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Essays on the impact of foreign direct investment and saving in China

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ESSAYS ON THE IMPACT OF FOREIGN DIRECT INVESTMENT AND SAVING IN CHINA

by

Alexandra Nica

A thesis submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree in Economics in the Graduate College of The University of Iowa

December 2013

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CERTIFICATE OF APPROVAL

PH.D THESIS

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To my parents Lucia and Spiridon, my aunt Aurora and my husband George
I love you!

Courage, so it be righteous, will gain all things.

Ludwig van Beethoven
Letter to Countess Erdody
April 1815

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ABSTRACT

This thesis consists of two chapters. The first chapter studies the influence of FDI in China's economic development and the second chapter analyzes the Chinese high saving puzzle. The influence of FDI in China's economic growth and development has been the subject of a lot of debate, especially given the record inflows that the country has been registering in the last decade. Using a neoclassical growth model with foreign capital, the first chapter of this thesis answers the quantitative question of how big of an impact FDI has in the economic development and growth of China through the capital accumulation process and through spillovers from foreign capital. It does so by taking into account the timing and effect of gradual reforms that have opened China's economy up to the world since 1979. The findings can then be viewed in four distinct stages, which correspond to four distinct time ranges marked by those reforms significant for the inflows of foreign direct investment. The results support the view that FDI has a significant impact on the real GDP per capita level in terms of capital accumulation, especially after the 1992 'South Tour' reform. In addition, FDI's effect on China's economic growth through the growth in foreign capital component has been quite significant, especially in third stage of the analysis. The spillover effect of FDI has not been as significant as the one through pure capital accumulation, however it has a heightened effect in the later stages of reforms, supporting the claim that China has attracted a higher quality foreign capital after its ascension to the World Trade Organization in 2001.

The second chapter addresses a very popular subject in the related literature, the Chinese high saving rate puzzle. Using a simple one-sector neoclassical growth model, this chapter answers the quantitative question of how much of the high level of the Chinese saving rate and how much of the increase

of over 15 percentage points over the last three decades it can explain via two different methodologies. The benchmark model approximates the average saving rate relatively well for the time range 1978 - 2000, however it cannot explain the second aspect of the puzzle, namely the increase in the saving rate level, especially after 2001, since China's entry into the World Trade Organization.

The transitory steady state model takes into account the effect of market liberalization reforms and offers a very good approximation of the increase in saving rate for the overall time range of the analysis. It also offers a relatively good approximation of the percentage point increase in the 2001-2011 decade, however it cannot reach the actual high level of the national saving rate. The gap between the data and the results of the transitory steady state model is relatively constant for the 1978-2000 range and it decreases for the last decade of the analysis, when the model values approach the data closer, suggesting that some aspect of the saving components might have to be included in future analysis, in order to explain both aspects of this puzzle simultaneously.

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CHAPTER 1
THE IMPORTANCE OF FDI IN CHINA'S DEVELOPMENT IMPACT OF GRADUAL REFORMS

1.1 Introduction

One of the most long-standing debates in economic literature concerns the influence and impact of foreign capital inflows on the economic growth of developing countries. Ever since globalization brought with it international capital mobility, its benefits and potential drawbacks have been studied and interpreted at length. A vast number of theoretical and empirical studies over the last five decades have contributed to both sides of this debate.

A significant subset of this literature is looking at the influence of foreign direct investment (FDI) on a developing country's growth experience. There are multiple avenues explored on how FDI impacts the recipient economy, some of them being through its influence on domestic physical capital accumulation, some through augmenting technological progress – particularly through spillovers – and through its effect on human capital accumulation. The existing literature has not reached a consensus on whether FDI contributes significantly to a country's economic growth and through what channels it does so with more efficiency.

One of the aforementioned avenues of research has elicited a lot of discussion and conflicting results. On the one hand there is the argument that domestic investment is complemented by foreign direct investment (FDI) and hence the latter has an enhanced impact in the recipient country's economic growth. On the other hand there is the fact that FDI might actually be crowding out domestic investment and have a harmful influence on the long-run economic development of the host country, because it encumbers and fundamentally changes the structure and efficient allocation of the country's domestic resources. A vast literature approaches these issues through different kind of methodologies. While the majority of this literature concentrates on explaining these phenomena through empirical studies and targeting large groups of countries and regions, it is very important to also look at individual countries' experiences, especially in the case when said countries have a significant impact or influence on the global economic environment.

From this point of view, one of the most interesting cases to study related to these phenomena is China, a country that went from being virtually closed to the world economy before the late 1970s to becoming the second largest recipient of FDI after 2000 and exhibiting a remarkable GDP growth rate of around 9.57% on average over the 1969 – 2011 time range and 9.97% over the 1978-2011 span, after its first crucial market liberalization reform was implemented.

This study addresses one of the most intriguing questions related to the present topic in China's case and it refers to the quantitative contribution of FDI to China's economic development in the context in which the economy went through a gradual liberalization of FDI inflows, while also going through a gradual and more protracted liberalization of domestic private investment. It does that by taking into account the restrictions on each type of investment and the timing for gradual liberalization. A different way to look at this question would be to investigate what would have happened to China's development in general and capital accumulation in particular in the case in which FDI would have been nonexistent.

The issue of FDI influence on the host country's economic development is by no means a novelty in the field of research, however it is still a very debated one and settling this controversy is part of what makes it worth pursuing. One other aspect related to the importance of this topic is that this problem is a crucial one in terms of policy-making and approaches to FDI inflows acceptance and incentive – offering strategies. This is valid not just for China's economy, but for a lot of developing countries that might be considering China's economic approach as an example for their own growth experience and goals. The most relevant case in point is India, which is frequently mentioned as being less successful in attracting FDI than its continental 'rival' and consequently exhibiting lower levels of growth. Such immediate conclusions cannot be considered accurate without a more rigorous study of each economy's growth experience, the type of FDI it attracts and through what channels it gets propagated. The wrong estimation would lead to erroneous policy decisions that could divert domestic resources from more efficient allocations and could affect the respective nation's development in the long run. For China itself this is an important conclusion to draw as well, because the growth experience of its inland provinces has been very different from the one of its coastal provinces, the latter being the ones on the receiving end of the majority of FDI inflows and exhibiting a higher income growth at the same time. If FDI turns out to be crucial in the economic growth of the coastal provinces, then more resources should be diverted to attract foreign capital to the inland provinces as well. Otherwise, those same resources could be put to more efficient use.

It is evident that FDI had an important role in China's evolution over the last four decades. Exactly how this role has manifested and what the influence of FDI has been on China's domestic capital accumulation is what is intriguing, because at the same time as FDI inflows were increasing, China's domestic saving rate was already soaring. So theoretically China had plenty of capital at its disposal and a shortage of it does not appear to be the main driver of such a high amount of FDI inflows.

Part of the explanation for this apparent puzzle resides in the fact that domestic private investors have been constrained for much longer than foreign investors in China's domestic market, so FDI supposedly bridged a gap that would have not been there in the case in which the private sector would have had proper access to the sizable domestic saving resources already available. As the case stands however, many of these resources had been diverted to inefficient state-owned enterprises, which still follow strategic national objectives rather than profit-maximizing ones.

At first glance it seems that in this particular scenario, FDI plays a beneficial role in China's economic development. It is very important in this context to take note of the specific timing of reforms, FDI inflows pattern and their relation to the degree of China's market liberalization before forming a more definite opinion on this issue. The reform timing and gradual liberalization of restriction on foreign direct investment inflows is what this paper incorporates in its analytical framework to investigate China's particular experience related to capital inflows and capital accumulation.

Another reason for which this study considers FDI's influence on economic growth primarily via domestic capital accumulation comes from the results of the majority of growth accounting literature applied to China, which finds that capital accumulation accounts for most of the growth in national income (Hu & Kahn, 1997; Wu, 2003; Kuijs & Wang, 2005) and that at the same time as the incremental capital – output ratio has been increasing over time (Farell, et. all, 2006).

In addition to the consideration of pure capital accumulation effects, there is also the issue of potential spillovers from foreign direct investment to take into account. This is also another topic of heated debate particularly for China, since the empirical results on FDI spillovers are mixed and in general the positive productivity spillover results are considered to be due to aggregation bias and to failure to consider the endogeneitiy of FDI inflows. In addition, studies on technology transfer and growth also yield results at opposite sides of the spectrum, from concluding that advanced technology has been transferred to surmising that only low quality technology has been transferred due to the preponderance of foreign direct investment geared towares labor-intensive manufacturing industries. Descriptive studies also contribute to the two-sided argument by considering the source of FDI inflows, with low quality inflows coming mainly from neighboring countries, while higher quality inflows come in a much smaller proportion from OECD countries, especially after China's entry in the World Trade Organization (WTO).

This study concentrates on establishing the quantitative impact of FDI in China's capital accumulation in an analytical framework, by taking into account some of the unique features brought into the country's development by the set of reforms designed to open it gradually to the world economy. Specifically this means considering the timing and type of restrictions imposed on different aspects of the economic activity during China's long reform period from a closed economy to the socialist market economy of the last decades. The analysis takes into account the pure accumulation effect of foreign direct investment inflows on aggregate capital and on the real GDP level and a generalized spillover effect through a quality measure that enters the production process via the foreign capital component.

This chapter is organized as follows. The next section contains an overview of the notable characteristics of China's FDI experience and of the relevant literature on this subject. The third section presents the analytical framework that is used to study the influence of FDI on China's capital accumulation process while taking into account the gradual reform liberalization. Section IV contains information on the data used, the calibration details and the results obtained from this analysis, while section V concludes this study.

1.2 FDI characteristics and literature review

China continues to attract an impressive amount of attention regarding its unique approach to transition and the amount of FDI it received since the first wave of reforms opened its economy to the world in the late 1970s. Since the 1990s China has attracted more FDI than any other developing country, becoming the second largest recipient country (after the United States) subsequent to the year 2000.

China began its gradual transition to a more market-oriented economy with a program of economic reforms in three stages, initiated by Deng Xiaoping with the initial Open Door Policy in 1978.

In 1979, a joint venture law was passed granting foreign direct investment legal status in the country as the first step in an open-door policy aimed to gradually liberalize China's economy. In this period, FDI was restricted to joint ventures in the newly designated four special economic zones (Shenzen, Zhuhai, Shanthou in the Guangdong province and Xiamen in the Fujian province). These special economic zones (SEZs) offered freedoms and advantages for foreign investors, such as concessionary tax policies, exemption of trade duties, easiness of entry and exit in the market.

During 1983 and 1984, income tax for foreign firms on interest on loans was reduced by 50 percent and 14 coastal cities were allowed to open further to the world economy with the purpose of attracting advanced technology through foreign investment. In 1985, the third stage of China's open-door policy is implemented when four large industrial zones are opened to FDI, following the experiments with the four special economic zones and 14 coastal cities (Prasad & Wei, 2005).

In the late 1980s and early 1990s more specific encouragements for FDI started to be put in place with the passage of the Wholly Foreign-Owned Enterprise Law (1986), which reduced input costs for labor and land, established a limited foreign currency exchange market for joint ventures and extended the joint-venture agreement established in 1979 to over 50 years. The importance of the 1986 provisions was that for the first time a more proactive approach was used, by providing incentives for FDI, rather than merely permitting it. At the same time, the previous restriction of foreign direct investment inflows only to the four SEZs was lifted. During the same year a related law required that wholly foreign-owned enterprises be either export-oriented or use advanced technology and equipment. This reform has been implemented specifically in the effort of promoting high-tech, capital-intensive FDI projects and attracting large multinational corporations (Fung, Iizaka & Tong, 2004).

While FDI inflows started to increase slightly after the 1986 reform, they still remained unremarkable however until the early 1990s. Even though FDI has been permitted at this point in China - without having to contend with the SEZs location constraint any longer - close restrictions on foreign ventures were still in place and consequently provided very little incentive for investment in the country. Among such restrictions were the requirements the government imposed on all foreign ventures to maintain its foreign exchange balance, which lead to little opportunity of repatriating profits (Fung, Iizaka & Tong, 2004).

The most significant wave of reforms – that brought the first attention-grabbing surge in FDI inflows with it – started with the “Spring Wind”(or “South Tour”) reform from 1992, when the Chinese domestic market became more open to foreign firms through a series of measures that improved the investment climate and reduced some of the risk that foreign investors encounter. Around this time, foreign direct investment originating primarily in the neighboring countries Hong Kong, Macao and Taiwan (HMT) start to decline. As a consequence, export-orientd FDI begins to give way to technology-oriented FDI.

FDI lost a little momentum for a few years during and after the Asian financial crisis of 1997-1998, until China’s ascension to WTO in December 2001. Around this time, two more notable reforms have to be mentioned. In 1997, domestic firm were allowed to start investing outside their provinces and in 1999 private property rights were recognized. After the WTO inclusion and the reform of 2003 when private ownership was officially protected, FDI picked up even more impressively than before, peaking around $110 billion (measured in constant 2000 USD) in 2007, followed by a sharp drop until 2009 of approximately $33 billion and then increasing again to reach slightly over $133 billion in 2010. The evolution of the foreign direct investment inflows for China for the interval 1979- 2011 can be observed in Figure 1.1.

The increase in FDI inflows in absolute value is no doubt outstanding and it is one of the main reasons for the majority of the favorable credit that it has received as one of the main drivers of growth. International agencies such as the International

Monetary Fund and the World Bank have called it the driving force behind China's growth performance (Huang 2001, Tseng & Zebregs, 2002). Several empirical studies have identified FDI as an important source of economic growth through different channels such as technology diffusion and domestic capital accumulation. In some cases FDI was found to contribute more to growth than domestic investment (Borensztein et all, 1998) while in others it is concluded that its growth enhancing effect is contingent on the degree of complementarity and substitution between FDI and domestic investment (de Mello, 1999).

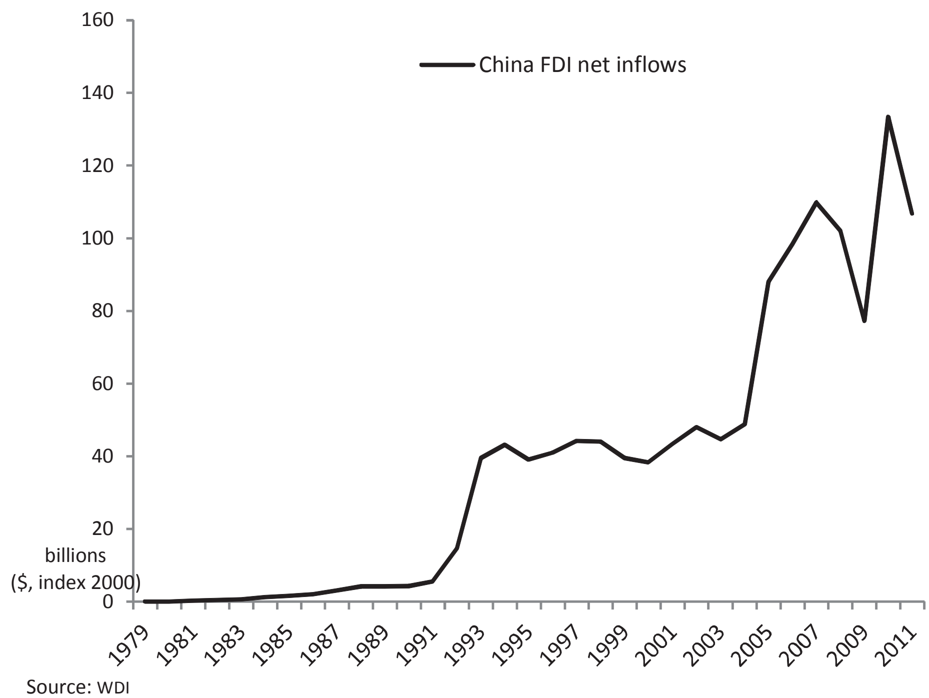

Figure 1.1 FDI inflows in China

Specifically for China, several econometric studies found FDI as a significant contributor to China's economic growth (Dees, 1998; Graham & Wada, 2001), while another part of the literature remains skeptical as to the exact magnitude of FDI's importance. The evidence and existing results are mixed, both in terms of the capital accumulation channel of FDI's influence and the technological spillover aspect. Huang (2001) for example argues that the foreign direct investment inflows in China have contributed neither to capital accumulation, nor to technological improvements through spillovers either. The argument for the former is that during the time in which FDI inflows have grown, China had one of the highest saving rates in the world and hence would have an abundance of capital and no need for foreign investment. The argument for the latter is that the domestically oriented FDI does not go through financing new capacity, but rather toward financing the acquisition of existing assets from financially insolvent state-owned enterprises (SOEs) and toward compensating for inefficiencies in capital allocation.

Given the mixed results and interpretations of the existing literature it is clear that, indeed just considering the absolute volume of FDI inflows in China is by no means telling the entire story of how they contribute to the economy's growth and development.

Examining the ratio of foreign direct investment inflows to real GDP displayed in Figure A.1 in Appendix A.3 and more importantly the ratio of FDI inflows to gross fixed capital formation (i.e. gross domestic investment) in China shows that FDI as a percentage of domestic investment drops almost ten percentage points between 1993 and 2004 and another seven percentage points between 2005 and 2009, as illustrated in Figure 1.2[1]. At the same time it is notable to observe that aside from a big increase in the early 1990s where FDI inflows reached to almost 20% out of gross domestic investment, the overall trend brings these inflows to approximately 10% of gross fixed capital formation for the majority of the time period of analysis. Out of real GDP this translates into over 6% of foreign direct investment at the highest point in the

[1] The data is taken from the World Bank Development Indicators database, unless otherwise noted. The details for each data series presented in this chapter are included in the Quantitative Analysis section 1.4.

early 1990s and a decrease to below 3% out of real GDP in 2004 and 2009.

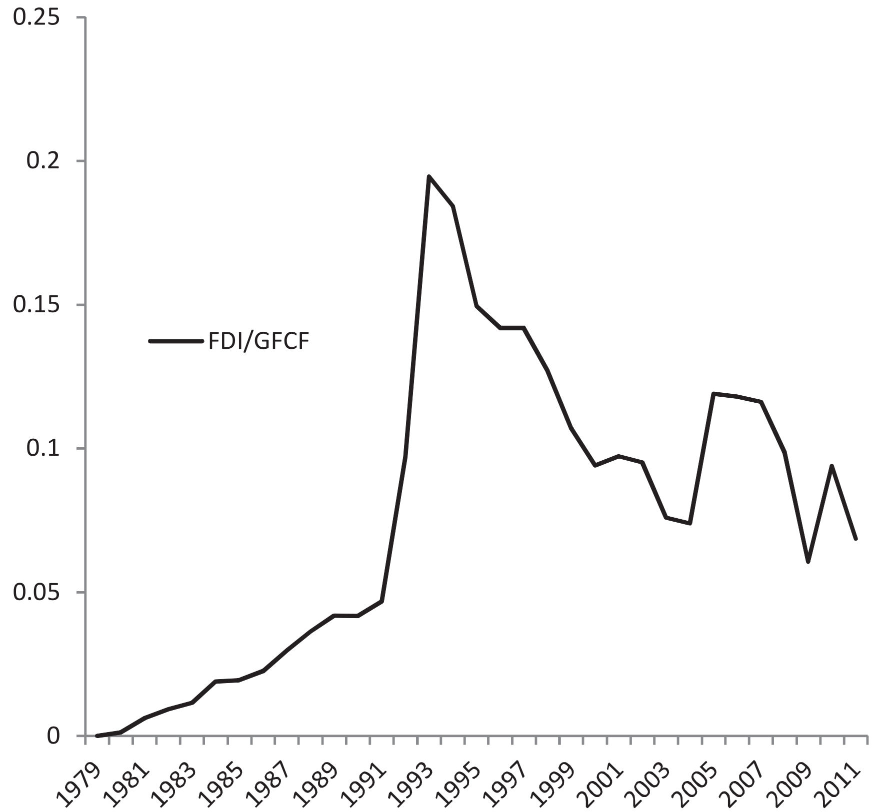

Figure 1.2 The FDI inflows to domestic investment ratio in China

This could be interpreted in multiple ways. One view would be that after the initial surge of FDI in the early 1990s, domestic investment was bolstered mainly through technological spillovers and started to increase rapidly, surpassing the rate of growth of FDI inflows. Another view would be that domestic investment has increased substantially due to the high level of the Chinese domestic saving rate and not necessarily due only to technological spillovers from foreign domestic investment. The data on absolute FDI inflows seems to support the observation that domestic investment has surpassed the growth of FDI inflows - regadless of the underlying cause - since between 1993 and 2004 it increased overall only by approximately \$11 billion (compared to the surge of almost \$34 billion between 1991 and 1993). A similar story seems to be happening for the 2005 – 2010 time range, when the surge in the absolute FDI inflows after 2001 brings an increase in the FDI to gross fixed capital formation (GFCF) ratio after 2003, while once again decreasing after this one time increase until 2010.

The crucial aspect to consider here is the timing of reforms and implicitly the degree of openness to capital inflows, while also taking into account the degree of restriction on domestic investment. These are unique features to China's development, since FDI has been "liberalized" so to speak much sooner and faster than private domestic investment. Comparing China's experience with countries in similar stages of development or developed countries that had a similar growth experience shows that a discrepancy on such a notable scale is not evidenced between the configuration of the actual FDI inflows and their ratio to domestic investment, as is the one that can be observed for China. An example of the general trend between the shape of FDI inflows and the shape of the ratio of FDI inflows to domestic investment for such countries is illustrated in Figures A.2 and A.3 in Appendix A.3.

Hence it must be the case that a significant influence on the unique pattern of the FDI to domestic investment ratio for China stems from the restrictions imposed both on foreign direct investment inflows and on domestic private investment and their gradual lessening as part of the "socialism with Chinese characteristics" plan to make the country's economy more market-oriented. It is noteworthy that until 1997 China's domestic companies were not allowed to invest outside their provinces, while foreign investment enterprises (FIE) did not have to face such restrictions. In addition, China's constitution didn't recognize property rights for Chinese private entrepreneurs until 1999, while foreign investment enterprises enjoyed those rights since 1982.

These facts, combined with the evidence of the increase in domestic investment (Figure A.4) since the early 1990s in absolute terms seem to suggest that FDI was more significant in the early stages of economic reforms and its relative importance decreased as domestic investment started to increase. However without a more in-depth analysis, such conclusions cannot be easily drawn, since the actual results could point to the complete opposite direction, as it is indeed the case of this study.

Going back to the FDI data characteristics and origin specifics, there is also more to this story to consider, beyond looking only at the data itself. The literature on sources and quality of FDI in China is quite insistent on the point that especially the early flows of foreign capital have not been of very high quality, being mostly export-oriented and coming from the main three Asian sources (Hong Kong, Macao and Taiwan). FDI from Hong Kong, Macao and Taiwan (THM) was more than 60% of China FDI before 1990 (Huang, 2004). This fact would then fail to give too much support to the technological spillovers theory, at least in the earlier decades of the country's development.

Aside from the obvious restrictions on domestic investment opportunities, the aforementioned limitations are also thought to account for the existence of a significant amount of "round-tripping" FDI. The IMF Committee on Balance of Payments Statistics defines "round-tripping" in two ways, as referring to the host economy. The first definition specifies round-tripping FDI to be domestic investment disguised as foreign direct investment through non-resident Special Purpose Entities (SPEs), which entails an investment from the host economy in a foreign economy with the purpose of reinvestment in the host economy. The second definition refers to a similar situation, but with the host economy as the "intermediary" in the chain of investment. The literature on China's round-tripping FDI refers mainly to the first definition when analyzing the source and the flows of capital in and out of the host economy. In other words, the kind of round-tripping FDI that it refers to is mainly considered to stem from creating FIE in neighboring countries such as Hong Kong or Taiwan and investing back into China, the purpose being to circumvent some of the barriers imposed on the domestic private sector or to take advantage of preferrential tax treatment for foreign enterprises. This trend has continued until the 21st century as well, and FDI inflows from this phenomenon are roughly estimated to be around 25% in 1992 (Tseng & Zebregs, 2002) or 30-50% of the total (Xiao, 2004). It is difficult though to ascertain with any kind of certainty what proportion of FDI could be of this particular origin, since something like this is very hard to measure. Prasad & Wei (2005) suggest that round-tripping FDI is mostly believed to origin in Hong Kong and while it is not possible to measure exactly how much of the total FDI originating in Hong Kong is of this particular type, the fact that all FDI coming from this source has declined by more than 20 percentage points since 1994 also implies that the round-tripping FDI has decreased with it. The authors then offer though that it is possible that some of the share of this type of foreign direct investment inflows have been picked up by small countries such as the Virgin Islands and Western Samoa, whose proportion in the share of FDI inflows source has increased. So, in other words, the existence and potential proportion of round-tripping FDI in the total foreign direct investment measure for inflows leads many researchers to believe that China's success in attracting FDI is misreported or exaggerated (Tseng & Zebregs, 2002) and that this is one of the factors contributing to the low quality FDI that dominated most of the flows before the early 1990s.

Starting with the mid 1990s and especially after China's ascension to WTO in 2001, the quality of FDI had changed however, being more domestic-market oriented and coming from OECD countries and advanced Asian neighboring economies such as Japan and Korea, as opposed to the export-oriented one, coming mostly from the THM group, in form of inputs and driven by low costs of labor.

One of the main causes for this particular content and trend of FDI inflows is the government strategy of targeting overseas Chinese as a source of foreign investment, especially in the first stages of the reforms. This kind of strategy has also been in the background of opening the SEZs as the first step of attracting foreign capital especially from Southeast Asian economies (Fung et. all, 2004). As a result, Hong Kong has been the most prevalent source of FDI inflows for China, especially in the period before 2000, albeit decreasing in importance after the early 1990's, going from 68.2% (share of FDI from Hong Kong out of total) in 1992 to 32% in 2004 (Prasad & Wei, 2005). At the same time, FDI's share from more advanced countries has increased in importance from 14.5% in 1992 to 30.9% in 2000, in particular the US's share going from 4.6% in 1992 to 10.8%, making it the second most important source of FDI for China, after Hong Kong (data compiled in Fung et all, 2004). Significant differences in FDI patterns and importance also occur at regional versus local level, with local governments offering strong support in mobilization of local capital and labor by foreign firms (Laurenceson &Tang, 2007).

These differences in the quality of FDI, as well as the general perception of them is one of the reasons why the spillover-related literature regarding foreign direct investment in China also produces mixed results. There are several avenues in which tehnological spillovers from FDI have been studied for China, from studies of multinational firms, to papers on patterns of FDI, determinants of FDI and empirical studies, most of them concentrated on firms within the same industry. Hale & Long (2007) survey the empirical literature and report that it consists of a wide range of estimates for the effects of FDI on the productivity of Chinese domestic firms. Most studies concentrate on how FDI affects total factor productivity of domestic firms or their labor productivity or both. The authors point to several potential biases in the empirical literature that could account for such a wide variety of results, such as aggregation biases, selection biases and the potential endogeneity of FDI. These problems are encountered in industry-level studies (Liu, 2001; Li, Liu & Parker, 2001), firm-level studies (Wei & Liu, 2006) and provincial-level studies (Huang J.T., 2004; Cheung &Lin, 2004). Hale & Long (2007) do not find evidence of productivity spillovers from FDI in China and conjecture that institutional factors could be a potential explanation for this phenomenon, such as limited labor mobility due to formal and informal labor market restrictions.

Given all the complexities of FDI inflows in China, it comes at no surprise that existing studies on FDI's contribution to China's capital accumulation oscillate between establishing whether or not FDI is an engine of growth, whether it has contributed to growth mostly through capital accumulation or spillovers, whether said spillovers are significant or not, or whether FDI itself is crowding–in domestic investment (Agosin & Meyer, 2000) or crowding it out (Sun 1998; Shan 2002) or both, depending on the level (domestic, regional or provincial) analyzed (Zhang 2001; Zhang 2011).

With the goal of incorporating the influence of reform restrictions in the analysis, this chapter departs from the traditional strictly empirical treatment of the question of the influence of FDI on economic growth and rather adopts a more analytical approach to establish the role of FDI in China's economic development, in particular its role in China's capital accumulation. One notable study (Wang, Wen & Xu, 2012) uses the neoclassical framework to study the pattern of two-way capital flows between developing countries and developed economies. China and the US are respectively used as representatives for the two countries in different stages of development and the authors distinguish between financial and fixed capital when studying the directions of the flows. In this manner one of the most prevalent puzzles for emerging economies in general and China in particular is accounted for, namely the significant difference that is observed between the marginal return on fixed capital and the interest rate, which is distinguished as the marginal return for financial capital. Additional implications of this particular setup yield even more interesting results, some at odds with those in the existing literature, such as persistent global imbalances between countries in different stages of development in the steady state and an immiseration effect of FDI in the sense that FDI is found to be harmful for the recipient country (in this case China) under financial frictions.

This study however abstracts from the distinction between financial and fixed capital, since the goal is to quantitatively determine the role of foreign direct investment in China's economy. Drawing from the characteristics of the neoclassical open economy growth model, this chapter follows a setup similar to the influential work of Barro, Mankiw & Sala-i Martin (1995), adopted later by Verdier (2008) and Lipschitz, Rochon and Verdier (2008) for the study of long-term capital movements and substitutability of domestic savings to capital inflows.

More specifically, the key feature introduced in the Barro, Mankiw & Sala-i Martin (1995) model of imperfect capital mobility is used in Verdier (2008) to study the link between domestic savings and debt accumulation and the cross-country variation in net external debt by looking at the data on net foreign liabilities over the 1970 - 1998 timespan. The same imperfect capital mobility characteristic of the model is used in combination with an additional one regarding China's surplus labor stemming from a rural to urban migration of the population in a more complex model by Lipschitz, Rochon & Verdier (2008). Their model is used to explain several features of China's development, such as the combination of high saving, high investment, high FDI inflows and low wages and the competitiveness of domestic investment, in the sense that an increase in marginal product of labor brings increases in employment and output, rather than only an increase in wages.

This study uses the same key feature to incorporate foreign capital in the neoclassical growth model, in order to establish the role of foreign direct investment in China's economic growth and development through the accumulation of foreign capital in the aggregate capital and aggregate output measure. The analysis concentrates on growth rate contributions to real GDP growth and effects on the real GDP per capita viewed from a pure capital accumulation effect on one hand and through a spillover effect on the other.

1.3 The Model

To reiterate on the brief description from the previous section, the analytical framework employed in this paper is related to the one described in the Barro, Mankiw & Sala-i Martin (1995) study of convergence in the neoclassical growth model. More recently Verdier (2008) used Barro, Mankiw & Sala-i Martin's setup with foreign capital in lieu of human capital in order to study the cross-country variation in net external debt for a sample of countries. Given the particularities of China's unique transition from a closed economy to a more market-oriented environment, the neoclassical open economy model with imperfect capital mobility offers a good framework for capturing some of the essential features needed for this analysis. More specifically, the imperfect capital mobility assumption offers the means to avoid the issue of immediate equalization of marginal products of capital that would occur in an open economy model with perfect capital mobility and consequently the immediate convergence of capital and output to their steady state levels.

Similar to the two aforementioned papers, the production technology is assumed to be Cobb-Douglas with three inputs, however the difference between the previous setups mentioned and the present one is the manner in which the two capital inputs enter the production function. The Verdier (2008) setup assumes a complementarity in production between the two types of capital, taking in consideration joint-venture-type situations in which foreign investors are reluctant to invest fully in certain projects because of risky business environments, moral hazard problems, default risk and other similar concerns. Hence in such situations domestic capital would complement foreign capital in production.

The purpose of this study however represents the focus on establishing quantitatively the role of FDI in China's capital accumulation and growth, by taking into account a pure capital accumulation effect and also a generalized spillover effect. In order to obtain relevant results for this objective, the two capital stocks behave more in the manner of substitutes rather than complements in forming the broad capital stock input of the production function. In addition, the foreign capital and domestic capital inputs differ qualitatively in the manner in which they enter the production process, as described in what follows.

To incorporate all the needed features of the present analysis, output is produced according to the following technology:

$$Y_t = A(K_t + \varphi_t Z_t)^{\alpha} {L_t}^{1-\alpha}$$

with K and Z representing the stocks of the two types of capital, domestic and foreign, with the share of broad capital in output given by α, where $0 < \alpha < 1$. The coefficient φ_t represents a quality measure of foreign capital, in other words it captures any potential spillovers' effects from foreign capital that would translate into a higher quality input in production. Thus, the higher φ_t is, the higher quality foreign capital enters into the broad capital input. The quality measure is closely linked to the gradual reform steps considered in this analysis and offers insights in the quantitative exercise not only to the overall effect of the potential spillovers from foreign direct investment, but also to the difference between the quality of spillovers from one reform step to another.

The third input L is labor, which grows at rate n. A is a fixed technology parameter.

The imperfect capital mobility assumption manifests itself in the manner in which capital could potentially be used as collateral, as it has been originally described in

Barro, Mankiw & Sala-i Martin (1995). Foreign capital Z moves freely and can be used as collateral for international borrowing, while only domestic savings can be used in order to accumulate domestic capital K, which describes the credit constraint imposed on the economy. Barro, Mankiw & Sala-i Martin (1995) considers the foreign capital as physical capital and the domestic capital as human capital. However the mention is made that domestic capital can be considered any kind of capital that is hard to borrow against, since the crucial assumption of the model is not what kind of capital is specifically considered for each form, but the fact that one type of the capital should be easy to use as collateral, while the other one should be hard to borrow against internationally.

The two capital stock types, K and Z evolve according to familiar capital accumulation equations described in what follows.

Domestic capital K_t evolves according to:

$$K_{t+1} = (1 - \delta_t)K_t + I_t \tag{1}$$

where I_t is domestic investment and $\delta_t \in (0, 1)$ is the depreciation rate.

Foreign capital Z_t evolves according to a similar capital accumulation equation:

$$Z_{t+1} = (1 - \delta_t)Z_t + J_t \tag{2}$$

where J_t is foreign direct investment and $\delta_t \in (0, 1)$ is the depreciation rate. The depreciation rate of the two types of capital is assumed to be the same.

The representative firm solves the familiar profit maximization problem:

$$\max_{K_t, Z_t, L_t} [A(K_t + \varphi_t Z_t)^\alpha {L_t}^{1-\alpha} - R_{kt}K_t - R_{zt}Z_t - w_t L_t]$$

where R_{kt} is the rental rate of domestic capital, R_{zt} is the rental rate of foreign capital and w_t is the wage rate per unit of labor. In this model, similar to Lipshitz, Rochon & Verdier (2008), China is considered a small open economy in terms of having to take the world interest rate r as given. According to this assumption and given that the foreign capital is the one that is internationally mobile, we can express the rental rate of foreign capital in terms of the world interest rate as $R_{zt} = r + \delta_t$ at any point in time.

The first order conditions from this maximization problem deliver the equality between the marginal products for each input and their factor prices:

$$\begin{aligned} \alpha A(K_t + \varphi_t Z_t)^{\alpha-1} {L_t}^{1-\alpha} &= R_{kt} \\ \alpha \varphi_t A(K_t + \varphi_t Z_t)^{\alpha-1} {L_t}^{1-\alpha} &= R_{zt} \\ (1-\alpha) A(K_t + \varphi_t Z_t)^{\alpha} {L_t}^{-\alpha} &= w_t \end{aligned} \tag{3}$$

The relationships obtained are modified to express every variable in per capita terms (where $x_t = \frac{X_t}{L_t}$ represents the variable X_t in per capita terms for any X).

Using the new expressions for each variable, the production function can now be used in its intensive form as:

$$y_t = A(k_t + \varphi_t z_t)^{\alpha} \tag{4}$$

Capital accumulation equations (1) and (2) now become:

$$\begin{aligned} k_{t+1}(1+n) &= k_t(1-\delta_t) + i_t \\ z_{t+1}(1+n) &= z_t(1-\delta_t) + j_t \end{aligned} \tag{5}$$

In addition, the first order conditions in (3) can now be reduced to the expressions displayed below, in which all variables are expressed in per-capita terms, with the exception of the technology parameter and the returns to domestic and foreign capital, respectively.

$$\begin{aligned} \alpha A(k_t+\varphi_t z_t)^{\alpha-1} &= \alpha\frac{y_t}{k_t+\varphi_t z_t}=R_{kt} \\ \alpha\varphi_t A(k_t+\varphi_t z_t)^{\alpha-1} &= \alpha\varphi_t\frac{y_t}{k_t+\varphi_t z_t}=R_{zt} \\ (1-\alpha)A(k_t+\varphi_t z_t)^{\alpha} &= (1-\alpha)y_t=w_t \end{aligned} \tag{3'}$$

From the two first order conditions relating the capital inputs to their respective returns we obtain the relationship between the return to foreign capital and return to domestic capital. This relationship underscores the importance of the spillover measure as the relative return of foreign capital in terms of domestic capital. For a fixed return on foreign capital, if the value of the return to domestic capital decreases, the quality of foreign capital that enters the production technology increases.

$$R_{zt}=\varphi_t R_{kt} \tag{6}$$

The previous condition combined with the small economy assumption $R_{zt}=r+\delta_t$ yields a return to domestic capital equal to:

$$R_{kt}=\frac{r+\delta_t}{\varphi_t}$$

Thus the marginal product of domestic capital is inversely related to the quality of foreign capital. The higher the quality measure evaluating spillovers from foreign capital is, the lower the return on domestic capital becomes.

The assumption that domestic capital cannot move freely as its foreign counterpart and can only be accumulated through domestic investment translates into: $S_t=I_t$ which in per capita terms becomes

$$i_t=s_t \tag{7}$$

There is no household optimization in this model and using the Solow-type assumption of an exogenous saving rate, investment per capita can be expressed as:

$$i_t = sy_t \tag{8}$$

where s represents the fixed saving rate at any point in time.

Combining this constraint with the capital accumulation expression for domestic capital yields:

$$k_{t+1}(1+n) = k_t(1-\delta_t) + sy_t \tag{9}$$

The condensed version of the production technology from (4), together with the first order condition for foreign capital and the small economy assumption are used in the above expression to obtain the equation of the dynamic evolution of the domestic capital stock:

$$k_{t+1}(1+n) = (1-\delta_t)k_t + sA^{\frac{1}{1-\alpha}}\left(\frac{\alpha\varphi_t}{r+\delta_t}\right)^{\frac{\alpha}{1-\alpha}} \tag{10}$$

This represents essentially the fundamental equation of the present model. It is very similar to its counterpart for the closed economy Solow model, but modified due to the existence of foreign capital in the production process. The actual investment component of the fundamental equation now depends on the world interest rate and it is augmented by the quality measure for foreign capital. As the world interest decreases, the actual investment component would increase. This effect would also be in place if the foreign capital is of equal or higher quality than the domestic capital and the quality measure increases, signifiying an improvement in the spillover aspect of foreign investment inflows as a component of foreign capital.

There are several transitory steady states to consider during the economy's path to its final steady state and they are chosen in such a way as to span the time periods between the most important stages of reforms with significance towards the opening of China's economy to the world and to the inflows of foreign direct investment.

Hence, each transitory steady state is delimited by relevant steps of the gradual reform process, containing the specific foreign direct investment inflow patterns that emerged as a consequence of each reform stage. For each of these steady states there is a specific level of the quality measure φ_t which changes with each succesive steady state to reflect the different quality attached to the foreign capital stock. The specific details on the choice of each relevant reform step and on the transitory steady state ranges, together with the calibrated values of the quality measure for each of these transitory steady states are described in the quantitative analysis section of this chapter.

Denoting a transitory steady state with m, the level of transitory steady state domestic capital to labor ratio is found by setting $k_m^* = k_{t+1} = k_t$, where $m = 1, 2, .3....$

This means that the steady state domestic capital to labor ratio in transitory steady state m[2] can be now written as illustrated in the following expression:

$$k_m^* = A_m^{\frac{1}{1-\alpha_m}} \frac{s}{n+\delta_m} \left(\frac{\alpha_m}{r+\delta_m} \right)^{\frac{\alpha_m}{1-\alpha_m}} \varphi_m^{\frac{\alpha_m}{1-\alpha_m}} \tag{11}$$

The expression for the steady state capital-labor ratio is directly related to the saving rate and the technology parameter and inversely related to the population growth rate and the depreciation rate, like it would be in the case of a closed economy model. Due to the existence of foreign capital in the model, the steady state capital-labor ratio is now also inversely related to the world interest rate and directly related to the quality measure for foreign capital. The share of aggregate capital in output has a direct influence on the magnitude of the effect of the quality measure on the domestic transitory steady state capital-labor ratio. If the foreign capital is of equal

[2] The subscript m on the parameters that appear in the steady state expressions of domestic capital per labor, output per labor and foreign capital per labor marks the transitory steady state parameters that take different values across transitory steady states, but maintain their corresponding values within each transitory steady state. The parameters with no subscript represent the time invariant parameters which maintain the same value within and across transitory steady states. The details on the choice and values of the time invariant and respectively transitory steady parameters are included in the calibration section (1.4.2) of the quantitative analysis part.

or better quality than the domestic capital, the higher the share of aggregate capital in ouput is, the more of the quality of foreign capital is reflected in the domestic capital-labor ratio.

Knowing k_m^* also yields the steady state expressions for y_m^* and z_m^* :

$$y_m^* = A_m^{\frac{1}{1-\alpha_m}} \left(\frac{\alpha_m}{r+\delta_m}\right)^{\frac{\alpha_m}{1-\alpha_m}} \varphi_m^{\frac{\alpha_m}{1-\alpha_m}} \tag{12}$$

$$z_m^* = A_m^{\frac{1}{1-\alpha_m}} \left(\frac{\alpha_m}{r+\delta_m}\right)^{\frac{\alpha_m}{1-\alpha_m}} \left[\frac{\alpha_m}{r+\delta_m} - \frac{1}{\varphi_m^*}\frac{s}{n+\delta_m}\right] \varphi_m^{\frac{\alpha_m}{1-\alpha_m}} \tag{13}$$

The particularities of the specific ranges allocated to each transitory steady state and the significance of their respective intervals chosen are described thoroughly in the ensuing quantitative analysis section.

1.4 Quantitative Analysis

The quantitative analysis part is divided in three main sections, the first on data choice and analysis, the second on the calibration of time invariant and transitory steady state parameters and the third on results.

1.4.1 Data considerations

The data used in the present analysis is taken mainly from the World Development Indicators (WDI) for the overall range of 1965-2011, unless noted otherwise. Additional data is taken from UNCTAD (1979-2011) for foreign direct investment inflows, Bai, C., Hsieh, C. & Qian, Y. (2006), Bai, C. & Qian, J (2007) and Bai, C. & Qian, J. (2010) for estimates and analysis of the labor share of output, which in turn is relevant in determining the values of the capital share of output needed in the present quantitative study.

Since the series for both domestic and foreign capital are not readily available in any of the existing data sources, they have to be constructed according to each of their respective accumulation process. The details on the data and methodology used for each of these constructs are described in what follows.

1.4.1.1 Capital stock sequences

Before elucidating the methodolgy used to calculate each capital stock sequence, some explanation is needed regarding a few of the 'ingredients' used in the capital accumulation equations. Each of the components' features and provenience are separately presented below.

Depreciation rate The depreciation rate series for China varies greatly throughout the studies of growth accounting and TFP valuations in the literature. For example Bai, Hsieh, Qian (2006) use a depreciation series with an average of around 10.82% over the range on which they calculate the return to capital (1978 - 2005), using as source China's National Bureau of Statistics (NBS). Islam & Dai (2009) on the other hand take depreciation data from various sources and have a much lower average over the time period considered in their study, starting with 3% over the time range 1952 -1978, 4% over 1979-1992 and 5% for 1993-2002. Dekle, R. & Vandenbroucke, G. (2012) use a 5% depreciation rate for the 1978-2003 range in calibrating their model. Aziz, J. (2007) considers a depreciation rate of 6% for the 1980 - 2005 range. Song, Z., Storesletten, K. & Zilibotti, F. (2011) consider a depreciation rate of 10% in their calibration , while Wang, Wen and Xu (2012) use a depreciation rate of 6.26%.

The present paper considers the data on consumption of fixed capital provided in the WDI series as the measure of the depreciation rate for the purpose of calculating the domestic and foreign capital stocks. This series displays an average of around 5.76% for the 1970 - 1978 range and 9.83% for the 1979 - 2011 span.

Transitory steady state considerations for the calibrated depreciation rate δ will be presented in the subsection on transitory steady state dependent parameters.

Domestic investment Domestic investment is taken in this paper as the gross fixed capital formation series from the WDI database for 1965-2011. A justification of this choice merits some attention in what follows, given the predominant choice of data in the related literature regarding this particular component of the capital accumulation process.

A large portion of the related literature uses the series of "investment in fixed assets" released by China's National Bureau of Statistics (NBS) as the measure of domestic investment. Bai, Hsieh, Qian (2006) on the other hand consider the series of "gross fixed capital formation" from NBS in their calculations of the real return to capital. Their reasoning for preferring the latter series to the more popular NBS one, is that the data on investment in fixed assets - as measured by China's NBS- includes the value of purchased land and expenditure on used machinery and preexisting structures and it is based solely on survey data for large investment projects, which understates aggregate investment.The China NBS gross fixed capital formation series is built by subtracting the value of land sales and expenditure on used machinery and buildings from the series of investment in fixed assets and adds expenditure on small-scale investment, which made it a suitable domestic investment series to use in constructing the capital series in Bai, Hsieh, Qian (2006).

Similarly, the data on gross fixed capital formation relayed in the WDI database does not take into consideration the value of land purchases or spending on used machinery, while incorporating the value of land improvements, purchases of equipment, construction of infrastructure, private, comercial and industrial buildings and so on.

To verify that there are no significant differences in measurement between the two series on gross fixed capital formation from WDI and from China's NBS respectively, calculation of the return to capital using the gross fixed capital formation series from WDI is performed in order to compare it with the series obtained in Bai, Hsieh, Qian (2006). The rate of return on capital obtained is compared to the series reported in

Bai, Hsieh, Qian (2006), by first using the same data for the share of capital in output and then by using the average share of capital for the 1965 - 2011 time period (0.48). Figure A.5 displays the outcomes thus obtained and it shows that especially the two series compared by using the same or very similar share of capital and the gross fixed capital formation series from the two different sources (China's NBS and WDI) yield close sequences of the return to capital results.

Foreign investment The foreign investment component in its respective capital accumulation process is included as the foreign investment inflow data availalble in the WDI and UNCTAD databases for the 1979-2011 period.

Capital series For the purpose of this analysis, both capital series are constructed using the perpetual inventory method applied to their own component characteristics. This method has been the preferred approach of obtaining capital stock sequences in the related literature for the last few decades of research, with only slight variations pertaining mostly to the type of data series used and to details such as the number of years taken into account for the average growth rate of the investment series considered in the calculation of the intial value of the capital stock.

In this study, the initial value of domestic capital is calculated for 1965 as the ratio of gross fixed capital formation during that year to the sum of the depreciation rate of that same year and the average growth rate of the gross fixed capital formation series for the first seven years of the range.

The foreign capital series is constructed using a similar methodology, while taking FDI inflows as the foreign investment added in the accumulation process in the manner described in the model detailed in the previous section. The inital value for foreign capital is taken at 1980, since the value for 1979 is extremely small and consequently the same year is used for the value of the depreciation rate, while the average growth rate of the foreign direct investment inflows starts in the same year as well. The technical details of this calculations are described in Appendix A1.

1.4.2 Calibration

The calibration of the present model involves two different kinds of parameters. The time invariant parameters are the exogenous variables of the model, that maintain their values over the entire time span of the analysis. The transitory steady state parameters are both exogenous and endogenous variables calibrated to match different data points with distinct values for each transitory steady state. The extent of each transitory steady state - which dictates the particular data range included in the calibration of each of these parameters - is chosen to match the reform events especially relevant to the extent and structure of the inflow of foreign direct investment.

Each of the aforementioned categories of parameters is detailed separately in the following subsections.

1.4.2.1 Time invariant parameters

The time invariant parameters of the model are the growth rate of labor force n, the world interest rate r and the savings rate s. These parameters are taken to match moments in the Chinese data for the entire time range of 1965-2011 to be relevant for the study both before and during the reform decades.

Table 1.1 Time invariant parameters

Parameter	Description	Value
n	labor force growth rate	0.014
s	savings rate	0.373
r	world interest rate	0.05

The growth rate of labor force n is chosen to match the average rate of population growth in China for the interval 1965 - 2011, which amounts to 1.405%. Hence the value of the labor force growth rate parameter is calibrated to 0.014.

The savings rate is calculated as $1 - \frac{C}{Y}$, where C represents final consumption expenditure and Y represents GDP from the WDI database for China. The average savings rate for the 1965-2011 time period is equal to 37.25% which leads to the calibrated value of the savings rate parameter of 0.373. The final consumption expenditure item includes measurements of household consumption and government consumption as well. Taking into account only private consumption would lead to an average saving rate of approximately 48% for the 1965-2011 interval.

The world interest rate is taken to be 5%, at the higher range of the estimates for the world interest rate in the last three decades to account for low-income and credit-constraint economy[3].

1.4.2.2 Model and transitory steady state parameters

The transitory steady state parameters are a set of exogenous and endogenous variables which are calibrated for each transitory steady state. These transitory steady states (denoted by TSS from here on) are matched with the timing of the most relevant reforms regarding foreign and domestic capital and the evolution of China's FDI inflows as depicted in Figure A.6 in Appendix A. There are four such chosen steady states in total, spanning approximately one decade per each range. The starting point of the present analysis is in 1965, pinned down by the availability of the statistical datasets of the World Development Indicators. The range of the first transitory steady state (TSS1) covers the years 1965 to 1978 of the pre-reform stage of development of the Chinese economy. The second transitory steady state (TSS2) starts with the year of the first significant reform centered on foreign investment inflows accessibility to the Chinese market, namely the joint venture law of 1979 that offered legal status to FDI inflows to the four special economic zones (SEZ) Shenzen,

[3] See Verdier (2008)

Zhuhai, Shanthou and Xiamen. The third transitory steady state's starting point is the most important reform that propelled China on the course of economic growth and higher international liberalization of its economy, specifically the "Spring Wind" reform of 1992. The fourth and final - in the present analysis - transitory steady state starts with the private property recognition reform of 2003 which followed closely on the trail of China's ascension to WTO in 2001 and which resulted in a great increase in absolute value of FDI inflows of approximately $60 billion between the two endpoints of the TSS4 range.

The transitory steady state parameters's descriptions for this model are summarized in Table 1.2. The exogenous TSS parameters are represented by the depreciation rate δ, the capital share of income α and the technology parameter A. The endogenous TSS parameter is represented by the quality measure φ, which is mathematically defined as a step function.

Table 1.2 Parameter description

Parameter	Description
δ	depreciation rate
α	capital share of output
A	technology parameter
φ	quality measure

Table 1.3 provides the values for the aforementioned transitory steady state (TSS) parameters at the starting point (SP) in 1965 and for each subsequent transitory steady state. Each transitory steady state is distinguished by its respective time range, chosen to reflect the most relevant reforms for foreign direct investment inflows, in the manner described previously.

Table 1.3 Transitory steady states (TSS) parameter values

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
Parameter	Value	Value	Value	Value	Value
δ	0.0467	0.0576	0.0984	0.0959	0.1027
α	0.4768	0.4787	0.4763	0.4825	0.4902
A	10.8114	10.7466	16.7017	24.1715	33.0837
Function	Value	Value	Value	Value	Value
φ	-	0.2996	1.0841	1.1126	1.1850

The depreciation rate is not a time invariant parameter in this model, contrary to the usual approach in the similar literature. It is taken into consideration for each transitory steady state to account for the difference observed in the data between the depreciation rate before the first reform was implemented and the depreciation rate in the subsequent reform years. In other words this approach takes into account the difference between the depreciation rate during the time when China's economy was virtually closed to the rest of the world and the depreciation rate after the first round of liberalization and opening doors to the world economy. Hence δ is calibrated to match the average of the consumption of capital data from the WDI database measured for each of the TSS time spans. The values obtained thus show clearly the difference between the average depreciation rate before the first crucial reform was implemented in 1978 - when it displayed values close to 6% - and the depreciation rate of the last three decades with values around 10%.

The literature on China's calibrated capital share of ouput varies from 0.35 in Aziz (2007) to 0.4 in Lipschitz, L., Rochon, C & Verdier, G (2008) and Wang, P., Wen, Y.

& Xu, Z. (2012) to 0.5 in Song, Z., Storesletten, K. & Zilibotti, F. (2011). This paper considers first the labor share of output from Bai, C., Hsieh, C. & Qian, Y. (2006), taken from China's NBS and calculated as a weighted average of the labor share of provinces provided by the NBS and the share of the respective province in GDP. The authors mention two potential concerns in calculating the share of labor by using the NBS data, related to the understatement of true labor income due to unmeasured nonwage benefits and the understatement of the true labor share due to unmeasured self-employment. However each of these concerns are addressed in their study since the NBS includes estimates on nonwage benefits in labor income and also specifically counts all self-employment income as labor income before 2005 and separately after 2005. Hence the estimates of labor share before 2005 are actually overstating the true labor share and understating the share of capital. Additional data is taken from Bai, C. & Qian, J (2007) and Bai, C. & Qian, J. (2010) to complement the values of the labor share after 2002 and to account for the rising debate on the significant decline of labor share of income in the last decade. The capital share of output is then calculated as (1−labor share of output) for the corresponding data set, while the calibration takes into account the average value of α for each of the transitory steady state time ranges. It is apparent that the calibrations for the capital share of income for each TSS are akin to the higher values used in related literature, coming very close to the 0.5 mark used in the most recent studies. It is to be noted that this is a high value for α, especially compared with countries in similar stages of development or with developed countries, where the share of capital in ouput's value is taken generally to be around 0.30.

The characteristics of the present model are used in the calibration of the quality measure φ_t. This is done in such a way as to match the average GDP per capita ratio for the Chinese economy for each of the chosen transitory steady states' time ranges. The methodology used in this calibration consists in solving the following equation, which results from the steady state expression of y_m^* :

$$\varphi_m^* = y_m^{*\frac{1-\alpha_m}{\alpha_m}} A_m^{-\frac{1}{\alpha_m}} \frac{r+\delta_m}{\alpha_m}$$

The measure φ shows an increase in the quality of foreign capital over the last five decades and a higher quality relatively to domestic capital for the last three transitory state ranges. Since foreign direct investment inflows were almost nonexistent in the range before the first significant reform was implemented in 1979, the value of the quality measure in TSS1 is not a reflection of the true calibre of foreign capital in that period. It is in fact not taken into consideration as a viable comparison term with the subsequent values of the quality measure for the rest of the transitory steady states, however the reason it is displayed among the results is because it is needed in terms of determining the calibration of the technology parameter A, as descibed in what follows.

The technology parameter A is calibrated to match the average GDP per capita ratio and the value of φ_m^* for each transitory steady state, using its expression from the intensive form of the production function:

$$A = \frac{y_t}{(k_t + \varphi_t z_t)^\alpha}$$

The initial value of A in 1965 is calculated by setting foreign capital in 1965 equal to zero. Since foreign direct investment around that time is virtually nonexistent and hence so would be the foreign capital stock entering the broad capital stock input in the production function, this assumption is likely. Alternatively the quality measure could be set to equal 1 to calculate the parameter A in 1965. In that case, since foreign capital it very close to zero, the value for the technology parameter is essentially identical to the one obtained by ignoring the foreign capital term.

This value of the parameter A thus obtained is considered to be the one at the beginning of the first transitory steady state (TSS1). Since the parameter A is not time dependent in the model, it will maintain that same value across the entire range of the first transitory steady state TSS1. Consequently the value of the quality measure φ for the first TSS is calculated by using this particular value of parameter A. The quality measure obtained from this calculation for the first transitory steady state is then used to obtain parameter A for the end of TSS1 and consequently the beginning of TSS2. Considering the new parameter A at the beginning of TSS2, the quality measure for TSS2 can be then computed for the second transitory steady state and with it the techology parameter for the third transitory steady state and so on until the both the quality measure and the technology parameter have set values for the last transitory steady state TSS4.

From Table 1.3 it is notable that the technology parameter has increased significantly over each subsequent transitory steady state, underlying the worldwide increase in technology especially after the second half of the 1990s. Even though the parameter A cannot capture the entire extent of technological progress due to the manner in which it is modeled, it represents a good level indicator for each transitory steady state in the analysis. For the present study, the main point of analysis is to determine the extend of the quality measure as an indicator of potential spillovers from foreign capital and for that purpose it is essential that said measure does not lose part of its quantitative importance to a more generalized metrics of technical progress. In this way it is preferred that parameter A may understate generalized technical progress as opposed to absorb part of the quality measure's importance in the present analysis.

The calibrated time invariant and transitory steady state parameters obtained above are used in a detailed quantitative analysis of the importance of FDI in China's growth and development, through growth rate contributions and through accumulation and spillover effects' examination. The results of this analysis are presented in the following subsection.

1.4.3 Results

In order to answer the question of how much FDI has contributed to China's development and growth in quantitative terms, the model of the third section of this study is used to ascertain the impact of foreign direct investment through the foreign capital component of the production function in the aggregate capital input and in the aggregate output, both in the form of pure accumulation effects and in the form of spillover effects. These effects are decomposed in the counterfactual part of this section, offering the most interesting outcomes of this analysis, together with the examination of the contribution of FDI to the real GDP growth of China through the foreign capital component of the production function.

1.4.3.1 Direct quantitative assessment

In the first sequence of results, a comparison between the results generated by the model and the data is made for real GDP and for real GDP per capita in China.

The model tends to underestimate the values for real GDP especially for the last two transitory steady states and tends to slightly overestimate the values for real GDP per capita, especially for transitory steady states two and three. This stems especially from the way the technology parameter is calculated and the necessity to keep it as an invariant measure per transitory steady state range. The technology parameter A - obtained in the manner detailed in the previous calibration section - cannot encompass the technological progress in its entirety within each range. However for the current analysis it is more important to evaluate it in this manner in order to avoid its potential overvaluation from including part of the spillover effect that should be contained in the quality measure φ.

The results of the comparison between the data and model values for real GDP per capita in China are illustrated below in Table 1.4 and in Figure A.7 in Appendix A.3. As previously stated, the model tends to slightly overestimate the data, especially for the last transitory steady state, in which the model predicts a 0.3% higher real GDP per capita value than the average of the data over the particular time range for TSS4. The highest overestimation is in place for the second transitory steady state, in which the model predicts a 5% higher real GDP per capita value than the data, while for the first and third transitory steady states, the overestimation reaches slightly above 3% in terms of the difference in the real GDP per capita values.

Table 1.4 Real GDP per capita results (bil. US$, index 2000)

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
Real GDP	Value	Value	Value	Value	Value
Model	100.138	129.294	304.401	800.576	1873.831
Data	100.138	125.485	289.292	776.978	1867.575
Δ	-	3.810	14.750	23.598	6.255
$\%dev$	-	3.0359	5.0986	3.0371	0.3349

Note: Δ = difference between model and data values

$\%dev$ = percent deviation from data value

Figure 1.3 below and Table A.3 from Appendix A.3 show a similar type of results, this time for real GDP in China. The difference between the model and data values show an underestimation of real GDP in the model with the highest percentage difference in transitory steady state two, closely followed by transitory steady state three. For both time ranges delimited by these transitory steady states, real GDP in the model values is lower than the data values by more than 6%. The model underestimates real GDP in the first transitory steady state by almost 5% and the closest model and data values are obtained for the last transitory steady state, where the underestimation in the model values reaches slighlty over 2%. Once again, these differences between the model and data values stem mainly from the fact that the technology parameter A cannot capture the value of technological progress over each transitory steady state time range in its entirety. This parameter was modeled and calibrated to be invariant within each transitory steady state - in the manner presented in the previous section - in order to not cause an inadvertent undervaluation of the quality measure.

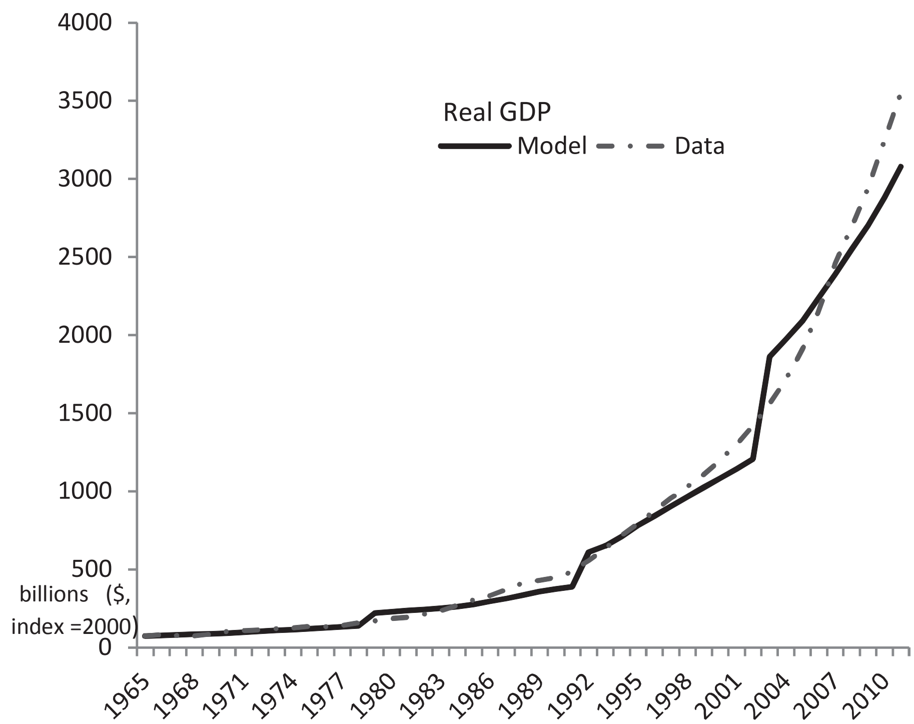

Figure 1.3 Real GDP in China - Model vs. Data

The percentage of FDI in GDP is then compared between the data and the model values. Since the model underestimates the value of real GDP for the transitory steady states, a slight difference in percentages is expected, with the model predicting a slightly higher proportion of FDI in GDP. The differences between the data and the model are shown in Table 1.5 below. The first transitory steady state does not show any values for these percentages because foreign direct investment inflows are virtually nonexistent before 1979.

Table 1.5. FDI as % of GDP

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
	Value	Value	Value	Value	Value
% FDI of GDP - Model	-	-	0.6519	4.4650	3.6752
% FDI of GDP - Data	-	-	0.5630	4.2721	3.6564
Δ	-	-	0.0890	0.1929	0.0188

Note: Δ = difference between model and data values

An important way to look at the FDI's impact in capital accumulation is to measure the percentage of FDI out of the aggregate capital stock values for each transitory steady state, where the aggregate capital stock represents the sum of domestic and foreign capital, including the measure of spillover for the foreign capital stock. In these terms, FDI represents a very small portion of the aggregate capital stock, with the highest value registered in fact in the decade before the biggest increase in absolute value of FDI inflows, as it can be seen from Table 1.6. After the first gradual reform of 1979, it comes to no surprise that FDI has a very small presence in the aggregate capital stock, of slightly over 0.4%, since FDI inflows have not been too notable during the first TSS. In transitory steady state three, FDI represents almost 2.7% of the aggregate capital stock, while in the last time range it drops by almost one percentage point, to 1.8%.

Table 1.6 FDI as % of aggregate capital

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
	Value	Value	Value	Value	Value
% FDI of $K_{aggregate}$	-	-	0.4076	2.6487	1.8353

Note: $K_{aggregate} = K + \varphi Z$

To be most consistent with the model presented, a better method to measure the importance of China's economic liberalization is through the foreign capital component of the aggregate capital stock measure.

Taken by itself, the percentage of foreign capital in the aggregate capital stock measures around 9% for the last two decades of the analysis. If the spillover effect is factored in, the percentage rises by approximately 1% for the two more significant transitory steady state ranges, as illustrated in Table 1.7.

Table 1.7 Foreign capital as % of aggregate capital

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
	Value	Value	Value	Value	Value
% Z of $K_{aggregate}$	-	-	0.9049	8.5676	9.0575
% φZ of $K_{aggregate}$	-	-	0.9811	9.5321	10.7285

Note: $K_{aggregate} = K + \varphi Z$

As a percentage of GDP however, foreign capital rises to values close to 16% in transitory steady state three and over 18% in transitory steady state four, whereas including the spillover component takes the percentage up to almost 18% in TSS3 and close to 22% of GDP respectively in the last transitory steady state. These results are summarized Table 1.8 below.

Table 1.8 Foreign capital as % of GDP

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
	Value	Value	Value	Value	Value
$\%Z$ of Y	-	-	1.5071	15.8678	18.1840
$\%\varphi Z$ of Y	-	-	1.6339	17.6542	21.5387

Note: Y = real GDP

The relevant results for the spillover measure φ are reiterated in Table 1.9, to summarize the quality aspect of the foreign capital that enters the production process for the different transitory steady state time ranges. The findings show that the foreign capital enters the production function exhibiting higher quality than the domestic capital for all three transitory steady states relevant for the analysis. In addition, the quality of foreign capital is increasing, from being almost 9% more qualitative in the second transitory steady state to being 18.5% more qualitative than domestic capital in the last transitory steady state.

This result confirms the conjectures that foreign direct investment inflows have exhibited higher quality after China's ascension to the World Trade Organization in 2001, than they had before the implementation of the extremely influential Spring Wind reform in 1992.

Table 1.9 Quality measure summary of relevant results

		TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
Function	Description	Value	Value	Value
φ	quality measure	1.0841	1.1126	1.1850

Next, an exercise of growth accounting is performed in order to ascertain the contribution of the foreign capital growth rate in the growth of GDP, along with the growth rates of the other components of the model's production function.

Using growth accounting methodology that is illustrated in detail in Appendix A.2, the growth acccounting expression that links the growth rates of inputs to the one of the output is given by the following expression:

$$\frac{\dot{Y}}{Y} = \alpha\xi_K \frac{\dot{K}}{K} + \varphi\alpha\xi_Z \frac{\dot{Z}}{Z} + (1-\alpha)\frac{\dot{L}}{L} + \frac{\dot{A}}{A}$$

where $\xi_K = \frac{K}{K+\varphi Z}$, $\xi_Z = \frac{Z}{K+\varphi Z}$ and $\xi_K + \varphi\xi_Z = 1$.

While the growth rate of domestic capital has maintained its most important contribution to the growth in real GDP throughout the entire period studied and also increased over the last three decades, the importance of the growth rate of labor and the growth rate of foreign capital has been decreasing, as it can be seen from Table 1.10. The decline in the growth rate of foreign capital stems from both a measurement issue that overstates significantly the share of foreign capital growth in the second transitory steady state and from the decline of the average growth rate of foreign capital in the final transitory steady state.

The difference between the contribution of foreign capital to the growth in GDP between transitory steady states three and four is driven by the difference in average growth rates of Z between the two time ranges. The higher growth rate in the third transitory steady state is mostly driven by the high increase in FDI inflows between 1992 and 1995 which translates into more than 50% growth in foreign capital between 1992 and 1993 and between 1994 and 1995 and of more than 100% growth in foreign capital between 1993 and 1994.

Table 1.10 Growth rates

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
	Value	Value	Value	Value	Value
$gr(Y)$	-	0.0651	0.0909	0.1026	0.1076
Contribution to gr(Y)					
$\alpha\xi_K gr(K)$	-	0.0455	0.0389	0.0527	0.0530
$\alpha\varphi\xi_Z gr(Z)$	-	-	0.0203[1]	0.0122	0.0055
$(1-\alpha)gr(L)$	-	0.0118	0.0075	0.0054	0.0028
$gr(residual^2)$	-	0.0077	0.0242	0.0325	0.0463

Notes:[1]Excluding the 1980 outlier yields a contribution of Z of 0.23%

[2]The residual captures the gr(Y) unexplained through K, Z or L

Ignoring the outlier in the second transitory steady state, the contribution of foreign capital to real GDP growth amounts to only around 0.23%, which becomes now the lowest contribution out of all the other categories of the growth accounting exercise. The highest contribution of foreign capital growth to real GDP growth appears in the third transitory steady state covering the years 1992-2002, when foreign capital contributes a significant 1.22% to the 10.26% growth in real GDP. This shows that FDI through the foreign capital component of output had an important influence in China's economic growth, especially after the "Spring Wind" reform of 1992. In addition, foreign capital's contribution to real GDP is more than the contribution of labor during that particular range. The same ranking maintains throughout the last transitory steady state as well, however the levels are now much lower, foreign capital contributing only 0.55% to the 10.76% growth in real GDP.

To get an even closer and better look at exactly how much foreign capital has influenced China's GDP, two separate counterfactual experiments are conducted. The first counterfactual experiments tests the pure accumulation effect and the second tests the spillover effect of FDI through foreign capital on real GDP per capita in China. The features and methodology of each counterfactual experiment are presented below.

1.4.3.2 Counterfactuals

This subsection contains the counterfactual experiments that test the importance of FDI in China's economy by considering on one hand its pure influence on capital accumulation and on the other hand its influence on growth in terms of spillover effects. The experiments are set up in such a way as not only to offer a quantitative answer to the contribution of foreign capital to China's development, but to also disentagle the two aforementioned effects.

Autarky In this experiment, autarky essentially describes the situation in which foreign capital is nonexistent, in order to asses what would have happened to China's economy if its gradual international liberalization had not taken place. The difference that arises between the aggregate capital stock that contains foreign capital and the aggregate capital stock in autarky underlines the importance of foreign capital in terms of the pure accumulation effect.

Further, the difference that arises between the value of aggregate output in the model economy and the value of aggregate output in autarky show the influence of foreign capital through accumulation on China's development and growth. Through the pure capital accumulation effect it results that foreign capital has contributed a surprising 5% to China's GDP per capita after the early 1990s. Or put in a different way, if foreign capital would have not existed in China because of no foreign direct investment inflows in the economy, the country's GDP per capita would have been 5% lower after the 1990s.

Table 1.11 Counterfactuals: Autarky - GDP per capita

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
	Value	Value	Value	Value	Value
$y_{aut}(Z=0)$	100.138	129.294	302.428	760.976	1772.663
y	100.138	129.294	304.041	800.576	1873.831
$\Delta = y - y_{aut}$	-	-	1.613	39.600	101.167
$\%\Delta/y$	-	-	0.5305	4.9464	5.3990
y_{data}	100.138	125.485	289.292	776.978	1867.575
$\%\Delta/y_{data}$	-	(3.036)	(4.541)	2.060	5.082

Notes: y = GDP per capita

$\%\Delta/y$ = percent deviation from model y

$\%\Delta/y_{data}$ = percent deviation from GDP per capita (data)

The increase in this type of contribution shows the significant change in market liberalization after the "South Tour" reform was implemented in 1992. The contribution of foreign capital further rises to around 5.4% of GDP per capita and 5.3% of real GDP respectively after China's entrance into the World Trade Organization.

Table 1.11 above summarizes these findings and Table A.4 in Appendix A.3 displays the corresponding results for the influence of foreign capital on China's real GDP.

The comparison of the autarky values and the data yields a wider range of results, with a much lower contribution of foreign capital to the GDP per capita level after the early 1990s. After 1992, if foreign capital would have not existed, real GDP per capita would have been 2.06% lower, while the same comparison after 2003 yields a diference of 5.1% between the autarky counterfactual experiment model values and the data. The values of comparison for real GDP are much higher in this case, with a contribution of over 7% in the second and fourth transitory steady state respectively and a very high 10.9% in the third transitory steady state. These larger differences stem from the differences between the original model's values and the data values, as explained in detail in part 1.4.3.1.

In addition, Table A.5 underlines the positive changes that inevitably have to occur now in the contribution of the domestic growth rate to the GDP growth rate because of the absence of the foreign capital influence. Not surprisingly, the lowest 'transfer' of growth rate contribution from foreign to domestic capital occurs in the second transitory steady state when foreign direct investment inflows were low in the benchmark model and consequently so was the level of the foreign capital. At the other end of the spectrum, the "highest" such change occurs in the last transitory steady state, when the quantitative contribution of foreign capital to output is the highest.

Quality equivalence (spillover effect) In the second counterfactual experiment, the scope is to consider both domestic and foreign capital as being of the same quality, in order to gauge the magnitude of the effect of any potential spillovers from the different quality of foreign capital. This is accomplished by comparing the two different scenarios, one in which the quality measure is dictated by the model calibration and the other in which the quality measure is fixed at the level equal to 1. The last assumption ensures that the second scenario takes into account both capital stocks of the same calibre.

The results of this counterfactual experiment are displayed in Table 1.12 for the effects on GDP per capita and Table A.6 for the effects on real GDP. In contrast to the previous autarky counterfactual experiment, the spillover effect does not have the same magnitude in terms of the difference between the values of GDP per capita for the two cases considered, amounting to a contribution of only 0.8% in GDP per capita in the last transitory steady state. Or in other words, if foreign capital would have been of the same quality as domestic capital, GDP per capita in China would have been 0.48% lower between 1992-2002 and 0.821% lower after 2003. However it is to be noted that there is a significant difference between the transitory steady state outcomes of the experiment, with a significant increase of the spillover effect in the last transitory steady state over the third and especially of the second transitory steady state. This result hence supports the claim that the quality of FDI and through it of foreign capital has been much lower after the first liberalization reform (starting in 1979), when FDI inflows were restricted to the special economic zones and were originating mainly from the neighbouring Hong Kong, Macao and Taiwan (HMT). At the same time these results also support the assertion that the quality of FDI inflows has increased significantly after China's ascension to WTO, seemingly because the origins of said FDI inflows changed from HMT to OECD countries and this range is precisely covered by the fourth transitory steady state of the present analysis.

The present study does not attempt to detail the actual sources and explain the motivations or direction of FDI inflows, but concentrates on the quantitative results of the spillover effects. Consequently the discussion is mainly addressed towards the numerical evidence that FDI and hence the foreign capital's quality and influence in determining China's GDP per capita values.

Table 1.12 Counterfactuals: Spillover effect - GDP per capita

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
	Value	Value	Value	Value	Value
$y_1(\varphi = 1)$	100.138	129.294	303.917	796.672	1858.451
y	100.138	129.294	304.041	800.576	1873.831
$\Delta = y - y_1$	-	-	0.125	3.904	15.380
$\%\Delta/y$	-	-	0.041	0.488	0.821
y_{data}	100.138	125.485	289.292	776.978	1867.575
$\%\Delta/y_{data}$	-	(3.036)	(5.056)	(2.535)	0.4886

Note: y = GDP per capita

$y_1 = y$ when $K_{aggregate} = K + Z$

$\%\Delta/y$ = percent deviation from model y

$\%\Delta/y_{data}$ = percent deviation from GDP per capita (data)

1.4.3.3 Sensitivity analysis

The results presented up to this point depend on the parameters chosen during the calibration exercise from the data and from the model, to match certain key moments in the Chinese data as described in the calibration section previously. The sensitivity analysis is performed by considering a few different choices for some of the data parameters, in order to see how responsive the endogenous calibration parameters and the results are to this type of change.

Capital share of output One interesting analysis is to consider the capital share of output as an invariant parameter of the model - as it is generally considered in the related literature - instead of a transitory steady state parameter and observe what consequences this particular assumption brings to the calibration of the endogenous transitory steady state parameters and to the most important results of the model.

The first experiment considers the capital share of output $\alpha = 0.48$, to match the average of the corresponding series for the entire time range discussed. The changes to the calibrated parameters φ and A, as well as the changes in GDP per capita and counterfactual experiments are summarized in Table 1.13. A similar experiment is conducted for $\alpha = 0.5$, which is the value of the capital share of output used in the most recent literature for China model calibrations. The results are illustrated in Table A.8.

The results for $\alpha = 0.48$ show that as the aggregate capital share of output decreases, the spillover measure increases, resulting in a higher quality foreign capital being included in the production process. At the same time, the technology parameter is also higher, while the magnitude of the impact of foreign capital in the capital accumulation process is magnified. The spillover effect responds quite strongly to the decrease in the capital share of output in the last two transitory steady states, approximately doubling its influence of the GDP per capita level from the benchmark model counterfactual exercise.

In contrast, when $\alpha = 0.5$, both the spillover measure and the technology parameter decrease for the higher aggregate capital share of output. The only exception is the change in the quality measure in the last transitory steady state, when it exhbits an increase over the benchmark model counterfactual value. At the same time, the response of capital accumulation process and spillover effect is more subdued than in the previous case, with increases only in the last two transitory steady states for the former and the last transitory steady state for the latter.

Table 1.13 Sensitivity analysis α=0.48

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
φ	-	0.2996	1.0841	1.1126	1.1850
φ_{new}	-	0.3039	1.0337	1.2216	1.4211
A	10.8114	10.7466	16.7017	24.1715	33.0837
A_{new}	10.6505	10.6736	16.3343	24.4962	35.6211
y	100.138	129.294	304.401	800.576	1873.831
y_{new}	100.138	129.308	304.116	800.249	1873.585
$\%\Delta/y_{data}$	-	3.0359	5.0986	3.0371	0.3349
$\%\Delta/y_{new-data}$	-	3.0472	5.1412	2.995	0.322
Counterfactuals Z = 0					
$\Delta = y - y_{aut}$	-	-	1.613	39.600	101.167
$\Delta_{new} = y_{new} - y_{new_{aut}}$	-	-	1.553	42.912	117.037
$\%\Delta/y$	-	-	0.531	4.947	5.399
$\%\Delta/y_{new}$	-	-	0.511	5.362	6.247
Counterfactuals $\varphi = 1$					
$\Delta = y - y_1$	-	-	0.125	3.904	15.380
$\Delta_{new} = y_{new} - y_{new_1}$	-	-	0.050	7.584	33.839
$\%\Delta/y$	-	-	0.041	0.488	0.821
$\%\Delta/y_{new}$	-	-	0.017	0.948	1.806

World interest rate Another parameter of the present model that can provide an interesting sensitivity analysis is the world interest rate. The benchmark model considers one of the values towards the higher spectrum used in the literature for low-income and credit constraint economies for the world interest rate. For the sensitivity analysis, a lower value is considered, namely r = 4% to see how responsive the model variables are, in particular the quality measure for foreign capital and the technology parameter. The findings are summarized in Table 1.14 below.

It is interesting to observe that the quality measure φ is highly responsive to the change in the world interest rate, a 1% decrease in world interest rate bringing about a decrease of approximately 10% in the spillover measure for each transitory steady state, which translated into a much lower quality addition of foreign capital in the production function. In other words, as the world interest rate decreases, foreign capital becomes closer in quality to the domestic capital, registering only 1.11% higher quality addition in the first transitory steady state, a 3.54% higher quality addition in the second TSS and a 9.96% higher quality addition to the production function for the last transitory steady state, which represents almost half of the contribution from the benchmark model.

The technology parameter A is less sensitive in the case of the change in the world interest rate, registering only slight increases as a result of the decrease in r for each of the last three relevant transitory steady states. Since the value of foreign capital is extremely small in the first transitory steady state, the difference between the benchmark model value of the technology parameter and its value obtained for the new model with the lower world interest rate is negligible.

Additionally, the counterfactual exercises provide more insight into the magnitude of the changes to model variables from this particular sensitivity analysis. It is interesting to observe that there is only a slight decrease in the values of the autarky counterfactual exercise between the benchmark model values and the new values for real GDP per capita after the change in r.

However the spillover effect shows a strong reaction to the change in interest rate, as it was expected from the change registered in the quality measure. For this particular effect, real GDP per capita shows a significant decrease in magnitude from the benchmark model for each transitory steady state, with the highest such change in the second TSS and the highest in the last transitory steady state.

Table 1.14 Sensitivity analysis $_{r=4\%}$

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
φ	-	0.2996	1.0841	1.1126	1.1850
φ_{new}	-	0.2717	1.0111	1.0354	1.0996
A	10.8114	10.7466	16.7017	24.1715	33.0837
A_{new}	10.8114	10.7466	16.7092	24.2563	33.2093
y	100.138	129.294	304.401	800.576	1873.831
y_{new}	100.138	129.294	304.071	800.698	1874.150
$\%\Delta/y_{data}$	-	3.0359	5.0986	3.0371	0.3349
$\%\Delta/y_{new-data}$	-	3.0359	5.1087	3.0528	0.3521
Counterfactuals Z = 0					
$\Delta = y - y_{aut}$	-	-	1.613	39.600	101.167
$\Delta_{new}= y_{new}-y_{new_{aut}}$	-	-	1.505	37.055	94.475
$\%\Delta/y$	-	-	0.531	4.947	5.399
$\%\Delta/y_{new}$	-	-	0.495	4.628	5.041
Counterfactuals $\varphi = 1$					
$\Delta = y - y_1$	-	-	0.125	3.904	15.380
$\Delta_{new}= y_{new}-y_{new_1}$	-	-	0.016	1.234	8.349
$\%\Delta/y$	-	-	0.041	0.488	0.821
$\%\Delta/y_{new}$	-	-	0.005	0.154	0.446

1.5 Conclusions

This study addresses a highly debated issue in the related literature, namely the importance of foreign direct investment in China's development and growth. Using a neoclassical growth model with foreign capital, this chapter answers the quantitative question of how big of an impact FDI had and continues to have in the economy of China, through a growth contribution analysis and through a capital accumulation analysis. The latter distinguishes between a pure capital accumulation effect and a quality spillover effect.

An important point of the present methodology is taking into account the timing and effect of several reforms that have opened China's economy up gradually to the world since 1979 and incorporating that timing into the analysis. The findings are then viewed in four distinct stages, which correspond to four distinct time ranges marked by reforms significant for the inflows of foreign direct investment.

The model employed arrives at the conclusion that FDI does indeed have a significant impact through growth rate contributions and through the accumulation of foreign capital, especially from the pure capital accumulation point of view. This results hence lend support to the view the FDI has a significant contribution in China's economic growth and development.

The spillover effect is not as significant in its overall effect. However tracking its evolution throughout the time ranges considered in the analysis, it is interesting to observe that the spillover effect is more significant in the latter two ranges analyzed when compared with the intial stages, which supports the view that FDI in China has improved quality-wise, especially after the country's ascension to WTO, thus becoming the recipient of foreign investment inflows from many OECD countries and replacing the majority of export-oriented, low-quality FDI coming from neighboring source countries.

Since FDI is found to be more significant especially in the period after the Spring

Wind reform of 1992, the results do not offer much support to the view that FDI was more significant in the earlier stages of reforms by serving as way to bridge an investment gap when domestic investment was restricted.

The issue of foreign direct investment importance in a country's capital accumulation and growth is a significant issue for present and future research, because understanding the underlying mechanisms and effects can help other countries emulate the strategies of those who have been succesful in attracting foreign inflows and using them efficiently in their growth experience. Specifically for China, an interesting venue of related future research would be to analyze the effect of FDI's contribution to the growth of specific provinces, since their experiences in attracting foreign direct investment inflows have been very different as a result of the gradual reforms imposed after the late 1970s.

CHAPTER 2
CHINA'S HIGH SAVING RATE PUZZLE
IMPACT OF MARKET LIBERALIZATION REFORMS

2.1 Introduction

This chapter addresses what has come to be known in the related literature as China's "high saving rate puzzle". Just as Japan was hailed a few decades ago as the highest saving country and at the same time as the growth miracle of its time, a similar view starts to surround China, due to an even higher saving rate and a considerable and sustained growth rate for over three decades.

There are several ways in which the domestic Chinese saving's rate puzzle has been defined across existing studies, but the most common threads in them have looked at two aspects of this issue. One aspect represents the puzzle of the notable high level of the national Chinese saving rate over the last forty years, attaining 30% in the early 1970s, while reaching and even surpassing 50% of GDP after 2005. The second aspect is the puzzle of the overall increase in the saving rate in terms of percentage points - specifically over 20 percentage points - since the mid-1960's and 15 percentage points since the gradual economic reforms towards openness and market liberalization were implemented in China starting in the late 1970's. The most intriguing part of this latter feature of the puzzle represents the increase of over 15 percentage points between the years 2000 - 2011, after a decrease in saving rate following 1994. The starting point of this last surge in the Chinese national saving rate surrounds the time of the country's entrance into the World Trade Organization (WTO) in 2001.

One of the main reasons of why this is an issue that grabbed the attention of so many researchers is that this high level of saving has persisted for several decades during which China has experienced also a high, and sustained level of growth. Viewed from this angle, China's saving rate puzzle is part of a more general high saving rate puzzle that developing countries with high and persistent rates of growth have been exhibiting. This has been - among other examples - the case of Japan during the 1950 – 1970, South Korea, Taiwan, Hong Kong in the interval 1960 -1980, Singapore in the range 1960 – 1980 and then again after 1987, Botswana during 1969-1988, Mauritius during 1980-1990, Malaysia during 1970-2000 and Kazahstan during 2000 - 2011. So in this respect, the Chinese saving puzzle is not quite as exclusive as it might appear at first glance and it seems that for the majority of countries which exhibit periods of sustained high growth, high national saving rates represent a more common occurence than the theory would have predicted. Some of China's regional counterparts have exhibited even higher levels of saving at certain points in time, such as Singapore and Malaysia.

For instance, according to Friedman's (1957) permanent income hypothesis, we would expect to see a decrease in the level of saving in an economy that exhibits high growth, because agents would save less when faced with a persistently high growth in income. However this is not what is observed for most of the fast growing countries in general and for China in particular, as the relevant case in point and the object of this study.

In addition, Modigliani's life cycle theory (1954), would predict increase in consumption spending and consequently a decrease in saving while consumer's incomes are rising, which is also not the case for China. Moreover, recent research in Chamon, Liu & Prasad (2010) suggest that contrary to the usual hump-shaped saving profile that we would expect to see over a consumer's lifecycle, the age-saving profile of China's household is markedly U-shaped.

Consequently it appears that the typical prediction that standard saving models make, that savings behave mostly according to the life-cycle and permanent income theories and are relatively independent of growth cannot be easily reconciled with the Chinese data. On the contrary, recent empirical evidence points toward a strong positive correlation between growth and saving, with the order of causality going from growth to savings and not the other way around as predicted in the Solow model and in the Permanent Income Hypothesis. Influential work on the level of causation from growth to saving has been documented in Carroll & Weil (1994) and Carroll, Overland & Weil (2000). Even if part of the increase in the saving rate is accounted for by the increase in income over poverty levels at first, the same argument cannot be applied for the next decades while the growth in saving rates persisted.

Another view and piece of the puzzle on Chinese saving is comprised in the fact that during all this period of growth, the real interest rate in China has remained very low and in some years has even been negative. Standard growth theory would predict that in this type of economy, the rate of return to capital would be high and thus in equilibrium the high interest rate would induce higher saving. Whereas China does exhibit a persistently high rate of return to capital of approximately 20% on average as documented in Bai, Hsieh & Qian (2006), the real interest rate has been extremely low, around 3-4% on average over the range 1978- 2011 (WDI). However, even given the low real interest rate and low and fixed deposit rates, savings in China are high and increasing.

Part of this phenomenon stems from the fact that Chinese households have little alternative ways to invest and insure themselves and their main vehicles of saving are deposits at commercial banks. Precautionary saving for a household, which is borrowing-constrained in this kind of environment, is offering part of the explanation of the incentive to keep saving even as the real interest rate is low as presented in an analytical framework in Wen (2010).

Which brings up the last piece of the puzzle that must be fit into China's saving story. Most of the existing literature on this subject studies household saving data and analyzes possible causes for this high level of saving, such as life-cycle theory, precautionary saving, habit-formation and consequences of the one-child policy. While several of them attain notable results in approximating the household saving data, none of the ones that attempt to explain the domestic saving rate in its entirety - and not just the household saving portion - manage to account for the high level of domestic saving observed in China.

The main reason for this kind of result is the fact that these studies cannot distinguish between household saving and national saving, which is usually the norm in the standard literature, where the assumption is that investment in the production sector is financed through the household saving channel in its entirety.

However in China's case, the distinction between household saving and national saving appears to be an important one, because the economy is plagued with capital market imperfections and private economic agents tend to be severely borrowing constrained. The channel that normally funnels household savings into the private production sector is for its most part severed and hence private firms have to rely on their own savings in order to finance their investment. In addition, the characteristics of different time periods are also important to consider in China's case, because of its unique approach to market liberalization, through gradual reforms which have been implemented since the late 1970s.

Along with the corporate savings in the private sector, retained earnings in the state-owned sector add up to form a significant portion of Chinese corporate and by extension aggregate domestic savings. Given the uniqueness of China's economic transition and the significant capital market constraints that restrict the use of household saving as investment in the production sector, it seems crucial that the different components of the structure of domestic saving are taken into account in the analysis of China's saving rate level and trend. More to the point, the data shows that the proportion of corporate and government saving in the domestic saving structure has increased especially in the last two decades. This also contributes to the relevance of considering the timing of market liberalization reforms as part of the present analysis, as each reform addressed several aspects of the Chinese economic environment, both the private and the public aspects of it.

Consequently, a growing part of the related literature begins to recognize the need of considering the components of Chinese national saving in the analysis of this particular puzzle, as it will be evidenced in some of the studies mentioned in the next section of this chapter. However there is still a lot of skepticism surrounding this particular issue, as another side of the literature is not convinced of the argument that the corporate and government saving components should be treated separately and not as implicitly flowing through the household channel as it would be the case in a complete markets framework.

The present study is addressing this controversy by using a simple one-sector neoclassical growth model to show how it performs quantitatively in relation to the two aspects of the Chinese saving puzzle. It further does so by using two distinct approaches. The more traditional approach addresses mostly the first aspect of the puzzle to show how much of the level of the national saving rate can be explained by using the growth rate of total factor productivity as the main driver of the analysis. The second approach takes into account the set of most relevant market liberalization- and privatization reforms in order to show how much of the level and of the increase in the national saving rate can be explained as a result of the gradual transition from a planned to a more market-oriented economy. The traditional approach offers some explanations on the first aspect of the puzzle, related to the high level of domestic saving, but it cannot explain the increase in domestic saving and its subsequent higher level after 2000. The second approach explains the increase in domestic saving quite well, however it shows a persistent gap between the model and data values, which suggest that some other aspect of the data has to be included in future analysis in order to be able to explain both sides of this puzzle simultaneously.

This paper is organized as follows. The next section contains an overview of the notable characteristics of China's saving rate evolution and of the relevant literature surrounding this subject. The third section presents the analytical framework employed in the analysis. Section IV contains information on the data used, calibration and the results obtained for both approaches and section V concludes.

2.2 Savings characteristics and previous literature

As mentioned in the previous section as well, the high level of aggregate Chinese savings has been at a core of a fast growing literature that attempts to explain the Chinese puzzle from a variety of research angles. The two aspects of the puzzle in the form of the high level reached of over 50% of GDP in 2011 and the overal increase in terms of approximately 15 percentage points since the implementations of the first market liberalization reforms can be seen closely in Figure 2.1. The increase of 15 percentage points covering the range 2000 - 2011 is especially noteworthy.

The data series for the domestic saving rate is taken from the World Development Indicators (WDI) for the time range 1978-2011. The calculation of domestic saving in the WDI database as an indirect measure is being done as the difference between GDP and total consumption, the latter including both household and government consumption. The saving rate is then found by dividing the resulting difference to GDP.

A new direct measurement method started in 1992, based on the flow of funds data published by the China's National Bureau of Statistics and available at CEIC. The two series are displayed in Figure 2.1 for comparison. It can be observed that the only significant difference between the two series is between the years 1992 and 2000, when the WDI data series has a pronounced 'hump' over the flow of funds data. However the increase in saving rate of 15 percentage points after the entrance of China in WTO in 2001 is virtually identical in the two databases. For most of the analysis in the present chapter the WDI data series is used because of its longer availability.

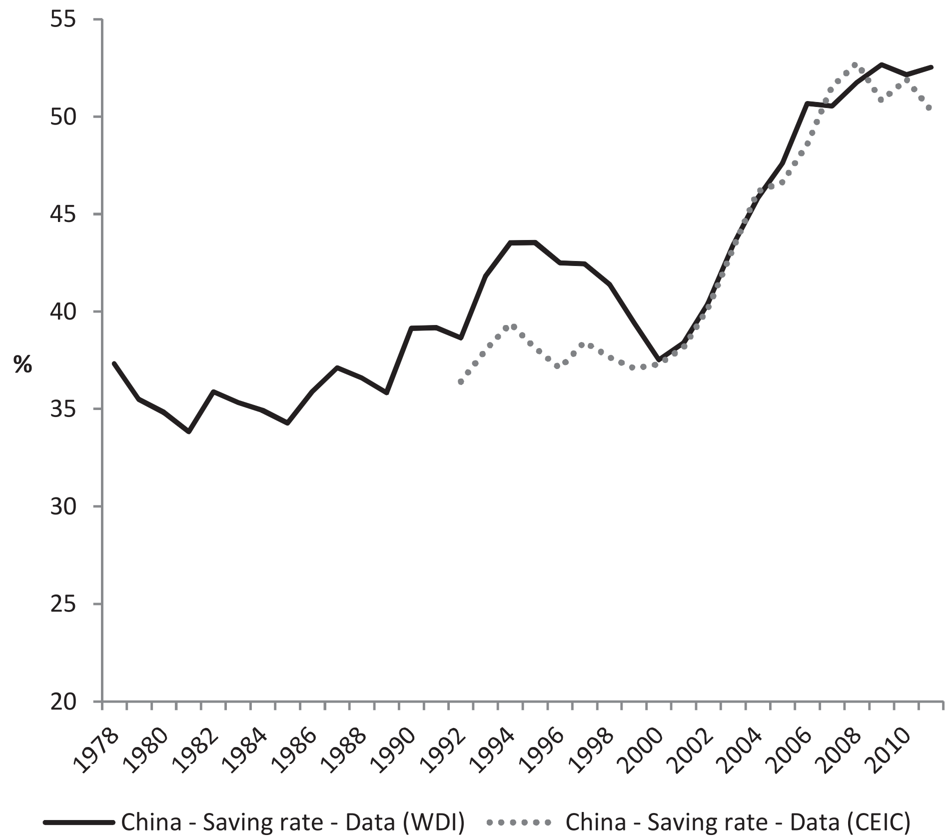

Figure 2.1 Domestic saving rate in China as % of GDP

It is important to point out first that China's experience of registering high and increasing saving rates during high and sustained periods of GDP growth is not quite as unique as the growing related literature seem to argue. Several countries have experienced high and increasing saving rates during periods of sustained increase in their gross domestic product, the majority of them albeit not reaching the same high saving rate level as China. However the trend is remarkably similar overall for such countries' national saving rate and it is interesting to observe it in the following examples in Figures 2.2 and 2.3 and Figures B.1 through B.5 in Appendix B.2.

Figure 2.2 shows India's experience and its increase in saving rate of more than 20 percentage points between 1960 and 2009, while going through a period of sustained

GDP growth. In terms of the aggregate saving level, India does not reach the highs of China's data, the largest attained level remaining below 35% for the 1960-2012 time range.

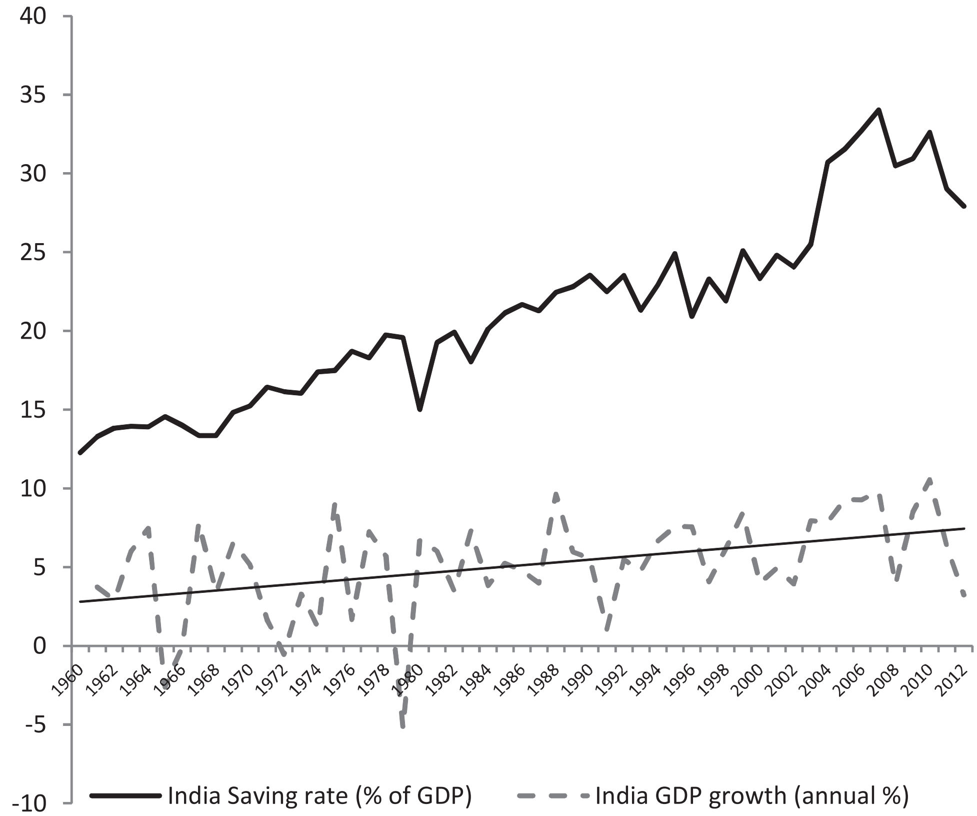

Figure 2.2 India - Saving rate and GDP growth rate

Singapore's experience on the other hand is a more intriguing one in terms of the domestic saving rate level and its overall increase since 1965. Similar to other countries exhibiting high and sustained GDP growth, Singapore shows an increase in its domestic saving rate level during the same time period as its sustained growth pattern. However this trend in Singapore's domestic saving rate surpasses even China's in terms of the magnitude of the increase - over 40 percentage points over the entire range - and the level attained, over 50% of GDP between 1995 and 1999 and again after 2005, as depicted in Figure 2.3.

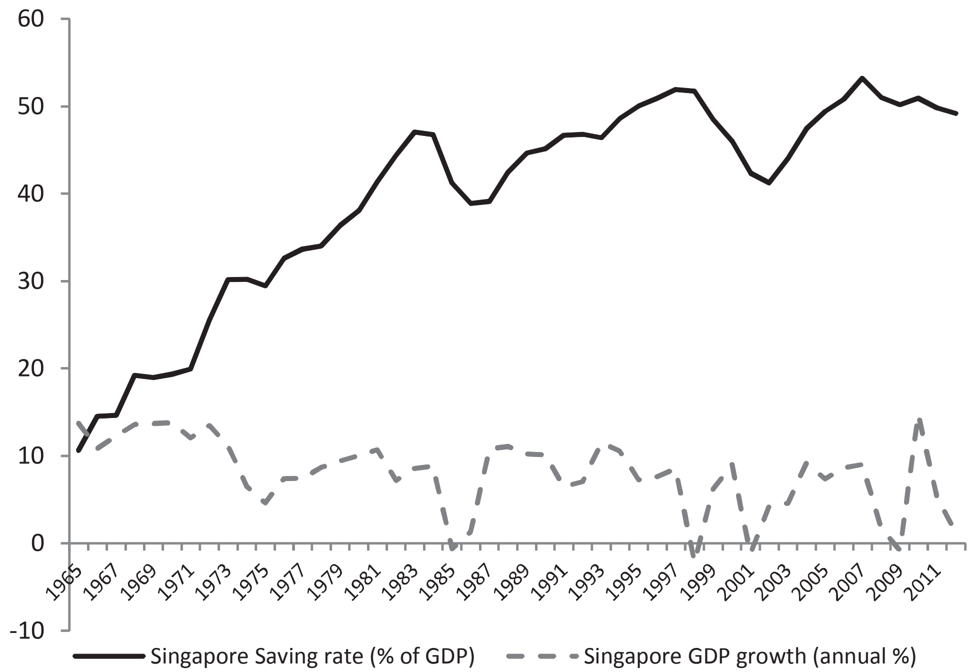

Figure 2.3 Singapore - Saving rate and GDP growth rate

Additional countries' experiences are summarized in Appendix B, in Figures B.1, B.2, and B.3 with Malaysia, Indonesia and Thailand showing a high level and increase of the saving rate during significant periods of growth, starting with the late 1960's until the late 1990's. A more recent example is Kazahstan (Figure B.4) with an increase of more than 30 percentage points of the saving rate between 1999 and 2008, reaching approximately 48% in the saving rate level at its highest position in 2008. Figure B.5 shows Botswana's saving and growth experience, with an increase of over 40 percentage points in the domestic saving rate since 1969 and a peak level attained of slightly over 50% in 1988, while maintaining and average of around 40% until 2007.

Summarizing China's regional experience with a few of the aforementioned countries yields very interesting patterns in Figure 2.4, since East and South Asia have been historically 'hubs' for miracle growth countries. It can be observed from this comparison that China has one of the highest level of the saving rate, but it is not as alone as expected in this particular experience. The increasing trend is also matched by its counterparts, and even surpassed in a few cases, such as Kazahstan.

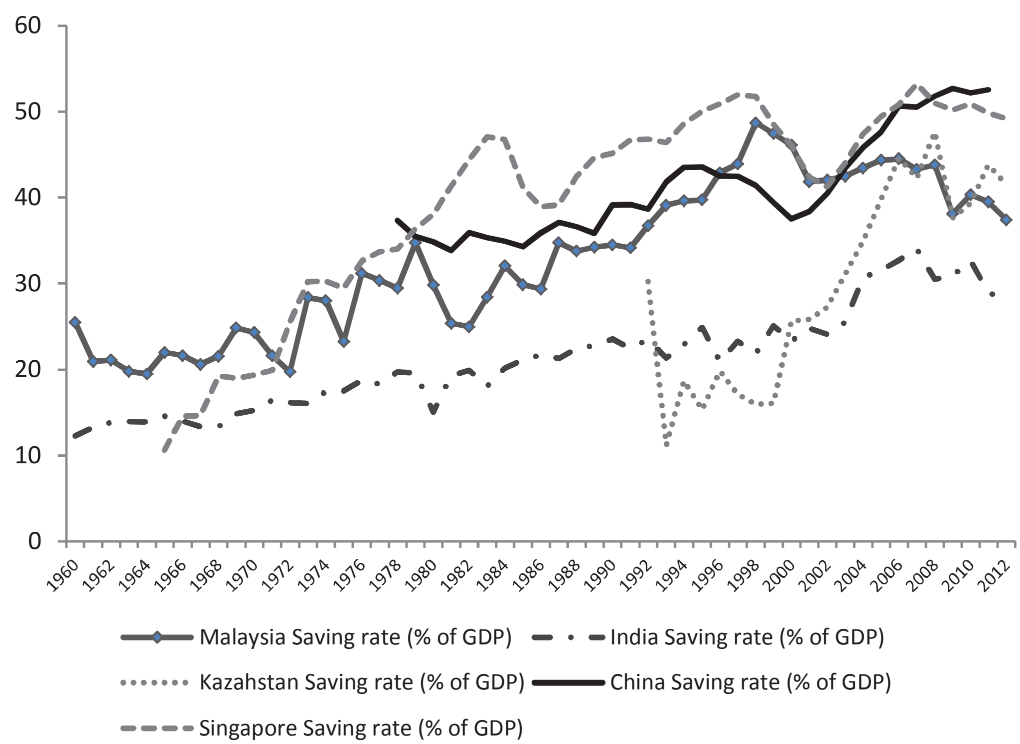

Figure 2.4 Regional country comparisons

An aggregation of East Asian and South Asian developing countries comparison is also included in Figure B.6 in Appendix B, with the aggregation data taken from the WDI database. Is it notable that the general trend in that particular aggregation is lead by China for the East Asian aggregation and India in the South Asian one. Another interesting comparison to be made is with countries of upper middle income level clasification (WDI). China is considered close to this particular category, according to the World Bank Development Indicators database aggregation. Figure B.7 compares China with the WDI aggregate for upper income level countries which shows China's higher level of saving rate and the bigger increase in terms of percentage points over the last decade as well.

As evidenced in the previous examples, China's saving and growth experience is not quite as unique as the vast related literature seems to imply. However it is undeniable that the Chinese saving rate level is very high from any potential perspective considered and the increase in terms of percentage points is substantial. Several studies have addressed the Chinese saving rate puzzle, with the focus on the potential underlying factors that have driven this impressive level and trend of the national saving rate. Among such factors are cultural features, demographics, liquidity constraints, precautionary saving, habit persistence, transition factors, high returns from saving, subsistence consumption, target saving, relative consumption and more recently rising optimism about growth. Given the factors listed, it comes to no surprise that the majority of the existing literature on this subject concentrates mostly on household behavior and incentives in order to explain the Chinese saving rate puzzle. Most studies attempt to explain only the household saving rate data and its particularities and in that respect the results obtained are quite significant, as it will be detailed in the following subsection. However when attempting to describe the domestic level of the saving rate only through household behavior and saving incentives, the existing models do not reach the desired patterns and trends.

For instance, one of the recent studies on the puzzle of Chinese saving in Wen (2010) explains in an analytical framework with precautionary savings the high-saving high-growth link for China, while also accounting for a low interest rate as it is observed in the data. This approach contrasts with the habit formation literature in which a high-saving high-growth link can be established, however high savings are achieved through high interest rates in the latter's models. The setup in Wen (2010) does reasonably well to find that with a 10% growth rate, the Chinese saving rate rises to a level around 30% of GDP. This result is lower than the 40% average for the national saving rate. However, as the author points out, the model used does not distinguish between household saving and national saving, because it assumes that the firms' investment is financed entirely by household savings. Furthermore, the author specifies that in order to explain the higher national saving rate level, corporate savings should be included in some form in the setup and methodology.

In a different kind of analysis, Lipshitz, Roshon & Verdier (2000) obtain stylized and qualitative results to explain several features of the Chinese economy, among which the triplet of high saving, high foreign direct investment and high growth, however their study is not specifically geared toward explaining the actual level and trend of the Chinese saving rate.

The present study concentrates on explaining aspects of the Chinese puzzle by using a simpler, standard neoclassical setup and in this respect it is most closely related to the work of Hayashi & Prescott (2002) and Chen, Imhoroglu, Imhoroglu (2005 & 2006), who study the Japanese saving rate in terms of a one-sector Ramsey-type model in which the driving force of the model is considered the total factor productivity growth rate. The details on the particularities of the setup and methodology used are outlined extensively in sections 3 and 4 of this chapter.

However, before considering the present setup, there is one more significant feature of the Chinese saving rate and corresponding literature to explore. Along these lines, the most recent trend in related research concentrates almost exclusively and at notable length on the issue of the Chinese national saving rate components and their role in driving the aggregate level of saving to its impressive heights. Specifically the main arguments in the majority of these studies outline the increased importance of corporate and government saving, even in the context in which household saving remains the highest contributor to the level of national saving (Kujis, 2006; Ma & Yi 2010; Young, Zhang & Zhou, 2011; Ma & Yang, 2013). Consequently, even tough the household saving component continues to be the most popular research object related to China's saving puzzle, corporate saving has gained a lot of momentum in related studies as well in the past decade. Details on each of these components and pertinent existing literature are presented in what follows.

2.2.1 Household saving and relevant literature

In general, the existing literature on China's saving rate puzzle is in consensus when describing household saving as the main component in China's saving structure. It started to rise after the first crucial market liberalization reform has been implemented in 1978 and has been persistently high since the late 1980's. Kraay (2000) documents a household saving rate of around 8% in 1978, increasing to as much as 17% in 1984 and oscillating around 11% of gross national product (GNP) until 1995. The study also points out the data and measurement issues prevalent for China and the differences between the data considered from household surveys and the data considered from changes in assets structure. The discrepancy between the two measures is quite significant, since for example in the 1990s the asset measure shows the household saving rate around 18% to 20% of GNP. This big difference in the two measures is bound to induce concern on the manner of interpreting saving behavior of Chinese households (Kraay, 2000). The survey-based data tends to underestimate income and hence the measure of saving is also underestimated for that particular set, which help partially explain the discrepancy.

The new measure of household savings based on flow of funds data from NBS and CEIC is available from 1992 until 2011. Figure 2.5 shows the proportion of household and other sectors' saving rate out of total disposable income, combined from this latter data set. The household saving rate (HHS) stays around the 20%-25% of GDP mark, with a slight increase in the last years, especially since 2004, while the corporate saving rate (FS) increased from slightly over 10% in 1992 to around 20% in 2004 and decreased to almost 17% in 2011.

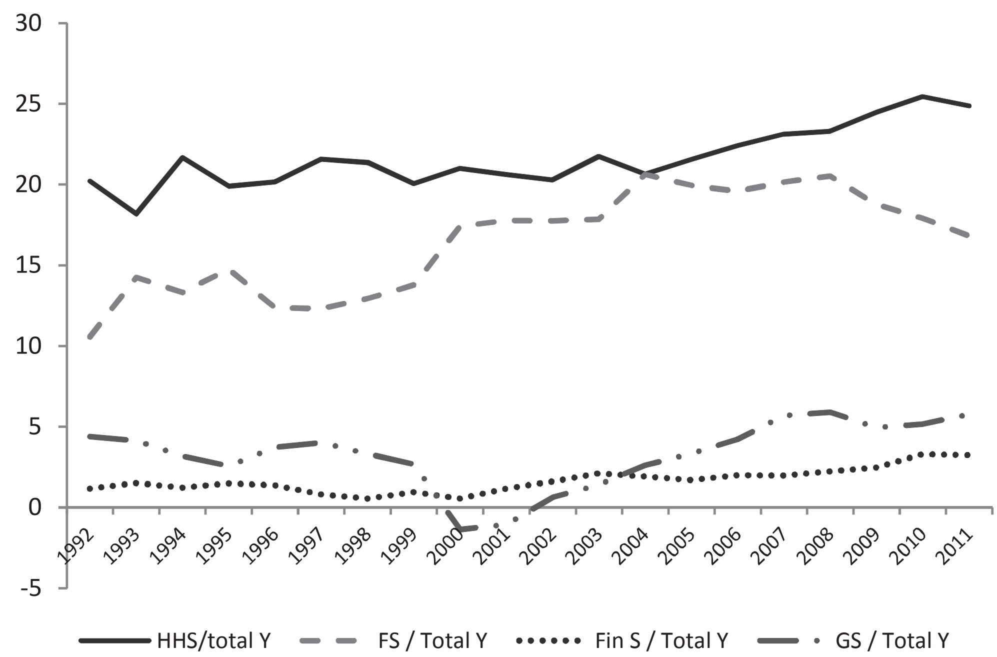

Figure 2.5 Sector saving as % of disposable income

Figure B.8 in Appendix B.2 exhibits a similar proportion of sectoral saving rate as a percentage of GDP this time, with very similar trends as Figure 2.5. The proportion of household saving and other sectors out of total saving is displayed in Figure B.9, showing that household saving has represented on average approximately 55% of national saving, while corporate saving has increased from 30% of total saving in 1992 to almost 50% in 2006 and 2007, while decreasing to 35% in 2011 .

Figure B.10 shows a comparison between the household saving rate as a proportion of household income versus the same rate as a proportion of total disposable income. It is interesting to observe that according to the flow of funds data, Chinese households save approximately 40% of their income in 2011, an increase from 30% in 1992. In the same figure, another comparison is drawn between the flow of funds (FoF) data and the National Bureau of Statistics (NBS) data on household saving as a proportion of household income, showing a similar kind of discrepancy in measurement as observed in Kraay (2000) for the 1978 - 1995 time range, stemming from the particularities of the survey data.

In Figure B.11, the asset measure of the household saving data available in Kraay (2000) for the 1978 - 1995 time range is combined with the flow of funds measure of the household saving data from CEIC, available from 1992 to 2011. The combined datasets show the impressive evolution of the Chinese households' saving rate, increasing from around 5% of GDP in 1978 to approximately 25% of GDP in 2011.

In addition, from the sectoral data presented above, it is noteworthy that the household saving component claims the highest proportion of national saving, albeit decreasing in the last decade. The increase in household saving as a proportion of GDP has been increasing, however it is not quite clear as how much of it has contributed to the increase in national saving. Part of the literature considers it the driving force behind the national savings level and increase in terms of percentage points, while another part is more circumspect of this specific role and importance (Kuijs, 2000; Aziz, 2007; Aziz & Cui, 2007). These studies also underline the importance of the decrease in household income as a percentage of total income, which would bear part of the expplanation of why the consumption share of households has decreased and hence the saving share increased (Ma & Yi, 2010)

Figure 2.6 shows the extend of household income in total disposable income (HHY/total Y) for the Chinese economy and the extent of the other three sectors' values as well, corporate (FirmsY/Total Y), financial institutions (FinInstY/totalY) and government (GY/total Y). Since 1992, it shows a decrease in the household proportion of total income from 68% to slightly over 60%.

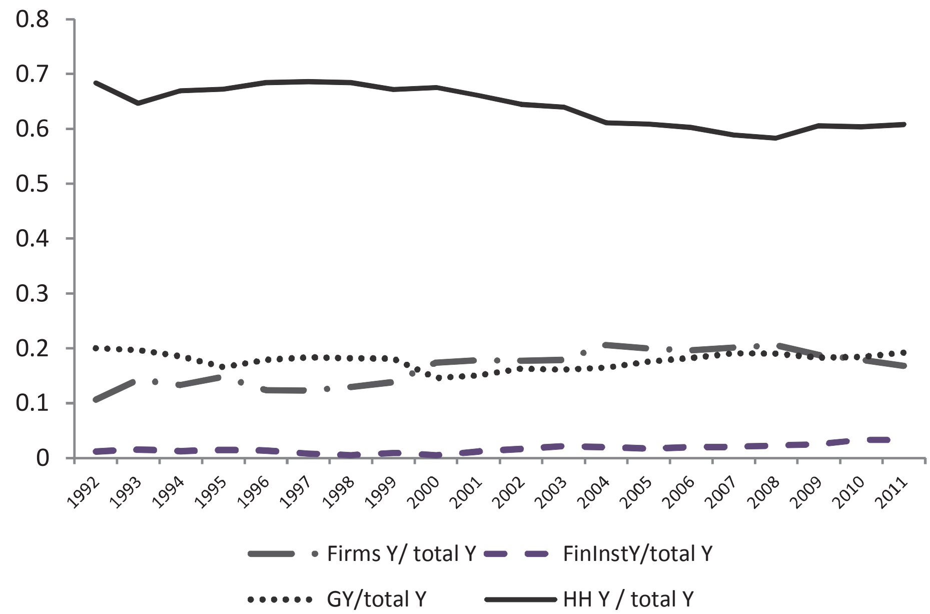

Figure 2.6 Sector income as proportion of total disposable income

Many papers have concentrated on explaining the high level of Chinese household saving and its potential causes. While a lot of this research has produced notable results, the findings are also mixed. For instance Modigliani & Cao (2004)'s study on life cycle saving predicts that the saving rate would increase for an increase in per capita income growth or for a decrease in the dependency ratio. The first result is at odds with the conclusions in Kraay (2000) and the latter with the findings of Horioka &Wan (2007). Chao, Lafargue & Yu (2011) contradict the main result as well, obtaining results that show that only 35% of the increase in household saving can be explained by the life-cycle hypothesis. Wei & Zhang (2011) study evidence from sex ratios to see the influence of the one-child policy on the household saving rate. The authors claim that the competitive saving motive is the main driver of the increase in household saving, because households with one son would raise saving in order to increase marriage attractiveness. They further note that the competitive saving motive explains more than any other potential factors such as precautionary saving, habit formation, life-cycle hypothesis which do not offer satisfactory answers to the saving behavior of Chinese households.

Harbaugh (2000) explores different justifications for the Chinese saving behavior, such as cultural factors, imperfect insurance, precautionary savings, minimum consumption and offers explanations and counterarguments for each of the theories encountered. The only factor that was deemed the most promising in this respect was the habit formation setup. Surprisingly, there is actually no habit formation model that has been applied specifically for China, although Caroll et all (2000) have addressed the issue of high growth-high saving causation, Most recently Wu (2012) looks at the expectations for the future for Chinese consumers and in this context at the rising optimism derived from decades of high growth. Within this context, the author rejects alternative models and factors taken into account, while suggesting that a multiplicative habit formation model might be able to explaine the high saving rate puzzle in China.

Within the household saving studies, an important subset looks at provincial level analysis and mostly at urban versus rural saving behavior. As evidenced in Figure 2.7, the saving rate of urban households has increased significantly since the late 1980s, while the rural saving rate has dropped back closer to its levels from the early 1980s.

This trend in the urban household saving rate has elicited a lot of attention, especially in the related empirical literature. Chamon & Prasad series of studies (2007, 2011) concentrate on the rising Chinese urban household saving rates and find that the age profile of savings has an unusual shape, suggesting virtually no consuimption smoothing over the life-cycle and saving being the highest among the youngest and oldest households. The authors find that borrowing constraints, low asset returns, pension reforms and rising expenditures on housing, education and health can partially explain this phenomenon. Nabar (2011) looks at the influence of interest rates on household saving decision, using a panel dataset for China's provinces. The findingins suggest that household saving are very responsive to changes in the real interest rate and that Chinese households act as if they have a target in mind and save for a wide variety of reasons, such as retirement consuimption, self-insurance and health shocks.

Figure 2.7 China - urban & rural saving rates

In general these results seem to suggest a strong precautionary saving motive, which is quite well represented by the aforementioned setup in Wen (2010) and its findings of a 30% saving rate for a 10% growth rate in GDP. While the author did not specifically look at only the household saving component, the specification is made that to explain the national saving level, the setup should most likely include the corporate saving component as well, for many of the motivations included below.

2.2.2 Corporate saving and relevant literature

The corporate saving component of the Chinese national saving rate has fueled a lot of the recent related discussions. It has been increasing as a percent of GDP since the late 1990s and hence led to many speculations on its ultimate importance in the level and increase of the domestic saving rate.

Corporate savings in China have to be considered from two sides, one from the state-owned enterprises sector and the other from the private firms' sector. China's market liberalization reforms have gradually changed each of these sector's composition and influence and an analysis cannot be done without taking into account both of these corporate aspects. Specifically, China's reforms from 1978, 1984 and 1994 have been instrumental in the evolution of the corporate saving component of national saving, especially in terms of state-owned enterprises evolution. For example, in 1994 the reforms encompassed, among other stipulations, an aggresive reform of state-owned enterprises (SOE) in order to unleash domestic entrepreneurship. The reform lead to massive layoffs, which have been speculated to be one of the causes of the surge in national saving rate, however that particular influence is not very clear from the data, especially considering different measurement sources. The same reform specified that state-owned enterprises - even listed ones - no longer owe divididents to the state, which has stimulated the existence and use of retained earnings by this sector. In other words, SOE profits are either reinvested or are put in low-earning deposit accounts. One consequence of this reform is the social responsibility that domestic SOE no longer carry and have the means to invest in new technologies, expand rapidly and seek out new markets. SOEs also receive incentives from local and central governments in the form of tax breaks, extremely affordable land, low utility prices, all of which keep the production costs low and raise profits that are consequently reinvested as retained earnings in further expansion.

On the other hand, private firms are met with a lot of constraints in financial and investment form. Until 1997, private firms were not allowed to invest outside their provinces, which limited severly their financial capabilities. In addition, the four Chinese main state owned banks have been constrainting loan conditions for private firms until as recently as the early 2000s. These banks provide the majority of financial intermediation, are crucial in terms of resource allocation and continue to favor state-owned enteprises, funneling household saving towards them (Szamosszegi & Kyle, 2011). At the same time bank lending rates are low because of the set low deposit rates established by the government. Consequently private enterprises have accumulated large savings as well because of poor financial intermediation and limited access to bank credit. Thus, the channel that normally funnels household savings into the private production sector is for its most part severed and hence private firms have to rely on their own savings in order to finance their investment.

Because of capital controls underdeveloped capital market limiting investment choices, China's savings provided state owned enterprises with captive and cheap source of financing through state-controlled banking system the corporate savings in terms of retained earnings are reinvested, since dividends no longer had to be paid after 1994.

On the other hand, private firms are met with a lot of constraints in financial and investment form. The four main state owned banks have been constrainting loan conditions for private firms until as recently as the beginning of year 2000. In 2000 a structured bank reform program was set in place in order to clean up nonperforming loans, recapitalizing banks, offer assistance in terms of opening the private sector to foreign participation and competition. Even so, the four main state-owned banks turned conservative and continue to credit large SOEs at the expense of the private firms. At the same time bank lending rates are low because of low deposit rates set by the government. Consequently private enterprises have accumulated large savings as well because of poor financial intermediation and limited access to bank credit. The channel that normally funnels household savings into the private production sector is for its most part severed and hence private firms have to rely on their own savings in order to finance their investment. Part of this aspect has been captured in Song, Storesletten & Zilliboti (2010), who use a two sector model of China in order to explain key features of the economy, such as the high output growth, high capital returns and large foreign surplus.

Thus, in general capital markets have not been a reliable alternative source of financing for firms or savings for households, since bonds and equity have been difficult to invest in and posed an additional constraint on domestic investment. Consequently private and more recently state-owned firms as well relied on internal savings for investment - albeit for different reasons - and consumers had to do the same especially for large purchases out of their budget, such as child care, education, pension, housing and durable goods especially after the 'breaking of the iron bowl' in the early 2000s.

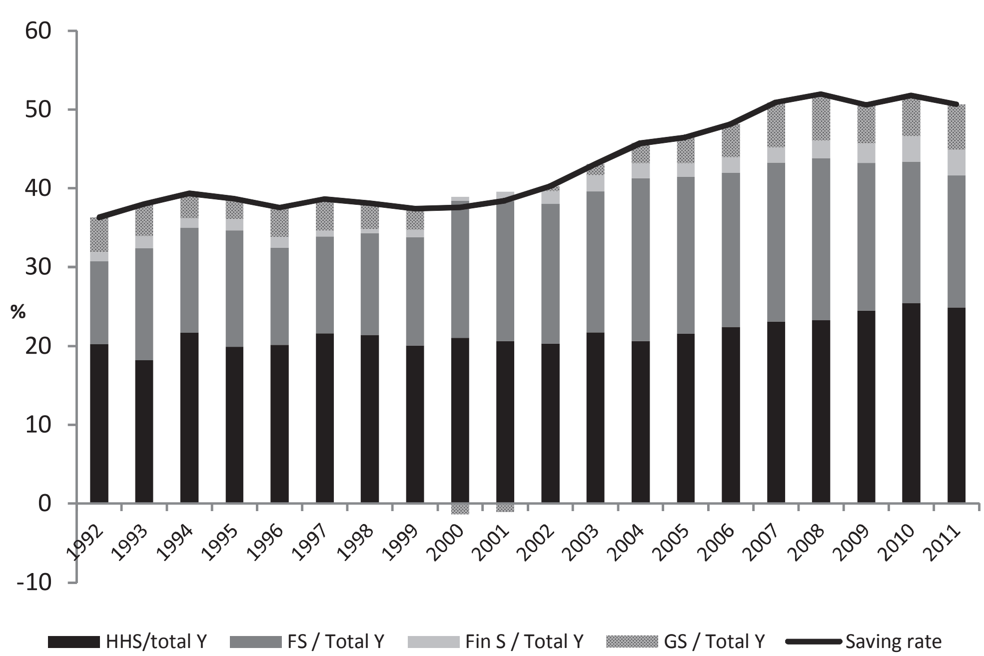

Figure 2.8 China - Saving rate components

It is the combination of all these facts that leads to the conclusion that corporate savings are important in China and they have been increasing to reflect various reform changes and the growing proportion of corporate saving as a component of total saving can be observed in Figure 2.8.

As the literature on this particular subject has grown in the last decade, the issue of corporate saving and its importance for China has been discussed at length, with mixed conclusions. Kujis (2006) finds that corporate saving along with the goverment saving component are the key drivers of national saving level and patterns. Yang, Zhang, Zhou (2011) offer a comprehensive descriptive and data-based study on various form of savings, including Chinese corporate saving and its comparison with other countries, arriving at the conclusion that in terms of the level, the corporate saving issue is not as prevalent as the growing literature seem to suggest. Bayoumi, Tong & Wei (2009) use firm level data to analyze corporate saving and arrive to the conclusion that Chinese corporate saving data is not higher than the global trend and that the saving behavior of private firms and SOE is the same, contrary to expectations. The authors conclude that corporate saving is not the component that the literature should concentrate when looking at the high Chinese level of saving.

Aziz (2007) has one of the few setups that attempts to incorporate corporate saving in the form of retained earnings explicitly in an analytical framework, in order to offer a quantitative base of why it should be an issue to consider. The retained earnings feature is introduced in terms of loans that firm have to take in order to be able to pay workers in advance, thus forcing them to rely on internal saving. From this particular setup, the aggregate saving rate is higher, although a more thorough analysis is needed in order to see if the actual level and trend of the national saving rate can be obtained in this manner.

The present chapter does not attempt to include corporate saving specifically in the setup, but rather studies the possibility of explaining the national saving rate level and trend through a simple neoclassical framework, in order to ascertain how much of the puzzle can be explained by a traditional model and whether the unexplained reminder comes to approximate features of the corporate saving component.

2.3 The Model

The analytical framework in this study is a simple one-sector neoclassical growth model and it represents a more simplified version of the Hayashi & Prescott (2002) setup. The latter was subsequently employed in Chen, Imhoroglu & Imhoroglu (2005 & 2006) to study the evolution of the national saving rate of Japan and US respectively by taking into account the entire data series for their model variables, with particular emphasis on the driving force of the model, the total factor productivity (TFP) growth rate. A similar setup and methodology was used in Aziz (2006) to investigate how well a neoclassical framework could explain a few key features of China's economy and what kind of distortions are responsible for the country's particular growth path.

As mentioned above, the present model is a more simplified version of the Ramsey-Cass-Koopman neoclassical framework employed in Chen, Imhoroglu & Imhoroglu (2006), with the modification that hours worked and leisure choices are not taken into the analysis. The main reason for the omission is that the data on hours worked for China is notoriously hard to find, especially in a form that would allow for a representative agent framework. Similarly the tax on capital income is not included in this setup because of the scarcity of specific data series, especially over different ranges covering the intervals between reforms.In the context of the present analysis however, this particular choice is preferred, as the main goal is to ascertain how well a simple neoclassical setup can address the Chinese saving puzzle. One possibility for future research would be to include these variables in the model and conduct sensitivity analysis to see how pronounced an influence they would have on the results. In particular for the series for hours worked, an average series of hours worked could be taken for relevant economies in the same region and during the same phase of transition. This could be then considered as a potential approximation for the corresponding Chinese series.

2.3.1 Households

The infinitely-lived representative household in this economy chooses consumption and saving to maximize its lifetime utility. Each household is endowed with an initial amount of capital K_0 and one unit of time which is supplied inelastically as labor. There is no uncertainty in the model. The representative household thus maximizes:

$$\sum_{t=0}^{\infty} \beta^t u(C_t)$$

subject to the budget constraint:

$$C_t + S_t \leq w_t N_t + r_t K_t + \Pi_t \tag{14}$$

$$K_{t+1} \geq 0$$

where $0 < \beta < 1$ is the discount factor. The left hand side of the budget constraint represents the household's expenditure in the form of consumption and saving, while the right hand side represents the household's income from labor, capital renting and transfers (Π_t) in form of firm's profits and government transfers net of taxes. Household size evolves according to: $N_{t+1} = N_t(1+n)$, where n is the population growth rate. The instantaneous utility function is of the constant relative risk aversion (CRRA) form $u(c_t) = \frac{c^{1-\sigma}-1}{1-\sigma}$, where $\sigma > 0$ and $c_t = \frac{C_t}{N_t}$ represents per capita consumption. In the special case when $\sigma = 1$, the instantaneous utility function becomes $u(c_t) = \ln(c_t)$. Since the utility function is strictly increasing in c, $(i.e. u'(c_t) > 0)$ the household budget constraint will hold with equality.

2.3.2 Technology

The representative firm in this model employs a Cobb-Douglas production technology with two inputs, capital (K) and labor (N):

$$Y_t = A_t K_t^{\alpha} N_t^{1-\alpha} \tag{15}$$

where A_t is total factor productivity and α is the share of capital in output. The growth rate of total factor productivity is γ_t where $\gamma_t + 1 = \frac{A_{t+1}}{A_t}$.

The firm maximizes the well-known profit function:

$$\max_{K_t, L_t,} [A_t K_t^{\alpha} N_t^{1-\alpha} - w_t N_t + r_t K_t]$$

where r_t is the rental rate of capital and w_t represents the wage rate.

The first order conditions associated with the firm's problem result in the following expressions:

$$\alpha A_t K_t^{\alpha-1} N_t^{1-\alpha} = r_t \tag{16}$$

$$(1-\alpha) A_t K_t^{\alpha} N_t^{-\alpha} = w_t \tag{17}$$

The capital stock evolves according to the following accumulation equation:

$$K_{t+1} = (1-\delta) K_t + I_t \tag{18}$$

where I_t is domestic investment and δ is the depreciation rate of the capital stock.

This model features a closed economy and in that case, the condition for the clearing of the goods market is:

$$S_t = I_t \tag{19}$$

where $S_t = Y_t - C_t$.

The market clearing condition implies that the household's budget constraint (14) features consumption and investment on its expenditure side.

2.3.3. Social Planner Problem

Since this is a complete markets model with no distorsions, the Second Welfare Theorem holds and the Social Planner problem can be solved for the equilibrium of the economy. Denoting $x_t = \frac{X_t}{L_t}$ as variable X in per capita terms, for any X and t, the Social Planner's problem can be sumarized as:

$$\max_{c_t, i_t, k_{t+1}} \sum_{t=0}^{\infty} \beta^t u(c_t) \tag{20}$$

subject to:

$$c_t + i_t = A_t k_t^{\alpha} + (1-\delta)k_t \tag{21}$$

$$k_{t+1}(1+n) = (1-\delta)k_t + i_t \tag{22}$$

$$c_{t,} k_{t+1} > 0$$

where equation (21) represents the resource constraint of the economy. The functional equation associated with this maximization problem is:

$$v(k_t) = \max_{c_{t t}, k_{t+1}} [u(c_t) + \beta v(k_{t+1})] \tag{23}$$

subject to:

$$c_t + k_{t+1}(1+n) = A_t k_t^{\alpha} + (1-\delta)k_t \tag{24}$$

The dynamic programming framework in (23) is solved to obtain the familiar Euler equation:

$$-u'(c_t)(1+n) + \beta u'(c_{t+1})(\alpha A_{t+1}k_{t+1}^{\alpha-1} + 1 - \delta) = 0$$

Rearranging this expression and recalling the first order condition for the firm's problem in (16) in per capita terms $\alpha A_t k_t^{\alpha-1} = \alpha \frac{y_t}{k_t} = r_t$, yields the standard intertemporal optimality condition:

$$\frac{u'(c_t)}{\beta u'(c_{t+1})}(1+n) = (r_{t+1} + 1 - \delta) \tag{25}$$

where the first term on the left hand side of the equation represents the inverse of the intertemporal marginal rate of substitution and the right hand side is equal to the net rate of return on capital plus one.

For the particular instantaneous utility function used in this setup, the Euler equation becomes:

$$\left(\frac{c_{t+1}}{c_t}\right)^{\sigma}(1+n) = \beta(r_{t+1} + 1 - \delta)$$

Along the balanced growth path the theory states that capital and output and related variables grow at the same rate $\dot{g}$.

From the firm's production function (15) the relationship between the growth rate of capital and the growth rate of TFP can be established as:

$$\gamma_t = \left[\frac{(1+g)}{(1+n)}\right]^{1-\alpha} - 1 \tag{26}$$

From the resource constraint the capital-output ratio is obtained as an expression depending on the parameters of the model and on the growth rate of capital:

$$\frac{k_t}{y_t} = \frac{\alpha}{\frac{(1+n)(1+g)^{\sigma}}{\beta} - 1 + \delta}$$

The capital-output ratio together with the resource constraint (24) are combined to obtain the expression for the saving rate of the model:

$$\frac{s_t}{y_t} = \alpha \frac{(1+g)(1+n) - 1 + \delta}{\frac{(1+n)(1+g)^{\sigma}}{\beta} - 1 + \delta}$$

Combining the saving rate equation with the relationship between the growth rates of the model (26) determines the dependence of the saving rate on the growth rate of TFP γ.

In steady state, all variables in per capita units are constant, in other words $k_{t+1} = k_t = k^*$, $y_{t+1} = y_t = y^*$ and so on. Using this requirement on the Euler equation (25), the steady state expressions for the capital-labor and output per capita ratios are obtained as

$$k^* = \left[\frac{\alpha A}{\frac{(1+n)}{\beta} - 1 + \delta} \right]^{\frac{1}{1-\alpha}}$$

and

$$y^* = A^{\frac{1}{1-\alpha}} \left[\frac{\alpha}{\frac{(1+n)}{\beta} - 1 + \delta} \right]^{\frac{\alpha}{1-\alpha}}$$

The steady state expression for the saving rate is:

$$\frac{s^*}{y^*} = \alpha \frac{(1+n) - 1 + \delta}{\frac{1+n}{\beta} - 1 + \delta}$$

To have a well-defined steady state, the assumption is made that $\frac{(1+n)}{\beta} > 1 - \delta$.

The model is analyzed quantitatively in the first part of the next section to ascertain how much of the level and path of the saving rate can be explained by using the series on the growth rate of TFP, similarly to the approach in Chen, Imhoroglu & Imhoroglu (2005). The analysis is done by calibrating the model to the steady state and observing the results over the entire period studied, 1978 - 2011.

In the second part of the analysis, the separate impact of the market liberalization reforms is taken into account in a similar manner in which they were considered for the analysis of the impact of FDI in China's economy in the first chapter of this study. Consequently a set of transitory steady states (TSS) is considered, delimited by the most relevant reforms regarding market liberalization and privatization of state owned enterprises as detailed in the next section.

Denoting a transitory steady state with m, the level of transitory steady state capital to labor ratio is found by setting $k^*_m = k_{t+1} = k_t$, where $m = 1, 2, .3 \ldots$

This means that the steady state capital to labor ratio in transitory steady state m[4] is:

$$k^*_m = \left[\frac{\alpha_m A_m}{\frac{(1+n)}{\beta_m} - 1 + \delta_m} \right]^{\frac{1}{1-\alpha_m}} \tag{27}$$

Consequently the expressions for TSS output to labor ratio and TSS saving rate are:

$$y^*_m = A_m^{\frac{1}{1-\alpha_m}} \left[\frac{\alpha_m}{\frac{(1+n)}{\beta_m} - 1 + \delta_m} \right]^{\frac{\alpha_m}{1-\alpha_m}}$$

and

$$\frac{s^*_m}{y^*_m} = \alpha_m \frac{(1+n) - 1 + \delta_m}{\frac{1+n}{\beta_m} - 1 + \delta_m}$$

Once again, the details of the specific time periods chosen for this particular set of transitory steady states and the significance of their respective intervals chosen is described in detail in the following quantitative analysis component of this study.

2.4 Quantitative Analysis

Similar to the first chapter, the quantitative analysis part is divided in three main sections, the first on data choice and analysis, the second on the calibration of time

[4]The subscript m on the parameters that appear in the steady state expressions of capital per labor, output per labor and the savings rate marks the transitory steady state parameters that take different values across transitory steady states, but maintain their corresponding values within each transitory steady state. The parameters with no subscript represent the time invariant parameters which maintain the same value within and across transitory steady states. The details on the choice and values of the time invariant and respectively transitory steady parameters are included in the calibration section (2.4.2) of the Quantitative Analysis section.

invariant and transitory steady state parameters and the third on results.

2.4.1 Data considerations

Data is taken from the World Development Indicators (WDI) for the 1978-2011 range and from CEIC Institutional Investor Company database for the range 1992 - 2011, especially the data related to the components of the Chinese national saving rate . Additional data is taken from Bai, C., Hsieh, C. & Qian, Y. (2006), Bai, C. & Qian, J (2007) and Bai, C. & Qian, J. (2010) for estimates and analysis of labor share of ouput. Since the series for domestic capital is not readily available in any of the existing data sources, is needs to be constructed according to its respective accumulation process.

Capital stock sequence The same 'ingredients' of the domestic capital accumulation process are used and described below, as it was the case in the first chapter. The main difference is that the data analysis in this chapter starts from 1978, when the first wave of liberalization reforms were implemented and the following subsections are amended to account for that difference where needed.

Depreciation rate As mentioned in the first chapter of this thesis as well, the depreciation rate series for China varies greatly throughout the studies of growth accounting and TFP valuations in the literature. For example Bai, Hsieh, Qian (2006) use a depreciation series with an average of around 10.82% over the range on which they calculate the return to capital (1978 - 2005), using as source China's National Bureau of Statistics (NBS). Islam & Dai (2009) on the other hand take depreciation data from various sources and have a much lower average over the time period considered in their study, starting with 3% over the time range 1952 -1978, 4% over 1979-1992 and 5% for 1993-2002. Dekle, R. & Vandenbroucke, G. (2012) use a 5% depreciation rate for the 1978-2003 range in calibrating their model. Aziz,

J. (2007) considers a depreciation rate of 6% for the 1980 - 2005 range. Song, Z., Storesletten, K. & Zilibotti, F. (2011) consider a depreciation rate of 10% in their calibration , while Wang, Wen and Xu (2012) use a depreciation rate of 6.26%.

The present chapter considers the data on consumption of fixed capital provided in the WDI series as the measure of the depreciation rate for the purpose of calculating the domestic capital stock. The difference between the series chosen in this chapter as opposed to the first chapter is that the time range is now reduced to 1978-2011, for which this series displays an average of approximately 9.83%.

Transitory steady state considerations for the calibrated depreciation rate δ will be presented in the subsection on transitory steady state dependent parameters.

Domestic investment Domestic investment is taken in this chapter as the gross fixed capital formation series from the WDI database for the time period 1978-2011. The choice is identical to the first chapter of this study, the only difference being the time range taken into account. The justification of the choice of this particular series is explained in detail in Chapter 1, subsection 1.4.1.1 and it applies in the same manner to the present analysis.

Capital series Once again, the domestic capital series is constructed using the perpetual inventory method applied to its own component characteristics. In this chapter, the initial value of domestic capital is calculated for 1978 as the ratio of gross fixed capital formation during that year to the sum of the depreciation rate of that same year and the average growth rate of the gross fixed capital formation series for the first seven years of the range. The technical details and the resulting values of this calculations are described in Appendix B1.

2.4.2 Calibration

The calibration section is divided in two distinct parts. The first part contains the time invariant parameters of the benchmark model. The second part contains the time invariant and transitory steady state parameters of the TSS variant of the model.

2.4.2.1 Benchmark Model calibration

The time invariant parameters of the benchmark model are the growth rate of labor force n, the discount factor β, the capital share of output α, the depreciation rate δ, the growth rate of total factor productivity γ and the inverse of the intertemporal elasticity of substitution or equivalently the coefficient of relative risk aversion (RRA), σ.The values of these parameters are summarized in Table 2.1

Table 2.1 Benchmark Model Parameters

Parameter	Description	Value
n	labor force growth rate	0.011
β	discount factor	0.952
α	capital share of output	0.482
δ	depreciation rate	0.099
γ	TFP growth rate	0.032
σ	coefficient of RRA	1

The growth rate of labor force n is chosen to match the average rate of population growth in China for the interval 1978 - 2011, which is equal to 1.047%. Hence the value of the labor force growth rate parameter is calibrated to 0.011. The value of the coefficient of relative risk aversion is set equal to 1, which reduces the analysis to the instantaneous utility function of the form $u(c_t) = \ln(c_t)$. The values for the capital share of output, depreciation rate and total factor productivity growth rate are taken as the sample averages of their corresponding series. The details on the particular capital share of ouput and depreciation series used are included in the first chapter of this thesis and are reiterated below in the transitory steady state parameters subsection of the TSS model calibration.

The average value displayed for the TFP growth rate corresponds to the following value for $(1+\gamma)^{\frac{1}{1-\alpha}} = 1.062$, which is the form in which the growth rate enters the expression for the saving rate. The total factor productivity series is obtained by calculating the TFP parameter out of the production function:

$$A_t = \frac{Y_t}{K_t^{\alpha} N_t^{1-\alpha}}$$

The discount factor is calibrated to match a steady state capital-output ratio equal to 3[5] and is found according to the following expression:

$$\beta = \frac{(1+n)\frac{k^*}{y^*}}{\alpha + \frac{k^*}{y^*}(1-\delta)}$$

The literature on the calibrated discount factor for China varies in terms of values and the vast majority considers values close to 0.99, for example Lipshitz, Roshon & Verdier(2007) consider a value of 0.9972, Wen et all (2010) consider 0.99 as the calibrated value of the discount factor, while Deckle & Vandenbroucke (2005) consider a value much closer to the one calibrated in the present model, of 0.95.

2.4.2.2 TSS Model calibration

As it was the case in the TSS calibration process from the first chapter, the calibration of the present model involves two different kind of parameters. The time

[5] See Chen, Imhoroglu, Imhoroglu (2006)

invariant parameters are the exogenous variables of the model, that maintain their values over the entire time span of the analysis. The transitory steady state parameters are both exogenous and endogenous variables calibrated to match different data points with distinct values for each transitory steady state. The extent of each transitory steady state - which dictates the particular data range included in the calibration of each of these parameters - is chosen to match the reform events especially relevant to the process of market liberalization and privatization of state-owned enteprises, which have been and still are a very big part of China's economy.

Each of the aforementioned categories of parameters is detailed separately in the following subsections.

Time invariant parameters The time invariant parameters of the model are the growth rate of labor force n and the coefficient of relative risk aversion σ. These parameters are taken to match moments in the Chinese data for the entire time range of 1978-2011 to be relevant for the study both before and during the reform decades. Their values are displayed in Table 2.2 below.

Table 2.2 Time invariant parameters (TSS)

Parameter	Description	Value
n	labor force growth rate	0.011
σ	coefficient of RRA	1

As in the case of the benchmark model, the growth rate of labor force n is chosen to match the average rate of population growth in China for the interval 1978 - 2011 and the value of the coefficient of relative risk aversion is set to 1, which would reduce the present analysis to the instantaneous utility function of the form $u(c_t) = \ln(c_t)$.

Model and transitory steady state parameters The transitory steady state parameters are a set of exogenous and endogenous variables which are calibrated for each transitory steady state. These transitory steady states (denoted by TSS as it was the case in the first chapter as well) are matched with the timing of the most relevant market liberalization reforms regarding saving and domestic investment in China, as depicted in Figure B.12 in Appendix B.

There are four such chosen steady states in total, spanning approximately one decade per each range. The starting point of the present analysis is in 1978 when the first market liberalization reform is instituted and China's economy starts opening to the world. The range of the first transitory steady state (TSS1) covers the years 1978 to 1984, from the first set of reforms to the first reforms geared specifically towards the reform of state-owned enterprises. The second transitory steady state (TSS2) extends until the year of the Spring Wind reform, that propelled China on the course of economic growth and higher international liberalization of its economy. The third transitory steady state begins in year 1993, between two very important market liberalization reforms, the Spring Wind reform from 2002 and the state-owned enterprises (SOE) reform of 1994. The fourth and final - in the present analysis - transitory steady state starts with the year in which China entered the World Trade Organization (2001) and which resulted in the high increase of over 15 percentage points of the saving rate from approximately 37.53% in 2000 to around 52.52% in 2011.

The transitory steady state parameters's descriptions for this model are summarized in Table 2.3. The exogenous TSS parameters for this model are the depreciation rate δ, the capital share of output α and the growth rate of GDP g. The endogenous transitory steady state parameters are represented by the discount factor β and the growth rate of TFP γ.

Table 2.3 Parameter description

Parameter	Description
δ	depreciation rate
α	capital share of output
γ	TFP growth rate
g	GDP growth rate
β	discount factor

Table 2.4 provides the details for the TSS parameters at the starting point (SP) in 1978 and in each subsequent transitory steady state. Each transitory steady state is distinguished by its respective time range, chosen to reflect the most relevant reforms that have influenced the Chinese domestic saving rate, in the manner described at the beginning of this subsection.

Table 2.4 Transitory steady states (TSS) parameters

	SP	TSS1	TSS2	TSS3	TSS4
	1978	1978-1984	1985-1992	1993-2000	2001-2011
Parameter	Value	Value	Value	Value	Value
δ	0.0940	0.1006	0.0953	0.0952	0.1023
α	0.4768	0.4766	0.4770	0.4825	0.4888
γ	0.0305	0.0305	0.0230	0.0300	0.0408
g	0.1170	0.0930	0.0956	0.1014	0.1038
β	0.8079	0.8284	0.8460	0.8755	0.9401

The depreciation rate is once again not a time invariant parameter in this model. It is taken into consideration for each transitory steady state and it is calibrated to match the average of the consumption of capital data from the WDI database measured for each of the TSS time spans.

The literature on China's calibrated capital share of ouput varies from 0.35 in Aziz (2007) to 0.4 in Lipschitz, L., Rochon, C & Verdier, G (2008) and Wang, P., Wen, Y. & Xu, Z. (2012) to 0.5 in Song, Z., Storesletten, K. & Zilibotti, F. (2011). This paper considers first the labor share of output from Bai, C., Hsieh, C. & Qian, Y. (2006), taken from China's NBS and calculated as a weighted average of the labor share of provinces provided by the NBS and the share of the respective province in GDP. The authors mention two potential concerns in calculating the share of labor by using the NBS data, related to the understatement of true labor income due to unmeasured nonwage benefits and the understatement of the true labor share due to unmeasured self-employment. However each of these concerns are addressed in their study since the NBS includes estimates on nonwage benefits in labor income and also specifically counts all self-employment income as labor income before 2005 and separately after 2005. Hence the estimates of labor share before 2005 are actually overstating the true labor share and understating the share of capital. Additional data is taken from Bai, C. & Qian, J (2007) and Bai, C. & Qian, J. (2010) to complement the values of the labor share after 2002 and to account for the rising debate on the significant decline of labor share of income in the last decade. The capital share of output is then calculated as (1−labor share of output) for the corresponding data set, while the calibration takes into account the average value of α for each of the transitory steady state time ranges. It is apparent that the calibrations for the capital share of income for each TSS are akin to the higher values used in related literature, coming very close to the 0.5 mark used in the most recent studies. It is to be noted that this is a high value for α, especially compared with countries in similar stages of development or with developed countries, where the share of capital in ouput's value is taken generally to be around 0.30.

The calculation of the TFP series is done similarly to the method in the benchmark model calibration and the TSS values for γ are taken as the averages of the series in the respective time ranges of each transitory steady state. Similarly the growth rate of GDP is taken as the average of each time range portion of the series in the calibration.

The calibration of the discount factor β is done in such a way as to match the average GDP per capita ratio for the Chinese economy for each of the chosen transitory steady states. The methodology used in this calibration consists in solving the following equation, which results from the expression of the capital-output ratio along the balanced growth path:

$$\beta = \frac{(1+n)(1+g)\frac{k}{y}}{\alpha + \frac{k}{y}(1-\delta)}$$

where the growth rate of output and the growth rate of total factor productivity relate according to: $(1+g) = (1+n)(1+\gamma)^{\frac{1}{1-\alpha}}$

The calibrated parameters obtained above are used in the quantitative analysis of the Chinese saving rate puzzle, the results of which are presented as follows.

2.4.3 Results

The results section is divided in two distinct parts to mirror the calibration section. The first part contains the results obtained in the case of the benchmark model. The second part displays the results obtained in the case of the transitory steady state (TSS) model.

2.4.3.1 Benchmark Model results

The results obtained in terms of the benchmark model with the respective parameter calibration are displayed in Figure 2.9. In this particular case the entire data series for the total factor productivity parameter is taken in the analysis, similarly to the type of analysis done in Chen, Imhoroglu, Imhoroglu (2005).

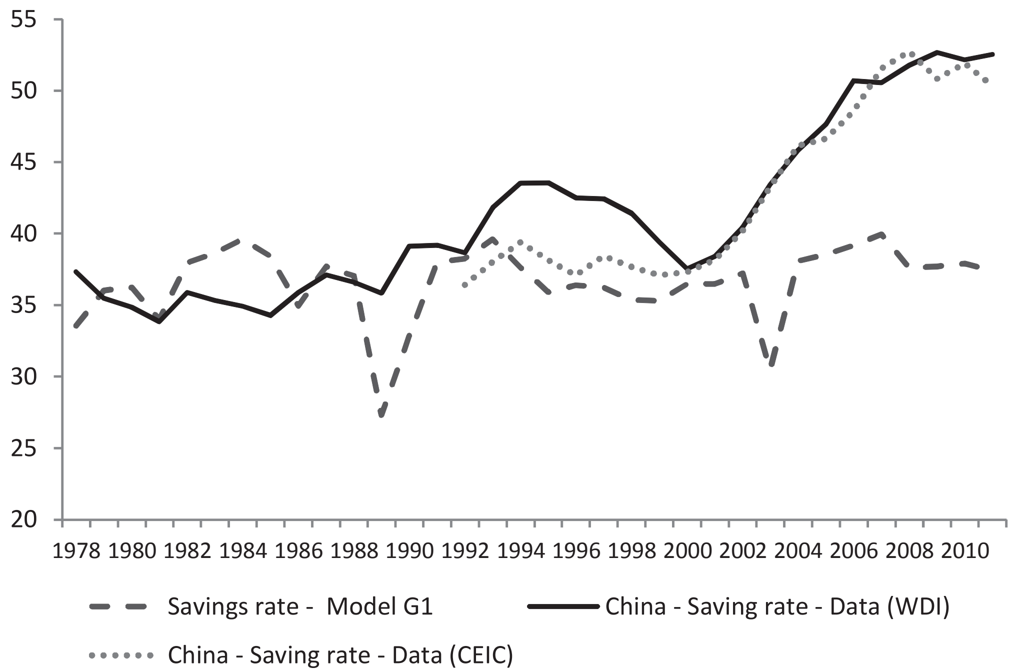

Figure 2.9 Saving Rate - Data vs Model (TFP growth rate series)

The model in which the TFP growth rate is considered the driving force for the level of Chinese saving rate is not very succesful in explaining this puzzle. It does slightly better on the level aspect of the puzzle, until 2000, with more success in the first half, from 1978 to 1992. The second aspect of the puzzle, of the increase in saving rate is not achieved by this particular version of the model.

In the next set of results, all the parameters are taken with their calibrated values, to generate strictly a level result for the Chinese saving rate (Figure 2.10). This portion of the results obviously is not set to address the second aspect of the puzzle (the increase in saving rates), only the level aspect.

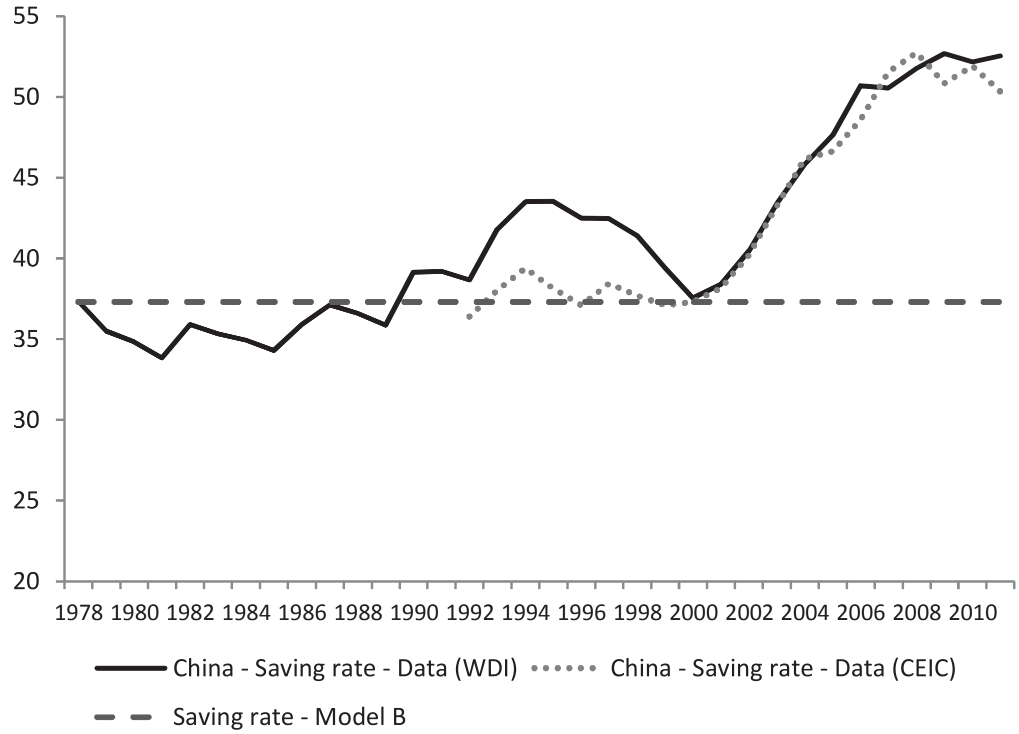

Figure 2.10 Saving Rate - Data vs Model (TFP growth rate fixed)

In these terms the model does slightly better than previously only for the range 1978 - 2000, at least in terms of the average saving rate of the series during that time period, as can be seen in Table 2.5, where s denotes the saving rate. The difference between the model and data values at the end of the data series has a significant 15% percent difference that remains unexplained through the benchmark model. Figures B.13 and B.14 show the results in the case in which the discount factor β is calibrated based on the real interest rate, which yields a value of $\beta = 0.983$

Table 2.5 Model vs Data

Variable	Model	Data
s	37.2910	38.1024[1]

Note:[1]data average 1978-2000

2.4.3.2 TSS Model results

The transitory steady state model results are displayed in Figure 2.11. The TSS model has more success in approximating the increase in saving rates, however it cannot approximate the actual level of the national saving rate. The analysis shows a persistent gap in the time range 1978-2000. For the interval 2001-2011 the gap still exists, but it is diminished in comparison with the earlier time range.

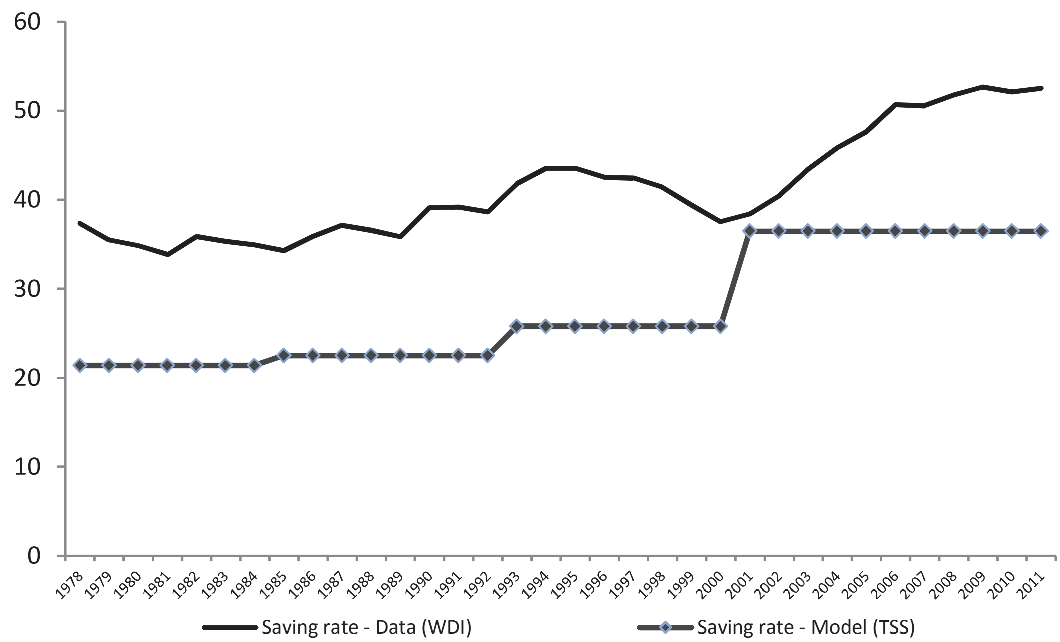

Figure 2.11 TSS Model vs Data

It is noteworthy that the transitory steady state model captures the second aspect of the puzzle in the form of increase in percentage points very well for the entire time range, as it can be seen from the values displayed in Table 2.6. It becomes slightly less accurate for the 2000-2011 interval, explaining only approximately 71.25% of the increase in percentage points of the national saving rate for that particular time range.

Table 2.6 Model vs Data

Time range	Measure	Model	Data
1978-2011	$\%pd^1$	15.09	15.19
2000-2011	$\%pd$	10.68	14.99

Note:[1] $\%pd$= percentage points difference

To measure the extent of the gap between the results of the TSS Model and the data, the difference between the data and the model values is evaluated and displayed in Figure 2.12. The difference between the transitory steady state model and data values for the interval 1978 - 1992 is roughly the same, measured at 14% from 1978 until 1984 and afterwards increasing slightly to 14.59% until 1992. A bigger increase results for the interval 1993-2000, with a gap of 15.74% between the data and the model values. For the last interval 2001-2011, the gap shrinks to 11.38% showing an overall better approximation of the higher level of the saving rate during that interval, but still with a significant unexplained difference left.

It is interesting to observe that for the interval 1992-2000, the gap between the TSS model and data values is quite close to the corporate saving data series, giving some support to the argument that this particular component of national saving should be taken into account in a model analysis of the saving rate level. For the 2001-2011 interval however, the similarity between the two series is no longer in existence, since the difference between the TSS model and national saving data values decreases over this interval, whereas the corporate saving rate values increase. Surprisingly this seems to suggest at first glance that corporate saving diminishes in its importance as a component of domestic saving especially around the time period in which the data shows that it would be increasing as a part of aggregate saving. This conjecture would then lend support to the part of the literature that argues that corporate saving is in fact not an important component and driver of the high level of the national saving rate for this particular time range.

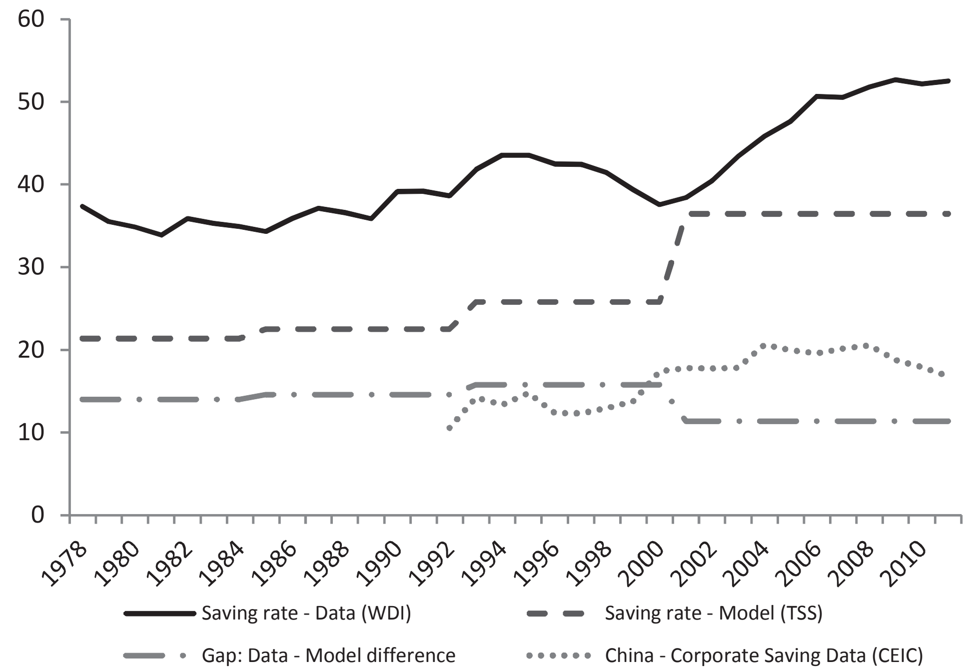

Figure 2.12 TSS Model and Data - Gap measurement

A different way to interpret this would be through the market liberalization component of the analysis. With each subsequent reform, China's economy becomes more market-oriented, the big state-owned components of it diminishing in importance, such as the Chinese state-owned enterprises and the large state-owned banks. The most significant changes in terms of the private sector's property rights and access to the capital market happened during China's preparation for WTO entrance. These changes brought the economy closer to a complete markets setup, which would then justify the better explanation of the aggregate saving rate level without having to account for separate components.

Further analysis however is needed for a more definite conclusion related to this particular aspect of the issue related to the components of the Chinese domestic saving rate.

2.5 Conclusions

This chapter addresses a very popular subject in the related literature, the Chinese high saving rate puzzle. Using a simple one-sector neoclassical growth model this study answers the quantitative questions of how much of the high level of the Chinese saving rate and how much of the increase of approximately 15 percentage points over the last three decades and in particular since 2001 this type of model can explain, via two different methodologies.

The benchmark model approximates the average saving rate relatively well for the time range 1978 - 2000, however it cannot explain the second aspect of the puzzle, the increase in the saving rate level, especially over the range 2001-2011, since China's entry into the World Trade Organization.

The transitory steady state (TSS) model offers a very good approximation of the increase in saving rate, especially over the entire range of the analysis (1978-2011). However this model is not able to reach the actual high level of the national saving rate. A persistent gap between the TSS model and the data exists over the entire range of the analysis. This difference is measured and the results show that it stays relatively constant over the 1978-2000 period, while shrinking after 2001.

The first time range mentioned shows that this particular gap may be approximated relatively accurately by the Chinese corporate saving data, offering support to the issue that in order to be able to explain the high level of the national Chinese saving rate, this component of saving has to be taken into account into the theoretical framework. For the last part of the time range however, this is no longer the case. On the contrary, this analysis seems to suggest that after 2001 corporate saving no longer retains the same importance in the process of obtaining the level of national saving as it had during the earlier time interval.

A more in depth analysis of this particular aspect is needed in order to be able to draw clear and definitive conclusions on the importance of the saving rate components in the determination of the level and trend of the national saving rate.

Consequently, this represents a very interesting and complex issue for future research, as it would give the opportunity to study several aspects of it, especially if the analysis concentrates on the components of the national saving rate. One possibility would be to construct a model of incomplete markets for instance, in order to include the retained earnings aspect of the firm's saving into the setup and thus to ascertain its importance in the overall level of the saving rate.

APPENDIX A
THE IMPORTANCE OF FDI IN CHINA'S DEVELOPMENT

A.1 Perpetual inventory method (PIM) - initial values

This section shows the details of constructing the starting points of both domestic and foreign capital series as needed for the scope of the analysis of the present model. Both capital series are constructed using the perpetual inventory method applied to their own component characteristics.

The domestic capital series is constructed using its accumulation process, once the value of K_0 is established, to cover the data range 1965 to 2011.

$$K_{t+1} = (1 - \delta_t)K_t + I_t$$

where I_t is the gross fixed capital formation series from WDI for the range 1965 - 2011 and $\delta_t \in (0, 1)$ is the depreciation rate taken as the consumption of fixed capital series from WDI for the range 1965-2011.

The foreign capital series is constructed using its accumulation process, once the value of Z_0 is established, to cover the data range 1980 to 2011.

$$Z_{t+1} = (1 - \delta_t)Z_t + J_t$$

where J_t is the foreign direct investment inflows series from WDI for the range 1980 - 2011 and $\delta_t \in (0, 1)$ is the depreciation rate taken as the consumption of fixed capital series from WDI for the range 1980-2011.

The initial value of the domestic capital stock in 1965 is obtained by taking the ratio of gross fixed capital formation (i.e. gross domestic investment) in 1965 to the sum of the depreciation rate in 1965 and the average growth rate of the gross fixed capital formation series for the first seven years of the analysis, in other words over the range 1965 - 1972.

$$K_{1965} = \frac{GFCF_{1965}}{\delta_{1965} + g^{GFCF}_{1965-1972}}$$

Table A.1 shows the initial values for gross domestic investment and depreciation rate, the average value for the domestic investment growth rate over the specified interval and the resulting initial value for the domestic capital stock.

Table A.1 PIM parameter values for initial domestic capital

Variable	Year	Description	Value
$GFCF$	1965	gross fixed capital formation[1]	12.039
δ	1965	depreciation rate	0.047
g^{GFCF}	$1965-1972$	average growth rate of domestic investment	0.111
K	1965	capital stock[1]	76.203

Note: [1]measured in constant bill.$, index 2000

The initial value of the foreign capital stock in 1980 is obtained by taking the ratio of foreign direct investment inflows in 1980 to the sum of the depreciation rate in 1980 and the average growth rate of the FDI inflows series for the first seven years of the FDI statistics database, i.e. over the range 1980 - 1982.

$$Z_{1980} = \frac{FDI_{1980}}{\delta_{1980} + g^{FDI}_{1980-1987}}$$

Table A.2 shows the initial values for foreign direct investment and depreciation rate, the average value for the foreign direct investment growth rate over the specified interval and the resulting initial value for the foreign capital stock.

Table A.2 PIM parameter values for inital foreign capital

Variable	Year	Description	Value
FDI	1980	FDI inflows[1]	0.0554
δ	1980	depreciation rate	0.105
g^{FDI}	$1980 - 1987$	average growth rate of FDI inflows	0.385
Z	1980	foreign capital stock[1]	0.1130

Note: [1]measured in constant bill.$, index 2000

A.2 Growth accounting expression

Starting with the production function, the first step is to express it in logarithm form in order to be able to derive the growth rates of each component. For the purpose of the growth accounting exercise, the technology parameter is considered time-dependent to capture the residual growth that cannot be explained through the growth of domestic capital, foreign capital and labor

$$Y_t = A_t(K_t + \varphi_t Z_t)^{\alpha} L_t^{1-\alpha}$$

Applying the natural logarithm to the previous function yields:

$$\ln Y_t = \ln A_t + \alpha \ln(K_t + \varphi_t Z_t) + (1-\alpha)\ln L_t$$

This new equation is then differentiated with respect to time in order to arrive at a relationship between the growth rate of output and the growth rates of inputs.

$$\frac{\dot{Y}}{Y} = \alpha \frac{\dot{K} + \dot{\varphi} Z + \varphi \dot{Z}}{(K + \varphi Z)} + (1-\alpha)\frac{\dot{L}}{L} + \frac{\dot{A}}{A}$$

Because φ is mathematically a step function in this model and thus is essentially a number at each differentiation step, the previous expression can be further expanded in order to obtain the growth accounting equation for the present model:

$$\frac{\dot{Y}}{Y} = \alpha \frac{\dot{K} + \varphi \dot{Z}}{(K + \varphi Z)} + (1-\alpha)\frac{\dot{L}}{L} = \alpha \frac{\dot{K}}{(K + \varphi Z)} + \varphi \alpha \frac{\dot{Z}}{(K + \varphi Z)} + (1-\alpha)\frac{\dot{L}}{L} + \frac{\dot{A}}{A}$$

Mathematical manipulation of the previous equation yields the following equivalent expression of the growth accounting equation:

$$\frac{\dot{Y}}{Y} = \alpha\frac{\dot{K}}{K}\frac{K}{(K+\varphi Z)} + \varphi\alpha\frac{\dot{Z}}{Z}\frac{Z}{(K+\varphi Z)} + (1-\alpha)\frac{\dot{L}}{L} + \frac{\dot{A}}{A}$$

where $\frac{K}{K+\varphi Z}$ is the weight of the domestic capital in aggregate total capital and $\frac{Z}{K+\varphi Z}$ is the weight of foreign capital in aggregate total capital.

Denoting $\xi_K = \frac{K}{K+\varphi Z}$ and $\xi_Z = \frac{Z}{K+\varphi Z}$, the growth accounting equation becomes:

$$\frac{\dot{Y}}{Y} = \alpha\xi_K\frac{\dot{K}}{K} + \varphi\alpha\xi_Z\frac{\dot{Z}}{Z} + (1-\alpha)\frac{\dot{L}}{L} + \frac{\dot{A}}{A}$$

where $\xi_K + \varphi\xi_Z = 1$.

A.3 Tables and figures

Table A.3 Real GDP results (bill. US$)

	SP	TSS1	TSS2	TSS3	TSS4
	1965	1965-1978	1979-1991	1992-2002	2003-2011
Real GDP	Value	Value	Value	Value	Value
Model	71.6169	102.2179	289.5752	900.9870	2415.4825
Data	71.6169	107.5406	310.1105	960.4538	2468.4395
Δ	-	5.3227	20.5353	59.4668	52.9570
$\%dev$	-	4.950	6.622	6.192	2.145

Note: Δ = difference between data and model values

$\%dev$ = percent deviation from data value

Table A.4 Counterfactuals: Autarky - real GDP

	SP	TSS1	TSS2	TSS3	TSS4
	1965	1965-1978	1979-1991	1992-2002	2003-2011
	Value	Value	Value	Value	Value
$Y_{aut}(Z=0)$	71.6169	102.2179	287.9728	856.0119	2285.1635
Y	71.6169	102.2179	289.5752	900.9870	2415.4825
$\Delta = Y - Y_{aut}$	-	-	1.6025	44.9751	130.3190
$\%\Delta/Y$	-	-	0.5534	4.9918	5.3952
Y_{data}	71.6169	107.5406	310.1105	960.4538	2468.4395
$\%\Delta/Y_{data}$	-	4.9495	7.1387	10.8742	7.4248

Note: Y = real GDP

$\%\Delta/Y$ = percent deviation from model Y

$\%\Delta/Y_{data}$ = percent deviation from real GDP (data)

Table A.5 Counterfactuals: Autarky - K growth rate contribution

	SP	TSS1	TSS2	TSS3	TSS4
	1965	1965-1978	1979-1991	1992-2002	2003-2011
	Value	Value	Value	Value	Value
$\alpha gr(K_{aut})$	-	0.0455	0.0393	0.0584	0.0594
$\alpha gr(K)$	-	0.0455	0.0389	0.0527	0.0530
$gr(residual)_{aut}$	-	0.0077	0.0440	0.0390	0.0454
$gr(residual)$	-	0.0077	0.0242	0.0325	0.0463

Table A.6 Counterfactuals: Spillover effect - real GDP

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
	Value	Value	Value	Value	Value
$Y_1(\varphi = 1)$	71.617	102.218	289.451	896.554	2395.670
Y	71.617	102.218	289.575	900.987	2415.482
$\Delta = Y - Y_1$	-	-	0.124	4.433	19.812
$\%\Delta/Y$	-	-	0.043	0.492	0.820

Y_{data}	71.617	107.541	310.111	960.454	2468.439
$\%\Delta/Y_{data}$	-	4.950	6.622	6.192	2.145

Note: Y = real GDP

$Y_1 = Y$ when $K_{aggregate} = K + Z$

$\%\Delta/Y$ = percent deviation from model Y

$\%\Delta/Y_{data}$ = percent deviation from real GDP (data)

Table A.7 Counterfactuals: Spillover effect - growth rates

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
	Value	Value	Value	Value	Value
$\alpha gr(K_1)$	-	0.0455	0.0389	0.0533	0.0539
$\alpha \xi_K gr(K)$	-	0.0455	0.0389	0.0527	0.0530
$\alpha \xi_Z gr(Z_1)$	-	-	0.0203	0.0111	0.0047
$\alpha \varphi \xi_Z gr(Z)$	-	-	0.0220	0.0122	0.0055
$gr(residual)_1$	-	0.0077	0.0257	0.0331	0.0462
$gr(residual)$	-	0.0077	0.0242	0.0325	0.0463

Note: $K_1 = K$ when $K_{aggregate} = K + Z$

$Z_1 = Z$ when $K_{aggregate} = K + Z$

Table A.8 Sensitivity analysis α=0.5

	SP 1965	TSS1 1965-1978	TSS2 1979-1991	TSS3 1992-2002	TSS4 2003-2011
φ	-	0.2996	1.0841	1.1126	1.1850
φ_{new}	-	0.2863	0.9268	1.0780	1.2522
A	10.8114	10.7466	16.7017	24.1715	33.0837
A_{new}	9.7010	9.6262	14.4915	21.3441	30.4267
y	100.138	129.294	304.401	800.576	1873.831
y_{new}	100.138	129.526	304.766	801.732	1874.156
$\%\Delta/y$	-	3.0359	5.0986	3.0371	0.3349
$\%\Delta/y_{new}$	-	3.221	5.353	3.186	0.352
Counterfactuals Z = 0					
$\Delta = y - y_{aut}$	-	-	1.613	39.600	101.167
$\Delta_{new} = y_{new} - y_{new_{aut}}$	-	-	1.461	39.998	108.539
$\%\Delta/y$	-	-	0.5305	4.9464	5.3990
$\%\Delta/y_{new}$	-	-	0.480	4.989	5.791
Counterfactuals $\varphi = 1$					
$\Delta = y - y_1$	-	-	0.125	3.904	15.380
$\Delta_{new} = y_{new} - y_{new_1}$	-	-	(0.115)	2.887	21.351
$\%\Delta/y$	-	-	0.041	0.488	0.821
$\%\Delta/y_{new}$	-	-	(0.038)	0.360	1.139

Figure A.1 Foreign direct investment in China as % of GDP

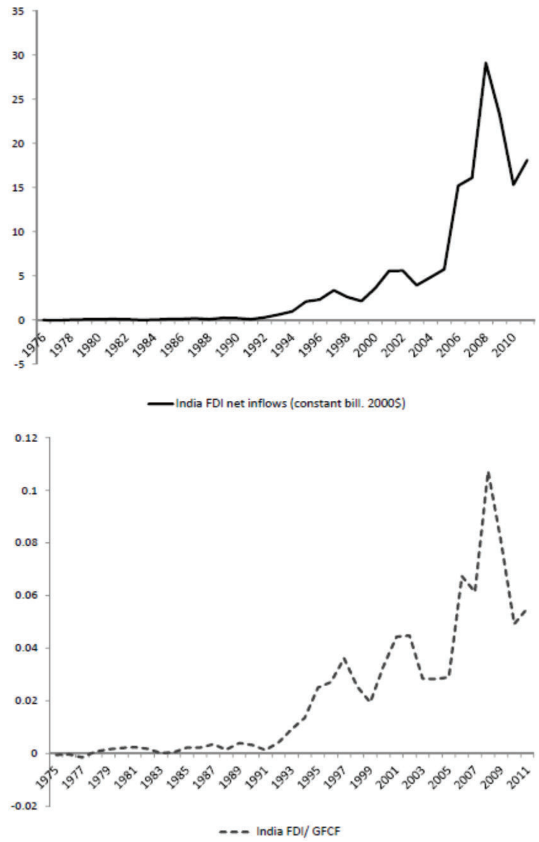

Figure A.2 India - FDI comparisons

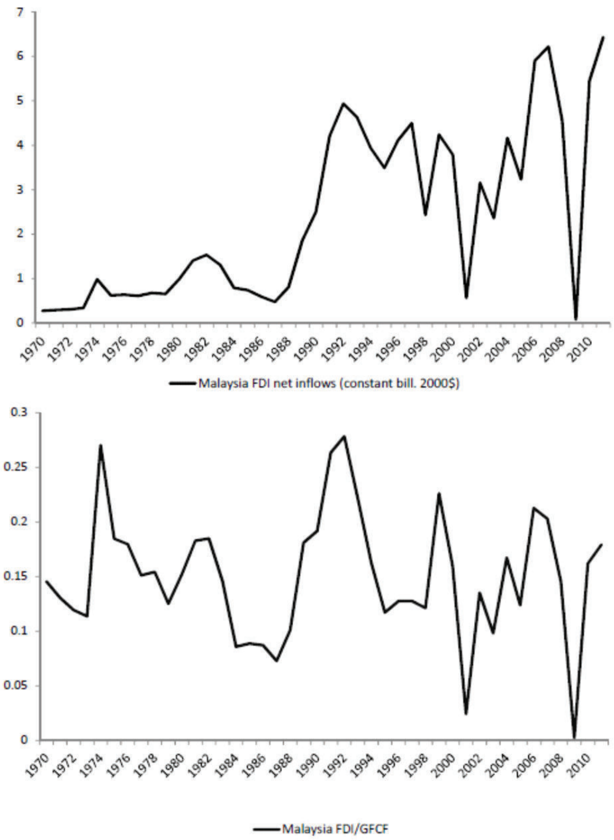

Figure A.3 Malaysia - FDI comparisons

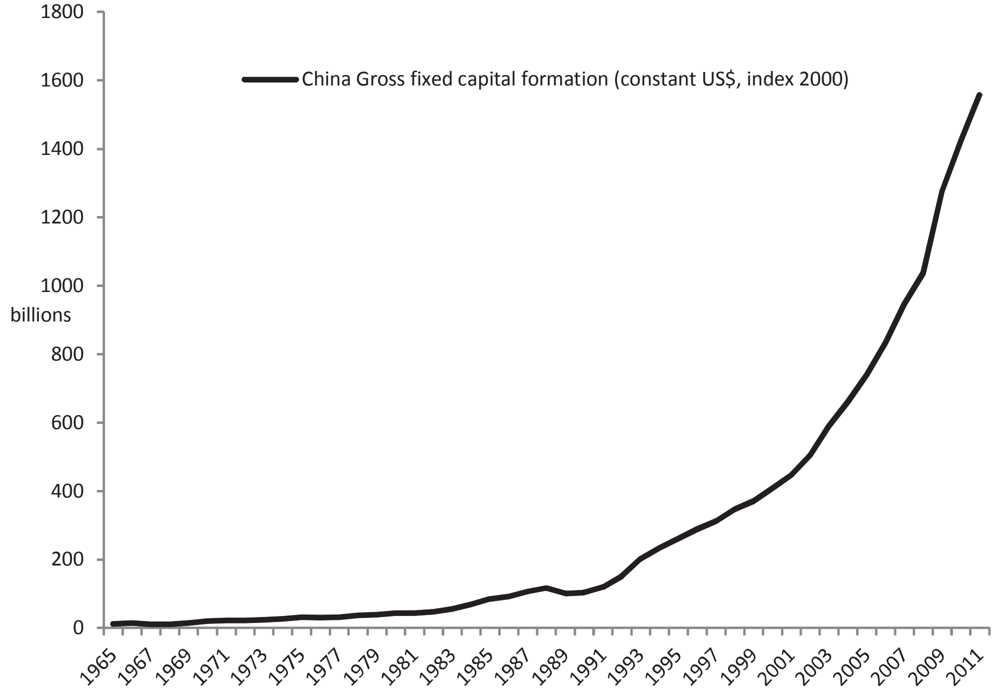

Figure A.4 Gross domestic investment in China

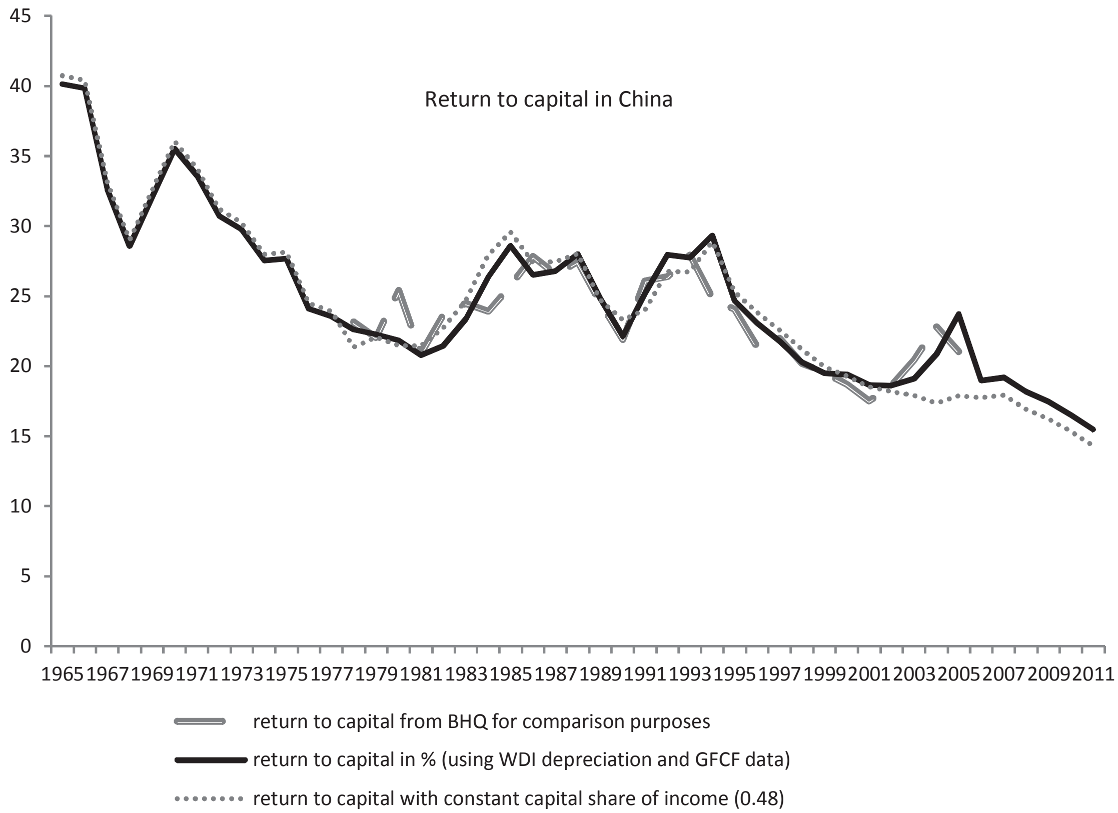

Figure A.5 Return to capital in China - comparisons

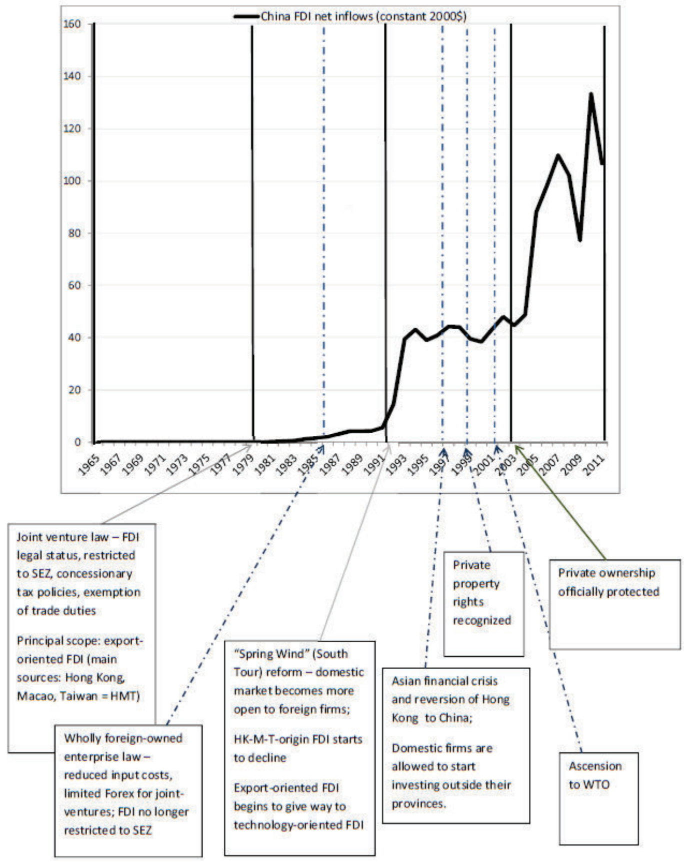

Figure A.6 FDI inflows and reform timing in China

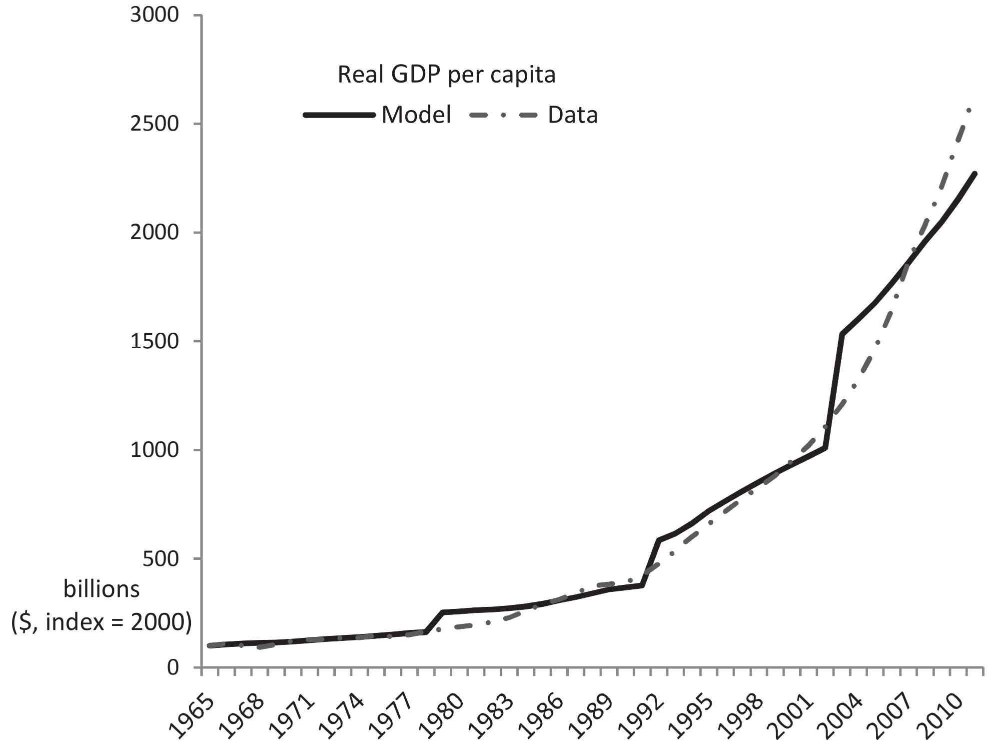

Figure A.7 GDP per capita in China - Model vs. Data

APPENDIX B
CHINA'S HIGH SAVING RATE PUZZLE

B.1 Perpetual inventory method (PIM) - initial values

This section represents the same methodology of calculating the domestic capital intial value, as the one presented in Appendix A.1 for the first chapter of this thesis. The difference is that this time the starting point of the analysis is the year 1978.

The domestic capital series is once again constructed using its accumulation process, once the value of K_0 is established, to cover the data range 1978 to 2011.

$$K_{t+1} = (1 - \delta_t)K_t + I_t$$

where I_t is the gross fixed capital formation series from WDI for the range 1978 - 2011 and $\delta_t \in (0, 1)$ is the depreciation rate taken as the consumption of fixed capital series from WDI for the range 1978-2011.

The initial value of the domestic capital stock in 1978 is obtained by taking the ratio of gross fixed capital formation (i.e. gross domestic investment) in 1978 to the sum of the depreciation rate in 1978 and the average growth rate of the gross fixed capital formation series for the first seven years of the analysis, i.e. over the range 1978 - 1985.

$$K_{1965} = \frac{GFCF_{1978}}{\delta_{1978} + g^{GFCF}_{1978-1985}}$$

Table B.1 shows the initial values for gross domestic investment and depreciation rate, the average value for the domestic investment growth rate over the specified interval and the resulting initial value for the domestic capital stock.

Table B.1 PIM parameter values for initial domestic capital

Variable	Year	Description	Value
$GFCF$	1978	gross fixed capital formation[1]	37.289
δ	1978	depreciation rate	0.094
g^{GFCF}	$1978 - 1985$	average growth rate of domestic investment	0.119
K	1978	capital stock[1]	174.413

Note: [1]measured in constant bill.$, index 2000

B.2 Figures

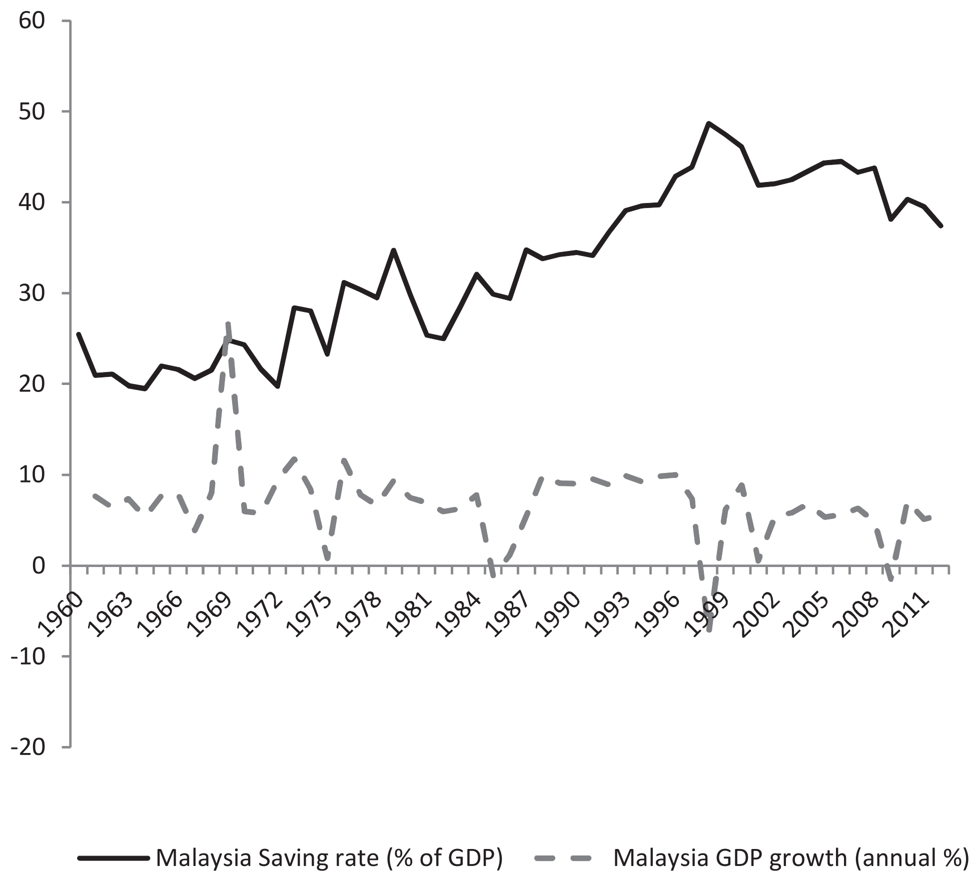

Figure B.1 Malaysia - Saving rate and GDP growth rate

Figure B.2 Indonesia - Saving rate and GDP growth rate

Figure B.3 Thailand - Saving rate and GDP growth rate

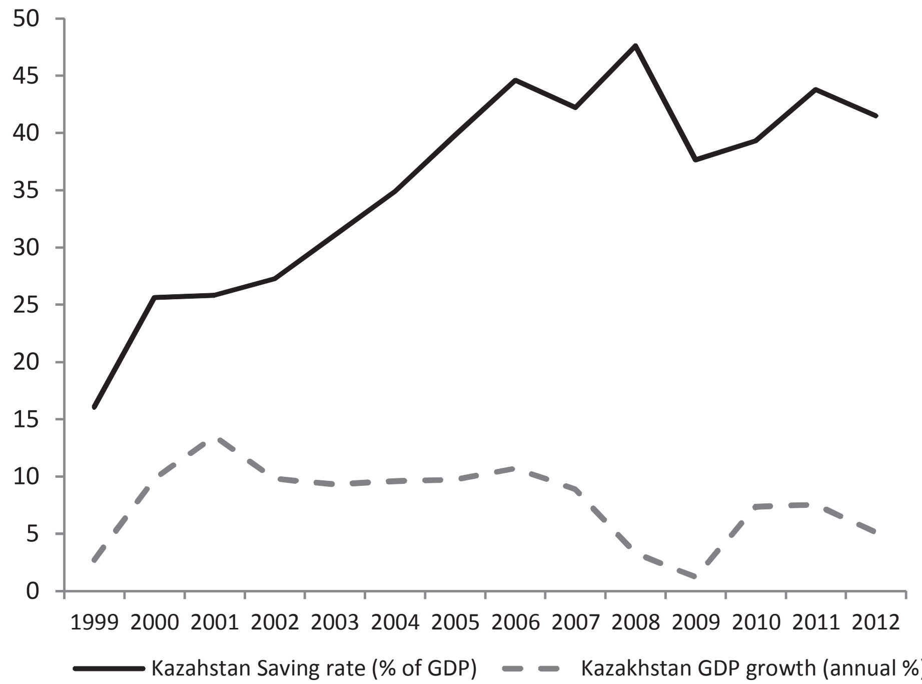

Figure B.4 Kazahstan - Saving rate and GDP growth rate

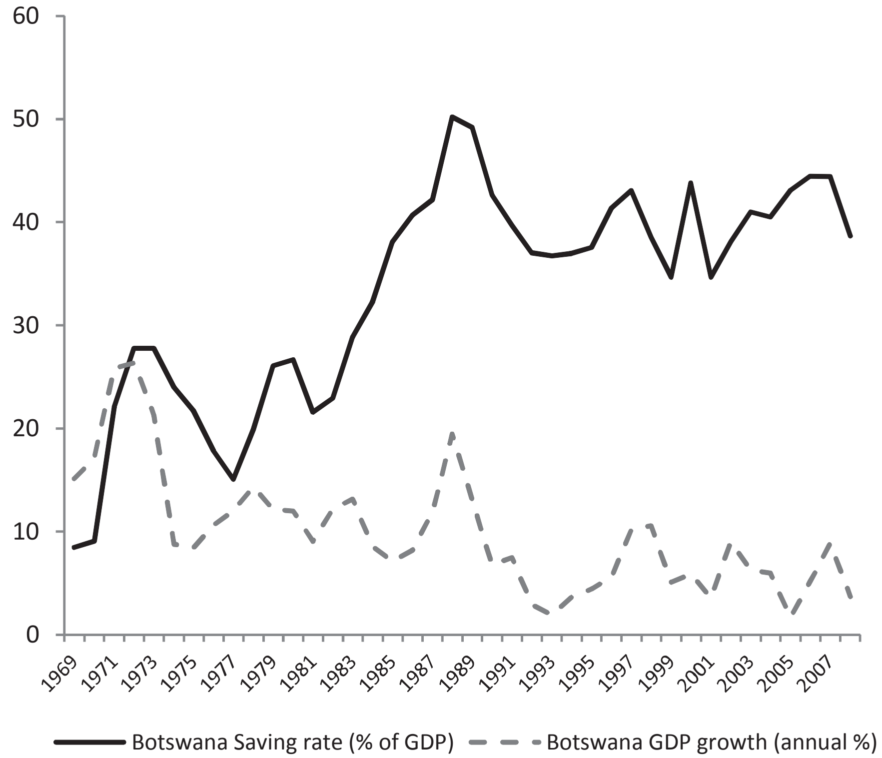

Figure B.5 Botswana - Saving rate and GDP growth rate

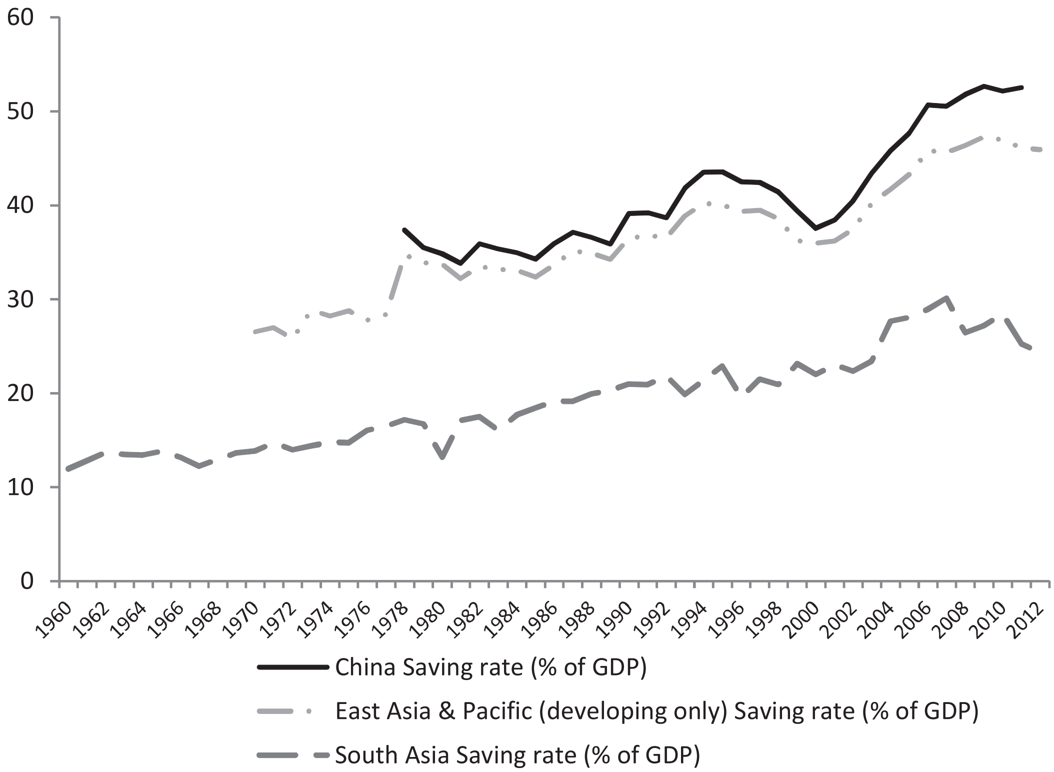

Figure B.6 Regional saving rate comparisons

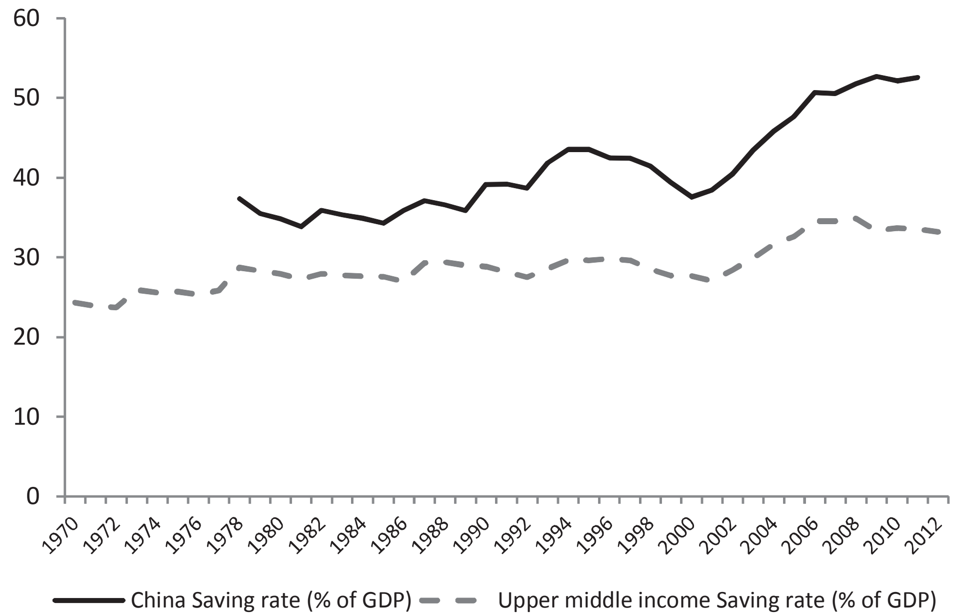

Figure B.7 Upper middle income level countries aggregate comparison

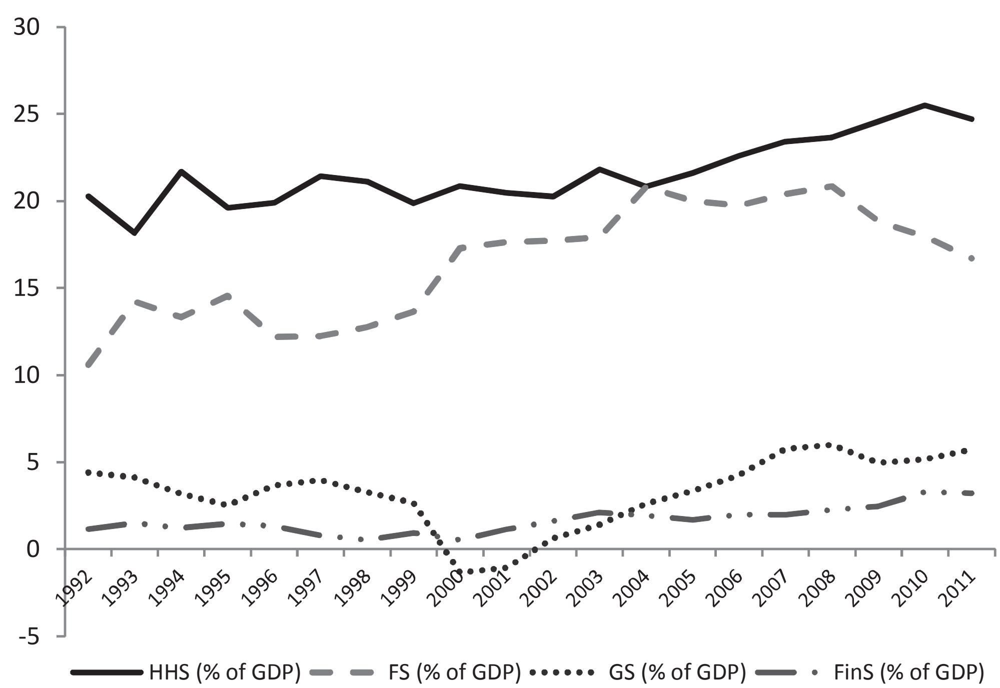

Figure B.8 Saving rate per sector as % of GDP

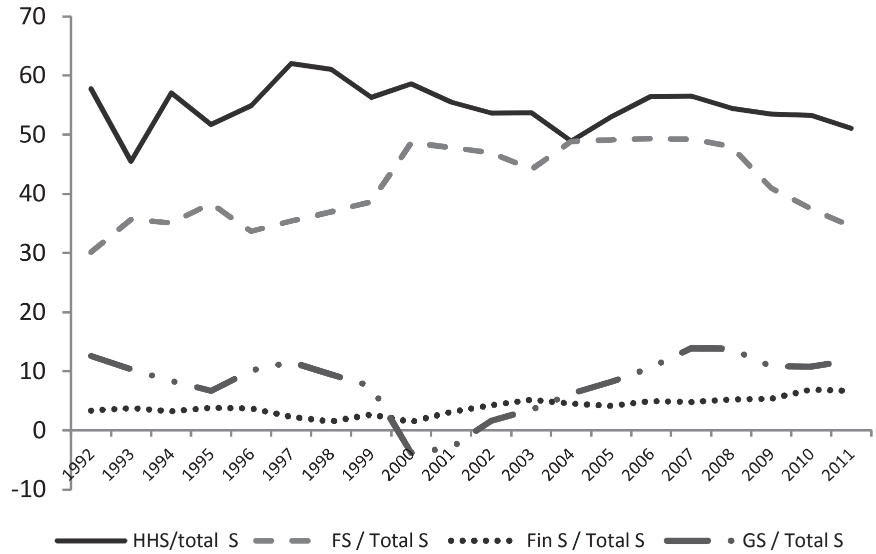

Figure B.9 Saving rate per sector as % of total saving

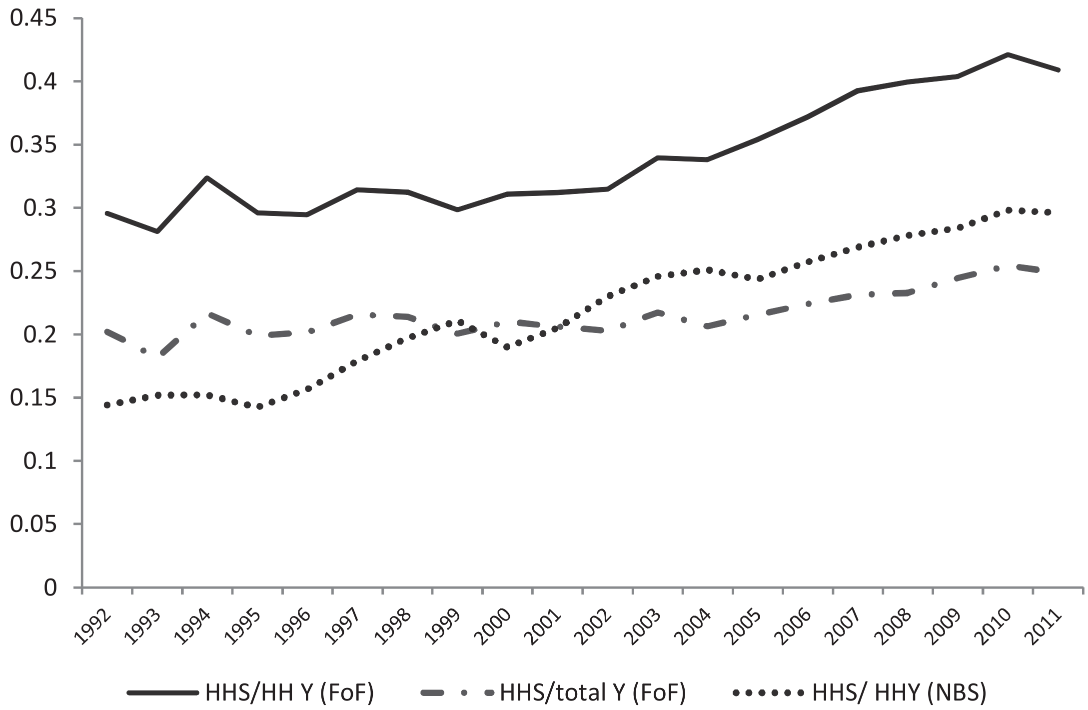

Figure B.10 Household saving as proportion of household income - comparison

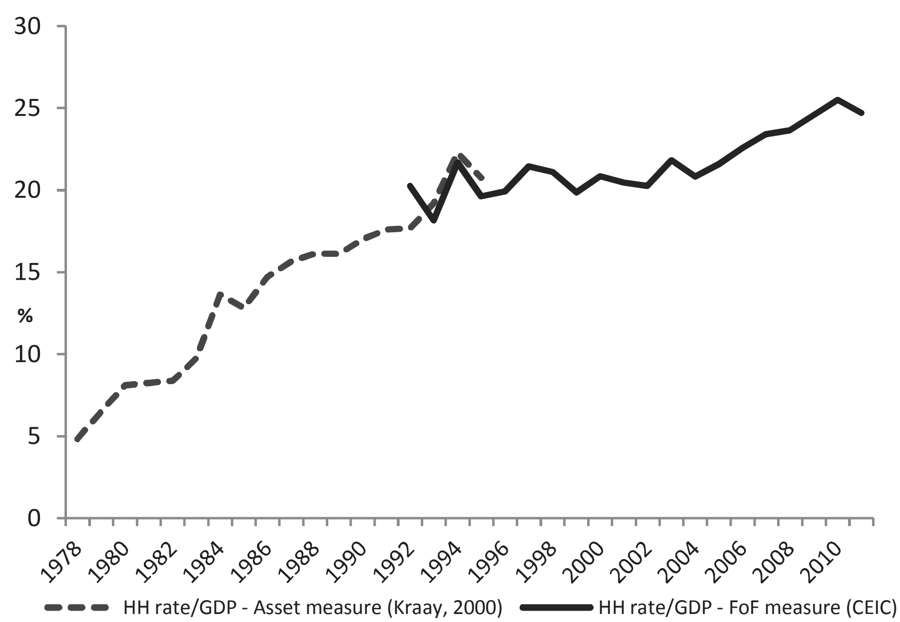

Figure B.11 Household saving rate

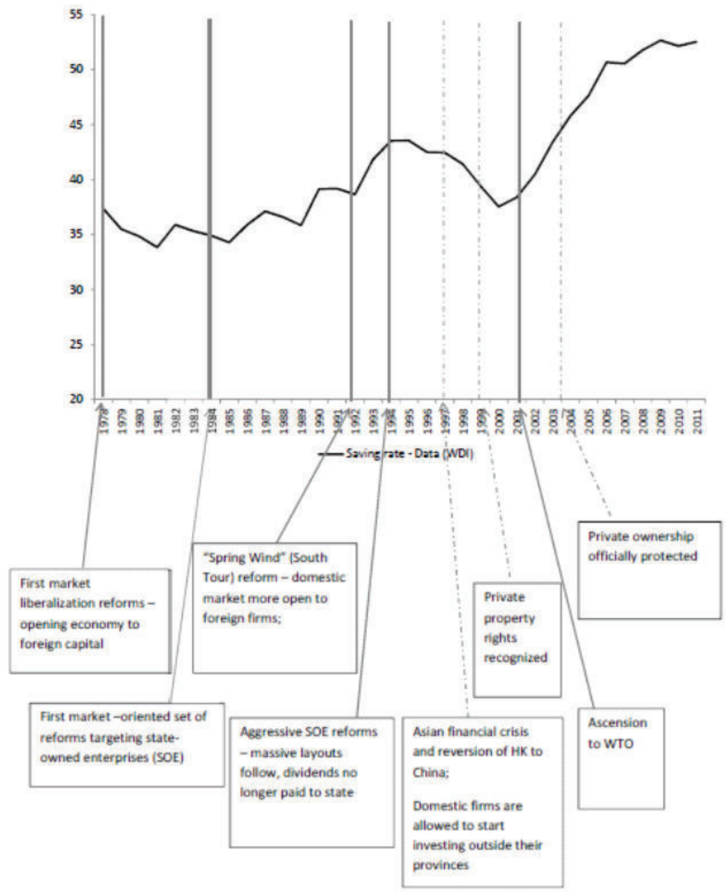

Figure B.12 The saving rate and the timing of reforms

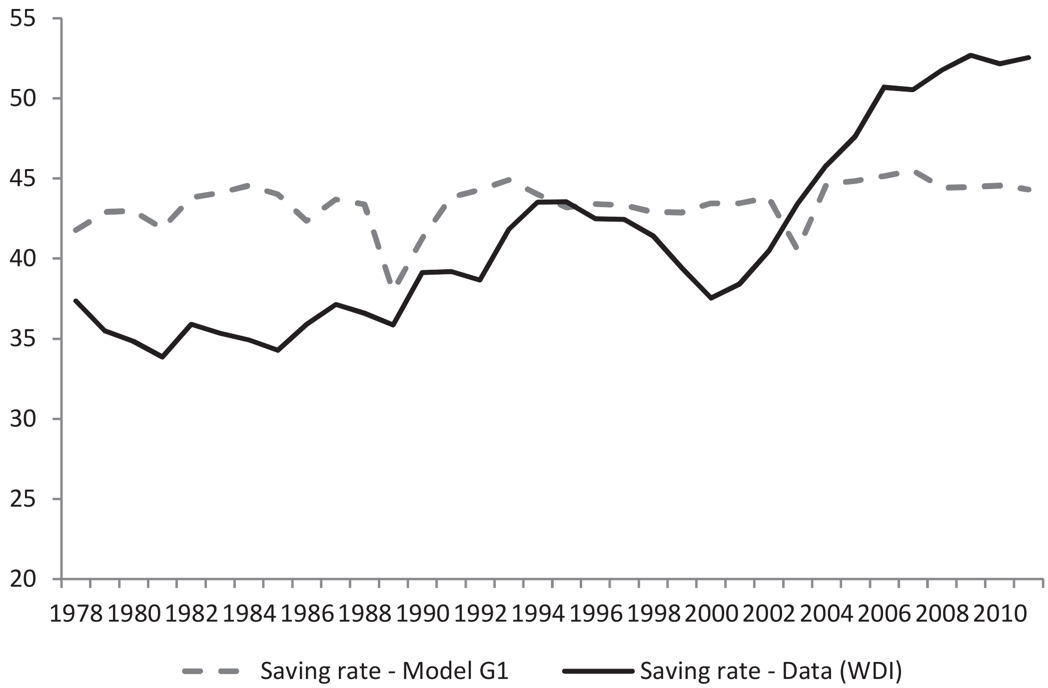

Figure B.13 Model vs Data - TFP series, $\beta = 0.983$

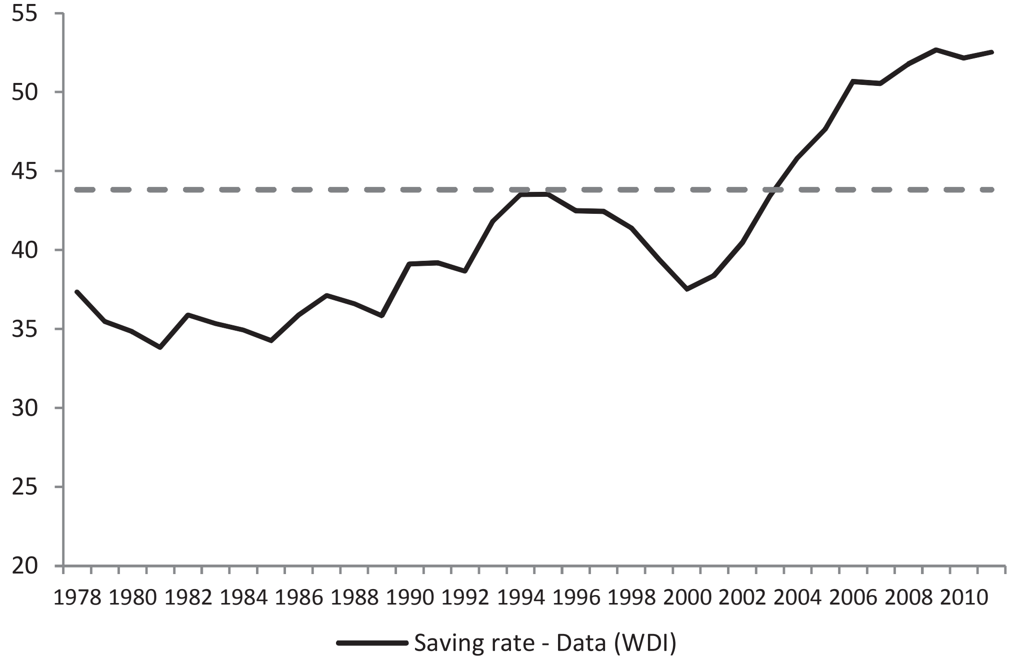

Figure B.14 Model vs Data - TFP fixed, $\beta = 0.983$

REFERENCES

Aghion, P, Comin, D., Howitt, P. & Tecu, I. (2009) -- "When does Domestic Saving Matter for Economic Growth" - *Harvard Business School Working Paper Series, WP 09-080.*

Agosin, M & Mayer, R. (2000) -- "Foreign Investment In Developing Countries: Does it Crowd in Domestic Investment?", *UNCTAD Discussion Paper Series 146, UNCTAD /OSG/DP/146 No. 146.*

Aziz, J. (2007) -- "Rebalancing China s Economy: What does Growth Theory tell us", *International Monetary Fund Working Paper Series, WP 06/291.*

Aziz, J. and Cui, L. (2007) - China s Low Consumption: The Neglected Role of Household Income" - *International Monetary Fund Working Paper Series, WP 07/181.*

Bai, C., Hsieh, C. & Qian, Y. (2006) - "The Return to Capital in China," *Brookings Papers on Economic Activity*, Economic Studies Program, The Brookings Institution, vol. 37(2006-2), pages 61-102.

Bai, C & Qian, Z. (2010) - "The Factor Income Distribution in China: 1978 - 2007", *China Economic Review*, vol. 21, pages 650 - 670.

Bai, C & Qian, Z. (2009) - "Factor Income Share in China: The Story Behind the Statistics" - *Economic Research Journal*, vol. 3, pages 27-41.

Bai, C & Qian, Z. (2007) - "Factor Income Distribution: The Story Behind the Statistics" - *Tsinghua University Working Paper*.

Barro, R., Mankiw, G. & Sala-i Martin, X. (1995) - "Capital Mobility in Neoclassical Models of Growth", *The American Economic Review*, vol. 85, No.1, pages 103 - 115.

Barro, R. & Sala-i Martin, X (1992) - "Convergence", *The Journal of Political Economy*, vol. 100, no.2, pages 223- 251.

Bevan, A. & Estrin, S. (2000) -- "The Determinants of Foreign Direct Investment in Transition Economies", *William Davidson Institute Working Paper No. 342*, Centre for New and Emerging Markets, London Business School.

Blanchard, O. & Giavazzi, F. (2005) -- "Rebalancing Growth in China: A Three-Handed Approach", *CEPR Discussion Papers Series, No. 5403.*

Borensztein, E., De Gregorio, J. & Lee, J-W. (1998) -- "How does Foreign Direct Investment Affect Economic Growth?", *Journal of International Economics*, vol. 45, pages 115-135.

Braunstein, E and Epstein, G (2002) -- " Bargaining Power and Foreign Direct Investment in China: Can 1.3 Billion Consumers Tame the Multinationals?" *University of Massachusetts Amherst, MA Working Paper.*

Caroll, C., & Weil, D. (1994) - "Saving and Growth: A Reinterpretation" – *Carnegie-Rochester Conference Series on Public Policy*

Caroll, C., Overland, J. & Weil, D. (2000) - "Saving and Growth with Habit Formation" - *American Economic Review*, Vol. 90(3), pages 341-355.

CEIC Statistical Database (1992 – 2011)

Chamon, M. & Prasad, E. (2010) -"Why are Saving Rates of Urban Households in China Rising?", *American Economic Journal: Macroeconomics*, Vol. 2(1), pages 93-130.

Chamon, M., Liu, K. & Prasad, E. (2011) - "Income Uncertainty and Household Savings in China", *NBER Working Paper No. 16565*.

Chen, C., Chang, L. & Zhang, Y. (1995) - "The Role of Foreign Direct Investment in China s Post- 1978 Economic Development", *World Development*, Vol. 23(4), pages 691-703.

Chen, K., Imhoroglu, A. & Imhoroglu, S. (2005) - "Secular Movements in US Saving and Consumption", *Society for Economic Dynamics Meeting Papers, No. 154.*

Chen, K., Imhoroglu, A. & Imhoroglu, S. (2006) - "The Japanese Saving Rate", *The American Economic Review*, Vol 96, No. 5, pages 1850 - 1858.

Cheung, K-Y. & Lin, P. (2004) - "Spillover Effects of FDI on Innovation in China: Evidence from Provincial Data" - *China Economic Review*, Vol 15(1), pages 25-44.

De Mello, L. (1999) -- "Foreign Direct Investment-led Growth: Evidence from Time Series and Panel Data," *Oxford Economic Papers*, Vol. 51, pages 133-51.

Dees, S. (1998) – "Foreign Direct Investment in China: Determinants and Effects", *Economics of Planning*, Vol. 31, pages 175 – 194.

Dekle, R. & Vandenbroucke, G. (2012) - "A Quantitative Analysis of China s Structural Transformation", *Journal of Economic Dynamics & Control*, Vol. 36, pages 119 - 135.

Farrell, D., Lund, S., Rosenfeld, J., Morin, F., Gupta, Y. & Greenberg, E. (2006) - "Putting China's capital to work: the value in financial system reform", McKinsey Global Institute Working Paper

Feldstein, M. & Horioka, C. (1980) -- "Domestic Saving and International Capital Flows", *Economic Journal*, Vol. 90 (358), pages 314 - 329.

Fetscherin, M., Voss, H. & Gugler, P. (2010) -- "30 Years of Foreign Direct Investment in China: An interdisciplinary literature review", *International Business Review*, vol. 19, pages 235--246.

Fung, K.C., Iizaka, H & Tong, S, (2004) -- "Foreign Direct Investment in China: Policy, Trend, Impact", *Global Economic Review*, vol. 33 (2), pages 99-130.

Ghazali, A, (2010) -- "Analyzing the Relationship between Foreign Direct Investment, Domestic Investment and Economic Growth for Pakistan", *International Research Journal of Finance and Economics*, vol. 46, pages 123-132.

Graham, E & Wada, E. (2001) -- "Foreign Direct Investment in China: Effects on Growth and Economic Performance", *Peterson Institute for International Economics Working Paper Series, WP01-3.*

Hale, G & Long, C (2006) - "What Determines Technological Spillovers of Foreign Direct Investment: Evidence from China", *Economic Growth Center, Yale University, Center Discussion Paper No. 934.*

Hale, G & Long, C (2011) - "Are There Productivity Spillovers from Foreign Direct Investment in China?", *Pacific Economic Review*, Vol. 16(2), pages 135-153.

Harbaugh, R. (2004) - "China s High Savings Rates", *National Chengchi University Conference Paper on "The Rise of China Revisited: Perception and Reality"*

Hayashi, F. & Prescott, E.C. (2002) - "The 1990s in Japan: A Lost Decade." *Review of Economic Dynamics*, Vol. 5(1), pages 206 --35.

Henley, J., Kirkpatrick, C. & Wilde, G., (1999)- "Foreign Direct Investment (FDI) in China: Recent Trends and Current Policy Issues", *The World Economy Journal*, Vol. 22, pages 223-243.

Hong, E & Sun, L. (2011) -- "Foreign Direct Investment and Full Factor Productivity in China -- A Spatial Dynamic Panel Analysis", *Oxford Bulletin of Economics and Statistics*, vol. 73, pages 771-791.

Hu, K. & Kahn, M.S. (1997) – "Why is China Growing so Fast", *International Monetary Fund Working Paper*

Huang, J-T. (2004) - "Spillovers from Taiwan, Hong Kong and Macau Investment and from other Foreign Investment in Chinese Industries", *Contemporary economic policy*, Vol. 22 (1), pages 13-25.

Huang, Y. (1998) -- "FDI in China: an Asian Perspective", *ISEAS Series on China and the Asia-Pacific*, The Institute of Southeast Asian Studies and The Chinese University Press, Singapore.

Huang, Y. (2001) -- "Internal and External Reforms: Experiences and Lessons from China", *Cato Journal*, Vol. 21, no.1, pages 43-64.

Huang, Y. (2001) -- "The Benefits of FDI in a Transitional Economy -- The Case of China", *OECD Global Forum on International Investment `New horizons and policy challenges for foreign Direct investment in the 21st century , Mexico City*.

Huang, Y. (2003) -- "One Country, Two Systems: Foreign-Invested Enterprises and Domestic Firms in China", *China Economic Review*, 14, pages 404-416.

Islam, N & Dai, E. (2009) - "Alternative Estimates of TFP Growth in China: Evidence from Application of the Dual Approach", *Resurgent China, Issues for the Future* , pages. 289-332, UK: Palgrave Macmillan.

Kaminsky, G. (2005) -- "International Capital Flows, Financial Stability and Growth", *UN/ DESA Working Paper No. 10, ST/ESA/2005/DWP/10*.

Kim, D. & Seo, J. (2003) -- "Does FDI Inflow Crowd Out Domestic Investment in Korea?", *Journal of Economic Studies*, Vol. 30, No. 6, pages 605-622.

Kraay, A. (2000) – "Household Saving in China", *World Bank Economic Review*, Vol. 13 (3), pages 545 – 570

Kuijs, L. (2005) – "Investment and Savings in China", *World Bank Working Paper Series, WPS 3633*

Kuijs, L. (2006) – "How will China s Savings-Investment Balance Evolve", *World Bank Policy Research Working Paper No. 3958*

Kuijs, L., & Wang, T. (2006) –"China's Pattern of Growth: Moving to Sustainability and Reducing Inequality", *China and the World Economy*, Vol. 14 (1), pages 1 – 14

Laurenceson, J & Tang, K, 2007 – "The FDI-income Growth Nexus: a review of the Chinese experience", *EAERG Discussion Paper Series, 0905*, University of Queensland.

Li, X., Liu X. & Parker D. (2001) – "Foreign Direct Investment and Productivity Spillovers in the Chinese Manufacturing Sector" - *Economic Systems*, Vol. 25 (4), pages 305-321.

Lipschitz, L., Rochon, C & Verdier, G (2008) -- "A Real Model of Transitional Growth and Competitiveness in China", *International Monetary Fund Working Paper Series, WP/08/99*.

Liu, Z. (2001) - "Foreign Direct Investment and Technology Spillover: Evidence from China", *Journal of Comparative Economics*, Vol. 30 (3), pages 579-602.

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, pages 1433-1440.

Liu, X., Song, H. and Romilly, P. (1997) -- "An Empirical Investigation of the Casual Relationship between Openness and Economic Growth in China", *Applied Economics*, Vol. 29, pages 1679-86.

Ma, G. & Yi, W. (2010) - "China s High Saving Rate: Myth and Reality", *BIS Working Paper, No. 312.*

Ma, G. & Yang, D.T. (2013) - "China s High Saving Puzzle", *IZA Working Paper Series, DP No. 7223*

Modigliani, F. & Cao, S. L. (2004) – "The Chinese Saving Puzzle and the Life-Cycle Hypothesis", *Journal of Economic Literature*, Vol. 24 (1), pages 145 – 170.

Nabar, M. (2011) - "Targets, Interest Rates and Household Saving in Urban China" - *IMF Working Paper Series, WP/11/23*

Prasad, E.(2009) -"Rebalancing Growth in Asia", *NBER Working Paper 15169*

Prasad, E. & Wei,S. (2005) - "The Chinese Approach to Capital Inflows: Patterns and Possible Explanations" - *International Monetary Fund Working Paper Series, WP/05/79.*

Rawski, T. (2002) -- "Will Investment Behavior Constrain China s Growth?", *China Economic Review*, Vol. 13, pages 361--372.

Shan, J. (2002) - "A VAR Approach to the Economics of FDI in China", *Applied Economics*, Vol. 7(34), pages 885-893.

Song, Z., Storesletten, K. & Zilibotti, F. (2011) -- "Growing like China", *American Economic Review*, Vol. 101, pages 202--241.

Sun, H.(1998) -- "Macroeconomic Impact of Direct Foreign Investment in China: 1979-96", *The World Economy*, Vol. 21 (5), pages 675-94.

Tang, S. (2005) -- "Does Foreign Direct Investment Crowd out Domestic Investment in China?", *Working Paper, School of International Business and Asian Studies, Griffith University, Queensland*.

Tang, S., Selvanathan, E.A. & Selvanathan, S. (2008) -- "Foreign Direct Investment, Domestic Investment and Economic Growth in China: A Time Series Analysis" -- *World Economy Journal*, Vol. 31, pages 1292 -- 1309.

Tseng, W. & Zebregs, H. (2002) -- " Foreign Direct Investment in China: Some lessons for other countries", *International Monetary Fund Discussion Paper Series, PDP/02/3*.

UNCTAD Database - International Data Series (1979-2011)

Verdier, G (2008) -- "What Drives Long Term Capital Flows? A Theoretical and Empirical Investigation", *Journal of International Economics*, Vol. 74 (1), pages 120 – 142

Waheed, A. (2004) -- "Foreign Capital Inflows and Economic Growth of Developing Countries: A Critical Survey of Selected Empirical Studies", *Journal of Economic Cooperation*, Vol 25, pages 1-36.

Wan, X. (2010) -- "A Literature Review on the Relationship between Foreign Direct Investment and Economic Growth", *International Business Research*, Vol.3, no.1.

Wang, P., Wen, Y. & Xu, Z. (2012) -- "Two-Way Capital Flows and Global Imbalances: A Neoclassical Approach", *Federal Reserve Bank of St. Louis Working Paper Series, WP 2012-016A.*

Wei, Y & Liu, X. (2006) - "Productivity Spillovers from R&D, Exports and FDI in China s Manufacturing Sector", *Journal of International Business Studies*, Vol. 37 (4), pages 544-557.

Wei, S-J. & Zhang, X. (2009) – "The Competitive Saving Motive: Evidence from Rising Sex Ratios and Saving Rates in China", *NBER Working Paper No. 15093*

Wen, Y. (2009) - "An Analytical Approach to Saving under Borrowing Constraints", *Federal Reserve Bank of St. Louis Working Paper 2009-026B.*

Wen, Y. (2010) - "Saving and Growth under Borrowing Constraints: Explaining the High Saving Rate Puzzle", *Federal Reserve Bank of St.Louis Working Paper 2009-045C.*

World Bank Statistical Database – Development Indicators (1965 – 2011).

Wu, Y. (2003) – "Has productivity contributed to China's growth?"- *Pacific Economic Review*, Vol. 8(1), pages 15-30.

Wu, W. (2012) - "High and Rising Chinese Saving: It's Still a Puzzle", *John Hopkins University, Job Market Paper.*

Xiao, G (2004) -- "People s Republic of China round-tripping FDI: scale, causes and implications", *Asian Development Bank Institute Discussion Paper No.7.*

Yang, D.T., Zhang, J. & Zhou, S. (2011) - "Why are Saving Rates So High in China", *NBER Working Paper Series, WP 16771.*

Yao, Shujie (2006) -- "On Economic growth, FDI and Exports in China", *Applied Economics*, Vol. 38, pages 339-351.

Yu, K., Xin X., Guo, P. & Liu, X (2011) - "Foreign Direct Investment and China s Regional Income Inequality", *Economic Modeling*, Vol. 28 (3), p ages 1348 - 1353.

Zhang, K. (2006) -- "Foreign Direct Investment and Economic Growth in China: A Panel Data Study for 1992-2004", *University of International Business and Economics `WTO, China and Asian Economies Conference, Beiijing, China*.

Zhang, K. H. (2001) - "What Attracts Foreign Multinational Corporations to China?" *Contemporary Economic Policy*, Vol. 19(3), pages 336--347.

Zhang, K.H., (2001) - "Does Foreign Direct Investment Promote Economic Growth? Evidence from East Asia and Latin America", *Contemporary Economic Policy*, Vol. 19 (2), pages 175-85.

Zhang, N. (2011) - "Foreign Direct Investment in China: Determinants and Impacts"- *University of Exeter Management Sciences Thesis*.