The Effects of Chinese trade on industrialization in Sub Saharan Africa

Master's Thesis

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Abstract:

In the last two decades the trade relations between China and countries in Sub Saharan Africa have intensified. This has led to a debate about the effects of these new relations on development in Africa. This thesis aims to contribute to this by analyzing the effects of Chinese exports on industrialization in Sub Saharan Africa. Chinese exports can both positively -by providing inputs for industrial production- and negatively -by creating competition- affect industrialization.
Two models are used to analyze these effects. First a Fixed-effects model is employed to analyze the effects over time. After that a Heckman model is used to deal with a selection bias in the sample. There is a differentiation in the amount of goods that China exports to the countries in the sample. A grouping was made based on this differentiation and the effects for these two groups were analyzed. Whilst Chinese exports to countries in Sub Saharan Africa have no effect over time, the Heckman model indicates that these Chinese exports have a significant effect. But these effects differ per country depending on the amount of goods that China exports to a country. Further research could further look into this differentiation of effects.

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Chapter 1: Introduction

In recent years, a number of emerging countries have increasingly become engaged with countries in Sub Saharan Africa (SSA). The most prominent and widely discussed country amongst this group is China. Since early 2000s China has increasingly invested and donated aid to Africa (Brautigam, 2009). But also the trade relations between China and Africa have strengthened over time. The Chinese trade with countries on the African continent has intensified in the last two decades (Eisenman, 2012). However, scholars and politicians remain divided about the Chinese intentions behind these new relations and the consequences that they will have for development in Africa.

The Chinese promote this relation as a "win-win cooperation" where both partners are equal and benefit. They are eager to present themselves as an alternative to Western aid, trade and investments. African leaders seem to agree and many countries have signed aid and investment deals with China. They see this Chinese emergence in Africa as a golden opportunity. Countries in the West however are not equally optimistic about the positive benefits of China-Africa relations. They see China as a rogue donor who gives aid to questionable regimes. China -they argue- mainly pursues its own interests and does not provide new or extra benefits for its African partners (Brautigam, 2009). The Chinese interest is mainly based on the abundance of natural resources on the African continent. In this sense it is not different from the Western interests in Africa, it creates a second "scramble for Africa" (Ayers, 2013).

Previous research on the effects of these relations between China and Africa has led to equally mixed results. While this trade with China did have a positive impact in some African countries, several authors and news outlets have written that Africa was rising in the last two decades as a result of Chinese trade, there are some downside. The recent growth on the continent was mainly driven by an increase demand for oil, minerals and other energy sources. This growth has not created any structural change in the African economies (Taylor, 2016). Trade between China and Sub Saharan Africa is dominated by natural resources, just like trade with developed countries has always been. Trade with China has created a shift in trading partners, but the types of goods exported by African countries has not diversified. The export of non-primary goods is even decreasing relative to primary exports (Schoeman, 2011). There are even indications that trade relations with emerging countries such as China negatively affect industries in SSA. Local industries are suffering from increased competition, both in domestic and international markets (Kaplinsky, 2008).

However, other research points out that the trade relation between China and countries in Sub Saharan Africa also has potential benefits. Trade with China can provide specific benefits that trade with the developed world does not provide. Emerging countries such as China have different interests and a different kind economy than Northern countries. Trade between developing countries and developed countries has made the region very dependent and has kept Africa in a state of underdevelopment (Dahi & Demir, 2017). Optimists about China-Africa relations hope that trade with non-developed countries such as China, which is called South-South (S-S) trade, provides an alternative for this dependency. They expect that this trade will become an alternative for the North and that it will boost technology spillovers. Trade with China can provide cheaper and more suitable inputs such machinery and intermediate goods that can be used to set up a manufacturing industry

in the region (Amighini & Sanfilippo, 2014). Research on this topic has shown that S-S trade can boost Southern exports and promote diversification of exports (Amighini & Sanfilippo, 2014; Dedier, 2017).

Whether trade with China is beneficial for African countries or not remains a topic for debate. This question of the effects of trade with China on African economies is interesting because it will also have an influence on industrialization in Africa, which is vital for the region if it wants to develop. Industrialization is important for development because it creates a structural changes in African economies. Such changes are required because these economies are usually still dominated by agricultural production and the extraction of natural resource. The dominance of these products in the production and exports of SSA countries makes the region very dependent on the prices and demand for these goods. Besides, as industrial production add more value to the end product and provides more employment opportunities, it is generally seen as a way to develop and create higher living standards (Wolf, 2016; Newman et al., 2016). Of the entire continent this industrialization is most important for the Sub Saharan African region, these countries are generally less developed their economies are still mostly based on primary production. The region is currently still the most underdeveloped region in the World, a process such as industrialization is therefore of importance for this region (World Bank, 2017)

It is therefore interesting to look at what the influence that Chinese trade has on industrialization in Sub Saharan African countries really is. Is their impact indeed beneficial as some suggest or is China mainly blocking the way of industrial development for Sub Saharan Africa? Has this increase in trade with China since the early 2000's really promoted industrialization or did this trade counteract the process? It can be expected that this increase in trade with China since the early 2000s has had an impact over time. This will be the focus of this thesis. Chapter 2 will deal with the theories behind industrialization and the potential effects of Chinese trade on this process. This will lead to several hypotheses. Chapter 3 will deal with the data and econometric methods used to analyze the effects of Chinese trade on industrialization. Chapter 4 will report the outcomes of these econometric analysis. Chapter 5 will conclude by discussing the result, giving some preliminary conclusions and by providing some suggestions for future research.

Chapter 2: Theoretical framework

Thought Chinese trade with countries in Sub Saharan Africa clearly can have both negative and positive effects for the SSA involved, some theories are required to better get an sense of what these potential effects may be and how to analyze them. First it is required to get a better sense of the importance of structural changes for development in SSA. Section 1 will focus on the reasons why industrialization is necessary for countries in SSA to develop. The second section will discuss theories on industrialization. The third section elaborates on the ways in which Chinese export can affect industrialization in Sub Saharan African countries, this will result in the formation of several hypotheses. The last section discussed several other factors that are not related to Chinese trade patterns but that do have an influence on industrialization in SSA. The chapter will end with a short conclusion.

2.1 Why industrialization?

Even though Sub Saharan Africa as a region has experienced economic growth in recent years. It is still lagging behind the rest of the world when it comes to development. The poverty rates in the region are amongst the highest in the world. Of the people living in extreme poverty worldwide, around 41 percent of them lives in Sub Saharan Africa (World Bank, 2017; Taylor, 2016). This recent growth in the region is mainly the result of an increase of demand for natural resources and oil, not a result of an increase in industrial production (Taylor, 2016). This will become problematic if prices for these primary goods decrease again. The current growth in the region is unsustainable because it is very dependent on this demand for primary commodities. A structural change is therefore required (Newman et al., 2016; Opoku & Yan, 2019).

This structural change can be in the form of industrialization when an economy shifts from agricultural to industrial production. Other types of structural change are also possible, economies can shift from primary production to services. This type of shift has partially taken place in recent years in Sub Saharan Africa. More and more people in this region are now employed in the services sector. However, agricultural production remains dominant. Such a shift towards services is an improvement because this sector adds more value and is more productive than agriculture. But services are not as productive as manufacturing. This is visible in output per worker statistics for the region. The output per worker in services is twice as high as in agriculture, but in manufacturing it is six times higher than in agriculture (Newman et al., 2016). Another disadvantage of this move to services is that it withholds the regions from some benefits that come with industrialization. Industrializations provides opportunities to gain technological and managerial knowledge and it fosters the creation of technological innovations. Skipping the industrialization phase means that a country misses these advantages. The service sector is important though, because its services are needed to build up an industrial sector. But industries are more important as this sector is more productive and will provide more jobs. This is a serious concern as there is currently much unemployment in African countries (Opoku & Yan, 2019).

The idea that industrialization is required in less developed regions such as Sub Saharan Africa is not a novelty. Industrialization is promoted as an main developmental strategy because many scholars believe that there is a positive relationship between the growth of the manufacturing sector and economic growth. Industrialization is seen as one of the most important engines of

economic development. (Kaldor, 1966; Opoku & Yan, 2019). It creates a range of advantages that help countries to develop. It first of all makes countries less dependent on production and exports of primary goods. It is also more productive than agriculture and provides more high paid jobs. This will help to diminish poverty rates in the SSA region.

2.1.1 Diminished dependency

As mentioned earlier, the dominance of primary production in Sub Saharan African economies keeps these countries dependent and prone to fluctuations in demand and supply. Several scholars see this dominance of primary production as an explanation for the lack of development in the region. They argue that trade with Northern and developed countries plays a large role in this. An important theory within the field of development economics is the Prebisch-Singer thesis which argues that international trade between the North and the South keeps developing countries dependent and underdeveloped. The thesis states that one of the reasons why this trade with developed countries are disadvantageous for developing countries are its terms of trade. These terms of trade deteriorate over time because developing countries export primary goods and import manufactured goods from the developed North. The prices of these primary goods will not increase as much as those for manufactured goods. A reason for this is the low income elasticity for primary goods. This means that when the income of consumers increases their demand for primary products will not increase much. For manufactured goods the income elasticity is higher, people will buy more of these when their income increases. As incomes rise in the North, the demand in the North for primary goods from the South will not increase and the prices of these goods will remain low. The opposite will happen in the South, if incomes increase the demand for manufactured imports will increase and with it the prices of these goods. As a result of this, the export prices of Southern countries remain low or decrease, while the prices of their imports increase. This deteriorates the terms of trade for the less developed countries and makes it harder for them to industrialize and develop. In this way the Southern countries are kept dependent (Oatly, 2012). Another issue with this trade pattern is that prices for primary goods are more prone to fluctuations than prices of manufactured goods, this makes primary exporters vulnerable in times when demand for their export is low (Qobo & Le Pere, 2018).

A shift from primary production to industrial production will make countries in the region less dependent on their natural resources and agricultural production (Newman et al., 2016). It furthermore makes these economies less dependent on the weather and prices of primary goods. These two can fluctuate over time and cause shocks in supply and demand for agricultural goods, this uncertainty will diminish with a move to industrialization (Bigsten & Söderbom, 2011; Qobo & Le Pere, 2018).

2.1.2 Productivity and value added

A second reason why industrialization would be desirable is that it can provide productivity gains and creates more jobs than agriculture. With industrialization labor moves from less productive sectors such as agriculture into more productive sectors. Agricultural production and other sources of primary production do not add much value to the final product as this type of production is not very sophisticated. Industrial production does add more value to the end product (Newman et al., 2016). Furthermore, industrial production provides more and better jobs than agriculture. This increase in higher quality jobs will help to reduce poverty in the

region. Currently, the quality of jobs in SSA countries is poor. The wages are low and because most people work in the informal economy and employ themselves, the job insecurity is high. A move to more productive sectors will lead to an increase of production per worker, which leads to an increase of wages per worker. This will help to alleviate the general living standard. Industrialization is especially important for Africa because the region has a large and young labor force. A move to industrialization would help to provide jobs for this increasing workforce (Newman et al., 2016; Wolf, 2016; Ramzi, 2007; Dahi & Demir, 2017).

2.2 How to industrialize: theories on industrialization

Different schools of thought within the field of international political economy and developmental economics have their own solutions for this underdevelopment. Structuralist scholars believe in Import Substitution as a way to deal with the dependence described by the Prebisch-Singer thesis (Balaam & Dillman, 2014). This is a state led approach to industrialization, which means that the state is strongly involved in promoting and planning industrialization. As part of import substitution policies governments impose tariffs on imports of manufactured goods coming from more advanced countries to protect their domestic industries and give them a chance to grow and become more competitive (Oatly, 2012).

Mercantilists believe in export-oriented growth as the way forward**.** Here states also actively plan the industrialization of their countries, but do this selectively and based on their comparative advantage. Usually these countries start by promoting the production of simple and labor intensive goods, these are protected from foreign competition so that they can grow and become more competitive. Over time these tariffs are reduced and the domestic firms start to export their manufactured goods instead of selling these in the domestic markets (Balaam & Dillman, 2014). This approach was followed by the late-industrialized countries in Eastern Asia. The successfulness of this policy is dependent on the demand for manufactured goods on the world markets (Wolf, 2016).

2.2.1 Difficulties of industrialization

Some of these policies were used by African governments in the previous decades. But until now this has not lead to successful industrialization in the region. African countries started to implement import substitution policies in the first years after their independence in the 1950s. This initially was quite successful, their industries boomed in the 1960s but this success did not last. In the 1970s the growth of the manufacturing sectors in the region slowed down as it could not put up with the growth of total output in these countries. These industries could not deliver the high levels of output because their productivity was not sufficient. Investments in the manufacturing sectors were made and large firms were set up in order to create employment. But firms were eventually not able to compete with foreign manufacturers and countries lacked sufficient human capital to make their planned industrialization work. In the 1980s the manufacturing sectors in African countries experienced a small revival again, but after 1988 Africa started to deindustrialize (Newman et al., 2016; Opoku & Yan, 2019).

Whilst industrialization is important for countries in Sub Saharan Africa, this process has not been easy or successful yet. The countries in the SSA region have some advantages and disadvantages when it comes to their position as future industrializers. These countries are, just like the Asian emerging countries, late industrializers, meaning that they will have to

industrialize after the developed and emerging nations have. Being a late industrializer has some disadvantages, is there already is a lot of competition in the world markets for manufactured and industrial goods which makes it harder for African economies to joint (Kaplinsky & Morris, 2009; Kaplinsky, 2008). The region has to implement certain policies or make use of certain comparative advantages to be able to compete with other producers in the world markets. Simply starting an industry and beginning to sell goods will not work. But, later industrializers have the advantage that they can learn from others. They do not have to reinvent the wheel and they can use technologies and knowledge created by earlier industrializers. This also means that they are dependent on the knowledge and skills of others to become competitive (Amsden, 1986 & 1991).

This transmission of knowledge itself has its complications. Market economists would simply argue that these late industrializers need to get their prices right and specialize in their comparative advantage to industrialize. The market will do the rest. But the experiences of late industrializers in East Asia show that industrializing is not that simple. These countries did not become competitive by specializing in their comparative advantage. They did so by improving their knowledge and skill levels. They did not initially have this knowhow and skill to compete in manufacturing, they gained it over time by borrowing technological knowledge from their competitors. They gradually learned how to do. Countries will not be able to take over technologies and immediately compete on the world markets right from the start. Technologies and knowhow cannot simply be brought from other nations, it is not a commodity. The process of transmitting such knowledge typically involves tacit and implicit knowhow, this cannot simply be written down and transmitted. This kind of knowledge can only be learned and transmitted by doing and this takes time. This process where an improvement in skill and knowledge over time increases productivity is called learning effects (Amsden, 1986 & 1991).

2.3 The effects of Chinese trade on industrialization

It is clear that industrialization is needed in SSA in order to develop and diminish poverty. This thesis is interested in how trade can affect this process, and more specifically how trade from a developing and Southern country such as China affects industrialization in Sub Saharan Africa. This trade has intensified in the last two decades, what have been the consequences for industrialization? Trade with the countries in the North and countries in the South can have different influences on industrialization in Sub Saharan Africa. As the Prebisch-Singer thesis shows, trade with the North has some negative effects. It is thought that trade with Southern countries can have different effects and can be more beneficial. However such effects are not visible yet. Even though the SSA region has started to trade more with Southern countries in recent years, Africa's recent growth is mainly the result of an increase in demand for natural resources. This demand increased as a result of the massive growth of the Chinese economy (Taylor, 2016). In this respect it can be argued that China and its effects through trade are not very different from the effects of Northern countries. However, Chinese trade can have some specific effects on industrialization in SSA that trade with Northern countries does not have. Trade with China has an impact on industrialization in three particular ways. The first effects are transmitted through exports of machinery and intermediate products from China to SSA countries. The second one is through the Chinese exports of simple manufactured goods, both to

the domestic SSA markets. The last effect on industrialization occurs through Chinese exports to third market in the developed world.

2.3.1 Through capital and intermediate goods

A first way is through the intermediate and capital goods exported by the Chinese to the domestic markets in SSA. Amongst these products are capital goods, such as machinery. Since the SSA region is not very competitive to produce such machinery, it has always been very dependent on imports of these machines. These capital goods are essential for economic growth, gaining access to new types of capital goods creates possibilities for productivity improvements (Munemo, 2013; Atta-Abkomah, 2015). Another influence of Chinese exports to SSA is via their exports of intermediate goods that can be used as an input for industrial production (He, 2013; Amighini & Sanfilippo, 2014). These new sources of inputs positively affect local production in several ways. A prominent way is through the technology spillovers these inputs can create. Besides these spillovers, the new Chinese inputs can also be beneficial for local industrialization processes because of the increase availability, can improve quality of end products, are more appropriate for local conditions and are cheaper than inputs coming from the North. In these various ways Chinese exports of capital and intermediate goods have a positive impact.

These new Chinese inputs first of all provide more opportunities for technology spillovers. New sorts of imports provide new opportunities to learn and transmit knowledge (Amighini & Sanfilippo, 2014). What matters for this type of spillover is the technology gap, this refers to how much more technological knowledge a trading partner has. In North-South trade this gap is typically larger because the North uses very advanced technologies. This means this type of trade provides the largest possibilities for knowledge transmission. The gap is smaller for South-South trade, the advantage here can be that it is easier to actually transmit knowledge because the two partners are more similar. The less developed trading partner is better able to absorb the new technology when the gap is smaller (Dahi & Demir, 2017; Amighini & Sanfilippo, 2014; He, 2013).

The technology gap is not the only aspect that matters for this technology transfer. The kind of trade where countries engage in also matters. South-South trade in general offers more potential for a technology transfer because it is mostly intra-industry whilst North-South trade is mainly inter-industry. Inter-industry is trade in final goods, where the South exports only simple low skill and technology intensive goods and the North exports goods that are skill and technology intensive. This offers less prospects of learning and technological spillovers. South-South trade is mostly intra-industry trade. This is trade in intermediate goods, where trade partner all do a part of the production process. This kind of trade gives potential for technological spillovers. The African countries involved in this type of intra-industry trade make a particular part of the final good, by engaging in this manufacturing process the African country learns how to use certain technologies and increases its technological knowledge (Amsden, 1986; Dahi & Demir, 2017).

A second way in which the availability of these new types of inputs can be complementary for local businesses is their effect on the amount of choice for local producers. These new inputs enrich the range of intermediate and capital goods available for local producers, so that they now have more options to choose from (Amighini & Sanfilippo, 2014). This increase in choice also matters for the technology spillovers. The availability of knowledge coming from countries

such as China make SSA countries less dependent on technologies from the North and enlarges their choices of technologies (Dahi & Demir, 2017). This increased availability can spur the creation of new types of goods and promote innovation. This effect was for example present for Chinese manufacturing firms when China ascended the WTO. Their membership of the WTO lowered tariffs and increased the availability of inputs which had a positive effect on the capacity of these firms to produce and export (Feng et al, 2016).

Thirdly, these new inputs can also be beneficial because they can increase the quality of the final product. When a new type of input is of a higher quality than those used earlier this naturally will lead to a higher quality end product (Amighini & Sanfilippo, 2014). This will increase the quality of the final product easily without having to change the production process or buying better machinery (He, 2013). With these new intermediate inputs local producers can upgrade and improve their production (Didier, 2017)

Fourthly, these new inputs can be beneficial for industrialization because they are more appropriate for local conditions. Southern trading partners, such as China, usually have a more similar kind of economy, production capacity and preferences than trading partners from the North. This can make their products more applicable for production in SSA. This is true for both intermediate and consumer goods exported to SSA (Dahi & Demir, 2017). Linder (1967) has a theory on this, he argues that producers will make and export products that mirror the preferences in their domestic markets. They will export these products to countries similar to those at home, this explains why the North mainly trades final goods with other Northern countries. Because Southern countries may have more similar demand structures and preferences, trade in intermediate and final products amongst these countries better suits the preferences and wishes of consumers and producers (Dahi & Demir, 2017; Linder, 1967).

Such similarity will make it more likely for technology spillovers to occur. It makes that Southern technology is more applicable and appropriate in the context of SSA economies and increases the chances of a successful technology transfer (Dahi & Demir, 2017; Amighini & Sanfilippo, 2014). Production in developed countries is usually very capital intensive and large scale. This makes the technologies and machines used in these processes less suitable for production in developing countries. Technologies coming from other developing or emerging countries such as China are more appropriate for production in SSA (Atta-Abkomah, 2015). This similarity matters because technology spillovers are not simply a matter of importing knowledge or starting to use different machines. As mentioned earlier, technological knowledge is not a commodity. It is a tacit kind of knowledge. This type of knowledge cannot simply be written down and transmitted, it is implicit. People learn it by doing or by watching others. And this learning by doing has its costs, these increase when the technology gap becomes larger and when the production structures differ a lot. So, with technologies from the North these learning costs and efforts are higher than with technologies from the South. The appropriateness and similarity of technological knowledge from Southern countries such as China will make it easier and less costly to transmit this tacit knowledge (Dahi & Demir, 2017; Amsden, 1986).

A last advantage the impact of these new inputs of the costs. Chinese inputs and machinery are typically cheaper. Their quality and lifespan might be lower, but their price allows more people

to buy these inputs and start producing which fosters industrialization (Jenkins, 2018; Kaplinsky & Morris, 2009; Kaplinsky, 2008).

The influence of Chinese capital goods such as machinery on African economies is already visible. China is already the major source of capital goods for these countries, and this importance will continue in the future (Munemo, 2013). Other studies found evidence suggesting that importing from China has a different impact than importing from Northern countries such as France and the United States. Chinese exports have a stronger influence on SSA exports than exports to SSA coming from the US or France (He, 2013).

2.3.2 Chinese exports of consumer goods

Chinese exports can have negative effects for SSA industries. China is currently dominant around the world when it comes to the production of labor-intensive manufactured goods. Chinese exports of such goods can have a negative impact on industrialization in SSA. The process of industrialization in less developed regions like Sub Saharan Africa typically begins with labor-intensive types of industrial production. These new industries are usually fragile at the start of this process. An increase of Chinese exports of such products to African countries creates competition for local manufacturing producers. This increased competition in the domestic market makes it harder for local producers to grow and thrive (Kaplinsky & Morris, 2009; Kaplinsky, 2008).

What makes this increase in competition so problematic are the differences in the comparative advantage and competitiveness of both China and countries in SSA with respect to labour-intensive manufactured goods. China is very competitive and has a large comparative advantage, countries in SSA do not have this. The competitiveness of labor intensive goods mainly depends on the costs and supply of labor. Currently China is the most competitive exporter of low skill and labor intensive manufactured goods. China's large labor supply ensures that there is plenty of labor available and that wages are low. This makes it very hard to compete with them, even for developed countries. It seems that China will keep this comparative advantage in the foreseeable future, but China is becoming more competitive in high skill manufacturing too. Most countries move to the production of more skill intensive products over time, if this would happen manufacturing industries in SSA countries would have a better chance (Giovannetti & Sanfilippo, 2016). Most SSA countries have a large supply of labor. This offers potential for creating a large-scale labor intensive industry. However, the real wages in manufacturing relative to GDP capital are high, this makes the region less competitive in manufacturing. Also, the region's productivity in the sector is low compared to others. These two things make SSA uncompetitive in labor intensive manufacturing, especially vis-à-vis China (Golub et al., 2017).

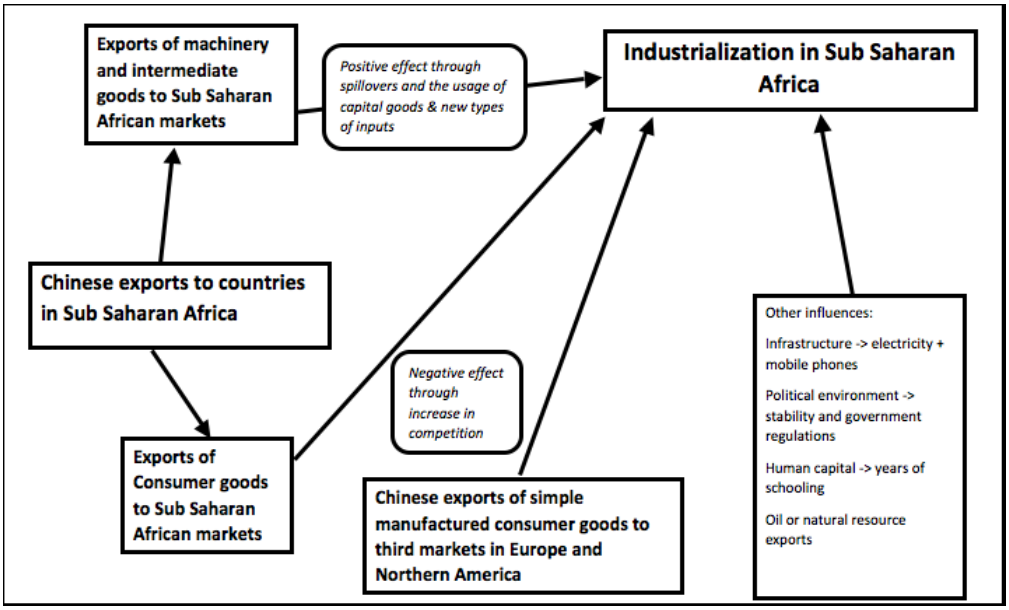
It is also possible that these increased exports from China come at the expense of exports of Northern producers to SSA markets. In that case exporters from the North suffer instead of local producers. But in that case there is simply a replacement of foreign exports of manufactured goods to local markets, and it will remain difficult for local producers to compete (Jenkins, 2018). What is more, the competitiveness of China with regards to low skilled labor intensive goods will be higher than those of the developed countries because developed countries do not have the a large labor force and low wages like China does.

2.3.3 Chinese exports to third markets

This increase domestic competition caused by Chinese exports to SSA markers is a direct effect. But Chinese exports of consumer goods have indirect effects too. This happens when the effect occurs in a third market. The worldwide Chinese exports can also make it harder for SSA countries to compete in markets in developed countries, especially because most SSA countries are not very competitive in the world markets for labor intensive low skilled goods (Kaplinsky & Morris, 2009; Kaplinsky, 2008). Here China crowds out manufacturing exports of other developing countries. This will affect SSA countries if they try to pursue a strategy of export led growth. When too many countries apply this strategy at the same time this can lead to problems (Ramzi, 2007). This difficulty in exporting manufactured goods is part of the fallacy of composition. Both on a domestic and on a global scale there are also limits to the amount of demand for a certain good. This means that not all developing and emerging countries can export the same type of manufactured goods at the same time because there will not be sufficient demand for these goods. In this case, if both China and developing countries in SSA export similar products to the West, there will not be sufficient demand for these goods. This intense competition will drive prices down and make it harder to for the less developed countries enter the market successfully (Wolf, 2016; Giovannetti & Sanfilippo, 2016; Athukorala, 2009; Ramzi, 2007).

Other developing countries, such as those in Eastern Asia, have similar "China fears" of not being able to compete with China. These fears for Chinese competition have increased after China's accession to the WTO. However, earlier research on this subject has shown that this crowding out effect is not equally strong for all types of manufacturing production. The negative impact is only visible for labor intensive goods, and it strongly depends on the circumstances and the comparative advantage of the developing country in question. For machinery production for example, the effects of Chinese increased export and production mainly had a complementary effect instead of a competing effect (Athukorala, 2009). But it seems feasible that the crowding out effects of labor intensive goods for SSA countries are warranted. The comparative advantage and competitiveness of African producers in the world markets is such that it will suffer from Chinese competition. Just like the competition that producers face in domestic markets, in the third markets they also may not be competitive enough to compete with China. Besides this, the size of a country and its degree of industrialization and development also plays a role in the influence that these crowding out effects have. Weaker and less developed countries will benefit less than larger and stronger ones. Which would mean that less developed countries in SSA will potentially be hit harder. More advanced countries have more power and influence, they can simply exports their manufactured goods where they want. Smaller and less powerful countries like those in SSA will simply have to accept this and deal with it (Dahi & Demir, 2017).

Figure 2.1: The effects of different types of Chinese exports on industrialization in Sub Saharan Africa



In sum, Chinese exports can have both positive and negative effects on industrialization in SSA. The type of effect seems to depend on the type product exported by the Chinese. Chinese exports of machinery and other types of capital goods have a positive influence on industrialization because these technologies can be used in the production process and can lead to technology spillovers. Intermediate goods in a similar way have a positive effect on industrialization. But Chinese exports of consumer goods to markets in SSA have a negative effect on industrialization because they make it harder for local producers to compete. Chinese exports of simple manufactured consumer goods to third markets will have a similar negative effect on industries in SSA. These effects on industrialization are summed up in figure 2.1. This leads to the following three hypothesis:

H1: Chinese exports of machinery and intermediate goods to Sub Saharan African markets have a positive effect on industrialization in Sub Saharan Africa.

H2: Chinese exports of simple labor-intensive manufactured consumer goods to Sub Saharan African markets have a negative effect on industrialization in Sub Saharan Africa.

H3: Chinese exports of simple labor-intensive manufactured consumer goods to third markets in developed countries have a negative effect on industrialization in Sub Saharan Africa.

2.4 Other influences on industrialization

There are three main ways in which Chinese trade influences the process of industrialization in Sub Saharan Africa. These influences on industrialization in SSA are summarized in figure 2.1. Besides Chinese exports there are also a couple of other factors of importance for industrialization, these are also mentioned in figure 2.1.

2.4.1 Business environment

A determinant for the efficiency of manufacturing factories in SSA is the business environment. The business environment in a country is determined by a combination of policies, institutions,

infrastructure, and geographical aspects. The functioning and effectiveness of these aspects of the business environment are deterministic for the costs of production and the functioning of markets. An effective business environment helps to promote investments in the manufacturing sector and makes it easier for new firms to enter the market (Eiffert et al., 2005 & 2008). The business environment can be determining for the transaction costs faced by firms, if the environment is poor the transaction cost will be high and this will discourage local firms (Söderbom & Teal, 2003). Two important aspects of the business environment that influence industrialization are the infrastructure quality and the political environment in the countries in question (Bah & Fang, 2015).

2.4.1.1 Infrastructure

Infrastructure matters because the manufacturing sector will need transportation of inputs, electricity supply and access to telecommunication to be successful (Eifert et al., 2008). Improvements in infrastructure are beneficial because they lead to a decrease in production cost which will encourage investments in local production. These investments consequently contribute to growth. Better infrastructure also lowers the adjustment cost for local businesses, in case of a change in demand it is now easier and less costly to change production and adjust to the new situation (Agénor & Moreno-Dodson, 2006; Carley et al., 2007).

The poor infrastructure in SSA has always been a constraint for growth of the manufacturing sectors in the region (Eifert et al., 2008). It has been one of the main reasons why the region -for example- struggles to become competitive in textile clothing (Carley et al., 2007). Infrastructure is less important for the production of agricultural goods or natural resource than for the manufacturing sector, which explains why infrastructure has not been a major issue until countries in the region have started to industrialize (Eifert et al., 2008). Of all aspects of infrastructure, poor electricity access in the region is one of the most important constraints for the industrial sector in the region. Second most important is transportation, this includes road and railway networks (Newman et al., 2016, P. 160).

2.4.1.2 Political environment

The political regulations and stability of a country are other important aspects of the business environment. Political instability can make it harder for a business to thrive and can be determining for the potential of countries to upgrade and diversify their exports (Amighini & Sanfilippo, 2014; Munemo, 2013). Well-functioning government regulations and bureaucracy matter as well. When these are inefficient the business costs will increase, which can be a major constraint for the industrialization process. Moreover, such inefficiency can make a country less competitive on the world markets. Better and more efficient regulations improve productivity and encourage investors to invest (Carey et al, 2017; Bah & Feng, 2015; Newman et al., 2016). Lastly, political stability and efficient government regulations also matter for technology transfers. A well-functioning political environment allows for efficient technology transfers to take place (Bommer et al., 1992).

2.4.2 Human capital

A last important factor for the emergence of an industrial industry, and for growth and development in SSA in general, are education levels or human capital (Munemo, 2013). The skill and education levels in Africa are lagging behind compared to the rest of the world. This is a

major constraint for industrialization in the region. Simple levels of education, such as primary schooling, already can have significant impact on industrialization. A basic primary education is essential for the industrialization process. It is needed to acquire and process new types of knowledge and accumulate technological knowledge, which helps the industrialization process move forward (Lall, 1992; Carey et al., 2007). Education is important for technology spillovers, a higher educated population is better able to copy and use Chinese technologies. Countries differ in their ability to take over technological knowledge from other countries. And one major aspect of the capability of countries to adopt new technologies is their stock of human capital. This includes skills attained with education and training but also skills acquired through experience (Lall, 1992).

With regard to these effects on industrialization the following hypotheses can be made:

H4: The quality of infrastructure in a SSA country is positively related with industrialization

H5: A stable and efficiently functioning political environment in a SSA country are positively related with industrialization.

H6: Education quality in a SSA country is positively related with industrialization.

2.5 Conclusion

Whilst Sub Saharan Africa as a region has experienced economic growth during the last decade, this had not yet let to a decrease of poverty in the region. To help improve the living conditions in the region a structural change of the economies in the region is required. The best way of creating such a structural change is by industrialization of the economy. Trade with Southern countries such as China can have both negative and positive influences on this industrialization process. Chinese exports of machinery and intermediate products to SSA markets can be used in local industries. These inputs have a positive effect and can complement the process. Chinese exports of consumer goods have a very different impact on industrialization, these compete with local producers and make it harder for them to thrive. Chinese exports of consumer goods to third markets have a similar negative effect. Because these Chinese exports have increased in the last two decades it can be expected that the effects of these three types of goods have become stronger over time as well. Besides exports, the political environment, infrastructure and human capital in SSA countries influence the industrialization process as well. The next chapter will focus on the data that will be used to analyze the influences on these six have influenced industrialization over time and the kind of model that will be used to do the econometric analysis.

Chapter 3: Methods

Now that the several ways in which Chinese exports and other factors that influence industrialization are discussed, a method is required to analyze these effects. This chapter will deal with the data and methods used for this. Section 1 will describe the data used and the potential issues that these data can cause. Section 2 will elaborate on the different econometric models that are most appropriate for the data and the purpose of this thesis. It will also discuss the multiple robustness checks that are used to critically assess the outcomes of the econometric models used. The chapter will end with a short conclusion.

3.1 Data

To find out how exports from China to countries in Sub Saharan Africa affects the industrialization process in these African countries an econometric analysis will be made. The choices of model and sample are made in order to estimate these effects as accurate as possible. The focus will be on the effects of Chinese exports of inputs and consumer goods to SSA countries, Chinese exports of consumer goods to third markets, infrastructure, human capital and the political environment in SSA countries on industrialization in these countries. There are thus six different types of influences on industrialization. Whilst these six in theory are clear categories, the categorization of the data in practice is not so straightforward.

Of these six, the Chinese exports of inputs and consumer goods are the most important. It is expected that inputs will be beneficial for industrialization processes and that consumer goods have a negative influence on the industrialization process. For these two types of exports, different types of data can be used. International trade data is always classified according to a classification system. Examples of these are the Harmonized System (HS) or the SITC (Standard International Trade Classification). Each of these systems has a different way of making categories of products, this means that different selections of export categories can be used as data to indicate the effect of Chinese exports of consumer goods and inputs. This selection of categories of data could lead to a measurement bias when incorrect or inadequate data categories are used. In an ideal case the exact number of Chinese exports of inputs and consumer goods are known and used. But the reality is that the exact data of these groups is not known, as an alternative a combination of either SITC or HS categories of exports is used. But this data may differ from the real amounts of export as there may be an error in the way the data is reported or because the data of the export classifications used may not exactly overlap with the real values (He, 2013). Furthermore, these two categories of exports are expected to have different effects on industrialization so it is important that the data for these two does not overlap. If for example the category inputs also includes products that are consumed in SSA countries the influence of this category of exports on industrialization might be less positive or negative. Using incorrect or very broad categories for the two types of exports can also lead to a measurement bias. To check for potential measurement biases two types of export data will be used. These two sets of data will not only use different classification for the export data. For the effects of infrastructure and the political environment there are also alternative indicators used.

From all the available data, two sets of data were created. The first one will be the base data, this includes those variables that are thought to most precisely represent the six influences described above. Then there is the alternative data, this dataset consists of variables that are similar to those of the base model but the categories used for the alternative data are thought to be less precise. In the

base data, a narrow classification of export types is used. And in the alternative dataset broader categorizations of these exports are used.

3.1.1 The base model data

In both datasets, the dependent variable is the Manufacturing Value Added in the SSA countries concerned. This is the value that the manufacturing industries in each country add to the GDP. When a country industrializes, this percentage becomes higher as the size of the manufacturing industry vis-a-vis other industries in the economy increases. This data is expressed as percentage of GDP to control for the size of the economies of the SSA countries in the sample.

The first major independent variable are the Chinese exports of intermediate and capital goods to SSA. For simplicity, this category will be revered to as the *input*. The second major independent variable are Chinese exports of consumer goods to SSA countries. This category will be referred to as *consumer.* Data for these two variables comes from the World Integrated Trade System (WITS) database. The WITS uses UN COMTRADE data. The WITS classifies data with the use of several classification, in this case the HS1988/92 categorization is used (WITS, 2019a). Within this classification it is possible to select different types of categories for the import and consumer goods variables. In the base dataset variables for the effects of the input and consumer exports will be created by merging together several HS1988 categories. The machinery and electricity HS1988 classification will be used for the input exports variable. The choice for only machinery is because intermediate goods tend to overlap with consumer goods, using only machinery ensures that the overlap between the two is minimal. A broader category will be used in the alternative data. Data on the exports of textiles & clothing, footwear and miscellaneous (also from the HS 1988) is used for the consumer good exports variable. Miscellaneous includes a couple of different kinds of products, amongst these are toys and furniture (WITS, 2019a). Together with exports of clothing and footwear these are typically the kind of simple low skill manufactured that infant industries in African countries try to produce (Jenkins & Edwards, 2006; Kaplinsky & Morris, 2008). Using these categorizes gives a narrow categorization of exports. Only those types of products that SSA producers usually start producing at the beginning of the industrialization process are used.

We expect the inputs variable to have a positive impact on industrialization. The Chinese exports of consumer goods –finalized goods- will mostly compete with local producers and are therefore expected to have a negative impact. Because manufacturing value added as percentage of GDP is used as a dependent, the values for Chinese exports are also corrected for the size of the SSA economy in question. They are both divided by the GDP of the country in question (WITS, 2019a). This GDP data comes from the World Bank Development Indicators, these data give the value of GDP in million US dollars (WDI, 2019a).

Besides these two indicators for Chinese exports to SSA, there is also an effect of Chinese exports to third markets. The variable *Third* will deal with this effect. For this variable data on Chinese exports of consumer goods to third markets in Northern America and Europe & Central Asia is used. These are the most prominent markets for such consumer goods, SSA producers are most likely to face competition in these markets. These two regions are merged together as one variable for third markets. Using two separate variables for these two markets would create a lot of correlation between these two. These data come from the WITS databank and the same classification of consumer goods is used here as for the data on Chinese exports of consumer goods to SSA. This data

only changes over time and is the same for all countries in the sample as all countries experience similar competition in third markets.

The rest of the variables are control variables. The first one controls for the effects of infrastructure. The variable *elect* is the percentage of people in the SSA countries in the sample who have access to electricity. This indicator comes from the World Bank World Development Indicators (WDI) (WDI, 2019b). Electricity is chosen as an indicator for the effects of infrastructure because of all aspects of infrastructure it has the largest influence on the industrialization process. Transportation has an equally large influence on industrialization but data on the quality of roads and railways is hard to find for Sub Saharan Africa (Newman et al., 2016).

The variable *gov.eff* controls for the effects of the government effectiveness in SSA countries on industrialization. Higher scores of countries on this index should foster industrialization. This data comes from the World Governance Indicators (WGI) database from the World Bank. It tries to estimate how the effectiveness of a government is perceived by its peoples. This quality and effectiveness depends on how effective the civil service operates, how independent a government is from political pressures and the degree in which a government can efficiently formulate and implement its own policies. The data gives the score of each country on the aggregate indicator, the values rage more or less from -2,5 to 2,5 (WGI, 2019).

Table 2.1: Overview of the variables and data sources

Variable	Description	Source	Expected effect
Inputs *inputs*	Chinese exports of intermediate and capital goods to SSA as a percentage of GDP	Comtrade through WITS database & World Development Indicators	Positive
Consumer goods *consumer*	Chinese exports of intermediate and capital goods to SSA as a percentage of GDP	Comtrade through WITS database & World Development Indicators	Negative
Exports to Europe and Northern America *third*	Chinese exports of consumer goods to Europe and Northern America	Comtrade through WITS database & World Development Indicators	Negative
Education Index *Ed.index*	Data from the education index created by the UN, values range between 0 and 1	Global Data Lab & UN Human Development Reports	Positive
Electricity elect	Percentage of people with access to electricity	World Development Indicators	Positive
Government Effectiveness *Gov.eff*	Index on effectiveness of government, includes their performance on Values range approximately between -2,5 and 2,5	World Governance Indicators	Positive

The variable *ed.index* controls for the effect that education levels in SSA countries have on industrialization. It is expected that better education or higher education levels promote industrialization and have a positive effect. The data for this variable comes from the Global Data Lab. The data consists of an education index composed by the UN with the usage of data on expected

and mean years of schooling in these countries. The United Nations uses this index for example to calculate the world development index. Scores on this index range from 0 to 1, with 1 meaning that a country has high levels of years of schooling (Human Development Indices and Indicators, 2018). Table 2.1 gives a summary of all data used.

3.1.2 The alternative data

The data described above will be used is the standard base data, it is however also possible to use different indicators. This will be done to test the robustness of the results. For the data on Chinese exports a different and broader classification will be used; the HS1988 classification based on the stage of production in which the product is traded. This classification consists of the following stages of production; raw materials, intermediate goods, capital goods and consumer goods. The categories intermediate goods and capital goods will be used for the inputs exports variable and the consumer goods category will be used for the consumer goods variable for both Chinese exports to SSA countries and Chinese exports to third markets (WITS, 2019a).

For the control variables for the effects of infrastructure and the political environment of a country, it is also possible to use different data. For infrastructure electricity can be replaced by data on the amount of mobile phone subscriptions per 100 people (*mob)* (WDI, 2019b). The number of mobile subscriptions will be influential for industrialization because landlines and older types of mobile connections are scarce in the region. SSA is expected to go straight from no access telecommunication to the usage mobile telecommunication. Besides, because mobile phones also provide access to Internet they are an important tool for digital bank transactions and other financial services that help facilitate industrialization (Singé, 2018). This indicator comes from the World Bank development indicators.

For the political environment the government effectiveness index can be replaced by another index from the same World Governance Indicators database: the index on political stability in countries (*pol.stab)*. This index again has values ranging approximately from -2,5 to 2,5. It indicates how likely the occurrence of periods of political instability and politically motivated violence in a country are (WGI, 2019).

3.1.3 Sample & Missing values

The estimation initially started with a sample of all Sub Saharan African countries, 29 in total. Data were collected for these countries for the years 1998 till 2017. However, for some of them data for the dependent variable was missing for more than two year. These countries were Burundi, Comoros, Djibouti, Equatorial Guinea, Eritrea, Madagascar, Mali, São Tomé and Principe, Senegal, Somalia, South Sudan and Sudan. These 12 countries were therefore excluded from the final sample. Another issue was the large amount of missing variables for the year 1998, for several indicators data for this year was absent. Therefore this year had to be dropped. In the end, a sample of 36 countries was left. For each of these countries there is data for the years 1999 until 2017. An overview of the countries in the sample can be found in the appendix.

When these countries are removed from the sample, some countries still had missing values. These were dealt with by using the dummy variable adjustment. The missing data was filled up with the average of these countries over time. And the observation where data was missing got a dummy to indicate the missing value, this dummy has the value one if the data for that observation was missing

(Allison, 2001). An overview of the countries that had missing values and how these were dealt with can be found in the appendix. To ensure that this removal of observations and adjustment of missing values did not affect the outcomes the original complete dataset will be used to check the robustness of the outcomes.

3.1.4 Data description

Now that all missing values are dealt with and all data is gathered, an overview of each variable can be made to get a better sense of what this data is like and which models might be suitable for this type of data. There is data for 36 countries, for 19 years. In total there are 684 observations for each variable. A list of all countries in the sample can be found in the appendix. Table 2.2 below gives some summary statistics for each variable. Please note that the values for the two types of exports are so low that none of them is higher than 0,001. To make these values interpretable the statistics for these two exports are multiplied by 1000, this makes it easier to read and report them. The values for the data on exports to third markets is given in Millions for similar reasons.

Table 2.2: Summary statistics

Variable	Mean	Standard deviation	Minimum	Maximum
Manufacturing value added as percentage of GDP	9,985	6,058	0,233	35,215
Chinese exports of Consumer goods	0,0212	0,0522	0,0000143	0,5231
Chinese exports of intermediate and capital goods	0,0093	0,0112	0,000000349	0,0787
Chinese exports of Consumer goods to Europe & North America	158 Million	89,5 Million	30,7 Million	273 Million
Government Effectiveness	-0,637	0,604	-1,884	1,049
Percentage of people with access to electricity	34,573	26,507	0,01	100
Education index	0,427	0,129	0,114	0,729

Besides these summary statistics, there are also histograms for each variable. These can be found in the appendix. These histograms give an indication of how each variable is distributed. When analyzing these, it becomes clear that not all variables are exactly normally distributed. The dependent variable manufacturing value added mostly has low values, no country has more than 40 percent manufacturing value added. There is a peak of observations centered around 5 percent. A small group of observations has higher values, around 35 percent. This indicates that some countries is the sample may have a larger manufacturing sector than the others in the sample. The histogram of the data on the two types of exports from China shows that these observations appear to be non-normally distributed. All values are fairly low and seem to be concentrated on the left, with some extreme values on the right. The export values are very low and none of them is higher than one percent. In the histograms of the three control variables the education index and the government effectiveness indicator both appear to have a normal distribution. The variable access to electricity does not appear to be normally distributed. Most values are concentrated on the left side of the histogram but there is also a cluster of values on the right side of the histogram.

For the two main dependent variables, Chinese exports of inputs and consumer goods to SSA, a scatterplot was made. This shows the correlation between each of these two variables and the dependent variable. In an ideal case it would be expected that these two have a linear correlation, with more exports leading to more or less -depending on the type of exports- manufacturing value added. But as the histograms already indicated, most of the values for the two types of exports are clustered to the left (close to zero). This is also visible in the two scatter plots. The majority of observations has a very low export percentage. It appears that there is no strong correlation, but the plotted line for both suggest that the two types of exports have a slight negative correlation with industrialization. However, there is a small cluster of observations to the right. These all have very low export values but a high amount of manufacturing value added. These observations may be so influential that they create a negative correlation, without them there probably would be a positive correlation. The data on Chinese exports to SSA countries is seems to be truncated to the left. Almost all observations are located to the left –around 0- with only a few observations on the right. This pattern indicates that there might be some sort of selection or grouping of observations. There might be an underlying reason why some observations are low whilst others are higher. A sample selection model can deal with this, this selection of econometric models in this study will take this into account (Breen, 1996).

The histograms discussed earlier showed that some variables had a non-normal distribution. To get more clarification about whether all the variables are normally distributed or not, a test was run. The Shapiro-Wilk Test was run for each of the variables. This test analyzes if a random variable has a normal distribution. The test variable is a W. This test can be used for samples with a N smaller than 2000. The null hypothesis of this test is that the data are normally distributed. The results of this test are reported in the appendix. For each variable the null hypothesis can be rejected (Zorn, 2011). This means that each of the variables is not normally distributed, even though some variables appear to have a normal distribution in their histograms. Normality of variables is not a requirement for running an OLS or a panel regression, the error terms have to be normally distributed (Wooldridge, 2013). So it is still possible to run the model with these non-normally distributed variables. However, to check whether this non-normality matters one of the robustness checks will be to run the same model using the logarithm of the variables. Using the log of a variable can diminish the skewness of the distribution (Wooldridge, 2013)

Another potential problem with this data could be that the control variables or the main dependent variables are correlated. To check if this correlation was present a Vif estimation was mad. None of the variables had a Vif higher than 5 or a Tol below 0,1. This means that none of them suffers from serious correlation. A table with the Vif and Tol values for each variable can be found in the appendix.

A last potential influence could be the effect of influential cases. Some countries or observations have divergent patterns that could significantly influence the outcomes. To find out which values are potentially problematic, two tests statistics were estimated; the Cook's D and the Lever. The Cook’s D test was run to see which observations are influential. Three countries had several outliers, these were Eswatini, Benin, Liberia, Gabon, Lesotho, The democratic republic of the Congo and Togo. Next, a Lever test was done. Several countries had some influential cases, these were Liberia, Benin, Togo, Niger and The Gambia. To control for the potential effect of these observations on the estimation a sample without these influential observations to do a robustness check. This means removing 66

observations from the sample. Because each observation for Eswatini was influential the country was removed entirely from the sample. This makes the sample less balanced, but it is preferred over deleting al observations from each country with outliers because that would have seriously diminished the amount of observations in the regression.

3.2 Econometric models

Now that all data has been gathered and potential issues are discussed it is time to select an econometric model that is most suitable for the data and the purpose of this study.

3.2.1 The panel regression

To analyze the effects of Chinese exports on industrialization in SSA over time a panel regression is used. In the panel regression the focus will be on the effects of different types of Chinese exports on industrialization in different countries in SSA over time. The effects and differences over time rather than the effects between countries are looked at because the main point of interest is whether these effects of Chinese exports have become stronger over time. Whether one country is doing better or worse than another one is not the main focus of this study.

Therefore a fixed effects model will be used to explore the effects of Chinese on manufacturing in SSA countries over time. In this model only the within effects are estimated. These are the effect of Chinese export over time for countries. Another option would be to use the random effects model. This model combines within and between effects in an efficient way. Between effects are the effects of Chinese exports between different countries. This covers the cross-sectional aspect of the panel and looks at differences between countries. Using a random effects model means that you get a sense of both the effects for countries over time and the difference in effects between countries (Verbeek, 2004). Since the between effects are not the main focus of this thesis, the fixed effects model will be used.

Furthermore, using the random effects model means that the data has to meet higher and stricter assumptions. The dependent variables have to be uncorrelated with the fixed effects term α_i and with the error term ε_{it}. It is therefore not always possible to use a random effects model (Verbeek, 2004). A Haussmann test was done to compare the differences in coefficients between the two models. A fixed effects and a random effects model were compared, this gave a probability of 0,3887. This means that both models can be used. But for now the fixed effects model since the focus is on the effects over time and are not interested in the differences between countries.

Three different types of Chinese export will be looked at. Firstly there are exports of capital and intermediate goods to SSA countries. These are expected to have a negative impact. The second type of exports Chinese exports of consumer goods to SSA countries. These are expected to create an increase in competition and have a negative effect. The third and last type of exports are those of consumer goods to Europe and Northern America, these are expected to have similar effects on industrialization in SSA. Both the base data and the alternative data will be used to run the Fixed effect model.

Using the base model data leads to the following estimation:

$$MVA_{it} = \beta_0 + \beta_1 input_{it} + \beta_2 cons._{it} + \beta_3 third_t + \beta_4 elect_{it} + \beta_5 gov.eff_{it} + \beta_6 ed.index_{it} + \alpha_i + \varepsilon_{it}$$

Where i = country and t = year. The α_i is the fixed effects error and ε_{it} is the general error term.

3.2.2 The Heckman selection model

This fixed effects model has some downsides. As the data overview of the export data already indicated, China exports more to some countries than to others. Some countries have a higher percentage of exports than others. It appears that there is a selection bias in two of the major independent variables. This is a problem because this will create correlation between two of the dependent variables (the two types of exports) and the error term. Because of this bias there actually is an extra aspect or variable that explains this bias but that is not included in the model. Because this effect is excluded, the error term will pick up the influence of this omitted variable and start to correlate with the dependent variable. To deal with this a two-step Heckman selection model can be used. This model deals with the selection bias by first estimating the chances of having high amounts of Chinese exports and by then using this estimated probability in the main regression in order to eliminate the correlation between the error term and the dependent variables (Breen, 1996).

To run such as Heckman model, a selection model is estimated. In this first model an extra and new variable that is independent of the main variable (manufacturing value added) is used to predict how this selection bias works (Breen, 1996). This first regression is a logit model that estimates the chances for SSA countries to import low or high amounts of goods from China are estimated. In this way the selection bias can be dealt with. The dependent variable of this model will be a binary variable indicating the probability of a country to be either a high or a low importer. This first model can be used to create the selection bias control factor, the lambda (λ). This is a summary measure that is used to represent the effects of all measures that are not included in the main model but that do influence whether a country imports a lot of Chinese goods or not. This Lambda is added to the second estimation, the model of interest. This model is almost the same as the one used in the fixed effect panel regression. This difference is that the lambda from the first regression will be added to this equation of interest, so that the selection bias is dealt with. The dependent of the first estimation will be used to estimate the effects of different types of Chinese exports on industrialization (Smits, 2003).

3.2.2.1 The Selection model

The first model is also referred to as the selection model, here the probability B_{it} of receiving high or low amounts of exports is estimated.

$$B_{it} = \beta_0 S_i + e_{1it}$$

Where S_i is a selection variable, this is a variable that determines whether a country imports a lot from China or not. This variable influences the amount of exports but is not allowed to influence MVA. The slope of this variable is β_0.

In the first selection regression a selection variable is used to explain the difference in amount of exports. It is know that some countries receive more exports than others and this variable is used to explain this difference. A good selection variable must have an determining impact on the amount of Chinese exports, but is not allowed to influence industrialization. Potential selection variables will be made based on data about the easiness of importing in the SSA countries in the sample. After all, if it is easy to import china will do this more than when it is hard to import in the SSA countries in the sample.

A first option is a binary variable that indicates if a country is landlocked. It is easier for China to export to countries that are not landlocked because the transportation will be easier for these countries. Being landlocked increases the transport and trade costs. Landlocked countries have relatively lower levels of development as result of this. Overall, landlocked countries have higher trade costs which will discourage China to export to them (Faye et al., 2004). Data on landlocked countries comes from the "UN office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States" (UN-OHRLLS, 2017).

Another option is to use an indicator for the administrative costs associated with importing. These are an important determinant for trade flows. Paperwork and other administrative procedures create an additional cost when producers import into a country. Such an increases in trade cost create higher trade barriers between countries (Hornok & Koren, 2015). It is reasonable to assume that China will export more to countries with less waiting time and administrative costs. The Doing Business survey of the World Bank has two indicators for this. The first one is the time it takes to import products into a country, this is data on the amount of hours or days it takes to deal with paperwork on the borders of the importing countries. The World Bank has data on how long it takes to comply with the custom regulations and other regulations that have to be met when importing goods. Another type of data is the time it takes to comply with all the document regulations of the importing country. Besides time, these documentation and custom regulations can also expressed in money. These regulations create a cost to import. Data on these costs are measured in US dollars (WDI, 2019c). When the time or cost increases it will be less attractive to import. This could also explain why some countries import more than others. Both this time and cost will be used to make a distinction between countries with high and low barriers. Based on this data two binary variables will be made: *lowcosts* and *lowtime.* These are 1 when the costs or time it takes to import are high and 0 otherwise. Countries are classified as low costs countries when the average cost for paperwork and customs over time is below 500 US dollar. Countries are classified as low time when the average time it takes to do the paperwork and get past the customs are both below 100 hours. This data comes from the World Bank doing business database. The only downside is that this data is only available for recent years (from 2014 till 2018) so these numbers may not say anything about the administrative costs in the SSA countries in the earlier years of the sample (WDI, 2019c). Another option would have been to use the average time and costs over time per country as a selection variable. Some Heckman models with the average time and costs were estimated, but these did not yield any satisfactory results, in all cases either the Lambda or the outcome of the Wald test was not significant. This meant that the requirements of running a Heckman model were not met.

In order to make this selection regression work, a dependent variable is needed. Countries have been classified as either low or high importers of Chinese goods. Countries are classified as low importers when the average percentage import of both inputs and consumer goods is below 0,00001 percent. This classification is made based on the average per country over time per product category. Of all countries, 14 are classified as high importers and 22 countries are classified as low importers. A list of the low and high export countries can be found in the appendix.

3.2.2.2 Second stage regression

The lambda from the first regression will be used to estimate the main regression:

$$MVA_{it} = \beta_0 + \beta_1\, input_{it} + \beta_2\, cons_{it} + \beta_3\, third_t + \beta_4 elect_{it} + \beta_5 ed.index_{it} + \beta_6 gov.eff_{it} + \beta_7 \lambda_{it} + e_{2it}$$

The coefficients of this regression will give an indication of the effects of the different independent variables on industrialization when a country is likely to receive higher amounts of Chinese exports.

The lambda and the two error terms in these two equations are important in order to determine whether this Heckman model is indeed better than a normal model. The Lambda has to be significant. If this is the case the omitted variables from the fixed effect model (those that cause the selection bias) have indeed an effect on whether a country imports a lot from China or not, and that this probability of high or low export does also influence the eventual effect on industrialization. If the Lambda is not significant a OLS or Fixed effects model would be better. Furthermore the two error terms have to be correlated, this is tested by the Wald test. This tests whether these two errors are independent or not. If the null hypothesis that the two are independent (Rho (ρ) =0) is rejected, the Heckman selection model is warranted (Breen, 1996).

3.3 Robustness checks

To check how robust the results from the Fixed effects and the Heckman model are, a couple of other models are run to see it altercations in data or types of models have a large impact on the outcomes. A first check is running a fixed effects model with the original dataset, this data includes all countries that were initially in the sample and has data for the year 1998 till 2017. The missing values are unchanged in this model. This data is used to see how large the influence of the dummy variable adjustment has been.

A second check is running a normal cross section OLS model, this will provide the between effects of Chinese exports on industrialization in SSA countries. Whilst the initial focus of the study is on within effects, it is interesting to check how the between effects are. Furthermore, the Heckman model can give coefficients that focus on the within effect, but it is also possible that the Heckman model is dominated by the cross-sectional aspects of the dataset. Running an OLS regression can give an indication of how the between effects for the data are, so that a better idea of the kind of coefficients that the Heckman model gives can be made. For this OLS regression the averages per country over time will be used, so that the effects on industrialization between countries can be estimated (Verbeek, 2004). This means that there will be 36 observation, one observation on each variable per country. The time aspect of the data is no longer present in the regression. Because the data on Chinese exports to third markets only changes over time an is the same for each country, STATA omits this effect from the cross sectional regression. The average exports to third countries over time are the same for each country, it therefore cannot be included into a cross sectional regression. This gives the following regression:

$$MVA_i = \beta_0 + \beta_1 input_i + \beta_2 cons._i + \beta_3 elect_i + \beta_4 gov.eff_i + \beta_5 ed.index_i + \varepsilon_i$$

Where i = country and the ε_i is the error term.

A third robustness check focuses on the potential effects of the non-normal distribution of the variables in the regression. As mentioned in the data section, none of the variables is normally distributed. A way of dealing with this is by using the log of all the variables and run a fixed effects and a Heckman model to see if this change in data matters. Using a logarithm can solve the skewness (Wooldridge, 2013). An issue here is that the data on government effectiveness. This data includes negative observations. This creates a problem because it is not possible to take the

logarithm of a negative value. Data on this index ranges from around -2,5 to 2,5. This is easy to deal with, a solution is to simply add three to each observation for this index (so each of the values for this index becomes positive) and then take the logarithm of this altered index. The values for the index are now all positive, but the effect remains the same. Higher scores still indicate a better performance of countries with respect to the effectiveness of their governments. This approach is preferred over the usage of only the log of the positive values for government effectiveness because that would create a large number of missing values which would cause a bias.

A last check is by using the base dataset but without the influential cases. Most of these observations are part of a couple of countries whose exports patterns are different from the rest. To check how influential these outliers in the sample are, a fixed effects and Heckman model without the influential observations is estimated.

3.4 Conclusion

In sum, the available data has its potential issues. But with the correct models and some robustness checks it should be possible to analyze how increases of Chinese exports to Sub Saharan African countries over time have affected industrialization in this region. For the effects over time a fixed effects panel regression will be used. This will give an indication of the effects of Chinese exports and the control variables over time as mentioned in the theoretic framework. The analysis of the data however indicated that not all countries in the sample receive equal amounts of exports, to deal with this a Heckman selection model will be used. This allows to correct for this bias in amount of exports. Other potential issues with the data are the measurement bias that could be present in the type of categorization used for the export data. To ensure that this does not affect the result, an alternative dataset was made. The outcomes of the Heckman and fixed effects models with the base dataset will be compared with those produced when this alternative data is used. Other potential issues are the influences of missing values, non-normality of data, influential observations and the type of model used. The robustness check will deal with these four potential issues. The next chapter will report the outcomes of these regressions.

Chapter 4: Results

Now that the data is all collected and the theoretical methods are discussed, the analysis can be made. Section 1 will give the outcomes of the fixed effects regression and section 2 will give the outcomes of the Heckman model. Section 3 will deal with the robustness checks.

4.1 Fixed effects panel regression

The fixed effects model will provide within estimators that say something about the effects of different types of Chinese exports over time on industrialization in countries in SSA. It is expected that Chinese exports of consumer goods will have a negative impact and Chinese exports that can be used as inputs will have a positive impact over time.

4.1.1 The base data

First the effects of Chinese exports are estimated with the base data, this is done in two steps. First the model with only the three main independent variables and the dummies for their missing values is estimated. Then the entire model is estimated. These results are summarized in the first two columns in the table below, column 1a and 1b. The coefficients for the dummies are not included in this table, these can be found in the full regression table in the appendix. Please note that in all regression tables the effects of third markets are usually given as 0. Third markets do have an effect, however this very small and its zero when the values are rounded up. The actual values can be found in the full regression tables in the appendix.

As shown in table 4.1 below, Chinese exports of inputs do indeed have a strong positive effect on industrialization over time and export of consumer goods have a negative effect. However, these effects are not significant in any of the two regressions. Chinese exports to third markets have a very small but significant negative effect on industrialization. As for the control variables, adding these does not influence the significance of Chinese exports of inputs or consumer goods to SSA countries. It does however alter the impact of the third markets. These become less strongly significant. None of these control variables have a significant effect on industrialization. The constant –which captures the fixed effects per country over time- has a positive effect on industrialization and is highly significant.

4.1.2 The alternative data

The usage of alternative data sources gives some slightly different results. The results of the fixed effects regressions with this data are given in columns 2a and 2b. The effects of Chinese exports of inputs and consumer goods to SSA countries is still not significant. The effect of third markets is still significant in the estimation with the three types of exports. But it now becomes insignificant in the model with the control variables. The usage of political stability instead of government effectiveness has made the indicator for political environment significant. The usage of mobile phone subscriptions has no effect. The coefficient for human capital has remained negative and insignificant. The constant is again positive and significant.

Table 4.1: Fixed effects regression

Variables:	1a Fixed effects: Main dependent variables	1b. Fixed effects: Complete model	2a Fixed effects Main dependent variables	2b Fixed effects: Complete model
Inputs	27 842,52 (1,60)	16 075,9 (0,92)	615,1847 (0,51)	-25,58636 (-0,02)
Consumer goods	-6 002,625 (-1,43)	-6 546,677 (-1,56)	-2 187,11 (-0,47)	-3 931 (-0,86)
Exports to third markets	-0,000**** (-6,44)	-0,000 * (1,84)	-0,000 **** (-6,38)	-0,000 (-0,91)
Constant	11,189**** (60,19)	13,084**** (6,69)	11,205**** (59,33)	12,100**** (8,32)
Control variables:				
Political environment		0,0249 (0,05)		0,853*** (3,39)
Human capital		-8,075 (-1,60)		-7,577 (-1,59)
Infrastructure		0,033 (1,47)		0,0003 (0,06)
Number of observations	684	684	684	684
Number of groups	36	36	36	36

The t-statistics are given in parentheses

P < 0,10 = *, P<0,05 = **, P<0,01 = ***, P<0,001 = ****

4.2. The Heckman selection model

The results of the fixed effects model have not been in accordance with was was expected beforehand. An explanation for this lack of results could be the selection bias in the sample. Running a Heckman selection model can solve these issues and provide better results, this model deals with these differences in the amount of Chinese exports to different SSA countries. The Heckman coefficients are not within effects such as in the fixed effects model. The coefficient could be both a within coefficient or a between coefficients. A combination of these two is also possible. Such a model consists of two regressions, a selection regression and an equation of interest. Three different selection variables are used. The first two are the time and costs of importing. It assumed that China exports more to countries that have a low time or costs to import. The last selection variable is landlocked.

4.2.1 The base data

Firstly the base data will be used to run the Heckman estimation. This means that the data on Chinese inputs will be data on Chinese exports of Machinery. For the consumer goods variable data

from the Footwear, Textile & Clothing and Miscellaneous classifications will be used. The results of this regression are summarized in table 4.2 below, the table gives the outcomes for the Heckman model with the three different types of selection variables. The first regression that uses low time to import for the selection variable already runs into problems. Although the Lambda in this regression is significant, the outcome of the Wald test is not significant. This indicates that it cannot be said with certainty that the two error terms of the selection equation and the equation of interest are correlated. This is a requirement to run the Heckman model. Because this is not met the results from this regression cannot be used. For the other two regressions the Lambda's are both significant, and in both cases the Wald test gives a significant result.

4.2.1.1 Low costs

The Heckman regression with low costs as selection variable does have a significant lambda of -15, that is significant at the 0,01 level. This lambda indicated that the unobserved aspects that influence whether the Chinese will export a lot or not are negative. Meaning that there are unobserved effects that influence this decision by the Chinese. The selection variable low costs has a small but positive effect on the Chinese decision of whether to export a lot or not. Electricity is also part of the selection equation, as it makes sense that China will export more to countries that have better infrastructure facilities. It has a small positive effect that is only significant at the 0,10 level.

The equation of interest gives a significant result for the effects of both Chinese exports of inputs and consumer goods on industrialization. However, the coefficients are the opposite of what was expected. Chinese exports of inputs to SSA countries have a strong negative impact whilst exports of consumer goods have a strong positive impact, both are significant. Exports to third markets do not have a significant impact. Of all the control variables, government effectiveness is the most significant. It has a negative impact on industrialization, contrary to what would be expected. Electricity has a small but significant (at 0,10) impact on industrialization. The effect of education is not significant .

4.2.1.2 Landlocked

The Heckman model with landlocked as selection variable gives similar result. The lambda from this model is significant at the 0,001 level. It is again negative, but now the coefficient is only -5,32. This indicates that the omitted variables from the equation of interest that influence whether China will exports or not have a negative effect on industrialization. Again the two types of Chinese exports are highly significant. Exports of machinery has a negative influence whilst the exports of consumer goods have a positive influence. Indicating that when the probability for a country to receive more exports from China increases, that inputs will have a negative impact and consumer goods will have a positive impact. Export to third markets have small negative coefficient that is significant at the 0,10 level. All control variables are significant. Education and electricity both have a positive influence on industrialization, government effectiveness has a negative impact.

What is the most puzzling of all these results is the fact that the exports of inputs and consumer goods have the opposite effect of what was expected. In these three first Heckman models the more restrictive categories of Chinese exports from the base model were used. Consumer goods in this instance, are Chinese exports of textiles & clothing, footwear and the category miscellaneous. The

Table 4.2: Heckman estimations

	3a. Manufacturing Value added (Equation of interest)	3b. Probability of importing from China Selection variable = low time	4a. Manufacturing Value added (Equation of interest)	4b. Probability of importing from China Selection variable = low costs	5a. Manufacturing value added (Equation of interest)	5b Probability of importing from China Selection variable = landlocked
Inputs	-345 245,1 (-1,20)		-423 437,4*** (-2,68)		-505 031,7**** (-5,57)	
Consumer goods	99 685,45 (0,30)		375 608,9** (2,04)		491 626**** (4,60)	
Exports to third markets	-0,000 (-0,07)		-0,000 (-0,77)		-0,000* (1,81)	
Selection variable:		-0,436**** (-3,99)		0,548**** (5,38)		1,468**** (11,42)
Control variables:						
Political environment	-6,283*** (-2,82)		-4,937**** (-4,37)		-4,784**** (-7,15)	
Human capital	11,140 (1,01)		7,654 (1,19)		14,275**** (4,08)	
Infrastructure	0,153** (2,01)	0,007**** (3,61)	0,059* (1,82)	0,004* (1,94)	0,057*** (3,45)	0,016**** (7,16)
Constant	-19,732* (-1,72)	0,194** (2,37)	12,238*** (2,76)	-0,059 (-0,68)	3,487** (2,15)	-0,731**** (-6,49)
Lambda	27,552** (2,00)		-15,272*** (-3,10)		-5,329**** (-4,59)	
Wald test of independence (Rho = 0)		Wald Chi2 (12) = 13,86 Prob > Chi2 = 0,3096		Wald Chi2 (12) = 32 Prob > Chi2 = 0,0014		Wald Chi2 (12) = 119,12 Prob > Chi2 = 0,000
Number of observations		Observations: 684 Selected: 418 Non selected: 266		Observations: 684 Selected: 418 Non selected: 266		Observations: 684 Selected: 418 Non selected: 266

The z-values are given in parentheses

P < 0,10 = *, P<0,05 = **, P<0,01 = ***, P<0,001 = ****

category inputs, in this instance only consist of exports of electrical machinery and equipment. This odd result could of course be caused by a measurement bias and the wrong categorizations have been selected. Perhaps a change of categorization could explain these odd outcomes. After all, if the broader categories are used maybe this influence is not visible?

4.2.2 The alternative data

To see how the Heckman results are when other export categories are used, the alternative data is also used. For the fixed effects model this did not have a large impact. But it can still be interesting to see what the effects are when a different type of categorization of Chinese exports is used. Because the selection variables low time and landlocked do not give a model with a significant Lambda, the focus will be on the Heckman models low costs as the selection variable. The results of this regression are in the table 4.3 below.

Table 4.3: Heckman estimations with the alternative data

	6a. Manufacturing Value added (Equation of interest)	**6b. Probability of importing from China Selection variable = low costs**
Inputs	-30 139,43 (-0,56)	
Consumer goods	-130 714,5* (1,84)	
Exports to third markets	-0,000 (-1,05)	
Selection variable:		0,569**** (5,57)
Control variables:		
Political environment	-1,778**** (-4,60)	
Human capital	17,017**** (5,40)	
Infrastructure	0,011 (0,73)	-0,001 (-0,55)
Constant	8,450**** (3,75)	0,085 (1,09)
Lambda	-7,768*** (-3,15)	
Wald test of independence (Rho = 0)	Wald Chi2 (12) = 68,37 Prob > Chi2 = 0,0000	
Number of observations	Observations: 684 Selected: 418 Non selected: 266	

The z-values are given in parentheses

P < 0,10 = *, P<0,05 = **, P<0,01 = ***, P<0,001 = ****

This alternative Heckman model indicates that both types of Chinese exports to SSA countries have a negative impact, thought the impact of consumer goods is stronger than the impact of inputs. Both these two are not as significant as in the previous Heckman models. The effect of inputs is not significant and consumer goods is only significant at a 0,10 level. Both education and political stability

now have a strong significant influence, mobile phone subscription has a small impact that is not significant. The political environment again has a negative impact and infrastructure and human capital again positively affect industrialization. Changing the types of exports thus matters, when using a very broad categorization of inputs this indicator is no longer significant. And consumer goods, which first had a positive coefficient now has a negative influence and is only slightly significant.

4.3.Robustness checks

To see if running different types of model or using a different kind of data make a difference for the results found earlier, a couple of alternative models were estimated. The regression tables for these regressions can be found in the appendix, their outcomes are only summarized by text in this section.

4.3.1 The original dataset

A first way to check the robustness of the result is by using the dataset with data on all countries for all years. The means using a dataset with 49 countries in total and data for the years 1998 till 2017. The base and the alternative data are both used for this, but only the fixed effect regression is estimated. Using this dataset does not seem to provide very different outcomes. The coefficients for the effects of Chinese exports of inputs and consumer goods are still not significant with both the base and the alternative data. The education index has now become significant, although this is only at the 0,10 level. The government effectiveness coefficient when using the base data has also become significant. The significance of the infrastructure coefficient has not changed at all.

4.3.2 The OLS cross section regression

The OLS regression provides between coefficients. These will differ from those of the fixed effects model because they give the effects of Chinese exports per country discarding the time effects. These between and within effects focus on different aspects of the sample (Verbeek, 2004). The Heckman model can be either one of these two or a combination of between and within effects. Running this OLS model should help to identify which of these two effects is dominant in the Heckman model. It also provides a check to see how influential the between effects of Chinese export are. In the cross sectional regression, the effects of machinery on industrialization are negative whilst the effects of consumer goods are positive. None of these two export types however has a significant effect. None of the control variables is significant either. Only the effects of Chinese exports to third markets is significant in the model without the control variables. It seems that the between coefficients are as useful as the within coefficients. Neither the cross-sectional nor the fixed effects regression provides significant results These outcomes do suggest that the Heckman model might indeed have coefficients that are mostly focusing on the between effects since the coefficients for the two types of Chinese exports have the same signs in the cross-section model as in the Heckman model.

4.3.3 The log model

As mentioned in the data description, none of the variables used in the Fixed effects and Heckman regressions has a normal distribution. Although this is not a requirement for running a panel regression, it can have an influence. Therefore these two models were estimated using the logarithm of the variables. Using a logarithm transforms the distribution of a variable and can make this distribution normal (Wooldridge, 2012). In this instance only the base data is used, not the

alternative dataset. The coefficients of these models are of course different, these are the percentage change when each of the variables is increased (Wooldridge, 2012). Altering the variables does have a slight impact for the fixed effects model. Both types of exports now have a positive impact on industrialization. And the effect of consumer goods is significant at 0,10. The effects of Chinese exports to third markets remain negative and significant. Of the control variables, only government effectiveness is now significant at 0,10. The other two are not significant, just like the fixed effects estimation. The effects of the Heckman model are barley affected by the transformation into logarithms. Effects of Chinese exports to SSA countries are again very significant, the same is true for the control variables and the Lambda. The question now remains of whether the non-normal distribution of the variables had an impact. For the Heckman model it clearly did not matter. For the Fixed effects regression it did alter the signs of the coefficients for Chinese exports. But only one of the two was significant, and only at the 0,10 level.

4.3.4 The dataset without outliers

The last alternative check looks at how influential the outliers in the sample are. Does removing these observations alter the results? For the fixed effects model, the outcomes are almost identical. Leaving these observations out makes the coefficient for exports of machinery positive and the coefficient for exports of consumer goods negative but neither of them is significant. Exports to third markets again have a negative and significant influence, this effect did not change. The coefficient for the effects of electricity access becomes significant at the 0,10 level, but apart from that there are no notable changes. The Heckman model for this sample without outliers only gave a significant Lambda & a significant Wald test result for the selection variable low costs. In this model, the coefficient for exports of machinery is still negative but no longer significant. The coefficients for exports of consumer goods and the control variables remain significant. The coefficient for exports to third markets has now also become significant. The largest change for the Heckman model seems to be the insignificance of machinery exports.

4.4 Conclusion

This chapter has shown that the fixed effects regression did not have the outcomes that were initially expected. The Heckman model did provide some interesting outcomes that were also significant. But these outcomes of come coefficients were the opposite of what was hypothesized in Chapter 2. Exports of machinery -inputs- have a negative influence on industrialization whilst exports of consumer goods have a positive impact. Besides this, the coefficient for the political environment was negative and significant. Indicating that in the Heckman model a better or more stable political environment does not positively affect industrialization. The robustness checks have shown that the usage of the full model did not affect the outcomes of the fixed effects estimation. Running OLS did not give significant results, but it does provide a strong indication that the Heckman model might be dominated by between effects rather than within effects. The last two checks mostly provided similar results to those of the original models. The fixed effects log model had different coefficients for the two types of exports and in the Heckman model without outliers the coefficient for machinery exports became insignificant. The next chapter will discuss these outcomes further and will look at potential ways of doing further research.

Chapter 5: Conclusion & discussion

In this study the effects of different types of Chinese exports of industrialization in Sub Saharan Africa have been analyzed. In the recent two decades the intensity of the economic relations between China and Africa have intensified. This has created a debate about the potential consequences of these relations for development in the African continent. This thesis aims to contribute to this by focusing on the effects of trade on industrialization, a process that is vital for economic development. At the start of this study it was hypothesized that the increase in trade relations could have both negative and positive effects. Now that the outcomes of the different models have been reported it is time to discuss these and to make some tentative conclusions. The different models used will help draw some cautious conclusions. This chapter will start with a short conclusion on the outcomes. These then will be further discussed and the chapter will end with a mention of the limitation of this study and a several recommendations for further research.

5.1 Conclusion

The results of the fixed effects regression suggest that the increase of Chinese exports to Sub Saharan African countries has not affected industrialization over time. However, it may be too early to draw any conclusions on this matter. Industrialization after all is a far-reaching change within an economies, it is a structural change of the economy. Such processes take time, perhaps within ten or fifteen years an effect is visible. But interestingly the Chinese competition on third markets did have a significant influence. This negatively affected the industrialization process, this could be a sign that the industries that exist in in the region are mainly focusing on markets abroad rather than markets at home.

After the fixed effect model a Heckman model was run to deal with some of the issues in the sample. But unlike the Fixed effects model it does not focus on the effects over time. The outcomes of this model are most likely a combination of between and within effects, this difference in coefficients probably explains why this model gave different outcomes that the Fixed effects regression. However, because the model provides coefficients that mix within and between effects, it is harder to correctly interpret the results. The Heckman model did give significant results for the main independent variables, but not for all selection variables. Clearly the selection bias matters for the effect that exports have on industrialization. The outcomes indicated that exports of consumer goods to SSA have a positive effect and those of machinery have a negative effect on industrialization. The effects of third markets are no longer significant. These outcomes are exactly the opposite of those from the fixed effects model. The three control variables all have a significant influence on industrialization. Whilst human capital and infrastructure have a positive impact, the coefficient for the political environment is negative. It seems that those countries with a higher amount of exports are those where consumer goods have positive effect and inputs a negative effect. And apparently the political environment has a negative impact on industrialization in countries with higher exports. This negative effect of the political environment is not a large surprise. Multiple scholars in the field have suggested that China tends to do business and trade with rouge donors. China is known for its willingness to do business with questionable regimes because unlike Western partners they usually do not have any requirement regarding the political environment in a country (Eisenman, 2012). The effects of Chinese exports of consumer goods and inputs raise more questions, how is it possible that in high export countries inputs have a negative effect on industrialization whilst consumer goods appear to contribute to industrialization?

5.2 Discussion

Whilst it is clear that there are no effects of the Chinese exports to Sub Saharan African countries on industrialization over time, the Heckman model does indicate that these two have a significant impact. The difference in type of coefficients of these two models can help explain the difference in outcomes. The Heckman model gives a significant outcome because there is an effect between countries and because the selection bias in the sample apparently matters. Countries differ in the amount of exports from China. This differentiation of intensity of exports appears to determine the effects of these exports. The effects of exports are different for high export countries than for low export countries. Those countries where more exports go to are also the ones where consumer goods have a positive effect and capital goods a negative effect.

To understand why these effects occur, it is required to know why some countries have a higher amount of exports than others. A potential theory could be that the countries with high exports also have a higher GDP, after all a higher GDP means a larger market and more potential demand. Usually such countries have a higher manufacturing value added. It can be argued that China exports more consumer goods and less machinery to these countries, because it is more likely that there is a demand for consumer goods. This would explain the signs of these two types of exports.

But some calculations with the data suggest otherwise, though high GDP is indeed correlated with high amounts of Manufacturing value added, the two export types are both very weakly and negatively correlated with GDP. However, when the absolute export values are used there suddenly is strong correlation between exports and GDP. What matters here is that the regressions all use the relative amount of exports, the value for exports is divided by the GDP of each country to control for the difference in size of the economies in the sample. An overview of the data shows that this may have biased the countries with a smaller GDP, these have a relatively high amount of exports to GDP. Countries with high absolute values of exports such as South Africa and Nigeria have low relative values of exports because their GDP is much larger. This means that overall the countries that are classified as high export countries do indeed have a high amount of relative exports, but their GDP is generally smaller. Those high export countries are not necessarily the ones with a high absolute export value. And because their GDP overall is lower, their MVA is also not very high.

Perhaps those countries classified as high export countries are also those that are not much concerned with industrialization. This study has assumed that all countries in the sample are starting to industrialize and that all countries are equally interested in changing the structure of their economies. But it could well be that some countries in the sample are more concerned with industrialization than others. The countries with a high amount of relative exports may not be focused on industrialization or perhaps have not started with it. It could be that they import consumer goods from China instead of making their own goods, this would explain the positive effect of those goods. And less machinery goes to these countries because they do not require them for industrialization. This is all speculation of course, but such theories could provide interesting research questions for future research. It is clear that there is a difference between countries and that a further analysis of the characteristics of these countries could help explain the effects of Chinese exports on industrialization in these countries.

5.4 Limitations and potential for future research

Thought this study has given some new insights on how Chinese trade affects industrialization in SSA, there are also limitations. Firstly there is the robustness of the results. In general the outcomes appear to be more or less robust, but there still are some weaknesses. The methodological section mentioned several issues that might affect the outcomes. The first one was the measurement bias, the usage of the alternative data did not affect the outcomes of the Fixed effects model. The Heckman model was slightly altered, the coefficients for the two exports became negative. But only the effect of consumer goods was significant. Another potential issue was the non-normal distribution of the variables. This did not affect the Heckman model, in the Fixed effects model the coefficient for consumer goods became positive and significant. However, only at 0,10. A last issue was the impact that influential cases could have, this did not matter for the results of the Fixed effects model. But for the Heckman model it did, the effect of machinery exports became insignificant. This is worrying because the Heckman model makes a distinction between high and low export countries. Perhaps those outliers are mostly concentrated amongst either the high export or the low export countries. This could have affected the outcomes and makes them weaker.

Despite all of this this study has made it clear that there are not yet any effect of Chinese exports on industrialization over time visible. The robustness checks of the Fixed effects model do not give an indication to doubt this. Future research could repeat the fixed effect approach after more time has passed to find out if there are any lagged effects on industrialization.

This study has furthermore provided evidence that the selection of countries matters for the type of effect that trade has. This overall seems to be a robust outcomes as well. However, the effects of influential cases may have affected the outcomes. Future research could focus on the differences between countries with high export values and countries with low export values. Getting a better picture of the motivations for China to export to countries in these region would help to understand the difference in effects of Chinese exports. It would be also interesting to put more emphasis on the differences in GDP and structure of economy of these countries and look into how this is related to the effects that Chinese exports have on industrialization.

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Appendix

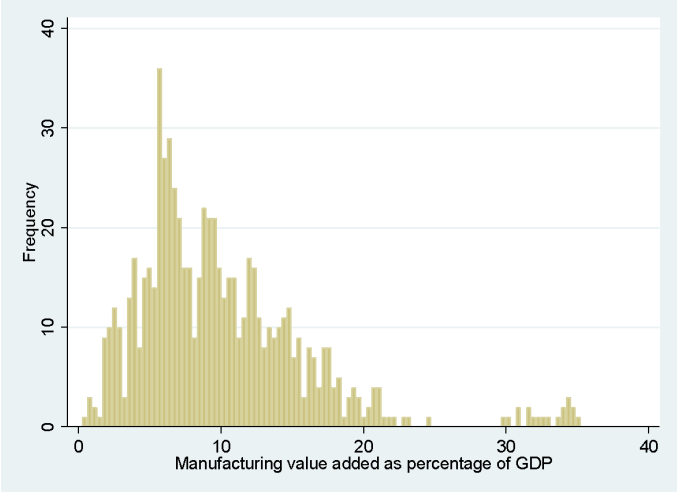
A. Missing values adjustments

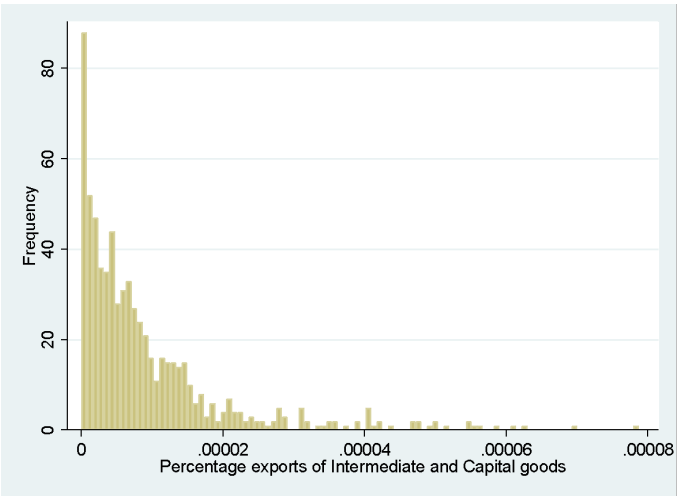
After the countries with large amounts of missing values for MVA were removed from the sample, only the Central African Republic and Mauritania had missing variables for MVA. But here only data for two years is missing. Some dependent variables also have missing. Access to electricity is available for most years, however the data for 2017 is not available for most countries. The average of the previous years is used as an indicator for 2017, combined with a missing value dummy. Data for the education index is available for the majority of the remaining countries. Only for the Seychelles is the data for this index missing for all years in the Global Data lab. Thankfully, the UN itself also has data available for this education index. The Global data lab was selected as the main source for the education index data because this data is easier to access and download. But the data on the UN site is exactly the same, therefore the data for the Seychelles was downloaded from the UN site and added to the Global Data lab data. After this adjustment. Data on the education index for Burkina Faso, Chad, Cabo Verde, Ethiopia, Guinea-Bissau, Nigeria and the Seychelles for several years is missing. These were dealt with these missing years by using the average of available data of the education index for these countries and add a dummy (Allison, 2001). The data on the government effectiveness index only have missing values for the years 1999 and 2001. This is deals with by using the average of the year before and the year after as a proxi.

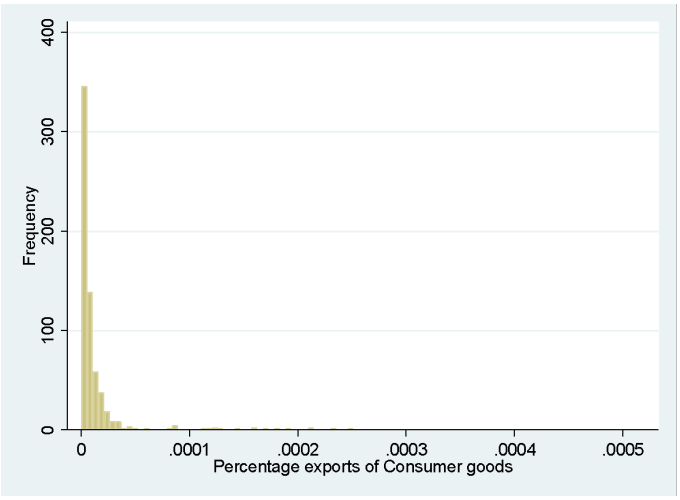
B. The sample

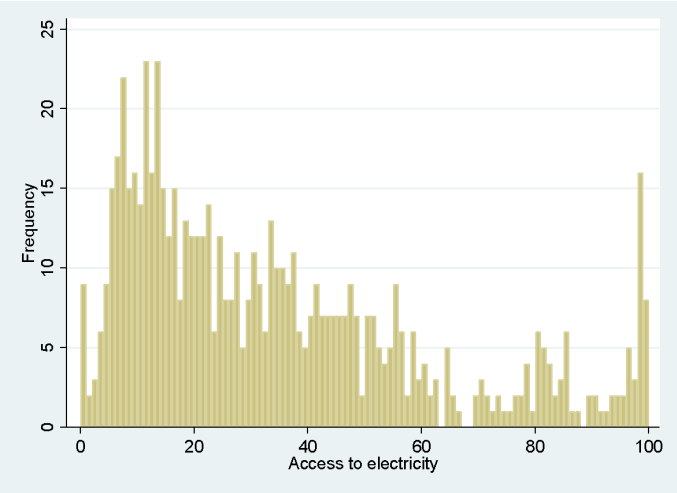
1 Angola	20 Malawi
2 Benin	21 Mauritania
3 Botswana	22 Mauritius
4 Burkina Faso	23 Mozambique
5 Cabo Verde	24 Namibia
6 Cameroon	25 Niger
7 Central African Republic	26 Nigeria
8 Chad	27 Rwanda
9 Congo, Dem. Rep.	28 Seychelles
10 Congo, Rep	29 Sierra Leone
11 Côte d'Ivoire	30 South Africa
12 Ethiopia	31 Swaziland
13 Gabon	32 Tanzania
14 Gambia, The	33 Togo
15 Ghana	34 Uganda
16 Guinea	35 Zambia
17 Kenya	36 Zimbabwe
18 Lesotho	
19 Liberia	

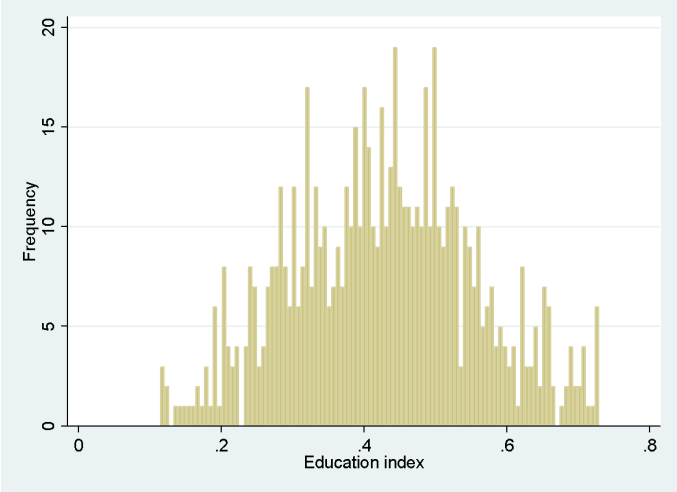
C. Histograms

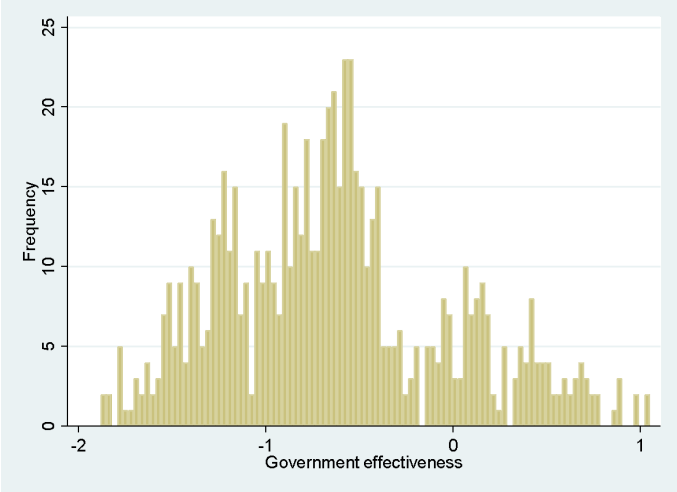




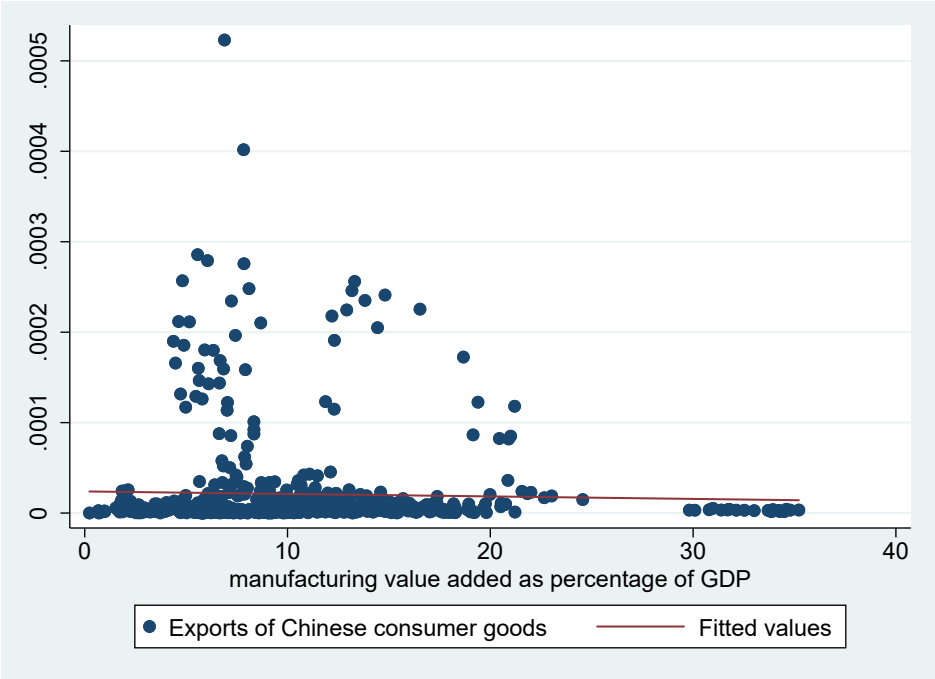


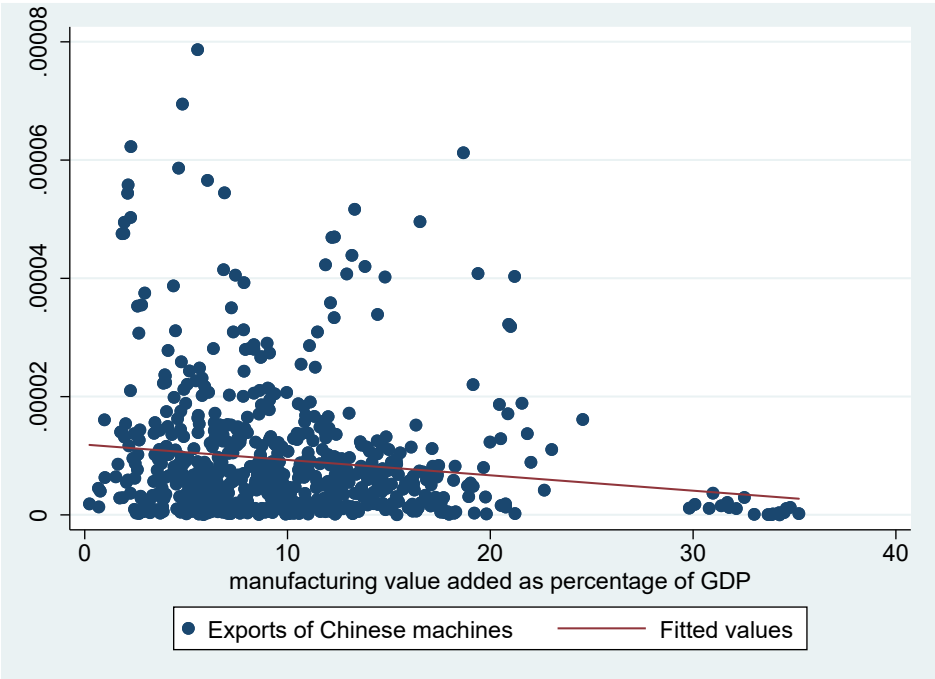






D. Scatter plots





E. Outcomes of the Shapiro-Wilk Test & Vif and Tol values

Variable	Observations	W	V	Z	Probability > z
MVA	684	0,881	53,165	9,684	0,0000
Inputs	684	0,725	122,610	11,721	0,0000
Consumer goods	684	0,406	256,228	13,601	0,0000
Third markets	684	0,902	43,641	9,203	0,0000
Government effectiveness	684	0,975	11,124	5,872	0,0000
Electricity	684	0,995	2,386	2,120	0,0170

Education index	684	0,892	48,012	9,436	0,0000

	Vif	**Tol**
Inputs	2,49	0,402
Education	2,43	0,412
Electricity	2,31	0,233
Consumer goods	2,09	0,479
Third markets	1,93	0,519
Government effectiveness	1,65	0,605

F. Results of the fixed effects estimation

Variables: 1: Base data	1a Fixed effects: Main dependent variables	1b. Fixed effects: Complete model	Variables: 2: Alternative data	2a Fixed effects Main dependent variables	2b Fixed effects: Complete model
Exports of inputs: Machinery	27 842,52 (1,60)	16 075,9 (0,92)	Exports of inputs: Capital & intermediate goods	615,1847 (0,51)	-25,58636 (-0,02)
Exports of consumer goods: exports of footwear, textile & clothing and miscellaneous	-6 002,625 (-1,43)	-6 546,677 (-1,56)	Exports of consumer goods	-2 187,11 (-0,47)	-3 931 (-0,86)
Exports to Europe & North America	-8,43 e-09**** (-6,44)	-5,37 e-09* (1,84)	Exports to Europe & North America	-4,94 e-09**** (-6,38)	-2,03 e-09 (-0,91)
Constant	11,18986**** (60,19)	13,08378**** (6,69)	Constant	11,20532**** (59,33)	12,1004**** (8,32)
Control variables:			Control variables:		
Political environment: Government effectiveness		0,0249446 (0,05)	Political environment: Political Stability		0,8528049*** (3,39)
Human capital: Education index		-8,075429 (-1,60)	Human capital: Education index		-7,576627 (-1,59)
Infrastructure: Electricity		0,03277591 (1,47)	Infrastructure: Mobile phone subscriptions		0,0003527 (0,06)
Dummies for the missing values:			Dummies for the missing values:		
MVA missing	0,9615266 (1,01)	0,9243438 (0,96)	MVA missing	1,163727 (1,21)	1,36446 (1,45)

Inputs	2,272898 (1,56)	1,345089 (0,90)	Inputs	2,883249* (1,70)	1,081937 (0,64)
Consumer goods	-4,358377*** (-2,80)	-2,980869* (-1,90)	Consumer goods	-5,972879*** (-2,99)	-3,731886* (-1,88)
Government effectiveness		-0,2719207 (-0,79)	Political stability		-0,12114118 (-0,35)
Education index		4,306429**** (5,31)	Education index		3,936477**** (4,83)
Electricity		0,24112 (0,53)	Mobile phone subscriptions		0,5536933 (0,45)
Number of observations Number of groups	684 36	684 36		684 36	684 36

The t-statistics are given in parentheses

P < 0,10 = *, P<0,05 = **, P<0,01 = ***, P<0,001 = ****

G. Results of the Heckman Selection model

	3a. Manufacturing Value added (Equation of interest)	3b. Probability of importing from China Selection variable = low time	4a. Manufacturing Value added (Equation of interest)	4b. Probability of importing from China Selection variable = low costs	5a. Manufacturing value added (Equation of interest)	5b Probability of importing from China Selection variable = landlocked
Exports of inputs: Machinery	-345 245,1 (-1,20)		-423 437,4*** (-2,68)		-505 031,7**** (-5,57)	
Exports of consumer goods: exports of footwear, textile & clothing and miscellaneous	99 685,45 (0,30)		375 608,9** (2,04)		491 626**** (4,60)	

Exports to Europe & North America	-1,15 e-09 (-0,07)		-6,71 e-09 (-0,77)		-9,43 e-09* (1,81)	
Selection variable:		-0,4360545**** (-3,99)		0,5478724**** (5,38)		1,468339**** (11,42)
Control variables:						
Political environment: Government effectiveness	-6,28314*** (-2,82)		-4,936563**** (-4,37)		-4,784188**** (-7,15)	
Human capital: Education index	11,14069 (1,01)		7,654331 (1,19)		14,27565**** (4,08)	
Infrastructure: Electricity	0,1532951** (2,01)	0,007272**** (3,61)	0,0599959* (1,82)	0,0036295* (1,94)	0,0567011*** (3,45)	0,0156364**** (7,16)
Constant	-19,7319* (-1,72)	0,194124** (2,37)	12,23847*** (2,76)	-0,0591652 (-0,68)	3,486602** (2,15)	-0,731318**** (-6,49)
Dummies:						
MVA	-6,965432 (-0,64)		-3,455783 (-0,61)		-6,557908* (-1,81)	
Inputs	4,192782 (0,37)		5,661404 (-0,96)		4,543305 (1,22)	
Consumer goods	-1,090353 (-0,09)		-0,6078761 (-0,09)		-0,0006398 (-0,00)	
Government effectiveness	0,0057646 (0,00)		-0,1685168 (-0,09)		-0,1419191 (-0,13)	
Education index	2,947393 (0,72)		2,318157 (0,76)		2,654632 (1,55)	
Electricity	0,7159933 (0,16)		0,8204512 (0,34)		1,005355 (0,73)	
Lambda	27,5523** (2,00)		-15,2717*** (-3,10)		-5,328888**** (-4,59)	
Wald test of independence (Rho = 0)	Rho = 1 (estimate of Rho was 1,2910304, is being truncated into 1) Wald Chi2 (12) = 13,86 Prob > Chi2 = 0,3096		Rho = -1.0000 (estimate of Rho was -1.2074138, is being truncated into 1) Wald Chi2 (12) = 32 Prob > Chi2 = 0,0014		Rho = -0,77598 Wald Chi2 (12) = 119,12 Prob > Chi2 = 0,000	
Number of observations	Observations: 684 Selected: 418		Observations: 684 Selected: 418		Observations: 684 Selected: 418	

	Non selected: 266	Non selected: 266	Non selected: 266

The z-values are given in parentheses

P < 0,10 = *, P<0,05 = **, P<0,01 = ***, P<0,001 = ****

H. Heckman model with alternative variables

	6a. Manufacturing Value added (Equation of interest)	6b. Probability of importing from China Selection variable = low costs
Exports of inputs: Capital & intermediate goods	-30 139,43 (-0,56)	
Exports of consumer goods	-130 714,5* (1,84)	
Exports to Europe & North America	-4,54 e-09 (-1,05)	
Selection variable:		0,5696469**** (5,57)
Control variables:		
Political environment: Political stability	-1,778115**** (-4,60)	
Human capital: Education index	17,01748**** (5,40)	
Infrastructure: Mobile phone subscriptions	0,0111098 (0,73)	-0,000658 (-0,55)
Constant	8,450457**** (3,75)	0,085169 (1,09)
MVA	-3,5075511 (-1,03)	
Capital & Intermediate goods	11,99063*** (2,68)	
Consumer goods	-7,133724 (-1,23)	
Political stability	-0,8818473 (-0,75)	

Education index	2,334409 (1,28)	
Mobile phone subscriptions	-4,530795 (-1,35)	
Lambda	-7,768835*** (-3,15)	
Wald test of independence (Rho = 0)	Rho = -0,93069 Wald Chi2 (12) = 68,37 Prob > Chi2 = 0,0000	
Number of observations	Observations: 684 Selected: 418 Non selected: 266	

The z-values are given in parentheses

P < 0,10 = *, P<0,05 = **, P<0,01 = ***, P<0,001 = ****

I. Robustness Check I: Results of the full model with the missing variables

Variables: 7: Base model	7a Fixed effects: Main dependent variables	7b. Fixed effects: Complete model	Variables: 8: Altered model	8a Fixed effects Main dependent variables	8b Fixed effects: Complete model
Exports of inputs: Machinery	17 281,6 (1,20)	8 563,192 (0,62)	Exports of inputs: Capital & intermediate goods	612,9335 (0,52)	101,3157 (0,09)
Exports of consumer goods: exports of footwear, textile & clothing and miscellaneous	-5 363,106 (-1,33)	-5 957,319 (-1,45)	Exports of consumer goods	-2 457,581 (-0,57)	-4517,032 (-1,11)
Exports to Europe & North America	-7,31 e-09**** (-6,18)	-1,01 e-09 (1,84)	Exports to Europe & North America	-4,54 e-09**** (-6,24)	-1,79 e-09 (-0,83)
Constant	11,26718**** (63,09)	14,2752**** (7,31)	Constant	11,27645**** (61,97)	14,34219**** (8,52)
Control variables:			Control variables:		

Political environment: Government effectiveness		0,186251 (0,34)	Political environment: Political Stability		0,5457344** (2,12)
Human capital: Education index		-9,248653* (-1,76)	Human capital: Education index		-8,46956* (-1,75)
Infrastructure: Electricity		0,0018985 (0,09)	Infrastructure: Mobile phone subscriptions		0,0051997 (0,06)
Number of observations Number of groups	757 44	620 43		755 44	651 43

The t-statistics are given in parentheses

P < 0,10 = *, P<0,05 = **, P<0,01 = ***, P<0,001 = ****

J. Robustness Check II: OLS: Cross section regression

Variables: 9: Base data	9a OLS: Main dependent variables	9b. OLS: Complete model
Exports of inputs: Machinery	-254 251,3 (-1,36)	-219 892,7 (-1,13)
Exports of consumer goods: exports of footwear, textile & clothing and miscellaneous	35 727,51 (1,04)	33 114,57 (0,94)
Constant	11,59171**** (7,46)	5,524702 (1,06)
Control variables:		
Political environment: Government effectiveness		-0,3575855 (-0,17)
Human capital: Education index		11,35727 (3,54)

Infrastructure: Electricity		0,0210039 (0,37)
R^2 R^2 Adjusted	0.0534 -0,0040	0,1428 -0,0000
Number of observations	36	36

The t-statistics are given in parentheses

P < 0,10 = *, P<0,05 = **, P<0,01 = ***, P<0,001 = ****

K. Robustness Check III: fixed effects and Heckman with log variables

Variables:	10a Fixed effects: Main dependent variables	10b. Fixed effects: Complete model	Variables: 11: Heckman model	11a. Manufacturing Value added (Equation of interest)	11b. Probability of importing from China Selection variable = low costs	12a Manufacturing value added (Equation of interest)	12b Probability of importing from China Selection variable = landlocked
Exports of inputs: Machinery	0,015 (0,78)	0,011 (0,61)	Exports of inputs: Machinery	-0,172*** (-3,08)		-0,189**** (-5,80)	
Exports of consumer goods: exports of footwear, textile & clothing and miscellaneous	0,043* (1,90)	0,043* (1,88)	Exports of consumer goods: exports of footwear, textile & clothing and miscellaneous	0,145** (2,46)		0,179**** (5,07)	
Exports to Europe & North America	-0,125**** (-4,26)	-0,091** (-2,17)	Exports to Europe & North America	-0,045 (-0,40)		-0,086 (-1,27)	
Constant	5,159**** (6,29)	4,296**** (3,96)	Selection variable:		0,437**** (5,37)		1,408**** (10,49)
Control variables:			Control variables:				

Political environment: Government effectiveness		0,256* (1,70)	Political environment: Government effectiveness	-0,684*** (-2,99)		-0,621**** (-4,46)	
Human capital: Education index		-0,090 (-0,51)	Human capital: Education index	0,204 (1,03)		0,419**** (3,63)	
Infrastructure: Electricity		-0,032 (-1,34)	Infrastructure: Electricity	0,206** (2,31)	0,088** (1,99)	0,221**** (4,47)	0,386**** (5,51)
Dummies for the missing values:			Constant	3,565 (1,28)	-0,212 (-1,40)	4,055** (2,09)	-1,405**** (-5,47)
MVA missing	0,106 (0,87)	0,139 (1,13)	MVA dummy	-0,136 (-0,25)		-0,395 (-1,11)	
Inputs	0,831**** (4,37)	0,692**** (3,55)	Inputs dummy	1,033* (1,79)		1,006*** (2,73)	
Consumer goods	-0,954*** (-4,76)	-0,794**** (-3,39)	Consumer goods dummy	-0,519 (-0,83)		-0,530 (-1,33)	
Government effectiveness		-0,065 (-1,38)	Government effectiveness dummy	-0,077 (-0,38)		-0,088 (-0,77)	
Education index		0,441**** (4,40)	Education index dummy	0,373 (1,28)		0,401** (2,38)	
Electricity		-0,008 (-0,15)	Electricity dummy	0,075 (0,33)		0,089 (0,67)	

Number of observations Number of groups	684 36	Lambda	-1,455*** (-3,20)		-0,540**** (-4,33)	
		Wald test of independence (Rho = 0)	Rho = -1, 0000 (estimate of Rho was -1.2003303, is being truncated into 1) Wald Chi2 (12) = 35,03 Prob > Chi2 = 0,0005		Rho = -0,792, Wald Chi2 (12) = 150,44 Prob > Chi2 = 0,0000	
			Observations: 684 Selected: 418 Non selected: 266		Observations: 684 Selected: 418 Non selected: 266	

The t-statistics or z-values are given in parentheses

P < 0,10 = *, P<0,05 = **, P<0,01 = ***, P<0,001 = ****

L. Robustness Check IV: Model without the outliers

Variables: 13: Fixed effects Base data	13a Fixed effects: Main dependent variables	13b. Fixed effects: Complete model	Variables: 14: Heckman model	14a Manufacturing value added (Equation of interest)	14b Probability of importing from China Selection variable = low costs
Exports of inputs: Machinery	23 770,88 (0,88)	5 152.202 (0,19)	Exports of inputs: Machinery	-162 002,5 (-1,62)	
Exports of consumer goods: exports of footwear, textile & clothing and miscellaneous	-4 455,647 (-0,44)	-7 781,068 (-0,77)	Exports of consumer goods: exports of footwear, textile & clothing and miscellaneous	323 428,3*** (3,00)	
Exports to Europe & North America	-7,50 e-09**** (-5,03)	-6,23 e-09** (-2,03)	Exports to Europe & North America	-1,32 e-08** (-2,51)	
Constant	10,349**** (53,69)	10,558**** (4,87)	Selection variable:		0,449**** (4,18)

Control variables:			Control variables:		
Political environment: Government effectiveness		-0,046 (-0,08)	Political environment: Government effectiveness	-3,480**** (-5,30)	
Human capital: Education index		-6,639 (-1,20)	Human capital: Education index	8,961**** (2,84)	
Infrastructure: Electricity		0,070*** (2,98)	Infrastructure: Electricity	0,055*** (2,84)	0,002 (1,08)
Dummies for the missing values:			Constant	7,565*** (2,66)	0,106 (1,15)
MVA missing	0,840 (0,82)	0,852 (0,84)	MVA dummy	1,589 (-0,47)	
Inputs	2,491* (1,73)	1,431 (0,98)	Inputs dummy	1,533 (0,43)	
Consumer goods	-4,131*** (-2,61)	-2,543 (-1,62)	Consumer goods dummy	-2,978530 (-0,74)	
Government effectiveness		0,096 (-0,28)	Government effectiveness dummy	0,244 (0,21)	
Education index		4,335**** (5,42)	Education index dummy	3,366* (1,90)	
Electricity		0,345 (0,75)	Electricity dummy	0,174 (0,12)	

Number of observations Number of groups	618 35	Lambda		-8,710** (-2,38)
		Wald test of independence	Rho = -1,000 (estimate of Rho was -1.1758886, is being truncated into 1), Wald Chi2 (12) = 58,03 Prob > Chi2 = 0,0000	
			Observations: 618 Selected: 395 Non selected: 223	

The t-values or z-values are given in parentheses

P < 0,10 = *, P<0,05 = **, P<0,01 = ***, P<0,001 = ****