The effect of Foreign Direct Investment on the Chinese economy between 1980 and 2010

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Abstract

Does foreign direct investment have a positive effect on China's GDP per capita? This thesis investigates the effect of FDI on GDP per capita in China between 1980 and 2010. The augmented Solow model is used as a framework to determine this effect. Prior to the actual empirics are an historical overview, analysis of growth drivers and an analysis on determinants of FDI. The results of my panel study show that FDI has a positive effect on GDP per capita. This result remains consistent and significant when additional control variables are added and when standard errors are clustered by province.

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1. Introduction

After the reforms in 1978, China achieved exceptional growth in the following decades. It started with the opening of 4 special economic zones (SEZ's). The following years more areas were opened to FDI. Market reforms and institutional changes were implemented to promote foreign direct investment (FDI) inflows and transform China from a heavily regulated economy to an open market economy. Between 1978 and 2010, China had an average yearly growth rate of 10%[1]. One of the most important factors of these market reforms has been the allowance and promotion of FDI inflows. FDI inflows increased from 430 million in 1982 to more than 240 billion in 2010[2]. The fact that FDI has a positive effect on growth is heavily discussed in an extensive body of literature. Studies from Dees (1998), Wei (1996), Liu (2008), Zhang (2001) research the effect of FDI on growth and the channels through which this growth is realised. According to the literature there are numerous channels through which FDI affects growth, including production efficiency, technology-spill overs, exports etc.

The main goal of this thesis is to isolate the effect of FDI on China's GDP per capita between 1980 and 2010. My thesis is an addition to the existing body of literature by investigation a longer time period. It also includes very recent years up to 2010 which is not investigated that extensively. The research question of this thesis is: *Does foreign direct investment have a positive effect on China's GDP per capita?*

To measure the effect of FDI on GDP per capita a panel study was conducted among 30 Chinese provinces over the time period between 1980 until 2010. This study measures the effects of FDI within a relatively long time period, thus giving a clear trend of how FDI affected GDP per capita over the years. To estimate the results as precise as possible multiple control variables were included. The results clearly show that FDI does have a positive significant effect of Chinese economic growth. The FDI variable remains significant and positive after adding control variables. As an additional robustness check, standard errors are clustered by province and the FDI variable remains significant and positive.

This study is structured in the following way. In section 2 the history of FDI inflows will be discussed. Different periods will be discussed, as well as the development of FDI. Section 3 will discuss the different drivers of growth in China. In this section multiple important drivers of Chinese growth and their interdependence will be discussed, as well as an extensive literary review among all drivers. Section 4 will be about the determinants of FDI. Three well known models will be discussed

[1] The average growth rate is based on data from worldbank.org.
[2] The FDI data comes from worldbank.org.

to give some theoretical background of what establishes FDI flows. After this determinants of FDI are discussed in accordance to one of the models, followed by a literary review on determinants of FDI in China. Section 5 will discuss the augmented Solow model and modifications to create the specification to measure the effect of FDI on GDP per capita in China. Section 6 discusses the data set, data modifications, estimation and the analysis of the results. Section 7 will be the conclusion.

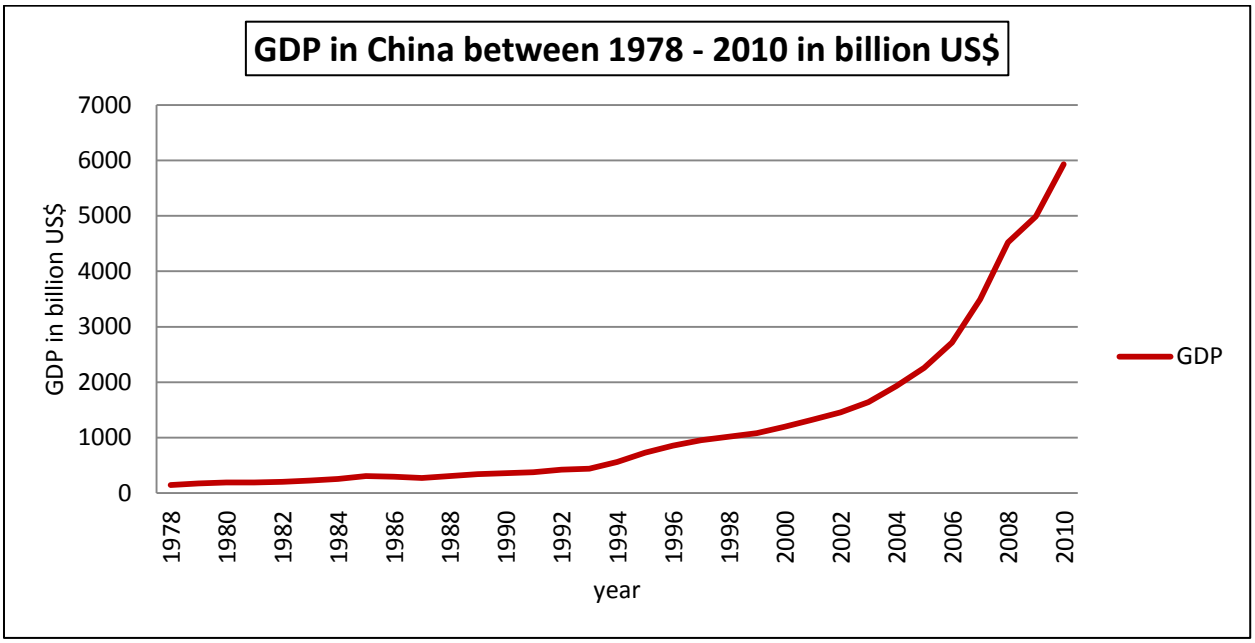
2. Historical overview

2.1. Before 1978

With an average growth of 10% between 1979 and 2010, China is one of the fastest growing countries in the world. The development of China's increase in total GDP and growth are shown in figure 1 and 2. It is shown that China's GDP has been exponentially increasing, especially after 1994. The growth rates are volatile, though exceptionally high over the entire time period.

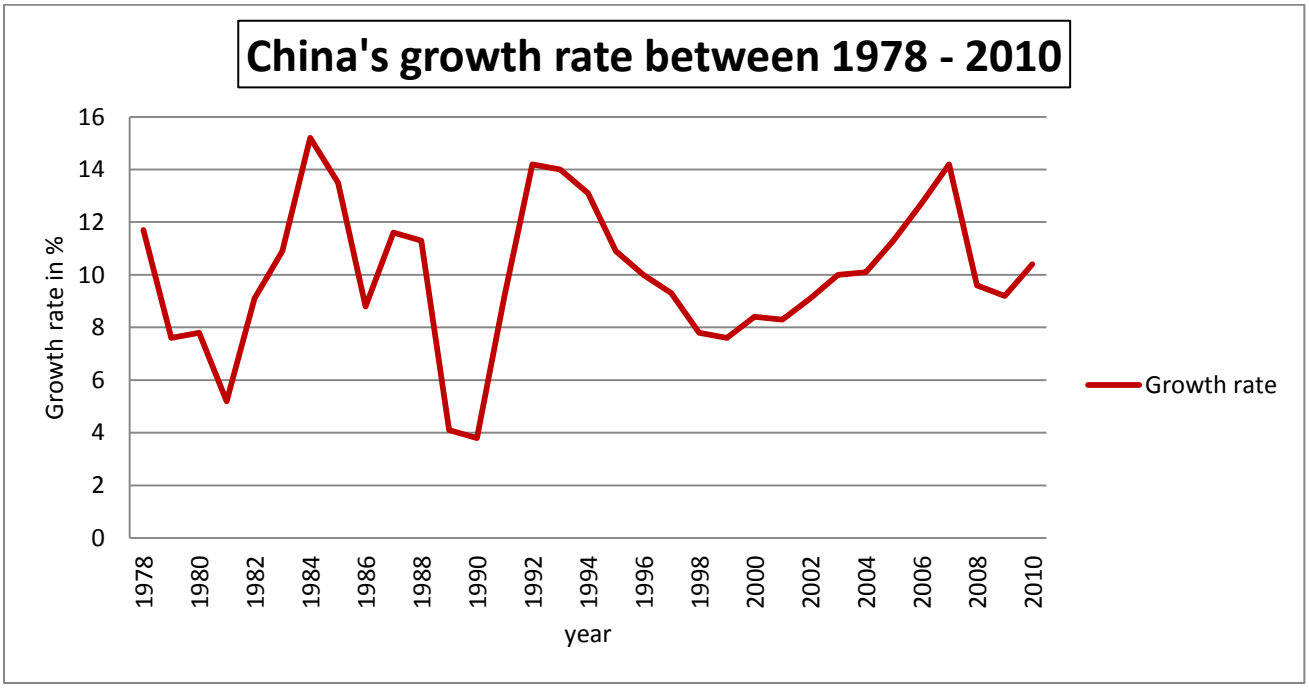
Since the beginning of the market reforms in 1978 initiated by Ding Xiaoping, the Chinese attitude towards export and foreign direct investment (FDI) changed. According to Wei (1995) there were two reasons for this attitude towards change. The first reason was the disastrous economic performance of China as a self-reliant country. The second reason for policy reforms were the high growth rates of Japan and the Asian-tigers. Before 1978 China was controlled by Mao Zedong. In this phase China was a heavily regulated closed economy where the main focus was on agriculture. Prices were fixed and China was good as non-existent on the world market. In the period between 1943 and 1976 Mao controlled China. During this period there was an overall trend of income equalization and a decreasing trend in the importance of education and occupation (Zhou, 2000). In this period China's export was non-existent and there were no foreign-owned enterprises. The reason for this was that Chinese leaders were suspicious of foreign money.

Figure 1: GDP in China between 1978 and 2010



Source: Data from the World Bank Database

Figure 2: China's growth rates between 1978 and 2010



Source: Data from the World Bank Database

2.2. Period 1978-1985

This changed in 1980 when joint venture law permitted FDI in four specific Special Economic Zones (SEZ's). The created zones were Shenzhen, Zhuhai and Shantou in the province Guangdong and Xiamen in the province Fujian. The SEZ's opened in 1980 are indicated by a blue circles in figure 3. The (SEZ's) were relatively free of regulations, had attractive tax regulations, were relatively independent and open for trade activities. The reason only a few of these select zones were created according to Dees (1998) was: ''*To limit the establishment of foreign firms in China geographically to the four Special Economic Zones''.*

After the reforms the importance of Township and village enterprises (TVE's) changed drastically. TVE's are market-oriented enterprises observed by local governments. Before the reforms TVE's were restricted to some basic industrial products. After the reforms TVE's were allowed to work more freely. Due to market reforms, growth and output in the agricultural sector were one of the main drivers of China's growth. Because of this increasing growth in the agricultural sector farmers demand for industrial products increased, which resulted in a growing number of TVE's in the rural industry. Another reason for growth of the rural industry was the lack of labour mobility and the lack of labour and capital market reforms. This resulted in labour and capital substitutions from the agricultural sector to the rural industry (Pomfret, 1997).

Despite the internal changes in China, the flow of FDI between 1979 and 1983 was very low. The number of projects only increased from 230 in 1979 to 396 in 1983, which increased the value of FDI from 0,5 billion to 1,5 billion. This period of *''sluggish increase''* is the first stage among three stages (Dees, 1998). He emphasized that in this stage, foreign investors took a *''wait-and-see-attitude''* towards investing in China. The *''sluggish increase''* might be explained by demographic and cultural factors from investors from Hong Kong and Macao instead of China's policy reforms (Dees, 1998).

Figure 3: Chinese SEZ's indicated per time period

Source: Originally *from World Bank (2009), adapted by The Geography of Transport Systems*[3].

2.3. Period 1986-1991

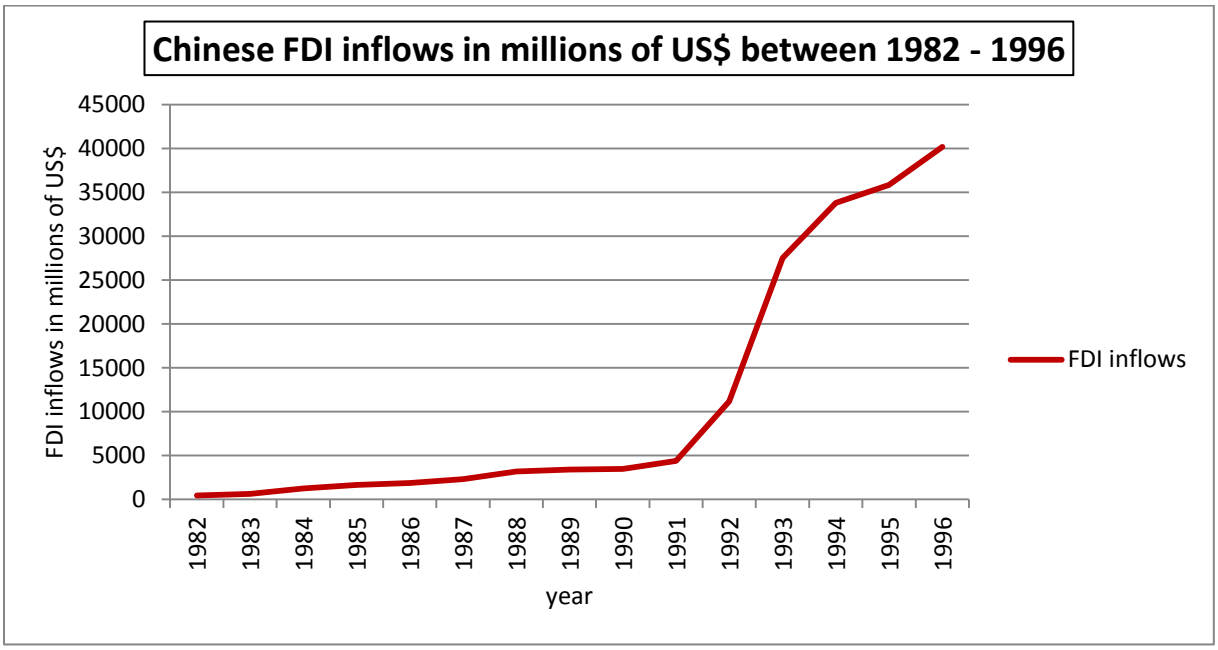
According to Sun et al. (2002) the second stage started when Chinese authorities realised the inflow of FDI was decreasing. Four years after the introduction of the first four special economic zones, 14 cities were opened to foreign direct investment in 1984. These are indicated by the red circles in figure 3. In 1985 three river deltas and three economic clusters were added to the areas

[3] China's special economic zones can be found with the following link: https://people.hofstra.edu/geotrans/eng/ch5en/conc5en/China_SEZ.html

open to FDI. These deltas, surrounded by an economic cluster, are indicated by the yellow circles in figure 3. After 1985 foreign investments stagnated due to high inflation. FDI was also concentrated in small businesses with a high focus on export (Sun et al., 2002) and with low levels of capitalisation and non-advanced technologies (Dees, 1997). As a result the ''PRC law'' was introduced in 1986. This law granted wholly owned foreign businesses legal rights. Also implemented later in 1986 were the ''Provisions for the Encouragement of Foreign Investment''[4]. The main goals of these provisions by the state council of China were to*: ''... improve the investment environment, to better facilitate the absorption of foreign investment, to introduce advanced technology, to improve product quality, to expand in order to generate foreign exchange and to develop the national economy.''*

In 1988 Hainan Island was separated from the mainland and was made an SEZ. Before 1988, Hainan was part of the Guangdong province. Hainan is indicated by the purple circle in figure 3.

Figure 4: FDI inflows in China between 1982 and 1996



Source: Data from the World Bank Database.

As discussed above China did their best to become more attractive for foreign investment and they succeeded. Figure 4 shows that FDI inflows increase with a small amount between 1986 and 1991 in comparison to the period before 1986. A larger amount of areas open to foreign investment seemed to positively affect the FDI inflows to China. Also preferable legislation, tax reduction, lower land fees, improved bureaucracy, a ban on expropriation, allowing foreign foreman in the board of

[4] Contexts of Provision for the Encouragement of Foreign Investment can be found with the following link: http://www.novexcn.com/encour_foregn_invest.html

directors and other changes seemed to have made a difference between 1986 and 1991. According to Chuang and Hsu (2004) the share of FDI to domestic fixed asset investment increased from 1% in 1983 to 17,08% in 1994. Dees (1997) shows that the proportion of industrial output produced by Foreign Funded Enterprises (FFE's) increased from 2% in 1978 to 5,7% in 1991 and to almost 17% in 1995. Cheng and Kwan (2000) researched the determinants of FDI in China between 1985 and 1995. The authors find that market size, infrastructure, special economic zones and policy changes have a positive significant effect on attracting FDI. The authors conclude that both the creation of the special economic zones and the policy changes have had a significant positive effect on attracting FDI.

2.4. Period 1992-1996

1992 is the year that introduces the large scale expansion of FDI in China. In 1992 China had expanded their total number of SEZ's to 60. These consisted of 5 original SEZ's, 15 coastal cities, 8 cities among river deltas, ports, 13 border cities and 19 inland cities[5]. Figure 3 shows that while in 1991 total FDI in China was 4.4 billion, FDI more than doubles the next year to 11 billion in 1992. Growth remains the following years. In 1993, 1994 and 1995 total FDI increases to around 27, 34 and 36 billion dollars[6]. After 1991 the amount of FDI inflows to China are rapidly increasing as can be observed in figure 4.

Fung et al. (2005) conducted a study about what attracted FDI to China between 1990 and 2002. They observed the FDI inflows from host countries with the highest outflows to China. These countries are Hong Kong, United States, Taiwan, Korea and Japan. In their study they conduct the usual determinants like labour costs and market size. The focus though, is on hard or soft infrastructure. Hard infrastructure indicates railways and highways and soft infrastructure indicates more transparent institutions. Soft infrastructure is indicated by the number of SEZ''s, coastal cities and economic and technological development zones. The authors conclude that soft infrastructure is more important than hard infrastructure in both developed and less developed areas in China. Quick market reforms are therefore the best way to attract more FDI according to Fung et al. (2005).

It is interesting to note that a lot of soft infrastructure is added between 1986 and 1991, which might have resulted in rapidly increasing FDI inflows after 1991. Figure 4 clearly shows a large increase in FDI inflows between 1992 and 1996. There is a visible trend between the SEZ's with preferable institutions and the fact that most of these SEZ's are directly connected to the East China Sea. Table 1 clearly shows that the majority of FDI inflows go to coastal provinces. Table 1 also shows

[5] Number of SEZ's in 1992 from ''The Geography of Transport Systems.''
Link: http://people.hofstra.edu/geotrans/eng/ch5en/conc5en/China_SEZ.html
[6] The FDI data comes from worldbank.org.

that between 1987 and 1996 total FDI inflows have increased substantially. It is also clear that between 84% and 92% of FDI is invested in coastal provinces. Large differences in FDI inflows between the 12 coastal provinces can be observed. Guangdong is clearly the province with the highest FDI inflows between 1987 and 1996, although the percentage of total FDI inflows decreases after 1990.

Table 1: FDI in millions per coastal province in million US$ and as % of total FDI inflows

Coastal Province	1987	1990	1993	1996
Beijing	95 (6,5%)	276 (8,2%)	667 (2,4%)	1553 (3,5%)
Fujian	51 (3,5%)	290 (8,7%)	2867 (10,3%)	4078 (9,3%)
Guangdong	593(40,6%)	1459 (43,8%)	7498 (27%)	11623(26,4%)
Guangxi	37 (2,5%)	30 (0,9%)	872 (3,1%)	666 (1,5%)
Hainan	9 (0,6%)	100 (3%)	1048 (3,8%)	789 (1,8%)
Hebei	7 (0,5%)	39 (1,2%)	357 (1,3%)	1236 (2,8)
Jiangsu	50 (3,4%)	141 (4,2%)	3001 (10,8%)	5072 (11,5%)
Liaoning	64 (13,9%)	257 (7,7%)	1227 (4,4%)	1671 (3,8%)
Shandong	24 (1,6%)	151 (4,5%)	1843 (6,6%)	2590 (5,9%)
Shanghai	212(14,5%)	177 (5,3%)	2317 (8,3%)	4716 (10,7%)
Tianjin	55 (3,8%)	83 (2,5%)	541 (1,9%)	2006 (4,6%)
Zhejiang	23 (1,6%)	48 (1,4%)	1033 (3,7%)	1520 (3,5%)
Interior provinces	241(16,5%)	284 (8,5%)	4582 (16,5%)	6530 (14,8)
Total	**1461**	**3335**	**27853**	**44050**
% FDI coastal	**83,5%**	**91,5%**	**83,6%**	**85,2%**
% FDI inland	**16,5%**	**8,5%**	**16,45%**	**14,82%**

Source: Chinadataonline.org

From the first four SEZ's that were opened to FDI in 1980, three were located in Guangdong. An explaining factor might be the agglomeration effect. According to Au et al. (2006) FDI has a strong self-reinforcing effect. According to this logic earlier opening gives a comparative advantage because old FDI attracts new FDI. This might have given Guangdong an advantage compared to the other provinces.

Another factor why Guangdong has such high FDI inflows is because it is located next to Hong Kong. An explanation why Guangdong's relative FDI inflows decreased after 1990 can probably be because the wages and prices got to high. According to Moltalvo et al. (2010) both the headcount

ratio in urban and rural areas in Guangdong decrease with 33% and 28,5% per annum. This decrease in both areas indicates that income increases and therefore costs could have been increasing. Honge Gong and Meng (2008) researched the price differences in urban China. Their data shows that the calculated spatial price index (SPI), using the Engel Curve approach, shows an average price of 1,3 in Guangdong. This might also explain why the relative share of FDI inflows decreased in Guangdong. Other provinces like Jiangsu, Fujian, Hebei and Shandong had strong increases in FDI inflows between 1987 and 1996. In relative terms Jiangsu's and Fujian's had the largest increase in FDI share of 11,5% and 9,3% in 1996. The relation between absolute FDI inflows and the spatial price index is interesting to note.

Table 2 shows the source countries of China's FDI inflows between 1987 and 1996. It is clear that especially Hong Kong/Macao invests a large amount of total invested FDI in China. Hong Kong/Macao, Japan and the United States are the largest investors in China in 1987. Together they account for around 88% of total invested FDI. Hong Kong/Macao large share can be explained due to geographical and cultural advantages. The same argument could be used for Japan. Though Hong Kong/Macao remains the largest investor in China between 1987 and 1996, ratios do change substantially after 1987. Taiwan does not invest until after 1990, where it directly invests a substantial amount of FDI between 1991 and 1996. Taiwan also starts its investment after 1990. Europe adds an increasing amount to total FDI between 1987 and 1996. The FDI flows from Southeast Asia are negligible. Overall the largest investors are Asian countries, although the shares of the United States and Europe are also substantial and increasing. Between 1987 and 1996 the United States and Europe increased its share from around 15% to more than 19%.

Table 2: FDI invested in China per country or region in million US$ and as % of total invested FDI

Country/Region	1987	1990	1993	1996
Hong Kong/Macao	1809 (68,3%)	2118 (56,4%)	18032 (64,9%)	20852 (49,5%)
Taiwan	-	-	3139 (11,3%)	3482 (8,3%)
Japan	267 (10,1%)	520 (13,8%)	1361 (4,9%)	3692 (8,8%)
Korea	-	-	381 (1,4%)	1504 (3,6%)
United States	271 (10,2%)	461 (12,3%)	2068 (7,4%)	5051 (12%)
Europe	124 (4,7%)	182 (4,8%)	794 (2,9%)	3031 (7,2%)
Southeast Asia	37 (0,014%)	65 (0,017%)	1005 (0,036%)	3185 (0,076%)
Others	139 (5,3%)	409 (10,9%)	991 (3,6%)	1356 (3,2%)
total	**2647 (100%)**	**3755 (100%)**	**27771 (100%)**	**42135 (100%)**

Source: China Statistical Yearbook

3. Drivers of growth in China

In this section the main determinants of economic growth in China will be discussed. In sub-section 3.1 the effect of export on growth will be discussed. The section ends with a literary overview of the effect of export on growth. In sub-section 3.2 human capital will be discussed as a determinant of growth. In sub-section 3.3 the effects of infrastructure on growth are analysed. Market reforms are discussed in sub-section 3.4. A brief historical overview evaluates important and influential market reforms and their effect on growth. In sub-section 3.5 the effect of FDI on growth will be evaluated. Different investment vehicles will also be discussed in this sub-section.

3.1. Export

Since the opening of China in 1978, export has been an important driving force behind China's growth. With the increasing inflow of FDI, export volumes were rapidly increasing. FDI inflows and exports are proven to go hand in hand (Liu, 2002). Mainly because of the Chinese focussing their policies on an increasing export oriented market. Another important result of FDI inflows being responsible for China's increasing exports is through the enhancement of the Chinese capital formation. This improvement in technology shifted the production, which was mainly agricultural, to manufacturing industrial products (Zhang, 2001). Before China opened its doors there was barely any participation on the world market. Political reforms by the Chinese government allowing FDI inflows resulted in both increased quantity and quality of Chinese exports.

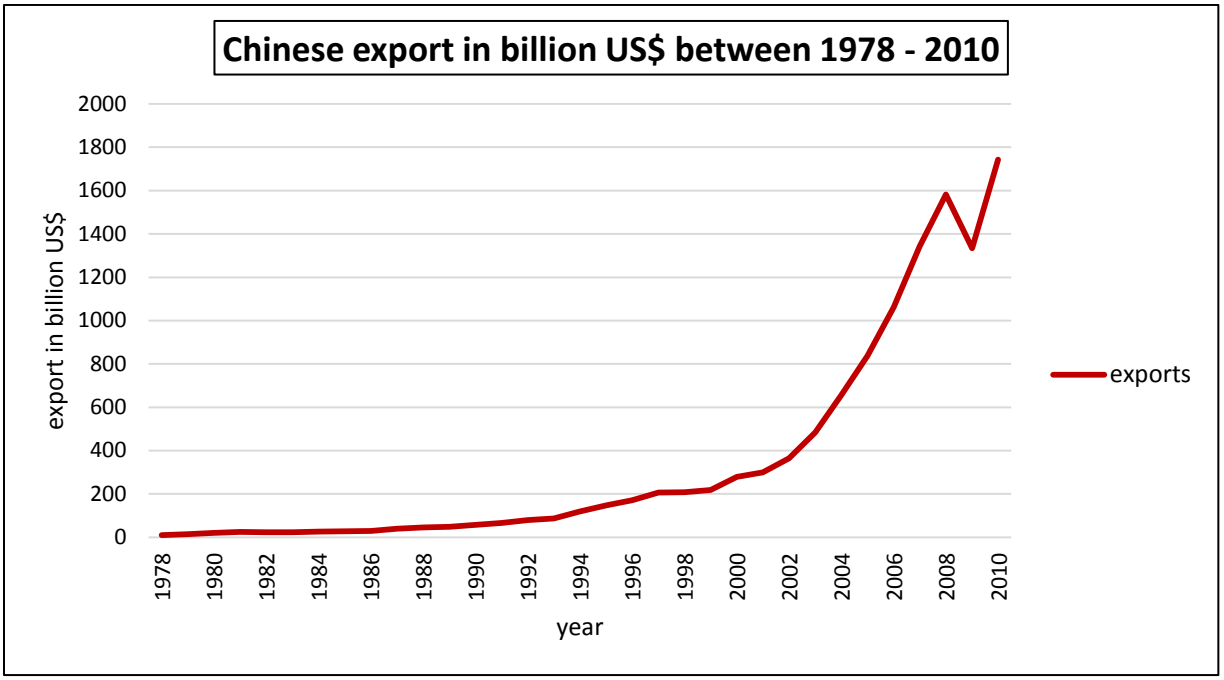
The trend of Chinese exports has been positive in the last decades. Figure 5 shows the increase of exports in billions of dollars between 1978 and 2010. Chinese export as a percentage of total GDP have been increasing over the last 30 years. Figure 6 shows an overview of export values as a percentage of GDP in China between 1978 and 2010. China's exports increased from 6,6% of GDP in 1978 to 16% of GDP in 1990. The share of exports kept increasing to 23% in 2000 and 29% in 2010[7]. The rapid growth in export is, as mentioned before, positively correlated with FDI inflows into China. The increase in export as a percentage of GDP coincides with increasing FDI inflows shown in figure 7. Both export as a percentage of GDP and FDI inflows in millions of dollars get a significant boost after 2002.

Koopman et al. (2008) find that in 2006 the foreign added value of Chinese exports is around 50%. Sectors that require a higher skill level have a higher share of foreign added value and sectors with a lower skill level have higher domestic added value. The authors also conclude that foreign

[7] Export data comes from worldbank.org

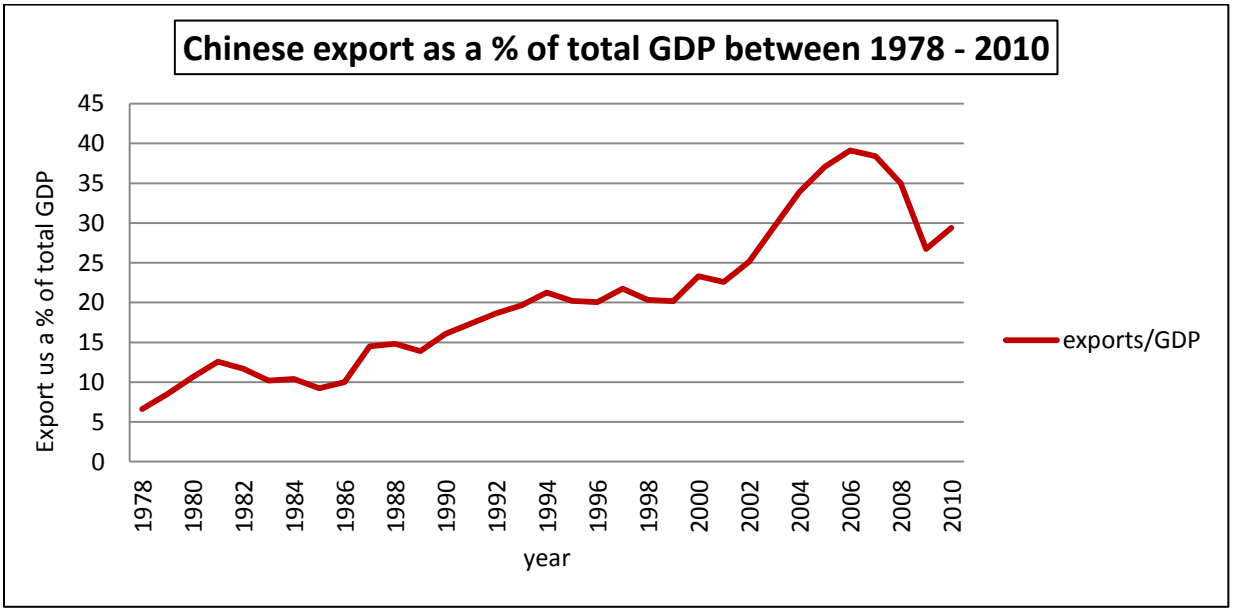
invested firms (FIE's) have a low share of domestic added value in their exports. (Koopman et al., 2008).

Figure 5: Chinese export between 1978 and 2010



Source: Data from the World Bank database

Figure 6: Chinese export as a percentage of total GDP between 1978 and 2010



Source: Data from the World Bank database

Zhang (2001) investigates the relation between FDI, export and economic growth. He uses cross section and panel data between 1984 and 1998 to assess the effect of FDI on the growth of the Chinese economy. According to Zhang (2001) FDI enhances China's growth through direct effects like

increased productivity and exports. The authors also find supportive evidence that FIE's effect on China's growth increases with FDI inflows between 1984 and 1998.

Liu et al. (2002) uses quarterly data for import, export, GDP and FDI between 1981 and 1997 to analyse the relationship between economic growth, FDI and trade. They show a two-way causal connection between FDI, economic growth and export. The relation between import and the other variables is weaker. FDI, economic growth and export do have an effect on import in the short run, but import does not have an effect on FDI, economic growth and export (Liu et al., 2002).

Tsen (2010) uses another method to determine the relation between exports, domestic demand and growth. The author uses granger causality among exports, domestic demand and growth. Particularly exports were responsible for the high growth rates between 1978 and 2002. Tsen (2010) argues that in 1978 the household consumption to GDP ratio was 49% while in 2002 the ratio decreased to 43.3%. Governmental consumption remained relatively constant. The export to GDP ratio however increased tremendously. In 1978 this ratio was 5.5% while it was 28.9% in 2002. The author argues that because domestic consumption decreased and governmental consumption remained constant, exports should be the larger contributor to China's growth. He concludes though that there is no supportive evidence that export or domestic consumption is superior. The author concludes, using granger causality tests, that there is a dynamic relationship between exports, domestic demand and economic growth. Export and domestic demand are both important for the growth of China. Economic growth is also important for both export and domestic consumption (Tsen, 2010).

Rodrik (2006) investigates the quality of China's export basket and its effect on GDP per capita. According to Rodrik (2006) an important determinant of growth is the sophisticated export basket of China. The author uses an indicator for the productivity level of countries and their export. This indicator is strongly correlated with GDP per capita. Countries with higher GDP per capita usually have higher indicators of productivity. China's sophistication level was six times higher than the associated GDP per capita should have been in 1992. Although this gap has decreased over time, the high productivity levels of China result in higher GDP growth than if the productivity levels would have been lower. Doubling the productivity level of China would result in a 6% increase in GDP per capita (Rodrik, 2006).

3.2. Human Capital

The effect of human capital accumulation has already been heavily studied in the last decades. Multiple cross-country studies and panel studies have been conducted and show positive and significant effects of human capital on economic growth. Barro (2001) finds in a panel study between 1965 and 1995 among 100 countries that growth is positively affected by the average starting level of adult males with secondary or higher schooling. According to Barro (2001) an explanation for this is that educated people are more complementary to newer technologies. Women, according to Barro (2001), are underutilized in the labor market of many countries.

Cohen and Soto (2007) use data across 95 countries between 1960 and 2000 and find a positive significant coefficient for schooling in both cross-country and panel study. They use the augmented Solow model and indicate human capital as an exponential function of years of schooling. Unlike earlier research in accordance to the augmented Solow model they find a positive and significant effect of schooling on growth. They also find significant positive effects of schooling if physical capital is added in the regressions.

Other studies argue that growth is not directly affected by human capital or that the effects are not directly linked to economic growth. Mankiw, Romer and Weil (1992) argue that human capital is an ordinary endogenous variable like physical capital and labour in their augmented Solow model. Human capital is unable to explain economic growth. Benhabib and Spiegel (1994) also fail to show the effect of human capital in a Cobb-Douglas regression using human and physical capital effects on GDP per capita growth rates. So alternatively they use a model to determine the effect of human capital stock on the growth of total factor productivity. These tests indicate that human capital has a positive effect on total factor productivity. According to Benhabib and Spiegel (1994) human capital has a direct effect on the domestic production of technological innovation and also affects growth through the speed of adopting foreign technologies.

The question of how much human capital contributes to the growth in China is subjected a lot of research. How much additional human capital could add to growth is another question of importance. China's investments as a percentage of GDP has always been lower than average compared to developed countries. Educational spending in China has increased from 2,2% of GDP in 1980 to 3,3% of GDP in 2008. This increase in educational spending is still fairly low if you compare it to the 5,6%, 5,5% and 5,5% in the US, France and Netherlands in 2008[8]. Current policies in China favour the investment in physical capital. An interesting relation between human and physical capital is discussed by Barro (2001), Fleisher et al. (2010), Heckman (2005), and Liu (2008). They argue that

[8] Source: United Nations Development Programme: link: https://data.undp.org/

human capital improves the skills of higher educated workers to operate newer forms of technology. Especially with China's favourable policies and huge FDI inflows this relation is interesting. It is also hard to establish the actual effect of human capital on growth through more efficient adaptation of newer technologies. According to Fleisher et al. (2010) there are other benefits to investing in human capital, namely:

- It raises people's productivity and skill.
- Skilled workers are more easily adaptable and easier to allocate.
- China's entry to the world market requires more highly educated workers.
- Human capital would benefit productivity to China's agricultural sectors.

According to Heckman (2005) China can benefit extensively from human capital investments. Human capital investments increase productivity through investment in skills, adaptability and allocative efficiency. Also imports of technological physical capital require higher skilled workers to operate. Heckman (2005) argues two important flaws in the educational system in China. First the fact that schooling is funded at a local level determines the amount of schooling people get. This makes the birth location the most important determinant for someone's schooling because rich provinces spend more on schooling than poor provinces. The second flaw is that there is a low incentive to invest in human capital because the return to education is too low.

Fleischer et al. (2010) argues that China's economic environment is perfect to research the effect of human capital on economic growth. The reason for this is the enormous growth rates of China and the large disparities between western, central and eastern China. Fleisher et al. (2010) argues that this provides an ''*important and useful episode for analysing the effects on human capital*". According to the literature human capital has a direct and an indirect effect on economic growth. The direct effect increases production through the skill of workers that positively affect total factor productivity. The indirect effect increases growth through knowledge and technology spill-overs (Fleisher et al., 2010).

Multiple arguments are made that especially provinces with higher educated citizens contribute to growth. Fleisher et al. (2010) investigates the two channels in which human capital can affect growth. The first one is the direct effect, in which educated people have higher marginal products and add more to total factor productivity than less-educated people. The other channel is indirect. Areas with highly educated workers can benefit from technology spill-overs and the ability to develop new technology and production techniques. According to Fleisher et al. (2010), using his total factor productivity growth equation, he concludes that both the direct effect and the indirect effect of human capital have a positive significant effect on total factor productivity.

Zhang (2001) studies the effect of FDI on the Chinese economy. He uses a growth model, cross-section analysis and a panel study consisting of 28 provinces between the years 1984 and 1998. He finds that the externality effect of FDI is significantly positive, except between 1984 and 1988. The interaction variable between human capital and FDI is also positive and significant, which according to the author suggests: *'' that there might exist complementary effects between FDI and human capital''*.

Liu (2008) focusses especially on the indirect effect of spill-overs from FDI investments on domestic firms in China. The author argues that domestic firms can learn from foreign invested firms in the long run. The author uses the endogenous growth model to explain the effect of spill-overs on domestic firm level. Evidence suggests that domestic output would decrease in the short run due to the costly learning experience, but will increase domestic output in the long run. The effects of spill-overs do not happen automatically. Domestic firms need to adapt to the level of technology by investing in know-how and human capital (Liu, 2008).

3.3. Infrastructure

Before the market reforms were implemented in China, a centralized government-plan was responsible for the placement of investments including infrastructure. A main focus of these plans was on a heavy industrial complex in Northern China. The creation of these complexes resulted in a transport network between Northern China and provinces with high amounts of natural resources. This resulted in a substantial increase of the railway network between 1952 and 1978 in northern China (Demurger, 2001).

In the existing literature infrastructure is a well-established determinant of economic growth. Three main functions of infrastructure are; the production of facilities to enhance economic activities, the reduction of transaction costs and time to enhance competitiveness and the creation of employment possibilities for the poor. After the market reforms infrastructure became a crucial factor in the export led strategies of China. Increasing FDI inflows and exports required higher infrastructural investments to prevent bottlenecks and sustain economic growth rates. China's enormous growth over the last three decades has been supported by massive infrastructure spending. Most of infrastructural spending was done by central, provincial and local governments. In 2006 75% of infrastructural spending was done by governmental bodies, while less than 2% was funded by FDI inflows in 2006. Total spending on infrastructure in 2006 was around 15% of GDP (Sahoo et al., 2010). The results of Sahoo et al. (2010) justify the usefulness of these huge investments. The author creates an infrastructural index consisting of six relevant indicators. This

index consist of; per capita electrical power consumption, per capita energy use, telephone lines per 1000 inhabitants, rail density per 1000 inhabitants, freight air transport in million tons per kilometre and paved roads as a percentage of total roads. To measure the effect, GMM and ARDL are used with data between 1975 and 2007. The coefficient of this infrastructural index is between 0,21 and 0,4 which indicates that a 1% increase in infrastructure results in a growth increase between 0,21% and 0,4% (Sahoo et al, 2010).

The shift from central to provincial and local governments started around 1992. This shift was caused by fiscal reforms and market reforms. Local governments became more responsible for the attraction of FDI. An interesting way to analyse the effect of infrastructure on growth is to investigate the relation between different provinces. Demurger (2001) uses the data of 24 Chinese provinces between 1985 and 1998 to determine the disparities between provinces according to the availability of infrastructure. The growth equation that is used indicates geographic location, telecommunication infrastructure and transport infrastructure as indicators that significantly enhance growth. The author also argues that especially transport infrastructure, geographical location and economic policy are the most important variables in explaining differences in provincial growth rates. Demurger (2001) also creates a ''regional classification'' in which province growth rates are compared to the national average growth rate. The goal is to analyse what components are responsible for these regional growth differences. The data shows that the coastal provinces benefit especially from transport and telecom infrastructure while the inland growth prosperities are much lower. According to the author an expansion of the transport and communication network would be especially good for rural areas. This would result in a more equal distribution of growth among provinces (Demurger, 2001).

Fleisher et al. (2010) researches the effect between physical capital, human capital, physical infrastructure, telecommunication infrastructure and FDI on total factor productivity. Provincial data between 1988 and 2003 is used. Road intensity is the proxy used to measure the effect of physical infrastructure. The authors are not able to find a significant coefficient for physical infrastructure. According to Fleisher et al. (2010) this might be because road intensity does not change quickly enough over time. The proxy used for telecommunication is telephone intensity which tests significant and positive.

3.4. Market reforms

In this sub-section market reforms will be discussed. In the last three decades China changed from a poor centrally planned economy into a market-oriented economy with high levels of development and investment. Starting in 1978 market reforms made China's high growth possible. Without these reforms China would probably still be a country primarily dependent on agriculture. There would probably be no inflow of FDI, low exports and low incentive to invest in infrastructure and education. When the need for market reforms became apparent in 1978 the first step to transform the centrally planned economy into a market oriented system was set.

The first market reform implemented to achieve this goal was the dual-track price system. In this system enterprises still had to produce their quotas at a fixed price as in the planned economy. If these quotas were fulfilled enterprises were allowed to sell their surplus at market prices instead of the fixed price. This reform is a step towards a market oriented system and it increases efficiency. While the supply, demand and price of the fixed quotas remained the same, overproduction was sold at market prices outside the planned supply. This system created efficiency through labour mobility between efficient and inefficient firms. After quotas were met, workers of inefficient planned firms relocated to efficient market-oriented firms. While the state bought 47,8 million tons of grain in 1978 and 50,5 million ton in 1988, total production increased from 304,8 million ton to 394,1 million ton (Qian, 2002). Over time the market becomes more focussed on the market-oriented part than on the state owned part. The labour market starts outgrowing the state sector. While the employment rate in the planned system is as good as stationary the market-oriented part rapidly increases. According to Qian (2002) employment in the non-state sector increased from 48,9 million in 1978 to 204,85 million in 1994.

After 1990 there were large scale privatizations among state-owned firms. Though the acceleration of privatization did not start until 1992, reforms were implemented more than 10 years before. The reforms first resulted in a lot of discontent due to the lack of development. The fact that private state-owned firms increased their market share, while decreasing the share of the state sector resulted in political resistance. Another factor responsible for the slow start of privatization in China was the absence of well-established private property rights laws. Mainly due to the lack of property rights for private firms 72% of output and 58% of employment was provided by local government firms in 1993 (Qian, 2002). While before 1992 the most important market segment remained local governmental firms, privatization of local governmental firms became a driving force behind China's growth.

Another important chain of reforms between 1980 and 1993 were to decentralize the government. This set of reforms to decentralize the government was also called the fiscal contracting

system. These measures were taken because of two developments. The ratio of central government revenue to total government revenue declined as well as the ratio total governmental revenue to GDP. To promote economic activity local governments gained more authority and responsibility. Local governments became able to distribute expenditures as they saw fit within certain guidelines. With these fiscal reforms the central government wanted to guarantee itself with a solid cash flow. It also wanted to give local governments an incentive to promote economic activity because local governments were allowed to keep large percentages of collected revenue. In accordance to the fiscal contraction systems local governments had to send back a share of their revenues to the central government.

According to Jin et al. (2001) the incentive towards economic activity has a positive significant effect on market development. By increasing the share of provincial government revenue, the rate of employment in non-state enterprises increases. The fiscal contracting system gave local governments incentive to assist non-state enterprises. The fiscal contracting system its problem became apparent in the late 1980's and the beginning of the 1990's.

According to Shen et al. (2012) there were three reasons the fiscal contracting system was reformed in 1993. First the ratio of central government revenue to total government revenue declined as well as the ratio total governmental revenue to GDP. Second were the fiscal disparities between local governments. Due to negotiations between local governments and the central government it became apparent that rich coastal provinces had more power than inland provinces. Lastly, due to neglecting local expenditure responsibilities, distrust between local and central government occurred. Legislation made it attractive for local governments to interfere with the local market. This resulted in distortions on the market and unfair competition.

In 1994 the tax sharing reform was introduced with as main goal to fix the fiscal problems between governmental bodies. The main objective of these reforms was to simplify the tax structure. Another goal was to make the relation between local and central government clearer. The reforms created a clear distinction between local, shared and central government taxes. The reforms of 1994 were a great success. The ratio of central government revenue to total government revenue increased substantially. The ratio of total governmental revenue to GDP had been decreasing from 1978 to 1995. It started increasing again after 1995. It decreased from 30% in 1978 to 10% in 1995 to 17% in 2005 (Shen et al., 2012).

Multiple market reforms are discussed in the sections above. To create higher efficiency and incentive, production and sales at market prices were allowed next to the quota's and fixed prices. Also the central government became decentralized and local governments gained more authority. Reforms gave local governments incentive to allow private enterprises to increase economic development and therefore higher revenue shares. A set of reforms in 1994 made the relation

between local and central government more transparent. The tax structures were simplified and a clear distinction between local and central governmental tax incomes and revenues became clear and simpler with great success.

While the first special economic zones were allowed in 1980, FDI inflows started booming after 1992. The open-door policies were promoted to attract foreign investment and increase export. Companies that focussed on export gained special treatment like special loans. While more and more special economic zones were opened and the government did their best to promote foreign investment, FDI did not boom until 1992. Therefore the relation between FDI inflows and the institutional reforms in China are interesting to note. Especially after the reforms of 1994 it became apparent that China became an interesting country for investors due to the high inflows of FDI. Not only the reforms that specifically promoted exports and FDI inflows, but also the overall quality of China's institutions probably made China more interesting for investors.

Though institutional reforms play a crucial role in the growth process of a country, it is very hard to find a causal relation of China's institutional reforms on economic growth. There is sufficient evidence that institutions effect growth through multiple channels. It is easy to argue that institutions enhance growth though export, because that was part of the focus of the established institutions. Chen et al. (2000) shows that China's special economic zones have a positive and significant effect on FDI inflows.

Demurger (2001) argues that policies regarding infrastructural equipment could increase growth and decrease provincial inequality. Chow (2004) draws an important conclusion from China's reform: *''that market institutions alone are insufficient for economic development, and human capital is a second most important factor''.* The second conclusion drawn by Chow is that: *''economic growth can take place under different political systems. If market institutions and human capital are sufficient for economic growth, then growth can take pace under different forms of government''.* In these conclusions regarding the reforms creating China's institutions it seems fair to say that good institutions are more a prerequisite than an actual growth driver. Good institutions attract drivers of growth. As discussed above infrastructure, human capital, FDI and export all have a positive effect on economic growth and all benefit from well-established institutions.

3.5. Foreign Direct Investment

3.5.1. Common forms of FDI in China

In this section the effect of FDI on growth will be discussed. First, the investment vehicles through which foreign invested enterprises (FIE's) mainly invest in China will be discussed. These foreign invested firms exist mainly in three forms: equity joint venture, cooperative joint venture and wholly owned foreign firm. There are more investment vehicles but these are the three most common and will therefore be discussed.

-E*quity joint venture*: An equity joint venture is a cooperation between a foreign firm and a Chinese firm. Risks and profits are distributed according to the amount of capital both parties imputed in the firm. The foreign part of the equity joint venture for example can input capital, equipment and technology while the host inputs the facility, materials and currency. Equity joint ventures were popular in the beginning stage of China's transformation into an open-market system.

-*Cooperative joint venture*: Cooperative joint ventures can be fairly similar to the equity joint venture. The difference being that with the cooperative joint venture there is no minimum input by the foreign part of the firm. This gives the foreign part of the firm the ability to be a minority shareholder. While a cooperative joint venture does not have to be a legal person, an equity joint venture does.

-*Wholly foreign owned firm*: A wholly foreign owned firm is a firm that owns all stocks of a Chinese company and is therefore a Chinese legal person and has to obey Chinese law. Wholly owned firms mostly produce the firm's product in China for export. Wholly foreign owned firms became a very popular form after 1990 because there was not much interference from the Chinese authorities. Wholly foreign owned firms are also an independent Chinese legal person which added to the popularity. They are expected by Chinese law to use advanced technologies and are export oriented.

3.5.2. The impact of FDI on economic growth

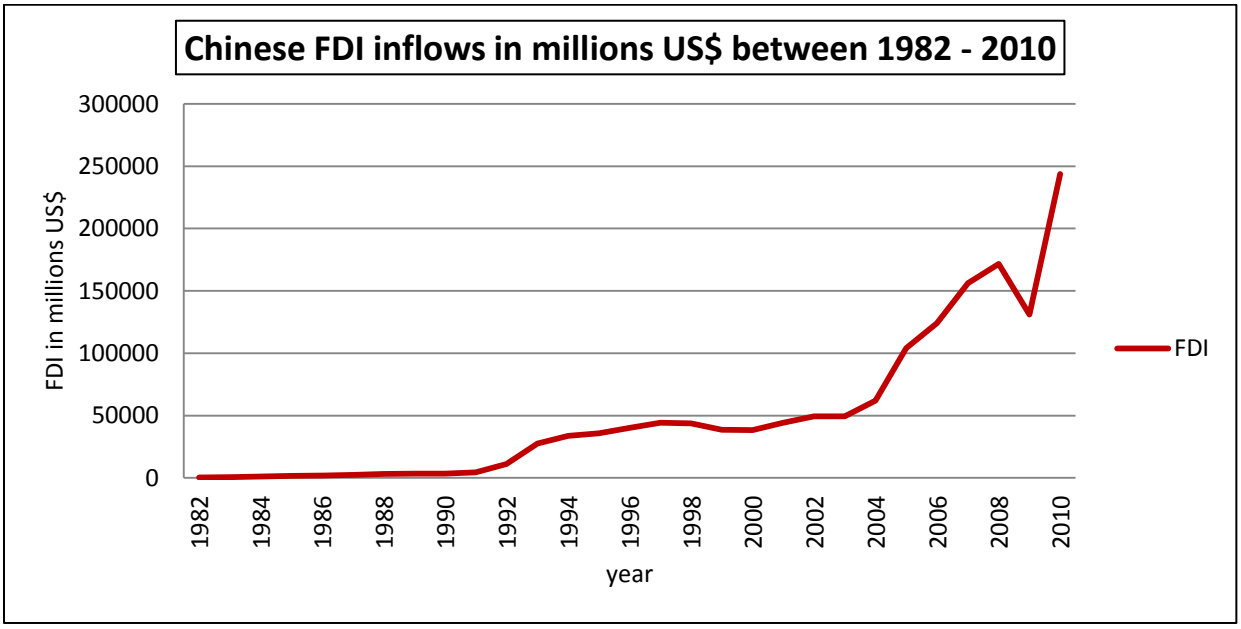
To really understand the importance of FDI it is necessary to determine the levels through which FDI affects economic growth. Figure 7 and figure 8 show Chinese FDI inflows in millions of dollars and as a percentage of total GDP. As can be observed in figure 4, the increase in FDI inflows up to 1996 was relatively small compared to the increase in the total timeframe between 1982 and 2010. The sluggish increase and decrease of FDI flows between 1996 and 2004 is followed by an exponential increase after 2004. FDI as a percentage of GDP increased significantly after 1990. Followed by small decrease, FDI inflows grew relatively on par with Chinese GDP. Especially between 2000 and 2010 FDI as a percentage of GDP fluctuated around 4% of total GDP.

According to Zhang (2001) there are four important ways how FDI effects growth. First, FDI inflows enhance the capital formation and the employment possibilities. Second, FDI promotes export focussed production. Third, FDI brings resources such as brand names, management skills and higher educated labour to China. Fourth, with the inflow of FDI technology transfers and spill-over effects occur.

While both FDI and domestic investment are inputs of basic physical capital there are some important differences. According to Yao et al. (2007) FDI positively affects the speed at which the adoption of General Purpose Technologies (GPT) takes place. FDI is therefore different from domestic investments. Though domestic investment is necessary to realize a country's growth, it does not bring advanced technologies like FDI does. GPT's are innovative technologies that can affect entire systems and global economies. Examples of these technologies are the computer and internet. Adoption of these new technologies can significantly boost the return of both physical and human capital. The adaptations of these technologies mostly happen when multinational enterprises enter the Chinese market. With their advanced technology and high efficiency they have an advantage over the domestic firms. To keep up domestic firms need to increase efficiency. The best to do this is by watching the multinational firms and learn from their processes. This could increase competition between domestic and foreign firms which can lead to higher efficiency. Another result of the adoption of general purpose technologies is that the gap between domestic and foreign firms decreases over time (Yao et al., 2007).

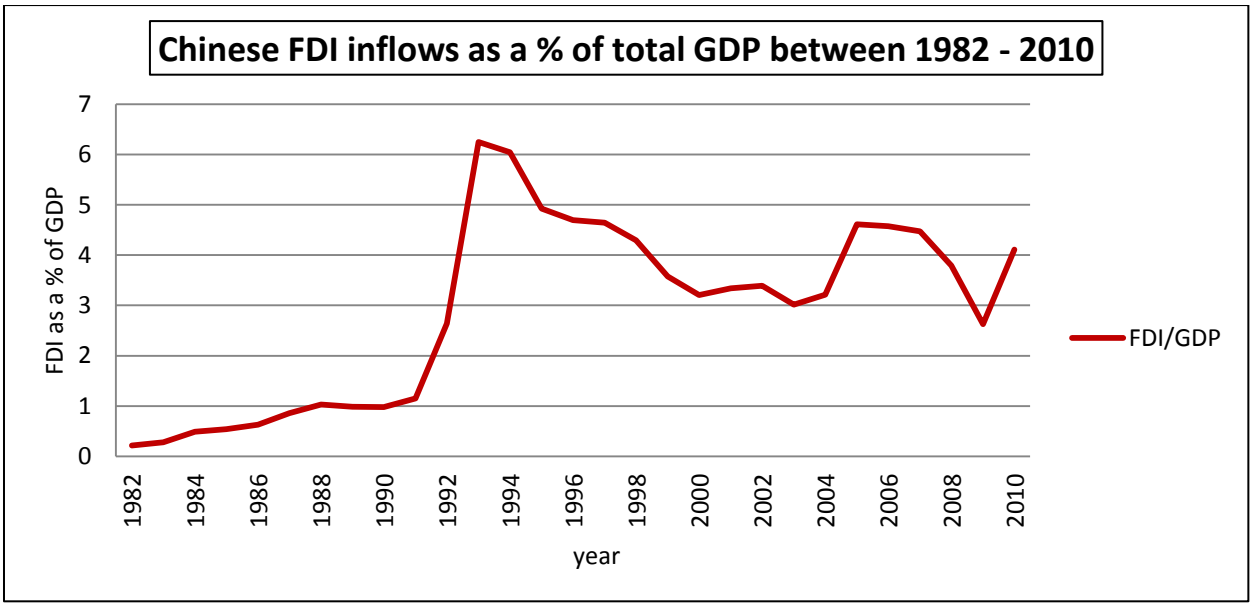
Beside GPT's foreign firms also bring other advanced technologies that were not available in the host country before. These technologies on itself increase productivity but also require a minimum level of certain factors to be efficiently implemented. Usually to adopt these advanced technologies a certain degree of educated labour is required. Other important factors are the level of available infrastructure and a well specified export focussed strategy (Yao et al., 2007).

Figure 7: Chinese FDI inflows between 1982 and 2010



Source: Data from the World Bank database

Figure 8: Chinese FDI inflows as a percentage of total GDP between 1982 and 2010



Source: Data from the World Bank database

To test the effect of FDI on production efficiency Yao et al. (2007) conduct a panel study between 1979 and 2003. They use provincial data and conclude that FDI is a mover of production efficiency. They use an augmented Cobb-Douglas production function and find that labour, capital, export, FDI, human capital and the real exchange rate all have a positive effect on GDP. They also find

that technological progress is responsible for 3,5% to 4,3% of economic growth. FDI contributes around 30% through technological progress to this growth.

Chuang et al. (2004) investigates the effect of FDI on the labour productivity of workers. They use the data among 30 provinces and cities with each more than 26 different industries. The data is from 1995. As FDI proxies they use the share of foreign firms in fixed assets and the share of foreign firms in employment. They show that private, individually owned, foreign invested firms in the south-eastern part of China are more productive in multiple sectors. The two proxies for FDI are also both positive and significant which indicates that a higher share of foreign firms results in higher productivity and higher spill-over effects. Chuang et al. (2004) also shows that a high technology gap has a smaller spill-over effect than a low technology gap. This indicates that the absorption of new technology is highest by domestic firms with the highest capacity and technology.

Dees (1998) investigates the effect of FDI on economic growth and concludes that this partly happens through technology spill-overs and diffusion. FDI has a significant positive effect on economic growth through the diffusion of technologies in the long run. Also the indicator for openness seems to have a positive and significant effect on economic growth. He achieves these results using a constant elasticity of a substitution production function.

Wei (1996) investigates the effect of FDI on Chinese growth, exports and the effort to reform. He uses city specific data between 1988 and 1990. The author concludes that FDI inflows have a significant positive effect on growth rates on the city-level. He also concludes that FDI is responsible for different growth rates in industrial output between cities. Foreign invested firms are more focussed on export than domestic firms and foreign invested firms do not replace the export of Chinese firms.

Liu (2008) uses an endogenous growth model to find an explanation of FDI results in technological spill-overs. A panel of Chinese manufacturing firms is used to make a distinction between level and rate effects of the spill-overs on productivity of domestic firms. These effects are measured in the short and the long run. The author finds that FDI creates positive spill-overs towards domestic firms. These spill-overs decrease the productivity of domestic firms in the short run but increases productivity in the long run. In accordance with the lower short run level effects the author argues that the adoption of new technologies is an expensive process.

Zhang (2001) investigates the role of FDI inflows and through which channels they effect growth in China. Provincial data between 1984 and 1998 are used to determine the effect of FDI on provincial growth levels. A panel study and cross-section study have been conducted. The results show that FDI inflows have a direct positive effect on Chinese growth rates and on GDP. These direct effects are specified as increased productivity levels and higher exports. Also the indirect effects show a positive effect on China's economic growth. The results also show that the effect of

additional invested FDI between 1980 and 1990 increases the effectiveness of foreign invested firms on China's economy.

4. Determinants of FDI

In this section the determinants of FDI will be discussed. There are different motivations behind foreign production which are natural resource seeking FDI, market seeking FDI, efficiency seeking FDI and strategic asset seeking FDI. These types of FDI are all subjected to a large body of literature. I will briefly discuss three theories. The theories that will be discussed are the Hymer-Kindleberger hypothesis, internalization theory and the eclectic paradigm. These theories are discussed in sub-section 4.1. Sub-section 4.2 discusses the determinants of FDI in accordance to the eclectic paradigm. Sub-Section 4.3 consists of a literary review on the determinants of FDI.

4.1. Theoretical background

4.1.1. Hymer-Kindleberger hypothesis

Until 1960 FDI was thought of as an international flow capital. The motivation behind these capital flows was believed to be the difference in interest rates between countries. One of the first to analyse FDI flows was Hymer. He asked questions about why multinational enterprises (MNE's) would go abroad, how they were able to sustain in a market where they had a disadvantage and why they wanted ownership in firms abroad. Written in 1960, but published in 1976 his article argued that FDI flows were not randomly distributed among different industries. His theory argued that for a foreign firm to be successful in a foreign host country the firm required specific advantages to overcome the added cost of doing business in a foreign country. The motivation behind FDI flows was that if a firm was able to suppress competition and create an imperfect market, the firm was most efficient and increased profits. Hymer claims that the existence of FDI flows are exclusively created by the created imperfections on the foreign market. Together with Kindleberger their work had a major impact.

4.1.2. Internalisation theory

According to Buckley and Casson (1976) internalization is a substitute for the external market. Here MNE's can tap into available information and start their activities with the use of their firm specific advantages. In other words, Multinational enterprises can supplement the external market. Due to market imperfections a firm can create an internal market for intermediate products to increase profits. The creation of these internal markets happens when a contractual relationship is replaced by an internal market. An internal market can also be established by creating a new market where the firm did not have a market of any kind before. According to Buckley and Casson there are four important factors that are important for the internalization process. These are region specific factors, industry specific factors, nation specific factors and firm specific factors. Compared to the Hymer-Kindleberger hypothesis where market power was the driving force behind internalization, the internalization theory is more about efficiency.

4.1.3. Eclectic paradigm (OLI paradigm)

Dunning (1973) argues that because capital flows involve input factors other than money inputs, higher interest rates cannot be the only motivation behind foreign capital investment. According to Dunning there are two important determinants explaining why international production is moved to a specific country. In 1979 Dunning created the eclectic paradigm due to dissatisfaction with the existing theories (Dunning, 1979). This theory suggested that FDI flows would take place if three determinants were satisfied, namely:

-*Ownership* (O) advantages, which refer to the advantages of the firm compared to the foreign firms in the host country.

-*Location* (L) advantages, which refer to the attractiveness of the location where ownership advantages could make it more favourable to produce.

-*Internalization* (I) advantages, which refer to the benefits a firm creates by internalizing compared to using the external market.

There must be some ownership advantages in a host country before an MNE internalizes the foreign market. Ownership advantages include certain production techniques, name familiarity and quality reputation. Other ownership advantages are know-how, skilled labour and management skills. The MNE also requires locational advantages. If there are no locational advantages, MNE's could allow foreign production facilities to use their advanced technologies to produce in a foreign country under their brand name. If a host country has strong locational advantages the MNE could

use their advanced ownership properties to start producing in the foreign country itself. Important types of locational advantage are market size, natural resources, cheap labour and transport costs. For MNE's there must be an internalization advantage to start producing in a foreign country. The internalization advantage shows the advantages of starting production in a foreign market instead of licencing another company to do it. If you licence another company they could decrease the quality to cut costs and increase profits which decreases ownership advantages like quality reputation. There is also no need to share the company's advanced technologies decreasing risk and increasing control. The different streams of FDI according to the eclectic paradigm are: market seeking FDI, natural resource seeking FDI, efficiency seeking FDI, strategic asset seeking FDI.

4.1.4. Model summary

It is apparent that all three theories differ from each other although there are also clear similarities. All firms require firm specific advantages or ownership advantages to be able to compete on a foreign market. The main reason to internalize a foreign market seems to be a competitive advantage in an imperfect foreign market. According to Hymer this advantage can only be utilized if the firm can act as an oligopolist or monopolist and use the firm's specific advantages. According to Buckley and Casson's internalization theory a firm does not need to acquire these levels of market power to profit from internalization. If overcoming the addition costs (transaction costs) of entering a foreign market is possible it is profitable to internalize a foreign market. The eclectic paradigm is a broader framework. The firm must have a competitive (ownership) advantage on the domestic and foreign market. Then the firm determines the risks and value of the foreign market by identifying the internalization advantages. If internalizing a market seems profitable the firm starts looking for locational advantages.

4.2. Analysis on determinant of FDI

In the Hymer-Kindleberger hypothesis and internalization theory the main motivation of internalization is increased efficiency and higher profits. In these models the 'why FDI exists' is more extensively discussed than the 'how these profits can be realized'. How FDI is actually invested remains fairly unexplained. In the eclectic paradigm however this is more extensively discussed. Therefore I will use the eclectic paradigm and the four streams to explain the determinants of FDI. The different streams of FDI being: market seeking FDI, natural resource seeking FDI, efficiency seeking FDI, strategic asset seeking FDI. Due to different goals of foreign investment some determinants are attractive to all forms of FDI. All forms of FDI profit from good infrastructure for example. Legislative changes that make the Chinese market more accessible attract FDI as well. Legislative changes like market accessibility, tax concessions, the reduction of trade barriers and the elimination of quotas and other obstacles had a positive effect on overall FDI inflows especially in China. The agglomeration effect is also mentioned as a determinant of FDI. This indicates that areas with high levels of FDI attract more FDI due to the presence of positive externalities. Cheng and Kwan (2000) find that this agglomeration effect exists in China. Another factor which can influence FDI flows are the social and cultural barriers. Larger cultural differences could make communication and the understanding of customs harder.

Looking from a market seeking perspective China is an extremely potent recipient of FDI. Due to its enormous population, large labour force, high growth and increasing purchasing abilities China suffices as a giant consumer market. Due to the large market and high growth and development rates MNE's can provide a very large market which gives them the possibility to profit from firm specific advantages like economies of scale. High growth and development rates also increase demand of more sophisticated products. Regulations like tariff barriers are also crucial determinants for the attraction of market-seeking FDI in China. Due to the fact that market seeking FDI is a substitute for the import of goods by the host country high trade barriers are an important motivation for MNE's to relocate their facilities to the host country to circumvent high trade barriers.

If we look at China from a natural resource seeking perspective the most important determinant is the natural resource endowment. China has huge amounts amount of coal in the north. China also possesses large amounts of metal and non-metal minerals. Also determinants like geographic location and openness are important determinants for acquiring and transporting natural resources.

Efficiency seeking FDI its main goal is to increase efficiency most commonly by investing in a country with a lower cost structure. The most important determinants are cheap factor

endowments. Especially an abundance of cheap labour is an important determinant. China is a popular choice because of its relatively low average wage rate. Other important factor endowments are cheap land and capital. Because efficiency seeking FDI does mainly focus on production in the host country, geographic location and transport costs are more important with efficiency seeking FDI than with market seeking FDI. China also has an attractive geographical location due to the fact that it gives access to surrounding Asian countries and it is in close proximity to North and South America.

Strategic asset seeking FDI is becoming a more popular form of FDI in China. Almost all strategic assets seeking FDI happens through mergers and acquisitions or the investment in joint ventures. Some purposes of this form of FDI are to acquire new technologies, tap new markets, reduce competition and gain larger knowledge of customs and other ways to acquire a long-term competitive advantage. A good example of strategic asset seeking FDI is the takeover of e-cigarette companies by tobacco companies. The main purpose is to decrease competition. But also to gain knowledge of the product and to some extent, tap into a new market. The determinants of strategic asset seeking FDI are therefore hard to acknowledge because it depends on the main goal of the investment.

4.3. Literature on determinants of FDI

Cheng and Kwan (2000) investigate the effect of multiple determinants on the attraction of FDI inflows in 29 provinces in China. As dependent variable they use the stock of FDI. The effect of the determinants is tested between 1985 and 1995. They divided the determinants of FDI in 5 sets which include; the market and its accessibility, labour related variables, policies, infrastructure and agglomeration effect. Results show that lagged FDI has is highly significant coefficient which indicates a strong reinforcing effect (agglomeration effect). The wage rate is negatively related to FDI inflows. Income per capita is also positive and significant. This indicates that areas with higher income per capita have a higher market potential, which attracts more FDI. All proxies for education and infrastructure are positive but insignificant. Only railroads test negative and insignificant. The policy variable tests positive and significant indicating that areas with more favourable policies towards FDI attract more FDI than areas without these policies (Cheng and Kwan, 2000).

Dees (1998) also investigates the determinants of FDI in China. He uses a panel between 1983 and 1995 which covers 11 countries that represent 90% of FDI flows toward China. As dependent variable he uses the stock of FDI in China for each country. A lagged FDI variable is used as an explanatory variable. Per capita income is used to proxy the market size. Two determinants are used as cost indicators which are the real wage rate and the real exchange rate. The author also

wants to determine the advantage or disadvantage of FDI over licencing in China. He measures this by using the export of a country towards China as a percentage of Chinese GDP. These proxies measure the ties to China and the availability of information. A higher export to GDP ratio results in more information and also cheaper information. Better ties to China result in more and cheaper information resulting in higher profitability of FDI over licencing. Another proxy is used to determine the advantage or disadvantage of FDI over licencing. These are the costs of licencing agreements. The proxy measures the number of patents each home country has. The assumption is that more patents represent a higher level of innovation, increasing the advantage of FDI over licencing. The results show that income per capita is positive and significant. Also that both the real wage rate and the real exchange rate are negative and significant indicating that lower wages and a lower exchange rate attract higher levels of FDI. Both proxies regarding the FDI or licencing decision are positive and significant. This indicates that trade relations between home countries and China positively influence FDI flows. Also higher levels of patents, indicating higher levels of innovation, positively affect FDI inflows (Dees, 1998).

Chen (1996) uses a conditional logit model with pooled cross section and time series data to find the regional determinants of FDI in China. All provinces are grouped in an eastern, middle and western category between 1987 and 1991. The model assumes that regional selection by foreign firms is motivated by profits maximization which is in accordance to the eclectic theory. Chen (1996) uses 5 explanatory variables which are: potential market extension, labour cost, allocative efficiency, transportation linkages and technological filtering. The estimation results show positive significant results for transport and technological filtering is the eastern provinces and potential market extension in the middle region of China (Chen, 1996).

Wei (1996) researches the sources and the consequences of FDI in China. As dependent variables he uses the FDI flows towards China from the 5 largest investors. The time period of this analysis is between 1987 and 1990. The author shows that in both a fixed effects and random effects model GDP, GDP per capita, distance to source country and the literacy rate all significantly affect the attraction of FDI towards China. The literacy rate represents human capital in these results. When the dependent variables are changed from flow to stock of FDI the coefficients change but remain significant (Wei, 1996).

Sun et al. (2002) conducts a panel study between 1986 and 1998 to determine the distribution of FDI inflows between Chinese provinces. The authors also test a sub-sample between 1986 and 1991 indicating the different stages of FDI development. The results show that GDP of provinces did not play a significant role before 1991 but became positive and significant after 1991. The results also show that wage is positively correlated with FDI inflows in the sub-sample, while it is negative correlated to FDI inflows in the full sample. These changes indicate that the nature of the

FDI flows is changed within the period of the full sample. Other important determinants of FDI in both the full and sub-sample are labour quality, infrastructure, openness and a stable political environment. The authors were not able to find evidence of the existence of an agglomeration effect (Sun et al., 2002).

Fung et al. (2005) investigate the effect of hard and soft infrastructure in China as determinants for FDI inflows from Hong Kong, Japan, U.S., Taiwan and Korea. They use a reduced form specification for FDI inflows from the source countries. Hard infrastructure is measured by railroads and highways. Soft infrastructure is measured by policy reforms. Policy reforms are measured by the output produced by State owned enterprises (SOE's) as a percentage of the total output. More output from SOE's indicates lower levels of reform. The authors also control for wage, GDP, education and policies. A panel study is used for each source country to determine the effects of hard and soft infrastructure on FDI flows from the 5 source countries. Results indicate that most FDI from the U.S., Hong Kong, Japan and Taiwan is attracted by soft infrastructure. Korea is the only country in which hard infrastructure is more important (Fung et al., 2005).

5. Theoretical framework

The model used to determine the relationship between FDI and GDP per capita will be discussed in this chapter. To gain insight in the determinants of growth in China, I will use the augmented Solow model created by Mankiw, Romer and Weil (1992). I will start by explaining the original Solow model in section 5.1. In section 5.2 the dynamics of the augmented Solow model will be discussed. In section 5.3 I will explain how FDI and the other control variables are integrated in the model. I will also explain how the final specification is structured.

5.1. The Solow model

The production function in the Solow model is given by the Cobb-Douglas function:

$$(1)\ Y(t) = F(K(t)^{a}\ (A(t)L(t)^{1-a})$$

The four basic variables of the model are Y, K, L and A. Where Y is the output, K is capital, L is labour and A is a determinant for technology. The central assumption of the Solow model is that the properties of the three inputs evolve over time (t). Capital and Labour are the two endogenous inputs in the Solow model, while technology growth g, the savings rate s and population growth n are exogenous.

The production function where output and capital are per effective unit of labour is indicated by the equation below:

$$(2)\ y(t) = f(k(t))^{a}$$

$y(t)$ indicates the output per effective unit of labour, and is given by $\frac{Y}{AL}$. $k(t)$ indicates capital per effective unit of labour and is given by $\frac{K}{AL}$.

Labour, L and technology, A, both grow exogenously at rate n and g:

$$(3)\ L(t) = L(0)e^{nt}$$

$$(4)\ A(t) = A(0)e^{gt}$$

L(0) and A(0) indicate the values of Labour and Knowledge at time 0. The assumption here is that both L and A grow exponentially. The output is divided between consumption and investment. The

part devoted to invest in savings is constant. One unit saved accumulates one unit of additional capital.

The existing capital depreciates at rate δ. The equation of capital accumulation is thus:

$$(5)\ \dot{K}(t) = sY(t) - \delta \text{K(t)}$$

A dot above the letter indicates that it is the derivative with respect to time. Equation (5) indicates that the change in Ḱ depends on the share of output that is saved and invested minus the depreciation of the existing capital.

Defining k as capital per effective unit of labour, where k is $\frac{K}{AL}$, the change in k, $\dot{k}$ is shown by the function:

$$(6)\ \dot{k} = sy(t) - (n + g + \delta)k(t)$$

This is the key equation of the Solow model. It states that the change in the rate of capital per effective labour is dependent on two terms. The first term is the part of the output per effective labour that is saved and invested. The second part indicates the amount of investment necessary to maintain the current capital stock. Because the quantity of effective labour is growing with rate n + g, the capital stock must grow at rate (n +g) k to keep k constant. Capital must also be replaced to keep k from falling. This is indicated by δk. If the actual investment is higher than the break-even investment $(n + g + \delta)k(t)$, $\dot{k}$ is increasing. If the actual investment per effective labour is smaller than the break-even investment, $\dot{k}$ is decreasing. If the two are equal, $\dot{k}$ is constant.

To find the steady-state level of k, $\dot{k}$ must be 0. The steady-state level of capital per effective unit of labour is indicated by $\dot{k}$. Substituting equation (2) into equation (7), and assuming that $\dot{k}$ = 0 gives you:

$$(7)\ 0 = sk^*(t)^a - (n + g + \delta)k^*(t)$$

Rewriting this equation to k^* gives:

$$(8)\ k^* = \left(\frac{s}{n+g+\delta}\right)^{\frac{1}{1-a}}$$

If we substitute equation (8) into the production function (2), take logs and rewrite to per capita instead of per unit of effective of labour, we get:

$$(9)\ ln\left(\frac{Y}{L}\right) = A(0) + \frac{\alpha}{1-\alpha}(s) - \frac{a}{(1-a)}(n+g+\delta) + gt$$

With this specification, g and δ are assumed to be constant across countries. Also assumed is that population growth and the savings rate are independent of the country-specific factors. This specification investigates if GDP per capita is higher in countries with higher saving rates and lower in countries with higher values of $(n+g+\delta)$. $A(0)$ indicates the technology factor.

Because Mankiw, Romer and Weil add human capital accumulation to the Solow model, their augmented Solow model is more suitable in explaining economic growth in China. The augmented Solow model will be discussed in the next section.

5.2. The augmented Solow model

In this section the augmented Solow model will be discussed. The model adds human capital accumulation to the equation. The production function now looks like:

$$(10) \qquad Y(t) = K(t)^{a} H(t)^{\beta} (A(t)L(t))^{1-a-\beta}$$

The five basic variables of the model are Y, K, H A and L. Where Y is the output, K is capital, H is human capital, A is a determinant of technology and L is labour. The central assumption of the augmented Solow model is that the properties of the four inputs evolve over time (t). Capital, labour and human capital are the three endogenous inputs in the augmented Solow model, while technology growth g, the savings rate s and population growth n are exogenous. The production function per effective unit of labour is now:

$$(11) \qquad y(t) = k(t)^{a} h(t)^{\beta}$$

k indicates capital per effective unit of labour, and h indicates human capital per unit of effective labour. The L and A grow exogenously at rate $n+g$. Human capital depreciates at the same rate as physical capital.

The dynamics of the change in physical and human capital are the same as in the original Solow model and are explained beneath equation (6). Human capital depreciates at the same rate as physical capital. The amount of output invested in either physical or human capital is costless. Mankiw, Romer and Weil (1992) assume that the two functions act similar. They also assume that $a+\beta$ is smaller than 1. This indicates that there are decreasing returns to scale and allow for a

steady-state level. If $a + \beta$ = 1, there would be constant returns to scale. This would allow for endless growth through the endogenous factors of the model. In this case there would be no steady-state level. It also allows for indefinite faster growth if a particular country saves more.

The steady state levels of the augmented Solow model are defined by:

(12) $$k^* = \left(\frac{s_k^{1-\beta} s_h^{\beta}}{n+g+\delta}\right)^{\frac{1}{1-a-\beta}}$$

(13) $$h^* = \left(\frac{s_k^{a} s_h^{1-a}}{n+g+\delta}\right)^{\frac{1}{1-a-\beta}}$$

If we substitute equation (12) and (13) into production function (11), rewrite to per capita, instead per unit of effective labour, we get:

(14) $$ln\left(\frac{Y}{L}\right) = A(0) + \frac{a+\beta}{1-a-\beta}(n + g + \delta) + \frac{a}{1-a-\beta} s_k + \frac{\beta}{1-a-\beta} s_h + gt$$

This equation shows how income per capita is affected by the accumulation of physical and human capital. The steady-state level of the augmented Solow model is higher than that of the original Solow Model.

In the augmented Solow model labour, fixed capital and human capital are the endogenous growth factors L, K and H. In this model, I will let gt include FDI, export, local governmental revenue, local governmental spending and infrastructure.

5.3. Towards the empirical specification adding FDI and control variables

In order to estimate the effect of FDI on GDP per capita some assumptions of the augmented Solow Model cannot be honoured. First, population growth cannot be constant because population growth varies over time and per province. Second, the yearly values of fixed domestic capital already include depreciation so there will be no explanatory variable $(n + g + \delta)$ included in the model. Third, the specification of the augmented Solow model on itself is not sufficient to estimate my specification because it would measure FDI, export, governmental revenue and governmental spending only through the constant and the error term. These variables will be added to the model through gt. Fourth, because it is not constant across countries and δ is included in the total of fixed domestic capital, I will measure fixed domestic capital as a percentage of total GDP instead of through $(n + g + \delta)$.

Table 3: Variable names, definitions and type of measurement

Variables	Definition	Type of measurement
Dependent variable		
Log(GDPpercapita)	Log(Total GDP/ total population)	Measured in Chinese Yuan
Independent variables		
Fixed capital	Fixed domestic capital/GDP	Measured as % of total GDP
Pop growth	(Pop at time t - pop at t-1)/ Total pop at time t-1)	Measured as growth rate compared to previous year
Human capital	Secondary + higher education/ total population	Measured as % of total population
Log(FDI)	Log(Foreign direct investment)	Measured in 100 million Chinese yuan
Log(export)	Log(Export)	Measured in 100 million Chinese yuan
Log(revenue)	Log(Local governmental expenditures)	Measured in 100 million Chinese yuan
Log(spending)	Log(Local government revenue)	Measured in 100 million Chinese yuan
Log(infrastructure)	Length of highway +railway in km as a % of square km per province	Length in km measured as a % of total square km

FDI will be added into the specification through gt because this input represents the technology growth. The reason FDI will not be inputted through k is that FDI adds more than just capital. As discussed by Chuang (2004), Dees (1998), Liu (2008), Yao et al. (2007) and Zhang (2001) FDI adds to the speed of the adoption of new technologies. This indicates that FDI does not only add capital but also boosts technological advancement. Because Chuang (2004) and Yao (2007) also conclude that FDI decreases the technological gap between domestic and foreign capital, the assumption that the same amount of foreign capital adds more to GDP per capita than domestic capital does seem reasonable. This makes including FDI in fixed domestic capital (k) not the best option for reliable results because foreign capital is more technological advanced. Therefore FDI will be included in gt.

To isolate the effect of FDI on GDP per capita other explanatory variables are added into the specification to explain economic growth in China. According to Koopman (2008), Liu (2002) and Zhang (2001) there exists an interdependent relationship between export, FDI and economic growth which makes export a crucial variable to include in the specification. Export is assumed to control for the direct effect on GDP per capita. The effect of FDI on GDP per capita is also assumed to be measured through export. Both governmental revenue and spending are assumed to affect economic activity on provincial level and are therefore added as control variables in the regression. High

amounts of governmental revenue and spending represent higher GDP per capita. Infrastructure, as well as export, is an explanatory variable that directly effects economic growth according to Demurger (2001) and Sahoo et al. (2010). Infrastructure, according to Sahoo (2010), also captures an indirect effect on economic growth through increases in FDI and exports. This makes infrastructure a good explanatory variable to isolate the effect of FDI on GDP per capita.

The following specification will be used to measure the effect of FDI on GDP per capita:

$$(15) \quad \ln(GDPpercapita)it = \beta_0 + \beta_1(popgrowth)it + \beta_2(fixedcapital)it + \beta_3(humancapital)it + gt + (\varepsilon)it$$

Equation (15) shows the original specification of the augmented Solow model, where $popgrowth, fixedcapital$ and $human\ capital$ represent the endogenous inputs L, K and H. The exogenous technology growth gt is used to input the additional explanatory variables to the specification. This is shown in equation (16).

$$(16) \quad gt = ln\beta_4(FDI)it + ln\beta_5(export)it + ln\beta_6(revenue)it + ln\beta_7(spending)it + ln\beta_8(infrastructure)it + \delta_1(Dummy)i + \delta_2(Dummy)t$$

Substituting equation (16) into equation (15) will give the following specification:

$$(17) \quad \ln(GDPpercapita)it = \beta_0 + \beta_1(popgrowth)it + \beta_2(fixedcapital)it + \beta_3(humancapital)it + ln\beta_4(FDI)it + ln\beta_5(export)it + ln\beta_6(revenue)it + ln\beta_7(spending)it + ln\beta_8(infrastructure)it + \delta_1(Dummy)i + \delta_2(Dummy)t + (\varepsilon)it$$

Equation (17) is the final specification and will be used in the next section to acquire the estimation results. In this specification GDP per capita is indicated by $\ln(GDPpercapita)it$. β_0 indicates the constant. Population growth is indicated by $\beta_1(popgrowth)it$. Fixed domestic capital as a percentage of total GDP is shown by $\beta_2(fixedcapital)it$. Human capital is captured by $\beta_3(humancapital)it$. According to the augmented Solow model, $\ln(y)it$ is calculated by these endogenous explanatory variables.

Equation (16) shows gt, which represents the variables I added to the original augmented Solow model. These variables are $(ln\beta_4(FDI)it)$, $(ln\beta_5(export)it)$, $(ln\beta_6(revenue)it)$, $(ln\beta_7(spending)it)$ and $(ln\beta_8(infrastructure)it)$. All variables are measured for province i, at time t. Where $i(i = 1, 2, 3, \dots \dots 30)$ and $t(t = 1, 2, 3 \dots \dots 31)$. For clarification table 3 shows the specifications of all variables.

gt also includes a province dummy $\delta_1(Dummy)i$ and a time dummy $\delta_2(Dummy)t$. $\delta_1(Dummy)i$ indicates a vector of province dummy variables, including dummies for $i(i = 1, 2, 3 \ldots \ldots 30)$ to each regression. $\delta_2(Dummy)t$ indicates a vector of time dummy variables, including dummies for $t(t = 1, 2, 3 \ldots \ldots 31)$ to each regression. $(\varepsilon)it$ represents the error term.

6. Empirics

In this section I will discuss the data used in this analysis in section 6.1. First, I discuss deleted data points and the augmentation of the variables. Second, I will discuss some possible problems that might be present and the quality of the data. In section 6.2 I will discuss the variables used in the analysis, their expected signs and specifications. In section 6.3 the estimation results are discussed.

6.1. Data

To find the effect of FDI on GDP per capita a panel data analysis will be conducted. This method is the best choice considering data among different provinces over a time period. Data is collected between 1980 and 2010 among 30 Chinese provinces. The names of the provinces used can be found in Appendix A. The number of observations with a complete dataset would be 30x31=930. Almost all data is obtained from allchinadataonline.org. The database gives access to multiple datasets created by the National Bureau of Statistics in China. It is produced by All China Market research Corporation and the China Data Center at the University of Michigan. To measure the effect of infrastructure on GDP per capita I scaled the length of railway and highway to the total size of each province in square kilometres. The data on province size comes from chinatoday.com. The descriptives can be observed in table 4.

Table 4: Descriptives

Variables:	Obs	Mean	Std. Dev.	Min	Max
Log(GDPpercapita)	923	3.56	.60	2.34	4.89
Log(FDI)	830	1.02	1.34	-2.98	3.29
Pop growth	906	.01	.01	-.08	.19
Fixed capital	930	.36	.15	.09	.93
(human capital)	855	.06	.021	.002	.13
Log(revenue)	930	1.98	.65	.03	3.65
Log(spending)	930	2.15	.68	.32	3.73
Log(infrastructure)	930	-.59	.40	-1.89	.29
Log(export)	915	1.93	.99	-1.22	4.49

I deleted the province Tibet from the analysis due to a lack of data. Tibet is also excluded because it received almost no FDI inflows. I removed outliers mainly from older data to prevent biased coefficients. I created scatterplots to check the correlation between all explanatory variables and the dependent variable. These scatterplots can be observed in Appendix B. I also used these

scatterplots to determine outliers in the data. Data points were deleted from the population growth variable that was assumable wrongly imputed. I also created a variable measuring human capital by combining secondary and higher education. I did this because the data for secondary education has very low correlation to GDP per capita and higher education has a non-linear correlation. By combining these two variables I created a variable that better represents the effect of human capital on GDP per capita. I decided not to use lower education because of its negative correlation to GDP per capita. In accordance to the augmented Solow model, human capital is supposed to have a positive effect on GDP per capita. Another reason I did not implement primary education is because the spill-over of FDI inflows stimulates higher forms of education according to the literature, which makes primary education not suited as a control variable.

To create the infrastructure variable, I used railway and highway data. I measured the length of railway and highway combined per square kilometre for each province. Highway however has a much larger effect than railway in this variable because the total length of highway is much larger than that of railway in most provinces. For my regression I took the logarithm of this variable to make it more linear. While the correlation between infrastructure and GDP per capita could still be better, the variables are better for measurement when used as logarithms.

To research the effect of FDI on GDP per capita a fixed effects model is used. This method is more compatible when investigating 30 provinces over 31 years than a random effects model. I added time dummies for every year and province dummies for every province to control for time and province specific effects. As expected in a fixed effects model all province dummies are omitted. Though omitted, coefficients differ. All time dummies are different from zero indicating year-specific effects among all provinces.

As can be seen in the scatterplots in Appendix B FDI, export, revenue and spending have a good distribution. The distribution looks normal and there is no sign of outliers that should be removed. The sign is also clearly positive for these explanatory variables. The distribution of I/Y is less good but will still suffice according to my knowledge. Population growth, education and infrastructure are not well distributed. With population growth I removed multiple extreme outliers, but it seems that the majority of data points are located between 0 and 0.2, and there is no clear positive or negative sign. With education it is clearly visible that secondary education is not specifically for the richer provinces and that there is no clear trend. Higher education is clearly for the provinces with higher levels of GDP per capita. I combined the two forms of education to stretch the graph more to the right so the trend between GDP per capita and education becomes clearer. Infrastructure is also hard to measure because as can be observed in the scatterplot the relation is clearly non-linear. It is however clear that a higher level of infrastructure is positively correlated to GDP per capita.

6.2. Variable specification

The specification that will be used in this study to determine the effect of FDI on GDP per capita is:

$$\ln(GDPpercap)it = \beta_0 + \beta_1(popgrowth)it + \beta_2(fixedcapital)it + \beta_3(humancapital)it + ln\beta_4(FDI)it + ln\beta_5(export)it + ln\beta_6(revenue)it + ln\beta_7(spending)it + ln\beta_8(infrastructure)it + \delta_1(Dummy)i + \delta_2(Dummy)t + (\varepsilon)it$$

The dependent variable used in this analysis is GDP per capita measured in Chinese Yuan. This form of measurement is used because it is in accordance with the augmented Solow model. This analysis has eight different explanatory variables that affect GDP per capita. These variables are: population growth, fixed domestic capital, human capital, FDI, export, government revenue, government spending and infrastructure. The main goal is to determine the effect of FDI on GDP per capita. To get measurements as reliable as possible, I will control for these variable categories to measure the effect of FDI on GDP per capita as precise as possible.

The first variable in the specification is population growth. This variable is measured in accordance to the augmented Solow model. Population growth is measured as the difference in population in two consecutive years divided by the previous year. The sign is expected to be negative as explained by the augmented Solow model. I chose not to use the logarithm because the first year of every province starts at zero and there are negative population growth values. If the logarithm is used, as I tried, around 60 observations would be lost which is not preferable for my results.

Also in accordance with the augmented Solow model is capital accumulation through the savings-rate. The savings-rate will be measured as the amount of fixed domestic capital as a percentage of total GDP in each year. Both the values of GDP and fixed domestic capital are measured in 100 million Yuan. Capital accumulation is dependent on the savings rate. Therefore measuring fixed domestic capital as a percentage of GDP is a good measure for the savings rate. The sign is expected to be positive as explained by the augmented Solow model.

Human capital is measured by the number of educated people as a percentage of the total population. Secondary and higher education are added up and measured as a percentage of the total population in each year. This measure of human capital is in accordance with the augmented Solow model. The indicator of human capital is measured in 10000 people. The total population is measured in 10000 people as well. The expected sign of human capital on GDP per capita is expected to be positive.

The main goal of this analysis is to measure the effect of FDI on GDP per capita. The original data from allchinadata.org was in 1000 US Dollars, so I used the real average exchange rate for each

year between 1980 and 2010 to transmute the data from US Dollars to Chinese Yuan. FDI is measured as a logarithm and is measured in 100 million Yuan. The sign of the coefficient is expected to be positive. It is fairly difficult to gain a good estimate due to omitted variable bias therefore it is important to add enough control variables. Another possible problem could be reverse causality. According to Liu et al. (2002) there is a two-way connection between growth and FDI.

Export is added to the regression as a control variable. The effect of export on growth has been heavily discussed in the literature. The relation between FDI inflows, export and growth is well established. Export was measured in 1000 US Dollars in the original data. I used the real average exchange rate for each year between 1980 and 2010 to transmute the data to Chinese Yuan. Export is measured as a logarithm and is measured in 100 million Yuan. The sign of export on GDP per capita is expected to be positive

As a control variable explaining GDP per capita, local government revenue will be used. Literature shows that provinces that generate higher revenue's account for higher growth. The sign of local governmental revenue is therefore expected to be positive. Higher provincial revenue's indicate that the province accumulates more output and taxes which indicate more growth activities and GDP accumulation. Therefore it is expected to have a positive effect on GDP per capita.

Local government spending is also added to the regression. The expectations are comparable to those of government revenue. The scatterplot shows that there is a linear correlation between spending and GDP per capita. This indicates an expected positive sign.

The last category used is infrastructure. To measure infrastructure two different forms of infrastructure will be used. These are highway and railway. Both variables are measured per 10000 kilometres. Highway and railway are added and divided by total square kilometres of each province. The province size is also measured in 10000 square kilometres. The infrastructure variable is expected to have a positive effect on GDP per capita. The logarithm is used because it seems to have a better distribution.

Time and provincial dummies are included into the regression to control for time and provincial specific effects. In the estimation 31 time dummies will added for each year from 1980 to 2010. 30 provincial dummies will also be added to represent the 30 provinces used in the regressions.

6.3. Estimation results and analysis

In this section I will discuss the results of my regressions. As explained before I used panel data from 30 Chinese provinces among 31 years. The time period stretches from 1980 until 2010. I excluded Tibet because of a lack of data. A Fixed effects model with year and province dummies is used to determine the effect of FDI on GDP per capita. The regression results are shown in table 5. The asterisks *, **, *** indicate significance levels of 10%, 5% and 1%. To see how variables affect each other I include more variables to the basic augmented Solow model regression which consist of population growth, fixed domestic capital and human capital.

In column (1) the results are shows if only the original variables of the augmented Solow model are included. In column (2) FDI is added. There are no province and time dummies added to these regressions. The only addition of column (1) and (2) is to show the difference between the coefficients if dummies are added. As shown in column (1), (2), (3) and (4) it is clear that the coefficients differ substantially if dummies are not included. The coefficients are heavily overestimated. This can be explained by the fact that there has not been controlled for years, indicating there will be a huge difference between data points over 31 years. Also the difference between the 30 provinces has not been accounted for. Dummies are added in all other regressions, except (1) and (2), showing much more believable coefficients.

In column (3) I only used population growth, fixed domestic capital and human capital. The explanatory variables are significant at a 1% significance level, except n. The reason I only added these variables to the regression is because I wanted to see how the endogenous inputs of the augmented Solow model reacted with as little interference as possible. The signs of k and human capital are positive as expected but the coefficient of population growth has the wrong sign and is insignificant. I expect the coefficient of human capital to be overestimated. The coefficient is exceptionally high. The number of observations in regression (3) is 847. This number, as can be observed in the table 4, can be explained by the missing data from population growth and human capital. GDP per capita misses a few data points as well.

In column (4) FDI is added to the regression. The coefficient is positive and significant at a 1% level. Adding FDI increases the coefficients of population growth and human capital. It also decreases the coefficient of fixed domestic capital. Adding FDI also decreases the significance level of domestic capital to a 10% significance level. The human capital coefficient also increases when adding FDI. According to the literature this is to be expected, although I still believe that the human capital variable is overestimated. The number of observations also decreases a lot due to fact that there are missing data among the FDI variable which might also influence the coefficients, R-squared and the F-statistic.

Table 5: Estimation results

Dependent variable: Log(GDPpercapita)								
Explanatory variables:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(FDI)		.28***		.015***	.018***	.023***	.023***	.023**
		(.006)		(.005)	(.005)	(.004)	(.004)	(.009)
Pop growth	1.65*	1.17***	.14	.21	-.06	-.19***	-.19*	-.19
	(.87)	(.42)	(.15)	(.14)	(.13)	(.11)	(.11)	(.14)
Fixed capital	2.30***	.46***	.07***	.05*	.13***	.08***	.08***	.08
	(.12)	(.07)	(.03)	(.03)	(.02)	(.02)	(.02)	(.06)
Human capital	10.49***	7.53***	1.04***	1.14***	.86***	.61***	.60***	.60
	(.80)	(.40)	(.16)	(.16)	(.14)	(.12)	(.13)	(.41)
Log(revenue)						.22***	.22***	.22***
						(.02)	(.02)	(.06)
Log(spending)						.18***	.18***	.18*
						(.03)	(.03)	(.10)
Log(infrastructure)							-.03	-.03
							(.02)	(.07)
Log(export)					.13***	.04***	.04***	.04
					(.01)	(.01)	(.01)	(.04)
Constant	2.07***	2.72***	4.34***	2.60***	2.59***	2.96***	2.93***	2.93***
	(.10)	(.03)	(.03)	(.03)	(.03)	(.08)	(.08)	(.20)
Number of obs.	847	752	847	752	751	751	751	751
R-Squared	0.6829	0.9119	0.9922	0.9912	0.9930	0.9949	0.9950	0.9950
F-stat	54.77	236.59	2687.79	2025.70	2472.84	3230.41	3148.64	3148.64
Provincial dummies	no	no	yes	yes	yes	yes	yes	yes
Time dummies	no	no	yes	yes	yes	yes	yes	yes
Clustered Std. Err.	no	no	no	no	no	no	no	yes

Note: asterisks indicate significance level and numbers in parentheses are standard errors.

In column (5) the export variable is included in the regression. The sign of this variable is positive as expected and significant at a 1% level. Including export results in a sign change for population growth but remains insignificant. The coefficients of fixed domestic capital and FDI both increase by adding export to the regression. The coefficient of fixed domestic capital also increases

from a 10% to a 1% significance level. The human capital coefficient decreases. The coefficient is still overestimated but it is a good sign that adding more control variables decreases the coefficient.

Column (6) shows the results when local governmental revenue and spending are added. Both variables have a large positive coefficient and are significant at a 1% level. The addition of both these variables results in population growth becoming significant at a 1% level. It also results in a decrease in the coefficients of fixed domestic capital, export and human capital. FDI increases however.

In column's (7) infrastructure is added. Infrastructure has a negative sign and is insignificant. This was not as expected but can probably be explained by the fact that the distribution of data points was not normal and there was no strong correlation between the infrastructure variable and GDP per capita. Adding infrastructure does only seem to affect the significance level of population growth which decreases from 1% to 10%. The other variables seem to be almost unaffected by the addition of infrastructure. This indicates that there is no strong correlation that might influence the coefficient. This is strange because the variable seems to be unaffected by the other variables but is still negative despite the positive correlation observed in the scatterplot.

Column (8) shows the regression with all variables but with standard errors clustered by province. These clustered standard errors correct for autocorrelation and heteroskedasticity over time within each of the 30 provinces. Column (8) shows that this changes the standard errors and significance levels of all variables substantially. Population growth, fixed domestic capital, human capital, infrastructure and export turn insignificant. Significance levels of FDI and governmental spending decrease but remain significant at a 5% and 10% level. Governmental revenue's significance level remains the same. It is good to see that despite the stronger assumptions the effect of FDI on GDP per capita is still significant.

Overall results show that FDI remains positive and the coefficient varies between 0.015 and 0.023 which indicates that if FDI increases with 1% this will result in an increase in GDP per capita of 0.015% to 0.023%. The FDI coefficient never loses its significance level. After adding control variables and using clustered standard errors FDI remains significant. Fixed domestic capital and export both seem to be variables that are solid and explain a lot of variance after adding them to the regression. Population growth seems to be very volatile and easily adapted after adding more variables. I cannot explain for example why governmental revenue and spending turn population growth significant. Governmental revenue and spending seem to both have a positive effect on GDP per capita. Also infrastructure does not seem to have the effect on the other variables as I had anticipated. An explanation might be the fact that it was wrongly measured. Human capital, though I believe overestimated, seems to have a solid positive effect on GDP per capita as predicted and in accordance with the augmented Solow model.

7. Conclusion

Preliminary to my research I try to shed light on the history of China to make the reader better understand how FDI affected China's growth during the last decades. In addition to the historical review, important growth factors that will be used in the empirical analysis are discussed using existing literature. A small model summary about what attracts FDI is added, as well as an analysis on the determinants that attract FDI using existing literature. These chapters are added to create a picture of China, its extensive growth and the role of FDI that is as complete as I could create it.

This thesis attempts to explain the effect of FDI inflows on China's GDP per capita. The research question of this thesis is: *Does foreign direct investment have a positive effect on China's GDP per capita?*

The empirical specification used in this thesis has the augmented Solow model as foundation. The effect of FDI on GDP per capita is explained by a function containing the original inputs population growth, fixed domestic capital and human capital in accordance to the augmented Solow model. In addition to these original inputs FDI, export, local governmental spending, local governmental revenue and infrastructure are integrated in the model as control variables. The relevance of these additional inputs and their effect on growth and each other is discussed in this thesis.

To estimate the effect of FDI on GDP per capita a panel study among 30 provinces over 31 years has been conducted. The majority of the results were as expected. Fixed domestic capital and human capital have a positive sign which is in accordance to the augmented Solow model. The sign of population growth is in accordance to the model but did not show consistent significant results. FDI, export, local governmental revenue and local governmental spending have a positive effect on growth which is in accordance to the majority of literature. Infrastructure however, did not show the result I expected. The sign remained negative and the coefficient insignificant.

The simple answer to my research question is yes. The results of FDI remained significant and positive during multiple regressions. Although additional control variables influenced the coefficient of FDI, the results remain significant at a 1% level during all regressions with normal standard errors. If the complete model is measured with standard errors clustered by province the FDI coefficient remains significant at a 5% level. This indicates that there is no heteroskedasticity and autocorrelation over time within the provinces. The estimation results show that the effect of FDI on GDP per capita varies between 0.015 and 0.023. This indicates that a 1% increase in FDI increases GDP per capita with 0.015% to 0.023%.

8. Bibliography

Articles:

Au, C.-C., Henderson, V. (2006) ''How migration restrictions limit agglomeration and productivity in China'', *Journal of Development Economics*, Vol. 80, 350-388

Barro, R. J. (2001) ''Human Capital: Growth, History, and Policy-A Session to Honor Stanley Engerman'', *The American Economic Review*, Vol. 91, 12-17

Benhabib, J., Spiegel, M. M. (1994) ''The role of human capital in economic development, Evidence from aggregate cross-country data'', *Journal of Monetary Economics*. Vol. 34, 143-173

Chen, B., Feng, Y. (2000) ''Determinants of economic growth in China: Private enterprise, education and openness'', *China Economic Review*, Vol. 11, 1-15

Chen, C. H. (1996) ''Regional determinants of foreign direct investment in mainland China'', *Journal of Economic Studies*, Vol. 23, 18-30

Cheng, L. K., Kwan, Y. K. (2000) '' What are the determinants of the location of foreign direct investment? The Chinese experience'', *Journal of International Economics*, Vol. 51, 379-400

Chow, G. C. (2004) ''Economic Reform and Growth in China'', *Annals of Economic and Finance*, Vol. 5, 127-152

Chuang, Y. C., Hsu, P. F. (2004) '' FDI, trade, and spillover efficiency: evidence from China's manufacturing sector'', *Applied Economics*, Vol. 36, 1103-1115

Cohen, D., Soto, M. (2007) "Growth and human capital: good data, good results'', *Journal of Economic Growth,* Vol. 12, 51-76

Dees, S. (1998) ''Foreign Direct Investment in China: Determinants and Effects'', *Economics of Planning*, 31, 175-194

Demurger, S. (2001) ''Infrastructure Development and Economic Growth: An Explanation for Regional Disparities in China?'', *Journal of Comparative Economics*, Vol. 29, 95-117

Dunning, J. H. (1973) ''The determinants of international production'', *Oxford Economic Papers*, Vol.25, 289-335

Dunning, J. H. (1979) ''Explaining changing patterns of international production: a search for the eclectic theory'', *Oxford Bulletin of Economics and Statistics*, Vol. 161, 269-295

Fleisher, B., Li H., Zhao, M. Q. (2010) ''Human capital, economic growth, and regional inequality in China'', *Journal of Development Economics*, 92, 215-231

Fung, K. C., Garcia-Herrero, A., Lizaka, H., Siu, A. (2005) ''Hard or soft? Institutional Reforms and Infrastructure Spending as Determinants of Foreign Direct Investment in China'', *Japanese Economic Review*, Vol. 56, 408-416

Heckman, J. J. (2005) ''China's human capital investment'', *China Economic Review*, Vol. 16, 50-70

Honge Gong, C., Meng, X. (2008) ''Regional Price Differences in Urban China 1986--2001: Estimation and Implication'', *IZA discussion papers*, No. 3621

Jin, H., Qian, Y., Weingast, B. R. (2001) ''Regional Decentralization and Fiscal Incentives: Federalsim, Chinese Style'', *Journal of Public Economics*, Vol. 89, 1719-1742

Koopman, R., Wang, Z., Wei, S.-J. (2008) ''HOW MUCH OF CHINESE EXPORTS IS REALLY MADE IN CHINA? ASSESSING DOMESTIC VALUE-ADDED WHEN PROCESSING TRADE IS PERVASIVE'', *Nber Working Paper,* No. 14109

Liu, X., Burridge, P., Sinclair, P. J. N. (2002) ''Relationships between economic growth, foreign direct investment and trade: evidence from China'', *Applied Economics*, Vol. 34, 1433-1440

Liu, Z. (2008) ''Foreign direct investment and technology spillovers: Theory and evidence'', *Journal of Development Economics*, 85, 176-193

Mankiw, G., Romer, D., Weil, N. (1992) ''Empirics of Economic Growth'', *The Quarterly Journal of Economics*, Vol. 107, 407-437

Montalvo, J., Ravellion, M. (2010) ''The pattern of growth and poverty reduction in China'', *Journal of Comparative Economics*, Vol. 38, 2-16

Pomfret, R. (1997) ''Growth and Transition: Why Has China's Performance Been So Different?'', *Journal of Comparative Economics*, Vol. 25, 422-440

Qian, Y. (2002) ''How Reform Worked in China'', *William Davidson Institute Working Paper*, No. 473

Rodrik, D. (2006) ''What's So Special about China's Exports?'', *NBER Working Paper,* No. 11947

Sahoo, P., Dash, R. K., Nataraj, G. (2010) ''Infrastructure Development and Economic Growth in China'', *Institute of Developing Economies, IDE Discussion paper*, No. 261

Shen, C., Jin, J., Zou, H. F. (2012) ''Fiscal decentralization in China: history, impact, challenges and next steps'', *Annals of Economics and Finance*, Vol. 13, 1-51

Sun, Q., Tong, W., Yu, Q. (2002) ''Determinants of foreign direct investment across China'', *Journal of International Money and Finance*, Vol. 21, 79-113

Tsen, W. H. (2010) ''Exports, Domestic Demand, and Economic Growth in China: Granger Causality Analysis'', *Review of Development Economics*, Vol. 14, 625-639

Wei, S. j. (1996) ''Foreign direct investment in China: Sources and consequences'', *University of Chicago Press, Financial Deregulation and Integration in East Asia*, NBER-EASE Vol. 5, 77-105

Yao, S., Wei, K. (2007) ''Economic growth in the presence of FDI: The perspective of newly industrialising economies'', *Journal of Comparative Economics*, Vol. 35, 211–234

Zhang, H. K. (2001) ''How does Foreign Direct Investment affect economic growth in China?'', *Economics of Transition*, Vol. 9, 679-693

Zhou, X. (2000) ''Economic Transformation and Income Inequality in Urban China: Evidence from Panel Data'', *American Journal of Sociology*, Vol. 105, 1135-1174

Books:

Hymer, S., Cohen, R. B. (1979) ''*The multinational corporation: A radical approach*, Cambridge University Press'', Cambridge

Buckley, P. J., Casson, M. C. (1976) ''*The Future of Multinational Enterprise*'', London, Macmillion

Background readings (not cited)

Gugler, Pl., Boie, B. (2008) ''The emergence of Chinese FDI: Determinants and Strategies of Chinese MNEs'', *Copenhagen Business School, Copenhagen*

Rugman, A. M., Verbeke, A. (2008) ''Internalization theory and its impact on the field of international business'', *International Business Scholarship: AIB Fellows on the First 50 Years and Beyond*, Vol. 14, 155-174

URL

https://people.hofstra.edu/geotrans/eng/ch5en/conc5en/China_SEZ.html

http://www.novexcn.com/encour_foregn_invest.html

http://www.fep.up.pt/docentes/fcastro/chapter%202.pdf

www.worldbank.org

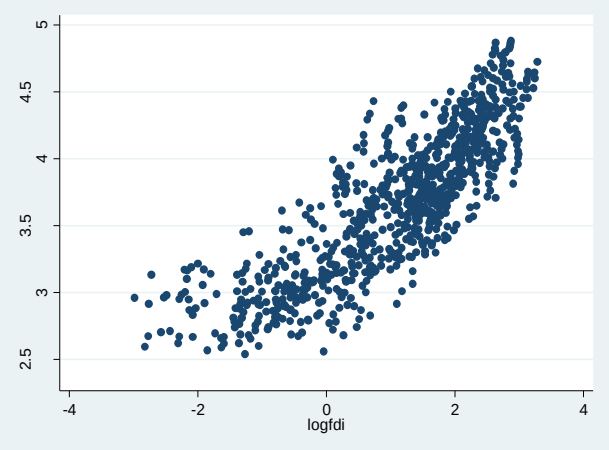
9. Appendix:

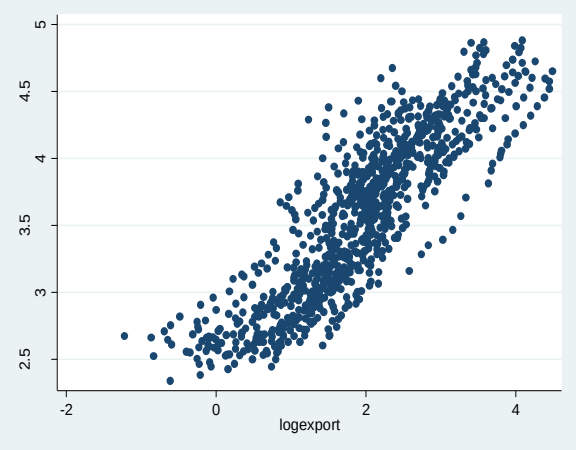
9.1. Appendix A: Chinese provinces used

Coastal provinces	Inland provinces
Beijing, Fujian, Guangdong, Guanxi, Hainan, Hebei, Jiangsu, Liaonig, Shandong, Shanghai,Tianjin, Zhejiang	Anhui, Chongqing, Gansu, Guizhou, Heilongjiang, Henan, Hubei, Hunan , Inner Mongolia, Jiangxi, Jilin, Ningxia, Qinghai, Shaanxi, Shanxi, Sichuan, Tibet (omitted), Xingjian, Yunnan

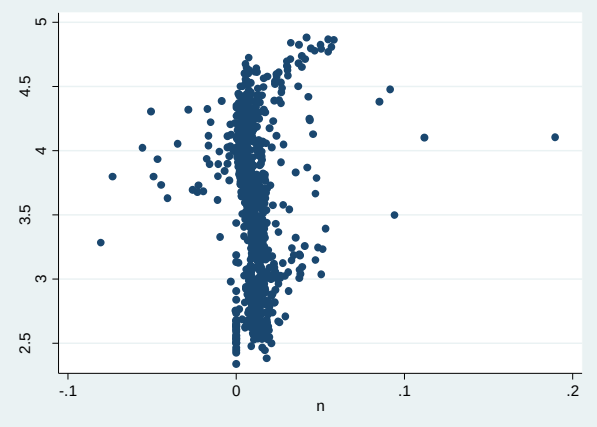
9.2. Appendix B: Scatterplots of all explanatory variables

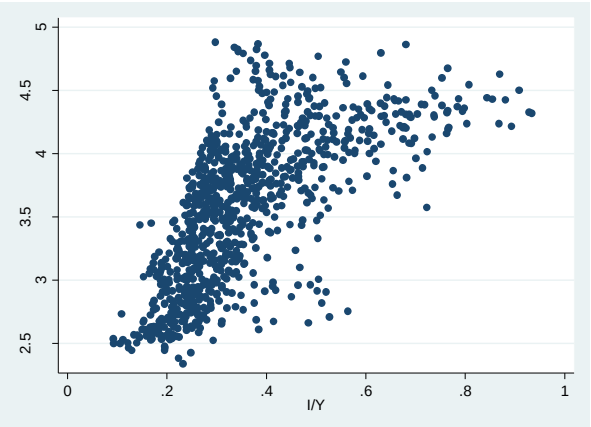
FDI and export:



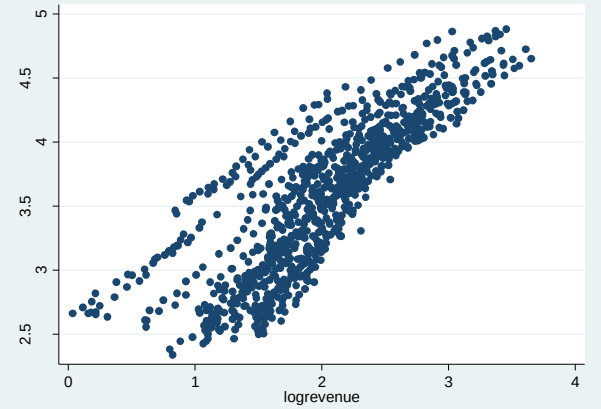


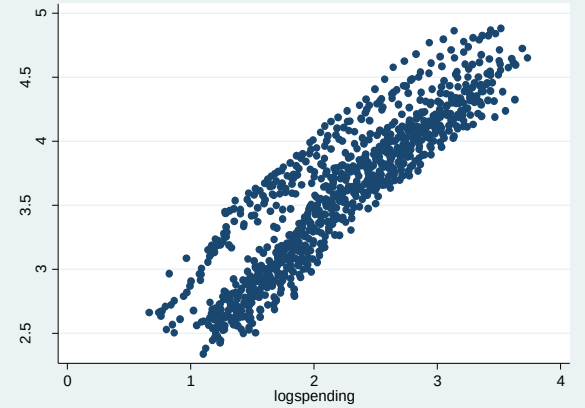
Population growth and fixed domestic capital:



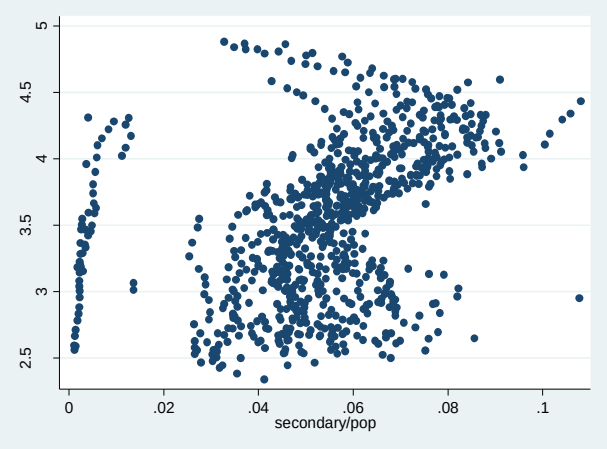


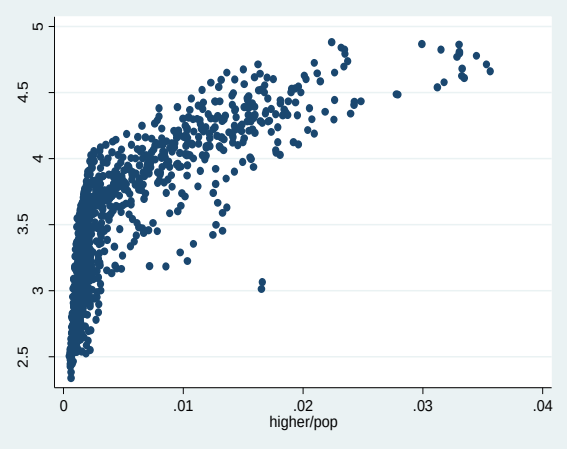
Local government revenue and spending:

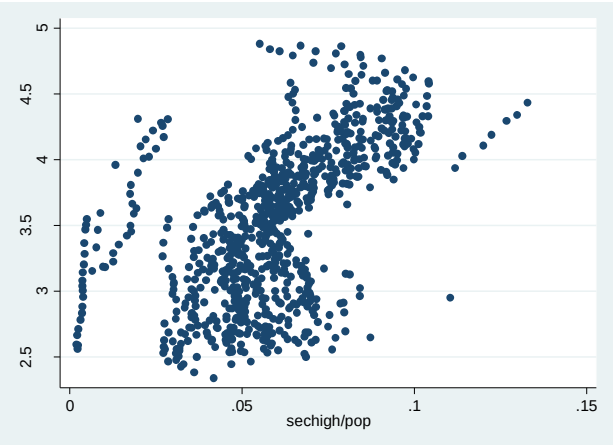




Education:







Infrastructure: