The margins of export competition: A new approach to evaluating the impact of China on South African exports to Sub-Saharan Africa*

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Draft: December 2012

Abstract

Chinese manufacturing exports to Sub-Saharan Africa challenge South Africa's economic influence in the region. To evaluate this, the paper develops and applies a conceptual framework that distinguishes between the intensive and extensive margins of Chinese export competition. South African exports of new and existing manufactured products to Sub-Saharan Africa are found to have been negatively affected by Chinese competition relative to exports from other countries. Consequently, South Africa's exports to the region in 2010 were 20% lower than they would have been if they had been affected to the same degree as other countries. The crowding-out effects are found to be strongest in medium- and low-technology products. Overall, the data suggest that Chinese exports of manufactures have diminished South Africa's participation and economic influence in the region.

1. Introduction

The past decade has seen a dramatic increase in China's participation in the African continent. China is now Africa's largest trading partner, both in terms of exports and imports. For example, between 2001 and 2011, total Chinese exports to Sub-Saharan Africa increased 13 fold in current US dollars, from $4.1 billion to $53.3 billion (IMF 2012). Foreign direct investment from China has risen, driven mostly by China's appetite for oil and other natural resources, but also recently expanding into agriculture, manufacturing and service industries (e.g. banking and telecommunications) (Broadman 2007, Kaplinsky & Morris 2008). China has also become an alternative source of foreign aid to African governments – see the 20 billion US dollar loan pledge to African nations during the Fifth Ministerial Conference of the Forum on China–Africa Cooperation (FOCAC) in July 2012.

China's increased involvement in Africa pose particular challenges to South Africa, the dominant economic power in the region. South African policy makers view the country as a "Gateway" for foreign and local investors and traders to access the rest of the African continent (Draper & Scholvin 2012, Economist 2012). There is some evidence to support this vision. South African banking, retail and telecommunication companies are prominent in many Sub-Saharan African (SSA) economies (Altman et al. 2005). The SSA market is disproportionately important for South Africa's exports of goods, particularly of manufactures which make up 86 % of its exports to the region and 20 % of the country's total manufacturing exports. South Africa also accounts for a high proportion of many African country exports and

imports, particularly the landlocked countries such as Zimbabwe, Zambia and Malawi (Edwards & Lawrence 2012).[1]

Yet, South Africa's gains from trade and economic influence in Sub-Saharan Africa threaten to be eroded by China's increased involvement in the region. Chinese exports to Africa are overwhelmingly manufactured goods, while African exports to China are mainly natural resources. While imports from China bring benefits to consumers in Africa through access to cheaper goods, they may pose a competitive threat to other exporters of manufactured goods to these markets, such as South Africa. Anecdotal evidence already suggests that South African exports to neighbouring countries have been crowded out by Chinese exports (Burke *et al*. 2008, Corkin 2008).[2]

The growth and composition of African trade flows with China have also fed concerns about deindustrialization of the region and the South African economy. This point was highlighted by South African President Zuma's comment at the 2012 FOCAC meeting that an unequal trade relationship based on the supply of raw materials was unsustainable (*Mail and Guardian* 19/7/2012).

These challenges to South African economic influence in the region have not yet been fully addressed in the literature. With few notable exceptions the existing literature has given limited attention to the effects of China on manufacturing in SSA (Goldstein et. al. 2006, Jenkins & Edwards 2006, Broadman 2007, Zafar 2007, Ademola et al. 2009, Brautigam 2009, Montonari & Prodi 2011). This partly reflects

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[1] Intra-regional trade has been encouraged by the implementation of a free trade agreement covering goods amongst Southern African Development Community (SADC) members.
[2] Burke et al. (2008, p.19) claim that "Chinese exports to South Africa neighbours such as Swaziland, Lesotho, Namibia and Mozambique have reduced the demand for South Africa's exports to these countries and this has had a detrimental effect on South African producers that have not been able to compete." South African construction companies have also found it increasingly difficult to compete with Chinese contractors in the region in recent years (Corkin 2008).

the perception that the main economic impacts on the region are on primary commodities. Exceptions include Giovannetti and Sanfilippo (2009) and Kaplinsky and Morris (2008), both of which find that Chinese competition has had a negative impact on African manufactured exports to the USA and the EU.[3]

More importantly, existing studies on SSA and other countries (Eichengreen et al. 2004, Greenaway et al. 2008, Lederman et al. 2009) have ignored the crowding-out effect of Chinese competition along the extensive margin (the export of new products). This is surprising, given recent theoretical and empirical developments that have emphasised the role of the extensive margin in driving patterns of export growth (Melitz 2003, Hummels & Klenow 2005, Chaney 2008) and the specialisation by countries in different products and in different varieties within product categories (Schott, 2004; Fontagné et al., 2008).

Much of Chinese export growth, at least to emerging economies, has been driven by the export of new products (Schott 2008, Amit & Freund 2010). By entering new products and markets, Chinese exporters may deter other firms from exporting to these markets, or may cause existing exporters to exit. The ability of competitors to respond to these competitive pressures may differ. Economies that are able to diversify into new products or export higher quality goods, may be better able to insulate themselves from the adverse terms of trade effects associated with Chinese

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[3] Giovannetti and Sanfilippo (2009) have extended this analysis to include the displacement of African producers in intra-regional trade. Montonari and Prodi (2011) have also looked at the impact of China on intra-regional trade in SSA and find a positive complementary effect that diminishes as the value of trade flows increases. None of these latter studies focus specifically on South Africa, the country that dominates intra-SSA trade in manufactures.

export competition (Hummels & Klenow 2005).[4] This dynamic of Chinese crowding-out effect is not well explored in the literature.

A key contribution of this paper is the development of an empirical framework to analyse the crowding-out effect of Chinese exports along both the extensive and intensive margins. This constitutes an important methodological innovation. The framework is then used to identify the extent to which Chinese exports have affected South African manufacturing exports to different SSA countries over the period 1997-2010. The analysis draws on disaggregated product-level data at the 4-or 6-digit level of the Harmonized System (HS).

The empirical analysis shows that South African exports to SSA have been more negatively affected by Chinese competition than those of other exporters of manufactures. The relatively strong crowding-out effect has been experienced along both the extensive and intensive margin. In terms of trade value, the latter effect dominates and reduced South African exports to the sample of African countries by around 20% of its 2010 value. South African exports to Angola, Nigeria and Ghana are the most affected. Crowding-out effects are strongest in medium- and low-technology products. Overall, the data suggest that Chinese exports of manufactures have diminished South Africa's participation and economic influence in the region.

The remainder of the paper is structured as follows. Section 2 discusses the data. Section 3 presents a background overview of South African and Chinese exports to SSA. This is followed in Section 4 by the development of the methodological framework that separates out the interactions between Chinese and South African

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[4] Kaplinsky and Paulino (2007) show how declines in unit values of European Union manufactured imports between 1988 and 2001 were concentrated in low-technology products and amongst low-income countries within each technology category. Chinese trade was a contributing factor (Kaplinsky 2006). See also Zafar (2007) on China's impact on the terms of trade in Sub-Saharan Africa.

exports at both the extensive and intensive margins. Section 5 applies this framework to the data while section 6 quantifies the impact on SA exports. Section 7 concludes the paper.

2. Data

Given the large number of countries in SSA and the intensive data requirements of the analysis, it was decided to focus on 10 countries which were the most important export markets for South Africa in the region. These are Angola, Democratic Republic of Congo (DRC), Ghana, Kenya, Malawi, Mozambique, Nigeria, Tanzania, Zambia and Zimbabwe. Between them, they accounted 87 % of South African exports of manufactured goods to SSA and 18 % of the country's total manufacturing exports in 2008.

One of the problems faced by the research is the unreliability of trade data for many SSA countries.[5] Because of this, the data for SSA imports was constructed from export data to each SSA country reported by South Africa, China and a selection of major exporting countries (see Table 1 for a list of reporter countries). This does not cover all sources of imports, but since the focus is on the relative performance of South African exports relative to China and other countries in these markets, this should not lead to significant biases in the results.

Because the focus is on competition with China and Chinese exports are overwhelmingly manufactures, the analysis is concentrated on manufactured products, although these are broadly defined to include resource based manufactures. To identify the trends in competition in products with different technological levels,

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[5] See Yeats (1990) for a detailed exposition of the quality of SSA trade data.

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Lall's (2000) classification of manufactured products into high-technology, medium-technology, low-technology and resource-based categories is used.

Table 1: Trade data used for the study

Reporter countries	South Africa, Australia, Canada, Germany, Spain, France, UK, Italy, Netherlands, USA, South Korea, ASEAN 5(Singapore, Malaysia, Indonesia, Thailand, Philippines), Hong Kong, India, China
African partner country	Zambia, Zimbabwe, Mozambique, DRC, Nigeria, Angola, Kenya, Tanzania, Malawi, Ghana
Time	Annual from 1997 to 2010
Product	HS6. Rev 96.
Source:	UN Comtrade

Note: Philippines and Thailand only reports HS6 Rev. 96 data from 2000 and 1999, respectively.

The data were obtained at the 6-digit level of the Harmonized System since it is important to have a sufficiently high level of disaggregation to ensure that the products which are being compared in the analysis do indeed compete with each other. In the case of the econometric analysis, the 6-digit data were aggregated to the 4-digit HS level, because of the large number of observations and to allow for within 4-digit HS complementarities to be captured. The period of analysis covers the years 1997 to 2010.

3. South Africa and China's Trade with SSA

Trade flows and trade shares

Following the ending of apartheid, South African exports of manufactures to other African countries grew rapidly, averaging 9.4 % per annum over the period 1997 to 2010. Exports from China grew even faster at 23.4 % per annum. Consequently, China's share of manufactured exports to the African sample rose sharply from 4.4% in 1997 to 21% in 2010. South Africa's share fell from 17.4% in 1997 to 13% in 2010, with much of this decline occurring from 2000.

Behind these patterns of aggregate growth lie important composition effects. Export growth of both countries has arisen from growth in sales of existing products to existing markets (*intensive* margin) and exports that are new either in terms of product or market (*extensive* margin). The 1990s and early 2000s, for example, was a period of rapid expansion by SA into new product/market combinations. As shown in Figure 1, South Africa exported less than 1900 6-digit HS product lines on average to each of the African countries in 1997. By 2002 this had grown to 2500, but then stabilized ending at 2597 lines in 2010 (out of a possible 4008 product lines imported by at least one African country in the sample in 2010). For China the increase in range of products exported on average to each African country in the sample is more dramatic and over a longer period rising from under 400 in 1997 to 1779 in 2010.

Figure 1: Average number of 6-digit HS products exported to each Sub-Saharan African country in sample
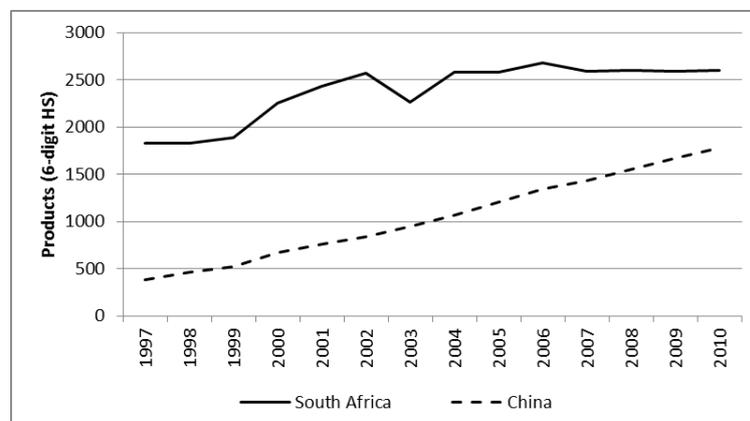
Source: Author's calculations using 6-digit HS level trade data obtained from UNComtrade.
Notes: The maximum number HS6-digit manufacturing products exported to Africa in any period is 4 400.

The extensive margin, therefore, played a prominent role in the growth of exports to SSA from both countries. To evaluate this further, Table 2 decomposes the growth in the value of SA and Chinese manufactured exports to the sample of African countries from 1997 to 2010 into their intensive and extensive margins. The export of

new products contributed substantially towards overall export growth: 25.4 % for South Africa, 54.4 % for China and 59.5 % for the remaining countries. All countries also halted exports of certain products, but the impact of this on overall growth was very small in the case of China and South Africa (less than two percent).

Table 2: Intensive and extensive margins of Chinese and South African manufacturing export growth to Africa, 1997-2010 (percent)

	South Africa	China	Others
Intensive	76.4	46.3	48.3
Extensive	23.6	53.7	51.7
Exit	-1.8	-0.7	-7.8
Entry	25.4	54.4	59.5
Average log growth rate	9.4	23.4	10.6

Source: Author's calculations using 6-digit HS level trade data obtained from UNComtrade.
Note: The extensive margin includes entry and exit effects.
Other countries exclude Philippines and Thailand who do not report trade in 1997.

The relative contribution of the extensive margin to export growth, as shown in Figure 2, also varies across exporter and destination. The extensive margin was a more important source of export growth for China than South Africa to all African export destinations, but was particularly large for exports to Angola, Mozambique, Malawi, Zimbabwe and Zambia (in excess of 70%). For South Africa, the extensive margin accounted for 30 % or more of the growth in exports to Nigeria, Tanzania and the DRC, but less than 10 % to Malawi and Zambia.

Figure 2: Share of extensive margin in growth of exports to Africa, 1997-2010
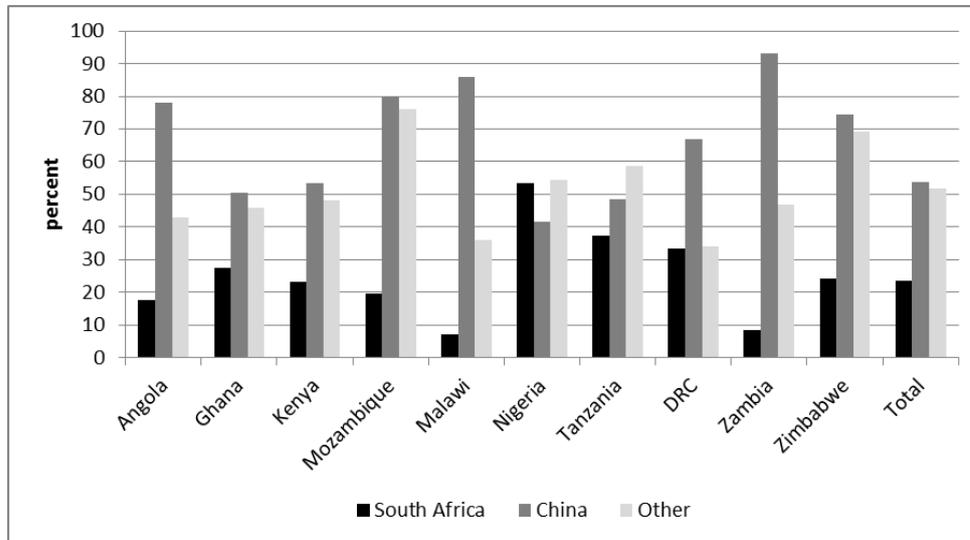

Source: Author's calculations using 6-digit HS level trade data obtained from UNComtrade.
Note: The extensive margin includes entry and exit effects.
Other countries exclude Philippines and Thailand who do not report trade in 1997

There are also important differences in the composition and source of export growth across technology categories. Table 3 presents the share structure and growth in manufacturing export value to Africa for China, South Africa and the rest of the sample between 1997 and 2010. Compared to South Africa, Chinese exports are concentrated in low-technology and high-technology products. Exports from South Africa are concentrated in medium-technology and resource-based manufactures, which together make up 71 % of the country's manufacturing exports to the sample of African countries.

Table 3: Export shares and export growth to Africa by technology level (percent)

	Share structure of exports, 2010			Growth in export value, 1997-2010		
	South Africa	China	Others	South Africa	China	Others
High-technology	6.8	17.7	12.5	6.8	24.5	9.1
Medium-technology	44.5	37.4	40.4	9.1	22.9	8.3
Low-technology	19.5	32.0	11.3	9.3	21.9	7.1

Resource-based	26.9	12.8	34.8	10.8	29.1	18.1
Other	2.2	0.1	1.0	17.0	41.6	8.0
Total	100.0	100.0	100.0	9.4	23.4	10.6

Source: Author's calculations using 6-digit HS level trade data obtained from UNComtrade and the technology classification developed by Lall (2000).
Notes: Growth in export values for category "Others" exclude Philippines and Thailand that do not report trade in 1997.

Looking at the growth rates, South African manufacturing export growth to Africa lagged that of other countries, particularly in high-technology and resource-based manufactures. One reason is the relatively low contribution of the extensive margin to South African export growth. The extensive margins of growth by technology category are presented for each country in Table 4. For China, growth along the extensive margin made up 68 % of the growth in exports of high-technology products, but only 17 % for South Africa. For South Africa, new exports in terms of product or market were a relatively important source of demand for resource-based manufactures, accounting for 43 % of export growth from 1997-2010.

Table 4: Extensive margins of Chinese and South African export growth to Africa by technology classification, 1997-2010 (percent)

	South Africa	China	Other
High-Tech	17.3	67.7	26.2
Medium-Tech	12.6	50.7	25.1
Low-Tech	14.9	48.3	42.2
Resource Based	42.7	56.0	81.6

Source: Author's calculations using 6-digit HS level trade data obtained from UNComtrade.
Note: The extensive margin combines the entry and exit effects.
Other countries exclude Philippines and Thailand that do not report trade in 1997.

Do Chinese products compete with South African exports?

The strong growth in exports of existing and new products by China, combined with a decline in South African export shares suggests an increase in competitive pressures on South African exporters. One approach to assessing this is to look at the extent to

which they both export the same products to each African markets. [6] Table 5 presents
various different indicators of the overlap in exports between South Africa and China.
The first two columns present the share of the value of South African exports at the 6-
digit level that faced competition from China in 1997 and 2010. Columns 3 and 4
present the proportion of the number of products for which there is an overlap.

In 1997 the proportion of products exported by South Africa which were also
exported by China to the same market accounted for 11% of South African export
items (at the HS 6-digit level). These products made up just less than 17 % of the total
value of South African exports to the region. By 2010 the overlap had risen to 55% of
the number of products exported by South Africa and around 74% of the total value of
South African exports.

**Table 5: Share of South African manufacturing exports facing competition from
China by export value and product count, percent**

	Share value of SA exports with overlap		Share number of SA export products with overlap	
	1997	2010	1997	2010
	(1)	(2)	(3)	(4)
Angola	9.2	78.9	8.7	65.5
Ghana	37.2	81.3	24.0	69.8
Kenya	18.0	74.1	25.3	71.6
Mozambique	7.7	72.3	5.5	50.9
Malawi	8.4	51.0	2.5	28.9
Nigeria	29.9	89.9	37.3	78.9
Tanzania	20.0	79.3	21.3	65.1
DRC	7.9	82.0	10.3	51.0
Zambia	10.3	76.4	5.2	45.6
Zimbabwe	24.7	64.9	11.2	41.0
Total	16.8	73.8	11.0	54.7

Source: Author's calculations using 6-digit HS level trade data obtained from UNComtrade.

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[6] The most commonly used measure of the extent of competition between Chinese and other countries'
exports is the Export Similarity Index. Jenkins (2008) criticises this measure as an indicator of either
the changes in competition from China over time or the extent of competition that a country faces from
China in different export markets as it is insensitive to levels of trade flows.

There is considerable variation between countries in the degree of overlap between South African and Chinese exports, but the trend in terms of increased competition is the same in all of them. The lowest overlap is in Malawi, which only established diplomatic relations with China in 2007 and where Chinese market penetration is less than elsewhere in the region. It is followed by Zimbabwe, where 40% of products exported from South Africa faced competition from China in 2010 (up from 10% in 1997) and these accounted for just under 50% of the value of exports. The overlap in 2010 was greatest in Nigeria (nearly 80%) followed by Kenya and Ghana (around 70%).

4. Identifying the competitiveness effects of Chinese exports

The previous section has shown that, particularly since China's entry into the WTO in 2001, the extent to which South African exports face competition from China in SSA has increased as Chinese exports have grown along both the intensive and extensive margins. South Africa's share of the export market has also declined. However this does not necessarily imply that Chinese products have displaced South African exports to these markets. This section explores further the connections between Chinese and South African exports.

Conceptual framework

Conceptually, Chinese exports can have four impacts on competing countries' trade flows. Firstly, entry by Chinese exporters into new product-destination combinations affects the probability of existing or alternative suppliers exporting that product to that destination. China's entry, for example, may cause existing exporters to exit, or in the case of complementary products, enter the market. This is what we refer to as the *Extensive-Extensive margin* impact.

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Secondly, changes in Chinese volumes or prices of goods that it already exports to a particular destination affect the export volumes or prices of competing exports also sold in that market. For example, for substitute products, an increase in Chinese exports to a country is expected to crowd-out and diminish the growth of their competitors' product. For complementary products, exports of the third country rise. Because the substitution or complementary effects occur across products already exported to the particular destination, we refer to this as the *Intensive-Intensive margin* impact.

A third impact is the effect that entry by China into new product-destination combinations has on the level of exports of countries already exporting to those destinations. The commencement of exports by China of production machinery to Kenya, for example, may enhance existing exports of maintenance services by South African firms. Alternatively, the entry by China may lead to a reduction in export volumes to Kenya by competing South African machiney producers. We refer to the effect of entry into or exit from product-destination combinations on existing exports by other countries as the *Extensive-Intensive margin* impact.

Finally, changes in export volumes by China may cause the exit or entry of competing suppliers of that product to that market. That is, changes in Chinese trade along the intensive margin may alter the range of products exported by other countries to that country. We refer to this effect as the *Intensive-Extensive margin* impact.

These margins are illustrated in a hypothetical diagram of exports (say of valves) by China and South Africa to Kenya from 2000 to 2005 presented in Figure 3. In 2002, Chinese valve exporters enter the Kenyan market. The diagram depicts two (of many) possible responses of SA firms exporting substitute valves to Kenya. In case (i) South African exporters of competing valves immediately exit the Kenyan

market and illustrates an *extensive-extensive* margin impact. In case (ii) the SA firms experience an immediate drop in export value followed by negative growth and finally exit in 2005.

This case illustrates the three other impacts. The entry of Chinese valves into the Kenyan market immediately reduced the value of South African valve exports (*extensive-intensive* margin) and then over the period 2002 to 2004 the strong growth in Chinese exports was associated with negative growth of SA valve exports (*intensive-intensive* margin). Finally, in 2005, continued growth in Chinese valve exports led to the exit of South African firms exporting valves to Kenya (*intensive-extensive* margin).

Figure 3: Margins of export competition
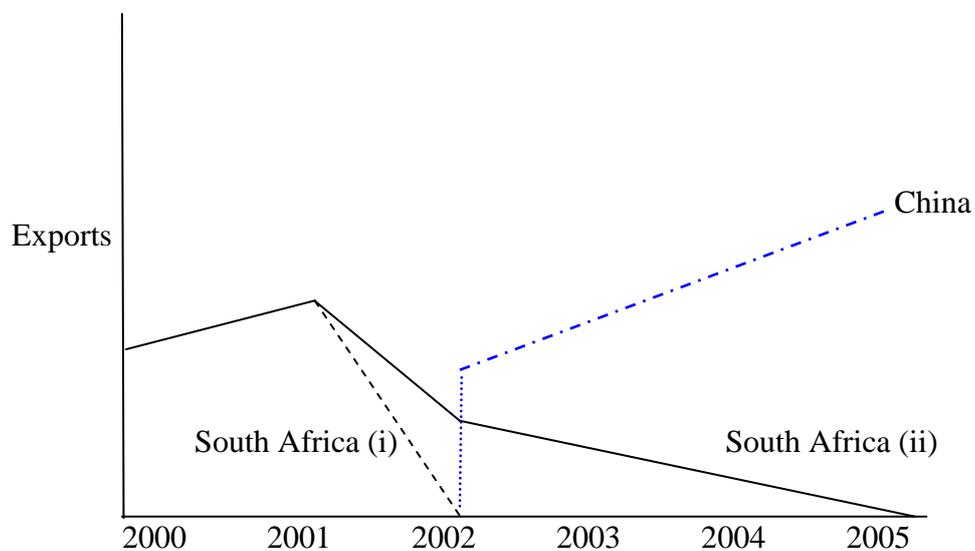
The hypothetical example also illustrates the limitations of existing empirical studies on the effect of China on competing country exports (Eichengreen et al. 2004, Greenaway et al. 2008, Giovannetti & Sanfilippo 2009, Montinari & Prodi 2011). These studies predominantly focus on the intensive-intensive margin impact of China

on exports from competing suppliers. Typically these studies estimate a variant of the simplified equation:

$$\ln X_{ijt} = \alpha + \phi_1 \ln X_{china, jt} + \beta Z + \varepsilon_{ijt}.\tag{1}$$

where X_{ijt} denotes the value exports by country i to destination j at time t, $X_{china,jt}$ refers to Chinese exports to destination j and Z denotes a vector of other controls. The coefficient ϕ_1 is interpreted as a measure of the crowding-out or crowding-in effect of Chinese exports.

The problems with this specification as applied to the hypothetical example above is that it leads to an under-estimate of the true impact of China on SA exports. The coefficient ϕ_1 is only identified by the variation in exports over years in which both countries export valves. In case (i) where SA firms exited the market there is no overlap in trade flows for the equation to be estimated. This negative impact on SA exports is therefore not taken into account in the estimation, leading to a biased estimate of the effect.

In case (ii), the equation is estimated over the period 2002 to 2004 where a negative relationship exists. This captures the intensive-intensive margin impact. The coefficient, however, is still biased and underestimates the true impact of China on SA exports. Firstly, the estimate does not capture the impact of entry in 2002 by China on the level of SA exports in that period relative to the prior period, which as shown in the diagram decline dramatically. The specification therefore excludes the *extensive-intensive* margin impact. Secondly, the estimate does not take into account the exit (the *intensive-extensive* margin) of South Africa from market after 2005 as the data are truncated with a lower bound of zero.

Estimation and specification

This paper therefore proposes an alternative product-level approach that explicitly estimates the crowding-out effect along each of these margins. The empirical approach initially follows that of Eichengreen et al. (2004) who apply a gravity modified to capture the crowding-out effect of China. The basic product-level gravity model is specified as:

$$VX_{ijkt} = \alpha + \phi_1 VXC_{china,jkt} + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 d_{ij} + Controls_{ijkt} + \varepsilon_{ijkt} \qquad (2)$$

where subscript i represents the exporter (reporter), j is the importer (partner), k is the product and t is the year. Y denotes income and d bilateral distance between trading partners. VX generally denotes the log value of bilateral exports from country i to country j. The indirect crowding out effect of Chinese exports is captured by the variable $VX_{china,jkt}$ which denotes Chinese exports of product k to country j at time t.

ϕ_1 is the coefficient of interest. A negative value of this coefficient is interpreted as a crowding-out effect of Chinese exports. A positive coefficient signifies a complementary impact of Chinese exports on country i's exports to the partner countries.

To estimate the marginal impact of Chinese exports on SA exports, an interaction term ($DSA_i \times VXC_{china,jkt}$) where DSA denotes a dummy variable for South Africa can be included:

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\begin{aligned}
VX_{ijkt} = \alpha + \phi_1 VXC_{china,jkt} + \phi_2 (DSA_i \times VXC_{china,jkt}) \\
+ \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 d_{ij} + Controls_{ijkt} + \varepsilon_{ijkt}
\end{aligned}
\qquad (3)
$$

The sign of ϕ_2 measures the marginal impact of China on SA exports relative to the Chinese crowding-out effect on exports from the rest of the world. The total or absolute effect of China on South African exports is given by $\phi_1 + \phi_2$.

An important consideration in estimating the above relationship is how to deal with heterogeneity within the data. The dependent variable in specification (3) varies across products (k), exporters (i), importers (j) and time (t). The explanatory variables are at much higher levels of aggregation – typically at country or country-pair level. The common approach is to account for this heterogeneity through the inclusion of product, country and time fixed effects.[7] These fixed effects deal with unobserved product, country and time characteristics that could otherwise bias the results.

These fixed effects, however, still does not fully exploit the variation in the data and impose potentially severe restrictions on the data. Product fixed effects, for example, implicitly impose a common base level of imports on exports of that product from all sources. Yet, as Schott (2004) points out there is substantial heterogeneity in the quality of imports across countries within each narrowly defined product category. Time fixed effects account time varying effects that are common across all countries and products, but not country specific or product specific time effects.

The approach followed in this paper is to impose as few restrictions on the model as possible. The error term is specified as

$$\varepsilon_{ijkt} = \lambda_{jkt} + \lambda_{ikt} + \lambda_{ijk} + \upsilon_{ijkt}$$

where λ_{ikt} captures exporter/product/time fixed effects, λ_{jkt} accounts for importer/product/time fixed effects and λ_{ijk} allows for country pair/product fixed effects.[8] The inclusion of these fixed effects reduces the equation (3) to:[9]

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[7] See Giovannetti and Sanfilippo (2009).
[8] The inclusion of these fixed effects control for the Anderson and van Wincoop (2003) indexes of multilateral resistance, which if ignored, lead to biased estimates.
[9] This specification is closer to the approach used by Freund and Özden (2009) to analyse the impact of Chinese competition on Latin America exports than the product-level approach of Giovannetti and Sanfilippo (2009).

$$VX_{ijkt} = \alpha + \phi_2(DSA_i \times VXC_{china,jkt}) + \varepsilon_{ijkt} \qquad (4)$$

As in equation (3), the coefficient ϕ_2 measures the marginal impact of Chinese

exports on South African exports relative to the control group, which in this case

includes all other exporting countries in the sample. A negative sign for ϕ_2 indicates

the Chinese exports affect South African exports negatively relative to alternative

export suppliers. In the case of substitute products, this would imply that South Africa

exports are more adversely affected by Chinese exports than the exports of alternative

suppliers. In the case of complementary goods, the positive coefficient would imply

that Chinese export growth has a weaker positive impact (and possibly a negative

impact overall) on South African exports than exports from alternative suppliers.

This specification has a number of benefits. A key concern for the estimation

of equation (3) is the endogeneity of Chinese exports. Omitted variables such as

global consumer sentiment prices that simultaneously affect exports of China and

competing sources introduce a positive correlation between $VXC_{china,jkt}$ and the error

term. The standard practice, initiated by Eichengreen et al. (2004), is to instrument

$VXC_{china,jkt}$ using bilateral distance between China and the partner country j. The cost

of this approach, however, is that one is unable to include country pair fixed effects as

they correlate perfectly with the instrument.

The specification in equation (4) is likely to attenuate the possible biases. The

inclusion of importer/product/time fixed effects deals with the omitted variable bias

arising from common omitted shocks that affect all exporters. Any remaining

endogeneity bias is only problematic if common shocks affect Chinese and South

African exports to Africa differently from the rest of the world.

A second benefit is that the fixed effects deal with biases that may arise from product-level changes in demand or supply characteristics within each country. For example, the exporter/product/time fixed effects control for changes in supply conditions within each exporting country that affect exports to all destinations equally. More importantly, the importer by product by time fixed effects control for changes in product composition of import demand within each African country. Its inclusion eliminates the Chinese export variable $VX_{china,jkt}$, but controls for common shifts in the product composition of exports as exporters respond to relative demand shifts. The simple inclusion of product fixed effects, time fixed effects and country fixed effects as in Giovannetti and Sanfilippo (2009), does not control for these compositional effects, potentially biasing their coefficient on Chinese exports upwards.

A severe limitation of the specification is that the estimates reveal only the marginal impact and not the absolute impact of China on South African exports.[10] The sign of the coefficient ϕ_2 is consistent with a positive or negative total impact for South Africa. Although not tested, the total impact for manufactured exports, however, is expected to be negative. Giovannetti and Sanfilippo (2009), for example, find that Chinese exports crowded out African exports to third countries, including African exports to other African countries.

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[10] We estimate more restrictive versions of specification (5) where we only include product, time and country fixed effects. This allows us to measure the common impact of China on all exporters, as well as the marginal impact on South African exports. The coefficient on the Chinese export variable is found to be positive, which contrasts with the sign found in other similar studies. One reason is that the instrument for Chinese exports (distance between China and the destination) is weak, largely because we have too few country pair observations. More importantly, the estimate is biased upwards by common responses (in terms of export value and entry into new product/destination combinations) by exporters to shifts in the product composition of import demand in African countries. The extensive margin is a relatively important source of growth in exports to Africa for all countries, compared, for example, with exports to advanced economies.

An additional consideration is that the commodity-boom led growth in Africa since 2000 can in part be attributed to Chinese growth via its demand for resources. South African exporters have indirectly benefited from the improved growth in Africa as the market expanded. Exporters from other countries have also benefited, so the marginal impact on South African exports is not obvious.[11] Similarly, while the estimates do not take into account across-product complementarities, this concern is less relevant for estimates of the marginal coefficient.

A final consideration is the level of data aggregation. The more aggregated the export data, the lower will be the contribution of the extensive margin towards export growth. The less aggregated the data, the less account is taken of possible complementary effects. The approach followed in this paper is to use data at the 4-digit HS level where there is some variation in the degree of processing within product categories. Therefore, complementary effects that work within, but not between, 4 digit HS groups will be captured.

5. Results

Four specifications of the export equations (4) are estimated:

A. *Intensive-intensive margin analysis*: In this specification, the log export value is used for both *VX* and *VXC*. This equation estimates the impact of growth of Chinese exports along the intensive margin on the value of SA exports in the same product-destination combinations.

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[11] Different marginal impacts would require differences in the income elasticity of demand in SSA for goods from different countries. Any differences in income elasticities, will most likely be captured in the estimated marginal coefficient as Chinese income, the missing variable, is closely correlated with Chinese exports.

B. *Extensive-extensive margin analysis*: In this specification, *VX* and *VXC* are dummy variables denoting whether product *k* is exported by country *i* or China to country *j* at time *t*. This equation estimates the impact of Chinese entry into new country/product combinations on the probability that South Africa exports those products

C. *Extensive – intensive margin analysis*: In this specification, *VX* denotes log export value and *VXC* denotes the extensive margin dummy variable for China. This equation estimates the impact of Chinese entry into new country/product combinations on the value of SA exports of those products.

D. *Intensive-extensive margin analysis*: In this specification, *VX* is the extensive margin dummy variable for all exporters and *VXC* is the log value (intensive margin) of Chinese exports. This equation estimates the impact of changes in the value of Chinese exports on entry and exit of SA exports of those products.

Table 6 presents a summary of the estimated marginal impacts of China on South African manufacturing exports for each of these specifications. The first quadrant, for example, presents the extensive-extensive margin impact of Chinese competition on SA exports. In each quadrant, the results are presented for the full sample of products, as well as products grouped according to the technology classification of Lall (2000).

Intensive-Intensive margin

Following the existing empirical literature, we first focus on the intensive-intensive margin results, presented in lower quadrant of the second column of Table 6. Increases in the value of existing exports from China are shown to negatively affect South African exports of these products. A 1% increase in Chinese exports to African

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countries is estimated to *reduce* SA exports by 0.053% relative to exports by other countries. The crowding-out effect is strongest for medium-technology and resource-based products where the coefficients are -0.063 and -0.059, respectively. The coefficients are all significant at the 5% level.

Table 6: The marginal impact of Chinese exports on South African manufacturing exports

		China	
		Extensive	**Intensive**
Extensive	**All products**	-0.007**	-0.013**
		(0.003)	(0.001)
	High-technology	-0.016*	-0.009**
		(0.007)	(0.002)
	Medium-technology	-0.014**	-0.016**
		(0.005)	(0.001)
	Low-technology	-0.016**	-0.012**
		(0.005)	(0.001)
	Low-technology	0.011*	-0.013**
		(0.005)	(0.002)
Intensive	**All products**	0.035+	-0.053**
		(0.019)	(0.005)
	High-technology	0.024	-0.035**
		(0.050)	(0.012)
	Medium-technology	0.066*	-0.063**
		(0.031)	(0.009)
	Low-technology	0.040	-0.048**
		(0.035)	(0.009)
	Low-technology	-0.008	-0.059**
		(0.042)	(0.012)

Notes: Regressions are estimated using OLS. All estimates include following fixed effects: reporter x hs4 x time , partner x hs4 x time and partner x reporter x hs4. The regression is conducted on the variables demeaned by the fixed effects. Robust standard errors in parentheses. ** $p<0.01$, * $p<0.05$, + $p<0.1$

These results corroborate those found by Giovannetti and Sanfilippo (2009). They find a relatively strong negative effect of Chinese exports on SSA exports flows from 1995 to 2005 in their growth regressions (coefficient of -0.072). The crowding out effect of China is strongest in the machinery & equipment sectors (coefficient of -0.118) which includes many medium technology products (vehicles, machinery

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except electrical, fabricated metal products). Further, the crowding-out effects are strongest on intra-SSA trade. Given South Africa's dominance in SSA and intra-SSA trade, their results to a large extent reflect the effect of China on SA regional exports.

Extensive-Extensive margin impact

The second set of estimates focus on the extensive-extensive margin impact of Chinese exports. The coefficients are presented in top quadrant of the first column of results in Table 6.

A significant negative association is estimated. The entry of China into a new product-destination combination reduces the probability of SA exporting that product to that destination by 0.7 % relative to other exporting countries in the sample. The extensive-extensive margin effect is also negative for high-technology, medium technology and low technology manufactures, but is positive (only at 10 % significance level) for resource based products. The strongest crowding-out impact with a coefficient of -0.016 is felt in low-technology products that include labour-intensive textiles, apparel and footwear.

These results suggest that entry by China into new markets negatively affected the diversification of South Africa's export bundle, as measured by the range of products exported to different African markets. Entry of China into new product/market combinations, for example, was more likely to deter entry by South Africa into those markets. China's entry was also more likely to lead to an exit by South African exporters in those product/market combinations

Extensive-Intensive margin impact

The third set of estimates (see lower quadrant of the first column of Table 6) identifies the relationship between the extensive margin of Chinese exports and the value of

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exports by South Africa. The coefficients here unlike the other parts of the table are generally positive (apart from the case of resource based industries) but insignificant (except for medium technology industries). Entry by China into particular product markets does not adversely affect South African exports relative to the prior period (and relative to exports by other countries), but, as revealed by the intensive-intensive margin results, once entered, Chinese export growth negatively affects SA exports relative to other countries.[12]

Intensive-Extensive margin impact

The final set of results presented in Table 6 (upper quadrant of column 2) looks at the impact of growth of Chinese exports on the range of products exported by South Africa. Highly significant and negative relationships are estimated suggesting that the growth in Chinese exports raises the probability that South African exporters exit (or do not enter) the market, relative to exporters in other countries. This holds for all technology classifications.

6. **How large are the likely impacts on South African manufactured exports and which markets are most affected?**

The results present new insights into the crowding-out effect of China on South African exports to SSA. These results suggest that the burden of Chinese export competition in SSA fell relatively heavily on South African exports. Compared to other exporting nations, South Africa is found to be less likely (relative to other exporters) to export a product to a SSA market that China enters (extensive-extensive margin) or experiences export growth (intensive-extensive margin). Further, in

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[12] In estimates including only pair fixed effects, a strong positive coefficient is estimated. This suggests that Chinese entry occurs in products that make up a high share of South African exports to each destination relative to other countries.

product-market combinations that overlap, increases in Chinese exports reduce the value of South African manufacturing exports to SSA relative to their impact on exports from other countries (intensive-intensive margin).

The size of the negative impact on South African exports, relative to other countries, can be calculated using the estimated coefficients and trade flows. The impact will depend on the size of the estimated coefficients as well as on changes in the overlap of exports between SA and China (extensive margin) and the growth in Chinese exports of these overlapping product to SSA countries (intensive margin).

Extensive margin impacts

The earlier decomposition revealed the extensive margin to be a relatively important source of manufacturing export growth to SSA over the period (see Table 2) for both China and South Africa. However, the crowding-out effect of Chinese trade on the range of products exported by South Africa, is small, despite the statistical significance of the relationship. [13]

China, South Africa and the other exporters in the sample jointly entered into many new product-destination combinations. For example, nearly two thirds of the increase in SA export value attributed to the extensive margin using 4-digit HS level data occurred in product market combinations also entered into by China. Similarly, the impact of Chinese exports on exit by South African exporters from product-destination combinations is small as exit made up only -1.8 % of the change in South African manufacturing export value from 1997 to 2010. The first order consumer

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[13] The use of 4-digit HS level trade data is likely to lead to an underestimate of the extensive-extensive margin impacts.

demand effects in destination countries dominate the second-order marginal effects of China on the range of products exported by South Africa. [14]

The future impact, however, may be larger. Over half the product-destination combinations exported by South Africa face competition from Chinese exports. The scope for crowding out effects is therefore substantially larger now than it was in the 1990s.

Intensive margin impacts

The dominant crowding-out impact of Chinese exports occurs along the intensive-intensive margin. Figure 4 presents South Africa's actual and counterfactual exports of manufactured goods to Africa from 1997 to 2010 using the *intensive-intensive margin* regression coefficients for each of the technology categories. The counterfactual exports represent what South African exports would have been, if the country faced a Chinese crowding-out effect that was equivalent to, as opposed to more negative than that of other competing exporters.

According to Figure 4, China's marginal impact on South African exports during the 1990s is minimal and reflects the low product/market overlap between South Africa and Chinese exports. From 2002, the crowding-out effect of Chinese exports rises as the product/market overlap increases and Chinese export volumes rise strongly. By 2010, South African manufacturing exports are estimated to be US$ 1 876 million lower than they otherwise would have been. This is equivalent to 20 % of the value of SA manufacturing exports to the region in that year. Alternatively,

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14 Similarly, the deterrent effect of Chinese entry is of second order importance. In 2010, China exported to only 199 product-destination combinations (at 4-digit HS level) not exported to by South Africa (3590 product-destination combinations at 6-digit level). These products account for around 20% of the value of Chinese exports in 2010 (using 6-digit data).

Chinese export growth in overlapping products reduced South African manufacturing exports to the region by 1.4 % per year.

Figure 4: South African actual, counterfactual and 'crowded-out' exports of manufactured goods to SSA
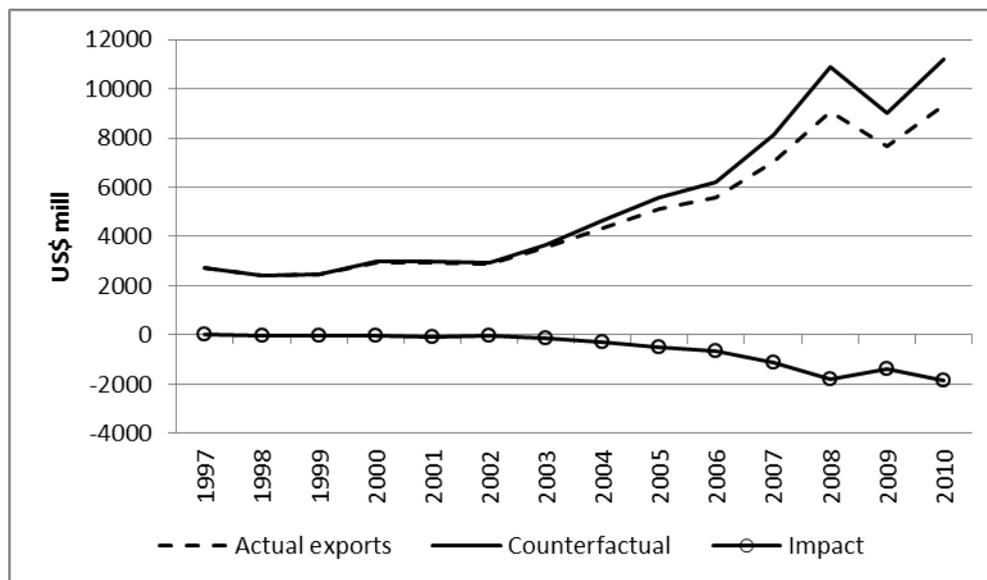
Note: Calculations based on the technology classification estimates.

At a country level, Table 7 shows that exports to Mozambique and Zambia experienced the largest crowding out effect measured in terms of value (US\$ 349 to 371 million or 19-20 % of the total impact). Over half the imports from these countries are sourced from South Africa. Growth in Chinese exports to these regions therefore overlapped with a large range of products already exported by South Africa.

Table 7: Cumulative impact of Chinese exports (intensive margin) on South African exports, 1997-2010

	'crowded-out' exports (US\$ mill)	Share 2010 value	Share total impact
Total	1876	20%	100%
Angola	183	28%	10%
Ghana	87	25%	5%
Kenya	135	20%	7%

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Mozambique	371	22%	20%
Malawi	50	12%	3%
Nigeria	164	28%	9%
Tanzania	103	19%	6%
DRC	164	20%	9%
Zambia	349	21%	19%
Zimbabwe	270	14%	14%

Note: Calculations based on the technology classification estimates.

As a proportion of 2010 export values, exports to Angola and Nigeria are the most affected and are estimated to be 28 % lower than they otherwise would have been. Nigeria is the dominant export destination for China in the African sample (over 40 of Chinese exports to African sample), whereas Angola experienced very rapid growth in Chinese imports (33 % per annum).

It is sometimes claimed that Chinese competition is felt mainly in low technology, labour-intensive products and that the threat is much less severe for exports of more sophisticated products or processed raw materials. Since low-technology products account for less than a quarter of South African exports to the ten SSA countries, if this were indeed the case, the impact would be relatively limited. However Chinese exports have diversified considerably in recent years into medium and high technology products (Schott, 2008).

Table 8 provides estimates of the impact of Chinese competition on South African exports of manufactures to the ten SSA economies in 2010 by level of technology. The crowding-out effect of China is found to be greatest in medium-technology products which are estimated to have been reduced by 1 118 million US$ (27% of their export value in 2010 or 60% of the overall impact). Low-technology products are also strongly affected, falling by 403 million US$ by 2010 (or 22 % of their 2010 export value). The smallest impact is experienced in the high-technology

category, which reflects a low overlap in product/market combinations as well as the relatively low crowding-out coefficient.

Table 8: Cumulative impact of Chinese exports (intensive margin) on South African exports, 1997-2010

	'crowded-out' exports (US$ mill)	Share 2010 value	Share total impact
All products	1876	20%	100%
By technology classification			
High-technology	98	16%	5%
Medium-technology	1118	27%	60%
Low-technology	403	22%	21%
Resource-based	247	10%	13%
Other	11	5%	1%

Note: Calculations based on the technology classification estimates.

Note that these are only partial estimates of the impact of Chinese exports on South Africa. The estimates reveal the marginal impact of Chinese exports on South Africa relative to other countries. If, as is suggested by much of the literature, Chinese exports also crowded out other country exports to Africa, then the overall impact on South African exports will be larger.

On the other hand, as noted earlier, the estimates do not account for indirect trade-enhancing effects such as the impact of Chinese GDP growth on growth in Africa or positive across-product complementarity effects. For example, the availability of cheap Chinese clothing products has facilitated the entry of South African retail chains into the African market. These retail chains also export other South African goods. It is quite possible, therefore, that taking the indirect effect of Chinese growth into account, the overall impact of China on South African exports to SSA would have been positive, despite the crowding-out effect analysed here.

7. Conclusion

Conceptually, a major contribution of the paper has been to distinguish between the effects of China's export growth along both the extensive and intensive margins on South Africa's export performance. Earlier literature on the impact of China on other developing countries' exports to third markets has not made this distinction, despite the general recognition of its importance in the broader trade literature. Indeed although not usually spelt out, the literature has in practice only estimated the effect of Chinese growth on the intensive margin of other countries' exports. The econometric specification adopted enabled us to distinguish four different combinations of extensive/intensive margin interactions.

Empirically the paper has shown that South African exports to its major markets in SSA have been more negatively affected by Chinese competition than those of other exporters of manufactures. As a result South Africa's exports to the region in 2010 were 20% lower than they would have been if they had been affected to the same degree as other countries. Exports of both low and medium technology products were particularly seriously affected.

Although the range of products in which China competes with South Africa increased considerably over the period, it was found that the major impact was on the intensive-intensive margin, in other words the effect of growing Chinese exports on the value of South African exports. There were also negative impacts of Chinese entry into new products on the value of South African exports of those products and also a higher probability of South Africa not exporting products when the value of Chinese exports of those products increased, but these were quantitatively less important than the intensive-intensive margin effects.

An implication of these results is that China has diminished South Africa's relative presence in the SSA markets, as measured by manufacturing exports. South

Africa has nevertheless experienced very rapid growth in manufactured exports to SSA over the past decade. However, it may be more difficult to sustain such growth rates in the future as South African exporters now face a far greater overlap in the range of products also exported by China.

These trends have potentially important implications for South African policy-makers as they engage with the region. They raise the importance of initiatives that reduce barriers to South African trade with the region. This includes, for example, the proposed trilateral free trade agreement between SADC, the Common Market of Eastern and Southern Africa (COMESA) and the East African Community (EAC).

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