Complementary and Competitive: The Impact of Chinese Trade on South African Manufacturing Exports

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Abstract

This paper makes use of South African industry level data to identify the effects of Chinese trade on South African manufacturing exports. It contributes to the existing literature by considering the implications of the different channels of exports identified in Kaplinsky et al. (2007) for Chinese exports. In particular, the direct complementary (positive) and indirect competitive (negative) channels are identified as the key channels for China-South Africa export relations. The impact of these channels are looked at, not only in the terms of aggregate export values, but also the extensive margin (product count). Overall, the results suggest a positive effect arising from Chinese exports. This result is, however, dulled by the negative implications of the indirect competitive channel effect on the extensive margin. A breakdown of the manufacturing sector into low and high-wage industries reveals that high-wage industries are the main recipients of benefits from Chinese exports through the direct complementary channel. Furthermore, the marginal effect of China from the rest of the world reveals a significantly positive difference in the high and low-wage industries for the aggregate export value and extensive margins respectively, while other specifications are inconclusive.

1. Introduction

Since China's accession into the World Trade Organisation (WTO) in 2001, trade with China, has increased dramatically across the world with China exploiting its comparative advantage for low-skill, low-wage products especially in the manufacturing sector. This sudden increase, has led to many new research papers dedicated to determining the extent and effects of increased Chinese exports. Countries have had to re-evaluate their stance on production processes and trade with China as a result. It is, therefore, of great interest to analyse the implications of China's expansion for South Africa given the limited existing literature. More specifically, this paper looks to uncover the impact of Chinese exports on South African manufacturing exports.

There are a few areas lacking examination which underline the importance of such an analysis. Firstly, despite a general perception that exports from China do more harm than good for the South African manufacturing sector, economic theory suggests that more complex dynamics are present resulting in ambiguity in allocating the correct signs to export effects from China.

On the one hand, Chinese exports may crowd-out South Africa's own exports in similar industries to third countries due to its cheaper labour costs while, on the other hand, the cheaper inputs from China may encourage South Africa's exports of downstream[1] products. The two examples provided here correspond to the indirect competitive and direct complementary channel effects on exports respectively. These arise from a combination of direct and indirect impacts with competitive and complementary trade (Kaplinsky et al., 2007).

Secondly, given the size of South Africa's manufacturing sector as well as its status as the leading economy in Africa, it is more exposed to external markets such as China relative to

[1] Downstream and upstream industries is used to describe industries that contain firms which are closer and further away from the finished goods product respectively.

the other smaller countries in Africa. This is exacerbated by the sudden rise of China since the turn of the millennium.

Most research done to date has focussed primarily on the direct competitive channel from China resulting in adverse conclusions for South African manufacturing exports. However, many benefits can also be derived from Chinese exports and need to be evaluated together with the costs. The lack of substantial research for South Africa and the different channels of exports leads to a gap that needs to be filled in order to better understand the country‘s export structure.

In order to achieve these objectives and plug the gaps in the existing literature, theoretical literature will first be consulted to guide the later analysis. Here, the different effects of trade will be discussed and evaluated in accordance with the objective of the paper. In conjunction with analysing the value of exports, the variety or number of products (extensive margin) exported will also be evaluated. A distinction on wages will be made to identify any differences arising from China's comparative advantage in labour.

To estimate these different channels, this paper will use a balanced panel dataset collected from 44 manufacturing industries over the time period 1992-2009. The Chinese export effect will be isolated and compared to the rest of the world to uncover the magnitude and distinctive nature of the effect it has on South African manufacturing exports (marginal effect).

The analysis reveals that for the aggregate export value, the positive direct complementary channel is the dominant channel of activity. In particular, bilateral trade with China (direct complementary channel) has been a key driver in high-wage industry export value growth but negligible for the low-wage industries. This result is in contrast to the dominant negative impacts on the South African extensive margin through the indirect competitive channel. The analysis conducted reveals conformance to the theoretical model established in Kaplinsky et al. (2007).

Furthermore, isolating the Chinese direct complementary channel impact on exports reveals that Chinese exports exhibit positive marginal effects from other countries when significant in the high-wage industries in terms of aggregate export value and the low-wage industries for the extensive margin. The results could be a signal for policies targeting an increase in focus on high-wage industries to promote growth further and movement away from low-wage, high labour intensive productions (Bloom et al., 2011).

The remainder of this paper will be structured as follows. The next section will give an overview of the literature surrounding export trade relationships with China. Within the literature review, a theoretical framework will be developed first, followed by discussions of the empirical literature. In rounding off, South Africa-specific studies will be evaluated and shortcomings identified. Thereafter, a discussion on the data will be laid out in section 3, followed by the methodology and results in section 4. Here, comparisons will be made with the theoretical predictions set out by current literature. Finally, the paper concludes in section 5.

2. Literature Review

2.1 Theoretical Framework

China's trading relationship with the world has been a hot topic of debate in recent times. China's accession into the World Trade Organisation (WTO) was a catalyst for a global boom in terms of demand and supply. This has precipitated a glut of research focussing on China over the past few years. The entry of China into the global trade network is likely to have implications on both the supply and demand side for goods and services traded internationally given that it has the largest population in the world. These dynamics have become somewhat complicated in recent times as the world continues to evolve. Rapid technological advancements, combined with trade liberalisation around the world, have resulted in fragmentation of production processes (Deardorff, 1998), making the analysis of exports more interesting.

In the past, production processes were inseparable and had to be produced at the same location. However, modern technology and transport routes have innovated the production process in the world. Goods such as medical supplies and food can now be refrigerated and kept fresh longer or even arrive much faster at the destination. Therefore, given new literature analysing fragmented production processes, the world market has grown and the concept of factor price equalisation has become more prominent in international trade (Deardorff, 1998). This has allowed intermediate input importing to come to the fore. The study of input importation is a more complex issue to deal with than the traditional output/finished goods imports mentioned earlier. Thus, consideration for both finished as well as intermediate goods needs to be considered in modern literature. Ultimately, the costs need to be weighed against the benefits in order to determine the net impact of Chinese trade.

The basis of any analysis needs to be underpinned by a keen understanding of the theoretical foundations insofar to provide a focal point around which the empirics can be evaluated. Kaplinsky et al. (2007) provide a detailed framework outlining the different avenues and types of effects that can arise from trade vis-à-vis China. Their paper identified three main vectors namely; trade, 'production and foreign direct investment (FDI)' as well as aid.

This paper is concerned primarily with the trade vector which Kaplinsky et al. (2007) identify to be where most of the impact has resided. Their paper also recognises shortfalls in identifying the other two vectors as gaps are identified in their concluding remarks, thereby making the trade channel seemingly the most reliable area of research at present. Table 1 illustrates the framework used in Kaplinsky et al. (2007) in identifying the different scenarios of trade with China.

Table 1: Framework for Assessing the Impact of Trade with China

Channel	**Impact**		
Trade		**Direct**	**Indirect**
	Complementary	Access to cheaper intermediate goods (inputs) or a wider variety of inputs embedded with foreign technology.	Involvement in global production networks with China. Substantial Chinese demand increases global prices.
	Competitive	Cheaper Chinese imports crowding-out domestic production.	Chinese exports crowding-out South African export markets.

Source: Framework drawn from Kaplinsky at al. (2007)

Using the matrix in table 1 as the theoretical underpinning of this paper reveals a 2 by 2 matrix identifying four different scenarios in which international trade affects a country's economy both domestically and internationally. Each of these scenarios will be evaluated to determine the channels of interest through which the Chinese exports act on South African manufacturing exports.

Looking at table 1, the second column distinguishes between complementary and competitive trade, whereas the second row identifies the direct and indirect impacts of trade. Direct impacts arise from 'direct' bilateral trade with China. For example, South Africa importing or exporting directly from or to China. Indirect impact links are born from third country effects, for example, China's exports to Botswana affecting demand or supply for the same/similar South African exports. Complementary trade refers to the effects that, when combined with domestic factor, are beneficial for a country, whereas competitive trade are those that are in competition with the domestic production of the same country and tend to be harmful. Looking at the combinations of each yields 4 different channels.

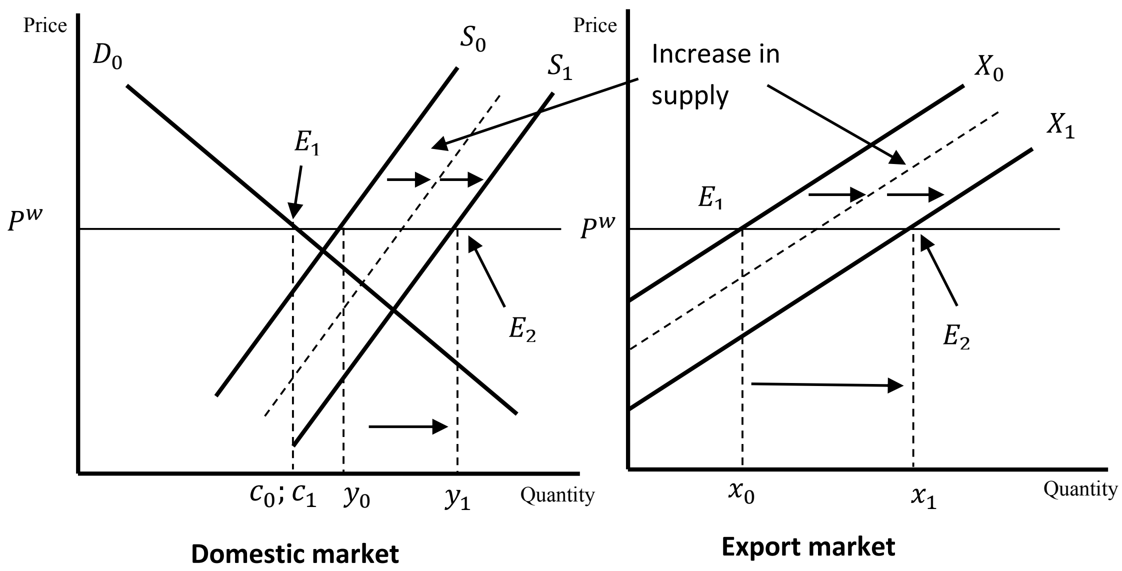
2.1.1 Direct Complementary Channel

The direct complementary channel arises from bilateral trade with China. The example provided in the matrix is one of cheaper intermediate products or alternatives embedded with foreign technology not available in the domestic economy. Extending this, domestic production will have greater scope to become more competitive on the international market, thereby, expanding its target market beyond the domestic market.[2] This is beneficial for the domestic country. Figure 1.1 shows this effect graphically.

The left and right hand panel represents the domestic and export markets respectively. The domestic market is initially in equilibrium at point E_1 corresponding to the world price P^w where domestic consumers consume c_0. At this point, there is an excess supply $(y_0 - c_0)$ which is exported at the world price. This corresponds to x_0 in the right panel of figure 1.1.

[2] Imported inputs also has the added benefit of increased participation in global value chains.

Figure 1.1



Source: Author's elaboration from Kaplinsky et al. (2007)

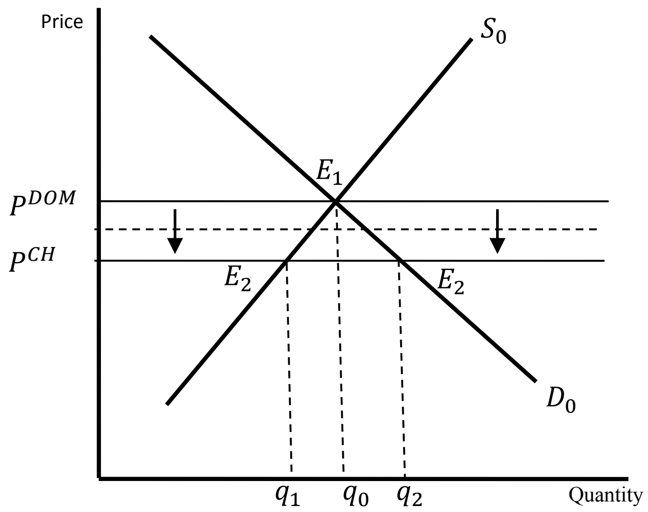
As input imports increase, domestic producers of the final product will increase production due to the lower priced imports[3] thereby pushing the supply curve outwards until a new equilibrium position is reached at E_2. The original supply curve has shifted outwards to S_1 where domestic consumption remains at $c_1 = c_0$. Assuming that the country in question here is a 'small'[4] country unable to affect the world economy and, given that the demand in the domestic economy remains constant, an increase in output produced from y_0 to y_1 along the x-axis is observed. This shift translates into an increase in exports as can be seen from the shift from x_0 to x_1 in the right panel. This is due to the excess output produced by $y_1 - y_0$.[5]

[3] This paper only deals with competitive imports, therefore, any increase in imports would represent a decrease in cost of sales for domestic producers thus encouraging increased production given the same level of price as before.
[4] The assumption of being a 'small' country assumes that the South African domestic economy has no effect on the global economy in terms of pricing power etc... through demand and supply mechanisms.
[5] This effect can also be replicated from a demand-side perspective. For example, Chinese increased demand for South African exports. However, given the objective of this paper, the main focus remains on export/supply-side effects from China's point of view.

2.1.2 Direct Competitive Channel

The direct competitive channel of international trade with China refers to the negative crowding-out effect of domestic production due to increased cheaper imports from China. One common example of this is the clothing and textiles industry. Cheap clothing and textile imports from China have created headaches for many countries over the past decade due to it putting domestic clothing and textile industries at risk of going bankrupt. Industries most vulnerable to this type of negative impact are typically those that are abundant in the same factor of production as China i.e. unskilled labour-intensive production processes. Figure 1.2 provides a graphical representation of this effect.

Figure 1.2



Domestic Market

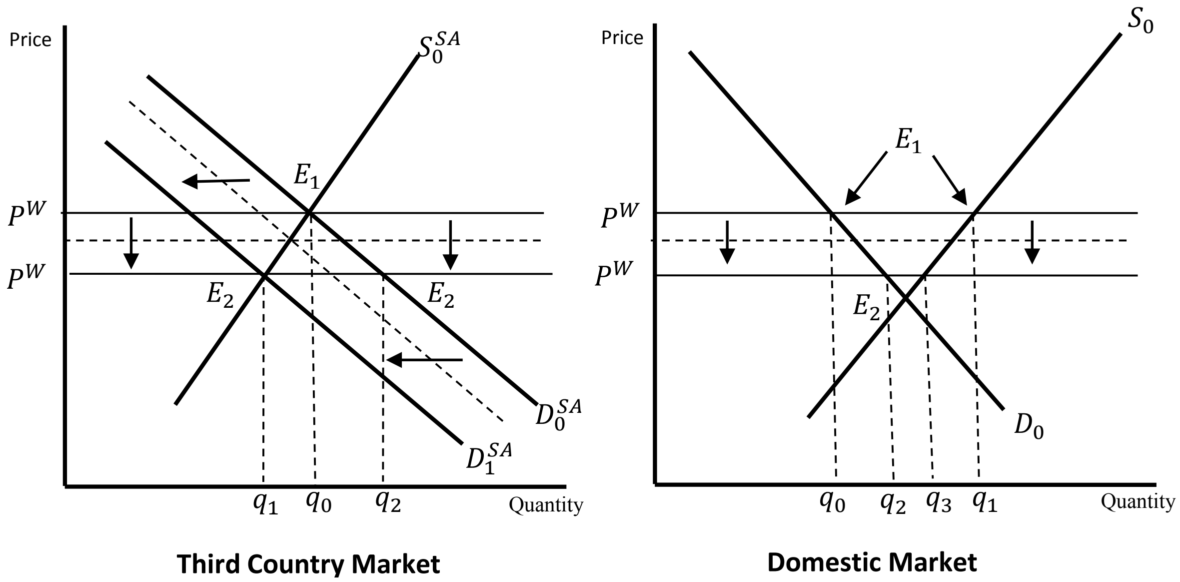
Source: Author's elaboration from Kaplinsky et al. (2007)

The domestic economy is initially in equilibrium at point E_1 where local firms produce quantity q_0 at the domestic price. At this point, the domestic market is saturated and satisfied by the domestic supply provided solely by the domestic firms. However, following an influx of relatively cheaper Chinese imports below the domestic price of the same good, the domestic economy moves to a new equilibrium position corresponding to E_2. At this new equilibrium, the total demand exceeds supply (demand is $q_2$whereas supply is q_1). These cheaper Chinese imports below the domestic economy equilibrium price will have the effect of crowding-out the inefficient domestic firms that are unable to produce at the new lower imported price, thus resulting in the shrinkage of local industries. The magnitude of the crowding-out can be observed from the difference between q_0 and q_1. In addition, as the price drops, the quantity local consumers demand increases from q_0 to q_2. These two effects combined results in a gap between local supply and demand that China plugs (q_2-q_1).

2.1.3 Indirect Competitive Channel

A primary example of an indirect competitive channel arising from international trade with China is their exports to a third country being competitive enough that it crowds-out the demand for a country's, say South Africa's, exports of the same product. The dynamics at play here are illustrated in figure 1.3, assuming that the domestic market is South Africa.

Figure 1.3



Source: Author's elaboration from Kaplinsky et al. (2007)

The left panel depicts the third country market demand and supply curves for South African products exported to their country (third country). The right panel shows the same effect from a South African perspective. Starting with the left panel, the economy is initially at equilibrium E_1 where demand and supply for South African exports are equal. The increase in

Chinese exports to the third country puts downward pressure on the world price, thereby making South African exports relatively more expensive resulting in a decrease in demand. The demand for South African exports curve shifts leftwards from D_0^{SA} to D_1^{SA}. At this new equilibrium, E_2 , the quantity demanded and supplied by South Africa is at a lower point q_1. Just as was the case for the direct competitive channel, the shortfall is picked up by Chinese exports (q_2-q_1).

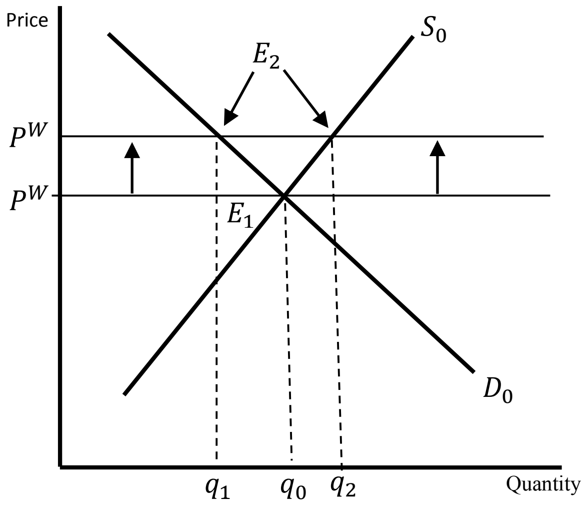
From a different viewpoint, the right panel depicts the South African economy starting off at an equilibrium position E_1. At E_1 there is an excess supply of magnitude $q_1 - q_0$ which is exported. As with the left panel, the decrease in world price is a result of an influx of cheaper Chinese exports pushing the world price to a lower level. From the South African (domestic) perspective, this will result in a decreased total quantity exported to $(q_3 - q_2)$. Interestingly, despite a diminishing excess supply by local firms, the quantity produced domestically has increased from q_0 to q_2. This fits well with findings of Melitz (2003) in which he finds that only the most productive firms are able to 'jump' a fixed cost and export. The decrease in price will now see firms not being able to meet said fixed costs given the cheaper world price. Therefore, firms which previously exported are unable to do so competitively anymore and are left to solely serve the domestic market. This results in more quantity produced for the local consumers. From the consumers and societal perspective this may even be more efficient for the economy as a whole given the diminishing deadweight loss from supplying closer to laissez-faire conditions.

2.1.4 Indirect Complementary Channel

Having just discussed the indirect competitive channel of Chinese exports, the indirect complementary channel is not much different. In sum, the dynamics are reversed for the indirect complementary channel in that benefits are now realised from Chinese trade instead of losses. An example of this type of effect typically originates from demand-induced global price increases affecting global supply chains. Given that China is the largest economy by population in the world, it follows that any positive change in the demand, whether through change in tastes or income levels, would apply upward pressure on world prices.

The increase in price for the finished goods has a knock-on effect on the upstream industry products. For example, if China demands cars from Germany, South Africa could indirectly benefit from an increase in the price of the car assuming Germany imports South African car parts as inputs to manufacture said car. In effect, the increase in the world price for cars will result in a demand for car inputs which South Africa exports, thus giving rise to an indirect effect. This effect is illustrated in figure 1.4.

Figure 1.4



Domestic Market

Source: Author's elaboration from Kaplinsky et al. (2007)

Figure 1.4 shows the domestic market initially at equilibrium position E_1 where firms produce output q_0. The indirect complementary channel sees the world price being pushed up, opening up opportunities to export at equilibrium position E_2. At the new price, local demand decreases from q_0 to q_1 allowing local firms to export the excess supply (q_2- q_1) at the cost to domestic consumers.

Having evaluated each of the four channels, and taking into account the primary focus around its export dynamics, the channels pertaining to Chinese exports[6] are identified as the direct

[6] The channels of exports refers to the export-related channels within the matrix of table 1 just discussed.

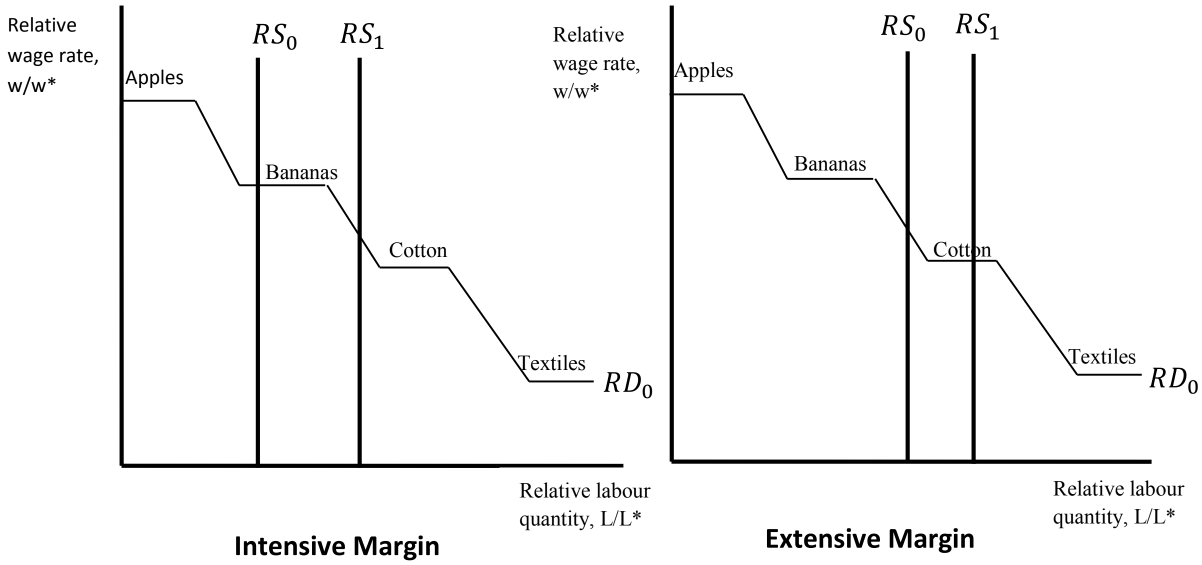
complementary and indirect competitive channels.[7] The Key insights from these 2 channels are that Chinese exports may crowd-out competing countries' exports to third countries and also that beneficial effects can be achieved by Chinese exports of intermediate and capital goods.

Having said this, there still remains some ambiguity with regards to the nature and type of products exported by the country of concern. The norm is to simply report results for the aggregate export changes, however, this does not give a very detailed account of the products exported. Aggregate export values can change through changes in the number of products exported (extensive margin) or changes in the value of exports of existing products (intensive margin). The case of the extensive is more interesting as it introduces a new dimension other than simply looking at export values.

[7] Note that within the direct competitive and indirect complementary channels of exports there also exists demand-side (Chinese imports) or domestic issues. Given that we are focussed on exports only, these factors are shelved for future research due to its minimal to no impact on exports.

2.1.5 *Dynamics of aggregate export values*

Figure 2: Ricardian Framework



Source: Krugman, Obstfeld and Melitz (2012): page 73

Figure 2 was adopted and adapted from a model used by Krugman, Obstfeld and Melitz (2012) which deals with a simplified Ricardian world with only 2 countries. The relative demand curve is unique in that it contains both downward sloping as well as flat sections. Each 'step' represents a different product or product group, with the intersection of the relative demand and supply curves determining which products are produced by the home country. All products or product groups situated to the left of the relative supply curve are produced by the home country while the products to the right are produced by the foreign country. If the relative supply curve lies on one of the 'flats' then both countries produce the quantity demanded of the 'flat product' at a set ratio. Intersection on the downward-sloping portions will not change the pattern of specialisation (Krugman, Obstfeld & Melitz, 2012: page 73). The two country framework may not accurately reflect the true trade relationships of the real world, however, the intuition can be extended to a full scale multi-country model.

Both graphs initially are at equilibrium position RS_0. The left panel domestic economy will produce and export apples and bananas, whereas in the right panel, the domestic economy will produce the same products but with more bananas. Conversely the foreign country will export textiles, cotton and bananas in the left panel and textiles and cotton in the right panel.

Continuing with the analogy of the direct complementary channel, I will deal with an increase in exports for the domestic country as a result of Chinese exports. Cheaper intermediate goods/inputs from China will result in firms becoming more competitive and be able to export a greater quantity of the finished goods as shown in figure 1.1. Mapping this graphically in figure 2 sees the relative supply curves in both panels shift rightwards from RS_0 to RS_1. The traditional Ricardian framework deals with relative labour and wage rates on the x and y-axes respectively. These simply refer to inputs and the costs of inputs vectors.

For the left panel, the rightward shift has resulted in the home country becoming the sole producer of bananas, thereby taking over the production previously produced by the foreign country. This translates into an increase in the aggregate export value. This is often referred to as a purely intensive margin change. The right hand panel, on the other hand, illustrates the case for the extensive margin. The extensive margin change comes about due to the relative supply curve (RS_0) shifting from a downward-sloping portion to a flat portion of the relative demand curve (RS_1). The new equilibrium position allows the home country to take on some production of cotton, thus, reducing the production of the foreign country, *ceteris paribus*. In comparison to RS_0, the home country is now exporting a new product signalling a change in the extensive margin.

The panels above prove that it is, not only the value of exports that is important, but also being able to identify the number/variety of products being exported. This dimension is often overlooked in favour of a standard export value analysis.

In summary of the theoretical framework, engaging in international trade with China gives rise to four main permutations arising from a combination of direct and indirect with complementary and competitive components as illustrated in table 1. Of particular interest is the indirect competitive and direct complementary channel[8] effects from China exports. Beyond simply categorising and identifying the channels through which Chinese exports affect the export performance of domestic economies, provisions also need to be made for the number of products exported. Not only is the aggregate export value of great interest, but the number of products (extensive margin) exported also plays a significant role in identifying the different avenues through which Chinese exports acts.

2.2 Empirical Framework

Having just discussed the implications of trade with China, empirical evidence will be consulted in order to lend credence to some of the theoretical foundations just established.

Giovannetti et al.(2009) used firm-level panel data from the 1990s and 2000s to look at the crowding-out effects of Chinese exports on African manufacturing exports seeing as this is where China holds its comparative advantage. Fixed effects regressions were used to accommodate the timespan and heterogeneity among firms in the dataset. Findings of this paper indicate a large negative impact on African manufactured exports to the USA and the EU. In addition, a more concentrated analysis on the Sub-Saharan Africa (SSA) region revealed Chinese exports to be especially detrimental to intra-regional and intra-SSA trade of manufacturing products. The most affected industry being the clothing and textile industry with other low, high labour-intensive sectors not far off (Giovannetti et al., 2009). Kaplinsky et al. (2007) along with Haugen (2011) go a step further to give consideration to the direct impacts and recognise some of the offsetting effects that these impacts may have with Haugen focussing primarily on micro-level data. Lall & Albaladejo (2004) also contribute to this literature by, not only looking at the benefits versus costs, but also give consideration to an extra channel in the form of partial threats when dealing with China and its trading partners.[9]

[8] For the rest of the paper, the word ‘channel’ may be omitted to save space.
[9] These were identified as the case in which both sets of parties experienced growth, but with China’s growth being faster than that of its trading partners (Lall & Albaladejo, 2004).

Despite these studies, there remains a limited amount of research that considers both the direct and indirect channels simultaneously. The research conducted in current studies have also predominantly been centred on the total margins of trade with hardly any concentration given to other measures of exports such as the extensive margin. The increased specialisation and breaking up of global supply chains mentioned in Deardorff (1998) has given greater importance to the extensive margin as countries seek to enter new niche markets as technology and supply chains become more sophisticated.

In the limited exposure to the extensive margin that has been documented in existing literature, there have been many conflicting views expressed by different papers researching the extensive margin (Besedes & Prusa, 2010). However, there does seem to be a general consensus that the importance of the extensive margin effect tends to fluctuate from country to country and is dependent on the sample size and nature of the data. For example, Kehoe & Ruhl (2013) found the extensive margin to be insignificant from evidence on bilateral trade flows between the United States, United Kingdom and China while Coughlin (2012) found that for the USA, the importance of the extensive margin differs from state to state.

Hummels and Klenow's (2005) seminal paper extends this to the country/aggregate level whereby they discussed the extensive margin in great detail through observed international trade patterns. In their paper, they pointed out that developed countries typically realise more benefits from the extensive margin up to 60% of their gross domestic product (GDP) whereas developing countries can experience very little to insignificant positive effects.

Persson (2010) makes use of poisson and negative binomial regression models in order to model the extensive margin. In this paper, the author concurs the findings of Hummels and Klenow (2005) for trade data relating to trade between developing countries and the EU. The author goes into detail on the increased costs of accessing new markets for developing countries relative to their developed counterparts which has resulted in less promising trends (Person, 2010).

Despite some of these studies emphasising the importance of the extensive margin in the international trade environment, existing studies have been slow to employ techniques to establish these effects. Of note, existing studies have tended to avoid discussing the impacts on the extensive margin that crowding-out from China presents. Chinese export growth can be quite harming to other countries in that it expands along new product lines in which other countries are already established or currently looking to establish themselves in (Edwards & Jenkins, 2013). In face of China's presence, countries with similar comparative advantages will need to differentiate themselves in the global market. This can be achieved by establishing a greater comparative advantage, producing higher quality goods or produce totally different goods just to name a few. These dynamics are not well documented or researched and there exists a lack of substantive knowledge on this topic.

Mion and Zhu (2013) made use of Belgian manufacturing firm-level data over the period 1996–2007 to identify whether the adverse Chinese effects documented above differ significantly from the rest of the world. Some of the more pertinent results they found that are relevant to this paper are that industry-level import competition from China reduces firm employment within firms and induces across firm reallocation in terms of employment within low-wage industries. Of particular interest is their finding that the effects observed from China in comparison to other low-wage and OECD countries are significantly different. The effect of China is unique and significant in that when its effect is taken out, the remaining country results become insignificant.

Furthermore, looking specifically at the composition and nature of competition from China reveals that products originating from China typically constitute cheap, low-wage products. Wages is a key differentiating feature that needs specific attention given that high and low wage firms may experience contrasting effects due to Chinese competition. Ashournia et al. (2013) discusses the adverse implications arising from Chinese import penetration for Danish firms. In their paper, they find significant increases in the wage gap of firms. In face of competition from Chinese imports, low-wage industries are suffering from a significant decrease in demand for their services far outweighing that of high-wage industries, thus, resulting in a more unequal distribution of income.

Bloom et al. (2011) reach a similar conclusion by looking at the issue from a different angle. They look at the effects that Chinese imports have on innovation and productivity in the manufacturing sector across twelve European countries. Their findings indicate a greater shift in innovation towards high-skill and high-wage industries within the manufacturing sector (Bloom et al., 2011). This finding reinforces the notion of an increase in the wage gap and general allocation of benefits in favour of more skilled and industries facing higher wage bills as a consequence of the influx of cheaper Chinese imports.

2.3 The Case of South Africa

The majority of existing research has seen a greater portion of research devoted to the analysis of China and its impact on developed/first world countries with little emphasis being placed on developing countries in particular to Africa. One of the primary concerns is the lack of credible data available in developing countries which would make inferences and findings unreliable. This is slowly being rectified over the past few years with more and more research being aimed at developing countries as data becomes available. One such country is South Africa given its status as Africa's leading economy. South Africa has been identified as one of the key emerging markets as is evident from its presence in BRICS.[10]

Edwards and Jenkins (2015b) analysed the effects of Chinese import penetration on the South African manufacturing sector. Their paper looked at the effects that Chinese trade has had on production, employment and productivity in the South African manufacturing sector from 1992 to 2010 (Edwards and Jenkins, 2015b). In their paper, they found that imports from China displaced production for local South African manufacturing products while it "…did not add significantly to industrial growth in South Africa."(Edwards and Jenkins, 2015b). The bilateral relationship uncovered is lopsided in favour of China in this regard. Furthermore, a

[10] BRICS countries refers to Brazil, Russia, India, China and South Africa.

negative overall impact of Chinese competition on manufacturing employment in South Africa is found partly due to the displacement of local production and also to increased productivity as inefficient firms are pushed out of the industry.

With regards to employment and production, Edwards and Jenkins (2015b) sought to classify the effects on employment and production further by implementing a median benchmark wage rate in order to bisect the manufacturing sector in South Africa. Findings in this regard attributed a major portion of employment and production reductions to the low-wage industries relative to the high-wage industries, thus reinforcing the notion of China's comparative advantage in high labour-intensive and low-wage industries. Their paper focussed mainly on the negative/competitive direct effects of trade, however, there was some evidence pointing towards lower producer price inflation in South Africa as a result of Chinese import penetration which helped reduce production cost increases.

In a separate study, Edwards and Jenkins (2015a) also analysed the impact of China from a different angle in which they looked to identify the existence and extent to which Chinese exports are crowding-out South African exports to South Africa's major trading partners. They found that China has had an adverse effect for South Africa in all of its major export destinations which is especially pronounced in the Sub-Saharan Africa (SSA) region. South African exports are 10% lower than it would otherwise have been if it had maintained its market share vis-à-vis China. Other findings concurred Edwards and Jenkins's (2015b) finding that low-wage and labour-intensive industries are the most affected.

There are also a few other studies that have looked at Chinese implications for South Africa (Dunne & Edwards, 2007; Edwards, 2001a, 2001b; Edwards, 2005; Edwards & Jenkins, 2015a, 2015b; Fedderke, 2006; Jenkins, 2008 and Jonsson & Subramanian, 2001), however, there still remains a great scope for analysis.

Despite the findings above, there still remains a few shortcomings in this area of research. The common area which seems to be systematically understated and omitted from current literature focussing on South African and Chinese trade relationships is the analysis of the complementary effects. Existing literature is predominantly focussed on the competitive effects that China poses for South Africa in particular the domestic environment. For example, Edwards and Jenkins (2015b) analysed how China has played a significant part in reduction in employment levels in South Africa with little mention of the positive/complementary effects. Complementary effects may include an increase in labour productivity or access to a greater variety or cheaper inputs, all of which have been in large part missing from existing literature.

In addition, the lack of research done on the extensive margin globally mentioned earlier extends to South Africa which Edwards & Jenkins (2013) identified through discussions regarding extensive margin analyses and its almost non-existent presence for countries in Africa. Evidence for analysing the South African extensive margin extends from the research done by Besedes & Prusa (2010) and Coughlin (2012) already mentioned.[11] Additionally, given the special trading ties afforded to South Africa through its BRICS membership, coupled with Baier et al., (2014) research on economic integration agreements finding significant and robust evidence of extensive margin action over time[12], proves further the need to introduce this analysis into this paper. Granted that, based on Hummels and Klenow (2005) and Persson's (2010) findings, one would not expect much growth/significance in the extensive margin for South Africa[13], however, it should still not preclude the analysis of the issue.

The lack of analysis and research in key areas identified above has, In part, led to a public perception that is not supportive of trade with China. Other factors and angles need to be explored before a final judgement is passed on the impact of Chinese competition. This is where this paper looks to contribute.

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[11] The findings and conclusions that different areas/countries possess different traits that create different extensive margin impacts warrants the analysis of South Africa.

[12] Baier et al. (2014) made use of gravity-type econometric analysis to uncover their results. This paper will, however, focus on a log-linear regression approach.

[13] Seeing as South African is considered a 'small' country in the world, Hummels & Klenow (2005) and Persson's (2010) finding that 'small' developing countries don't enjoy significant positive movements in the extensive margin would apply.

2.4 Contribution

This paper will look to plug some of the holes and shortcomings mentioned in the existing literature. It will draw inspiration from current available research in using similar analytical techniques to add to the current findings by exploring effects of Chinese exports on South African manufacturing exports.

The main avenues of contribution will be the analysis of the direct complementary and indirect competitive effects arising from Chinese exports. These effects will be looked at in terms of the aggregate export value as well as the extensive margin (product count) of exports. This will enable one to better understand the nature of the products exported by the South African manufacturing sector. For example, it will allow people to identify firms/industries where product lines are expanding and industries where product value is increasing. The separation of the extensive margin of exports from the aggregate export value analysis allows this paper to identify the changes in different export measures arising from Chinese exports.

Distinguishing between the different wage structures of exporters will also be a crucial cog in identifying the different effects on South African exports given China's global comparative advantage in this regard. There has been overwhelming evidence attesting to large differences between firm responses based on their wage levels. Bloom et al. (2011) found significant differences between low and high-wage industries within each sector in face of Chinese competition. Edwards and Jenkins (2015b) also found highly significant results once accounting for wages when looking at South African dynamics in response to China. In this paper, I will employ similar techniques as Edwards and Jenkins (2015b) to look at the wage differences.

3. Data

This paper makes use of industry-level data used in Edwards and Jenkins (2015b), as well as data downloaded from the UN Comtrade (2015) database.[14] The data consists of a variety of indices containing 44 manufacturing industries based on their 3 digit Standard Industrial Classification (SIC) code. Table 2 provides the codes for each industry in the dataset along with its description. For convenience, each industry is allocated into either high or low-wage industries within the manufacturing sector.[15] A concordance table was used to convert any 6 digit HS (Harmonised System) codes to the 3 digit SIC codes in accordance with the UN Comtrade (2015) database.

Table 2
Wage Classification of Industries in the Manufacturing Sector

High-wage Industries		Low-wage Industries	
SIC	**Industry**	**SIC**	**Industry**
305	Beverages	301	Meat, fish, fruit, vegetables, oils & fat
323	Paper and paper products	302	Dairy products
324	Publishing	303	Grain milling & animal feeds
325/6	Printing and related services	304	Other food products
331/2	Coke oven and petroleum products	311	Spinning and weaving
334	Basic chemicals	312	Other textiles
335/6	Other chemicals	313	Knitted and crocheted fabrics
337	Rubber products	314/5	Clothing
341	Glass and glass products	316	Leather and leather products
351	Basic iron and steel	317	Footwear
352	Non-ferrous metals	321	Sawmilling and planing of wood
356/9	General purpose machinery	322	Wood and wood products
357	Special purpose machinery	338	Plastic products
361	Electrical motors, generators and transformers	342	Non-metallic mineral products
362	Electricity distribution and control apparatus	354	Structural steel products
363	Insulated wire and cable	355	Other fabricated metal products
364	Accumulators and batteries	358	Household appliances
366	Other electrical equipment	365	Electric lamps and lighting equipment
371/2/3	TV, radio and other electronic equipment	374/5/6	Medical, measuring and controlling equipment
381	Motor vehicles	383	Parts and accessories for motor vehicles
382	Bodies for motor vehicles	391	Furniture
384/5/6/7	Other transport equipment	392	Other manufacturing

Source: Author's calculations using Edwards and Jenkins (2015b) data.

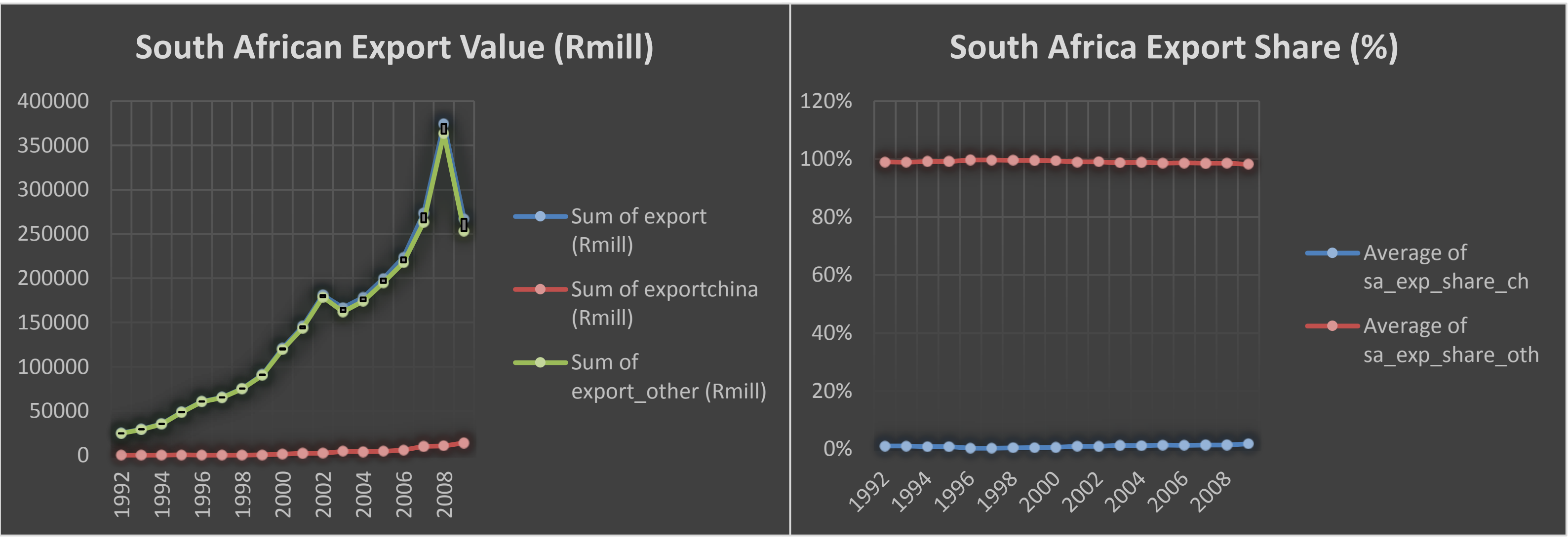
[14] Ideally, firm level data would be used in order to look at dynamics at the micro level, however, data availability was an issue.
[15] Recall from the literature review, the analysis will encompass a separation of the manufacturing sectors into high and low-wage industries. Table 2 is arranged to convey this information for convenience.

3.1 Aggregate Export Value and Extensive Margins

3.1.1 Aggregate Export Value

The total (aggregate) export value in millions of rands was downloaded and deflated from the UN Comtrade (2015) database.[16] A graphic summary of the data is presented in figure 3.

Figure 3



Source: Author's calculations using UN Comtrade(2015) data.

The left panel reveals that the aggregate export value to China remained relatively constant at levels well below R50 trillion throughout the period under analysis. The right panel illustrates the same story with percentages reiterating an almost negligible trend from China. However, there is a source of optimism in that the trend experiences a slight increase in slope indicative of a faster pace of export growth after China's accession into the WTO in 2001. To have a better understanding of the aggregate export value, the export values of each industry also needs to be evaluated.

Some of the key industries for the aggregate South African manufacturing export value are the 'basic iron and steel' (R45 trillion), 'motor vehicles' (R27 trillion) and 'basic chemicals' (R21 trillion) industries. The top panel of figure A in the appendix shows the general trend of these

[16] Deflated measures are used to remove inflationary bias.

industries among the other top 7 contributors while the bottom panel illustrates the trends for the bottom 10 industries; both in millions of rands. The least significant industries include the ‘printing and related services’ (R0.23 trillion) and ‘footwear’ (R0.21 trillion)[17] industries. All industries have experienced growth in their export value since 1992 and peaked in 2007 just prior to the global financial crisis after which industries saw a decline in export values.

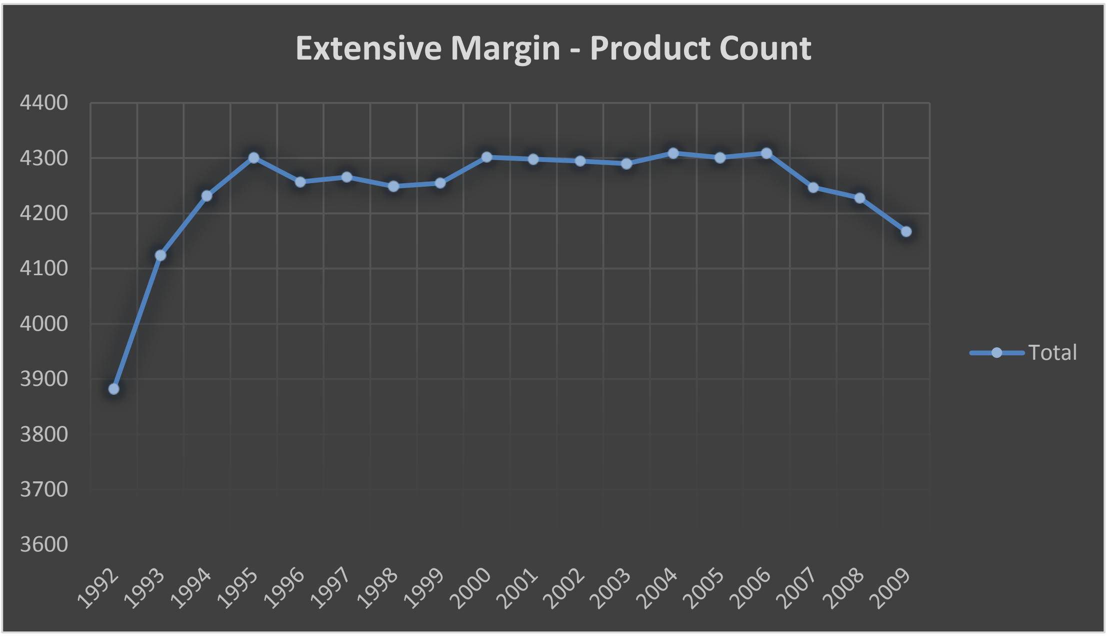
3.1.2 Extensive Margin/Product Count

The extensive margin is constructed in accordance with Persson (2010) as the number of products exported. In terms of data collection, the 6-digit HS codes for each exported product was downloaded from the UN Comtrade (2015) database, and then converted to 3-digit SIC codes via the concordance table. Each 3-digit code, which corresponds to the panel data of 44 industries, was then summed and allocated to each time period in the panel.

Figure 4 provides a summary of the extensive margin data collected. From the graph, the total product count/extensive margin is observed to increase from 1992 to 1994. The main cause for this is the lifting of sanctions on South Africa from the rest of the world in face of the fall of apartheid in 1990. The growth observed thereafter has subsequently tapered off with a prominent decline post 2006 reaching a final total of 4167 (from 3882 in 1992) manufacturing products being exported in 2009. This trend does not look promising for future export growth prospects in terms of product variety. China’s general comparative advantage in manufacturing products in combination with its accession into the WTO could see the persistence of the downward trend observed from 2006 - 2009.

[17] All values stipulated in parenthesis are 2009 year values.

Figure 4



Source: Author's calculations using UN Comtrade (2015) data.

Breaking down the total product counts into each industry reveals that the 'chemicals' industry, which exported over 500 different products in 2009 (up from 481 in 1992), has the most variety of products exported. The 'spinning and weaving' industry has also grown from exporting 272 products in 1992 to 306 products in 2009.[18]

Other than these two industries, most of the other industries have remained relatively constant over the same time period. The lowest contributors to the total exported product count are the 'bodies for motor vehicles' and 'printing and related services' industries; both of which have seen no change from the 8 products exports since 1992.

One possible explanation for this trend is the way each industry is classified in terms of its SIC code. For example, the variation of products in the 'bodies for motor vehicles' industry may be more limited than the 'chemicals' industry which can contain many different product variations depending on the molecular structure of each chemical.

[18] Figure B in the appendix illustrates the trends of each industry. The top and bottom panels show the top and bottom 10 industries by product count/extensive margin respectively.

3.2 Indirect Competitive Variable

Additional variables also needed to be constructed in order to account for the variables of interest in this paper, namely the indirect competitive and direct complementary channels of trade. The indirect competitive channel of Chinese exports was constructed as follows:

$$SX_{it}^{CH} = \frac{\sum_{i=1}^{44} X_{it}^{CH}}{\sum_{i=1}^{44} M_{it}^{WLD}}$$

Where, $\sum_{i=1}^{44} X_{it}^{CH}$ indicates the summation of each industry in the manufacturing sector classified via the SIC 3-digit code in each time period (1992-2009) for Chinese industry exports to the world. $\sum_{i=1}^{44} M_{it}^{WLD}$ represents the summation of each industry in the manufacturing sector classified via the SIC 3-digit code in each time period (1992-2009) for world industry exports to the world. As a whole, the equation measures the global import share of Chinese exports to the world.[19]

This measure will be used as a proxy for the indirect competitive effect. As the share of Chinese exports increase, it will crowd-out exports from the rest of the world, *ceteris paribus*. This is viewed as a 'threat' since the increase in the share of Chinese exports in world trade will result in goods previously exported by local industries to be replaced, typically with cheaper substitutes or better quality goods at the same price from China.

Figure 5 provides two line graphs illustrating China's share of global imports from 1992 to 2009. The left panel documents the total value of imports in thousands of US dollars. Up/down bars are overlaid to indicate the distance between the different measures of concern. From the size of the bars, it is clear that the Chinese global import share has risen over the time period under analysis.

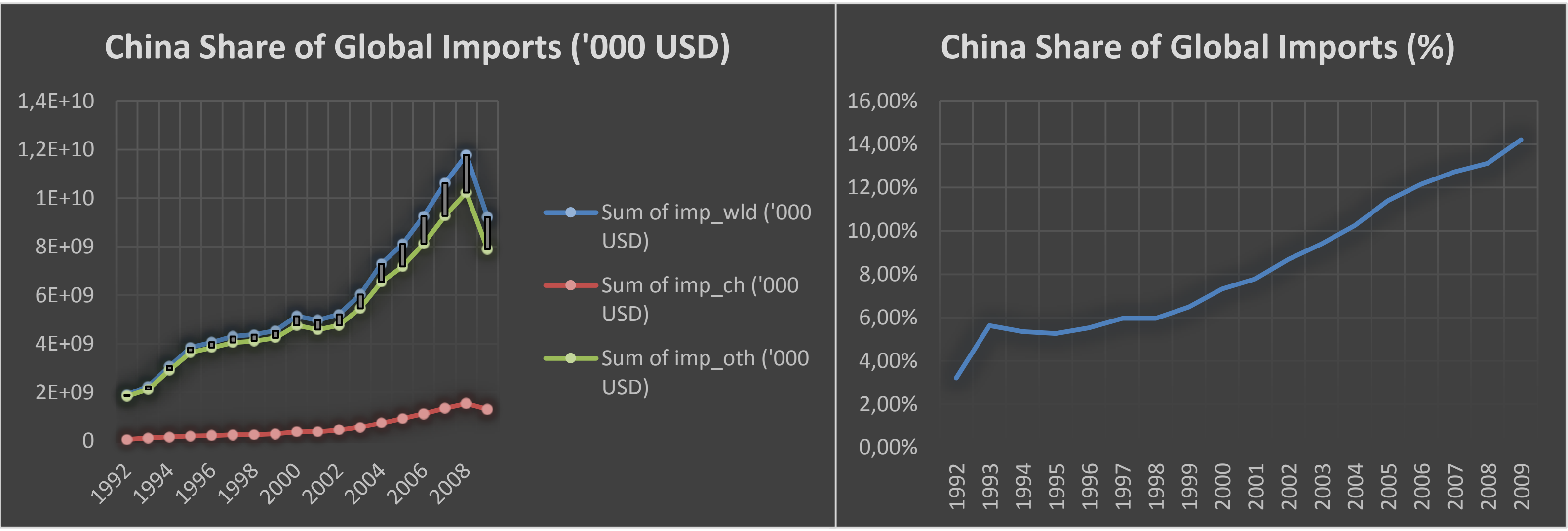
The right hand panel underlines this point by plotting the percentage of global import share for China. This trend is more pronounced given less interference from other values. In 1992 the Chinese global share of imports was only 3.20% and this statistic has increased ever since,

[19] Conforming to the manufacturing sector data already available, this data was collected from the UN Comtrade (2015) database from 1992 to 2009 using the HS 6-digit classification codes.

barring 1994, to 14.21% in 2009. To understand the main drivers to this rapid rise in Chinese exports, closer inspection within the manufacturing is required seeing as the effect was not equal across all industries.

The highest share of Chinese global import share originates from its 'footwear' (from 21% to 47%), 'clothing' (from 16% to 43%), 'other manufacturing' (from 15% to 40%) and 'leather products' (from 16% to 41%) industries while industries such as 'chemicals' only contributed 5% in 2009. The other highest contributors by industry to China's rise and their level of involvement in world imports can be found in figure C of the appendix.

Figure 5



Source: Author's calculations using UN Comtrade (2015) data.

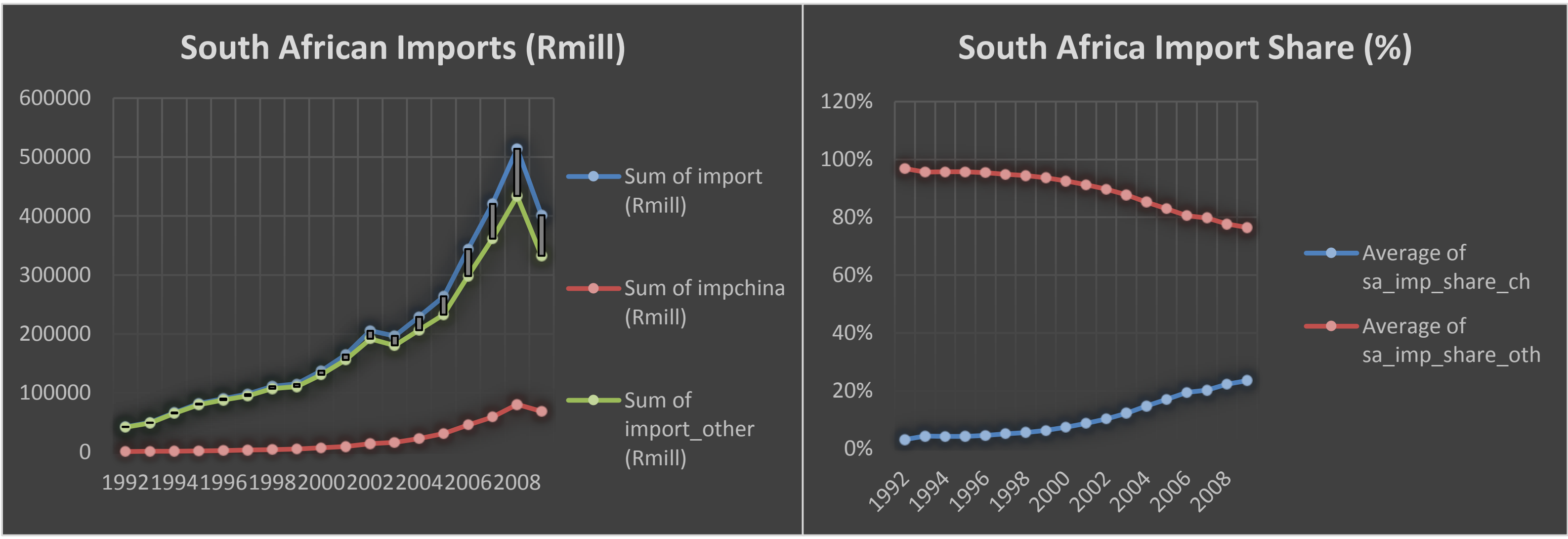
Looking more specifically at China's presence in South Africa (figure 6) reveals a similar outlook. The left panel shows the total value of imports from China in millions of rands with China showing a clear upward trend. This trend becomes more pronounced after China acceded into the World Trade Organisation (WTO) in late 2001.[20] The extent of this rise is made clearer in the right panel where the Chinese composition of South African imports is

[20] The only downward trend can be attributable to the global financial crises of 2007/2008. Even then, the China trend does not dip much in comparison to the rest of the world.

plotted as a percentage of total imports. In 1992, China only represented 3% of South African imports on average in the manufacturing sector, however, by 2009 this number swelled to almost a quarter of South African imports (24%).

Identifying the key industries contributing to this rapid increase uncovers that the 'footwear' (from 21% to 73%), 'clothing' (from 28% to 71%), 'knitted and crocheted fabrics' (from 7% to 62%) and 'household appliances' (from 5% to 62%) contributing more than 60% of South African imports in 2009. All four of the above industries have more than doubled their presence in South Africa since 1992 thereby underlining, not only China's comparative and competitive advantage, in these manufacturing industries, but also China's ability to develop production and comparative advantages over time. This trend persists for the manufacturing sector as a whole. As was with figure C, figure D in the appendix provides a more detailed illustration and breakdown of each of the industries in the manufacturing sector and their level of involvement in South African manufacturing imports.

Figure 6



Source: Author's calculations using UN Comtrade (2015) data.

Contrasting figures 5 and 6 reveals that, if anything, China exerts more dominance in the South African manufacturing sector vis-à-vis the rest of the world. The total number of

Chinese manufacturing industries constituting above 20% market share in the world are 15 out of the 44 (34%) industries, whereas for South Africa it is around 25 industries (57%).

Another key distinction between the two figures is the level of growth and import penetration. For example, in the world economy, the 'clothing' and 'footwear' industries only cede between 40% and 50% of its import market share to China, whereas, the same South African industries gives up more than 70%. This gives China a monopoly-esque status in these industries.

3.3 Direct Complementary Variable

A measure for the direct complementary channel of exports is obtained from Edwards and Jenkins (2015b). It takes the form of import penetration of inputs where import penetration is defined as the proportion of domestic demand that imports from the rest of the world comprises. The equation below clarifies this point.

$$mpenet_{it} = {}^{M_{it}}/_{D_{it}}$$

Where

M_{it} is imports into industry i at time t

D_{it} is domestic demand of industry i at time t

Domestic demand can be disseminated into 3 different components. These components are sales, export and imports.

$$D_{it} = sales_{it} - export_{it} + import_{it}$$

Identifying the import penetration variable, however, is insufficient for the purposes of this paper as it fails to identify the complementary component of the effect. The equation above consists of the total import penetration which includes both finished and intermediate goods however, the direct complementary effect in this paper is primarily concerned with the benefits arising for South African exports. The role of that imported finished goods occupies is predominantly restricted to the domestic market only.

In order to isolate the import penetration in inputs effect, further manipulation is needed. Every good imported is weighted in accordance with the significance that each constituted in the production process of each manufacturing industry.[21]

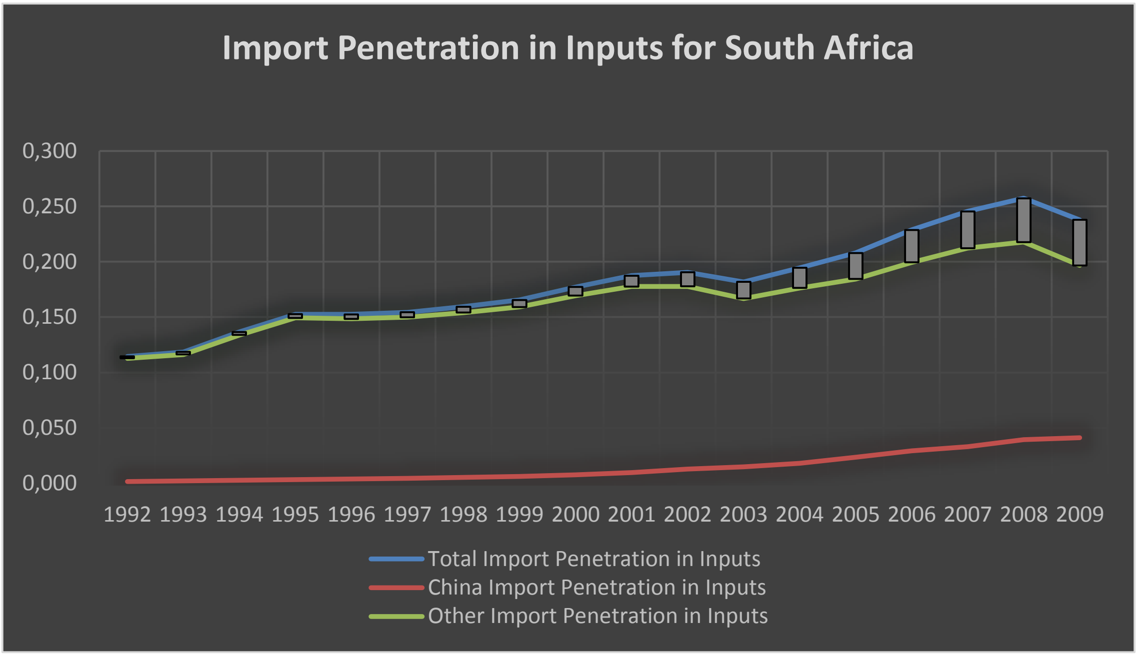
$$mpenet\ inputs_{jt} = \sum_{i=1}^{44} w_{ij} mpenet_{it}$$

Where w_{ij} represents the share of industry i in intermediate input costs of industry j. $mpenet\ inputs_{it}$ was constructed for China as well as the rest of the world.

Figure 7 presents an aggregate representation of the direct complementary channel. It illustrates the level of import penetration in inputs of China in the South African manufacturing sector. The up/down bars, once again, suggests an upward trend of China's presence in South Africa from 1992-2009. During the 1990s, the import penetration of inputs from China remained relatively constant as the import penetration in inputs of other (rest of the world) countries followed the total import penetration levels closely. However, since the turn of the millennium, China's influence in the South African market has increased in relation to the rest of the world. This supports Edwards and Jenkins' (2015b) finding that China accounted for more than three-quarters of the total import penetration[22].

[21] The weightings were obtained through the use of input-output tables from StatsSA for the year 2000 (Edwards & Jenkins, 2015b).
[22] Total import penetration by definition includes total import penetration in inputs.

Figure 7



Source: Author's calculations using Edwards & Jenkins (2015b) data.

Table 3 shows more precise figures with some extra calculations done for three different time periods. Since 2000, China has contributed over 50% (51.07% and 54.97% in 2005 and 2009 respectively) to the total import penetration in inputs for South Africa. The import penetration in inputs from China has risen from 0.008 in 2000 to 0.041 in 2009, whereas import penetration in inputs from the rest of the world (other) has only slightly increased from 0.169 in 2000 to 0.197 in 2009. One must, however, still be mindful of the fact that China's rapid rise and high growth rates are from a low base relative to the rest of the world.

Table 3

Import Penetration in Inputs since 2000

	2000	2005	2009
Import Penetration in Inputs, Total	0.177	0.208	0.238
Import Penetration in Inputs, Other	0.169	0.184	0.197
Import Penetration in Inputs, China	0.008	0.023	0.041

Source: Author's calculations using Edwards and Jenkins (2015b) data.
Notes: Import penetration in inputs is the weighted average import penetration in intermediate inputs used in each industry.

Breaking down these numbers by industry reveals the extent to which each industry has been exposed to import penetration in inputs. These numbers are illustrated in table 4 where growth rates and proportion of total columns have been added. We see that industries with the highest import penetration of inputs from China are the 'clothing', 'footwear' and 'television, radio and other electronic equipment' industries with values of 0.1408, 0.1728 and 0.1757 respectively in 2009. These have exhibited high growth rates in excess of 1000% since 1992, with each ranking among the top industries representing the highest proportion of total at 45.7851%, 49.8217% and 29.5348%. 'Household appliances' occupies the third highest proportion of total at 33.3763% despite having a relatively lower absolute value to the three industries just mentioned, while the 'special purpose machinery' industry experienced the highest growth rate at 11,167.73% albeit from a much lower base.

Industries whose goods are not that widely used as inputs include the food industries (SIC 301-305) with values ranging from 0.0088 to 0.0170. Overall, it is no surprise that these observations correspond to those analysed in figure 6. In other words, the industries with the greatest presence in South African imports are the same ones as those with the highest import penetration in inputs. This validates the notion that not all Chinese imports are harmful to the economy, as well as furthering the concept of global supply chains. For example, cheap textiles may crowd-out local industries but they may also serve as a boost to producers of downstream products in providing cheaper inputs thus lowering the cost of production.

Table 4

Import Penetration of Inputs in South Africa

		Import Penetration of Inputs -China		Growth (%)	Import Penetration of Inputs - Rest of World		Growth (%)	Proportion of Total	
SIC	Industry Description	1992	2009	1992-2009	1992	2009	1992-2009	1992	2009
301	Meat, fish, fruit, vegetables, oils & fat	0.0021	0.0088	312.0092	0.0942	0.1016	7.8697	2.2271	8.0038
302	Dairy products	0.0020	0.0085	330.1956	0.0816	0.0823	0.7939	2.3551	9.3335
303	Grain milling & animal feeds	0.0025	0.0075	204.9170	0.1003	0.0977	-2.6573	2.3960	7.1403
304	Other food products	0.0012	0.0066	470.0362	0.0606	0.0901	48.6643	1.8742	6.8239
305	Beverages	0.0009	0.0170	1796.9598	0.0616	0.0975	58.3449	1.4373	14.8713
311	Spinning and weaving	0.0040	0.0710	1654.3222	0.1482	0.1842	24.3322	2.6606	27.8325
312	Other textiles	0.0030	0.0596	1912.7542	0.1384	0.1928	39.2401	2.0937	23.6128
313	Knitted and crocheted fabrics	0.0044	0.0827	1790.9415	0.1277	0.1681	31.6296	3.3096	32.9629
314/5	Clothing	0.0065	0.1408	2064.7397	0.1383	0.1667	20.5187	4.4906	45.7851
316	Leather and leather products	0.0040	0.0489	1122.0793	0.1227	0.1835	49.5127	3.1559	21.0338
317	Footwear	0.0129	0.1728	1236.9752	0.1439	0.1740	20.9061	8.2392	49.8217
321	Sawmilling and planing of wood	0.0020	0.0135	571.8535	0.0910	0.0950	4.4731	2.1573	12.4182
322	Wood and wood products	0.0020	0.0135	571.8535	0.0910	0.0950	4.4731	2.1573	12.4182
323	Paper and paper products	0.0008	0.0150	1854.8530	0.1084	0.1601	47.6764	0.7025	8.5627
324	Publishing	0.0003	0.0211	8257.3314	0.1176	0.2055	74.7749	0.2141	9.3070
325/6	Printing and related services	0.0003	0.0211	8257.3314	0.1176	0.2055	74.7749	0.2141	9.3070
331/2	Coke oven and petroleum products	0.0008	0.0073	785.2554	0.0373	0.2911	680.0785	2.1486	2.4312
334	Basic chemicals	0.0009	0.0181	1910.0896	0.1129	0.2224	97.0297	0.7901	7.5146
335/6	Other chemicals	0.0010	0.0241	2345.2057	0.1454	0.2373	63.2378	0.6727	9.2103
337	Rubber products	0.0017	0.0288	1643.2960	0.1268	0.2017	59.1159	1.2874	12.5024
338	Plastic products	0.0009	0.0286	3005.7631	0.1540	0.2505	62.6504	0.5947	10.2520
341	Glass and glass products	0.0010	0.0273	2518.8424	0.0741	0.1472	98.5230	1.3862	15.6423
342	Non-metallic mineral products	0.0006	0.0162	2458.7406	0.0486	0.1849	280.4307	1.2882	8.0692
351	Basic iron and steel	0.0006	0.0168	2618.3431	0.0414	0.2296	454.9014	1.4736	6.8266
352	Non-ferrous metals	0.0005	0.0119	2136.2051	0.0526	0.2088	297.0899	0.9994	5.3790
354	Structural steel products	0.0005	0.0360	6983.4036	0.0715	0.1423	98.8981	0.7063	20.2118
355	Other fabricated metal products	0.0004	0.0368	9135.5422	0.0802	0.1673	108.6267	0.4944	18.0283
356/9	General purpose machinery	0.0007	0.0680	9714.1886	0.1369	0.2700	97.1678	0.5037	20.1266
357	Special purpose machinery	0.0008	0.0871	11167.7303	0.1697	0.3245	91.2533	0.4532	21.1508
358	Household appliances	0.0018	0.0724	3999.3309	0.0869	0.1446	66.3896	1.9929	33.3763
361	Electrical motors, generators and transformers	0.0006	0.0363	5521.8114	0.0861	0.1901	120.7028	0.7442	16.0363
362	Electricity distribution and control apparatus	0.0006	0.0348	5816.0075	0.1137	0.2204	93.9130	0.5146	13.6305
363	Insulated wire and cable	0.0004	0.0303	6660.5214	0.1008	0.2239	122.1491	0.4429	11.9241
364	Accumulators and batteries	0.0005	0.0165	3284.4565	0.0602	0.1212	101.3178	0.8035	11.9855
365	Electric lamps and lighting equipment	0.0007	0.0392	5692.6738	0.1119	0.2114	88.8675	0.6013	15.6496
366	Other electrical equipment	0.0007	0.0389	5813.3299	0.1106	0.2291	107.1969	0.5915	14.5164
371/2/3	Television, radio and other electronic equipment	0.0030	0.1757	5661.1286	0.2608	0.4192	60.7659	1.1561	29.5348
374/5/6	Medical, measuring and controlling equipment	0.0018	0.0465	2501.0614	0.1717	0.2941	71.3264	1.0308	13.6539
381	Motor vehicles	0.0010	0.0355	3449.0642	0.1884	0.2401	27.4732	0.5288	12.8928
382	Bodies for motor vehicles	0.0010	0.0355	3449.0642	0.1884	0.2401	27.4732	0.5288	12.8928
383	Parts and accessories for motor vehicles	0.0010	0.0328	3051.4598	0.1434	0.2065	43.9449	0.7212	13.7223
384/5/6/7	Other transport equipment	0.0013	0.0398	3079.4093	0.1945	0.3569	83.4849	0.6395	10.0329
391	Furniture	0.0023	0.0418	1712.9777	0.0942	0.1329	41.1706	2.3922	23.9400
392	Other manufacturing	0.0010	0.0192	1896.6548	0.0583	0.2477	324.8462	1.6211	7.1874

Source: Author's calculations using Edwards and Jenkins (2015b) data.

Notes: Import penetration in inputs is the weighted average import penetration in intermediate inputs used in each industry.

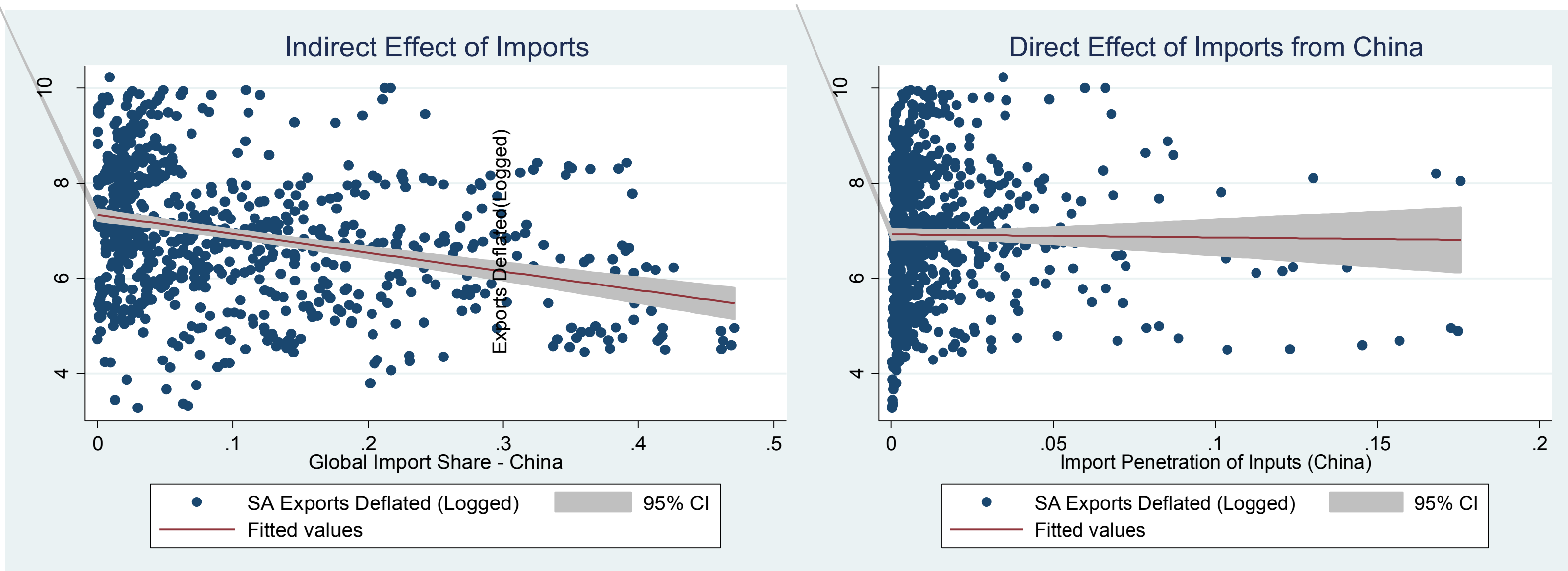
3.4 Preliminary analysis of key relationships

Having just established the key variables for this paper, the aggregate export value and extensive margins are combined with the indirect competitive and direct complementary channels to postulate the expected relationships that would prevail in an econometric analysis. These postulates will be drawn from the theoretical framework developed and discussed in the literature review section.

Looking back to the theoretical framework reveals that the expectations of the indirect competitive and direct complementary effect on exports to be negative and positive respectively. Given that the theoretical framework was established for aggregate export values, it is not as clear-cut to determine the relationships for the extensive margin. In general, the trends of the extensive margin are similar in nature and are expected to move in the same direction as the aggregate export value. In sum, the direct complementary effect on exports is expected to exhibit a positive relationship, whereas, the indirect competitive effect on exports is expected to exhibit a negative relationship.

A preliminary inspection to discern the general relationship between the direct complementary and indirect competitive channels (independent variables) with respect to the aggregate export value and extensive margins (dependent variables) was performed to verify each of the above postulates. For this purpose, scatterplot graphs will be utilised and are illustrated as figures 8 and 9.

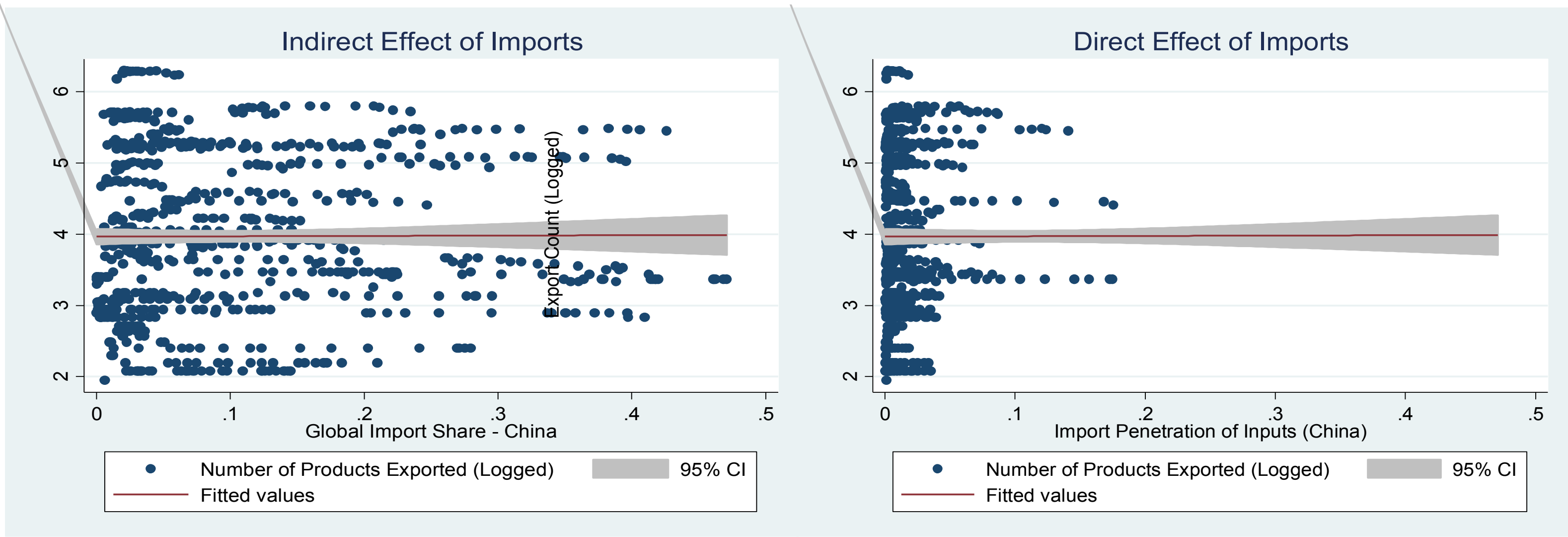
Figure 8



Source: Stata calculations using UN Comtrade (2015) and Edwards & Jenkins (2015b) data.

Figure 8 is a scatterplot graph illustrating the relationships between the aggregate export value and the two main channels of interest (competitive indirect and complementary direct channels). The left panel analyses the indirect competitive effect of imports (x-axis) on the log of the real export value (export value deflated) which is plotted on the y-axis. There does seem to be a lot of variation which is promising. Overlaying a line of best fit with a 95% confidence interval seems to indicate a negative linear relationship between the two variables confirming the initial theoretical prediction. The right panel shows the linear relationship between the direct complementary channel effects and the aggregate exports. Given the nature of the plots, no clear relationship is evident and further investigation is needed before making a final judgement.

Figure 9



Source: Stata calculations using UN Comtrade (2015) and Edwards & Jenkins (2015b) data.

Figure 9 illustrates the relationship between the same independent variables but for the extensive margin (export count). The export count variable was logged in order to conduct the linear analysis in line with the nature of scatterplot graphs. Despite logging the export count variable, the scatterplot does still raise some concerns regarding the nature of the relationship and plot distribution. To emphasise this point, overlaying the line of best fit with a 95% confidence interval reveals inconclusive relationships for every channel. Figure 9A in the appendix includes the LOWESS (Locally Weighted Scatterplot Smoothing) technique in Stata to help uncover the possibility of a non-linear relationship. The evidence from the non-linear trend of the LOWESS technique also fails to exhibit an obvious trend.

In general, the scatterplots only reveal the linear relationship between 2 variables with no consideration given to other factors. For example, there may be other confounding variables that may interact with the key variables in reality that will result in more accurate estimations of the true relationships (one may want to make provisions for 3 or more other variables).

Before moving on to the methodology and results section, a few limitations with regards to the data need to be discussed. Firstly, the nature of the data restricts the estimates to industry-level effects and does not provide more detailed information on data at disaggregate levels. This precludes inferences on within and between-firm effects. Secondly, the data is only available for the manufacturing sector which further restricts inferences from being made regarding the primary and tertiary sectors and, by extension, the country (macroeconomic environment) in general. This is problematic as these may contribute to South African trade margins in the long run as South Africa industries shifts towards more tertiary-orientated export growth. However, given the data constraints, conclusions on this nature cannot be drawn. Further research is needed to make final conclusions based on the South African economy as a whole.

4. Methodology and Results[23]

4.1 Aggregate Export Value

The core econometric model for the aggregate export value is as follows:

$$export\ value_{it} = \beta_0 + \beta_1 SX_{it}^{CH} + \beta_2 input\ mpenet\ total_{it} + \beta_4 input\ mpenet\ ch_{it} + u_{it}$$

The $export\ value_{it}$ variable is the dependent variable which represents the logged aggregate value of exports deflated for the South Africa manufacturing sector in millions of rands.

The SX_{it}^{CH} is the global import share of Chinese exports. This variable represents the indirect competitive channel of exports from China on South African manufacturing exports. Expected sign is negative.

The $input\ mpenet\ total_{it}$ variable represents the import penetration of inputs from all countries (including China). Constitutes the direct complementary channel of exports from the world on South African manufacturing exports. Expected sign is positive.

The $input\ mpenet\ ch_{it}$ variable represents the import penetration of inputs from China. Constitutes the direct complementary channel of exports from China on South African manufacturing exports. Expected sign is positive.

The two main variables of interest of this paper (direct complementary and indirect competitive effects/channels for China) are included on the right hand side of the equation in order to gauge the differing impacts on the exports, which in this case is the aggregate export value. A separate, but similar analysis of the extensive margin will be conducted at a later stage. The inclusion of both the total and Chinese input penetration variables is so that the paper can uncover the marginal effects arising from Chinese exports.[24]

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[23] Stata will be used to run all econometric analysis in this paper.
[24] The interpretation of the coefficients relating to the direct complementary channel will, therefore, be of the marginal nature (i.e. how China differs from the rest of the world).

The core econometric model is first estimated via the standard ordinary least squares (OLS) regression method. This allows one to identify the different effects on exports through each of the coefficients, however, these may be biased due to a number of concerns. These concerns, along with any other linear analysis, relate to the classic linear model (CLM) assumptions.[25] Any violations of these assumptions creates less credible coefficients (Wooldridge, 2009).

The first 3 Gauss-Markov assumptions are pretty straightforward and can be proven via inspection. The main concern comes in with assumption 4; the zero-conditional mean/exogeneity assumption crucial to reporting unbiased coefficients.[26] There may be variables that are contained in the error term (unobservable variables) that have significant variation in relation to the model being estimated. Failure to include such variables will result in omitted variable bias.

Two variables, real wages and productivity, were identified given their expected correlation with both the independent and dependent variables of the model. Adding these to the model yields the following:

$$export\ value_{it} = \beta_0 + \beta_1 SX_{it}^{CH} + \beta_2 input\ mpenet\ other_{it} + \beta_4 input\ mpenet\ ch_{it} + \beta_5 real\ wage_{it} + \beta_6 productivity_{it} + u_{it}$$

The $real\ wage_{it}$ variable is the wage of people employed in the manufacturing sector in South Africa adjusted for inflation and logged. Interaction between real wages and import penetration in inputs reveal a positive relationship. Firms that are faced with higher costs of labour may choose to substitute labour for cheaper inputs from China which makes omitting this variable a dangerous prospect given the zero-conditional mean assumption. Once both

[25] Assumptions include: Linear in parameters; random sampling; no perfect collinearity; zero conditional mean and homoscedasticity which are otherwise known as the Gauss-Markov assumptions. A further assumption of normally distributed errors is also included to form the CLM assumptions mentioned here.

[26] Zero conditional mean assumption: $E(u|x_1, x_2, x_3, \dots, x_n) = 0$. Violation of this condition will result in biased coefficients.

variables are controlled for in the model, theory predicts a negative relationship between wages and the aggregate export value. Higher real wages limits the scope of sales through supply by specific firms/industries. An increase in the real wage faced by firms would most probably indicate their inability to produce and export at competitive world prices, *ceteris paribus*.

The $productivity_{it}$ variable is computed and proxied by the output per person employed in the manufacturing sector for the 44 industries given the difficulty in observing and collecting data on it.

$$productivity_{it} = \frac{output_{it}}{employment_{it}}$$

One may argue against the validity of this as a proxy, however, accounting for such a measure will ensure at worst a reduction in any biases that may have been present before. In addition measures for productivity in past and current literature have also used this definition of productivity in their research (Edwards and Jenkins, 2015b). Of particular interest is that they uncover a positive and significant impact of import penetration in inputs on the labour productivity in South Africa using a similar set of data (Edwards and Jenkins, 2015b). Other research regarding countries outside of South Africa also find a strong link here (Acemoglu, 2002; Mion & Zhu, 2013; Thoenig & Verdier, 2003 and Wood, 1994). This variable is expected to have a positive expected sign in relation to the aggregate export value.

Table 5 reports the coefficients of the variables specified in the econometric model for the core and extended model specifications using the pooled OLS method. In column 1, all the coefficients are highly significant and exhibit the expected signs with the exception of the import penetration in inputs from China variable which is insignificant. An increase in the Chinese global import share by 1 percentage point (0.01 unit) gives rise to a decrease in

overall exports by the South African manufacturing sector by 5.52% on average, *ceteris paribus*[27], thus, justifying the theory on the indirect competitive channel for exports.[28]
Due to the insignificance, import penetration in inputs from China does not have a marginal effect. In other words, the effect from China is the same as the effect from other countries (rest of the world) which is positive and highly significant. Column 2 refers to the extended framework with productivity and wage included. Significance levels don't change from the core model with the new variables added also yielding highly significance coefficients signs. The highly significant negative sign on the productivity measure is counterintuitive as it goes against the theory discussed above and established by Melitz (2003). This may be a result of other factors not yet controlled for in the econometric model.

Despite this, one promising feature is that the R-squared (goodness-of-fit) measure of the model has increased from 0.183 to 0.364 across the two specifications indicating that the extended model does capture greater variation for the aggregate exports measure.

[27] When discussing or interpreting coefficients from the regression tables, the 'on average, ceteris paribus' phrase applies. This phrase may be left out at times in the remainder of the paper in order to be concise.
[28] Given that the variables of interest are constructed as ratios, it is more applicable to speak of a 0.01 unit increase rather than the standard 1 unit increase which would make no sense at all in these circumstances.

Table 5
Regression Results for Aggregate Export Value (Log of Export Value Deflated)

	(1)	(2)
VARIABLES	Core	Extended
Global Import Share - China	-5.518**	-2.135**
	(0.520)	(0.526)
Import Penetration in inputs, Total	4.554**	4.752**
	(0.643)	(0.604)
Import Penetration in inputs, China	3.589	-1.271
	(2.928)	(2.629)
Ln(Productivity)		-0.682**
		(0.047)
Ln(Real Wage)		0.752**
		(0.101)
Constant	6.614**	8.886**
	(0.116)	(0.258)
Fixed Effects	No	No
Observations	792	792
R-squared	0.183	0.364

Notes: Estimates presented in the table above are based on annual data collected for 44 industries from 1992-2009. The dependent variable is the value of exports deflated measured in millions of rands (natural log). Global import share - China is measured as described previously. The variable Import Penetration in inputs measures the weighted average import penetration in intermediate inputs used in each sector. Productivity measure is calculated as output per worker and real wage is measured in thousands of rands. Robust standard errors are reported in parentheses. ** p<0.01, * p<0.05, + p<0.1

4.1.1 Fixed Effects Discussion

Despite controlling for factors such as productivity and the real wage, there may still be other unobserved variables unaccounted for as is evident from some of the unintuitive signs for the independent variables reported in column 2 of table 5. The low R-squared measure is also cause for some concern. Such variables may include comparative advantage, exogenous technological shocks and exchange rate fluctuations over time and across industries. For example, comparative advantage has a negative impact on the import penetration of inputs from China to South Africa and a positive impact on the aggregate export value or product count (extensive margin) for South African exports. Omission of such a variable would result in a downward bias for the coefficient reported on the import penetration of inputs from

China (Wooldridge, 2009: 90-91). In addition, there may also exist differences across different industries and time that may influence the credibility of the final results.[29]

A common remedy for the aforementioned types of problems in panel data is typically to introduce fixed-effects. For example, industry fixed effects allows one to remove sector varying unobserved effects from the unobservable term (u_{it}) such as comparative advantage that would otherwise have biased the coefficients of the independent variables as already discussed.[30] For the purposes of this paper, two-way fixed effects is utilised given that the dataset contains both an industry and time component.

Consequently, $year\ dummy$ and $industry\ dummy$ variables are added to the core econometric model specification for the two-way fixed effect panel regression. The final econometric model specification is as follows:

$$export\ value_{it} = \beta_0 + \beta_1 SX_{it}^{CH} + \beta_2 input\ mpenet\ total_{it} + \beta_4 input\ mpenet\ ch_{it} + \beta_5 real\ wage_{it} + \beta_6 productivity_{it} + \beta_7 year\ dummy + \beta_8 industry\ dummy + u_{it}$$

4.1.2 Homoscedasticity and Normality of Errors

Assumptions 5 and 6 of the CLM assumptions relating to homoscedasticity and normality of errors respectively can more obviously be tested and remedied through econometric techniques. Assumption 5 regarding homoscedasticity is counteracted by reporting robust standard errors in the rest of this paper. Assumption 6 regarding the normality of errors is mitigated by running log-linear specifications where necessary. Residual plot of errors along with the kernel density plot of the aggregate exports dependent variable can be found in the appendix (Figure E).[31]

[29] One such difference would include differences in the classification of goods within an industry that may affect the diversity and type of goods classified. This could, for example, affect the export count results (extensive margin).
[30] The fixed effects regression technique also saves one the trouble of having to 'normalise' the dependent variables to remove differences across industries.
[31] The plots in both panel A and B indicate that the data conforms closely to assumption 6.

4.1.3 Fixed Effect Results

Table 5.1 reports the results from the extended econometric model specifications with fixed effects and robust standard errors. The first column shows the results for the whole manufacturing sector whereas the next two columns makes the distinction between low and high-wage industries. In accordance with methods used in Edwards and Jenkins (2015b), the median wage level was used in order to bisect the South African manufacturing sector.

Table 5.1
Regression Results for Aggregate Export Value (Log of Export Value Deflated)

	(1)	(2)	(3)
VARIABLES	Extended	Low-wage Industries	High-wage Industries
Global Import Share - China	-0.145	-0.427	0.534
	(1.160)	(1.305)	(1.890)
Import Penetration in inputs, Total	3.403**	3.348	1.222
	(1.110)	(2.717)	(1.483)
Import Penetration in inputs, China	-2.138	-5.679	7.525+
	(3.806)	(3.359)	(3.632)
Ln(Productivity)	-0.078	-0.165	0.172
	(0.109)	(0.174)	(0.132)
Ln(Real Wage)	-0.184	0.236	-0.544*
	(0.196)	(0.275)	(0.207)
Constant	5.276**	6.235**	4.712**
	(0.521)	(0.796)	(0.569)
Fixed Effects	Yes	Yes	Yes
Observations	792	396	396
R-squared	0.643	0.574	0.762

Notes: Estimates presented in the table above are based on annual data collected for 44 industries from 1992-2009. The dependent variable is the value of exports deflated measured in millions of rands (natural log). Global import share - China is measured as described previously. The variable Import Penetration in inputs measures the weighted average import penetration in intermediate inputs used in each sector. Productivity measure is calculated as output per worker and real wage is measured in thousands of rands. Year and industry variables are included to conduct two-way fixed effects analysis. Robust standard errors are reported in parentheses. ** p<0.01, * p<0.05, + p<0.1

Looking first at column 1, the addition of the two-way fixed effects model results in a slightly better reflection of expectations but at the cost of statistical significance. For example, the highly significant productivity and real wage coefficients of table 5 are now insignificant. In addition, the indirect competitive effect has also changed from being highly significant in table 5 to not being significant at all in table 5.1 despite retaining the negative sign. The insignificance of the China-specific import penetration of inputs variable suggests that its effect does not differ significantly from other countries (rest of the world). The significance of the world (total) direct complementary channel reveals that a 1 percentage point increase in import penetration of inputs from the world (including China) translates into a 3.403% increase in South African aggregate manufacturing 'real'[32] exports confirming the expectation of a positive sign.

Columns 2 and 3 of table 5.1 go a step further by providing a breakdown of the column 1 model into low and high-wage industries respectively in search for more promising coefficients and results. Given China's comparative advantage in low-wage industries as previously mentioned, it would make sense that this differentiation be made. Intuition predicts a positive Chinese influence for high-wage than low-wage industries given the availability of cheap and unskilled labour in China relative to South Africa. Chinese imports will typically compete with the low-wage, unskilled industries for the same market and often results in the exit of these industries. Despite increased pressure on inefficient low-wage firms, it does allow some downstream industries the luxury of gaining access to cheaper imports in face of the Chinese competition. Moreover, Chinese imports could also provide a differentiated product and allow South African firms access to a more diverse market. Therefore, one would reasonably expect most of the gains to be realised in the downstream, high-wage industries.

A closer look at columns 2 and 3 reveals that the low-wage industry regression specification lacks significance, however, the high-wage industry regression specification yields significant and positive results in confirmation of the intuition put forth above. What is promising is that the Chinese import penetration in inputs variable reported is large (7.525) and significant at the 10% level. The magnitude of the effect outstrips that of the rest of the world which yields inconclusive coefficients in both columns. This indicates that the Chinese export effect is significantly different from the rest of the world effect on South African manufacturing exports.

[32] Refers to the fact that the dependent variable has been deflated. In future, the term 'real' may be omitted for efficiency purposes.

A 1 percentage point increase in the import penetration of inputs from China will result in a 7.525% increase over and above the rest of the world effect for the aggregate export value. Overall, a 1 percentage point increase in the import penetration of inputs from China will result in a 8.747% increase in the aggregate exports.[33] The real wage coefficient conforms to the expectations laid out at the outset (negative) and is significant at the 5% level. A 1% increase in the real wage results in a 0.544% decrease in the real export value on average, *ceteris paribus*. Both the indirect competitive effect on exports and productivity measures are insignificant.

A final point to note when comparing the different specifications is the goodness-of-fit measures reported at the bottom of each column. The R-squared measure for the high-wage industries is 0.762 indicating that it is the model, out of the other 2, in which most of the variation of the aggregate export value has been explained by the independent variables. Columns 1 and 2 of table 5.1 report R-squared measures of 0.642 and 0.574 respectively, thus, giving a sense of how well the model is fitted in each scenario.

4.1.4 Serial Correlation

Regression diagnostics in the form of the Wooldridge (2002) test for panel data were run in Stata to test for serial correlation. [34] The test indicated the potential presence of first-order serial correlation meaning that the error term is correlated to the error term from the preceding time period.

The two-way fixed effects regressions employed does deal with serial correlation since time and sector variant factors are removed (Wooldridge, 2009). However, there still remains some concern regarding factors that are not accounted for through the fixed effects model. In order to combat this, a different model specification is adopted to address any residual

[33] Given the nature of the variables in the regression, the coefficient on the total import penetration in inputs must be added to the import penetration in inputs from China given that the total measure includes the Chinese effect.

[34] The Wooldridge (2002) test against the null hypothesis of no serial correlation was found to be highly significant with a test statistic of 55.030, indicating the presence of serial correlation.

serial correlation that may still be present. In this respect, the Prais-Winsten (1954) method with fixed effects, also used in Cheung and Ma (2011), is adopted (Cheung & Ma, 2011: 169).

The Prais-Winsten method involves the transformation of the regression coefficients in order to eliminate the serial correlation; error term from the previous time period. In short, the regression equations for each of the two time periods are estimated in order to predict the error terms, from which they are regressed upon each other to obtain 'rho' (correlation between the errors across time periods). Finally, substitution and simplifying results in a new transformed econometric model whereby a new set of coefficients and standard errors are estimated. This new model, with differently specified variables, is now without the problem of serial correlation (Cheung & Ma, 2011: 169). In general form the final result of the transformation is as follows:

$$Y_{it}^{*} = \alpha + \beta X_{it}^{*} + v_{it}$$

Where $Y_{it}^{*} = Y_{it} - \rho Y_{it-1}$, $X_{it}^{*} = X_{it} - \rho X_{it-1}$, $E(v_{it}|X_{it}) = 0$ and $\alpha = \delta(1-\rho)$. X and Y are vectors for the independent and dependent variable respectively. X contains all the independent variables specified in the initial regression equations run in table 5.1 and Y represents the log of aggregate export value deflated. Note that the original error terms u_{it} have cancelled each other out. The derivation of the generic equation can be found at the end of the appendix section. The coefficients from the newly specified econometric model are recorded in column 1 of table 5.2.

Table 5.2
Regression Results for Aggregate Export Value (Log of Export Value Deflated)

VARIABLES	(1) Prais-Winsten	(2) Robust - Lag	(3) Robust - Arellano-Bond
Export Deflated (-1)		0.669**	0.523**
		(0.058)	(0.157)
Global Import Share - China	0.232	-0.547	-0.986
	(0.541)	(0.486)	(1.091)
Import penetration in inputs, Total	2.069**	1.424*	1.757
	(0.675)	(0.609)	(1.120)
Import penetration in inputs, China	-1.122	-0.525	-2.480
	(1.862)	(1.334)	(2.588)
Ln(Productivity)	-0.071	0.125*	0.353**
	(0.074)	(0.048)	(0.120)
Ln(Real Wage)	-0.256*	-0.098	-0.584
	(0.111)	(0.071)	(0.469)
Constant	6.589**	1.597**	
	(0.330)	(0.328)	
Fixed Effects	Yes	Yes	Yes
Observations	792	748	704
R-squared	0.983	0.788	

Notes: Column 1 reports the Prais-Winsten (1954) transformation technique for serial correlation. Columns 2 and 3 are dynamic models dealing with potential misspecification issues in the initial static model. Robust standard errors in parentheses
** p<0.01, * p<0.05, + p<0.1

The only difference between the Prais-Winsten and initial 'extended' model (column 1 of table 5.1) is the change of significance of the real wage variable which now conforms to expectations in being negative. The coefficients in column 1 seems to suggest that the coefficients of the initial model were overestimated (an increase of 2.069% in the aggregate export value as opposed to 3.403% for a 1 percentage point increase in the total import penetration in inputs variable).[35] Nonetheless, the sign and significance of the key variables have remained robust across the different specifications.

Given that both the initial and transformed models are linear specifications, comparisons between the two different R-squared measures can be made. This reveals that the Prais-

[35] Given the transformation of the original core econometric model to a different model, direct comparisons in terms of coefficients and interpretations can be tricky. This is due mainly to the composition of the dependent and independent variables being altered to reflect differences of the original level variables across different time periods which is, subsequently, dependent on the estimated rho value.

Winsten transformation has improved the fit of the model in comparison with the initial model. The higher R-squared measure of 0.983 from 0.643 lends more credibility and confidence to the inferences as it suggests that most of the dependent variables variation has been accounted for in the new model. These results are replicated in the appendix for low and high-wage industries where the same trends are observed. This serves to reinforce the results obtained in the initial/original analysis.[36]

One limitation of the Prais-Winsten transformation is that it doesn't perform as well in small samples. Given that the sample size under consideration is quite limited, this could detract from the credibility of the coefficients.

4.1.5 Misspecification

Returning to the initial static econometric model, there are often problems regarding misspecification in econometric models as these violate the zero-conditional mean assumption for linear models. Furthermore, misspecification of the econometric model is highly likely to also result in violations of the other linear model assumptions in terms of homoscedasticity and serial correlation. Unobserved factors can have a significant impact on the model coefficients and test statistics which, in turn, impedes accurate inferences. This problem is exacerbated in face of limited amount of observational data to control for in the econometric model.

Having already controlled for wages and productivity[37] along with the variables of interest[38], robustness of the initial econometric model (column 1 of table 5.1) to the inclusion of other independent variables is checked. A one period lagged dependent variable is used to specify

[36] The standard errors in the Prais-Winsten adjusted model are observed to be lower than the initial model, suggesting that the Prais-Winsten model is more efficient. This result was also discovered in Cheung and Ma (2011).

[37] Concerns regarding correlation between wages and productivity were addressed by running the specified regression with each variable separately in the econometric specification. Results reveal coefficients not significantly different to those reported, lending supporting the inclusion of both variables.

[38] Given similar correlation concerns regarding the direct complementary and indirect competitive channels, regressions were also run here with each variable separately. Once again, no significantly different coefficients were obtained.

a dynamic model. The lagged dependent variable acts as a proxy variable for potential unobserved factors. In this regard, two different adjustments were implemented with the first method running a linear regression, while the second uses a generalised method of moments (GMM) model specification developed by Arellano and Bond (1991). These results are illustrated in table 5.2 alongside the Prais-Winsten estimation.

Coefficients observed indicates that the lagged dependent variable is highly significant (1% level) meaning that aggregate export value in the previous time period has a spillover effect on the current real export value. The magnitude of 0.669 suggests that a 1% increase in the export value in the previous time period increases the export value in the current time period by 0.67%. Alternatively, one can interpret this as being that 67% of exports in one period is retained over to the next time period. Large deviations from the static model are not observed. The only discrepancies lie in the total import penetration of inputs variable which is now only significant at the 5% level and the productivity variable which has become positive and significant at the 5% level, which is in accordance with expectations.

There are two main concerns that relate to this first type of dynamic model specification. Firstly, adding a lagged dependent variable on the right hand side of the equation can result in other variables being suppressed given the large amount of similarity with the left hand side. This can result in the coefficient not having a meaningful interpretation (Achen, 2000). Secondly, given the structure of the data, simply adding a lagged dependent variable typically gives rise to Nickell Bias (Nickell, 1981).

The first concern does not seem to pose too big of a problem in the model given the plausible interpretation of the coefficients and relative robustness of the overall model. In order to address the second concern regarding the potential Nickell bias, a second method developed by Arellano & Bond (1991) is used. Their method utilises a GMM estimator in order to conduct a dynamic fixed effects regression analysis. The results are reported in column 3 of table 5.2. The total import penetration of inputs variable has become insignificant while the productivity measure has become more pronounced at the 1% level. Both coefficients have increased in magnitude (1.757 and 0.353 for the import penetration of inputs and productivity measures respectively). Tables 1 and 2 in the appendix provide the dynamic models for the low and high-wage industries respectively. The low-wage industries exhibit robust coefficients with changes in the high-wage industries.[39]

One of the main concerns when dealing with Arellano and Bond (1991) type regressions is the problem of too few observations coupled with a large number of instruments used in the GMM analysis. Given that the dataset under analysis only contains a maximum of 44 industries, it may explain why the Arellano-Bond (1991) method differs from the other model specifications.

Concluding the aggregate export value analysis reveals the relationships between Chinese exports and South African manufacturing exports to be robust even after adjusting for potential problems of serial correlation and misspecification. The results from the analyses suggests that most of the action originating from Chinese exports is positive and concentrated in the high-wage industries through the direct complementary channel of exports. This is in line with the theoretical framework previously outlined. No significant crowding-out (negative) effects are reported through the indirect competitive channel.

4.2 Extensive Margin

The baseline model for the analysis of the extensive margin is as follows:

$$export\ count_{it} = \beta_0 + \beta_1 SX_{it}^{CH} + \beta_2 input\ mpenet\ total_{it} + \beta_4 input\ mpenet\ ch_{it} + \beta_5 wage_{it} + \beta_6 productivity_{it} + \beta_7 year\ dummy + \beta_8 sector\ dummy + u_{it}$$

The $export\ count_{it}$ variable represents the number of products exported by the manufacturing sector in South Africa. Independent variables are as specified in the aggregate

[39] The import penetration in inputs from China and real wage variables not being significant anymore and the productivity measure becoming positive and significant at the 5% level.

exports econometric model. Like the aggregate exports regression, a two-way fixed effects model was used with year and industry fixed effects.

There have been contrasting views on dealing with the extensive margin given the special nature of the dependent variable specified, namely, the strictly positive and discrete qualities of count data. This creates a few problems in terms of accurate econometric analysis under a standard linear model specification. There are two main methods that are most commonly used in the existing literature.

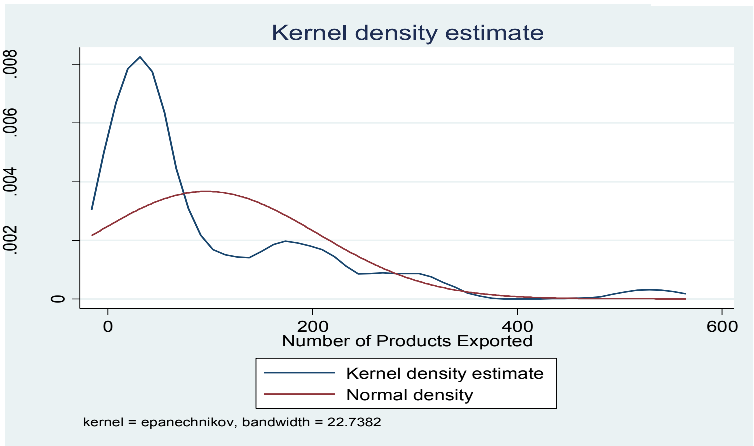
The first method explored by Persson (2010) and Hummels & Klenow (2005) has been to adopt different more count-specific (poisson and negative binomial) econometric models. The other method is the use of a log-linear regression model. Santos Silva et al. (2013) examined such a model and found evidence suggesting a good fit with the data. Given these two contrasting techniques, both count-specific and log-linear models will be contrasted for any discrepancies.

4.2.1 Linear models

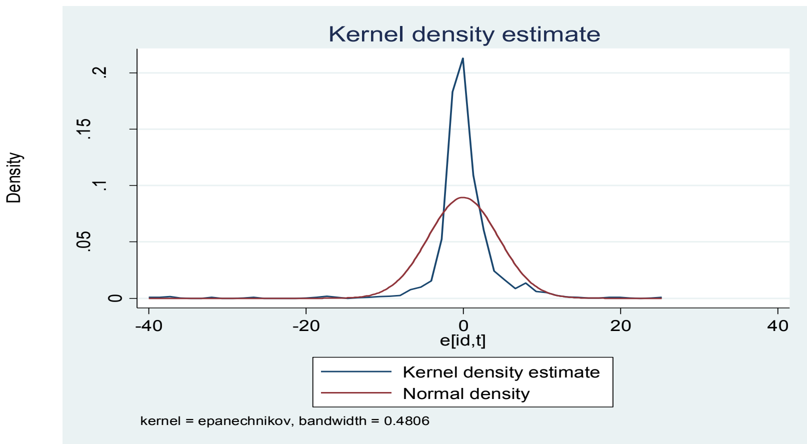
A standard OLS model contrasting the log-linear and linear specifications will be dealt with first. Using a log-linear specification for the model eliminates the possibility of negative values and, historically, has provided evidence of fitting count data better than the standard linear OLS regression (Santos Silva et al., 2013).

Figure 10 provides a comparison between the two different specifications for the OLS regression. Panels A and B reflect the level export count variable and error distributions respectively overlaid with the normal density distribution. Panels C and D illustrate the same information for the logged export count variable. Recalling the assumption regarding the normality of errors for OLS models stipulated for the aggregate export value analysis, it is quite obvious that the bottom two panel specifications (logged dependent variable) conforms more accurately to the assumptions relative to that of the level variable. Dealing with the other model assumptions, the same precautions were taken as in the aggregate export value analysis. The results from the log-linear regression are reported in table 6.

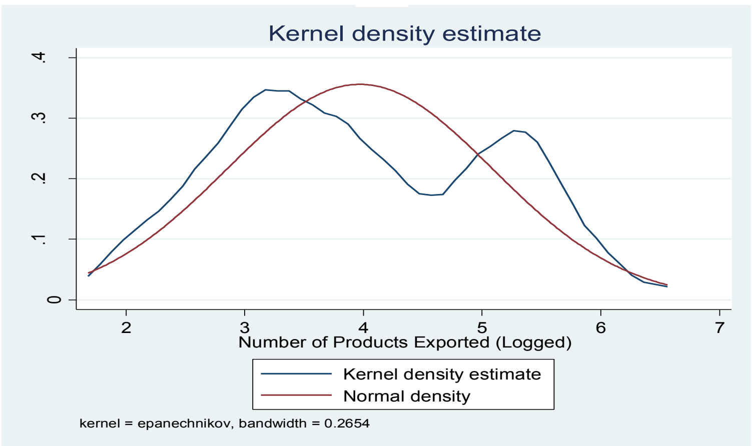
Figure 10



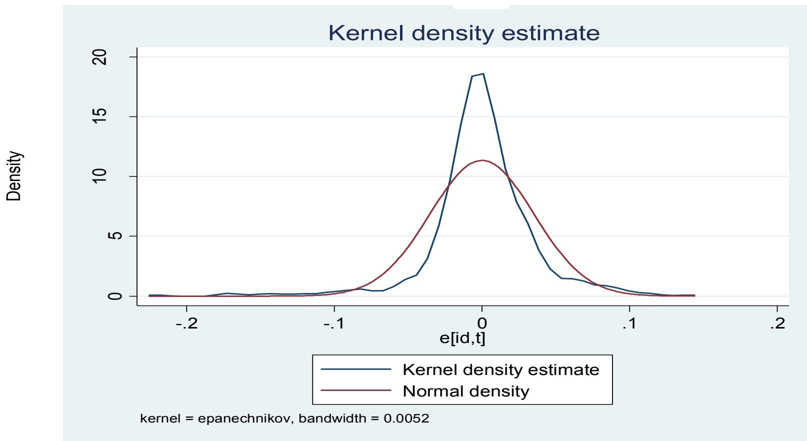
A



B



C



D

Source: Stata calculations using UN Comtrade (2015) data.

Table 6
Regression Results for Extensive Margin (Log of Export Count) – Linear Model

VARIABLES	(1) Extended	(2) Low-wage Industries	(3) High-wage Industries
Global Import Share - China	-0.395**	-0.400**	-0.314**
	(0.099)	(0.125)	(0.107)
Import Penetration in inputs, Total	-0.048	-0.480	0.262
	(0.196)	(0.284)	(0.205)
Import Penetration in inputs, China	0.162	0.421*	-0.111
	(0.164)	(0.191)	(0.202)
Ln(Productivity)	0.006	-0.019	0.016
	(0.017)	(0.019)	(0.020)
Ln(Real Wage)	-0.036	-0.020	-0.036
	(0.026)	(0.035)	(0.034)
Constant	3.819**	4.008**	3.691**
	(0.079)	(0.103)	(0.096)
Fixed Effects	Yes	Yes	Yes
Observations	792	396	396
R-squared	0.380	0.532	0.332

Notes: See table 5.1.The only difference here is that the dependent variable has changed to a product count variable as opposed to the aggregate export value specified previously. Robust standard errors are reported in parentheses. ** p<0.01, * p<0.05, + p<0.1.

The model specifications of columns 1 through 3 are identical to that of the aggregate export value results in table 5.1. Column 1 reports the results from the fully specified/extended two-way fixed effects econometric model. Columns 2 and 3 split the data into 2 based on the median wage of the manufacturing sector in South Africa.

Looking closer at the coefficients in column 1 of table 6 reveals that the indirect competitive channel effects of Chinese exports is negative and highly significant (-0.395) at the 1% level. This suggests that an increase in the world composition of Chinese imports will result in a decrease in the total number of manufacturing products exported from South Africa. This is as expected and conforms to the theoretical framework developed in section 2. More specifically, a 1 percentage point (0.01 unit) increase in the Chinese share of global imports, reduces the variety of goods exported from South Africa by 0.395% on average, all else constant. The rest of the model in column 1 does not reveal any other significant variables.

For low-wage industries a 1 percentage point increase in China's global import share reduces the variety/number of products exported from South Africa by 0.4%. This figure is lower at 0.314% in column 3 suggesting that high-wage industries are, on average, less affected by China's increased presence in the global economy. This is intuitive as China's comparative advantage in low-wage industries directly competes with low-wage industry exports from South Africa, thereby crowding-out more of these products relative to high-wage industries to third countries.

Given that the variable was constructed as a ratio of China to the world, the negative sign indicates that China's effect on South Africa is negative relative to that from the rest of the world. Edwards and Jenkins (2015a) uncover similar findings in that, relative to the rest of the world, China's increased exports to the world crowds-out exports from South Africa to Sub-Saharan Africa (Edwards & Jenkins, 2015a).

There is one significant difference between the columns in table 6. The Chinese variable for import penetration (direct complementary channel for exports from China) suggests that China has a unique effect on the extensive margin that is different and positive in comparison to the rest of the world. The coefficient of 0.421 suggests that the direct complementary channel effect of exports from China results in 0.421% more products being exported in comparison to the rest of the world, for every 1 percentage point increase in import penetration of inputs. This marginal positive result for low-wage industries may be a result of Chinese imports being more useful in terms of inputs for more products than its global counterparts. For example, inputs from China might be less specialised and more commonly used in the production of different products as opposed to a more high-tech import from the United States of America (USA). This would enable industries to exploit this in order to expand into new markets.

4.2.2 Count-specific models

This paper now draws on the analytical methods used by Persson (2010) namely, the Poisson and negative binomial regression models. Dealing with the Poisson estimation first yields table 5 in the appendix. The results do not provide for good reading as a lack of significance limits inferences regarding the coefficients reported.

Upon examination of the assumptions for the Poisson model, one of the key assumptions of the Poisson distribution was found to be violated. This assumption assumes that the mean and variance of the count data are equal. In the case of the dataset used, it was found that the variance is significantly (ten times) greater than the mean indicating that, by modelling the extensive margin by means of a Poisson distribution, leads to the problem of overdispersion. One of the remedies for this is to relax the assumption through the use of another more generalised and less restrictive count-specific regression model– the negative binomial regression method. The results from the negative binomial estimation is displayed in table 7.

Table 7
Regression Results for Extensive Margin (Export Count) - Negative Binomial[40]

VARIABLES	(1) Extended	(2) Low-wage Industries	(3) High-wage Industries
Global Import Share - China	-0.195**	-0.432**	-0.058
	(0.063)	(0.085)	(0.065)
Import Penetration in inputs, Total	-0.343**	-0.556**	0.075
	(0.095)	(0.147)	(0.094)
Import Penetration in inputs, China	0.422**	0.538**	-0.012
	(0.105)	(0.132)	(0.156)
Ln(Productivity)	0.003	0.016	0.014
	(0.010)	(0.014)	(0.013)
Ln(Real Wage)	-0.011	0.004	0.011
	(0.011)	(0.016)	(0.017)
Constant	5.305**	5.317**	2.980**
	(0.038)	(0.053)	(0.039)
Fixed Effects	Yes	Yes	Yes
Observations	792	396	396

Notes: Regressions run using the negative binomial method with product count dependent variable. Information for independent variables are the same as table 5.1. Robust standard errors are reported in parentheses. ** p<0.01, * p<0.05, + p<0.1.

[40] No R-squared is reported due to the contentious nature of its interpretation.

Comparing these results to the Poisson estimation method, we see that all the coefficients remain the same but with adjustments to the significance level which allows a more meaningful interpretation of the relationships of interest, as well as bypassing the violation of the parameter assumptions. The key reason here being that the standard errors have been significantly adjusted to reflect the relaxation of the restrictive Poisson assumptions.

It is observed that the global import share variable for China is highly significant and negative across columns 1 and 2 at the 1% level, thus, reinforcing the claim that Chinese competition crowds-out South African exports on the international market. The insignificance of the high-wage industry variables does differ from table 6 in that the indirect competitive effect on exports is no longer significant. Nonetheless, this still serves as confirmation of the subdued negative effect on high relative to low-wage industries identified in the linear fixed effects analysis.

Additional information revealed in table 7 is the negative and highly significant (1% level) coefficients attributable to the total import penetration in inputs variable in columns 1 and 2. The negative sign indicates that import penetration in inputs from the world has a negative impact on the variety of products exported from South Africa. A possible explanation for this is that imported inputs may be too specialised to be used in the production in a variety of products/industries and are only beneficial for a select few industries. This will in turn result in the exit of domestic industries that previously supplied these inputs, thus reducing the scope of exported products over time.

Taking into account the Chinese effect in isolation, the direct complementary channel effect of Chinese exports is highly significant and positive relative to the rest of the world for the low-wage and overall specifications (column 1 and 2). The positive coefficients indicate that the effect from China is different, and more beneficial for South African manufacturing exports than the effects identified for the world effect in the previous paragraph. In column 1, the positive Chinese effect is large enough to more than offset the total import penetration coefficient which translates into an overall positive effect from China through the direct complementary channel. However, this effect is in contrast with the highly significant crowding-out effect.

In sum, the count-specific and linear fixed effects models yield similar results regarding the key (China) variables. Across the two models, the significant negative indirect competitive and positive direct complementary effect of exports from China are robust with the only exception occurring in the high-wage industries. However, this discrepancy has minimal bearing on the interpretation as the findings are both indicative of an attenuated effect for the high-wage industries. The net Chinese effect (calculated by taking the sum of both import penetration in inputs coefficients) is still negative as indicated in both tables. This coupled with the significant crowding-out effect indicates a dominating negative indirect competitive effect from China for the extensive margin of exports in South Africa.

4.2.3 Serial Correlation and Misspecification

Given that the two different specifications (log-linear and negative binomial models) do not deviate much from each other, this section will continue with the log-linear model.[41] As was with the aggregate export value regression, adjustments are made for both serial correlation and misspecification for the extensive margin. These results are reported in table 8.

[41] Any comparisons between the inferences are likely to also apply to the negative binomial model given the similarities.

Table 8
Regression Results for Extensive margin (Log of Export Count)

VARIABLES	(1) Prais-Winsten	(2) Robust - Lag	(3) Robust - Arellano-Bond
Export Count (-1)		0.561**	0.336
		(0.041)	(0.410)
Global Import Share - China	-0.310**	-0.095*	0.054
	(0.055)	(0.041)	(0.166)
Import penetration in inputs, Other	-0.024	0.056	-0.168
	(0.077)	(0.067)	(0.172)
Import penetration in inputs, China	0.033	0.042	-0.057
	(0.092)	(0.064)	(0.369)
Ln(Productivity)	0.017*	0.000	0.014
	(0.007)	(0.006)	(0.009)
Ln(Real Wage)	-0.024*	-0.011	-0.040+
	(0.012)	(0.009)	(0.022)
Constant	5.242**	1.714**	
	(0.039)	(0.154)	
Fixed Effects	Yes	Yes	Yes
Observations	792	748	704
R-squared	0.999	0.537	

Notes: Column 1 reports the Prais-Winsten (1954) transformation technique for serial correlation. Columns 2 and 3 are dynamic models dealing with potential misspecification issues in the initial static model. Robust standard errors in parentheses
** p<0.01, * p<0.05, + p<0.1

Column 1 reports the Prais-Winsten (1954) estimates used to correct for possible serial correlation. The results are promising in that the key variables do not change sign or significance from the original extensive margin model specified in column 1 of table 6. The magnitude of the coefficients are also similar, however, as mentioned previously, caution needs to be exercised when comparing coefficients across two different econometric model specifications.

To address the misspecification problem, a one-period lag dependent variable is included. Looking at column 2 in table 8 indicates that the one period lag is highly significant and positive at the 1% level. The value of 0.561 indicates that 56.1% of the current products exported is due to the number of exported products from the previous period on average, *ceteris paribus*. Other than the significance of the Chinese global import share variable dropping to only being significant at the 5% level, there are no other significantly different variables.

The Arellano-Bond method (Arellano & Bond, 1991) reported in column 3 accounts for Nickel bias (Nickel, 1981). Coefficients in column 3 are not informative at all in the sense that all significance in the model has been stripped away from running this type of GMM analysis. Even the lagged dependent variable does not exhibit significance which emphasises the need to exercise caution when reviewing such analyses. As discussed earlier, the Arellano-Bond GMM method loses credibility in face a small sample size, resulting in a model with less ‘power’.

Tables 3 and 4 in the appendix present the same model specifications as table 8 for the low and high-wage industries respectively. The Prais-Winsten specifications do reveal some changes in significance in comparison to the initial static model coefficients in terms of the direct complementary channels. This is also found to be the case for the dynamic model specifications.

In summary of the extensive margin, 3 different estimation techniques were run. Due to the nature of the dependent variable (count data) and conflicting findings in current research papers, this paper made use of linear and count-specific models. In terms of the count-specific models, the poisson model was first estimated, however, after running a few diagnostic checks in terms of goodness-of-fit, the model was discarded on the basis of overdispersion. As a result, the more general negative binomial model was used. These results were contrasted with a log-linear model.

The results obtained from running the extensive margin using the negative binomial regression model differed only slightly from the log-linear estimation technique. However, when subjected to serial correlation and misspecification adjustments, the coefficients associated with the direct complementary effect became ambiguous. This was a result of changes in significance levels across different models. Nevertheless, when significant, the direct complementary Chinese effect is positive and conforms to the theory.

One of the results that is consistent across all extensive margin specifications is the highly significant negative indirect competitive effect on the number of products exported by South Africa. The negative impact on the extensive margin can be derived from increased border controls and/or the restrictions in place in terms of infrastructure that prevent the expansion of exports into new markets for 'small', developing countries (Hummels & Klenow, 2005; Persson, 2010). The other robust result comes from the positive marginal Chinese direct complementary effect on the product count in low-wage industries which may be indicative of the greater flexibility of use for Chinese imports of inputs relative to the rest of the world.

Tying all of the analysis done in this section together, one can conclude that the rise of China, and any subsequent increase in China's global presence, has an overall positive impact on high-wage South African manufacturing exports as is evident from the analysis of the aggregate export value. Deeper analysis reveals that these positive effects may not be realised for all measures of exports. The significant negative effects from the extensive margin of exports dampens the optimism that may arise from the aggregate outlook. Despite some consistent marginal positivity emanating from low-wage industries, there is strong evidence that the variety of products exported by the South African manufacturing sector is diminishing in the face of increased Chinese competition. This can potentially cause problems in the long-run as South Africa may be becoming too dependent on a few select industries.

When evaluating these results, one should be cognisant of one potential shortcoming arising from demand-side factors not focussed on in this paper causing interference through omitted variable bias. More specifically, demand-side factors such as Chinese imports will tend to negatively bias the coefficients on the variables of interest (direct complementary and indirect competitive channel variables) due to its negative correlation with said variables. Therefore, any negative coefficient identified would be overemphasised and positive effects underestimated resulting in the approach adopted by this paper to be more conservative.

Ultimately, more positive implications for South African exports will arise than otherwise reported.

A policy implication for the Department of Trade and Industry (DTI) may be to gear policies at the expansion and development of high-wage export-orientated industries, and to promote the expansion of the most productive industries into new markets so that the South African manufacturing sector does not become stagnant once existing markets become fully saturated in the long-run. One example would be to form an African trading bloc in terms of free trade areas similar to that of SACU (Southern Africa Customs Union) that affords South Africa preferential access to these markets and reduced barriers to entry relative to that of China. This would, to some extent, limit/reduce China's competitiveness in these markets. This may be optimistic given the inherent structural and political differences in Africa but small steps can be taken in the short-run in terms of extending the SACU agreement to include a few more countries (those that are more or less structurally aligned with SACU) and gradually increase the members within such an agreement over time.

5. Conclusion

The research conducted by this paper uncovers the significant impact that Chinese competition, in particular its exports, has had on the South African manufacturing sector. Preliminary calculations using the raw data revealed that import penetration in inputs have been increasing over time. In particular China has accounted for just under 60% of this increase since its accession into the WTO. The importance of China cannot be understated and the results from the analysis in this paper show this.

Overall, positive effects are derived for the aggregate export value analysis with significant coefficients identified through the direct complementary channel. In terms of the different wage industries, the positive Chinese effect is found to be concentrated in the high-wage industries. No significant coefficients are reported for the low-wage industries. The results reported are robust to any changes in specification for serial correlation and misspecification concerns.

The outlook for the South African manufacturing sector in terms of the extensive margin of exports does not look as favourable, given that the indirect competitive channel effect from China is negative and highly significant (1% level). This result is in line with findings by Edwards and Jenkins (2015a) in which significant crowding-out effects are also identified. Hummels, Klenow (2005) and Persson (2010) reinforce this notion by arguing that trade costs in terms of barriers to entry and lack of infrastructure hinder growth for developing/small countries in terms of the extensive margin. Despite these negative effects, one consistent positive result does exist in the low-wage industries for the Chinese direct complementary channel.

Furthermore, the magnitude and significance of the high-wage industry coefficients, indicate that these industries seem to be less susceptible to the adverse effects of Chinese competition along the extensive margin. This suggests that South African high-wage manufacturing industries are the main beneficiaries (industries who are gaining the most and also losing the least) from Chinese competition.

The direct complementary and indirect competitive channels uncovered are in accordance with the theoretical framework based on Kaplinsky et al. (2007) established in section 2. In addition, looking at China's marginal effect, China performs favourably (positive and significant from the rest of the world) across both margins for the direct complementary channel effect on South African manufacturing exports. However, the lack of consistent results for the extensive margin, after being subjected to adjustments for serial correlation does create some ambiguity. Nevertheless, there is evidence in accordance with those of Mion and Zhu (2013) who find unique Chinese effects and justifies its separate analysis.

Policy implications of these findings would suggest expansive policies geared towards high-wage industries to boost the aggregate export value. Given the diminishing influence of the South African low-wage manufacturing industries, perhaps the best type of policies to implement are ones to expand the product line of those exported by the high-wage industries. Alternatively, negotiations with South African trade partners in Africa could be made to allow better access and lower trade barriers in terms of costs and border controls to facilitate increased competitiveness of South African exports. This looks to solve some of the problems identified by Hummels and Klenow (2005) regarding shortcomings of the extensive margin for 'small' countries.

All this suggests that the dynamics at play for Chinese-South African export relations are more sophisticated than most people believe. It is not simply a one-dimensional issue, but one that contains different channels (direct complementary and indirect competitive) that are contingent on the types of goods being traded (intermediate or finished/final). Furthermore, simply observing the aggregate export values are insufficient in understanding the full implications as was shown by the analysis of the extensive margin. This paper has uncovered some of the dynamics at play, but there still exists other channels (direct competitive and indirect complementary) that were not discussed. These other channels would need to be considered in order to obtain a better overall picture of how Chinese exports affects South Africa both domestically and internationally.

When evaluating the results of this paper, one must be cognisant of the fact that these results can only be inferred for the South African manufacturing sector at the industry level; therefore, one is unable to critically evaluate or draw conclusions pertaining to variation of individual firms within each industry of manufactures. Furthermore, given the absence of data from the primary and tertiary sectors, the results does not allow one to draw conclusions at the macro level.

Despite these omissions, the manufacturing sector still provides very important information given the historical emphasis that policy-makers have placed on the industrial/manufacturing sector in South Africa. However, in the future as the economy develops, we will see a greater emphasis being placed on high-skilled and, most likely, high-wage industries as the economy shifts towards the tertiary sector. Both the primary and tertiary sectors are beyond the scope of this paper and should be kept in mind when ruminating the findings of this paper.

References

Acemoglu, D. 2002. "Technical change, inequality, and the labour market." *Journal of Economic Literature, 40,* 7-72. doi: 10.1257/jel.40.1.7

Achen, C.H. 2000. "Why lagged Dependent Variables Can Suppress the Explanatory Power of Other Independent Variables." *Paper presented at the annual meeting of the political methodology section of the American Political Science Association*, UCLA.

Arellano, M., & Bond, S. 1991. "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations." *The Review of Economic studies, 58,* 277-297. doi:10.2307/2297968.

Ashournia, D, Munch, J., & Nguyen, D. 2013. "The Impact of Chinese Import Penetration on Danish Firms and Workers." *Journal of Economic Literature: F16.*

Baier, S.L., Bergstrand, J.H., & Feng, M.2014. "Economics integration agreements and the margins of international trade." *Journal of International Economics, 93*, 339-350.

Besedes, T., & Prusa, T.J. 2010. "The role of the extensive and intensive margins and export growth" *Journal of Development Economics, 96,* 371-379.

Bloom, N., Draca, M., & Van Reenen, J. 2011 "*Trade Induced Technical Change? The Impact of Chinese Imports on innovation, IT and Productivity.*" (NBER Working Paper No. 16717).

Cheung, Y.W., & Ma, G. 2011. "Asia and China in the Global Economy." *World Scientific Publishing: Singapore.* 169-176.

Coughlin, C.C. 2012. "Extensive and Intensive Trade Margins: A State-by-State View" *Federal Reserve Bank of St. Louis Working Paper 2012-002A.*

Deardorff, A. 1998. "Fragmentation across Cones." *Research Seminar in International Economics*. Discussion Paper No. 427.

Dunne, P., & Edwards, L. 2007. "Trade, enterprise production and employment." *Journal for Studies in Economics and Econometrics, 31,* 49-68.

Edwards, L. 2001a. "Globalisation and the skills bias of occupational employment in South Africa." *The South African Journal of Economics, 69*(1), 40-71. doi:10.1111/j.1813-6982.2001.tb00002.x

Edwards, L. 2001b. “Trade and the structure of South African production, 1984-97.” *Development Southern Africa, 18,* 1471-491. doi: 10.1080/03768350120083905

Edwards, L. 2005. “Has South Africa liberalised its trade?” *The South African Journal of Economics, 73,* 754-775. doi:10.1111/j.1813-6982.2005.00052.x

Edwards, L., & Jenkins, R. 2013. “The margins of export competition: A new approach to evaluating the impact of China on South African exports to Sub-Saharan Africa.” Journal of Policy Modeling, 36(1), S132-S150. doi: 10.1016/j.jpolmod.2013.10.003

Edwards, L., & Jenkins, R. 2015a. “Is China ‘Crowding Out’ South African Exports of Manufactures?” *European Journal of Development Research.* doi: 10.1057/ejdr.2014.72

Edwards, L., & Jenkins, R. 2015b. “The Impact of Chinese Import Penetration on the South African manufacturing sector.” *The Journal of Development Studies, 51*(4), 447-463, doi:10.1080/00220388.2014.983912

Fedderke, J.W. 2006. “Technology, Human Capital and Growth: Evidence from a Middle Income Country Case Study Applying Dynamic Heterogeneous Panel Analysis”, in South African Reserve Bank, Banco de Mexico and the People’s Bank of China (eds.), *Economic Growth,* proceedings of a G20 seminar paper help in Pretoria, South Africa, 4-5 August 2005.

Giovannetti, G., & Sanfilippo, M. 2009. “Do Chinese Exports Crowd-Out African Goods? An econometric analysis by country and sector.” *European Journal of Development Research Special Issue, 24*(1).

Haugen, H.O. 2011. “Chinese Exports to Africa: Competition, Complementarity and Cooperation between Micro-Level Actors.” *Forum for Development Studies, 38*(2), 157-176. doi:10.1080/08039410.2011.572286.

Hummels, D., & Klenow, P.J. 2005. “The variety and quality of a nation’s exports.” *American Economics Review, 95*, 704-723.

Jenkins, R. 2008. “Trade, technology and employment in South Africa.” *Journal of Development Studies, 44(*1), 60-79. doi: 10.1080/00220380701722308

Jonsson, G., & Subramanian, A. 2001. “Dynamic gains from trade: Evidence from South Africa.” *International Monetary Fund Staff Papers, 48(*1), 197-224.

Kaplinksy R., McCormich D. & Morris, M. 2007. “The Impact of China on Sub-Saharan Africa.” *Institute of Development Studies: Working Paper 291.*

Kehoe, T.J., & Ruhl, K.J. 2013. “How Important is the new goods margin in international trade?” *Federal Reserve Rank of Minneapolis Research Department Staff Report 324.*

Krugman, P., Obstfeld, M., & Melitz, M. 2012. *International Economics Theory & Policy*. Ninth Edition. Essex: Pearson Education limited. 73.

Lall, S., & Albaladejo, M. 2004. “China’s Competitive Performance: A Threat to East Asian Manufactured Exports?” *World Development, 32*(9), 1441-1466. doi:10.1016/j.worlddev.2004.03.006.

Melitz, M.J. 2003. “The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity,”*Econometrica* 71, 1695–1725. doi: 10.1111/1468-0262.00467

Mion, G., & Zhu, L. 2013. “Import Competition from and Offshoring to China: A Curse or Blessing for Firms?” *Journal of International Economics, 89*(1), 202-215.

Nickell, S. 1981. “Biases in Dynamic Models with Fixed Effects.” *Econometrica, 49*(6).

Persson, M. 2010. “Trade Facilitation and the Extensive Margin” *Research Institute of Industrial Economics (IFN) Working Paper 828.*

Prais, S.J., & Winsten C.B. 1954. “Trend Estimator and Serial Correlation”. *Cowles Commission: Discussion Paper,* 383*.*

Santos Silva, J.M.C., Tenreyro, S., & Wei, K. 2013. “Estimating the extensive margin of trade” *Journal of International Economics, 93,* 67-75.

Thoenig, M., & Verdier, T. 2003. “A theory of defensive skill-biased innovation and globalization. *American economic Review, 93,* 709-728. doi: 10.1257/000282803322157052

Wood, A. 1994. “North-South trade, employment and inequality: Changing fortunes in a skill-driven world.” *The Journal of Developing Areas, 45*(1).

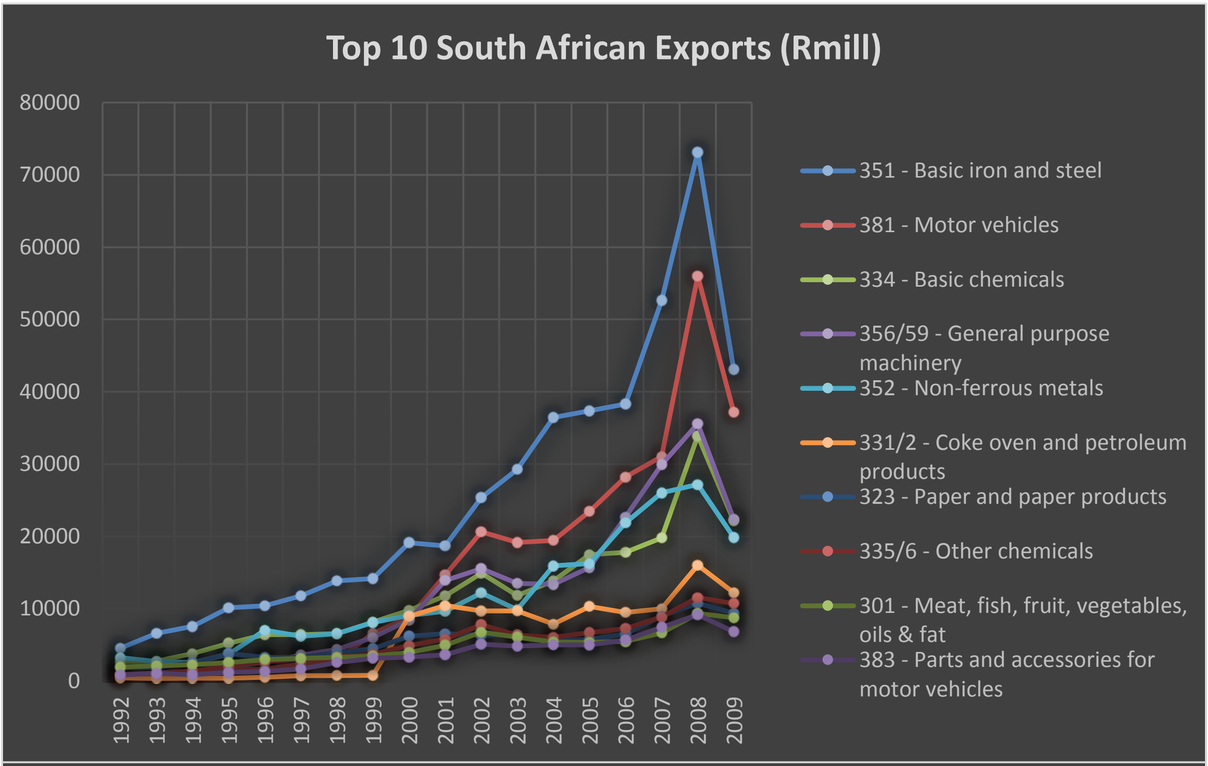
Wooldridge, J.M. 2002. “Econometric Analysis of Cross Section and Panel Data.” Cambridge, MA: MIT Press.

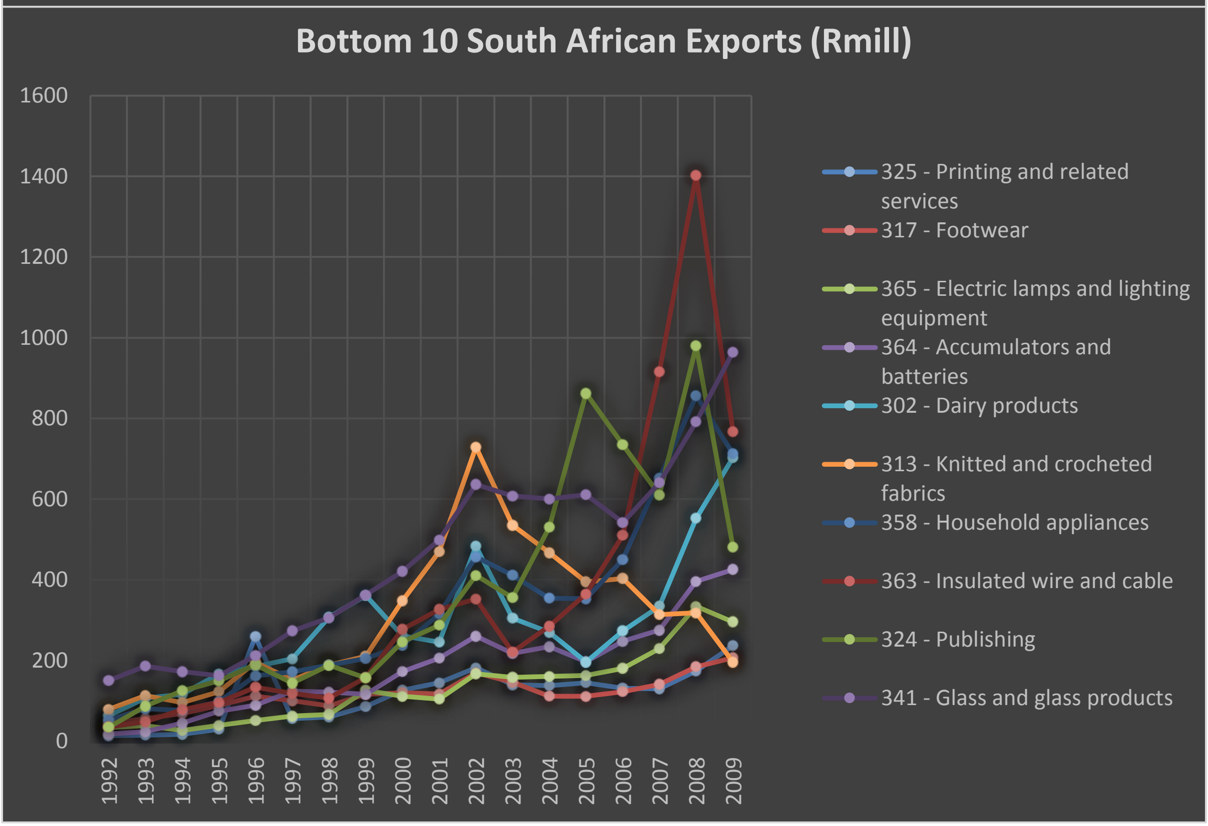
Wooldridge, J.M. 2009. “Introductory Econometrics: A Modern Approach, 4th ed.” South Western Cengage Learning: Canada.

UN COMTRADE. 2015. United Nations COMTRADE database, DESA/UNSD. Retrieved June 5, 2015, from http://www.comtrade.un.org/db/

Appendix

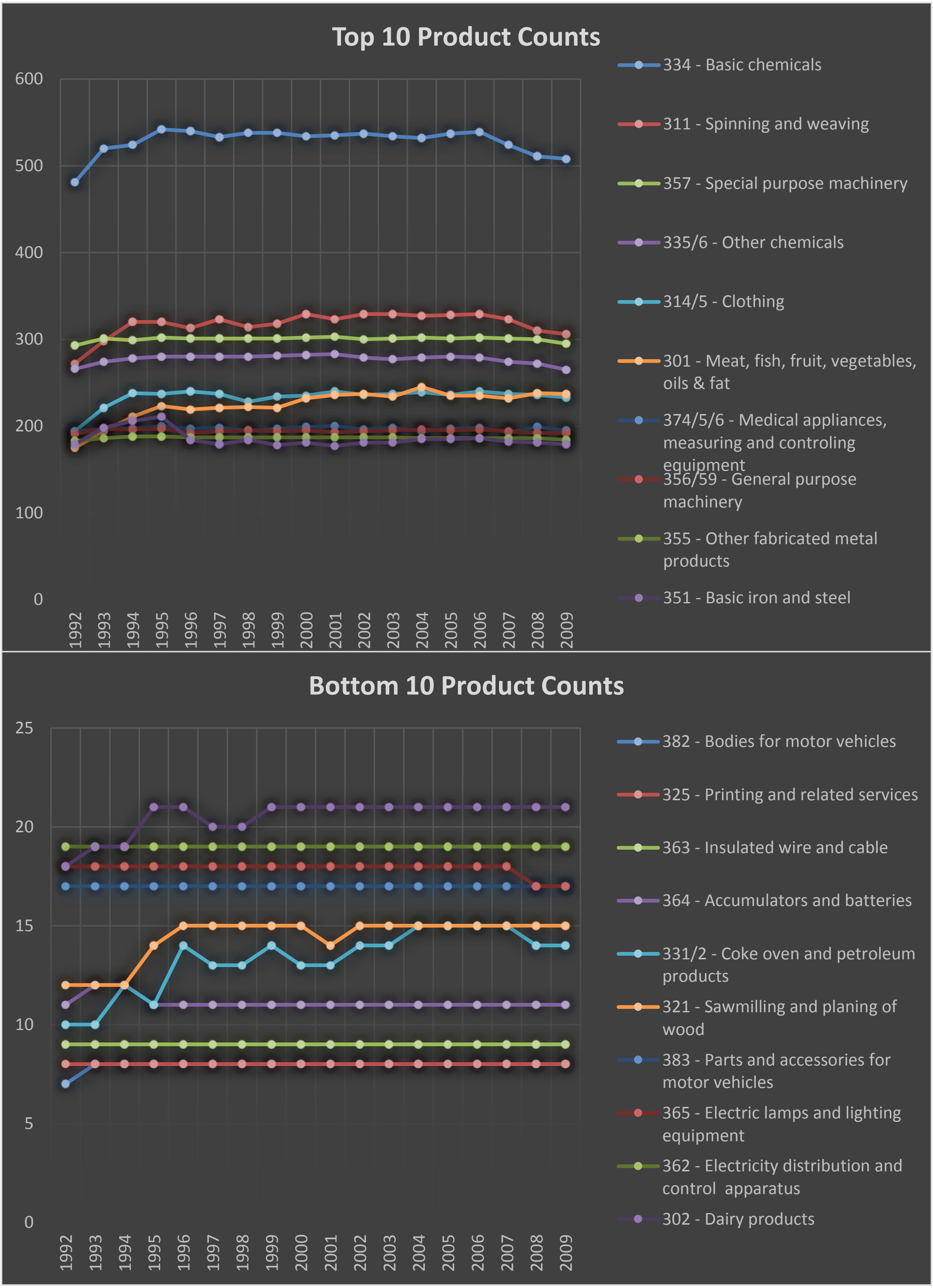
Figure A





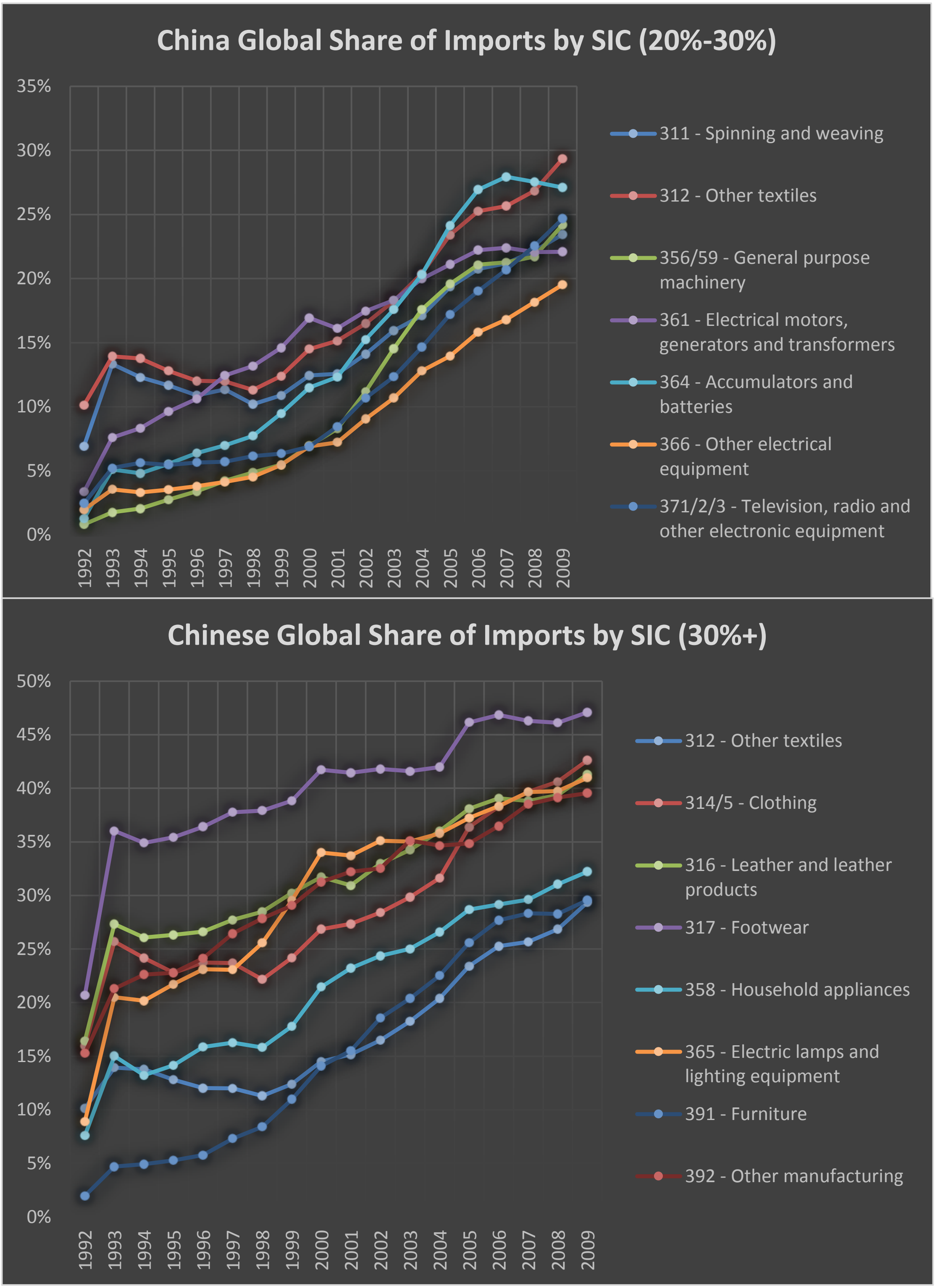
Source: Author's calculations using UN Comtrade (2015) data.

Figure B



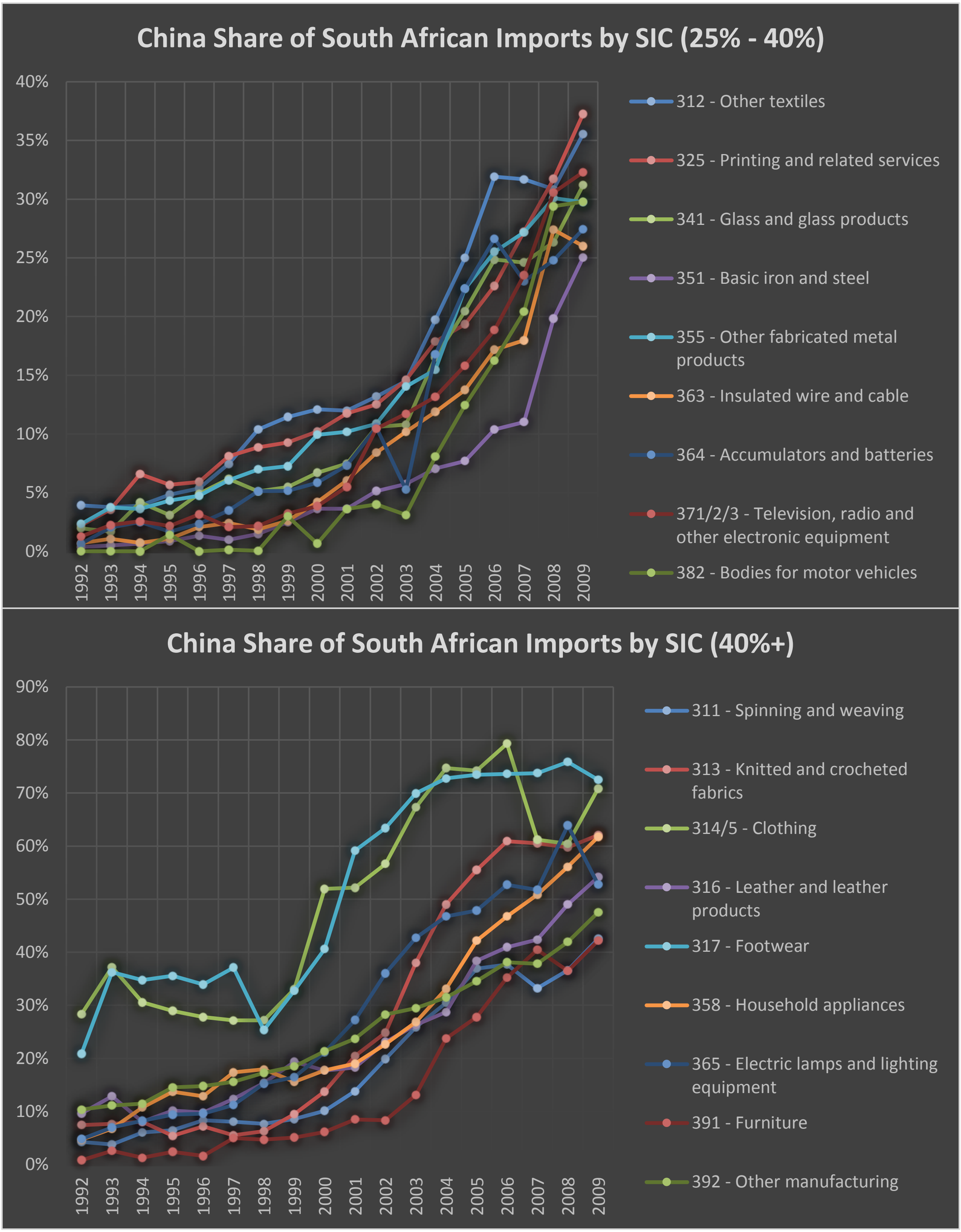
Source: Author's calculations using UN Comtrade (2015) data.

Figure C



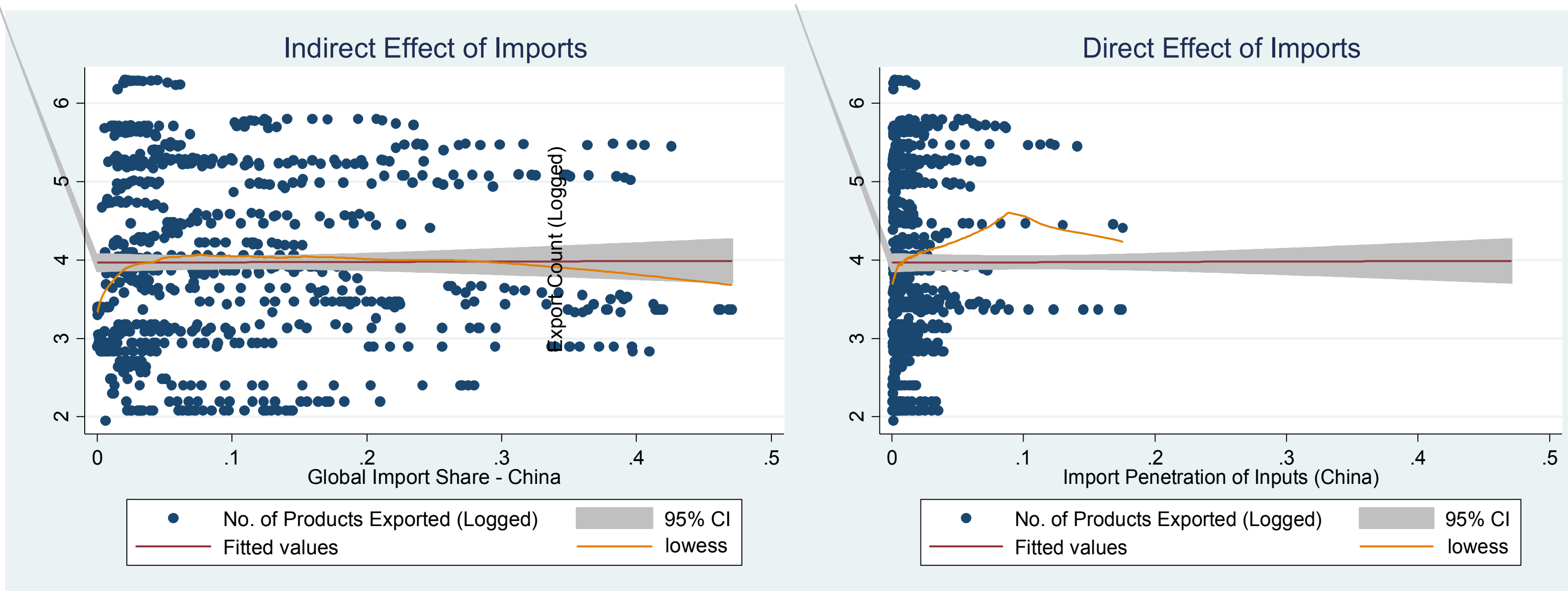
Source: Author's calculations using UN Comtrade (2015) data.

Figure D



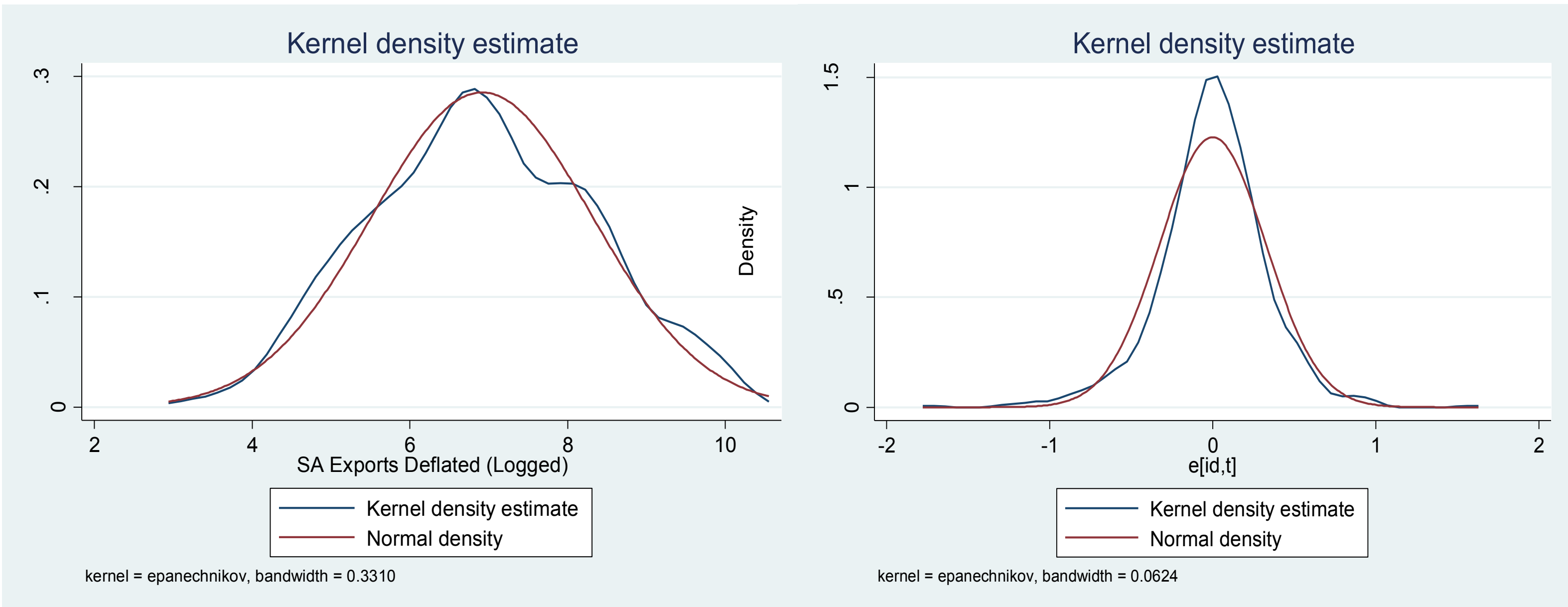
Source: Author's calculations using UN Comtrade (2015) data.

Figure 9A



Source: Stata calculations using UN Comtrade (2015) and Edwards & Jenkins (2015b) data.

Figure E



A B

Source: Stata calculations using UN Comtrade (2015) data.

Table 1

Regression Results for Aggregate Export Value (Log of Export Value Deflated) Low-wage Industries

	(1)	(2)	(3)
VARIABLES	Prais-Winsten	Robust - Lag	Robust - Arellano-Bond
Export Deflated (-1)		0.672**	0.706**
		(0.052)	(0.121)
Global Import Share - China	0.088	-0.742	-1.181
	(0.755)	(0.597)	(0.783)
Import penetration in inputs, Total	0.059	1.289	-2.609
	(1.308)	(1.410)	(1.469)
Import penetration in inputs, China	-4.355	-1.587	-0.625
	(2.44)	(1.459)	(1.666)
Ln(Productivity)	-0.112	0.123	0.318
	(0.121)	(0.081)	(0.211)
Ln(Real Wage)	0.140	-0.039	-0.532
	(0.156)	(0.114)	(0.375)
Constant	7.850**	1.812**	
	(0.425)	(0.465)	
Fixed Effects	Yes	Yes	Yes
Observations	396	374	352
R-squared	0.982	0.788	

Notes: Column 1 reports the Prais-Winsten (1954) transformation technique for serial correlation. Columns 2 and 3 are dynamic models dealing with potential misspecification issues in the initial static model. Robust standard errors in parentheses.
** $p<0.01$, * $p<0.05$, + $p<0.1$

Table 2
Regression Results for Aggregate Export Value (Log of Export Value Deflated) High-wage Industries

	(1)	(2)	(3)
VARIABLES	Prais -Winsten	Robust - Lag	Robust - Arellano-Bond
Export Deflated (-1)		0.596**	0.360**
		(0.110)	(0.157)
Global Import Share - China	1.351	-0.318	-0.728
	(0.765)	(0.791)	(1.777)
Import penetration in inputs, Total	1.984**	0.833	1.923
	(0.738)	(0.803)	(1.283)
Import penetration in inputs, China	5.412**	2.948+	3.041
	(1.932)	(1.592)	(3.937)
Ln(Productivity)	0.267**	0.188*	0.305+
	(0.092)	(0.067)	(0.150)
Ln(Real Wage)	-0.569**	-0.207	-0.772
	(0.128)	(0.131)	(0.452)
Constant	6.318**	1.880**	
	(0.613)	(0.465)	
Fixed Effects	Yes	Yes	Yes
Observations	396	374	352
R-squared	0.978	0.830	

Notes: Column 1 reports the Prais-Winsten (1954) transformation technique for serial correlation. Columns 2 and 3 are dynamic models dealing with potential misspecification issues in the initial static model. Robust standard errors in parentheses.
** p<0.01, * p<0.05, + p<0.1

Table 3
Regression Results for Extensive Margin (Log of Export Count) Low-wage Industries

	(1)	(2)	(3)
VARIABLES	Prais-Winsten	Robust - Lag	Robust - Arellano-Bond
Export Deflated (-1)		0.550**	0.248
		(0.072)	(0.278)
Global Import Share - China	-0.378**	-0.126*	-0.105
	(0.079)	(0.065)	(0.145)
Import penetration in inputs, Total	-0.228+	0.020	0.176
	(0.116)	(0.171)	(0.343)
Import penetration in inputs, China	0.203+	0.002	-0.165
	(0.119)	(0.086)	(0.364)
Ln(Productivity)	-0.010	-0.003	0.009
	(0.012)	(0.009)	(0.020)
Ln(Real Wage)	0.005	-0.010	0.034
	(0.013)	(0.0180	(0.079)
Constant	5.315**	1.825**	
	(0.039)	(0.342)	
Fixed Effects	Yes	Yes	Yes
Observations	396	374	352
R-squared	0.999	0.616	

Notes: Column 1 reports the Prais-Winsten (1954) transformation technique for serial correlation. Columns 2 and 3 are dynamic models dealing with potential misspecification issues in the initial static model. Robust standard errors in parentheses.
** p<0.01, * p<0.05, + p<0.1

Table 4
Regression Results for Extensive Margin (Log of Export Count) High-wage Industries

	(1)	(2)	(3)
VARIABLES	Prais-Winsten	Robust - Lag	Robust - Arellano-Bond
Export Deflated (-1)		0.550**	0.307*
		(0.051)	(0.117)
Global Import Share - China	-0.297**	-0.053	0.417
	(0.171)	(0.042)	(0.388)
Import penetration in inputs, Total	0.171+	0.101	-0.171
	(0.091)	(0.085)	(0.180)
Import penetration in inputs, China	-0.168	-0.044	-0.263
	(0.202)	(0.117)	(0.377)
Ln(Productivity)	0.029**	0.004	0.025*
	(0.009)	(0.007)	(0.011)
Ln(Real Wage)	-0.028	-0.010	-0.021
	(0.019)	(0.012)	(0.013)
Constant	3.691**	1.698**	
	(0.096)	(0.165)	
Fixed Effects	Yes	Yes	Yes
Observations	396	374	352
R-squared	0.998	0.473	

Notes: Column 1 reports the Prais-Winsten (1954) transformation technique for serial correlation. Columns 2 and 3 are dynamic models dealing with potential misspecification issues in the initial static model. Robust standard errors in parentheses.
** p<0.01, * p<0.05, + p<0.1

Table 5
Regression Results for Extensive Margin (Log of Export Count) -Poisson

VARIABLES	(1) Extended	(2) Low-wage Industries	(3) High-wage Industries
Global Import Share - China	-0.195	-0.432	-0.058
	(0.170)	(0.280)	(0.277)
Import penetration in inputs, Total	-0.343*	-0.556	0.075
	(0.168)	(0.355)	(0.239)
Import penetration in inputs, China	0.422	0.538	-0.012
	(0.334)	(0.502)	(0.540)
Ln(Productivity)	0.003	0.016	0.014
	(0.022)	(0.041)	(0.029)
Ln(Real Wage)	-0.011	0.004	0.011
	(0.030)	(0.044)	(0.045)
Constant	5.305**	5.317**	2.980**
	(0.084)	(0.125)	(0.115)
Fixed Effects	Yes	Yes	Yes
Observations	792	396	396

Notes: Regressions run using the poisson method with product count dependent variable. Columns 2 and 3 divides the data into low and high-wage industries respectively. Robust standard errors in parentheses.
** p<0.01, * p<0.05, + p<0.1

Generic derivation of the Prais-Winsten transformation regression equation

1. Regression equation for time period t: $Y_{it} = \delta + \beta X_{it} + u_{it}$
2. Regression equation for time period t-1: $Y_{it-1} = \delta + \beta X_{it-1} + u_{it-1}$
3. First-order serial correlation with correlation ρ: $u_{it} = \rho u_{it-1} + v_{it}$
   Where v_t is white noise.

4. Substituting equation 3 into equation 1: $Y_{it} = \delta + \beta X_{it} + \rho u_{it-1} + v_{it}$
5. Multiplying equation 2 by ρ: $\rho Y_{it-1} = \rho\delta + \rho\beta X_{it-1} + \rho u_{it-1}$

6. Subtracting equation 5 from equation 4:

$$Y_{it} - \rho Y_{it-1} = \delta - \rho\delta + \beta X_{it-1} - \rho\beta X_{it-1} + \rho u_{it-1} - \rho u_{it-1} + v_{it}$$

7. Cancelling out like terms and simplifying:

$$Y_{it} - \rho Y_{it-1} = \delta(1-\rho) + \beta(X_{it-1} - \rho X_{it-1}) + v_{it}$$

8. Finally:

$$Y_{it}{}^{*} = \alpha + \beta X_{it}{}^{*} + v_{it}$$

Where,

$Y_{it}{}^{*} = Y_{it} - \rho Y_{it-1}$, $X_{it}{}^{*} = X_{it} - \rho X_{it-1}$, $E(v_{it}|X_{it}) = 0$ and $\alpha = \delta(1-\rho)$