitute for imports from other countries.
7. In another paper, Batista (2008) develops an alternative method of distributing gains and losses in market share which takes into account the relative growth rates of exports of different countries.
8. Using the alternative methodology proposed by Batista (2008), displacement of domestic production accounted for a lower 60 per cent share (or 4% of local production in 2001) of the total gain by China in the period 2001–2010. The lower values reflects the fact that under the Batista (2008) method some of the gains by China in a particular product are regarded as being at the expense of imports from the rest of the world, even though the share of the latter in domestic absorption has increased, provided China's share is increasing at a faster rate.
9. This value is calculated as the loss in domestic output due to Chinese imports from 1992 to 2010 divided by the sum of total output in 2010 and the loss in domestic output due to Chinese imports. A partial offset to increased import penetration from China was the increased exports to China between 1992 and 2010, which came to 6.7 billion rand (see Table 5). This was substantially less than the 37.5 billion rand displaced by increased imports from China.
10. See Leamer (2000) for a more detailed critique of using the factor content of products to calculate the impact of trade on employment and wages. See also Rodrik (1997), who argues that increases in import competition raise the derived labour demand elasticity, hence depressing wages and employment in those industries.
11. The calculations also only relate to the direct effects of imports from China and do 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 of domestic clothing production, which affect the domestic market for South African textile manufacturers. Similarly, the employment created in downstream industries retailing cheaper Chinese products is not measured.
12. Alternative estimates where we include import penetration into a demand for labour function, following Milner and Wright (1998) and Greenaway, Hine and Wright (1999), corroborates our findings in this section, although the estimated impact of Chinese import penetration on labour is greater in the alternative estimates.
13. To test the robustness of these results, we also estimated a dynamic fixed effects model (specified as a partial adjustments model) using the first-differenced generalised methods of moment (GMM) estimator of Arellano and Bond (1991). Chinese import penetration and the capital–labour ratio were assumed to be endogenous. The coefficient on Chinese import penetration was found to be insignificant. The GMM estimates, however, should be treated with caution, as the number of industries is low (44) and the number of instruments rises rapidly as the time dimension of the data increases.

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