

“Go West Young Man”:

Economic Growth and the Role of Infrastructure Provision in the Pan-Pearl River Delta, China

Author: Samuel Costa
Supervisor: Magnus Andersson



Abstract

The purpose of the thesis is to analyze the recent growth figures of China and understand whether China will be able to sustain its outstanding economic growth pattern, in a time when it needs to rebalance its economy from investments towards domestic consumption. In fact, if China does not rebalance its economy to a consumption-led economy, it might face difficulties to repay the massive investments that, before the global financial crisis, have been financed by China's trade balance surpluses. To succeed, China will have to increase its productivity and synergistically grow throughout its whole territory. To understand the current state of the economy, under the framework of economic growth theories, I operated an empirical analysis of statistics released by different provincial bureaus, which yielded a unique dataset of the region of the Pan Pearl River Delta. The empirical analysis shows how eight, out of nine, provinces in the sample share some worrisome traits. In fact, all of the provinces, but Fujian, accumulate sensible deficits due to the massive investments operated throughout the years from 2000 until 2010. In retrospective, the quantities of investments in infrastructures seem to be excessive and question how China will pay for these and sustain its increasing indebtedness.

Foreword

First of all I want to thank my family, my father Franco Costa, my mother José Pauline Beemsterboer, my brother Sebastian, my adorable sister Carlotta and Kathryn. My gratefulness goes especially to Kathryn that during the process of writing and researching had to witness my erratic changes of mood.

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List of abbreviations

CSB: Chinese Statistical Bureau

CPI: consumer price index

GDP: Gross Domestic Product

GIS: Geographic Information System

GLF: Great Leap Forward

GPP: Gross Provincial Product

HK: Hong Kong

MC: Macao

MPK: marginal product

NBS: National Bureau Statistics

NDRC: National Development and Reform Commission

NPL: non-performing loan

PPRD: Pan-Pearl River Delta

PRD: Pearl River Delta

R^2 : Coefficient of Determination – R-squared.

TVE: Town and Village Enterprise

WDP: Western Development Program

WTO: World Trade Organization

1. Introduction

1.1 Background

After the successful developments of Japan and the miraculous East Asian Tigers, China is finally experiencing, with certain continuity, a tremendous economic growth pattern that is in some regards comparable to its regional counterparts. The result of these outstanding performances is the gradual integration of the whole Asian region into an intertwined world economy. In fact, in the aftermath of the Second World War, Japan first, and soon the rest of the region, weakened the economic hegemony of the West that was driven by the divergence created by the Industrial revolution in 1800s. Specifically for China, economic development started to gain impetus after the economic reforms of Deng Xiaoping in 1978 that integrated the coastal areas of China to the World Economy, registering two digit economic growth figures. Throughout the years since 1978, because of this outstanding development, China successfully lifted 600 million people out of poverty (Oppen and Nee, 2012). However, this tremendous pace of development is suddenly and gradually reducing its momentum, also in response to the diminishing demands of the world economy, struck by the global financial crisis. As a consequence, among academia and the news media, questions have been raised about the sustainability of Chinese economic growth (Anderlini, 2012; Rabinovitch, 2012; Wolf, 2013).

1.2 Research objective

The purpose of the thesis is to analyze the recent growth figures of China and understand whether the Chinese government will be able to sustain its outstanding economic growth pattern. This research will aim at procuring empirical evidence on the phenomenon of economic growth in China in order to produce economic policy prescriptions with the analysis of a series of provincial statistical yearbooks published by the National Bureau of Statistics of China (2012),.

More specifically, the aim of the enquiry will be to scrutinize the figures of economic growth and evaluate the role of investments in fixed assets, also in consideration of the pivotal role of

infrastructure investments in emerging and transitional economies (Wubiao, 2011). The analysis will be conducted assessing the progress of infrastructures since the turning of the new millennium in a sample of provinces in the Pan Pearl River Delta (PPRD), the selected area of analysis. Moreover, China, due to its vast topographic size needs to address to the issue of asymmetric development combining effective policies on a national level and policy implementation on a local level. For this reason, a further intention is to analyze national government policies and the relation with the local governments' implementation. Furthermore, to evaluate the development of the provincial economies and their infrastructure provision, this research will spatially analyze, through the utilization of ArcGIS, the effect on leading areas of development and lagging areas of development (World Bank, 2009).

1.3 Research questions

The research seeks to analyze provincial growth in the Pan-Pearl River Delta and the relation of growth with infrastructure investments. In other words, the aim is to study the relationship between economic growth and infrastructures.

- Is there any empirical evidence of the positive correlation between economic growth and infrastructure provision?
- Is there a common pattern among the regions of the Pan Pearl River Delta?

An exploration of economic growth theories will question whether it is possible to position China within any of the economic growth theories framework. Additionally, an analysis of the last three "Five Year Plans", the recent stimulus package, and a series of statistics (elaborated merging various issues of the Chinese Provincial Statistical Yearbooks), will help us assess the government's intentions in terms of economic growth and investments in infrastructure.

1.4 Thesis disposition

The thesis is structured as follows: after having introduced the research, the second chapter describes the background of the thesis in terms of economic growth, central and local government policies, geography and rural and urban division. The third chapter focuses on the methodology of the thesis where core assumptions and limitations of the research will be

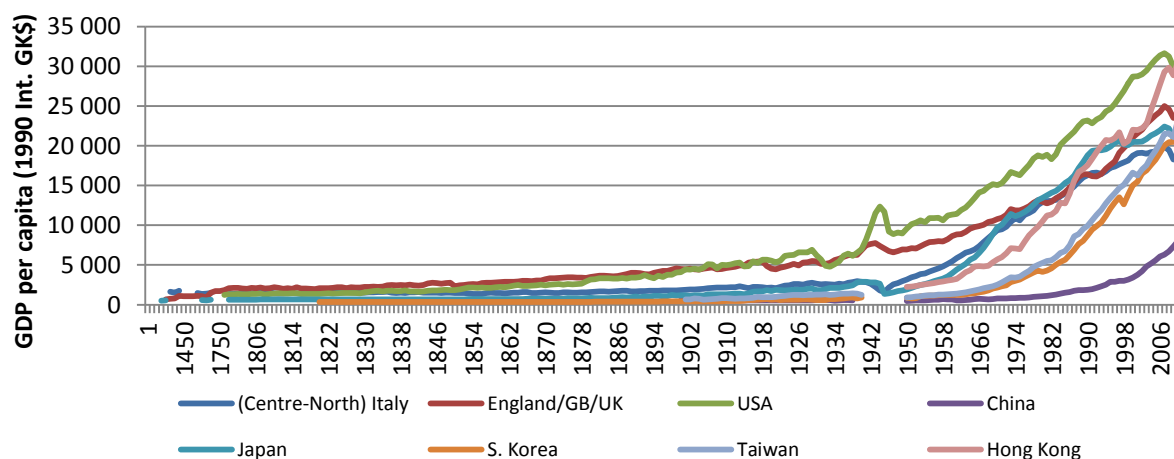
stated. The fourth section drives us through the evolution of economic growth theories since the Second World War in the World Economy first, and then specifically in China. The fifth section is devoted to the description of the data. In the sixth section, the empirical analysis, will give us a glimpse of the imminent threats that China's local governments might soon experience. Finally, the last section summarizes the research and questions the future development of the Chinese Economy.

2. Economic Growth, Geography and infrastructures in the Pan Pearl River Delta

2.1 Economic growth

Over the past 2000 years, among scholars, there is a near-consensus on the evolution of economic growth. In fact, from the Roman Empire until the middle Ages, practically, there has not been any advancement in technology: most of the workforce was employed in self-sustaining agriculture. Output stagnation, together with the increase of population, led to the creation of the Malthusian theory: a trap with insufficient production for the ever increasing population (Melanima, 1998; Clark, 2008). The British political economist would have positively forecasted the end of the world if not for the industrial revolution, which slowly increased output productivity in Western Europe. From an increase of 53% over almost 2000 years until 1820 (Maddison, 2001, cited in Howitt, 2008), the World economy was able to achieve an increase of Gross Domestic Product 15 fold, from 1820 until 1996 (Maddison, 1997 in Melanima, 1998, page 43). In addition, after the Second World War the whole World finally experienced relatively high growth rates. In other words, after the Second World War, several East Asian Economies started to catch up with the West, integrating their economies into the global market, and reducing the divergence experienced in the years until the Second World War (figure 1). Nevertheless, the levels of GDP per capita of China today are comparable with the levels of GDP per capita of the United Kingdom and the United States prior to World War II in 1939.

Graph 1: Economic growth patterns in a selection of countries

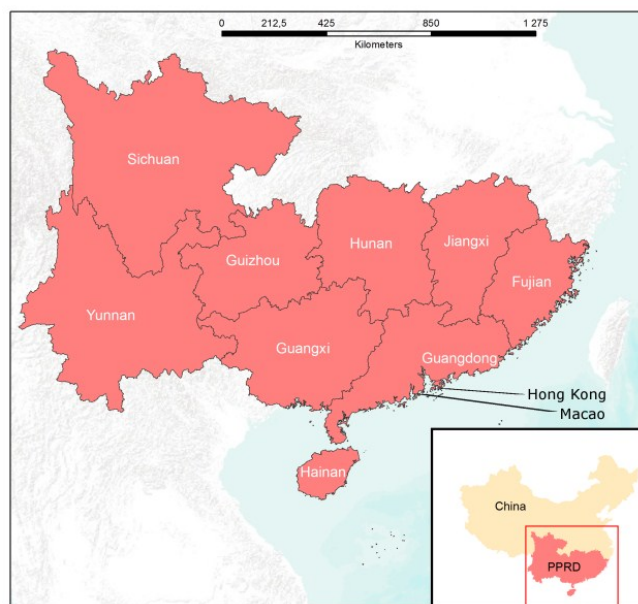


2.2 The context of the research and its geographical setting

The Pan-Pearl River Delta (PPRD, figure 1, in light orange) is the Southern Chinese geographical region composed by nine provinces and two special administrative regions. The PPRD covers an area of 2.007.700 square kilometers and is 20.92% of the total size of China. Its population, with 467.27 million people, totals to 34.88% of the whole Chinese Population. In addition, 29.03% of the total GDP of China is produced by the PPRD (CSB, 2011).

The PPRD (Figure 1) is a recent area of analysis composed by the provinces of Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hunan, Jiangxi, Sichuan and Yunnan. In addition, in the area of Guangdong the two special administrative zones of Hong Kong and Macao complete the Economic Cooperation (Yeung and ShenJianfa, 2008; Yeh, and Xu, 2011).

Figure 1: the Pan-Pearl River Delta Economic Cooperation, nine provinces HK and MC



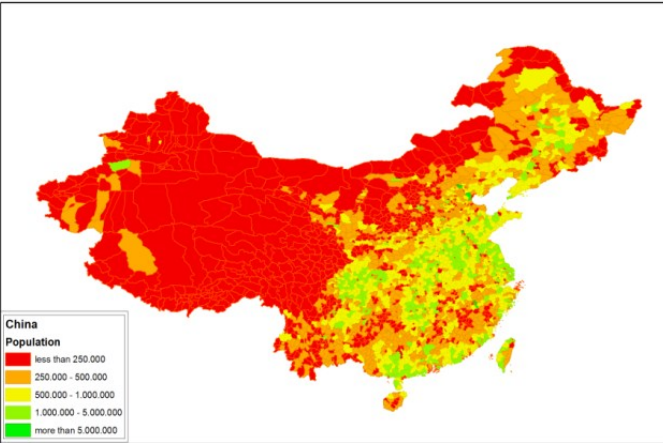
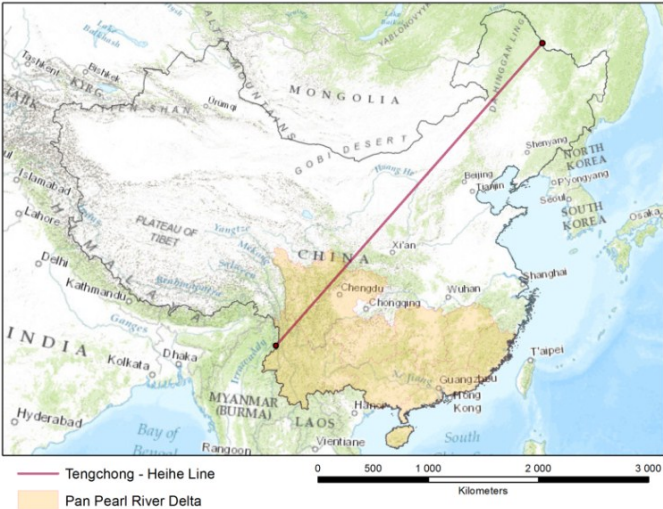
Source: author spatial elaboration

Interestingly, Chongqing has been excluded from the Pan-Pearl River Delta Regional Cooperation, despite its geographical proximity, as of a decision of Guangdong and Guangzhou (Y.M. Yeung and ShenJianfa. 2008, page 86). As we can see from figure 2, in the next page, most of the territory of the region lays on the East of the Tengchong - Heihe (or Tengchong-Aihui) line. The line divides the area of China in two halves: the western half is mainly high and arid and the other, the Eastern half is comparatively flat and fertile. Only

parts of Sichuan and Yunnan lay on the Western half of China. This is an important note, also in regards to the population distribution of China, which is highly concentrated in the fertile Eastern half of the Chinese country. As much as 94% of the population lives in the Eastern half (Naughton, 2007).

To illustrate, figure 3, below, in red depicts the municipalities that register less than 250.000 inhabitants and gradually reaches the bright green municipalities with more than 5.000.000 inhabitants. We can easily notice how the majority of the population is living in the East and South-East coastal provinces of China.

Figure 2 (above): China and the PPRD
Figure 3 (below): Chinese Population Distribution

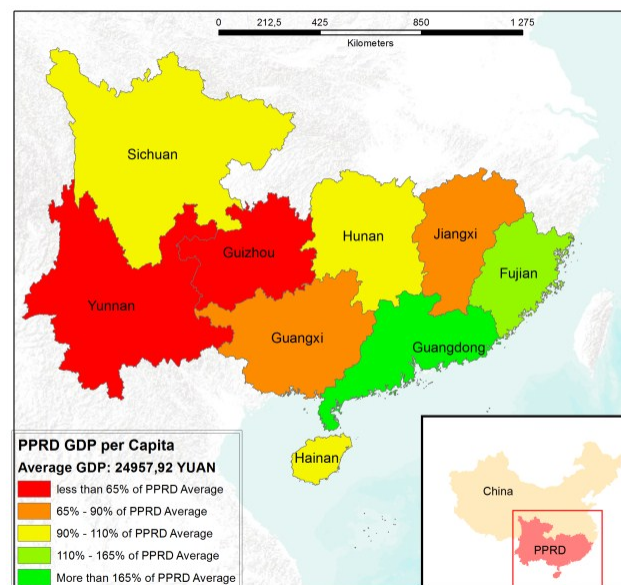


Source: author spatial elaboration of various issues of Chinese Statistical Yearbooks (2011)

2.3 The Pan Pearl River delta Economic setting

On the 28th of November 2012 the Eight PPRD Forum was held in Hainan, Haikou district (Hainan News, 2012; 8th PPRD website, 2012). Eight years have passed since the first forum was held the 1st, 2nd and 3rd of June 2004 in the capital cities of Hong Kong, Macau and Guangzhou, in Guangdong Province (Yeung, 2005).

Figure 4: GDP per capita as compared to the average GDP per capita of the PPRD



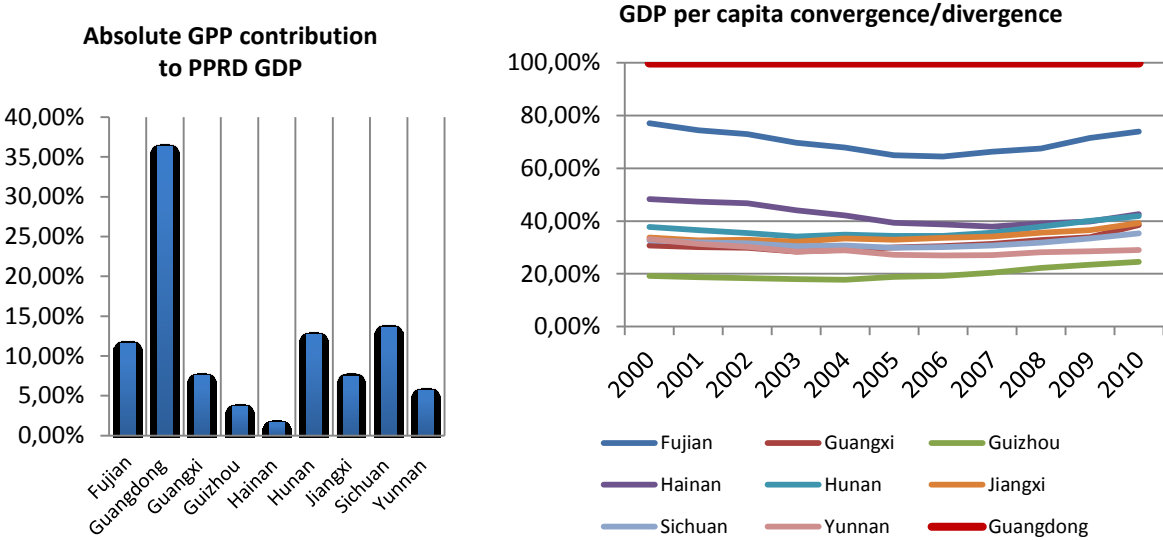
Source: author elaboration of CSB (2011), see appendix for table with provinces' single statistics

The economic policies of 1978, which resulted in the setting of the opening up of the Chinese economy, strongly affected the development of the coastal-mainland divide. In fact, the coastal provinces benefited enormously from the connection with the World Economy, especially in comparative terms with the rest of the country. Further economic reforms, in the beginning of the 90s, precipitated even more the inequalities between the Eastern – Coastal - Provinces and the inland provinces. To obviate to the growing disparities, the Chinese government started the Western Development Program (WDP) in 1999; the WDP aimed at conveying sensible investments to the inland provinces rather than to the industrialized coastal areas (Onishi, 2001). Figure 4 (above) illustrates GDP per capita of the coastal provinces (in green) that result richer than the average GDP per capita of the nine provinces,

which is lowest in the provinces of Guizhou and Yunnan. In this regard, labor mobility within the provinces of the Pan-PRD would highly increase the productivity of the regions that are lagging behind: in 2010, on average, a person living in Guangdong earned 4,08 times more (53996yuan) than a person living in Guizhou (13229yuan) (CSB, 2012).

Figure 5 describes the relative incidence of the provincial economies to the aggregate Pan-Pearl River Delta Economy. From the graph, one could easily assess how Guangdong, also in regards of its pioneering development, represents a leading area of development and retains over a third of the whole economic production of the region. However, after the start of the economic cooperation, in 2004, the provincial economies seem to be converging towards higher levels of relative economic importance, with GDP per capita converging towards the values of Guangdong (graph on the right, GDP Guangdong = 100%).

Figure 5: Relative incidence of the provincial economies to the PPRD GDP (left); and (right) divergence/convergence of GDP per capita in comparison to the GDP per capita of Guangdong.

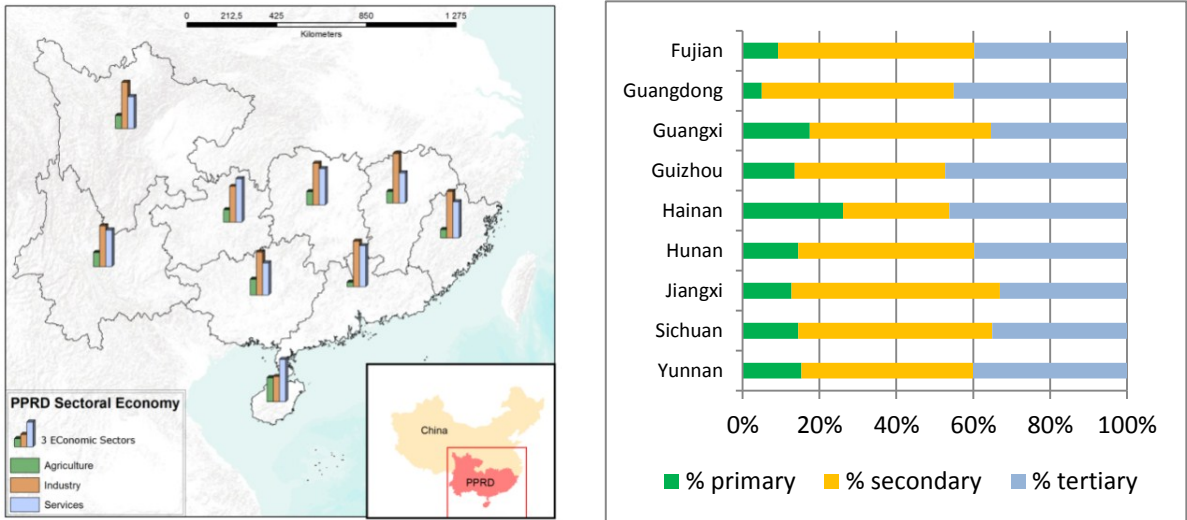


Source: author elaboration of various issues of Chinese Statistical Yearbooks (2012)

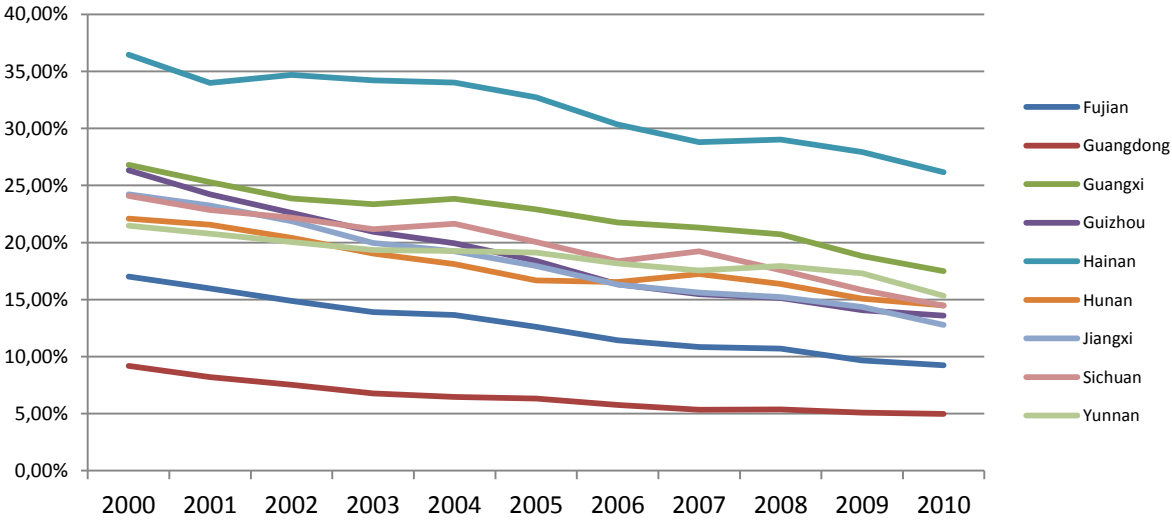
From the analysis of the different gross provincial products (GPP) one can assess the benefits of the regional cooperation. In fact, the agricultural provinces of Guangxi, Yunnan and Hainan, complement the more industrial provinces of Fujian and Guangdong. Moreover, the Pan Pearl River Delta Cooperation yields mutual benefits that can be found in the surplus of power generation of Yunnan, Sichuan, and Guizhou, which participate in the “West-to-East

Electricity Transmission” program (Oakes, 2004). Furthermore, land scarcity in the Pearl River Delta, urges the support of the neighboring provinces to sustain economic growth and especially the quality of growth in regards of energy resources and living environment (Chen, 2010). Finally, all of the provinces are operating structural reforms with the reduction of the share of agriculture to their GPP (Figure 6, below in this page).

Figure 6: the PPRD provinces economies in 2010 and their GPP in regards to the PPRD GDP



PPRD Provinces share of agriculture

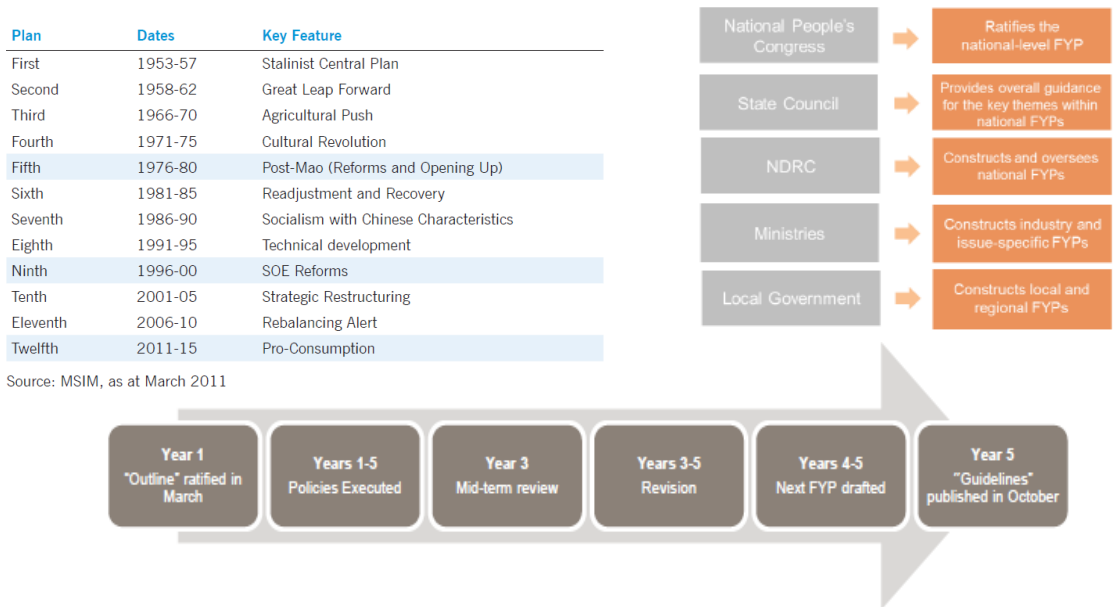


Source: author elaboration of statistics and spatial elaboration of CSB (2012)

2.4 The government policies

The Chinese socialist market economy system, since Mao’s leadership in 1953, has been releasing, five year plans for National Economic and Social Development, modeled on the Soviet-style command economy (Business Monitor International, 2012). Those plans could be assessed as blueprints, *statements of intents* of the government (Ash et al, 2012). Since the First Five Year Plan the Chinese Economy has been implementing 12 Five Year plans with different key features, summarized in the figure below.

Figure 7: on the upper right, general responsibilities of the different institutions of the Chinese government. Above is a general representation of a typical five year plan.



Source: APCO worldwide and Morgan Stanley in Roach (2011)

After the turning of the millennium with China’s accession to the WTO in 2001 and the release of the Tenth Five Year Plan (2001-2005) acknowledge the accession of China to the world market and the market orientation of the Chinese economy that focuses at high, sustainable and efficient growth levels (Naughton, 2005). As a consequence, due to the increasing integration in the World Market and the modifications in the economic structure, the 10th Five Year Plan shifted its etymology from “plan” (*jihua*) to long-range plan or program (*guihua*) (Wong, 2012). Moreover, the successive five years plan confirmed this tendency rechristening the plan a guideline: “Eleventh Five-Year Guidelines”. The guidelines would epitomize the shift towards an increased market orientation and the government’s

distancing itself from the affair of the economy that increasingly becomes less reliant on the centrally planned structure. Moreover, during this Five Year Plan the government aimed at rebalancing the Chinese economic development model and the quality of growth rather than the quantity (BMI, 2012; Fung and Peng, 2012; Roach 2011).

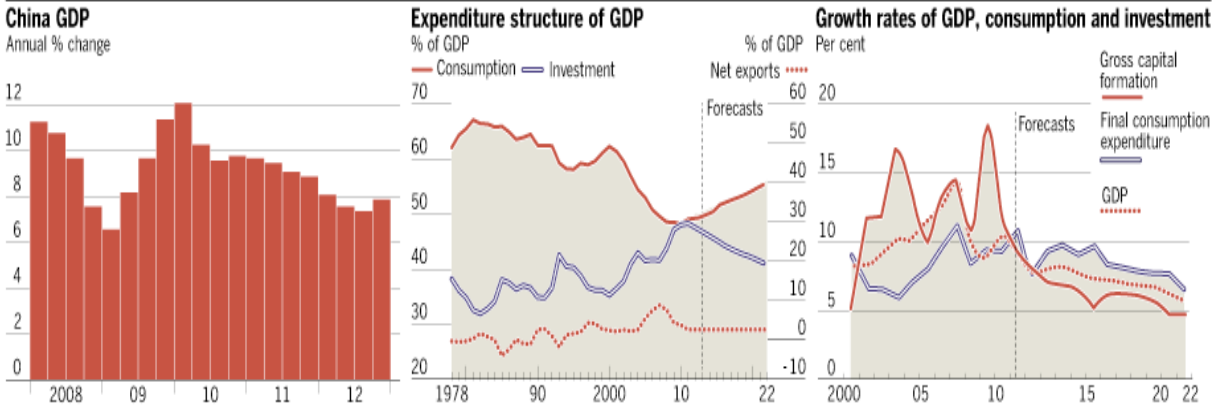
To assess the misalignment between the blueprints and their implementation, we can analyze the response of the Chinese government to the global financial crisis. In fact, the government, in response to the global financial crisis operated a massive fiscal stimulus released on the 5th November 2008 by the State council with the aim of investing 4 trillion RMB: 568 billion dollars totaling 12,5% of the whole Chinese gross domestic product, to be invested from the end of 2008 until the end of 2010 (Naughton, 2009). Of this huge investment plan, the government entrusted 30% of the overall stimulus during the whole timeframe until 2010, and aimed, through the spillover effect of *Marshallian externalities*, to revive and kick start the economy in the hope of attracting further local and foreign investment. Initially, the investment plan aimed at investing 60% of the whole stimulus package in Transport and power infrastructure¹. However, the different tranches of the actual investment plan delineate a different allocation. In fact, of the 120 billion RMB that were initially invested in the fourth quarter of 2008, 20 billion were addressed to the reconstruction process of the Sichuan earthquake and the remaining 100 were allocated to strategic areas, of which Transport and power infrastructure only represented 25% of the whole investment tranche. The second tranche reduced to 21% the investment of the government in infrastructures, in order to increase the investments towards sectors of a more immediate impact on the people's livelihood (Naughton, 2009).

Consequently, the 12th Five Year Plan/Guidelines (2011-2015) building on the guidelines of the 11th Five Year Plan of quality growth, aims at progressively shift the Chinese economy from an investment-led to a consumption-driven economy with a focus on services and an increase of production of value-added goods, which would attempt to rebalance the disproportions created by an intensive growth with unbalanced and asymmetric developments. In order to succeed the government is planning to build upon the service sector, the social safety net and support rural incomes; the outcome of those policies will be respectively to create jobs, increase the spending propensity and to increase wages (Roach, 2011). However,

¹The remaining 40% of the investment plan was divided into: Rural village infrastructure (12%), rural village infrastructure (12%), affordable housing (9%), technological innovation and structural adjustment (5%) and health and education (1%) (Naughton, 2009, page 7)

due to the increasing marketization of the Chinese economy, it becomes increasingly difficult to set an agenda for the economy, which is steadily moving away from the central plan to a “new economic planning with Chinese characteristics (Wong, 2012). Nevertheless, the shift in the Chinese Economy is a long-term process that will be reflected by the reduction of investments (as shown in the figure below) that are expected to counterbalance the increase in consumption in the years to come until 2022 (Wolf, 2013). Nonetheless, the shift towards long-term consumption has to be achieved withstanding the internal and external instabilities and focusing on the attenuation of fear-driven preventive saving attitude in the short term, always bearing in mind the risks linked with inflationary dynamics (Roach, 2011).

Figure 8: Economic Growth and the shift from investment to consumption



Source: Thomas Reuters Datastream; Haver Analytics; Development Research of the State Council

2.5 The Local, Central and Interprovincial Government Conundrum

It is also common to see “bridges to nowhere” being built simply because the local senator or congressman has the political muscle to get funds approved. (Mankiw, 2010)

Inter-jurisdiction competition and pro-growth political culture in the local jurisdiction might result in sensible misalignment between the central plan policies and the actual implementation (Wong, 2012). In fact, Chinese Policies, in a regional context, suffer from the misalignment between the interests of the Central Government and the policy implementation of the different local governments. To illustrate, the local governments aim at profit

maximization, especially in short term economic development, which in turn enhances political accountability. In addition, local officials, usually promoted by their growth performances, are eager to boost their growth performances at all costs, trying with all their means to collect the funding necessary for the investments (Rabinovitch, 2012). However, local banks are reluctant to lend to local governments because in fear of the risk of producing more non-performing loans and overdue loans after the successive stimulus packages. Moreover, the different provinces fuel competition between each other's jurisdictions to enhance investments, both local and foreign. According to De Hu and Hailong Ma (2010) the competition amongst the different jurisdictions focuses on improvements on three main factors: ameliorating the investment atmosphere, smoothing the judicial system and enhancing the government efficiency. On one hand, this can be seen as a healthy competition that fuels cooperation and efficiency; on the other hand, it stimulates seclusion and separatism fostering values such as 'individuality', 'autonomy' and 'sense of superiority' (ibid.). As a result, lacking an external promoter, be it the Central Government or Foreign Direct Investment, there will be little encouragement of inter-provincial cooperation. In addition, in the context of local investments, worrisome is the article of Jamil Anderlini (2012) that denounces how local administrations have been accessing the credit market through investment vehicles set up to avoid government restrictions. Anderlini continues arguing that many of the investments financed through those vehicles, have been wasteful and might produce non-performing loans. All of these attitudes are resulting in the decline of confidence in local governments, which continue to announce enormous investment, which are often very inflated (Zhang Zhiwei, 2012, cited in Anderlini, 2012). In addition, the reluctance of banks to lend to local officials and other borrowers, especially in the aftermath of the global financial crisis, ignited the development of shadow banking that has quadrupled its size since 2008 (Rabinovitch, 2013). The problem here is to assess whether this non-performing loans and overdue loans are uneconomical and are actually producing overcapacity and overinvestment².

2.6 Urbanization and the Rural-Urban divide

Urbanization is an important drive of economic growth because of its correlation with the increasing productivity given by the mobility from the primary to the secondary and tertiary sector. In China, urbanization has unique patterns that highly depend on the government

²On overinvestment in China see Rabinovitch (2012): *China: The road to nowhere*, the Financial Times

policies. The value of urbanization prompted by the Great Leap Forward (GLF), was clearly unsustainable, and China in the years after the GLF and until the economic reforms of 1978, actually de-urbanized. This atypical pattern clearly demonstrates the tight controls operated by the central government and the impact of the *hukou* system. After this uncommon pattern, the economy re-established urbanization rates comparable to a developing country. These urbanization rates reflect the *Rural-Urban migration*, which recently (data for the 2000 census) estimated a “floating population” of 144 million, or 12% of China’s population. These migrants are comparable to the undocumented Mexican workers working in the U.S. cities: they are discriminated and confined to the outskirts of the city. Of these 144 million, 20 million succeeded in changing their status from rural to urban, especially thanks to their high levels of education. This difference in educational and economic background often confines the rural dwellers within the traditional economy (Naughton, 2007).

When analyzing economic growth in China, and in the Pan Pearl River Delta, one should acknowledge the Urban-Rural divide and especially the *hukou* system (Naughton, 2007, page 124), which only recently reduced some of its rigidity for temporary registrations and employment for migrants. The Rural-Urban divide finds its roots in the Socialist Era, in the 50s, when extensive administrative barriers were set to the command economy. A dualistic system formed with the division of urban and rural was established in the 50s when private property in land was abolished to the benefit of “collective” land. On the other side, in urban areas, every business or enterprise was put under government control, under state ownership. As a consequence, the urban workers were part of the strong state ownership; whereas, the rural workers were part of the collectives that had to pay their tributes to the central government, through procurements and taxes. Effectively, the rural workers were at service of the government and subsequently of the urban workers (which worked for nationalized state enterprises). The government would extract resources from the agricultural sector to pour into the industrial sector. This condition would become increasingly severe in the famine immediately after the Great Leap Forward, when the government would continue to extract agricultural output from the rural workers to feed the urban workers, which comparatively spared the worst only until the government couldn’t provide food to the urban dwellers either and decided to enforce the ban on rural to urban mobility, requiring permits, *hukou*, to eat and live in the urban setting. After the Great Leap Forward it became increasingly difficult, if not impossible, to migrate from the rural to the urban setting. Only after the economic reforms of the 80s, the rigidity in the gap between urban and rural softened. However, most of the

privileges of the urban dwellers remain and the rural dwellers are only partly integrating in the urban setting (Naughton, 2007).

The *Urban Economic System* assigns privileges to urban dwellers regularly holding a *hukou* and their consequent membership in a *danwei*, a work unit, placement of employ of the People's Republic of China. These distorted privileges are low prices, job security, welfare benefits and low cost housing. The *DANWEIs* could be State Owned enterprises (SOEs), Public Service Units (PSUs) and government departments. In addition, *Urban Property Rights* were entitled to the state that in the 50s nationalized all urban lands. The property of the urban land stayed within the government until the 90s when transferable urban leaseholds emerged: land use for 50 years started to be bought and sold.

The *Rural Economic System*, laid outside the government system, and was, at least theoretically an autonomous organization. However, any important decision had to be acknowledged by the government and local party officials. Thus, being marginally regulated from the government the rural economic system was comparatively looser than the urban one. *Rural Property Rights*, as for the economic system itself, stayed outside of the government jurisdiction. Nonetheless, the collective system drastically changed during the economic reforms in the early 80s and collective farming shifted to family farming. The division of the land was arranged with some pre-established formulas that assigned plots of land to the collective households. Nevertheless, the farmers never own the land they farm and they sign contracts with the collective that provides land-use rights for a maximum of 50 years. One of the big constraints associated to these land-use rights resides in the property itself. In fact, especially in a dynamic country like China, there is a frequent request for reallocation of land from rural to urban. In this case, Chinese collectives would sell the land and relocate the (angry) farmer. The land-use right would be assigned to different households but never its ownership, which stayed within the collective, or Town and Village Enterprise (TVE) (Naughton, 2007).

3. Methodology

3.1 Core assumptions

In this thesis, I assume the possibility of analyzing economic growth in China through quantitative methods and a positivist stance, which will assess the presence or absence of patterns. As a consequence, the research is constructed utilizing the Statistical Method (Moses and Knutsen, 2007, page 70), where I focused on the empirical analysis of the latest statistics provided by different provincial issues of the Chinese Statistical Bureau (2012).

“The scientific method of quantitative approach can be explained in broad term as entailing the collection of numerical data and as exhibiting a view of the relationship between research and theory as deductive” (Bryman,2004, pp.62).

In this opening analysis, the focus lays in the description and measurement of the relationship of economic growth and the provision of infrastructures in the years 2000 to 2010 (the latest date of available statistics). In the analysis, infrastructures are conceptualized as economic infrastructures, and more specifically as road transport infrastructures. Additionally, to exemplify the understanding of the statistics, I operated a spatial analysis through the utilization of the program ArcGIS, which enables the spatial depiction of the statistics.

After these preliminary descriptive analyses, I shift my ontological standpoint from the mere descriptive statistics to inferential statistics where I compute a multivariate analysis that inspects the co-variation of several explanatory variables of the provincial gross domestic product growth, the dependent variable. Over the time 2000 to 2010, the resulting panel data analysis is the modification of an endogenous growth model, first proposed by Sylvie Demurger (2001).

3.2 Methods

The thesis has been structured through quantitative methods and the use of statistics provided by the Chinese government. At first, the research focuses on the description of growth and infrastructure provision through a study which is initially cross sectional (for the year 2010)

and then longitudinal (from the years from 2000 to 2010). In my first analysis, I use what Ragin (2011) defines the comparative method because I address the analysis across nine cases (the nine provinces of the Pan Pearl River Delta), trying to understand how the provinces differ using a moderate number of observations. After that, through an exploratory research (Davies, 2006), the research addresses to a multiple regression analysis of a series of secondary sources provided by the Chinese Statistical Bureau. This enquiry is a panel analysis conducted within the endogenous growth theory framework, where the aim is to analyze differences in provision of infrastructures in the area of analysis, the Pan Pearl River Delta. To operate this analysis it is crucial to define the variables (a matrix of the variables can be found in the appendix), which have to be assigned before the quantitative analysis itself, which will in turn test and measure the variables previously defined (Ragin, 2011, page 173).

3.3 Multiple Regression analysis

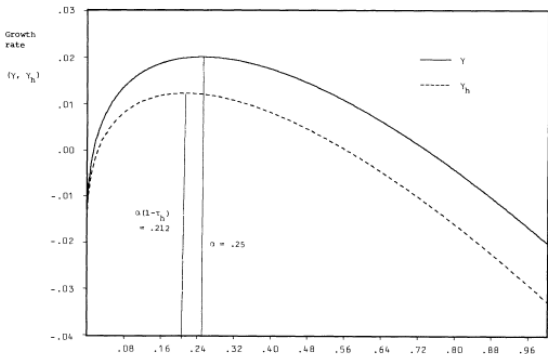
The aim of the regression analysis is to analyze empirical data to assess “how much” infrastructure provision associates with economic growth, within the framework of the endogenous growth theory. The regression analysis will aim at understanding whether a higher provision of infrastructures, generally leads to a higher and sustained economic growth pattern. As a consequence, in the regression the phenomenon of growth, which represents our dependent variable, will be explained through a series of independent variables that should account to the variation of the dependent variable. In addition, correlations within different other variables will assess the presence or absence of a general pattern (Ragin, 2011).

The empirical data collection, necessary to run the regression, is computed from the sample of different provincial yearbooks published by the Chinese Bureau of Statistics (2005, 2007 and 2011). The outcome of the sample is the creation of a unique panel dataset of the PPRD composed of the statistics necessary to run the multiple regression analysis within the desired framework of analysis. After the creation of the sample, the regression analysis will be run through the utilization of the program STATA, which allows the analysis of panels, time series and cross sectional analysis. With this statistical software package, it will possible to assess whether there is an association between economic growth and infrastructures. Nevertheless, the analysis will not be restricted to these two variables only, but will include several other variables to avoid biases of omitted variables.

3.4 Limitations

Limitations reside in the reliability and accuracy of the data and the possibility of including or neglecting variables in the endogenous growth model. The neglected or included variables could as well be misconceived: a clear definition of the variable becomes crucial. Moreover, a naturalist ontology presumes that one could analyze the social world regardless from the social sphere, through a mere analysis of statistics. Alluring as it may seem, this possibility remains quite unlikely, especially in China, where a command economy might prevent the growth model to accurately predict a pattern. Thus, an econometric and quantitative analysis could be biased and should be considered as the base for further and deeper understanding of the phenomenon, which could be operated with qualitative methods, especially in the definition and analysis of the variables in different contexts; and, particularly, in regards to the analysis of outliers, which might present unique characteristics that a mere quantitative analysis would fail to outline. Additionally, limitations lay in the nature of the research itself, which is based on an ethnocentric stance, because of the mere analysis of the statistics and the absence of contextualization, which should be expanded in following and more focused analysis of the phenomenon under inquiry. Regarding the regression analysis, limitations lay in the assumption of describing the phenomenon under investigation as a linear function. However, Allison (2001) argues that regression analysis remains a straightforward study that is generally accepted as valid. Nevertheless, one should acknowledge that the phenomenon under analysis could be a non-linear function, especially because, in general, functions are not necessarily linear. To illustrate, concerning infrastructure provision, Barro (1990) hypothesizes that after a certain level of investments in infrastructures, further infrastructures would hinder rather than enhance growth (below a figure that illustrates the concept graphically).

Figure 9: Barro’s U-shaped curve of government spending



Source: Barro (1990), page 118

4. Theoretical framework

4.1 Theoretical considerations

Within the framework of economic growth long lasting has been, and is probably going to be, the debate within convergence and divide within a country and across countries. Moreover, it is difficult to clearly state a single and main growth determinant, as growth determinants increase with the passing of time despite the limitation of available data (Johnson et al. 2010, page 1121). Harberger (1987) and Solow (1995), among others, denounced the difficulty of creating a general regression model rather than one ad hoc, country specific model. Considering these limitations, in my research I focus on the variable of infrastructure, which I consider crucial in China, also in vision of the government budgeting of the recent fiscal stimulus (Naughton, 2009; Anderlini, 2012)³. By infrastructure, intending physical infrastructures, economic infrastructure, and specifically transport infrastructures. Therefore, the concept of infrastructures in my theoretical framework refers to the endowment of roads and railways in the Chinese region of the Pan Pearl River Delta.

Road infrastructures are part of the broader concept of economic infrastructures. Within the domain of economic infrastructures, one should also acknowledge the presence of telecommunications, utilities and power supply. Nonetheless, infrastructure can be defined as social infrastructures when addressed to the analysis of the access and reliability of healthcare, education and research (Fourie, 2006). Yet, scope of this research is the analysis of road infrastructures, which remains of central importance in the Chinese economic policy, and using the words of the World Development report (1994):

Infrastructure represent, if not the engine, then the wheels, of economic activity.

Furthermore, the importance of infrastructures, in the aftermath of the Second World War, has been discussed by a multitude of authors⁴. Generally, the aim of the arguments concerns the

³60% of the fiscal stimulus processed in 2010 is addressed to infrastructure investments (25% of this investment is addressed to transport infrastructures). The fiscal stimulus of 2008 also devoted 1TN YUAN to infrastructures, on a total of 4,86TN

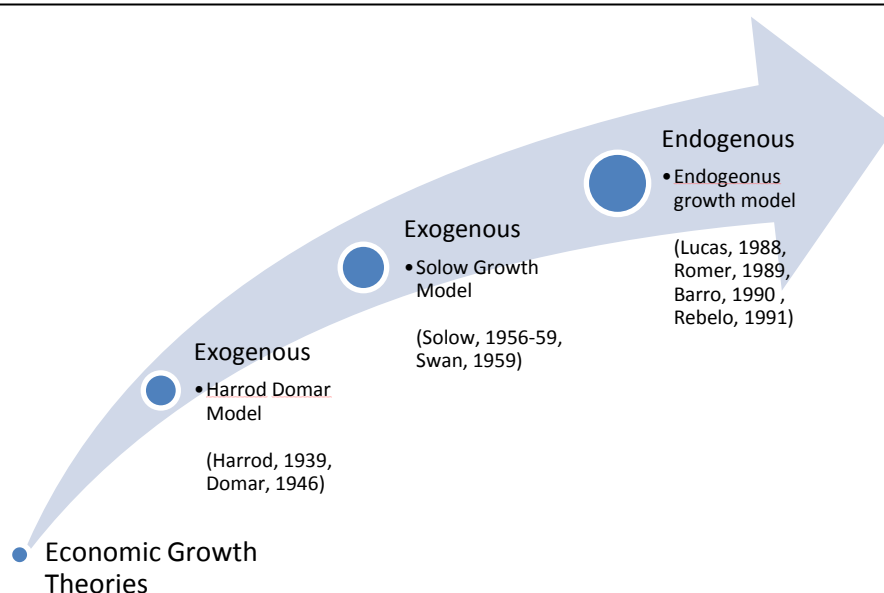
⁴ Among the authors, Paul Rosenstein Rodan (1943), Ragnar Nurske (1952), Hirschman (1958), Aschauer (1989), Munnell (1990), Garcia-Mila - McGuire (1992), Uchimura - Gao (1993), World Bank (1994).

profitability of investments in public non-excludable and non-rivalrous goods (Burda, 2013, page 97; Daron Acemoglu, 2009, page 818).

4.2 Economic growth theories: from the exogenous growth model to the endogenous growth model

My theoretical framework is the result of the review of a selection of chapters from prominent economists⁵ that analyze growth in the aftermath of the Second World War. Through the lead set by these prominent economists and the interpretation of several other articles I was able to draw a timeline of the evolution of economic growth models (figure 6).

Figure 10: the evolution of Economic Growth Theories



Source: author creation

4.2.1 The Harrod-Domar Model

The Harrod-Domar model (cited in Naughton, 2007, page 145), is among the simplest model of exogenous growth; it assumes that labor, in the production function, could be neglected

⁵ Blanchard (2011), Mankiw (2010), Krugman (2013), Burda, Wyplosz (2013), Naughton (2007).

because abundant to a point that its cost is irrelevant and can be omitted from the growth analysis. As a consequence, the production function will depend only on fixed capital and will be represented by a linear function that assumes constant returns on scale (Burda, 2013):

$$Y = 1/k \times K$$

In the linear function, k is the necessary ratio capital/output to produce one unit of output. From these assumptions, growth is given by the increments in capital stock, our only variable:

$$\Delta Y = 1/k \times \Delta K$$

$$\Delta Y/Y = 1/k \times \Delta K/Y$$

Here $\Delta K/Y$ equals the investment and $1/k$ is a fixed capital/output ratio; $\Delta Y/Y$ represents the growth rate. As a consequence, readjusting the function so that growth is a linear function of investment we have:

$$\text{Growth} = i/k$$

This model implies that the more the investment the more the development. In the case of China with an investment rate totaling over 40% of total GDP and assuming a capital/output ratio of 4 (Naughton, 2007, page 146), according to the model, the growth rate of China would average around 10%. However, despite its good prediction of the Chinese growth path this estimate is too much of a simplification that does not include the effect of depreciation, technological progress, population growth and the level of productivity. These interacting factors of growth are better explained in the Solow Growth Model (Solow, 1956-59).

4.2.2 The Solow Growth Model

Although the Solow growth model is not utilized in the empirical analysis of Chapter 6, its variables are the basis for the successive endogenous growth models. The Solow growth model sparks from the Harrod-Domar model and defines growth as dependent on the level of savings, population growth and technological progress; growth in the capital stock, growth in the labor force and advances in technology. The production function in this context depends on the capital stock and labor force (Mankiw, 2010):

$$Y = F(K,L)$$

The model assumes that the production function has constant returns of scale (as in the Harrod-Domar model) where an equal percentage increase in all factors of production causes an increase in output of the same percentage:

$$zY = F(zK, zL)$$

In the function above, z is the increase in production of any given factor. This assumption allows us to analyze the production relative to the quantity of labor. To acknowledge this we can substitute $1/L$ to z :

$$Y/L = F(K/L, 1)$$

This result shows us how the output per worker, depends on the value of capital per worker and a constant value of 1. Since the value of labor quantity can be neglected (because equal to 1), we can then denote the values of output per worker (Y/L) and capital per worker (K/L) as y and k :

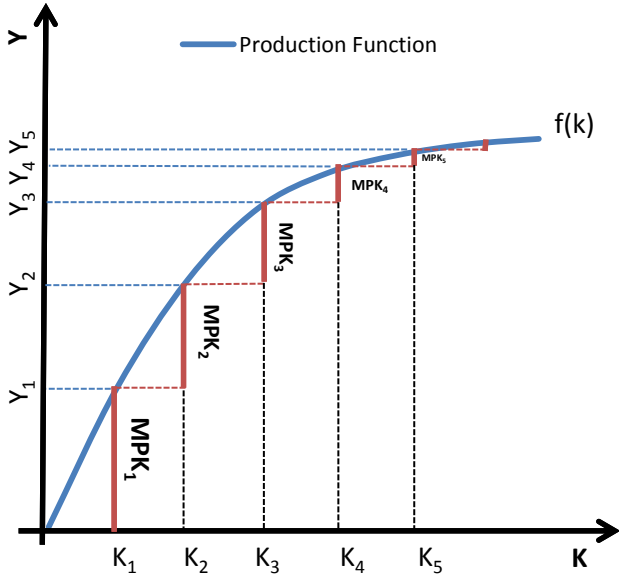
$$y = f(k)$$

From this new function we can evidence how an extra unit increase in capital affects the worker's output. This translates in the Marginal Product of Capital:

$$MPK = f(k+1) - f(k)$$

Graph 2: Marginal Product of Capital in the hypothesis of positive but decreasing marginal productivity

Source: author creation



The figure in the previous page shows how the production function is depicted under the condition of positive and diminishing marginal products. As a consequence of the diminishing returns, the marginal products (MPK) decrease at any extra addition of capital.

As mentioned above, the production function (in blue in the figure) illustrates how much output the economy is capable to produce. However, the output in turns can be divided into consumption and investment (savings):

$$y = c + i$$

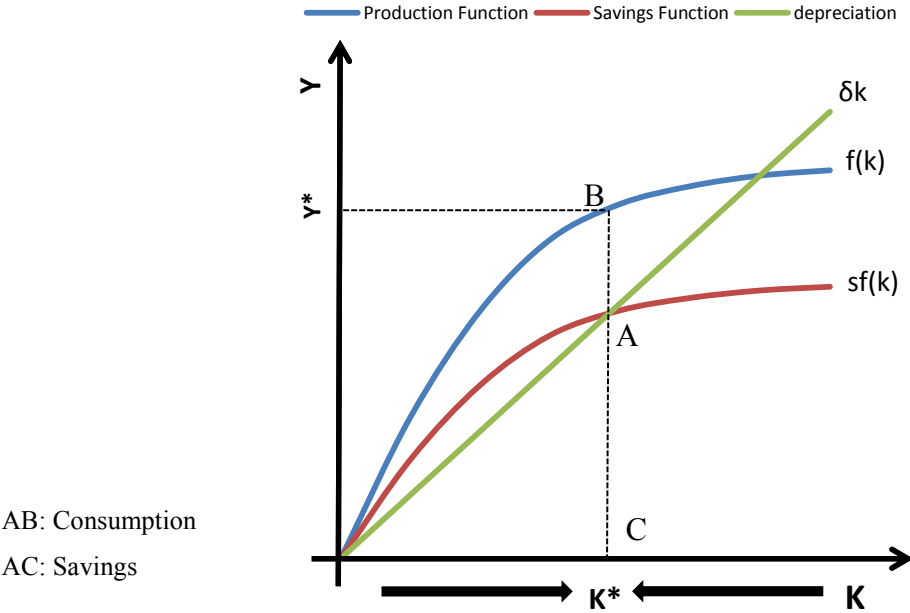
Under the Solow assumptions, this equation neglects the influence of the government and the effect of net exports (which will be included later in this chapter). Moreover, Solow assumes that every year one person consumes a fraction of his income and saves another fraction:

$$c = (1-s) y$$

From this:

$$Y = (1-s) y + i \rightarrow \quad y = y - sy + i \rightarrow \quad i = sy$$

Graph 3: Production function under a basic Solow growth model



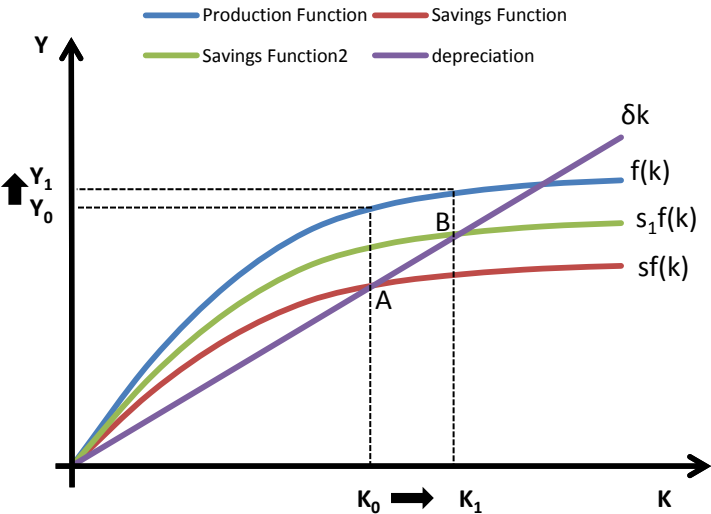
Source: author creation

Solow continues demonstrating that capital stocks depend on both investment and the capital depreciation δ (as depicted in the picture in the previous page). Moreover, he argues that the economies converge to the steady state level of k^* that represents the long-run equilibrium of the economy. Higher levels than k^* indicate that the capital stocks are higher than the depreciation of the investments, forcing the value of investments to decrease. Contrarily, when levels of investments are lower than k^* , the capital stock exceeds the quantity of depreciation and will tend to boost investments until they reach the level of steady state.

In his book Blanchard (2011, page 228) clarifies the dynamics in the movements towards k^* . In fact, the author argues that investments on the left side of k^* , where savings (investments) are higher than depreciation, would add capital to the capital stock, moving the position of k towards k^* . On the other side, investments higher than k^* would present savings (investments) inferior to depreciation, reducing the capital stock and converging from a higher k towards k^* , the long term economics equilibrium. Investments are intended as the necessary investment to keep the capital unchanged overtime, regardless from depreciation.

In addition, increases in saving rates have a positive effect on the production function but only until the new economy reaches its new steady state at a higher output per worker. Increasing the rate of savings moves the function of savings upwards, increasing the capital stock in the steady state (from A to B in graph 4).

Graph 4: An increase in the savings rate of an economy in a basic Solow growth model

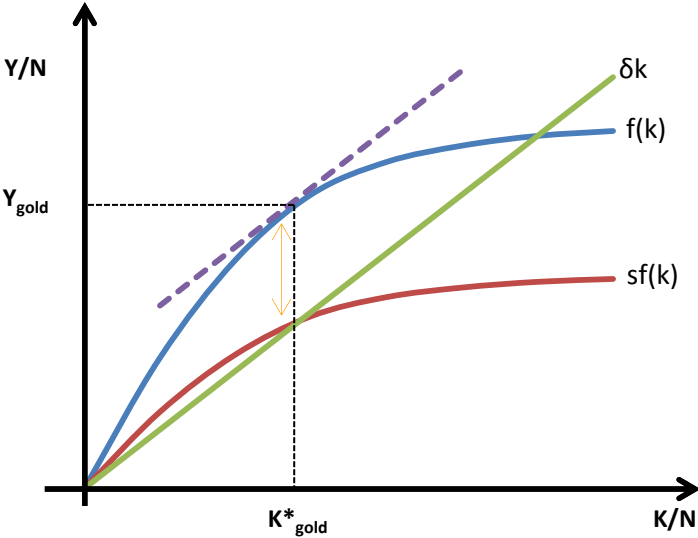


Source: author creation

Would this mean that the more savings mean the better the economy?

Unfortunately for policy makers and other Solow model life realizations, it is not realistic to apply a maximum level of savings, because today's benefit of consumption outpaces tomorrow's benefit of increased but "future" consumption: especially because generations usually change. Additionally, to further justify why higher savings are not the ideal to pursue, we should think that people prefer to consume rather than produce: the quantity produced is less important than the quantity consumed. As a consequence, considering that output is not the same as consumption, especially in consideration of the fact that, absurdly, an ideal 100% saving rate would produce the highest outcome but no consumption, a condition that cannot be considered realistic. An important notice here is that the saving rate affects the value of output of the economy but not its growth: in order to grow an economy requires improvements in productivity.

Graph 5: The Golden Rule Steady State in a basic Solow Growth Model



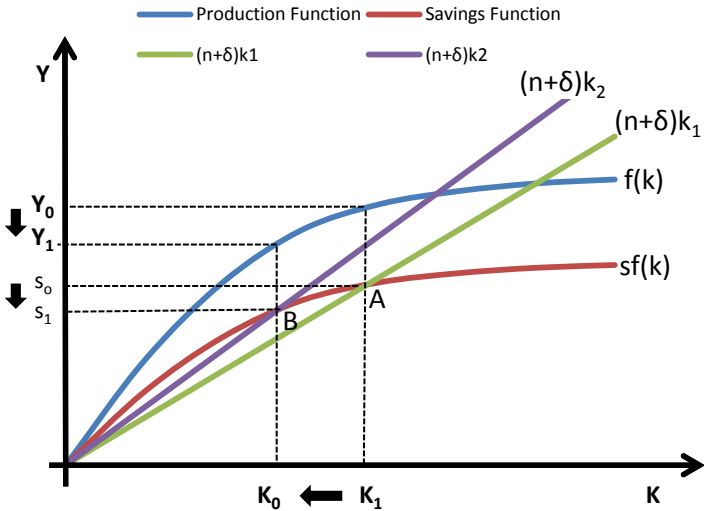
Source: author creation

Because of this caveat Solow introduces the concept of Golden Rule of Level of Capital that indicates the value of k that maximizes consumption (in yellow in graph 5 above). The saving rate has to adapt to reach the Golden Rule Steady state.

In this level of Golden Rule of Level of Capital consumption is maximized for today's generation rather than tomorrow's.

However, in our analysis we should not miss to include other variables, that in the abovementioned analysis we assumed constant: population growth and technological progress. In the graph below we assume an increase in population that reduces the levels of capital and output, adding its negative effect on investments together with the depreciation

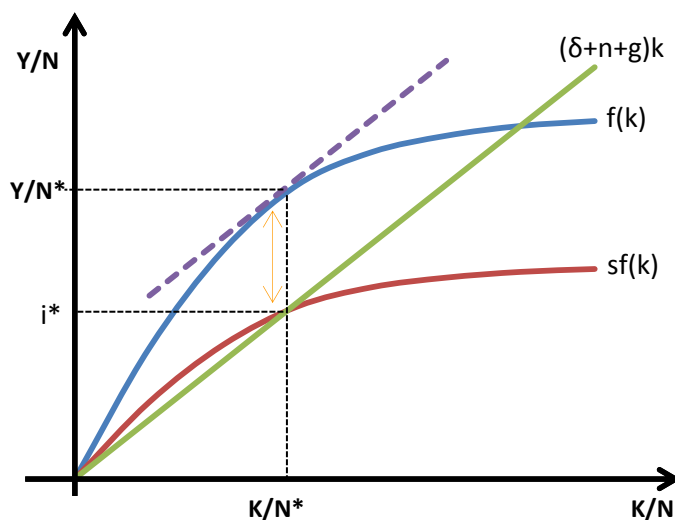
Graph 6: The introduction of the variable of population growth in a basic Solow Growth Model



Source: author creation

In addition to population growth, also technological progress influences the steady state level of investments. With the addition of technology the capital requested for the production of the same quantity of output is reduced and will be considered as the level of capital per effective worker (K/AN). As a consequence, in order to maintain constant the level of capital per effective worker, the required investments should counterbalance the effect of depreciation, technological progress and population growth (as shown in graph 7 in the following page).

Graph 7: The introduction of technological progress, the last variable in the basic Solow Growth Model



Source: author creation

Labor-augmenting technological progress indicates the rate to which technology contributes in labor efficiency. In order to keep the value of k constant, not only depreciation and population growth influence the break even investment but also gk , which is needed to provide capital for the newly created capital addition of technological progress. In the function of the graph above, g indicates the necessary capital for the newly created “effective workers”, which benefit from the technological progress. According to Solow, *only technological progress, considered exogenous, can explain sustained growth and persistently rising living standards.*

4.2.3 Endogenous Growth Model

The Solow growth model, assumes technology to be exogenous, a big assumption of economic activity where technology could be endogenized. Moreover, the Solow growth model misses to explain, why social returns increase (or remain constant) overtime. The Endogenous Growth Model argues about the possibility of combined growth of both physical and human capital, realizing infinite growth with steady increases in physical Capital and human capital (skilled labor) (Blanchard, 2011, page 242). According to this model, Externalities, Knowledge and Constant, or increasing, returns on scale produce Non-declining

Marginal Productivity (Burda, 2013, page 97). In this framework, extra investments will not produce declining marginal productivity but rather further investment and further productivity especially assisted by technology transfers with Foreign Direct Investment.

The difference between endogenous and exogenous lays mostly in the definition of capital: whether this includes knowledge or other impalpable dynamics. In the case of a broad and volatile definition of capital, that includes knowledge, the endogenous growth theory would suit better the enquiry than an exogenous theory that solely and mostly refers to physical and tangible capital. Under these specifications, it is apparent that the endogenous growth theory, including more specificity in its models, should be able to better resemble reality. In other words, both models determine economic growth through the interaction of human capital, physical capital and technology. However, this last factor of economic growth substantially changes between one model and the other.

4.3 The location of China within the Economic Growth theory framework

For much of the first millennium, and until the fifteenth century, China probably had the world's highest level of output per person. For a couple of centuries, leadership moved to the cities of northern Italy. But until the nineteenth century, differences across countries were typically much smaller than they are today. Starting in the nineteenth century, a number of countries, first in Western Europe and then in North and South America, started growing faster than others. Since then, a number of other countries, most notably in Asia, have started growing fast and are converging. Many others, mainly in Africa, are not.

- Olivier Blanchard (2011)

Having analyzed the different growth models, one could assess how China fits within the different models. Initially, considering the simplistic Harrod-Domar model, and assuming a value of capital to output of 4 (Naughton, 2007), one could forecast a plausible Chinese growth rate of 10% (for an assessment of the capital to output ratio of the PPRD sample, see the empirical analysis on chapter 6 and the appendix, which delineate an higher value). However, the Harrod-Domar model assumes that production function solely depend on the variables of fixed capital investments, neglecting many other variables present in real life dynamics.

In order to ameliorate our representation of the reality, the theoretical framework expanded from the Harrod-Domar into the Solow growth model, which adds several variables to its production function (intended as the output or income per worker). In fact the model includes the variables of the savings rate, the population growth rate, the rate of depreciation and the capital per effective worker. Though, this model doesn't apply well to the Chinese context which is favoring, at least in the hopes of the government, in non-decreasing marginal productivity. Nevertheless, in my research, because of the Chinese characteristics, I assume infrastructure investments accountable for much of the Economic growth in China, using a long-run perspective. In support of my theoretical consideration, Bosworth and Collins (2007) of the Brookings institution explain the difference in growth figures between China and India, as dependent on Chinese higher levels of investments (*physical capital*) and technological advancements. Investments, ironically, have been rising since China quit the Big Push development strategy (Naughton, 2007, page 56) and have sustained at really high levels, adding gross fixed capital to the capital stock of China. Interestingly, inventory accumulation or "general over-production" has been gradually decreasing since 1978 to values close to nil (Naughton, 2007, page 145). Despite, these recent comforting results of the Chinese lack of over-production, fallacies can be seen in the years until 1999, where over-investments, not driven by the market, but by the planned economy, led to sensible wastes and inventory accumulation. Moreover, this sustained and rising investment values are unprecedented in economic history, if not for Japan and Korea, which however didn't depend as much on Foreign Direct Investments as China does. In other words, Chinese growth is partially boosted by Foreign Direct Investments (FDIs). This said FDIs are not crucial in the Chinese economic growth figures, which independently from FDIs seem to register a level of investments able to sustain a current account surplus on a national level. In fact, according to Chinese National Statistics the current account surpluses, and investments, are sustained by the really high level of domestic savings. Nevertheless, FDIs play a really important role, in regards of the transfer of know how to domestic firms, which in turn boosts domestic investment. Sustained growth is accomplished through structural change, which enhances productivity and, consequently, output. Labor moves from unproductive and self-sustaining jobs of the primary sector to the newly created and more productive secondary and, on a lesser extent, tertiary sectors. Naughton (2007) argues that the Chinese Economy will continue to grow, for about ten years, until labor force growth and labor force transfer from the rural to the urban more productive setting will endure, until reaching the steady state.

However, one should bear in mind that countries, at times, and in the case of China, through industrial policies allocate investments; the returns on those investments are difficult to measure, private investments can easily be assessed by their profitability, but public investments have a much more difficult measurement assessment. A long literature has been focusing on the benefit of infrastructure investments, both in China and elsewhere in the world: no consent has been reached and the outcomes result really country-specific and time frame specific⁶. For this reason, purpose of this research is to find empirical evidence on the benefit of infrastructure investments in the Chinese context withstanding Barro's (1990) U-shaped curve of government spending.

Among the different endogenous growth models⁷, I rely on the model of Barro (1990) whom endogenizes government spending. Likewise, Munnell (1990), Aschauer (1988) and particularly their expansion in the model⁸ of Sylvie Demurger (2001) estimate growth by using a Barro-type framework.

要想富，先修路
Yàoxiǎngfù, xiānxiūlù
Wanna be rich? Build roads first!

Demurger (2012)

⁶Aschauer (1989), Munnell (1990), Uchimura and Gao (1993), Bergman and Marom (1995), Shah (1992), Bajo-Rubio and Sosvilla-Rivero (1993), Seitz (1993), Mera (1973), Prud'homme (1993), Canning and Fay (1993), Baffes and Shah (1993), Easterly and Rebelo (1996), Gracia Milla (1996), Wylie (1996), Ma and Li (2001), Jalan and Ravallion (2002), Lou (2003), Fan and Chan (2004), Zhang (2007), Romp and DeHaan (2007), Sahoo and Dash (2008), Newell and Chao (2009), Yu et al (2012)

⁷Romer (1986), Becker Barro (1988), Lucas (1988), Romer (1989) and Rebelo (1991).

⁸ $G_{it} = \alpha_i + \eta_t + \beta Ln(y_{it-1}) + \gamma X_{it} + \phi Z_{it} + \psi W_{it} + u_{it}$

5. Metadata

5.1 The sample

The sample under analysis is representative of the Chinese diversity. In fact, among the nine selected provinces, Fujian and Guangdong are part of the East and Coastal area of China, which first in 1979, for a decision of the Central Government, was connected to the world economy. The cities of Zhuhai, Shantou and Shenzhen in Guangdong Province and Xiamen in Fujian, in fact represent the first modern promoters of Chinese connections with the World Economy (Grivoyannis, 2012, page 8); Guangxi, Hunan, Hainan and Jiagnxi are representative of the central region of China; and, Guizhou, Sichuan and Yunnan embody the characteristics of the Western region of China.

5.2 Data Collection

The dataset of the thesis has been processed with the gathering and computation of several Chinese statistics from different Statistical Yearbooks of Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hunan, Jiangxi, Sichuan, Yunnan (2011, 2007, 2002). However, data statistics could lack accuracy because of the aforementioned misalignment between the local and central governments that independently produce their statistics and cause the reduction of data reliability, which will be further discussed later in this chapter.

5.2 Econometric model

In the Endogenous growth theory theoretical framework, within the inferential statistics setting, the aim is to test the statistical significance of certain variables through an econometric model. To test the relevance of the variable I utilize and shape a model, first introduced by Demurger (2001), which I apply on my area of analysis with some changes that comply with the purpose of this enquiry:

$$G_{it} = \alpha_i + \eta_t + \beta \ln(y_{it-1}) + \gamma X_{it} + \phi Z_{it} + u_{it}$$

In the model, the variables reflect the ones initially proposed by Demurger (2001, page104) but vary in some specific circumstances. To illustrate, the dependent variable G, necessary to evaluate the growth patterns, remains equal to the former model and characterizes the average annual growth rate of real GDP per capita; y, as in the model proposed by Demurger, characterizes the level of real GDP per capita; X encompasses a set of variables accountable for physical capital; Z contains the same measures of geographical constraints; α_i and η_t are province- and time-specific parameters, which we will here associate to the nine different provinces of the Pan Pearl River Delta.

5.3 Data Limitations

The reliability of Chinese data is a controversial topic, which we cannot obviate from discussing. Among others, Maddison (1998), Rawski (2001, 2002), Holz (2007), Dyer (2009) and Anderlini (2012) argued about the low reliability and poor accuracy of the Chinese statistics. Rawski and Holz are particularly skeptic about the figures that the government published in the years immediately after the Asian financial crisis. However, Naughton (2007) and Rawski (2008) argue that the Chinese official data are the most reliable data we have and have not been proven wrong so far, especially in regards of their depiction of long-term trends and in consideration of their belonging to a developing economy where the dynamics are really fast and at times evanescent. Moreover, in my research I decided to enhance data consistency, gathering data from 2000 onwards, because of a major replacement in the data collection system in 1998, after the financial crisis. Nevertheless, some of the Chinese estimations for some indicators might result in unclear and indefinite values, which are rarely comparable with any familiar data collection systems: we should really analyze the data with the necessary farsightedness— with a grain of salt or even a *rock of salt* (Holz, 2007). However, growth is not completely deceptive because of the sensible increase of exports in other countries, which indirectly validate the Chinese growth figures. Also Blanchard (2011, page 261) warns the reader about the poor reliability of Chinese data in comparison to OECD data quality. Nevertheless, in his analysis, he accounts technology as the main drive of Chinese economic growth, especially in consideration of the transfer of labor from the low

productivity regions to the urbanized regions. Secondly, he accounts the importation of technology as a supporting drive to labor productivity. However, he also concludes arguing that, China, in order to sustain its high pace of growth, has to invest levels of output as big as 41% of the gross domestic output. Nevertheless, the Chinese growth pattern, withstanding these considerations on data accuracy, together with the Japanese Economy, from 1955 to 1973⁹, the South Korean and Taiwanese, 60s – 1996¹⁰, result the most remarkable economic growth performance economic history has ever recorded.

⁹ Johnson (1982), (Kuznets, 1988), World Bank (1993)

¹⁰ Kuznets, (1988), World Bank (1993), Rodrik, D (1994) , ADB (1997), Hsiao (2003), Kasahara, (2004)

6. Empirical Analysis

6.1 Descriptive statistics analysis

The empirical analysis generates from the computation of different provincial statistics yearbooks. The result is the creation of a unique dataset of the Pan Pearl River Delta. The dataset was created within two different timeframes: one from the year 2000 until the year 2010, the other from the year 1992 until 2010. However, the dataset from 1992 to 2010 suffers from poor reliability due to the low data accuracy in relation to the premature stage of the Chinese economy and a statistical bureau reform of 1998, enacted to increase data accuracy and implement some corrections. As a consequence, the dataset from 2000 until 2010 would result somewhat more accurate in comparison to the dataset dating back to 1992. The first dataset (table 1) is composed by the computation of statistics of the PPRD provinces in 11 years, from 2000 until 2010. The result is a time-series dataset of 99 observations with several different variables. According to the Chinese Statistics (CSB, 2012), Real GDP growth has been ranging from values of 3,39% in Guangxi in 2000 to 23,08% in Guzhou in 2005. The variable of Real GDP growth has been computed with the deflation of nominal GDP with the consumer price indexes statistics of the provinces in the various years from 2000 until 2010 (a graphic result of the GDP growth pattern is shown in figure 12, in the next page). The other variables will be examined singularly in this chapter.

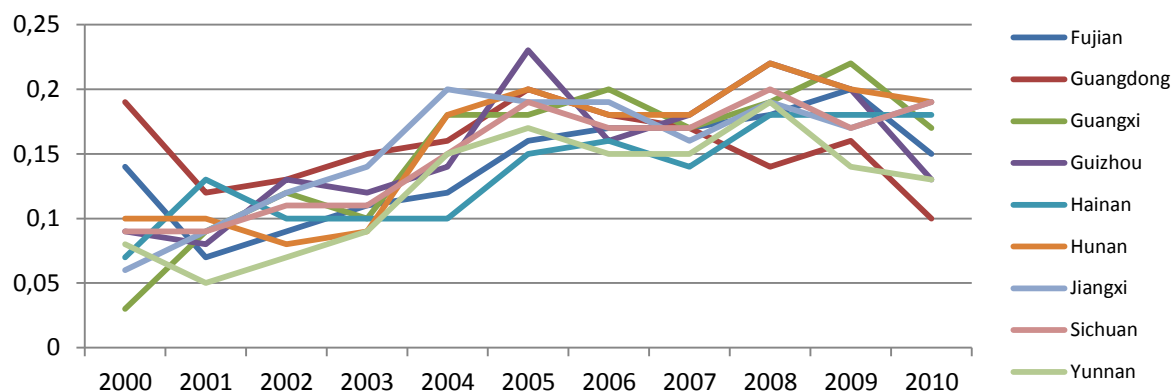
Table 1: Pan Pearl River Delta Dataset from 2000 until 2010

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Year	99	2005	3,178371	2000	2010
Real GDP growth	99	0,1470	0,0446	0,0339	0,2308
Population Density	99	258,1313	110,3072	108,0000	581,0000
FDI in US\$	99	478925,3	758180	8098	3646583
GDP share invested	99	0,4614	0,1575	0,2736	0,9281
Urbanization	99	0,3486	0,0917	0,1861	0,5708
Highways in Kilometers	99	106037	61867	17401	266000
Railways in Kilometers	99	2102,6360	815,7265	214	4000
Land area	99	2220,9780	1281,7250	353,5	4840,6
Highway Density	99	51,8855	22,3269	18,7993	107,6224
Railway Density	99	1,0891	0,3888	0,4131	2,6082

Source: Author's elaboration of various issues of CSB statistics

Figure 11: Real GDP growth in the Pan Pearl River Delta

$$Real\ GDP\ growth_i = \frac{Nominal\ GDP_i}{PCI_i}$$



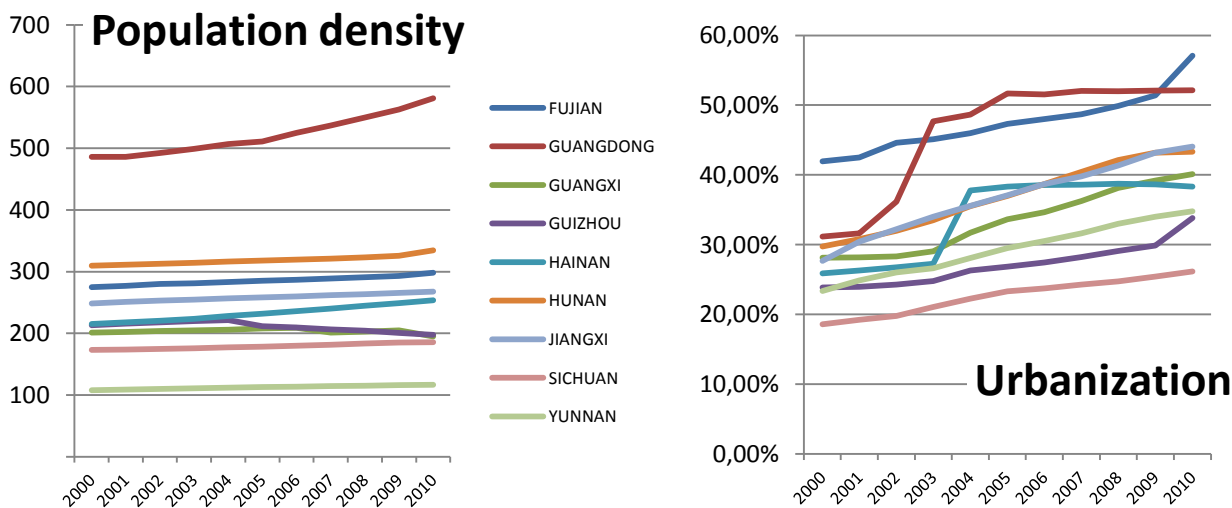
Source: Author's elaboration of various issues of CSB statistics

Real GDP growth has been calculated deflating nominal GDP values with the consumer price indexes

6.2 Population and Productivity

Population Density registers its highest levels in the coastal province of Guangdong with 581 people per square kilometer, and lowest in Yunnan in the year 2000 with 108 people per square kilometer. Strictly related with the population density is the urbanization rate. The lowest urbanization rate has been recorded in the year 2000 by Sichuan (with 18,6%), opposed by the highly urbanized coastal region of Fujian that in the last year under analysis overtook Guangdong in terms of urbanization with a rate of 57,08% (below a graphical representation of the time series of these two variables).

Figure 12: GDP share invested in the provinces of the Pan Pearl River Delta



Source: Author's elaboration of various issues of CSB statistics

$$Urbanization_{it} = \frac{Urban\ Population_{it}}{Total\ Population_{it}}$$

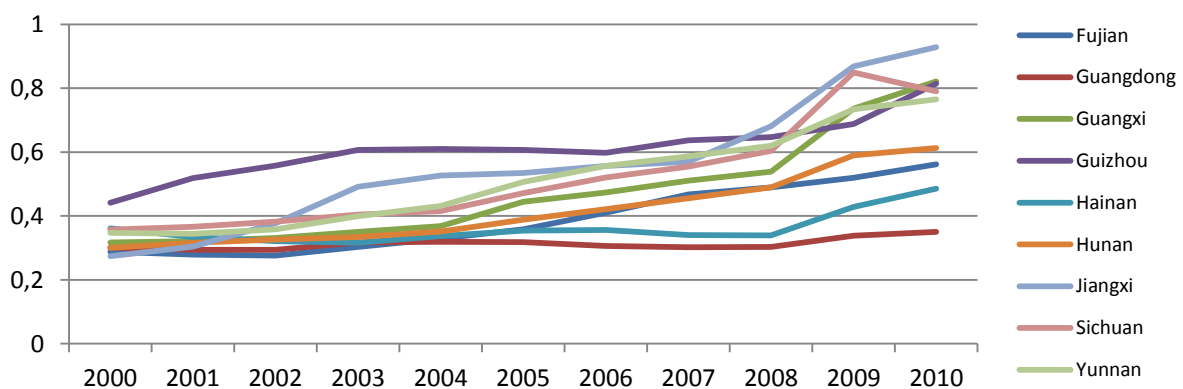
$$Pop\ Density_i = \frac{Total\ Population_{it}}{Land\ Area_{it}}$$

The statistics of Yunnan, Sichuan and Jiangxi suffer from the misalignment between “urban” and “Nonagricultural” statistics. However, Naughton (2007, page 126) describes nonagricultural residents the ones with urban residence permits and could be compared to the urban population statistics. Population density tends to be constant (or slowly increasing) overtime due to the effect of the one child policy, whereas, urbanization increases registering increasing productivity with the migration of rural dwellers into the urban economic setting. This is particularly true with the urbanization of lagging areas of development that favor the most from increase in urbanization rates. Moreover, the sharp increase in population density registered in Guangdong, denotes the attitude of rural dwellers to move to the coastal regions in search of better opportunities. In addition, productivity can also be assessed with the reduction of the share of low productive agriculture output, in spite of the secondary and tertiary sector output (figure 6 on page 9 of this thesis).

6.3 The share of investments and the provinces' budgets

The share of GDP invested (figure 13), computed as the ratio of total investment in fixed assets as a share of nominal GDP, ranges from the lowest values registered in the developed provinces of Fujian, Hainan and Guangdong, to the lagging provinces of the Center and West that register values of investments averaging 80% of their whole gross provincial product.

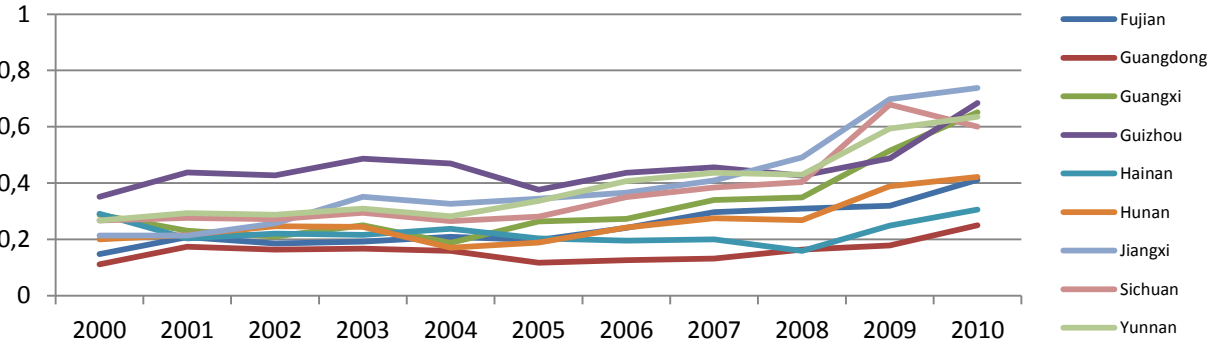
Figure 13: GDP share invested in the provinces of the Pan Pearl River Delta



Source: Author's elaboration of various issues of CSB statistics
Share invested is calculated as a share of provincial nominal GDP

However, applying some basic concepts of public finance ($Y = C + I + G + NX$) and deducting the values of Real GDP growth (figure 12) to the values of investments (figure 13), one can easily assess how the local governments are creating deficits that require to be financed with trade balances surpluses, tax revenues or central government subsidies (figure 15). All of the provinces, throughout the 10 years under analysis, have been accumulating debt that has increased in the years in the aftermath of the global financial crisis also due to the fiscal stimulus enacted from the Central Government in November 2008.

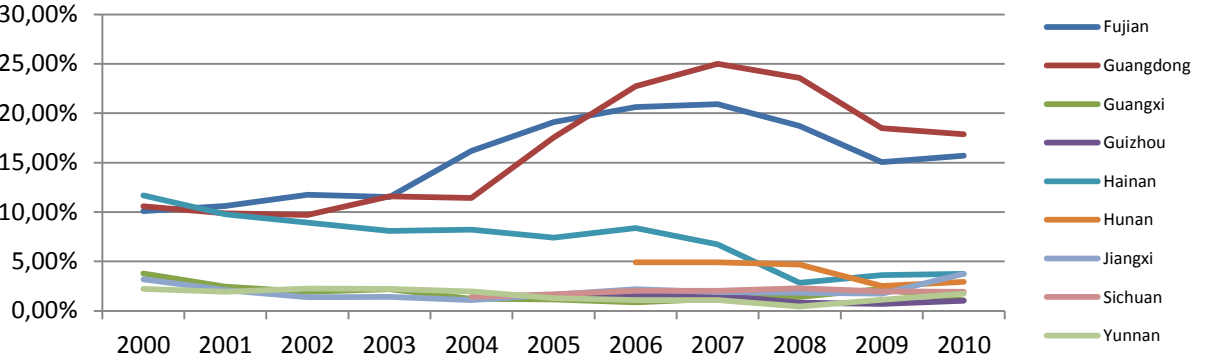
Figure 14: GDP deficits in the provinces of the Pan Pearl River Delta



Source: Author's elaboration calculated as GDP growth – GDP invested

From the analysis of the statistics on local government budget balances (CBS, 2012) we can assess how all of the local governments at a provincial level are running budgetary deficits with revenues always inferior to the expenditures value, accumulating an over-increasing fiscal deficit (see figure 17). In addition, only Fujian and Guangdong are able to partly counterbalance the deficits with high trade balances surpluses (Figure 16). In fact, the difference between the goods exported and the ones imported equals to values that (respectively) total, in 2010, 15.71% and 17.87% of their respective gross provincial product.

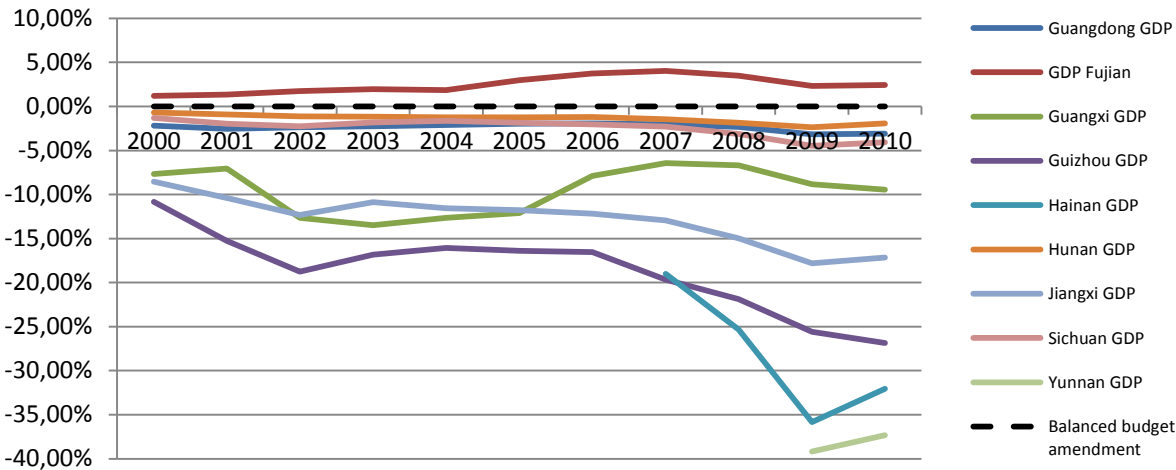
Figure 15: Trade Balances of the Pan Pearl River Delta Provinces



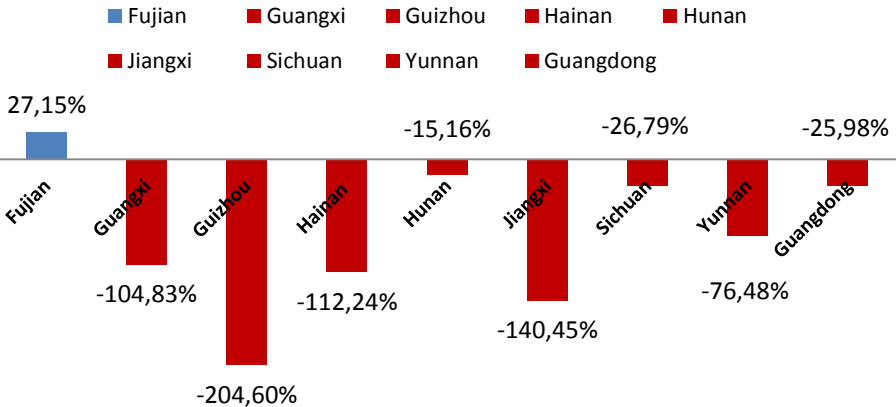
Source: Author's elaboration of various issues of CSB statistics
 Provincial Exports minus the provincial imports
 Full values in appendix

As a consequence, given the really high level of investments, shown by the empirical evidence, China necessitates increasing its productivity and will be soon facing an increase in diminishing returns if it continues to accumulate capital stock and overproduction. Moreover, Chinese savings, according to Gryvoyannis (2012), despite their really high level are not sufficient to fully finance the investment spending. In addition the borrowers face difficulties to return their debts and could face a liquidity crisis (BMI, 2013, page 18) especially in regards to the decreasing returns and low profitability of Non performing loans, which were ignited by the turmoil in the World Economy and could be aggravated by a possible future run of Chinese investors in the shadow banking system.

Figure 16: Provincial government balances as the difference of revenues to expenditures



Cumulative deficit/surplus: 2000-2010



Source: author elaboration

Where the values of Hainan and Yunnan are only partial (respectively since 2007 and 2009) and their deficit would most likely increase if it would be possible to include the years dating back until 2000.

6.4 The Transport Infrastructure sector

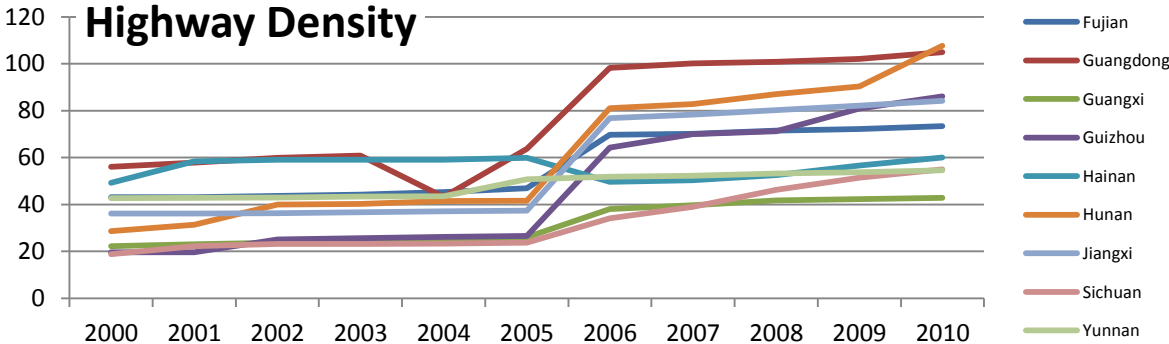
The value of road infrastructure has been computed with the analysis of the statistics of highways and railways in the nine provinces of the Pan Pearl River Delta. The statistics have been normalized with the size of each province:

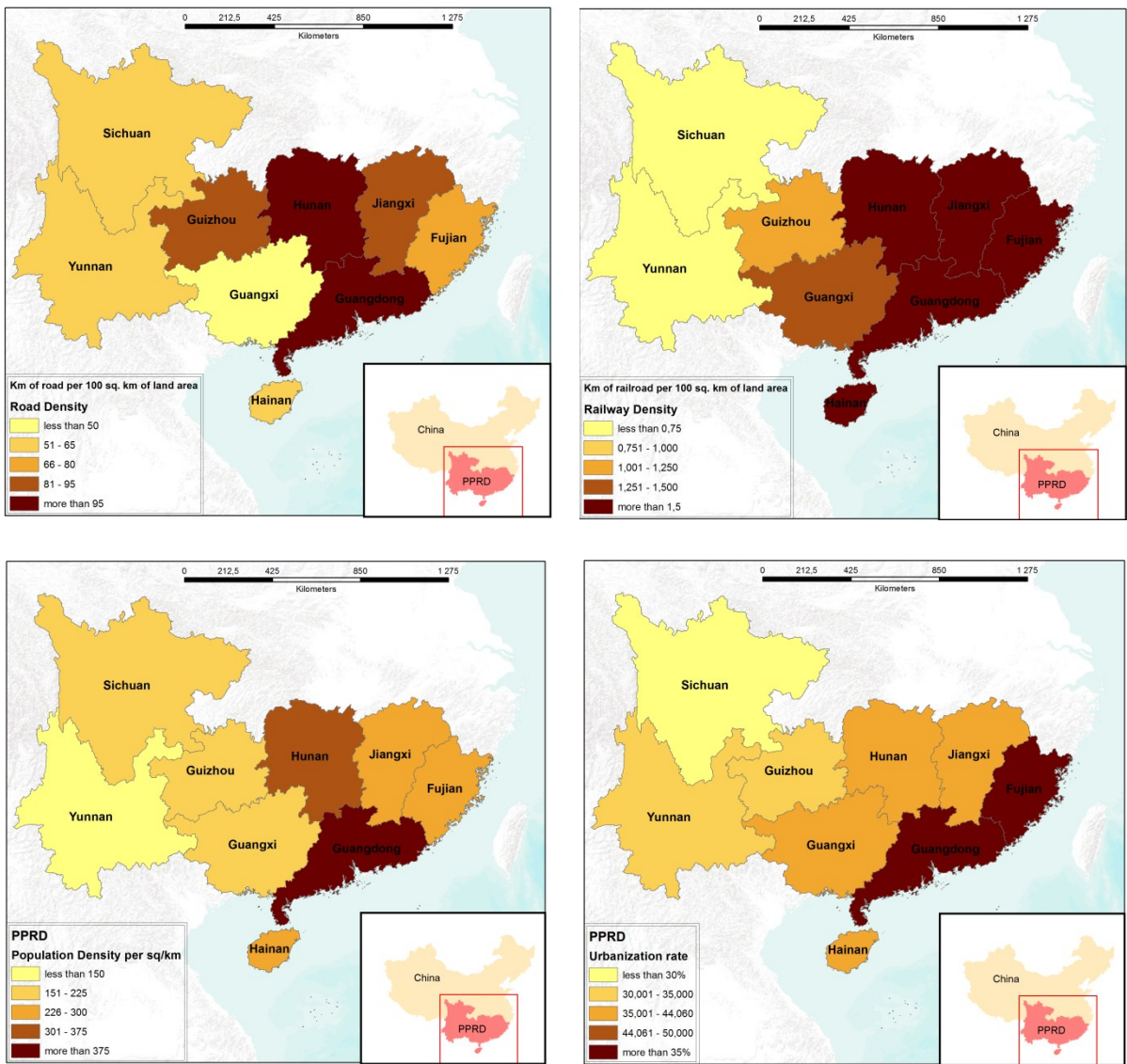
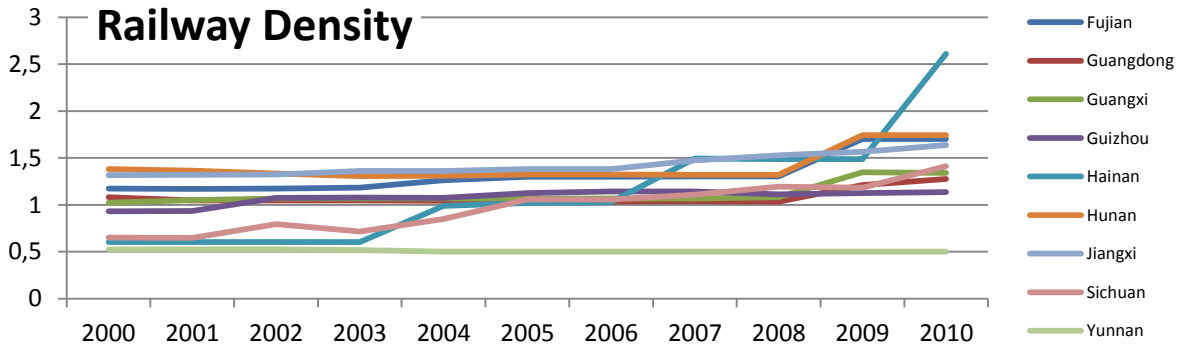
$$Highway\ Density_{it} = \frac{Highways\ in\ Km_{it}}{land\ area_{it}}$$

$$Railway\ Density_{it} = \frac{Railways\ in\ Km_{it}}{land\ area_{it}}$$

One of the effects of the abovementioned investments in fixed assets and consequent debt load is that all of the provinces in the Pan Pearl River Delta have been increasing their economic capacity increasing infrastructures provision, as expressed by the increase in density per square kilometer of both highways and railways (see figure 18 on this and the next page for further details). Specifically, we witness a steady increase in infrastructure provision with steep increases in infrastructure investments in the years immediately after the agreement of the Pan Pearl River Delta Economic Cooperation (2004/2005 for road infrastructure) and after the global financial crisis (after 2008, especially pertaining advancements in railroads density). However, if the numbers of the Chinese Statistical Bureau on cumulative deficit are correct, China might be soon experiencing what the United States have been experiencing “going West” in the 19th century, with railroad ventures going bankrupt because financed by insolvent local governments (Marantz, 2012).

Figure 17: Transport Infrastructure provision in the Pan Pearl River Delta





Source: Author's elaboration of various issues of CSB statistics and spatial elaboration for 2010

The four maps in the lower part of figure 18 (above) denote the correlation between Road and Railroad Density and the values of urbanization and population density that will be analyzed in the next paragraph.

6.5 Correlation analysis

As expected, all of the effects of Population Density, Foreign Direct Investments (FDI), GDP share invested, Urbanization and transport density have a positive correlation with the values of Real GDP growth (see Correlation Matrix on table). However, if one would assess the statistical significance of the correlations, would notice how Population Density and FDI are not significant at neither of the 5 or 1 percent level. Whereas, all of the other variables are statistically significant at a level of 1% or better and register a positive correlation with the variable of Real GDP growth. More specifically the share of GDP invested is moderately correlated with Real GDP growth. Interestingly, GDP share invested is negatively correlated with the population density, denoting how the investments tend to correlated with provinces with a lower population density. Furthermore, the more urbanized and densely populated provinces tend to be correlated with a high density of both highways and railways (also evident from the similarity of the spatial elaboration of the statistics in the previous page). Another important notice is that Foreign Direct Investments tend to be highly correlated with the population density and moderately correlated with the density of highways, denoting how better transport infrastructures, set the condition for further investments, especially in populous areas, as expected by the Central and Local governments. However, this doesn't seem to apply to the railway density, comparatively less correlated with Foreign Direct Investments and not statistically significant.

Table 2: Correlation Matrix of the dataset 2000-2010

	Real GDP growth	Pop Density	FDI	GDP Share Invested	Urbaniz	Highway density	Railway density
Real GDP growth	1						
Population Density	0.1436	1					
FDI	0.1680	0.8494**	1				
GDP Share Invested	0.4891**	-0.3715**	-0.24**	1			
urbanization	0.3456**	0.6655**	0.681**	-0.0626	1		
h/way dens	0.3880**	0.5223**	0.551**	0.2073**	0.66**	1	
r/way dens	0.2559**	0.3941**	0.1155	0.0419	0.56**	0.3399**	1

* denotes a statistical significance at the 5% level or better

** denotes a statistical significance at the 1% level or better

Source: Author's correlations analysis of various CSB statistics (2000-2010)

Nevertheless, the dataset from 2000 until 2010 (table 2) suffers from the relatively small number of observations in the sample. In fact, from the year 2000, until 2010, the nine provinces register 99 unique values. One of the consequences of the small sample is that it might only approximate the effects of the correlations between its variables. For this reason, despite the problems connected with the reliability of data prior to 1998, I created another dataset of statistics dating back to 1992 (the complete table can be found in appendix). The addition of eight years in the time series dataset allows the inclusion of another 72 observations that increase the dataset to a sample of 171 observations. Difficulties of reliability arise especially in regards of the different economic setting before the accession of China to the World Trade Organization in 2001 and the Statistical Bureau restructuring. This is particularly evident when analyzing the correlations of the dataset from 1992 until 2010 (table 3, below). In fact, the correlation between the variables loses statistical significance but in the case of FDI that register a weak correlation with Real GDP growth. Moreover, the sign of the correlation, unexpectedly, changes from positive to negative in the correlation of Real GDP growth with the variables of urbanization, highway density and railway density. Nevertheless, consistency is not completely absent in the two datasets. In fact, we can assess the high correlation between the values of Foreign Direct Investments and the variables of Population Density and highway density. FDIs tend to be concentrated in highly populous areas with good transport infrastructures.

Table 3: Pan Pearl River Delta Dataset: 1992-2010

	Real GDP growth	Pop Density	FDI	GDP Share Invested	Urbaniz	Highway density	Railway density
Real GDP growth	1						
Population Density	0.0401	1					
FDI	0.2358**	0.7931**	1				
GDP Share Invested	0.0066	-0.1928*	-0.0921	1			
urbanization	-0.1144	0.3812**	0.4678**	0.2154**	1		
h/way dens	-0.0402	0.5041**	0.4735**	0.4133**	0.5921**	1	
r/way dens	-0.0630	0.4636**	0.1038	0.1108	0.3734**	0.4059**	1

* denotes a statistical significance at the 5% level or better

** denotes a statistical significance at the 1% level or better

Source: Author's elaboration

6.6 Regression analysis

In order to analyze the presence of causation, rather than correlation, within the dependent variable of economic growth and the other independent variables of our model aim of this paragraph is to run a multiple regression analysis. The regression analysis aims at emulating the econometric model first proposed by Demurger¹¹ (2001).

The model has been slightly modified to comply with the task assigned to the regression analysis: understand whether infrastructure provision is significantly related to economic growth. In other words, the task is to estimate the effect of infrastructure provision on economic growth. In the first group of regressions (full regression results in the next page, table 4), operated with the dataset from 2000 until 2010, I fail to find statistical significance on the transport infrastructures variables if I don't apply any lag to the time series (1). To illustrate, in the regression computed with the first dataset without lags, Real GDP Growth (1) denotes that the only statistically significant variable is represented by the share of GDP invested. However, unexpectedly, the effect of Foreign Direct Investments is negatively correlated with Real GDP growth. Applying lags to the dependent variable in the regression, we assume that the effects of the independent variable yield their effect with a delay of one year (2), two years (3) and three years (4). All of the lags result in the increase in the value of R^2 and, as expected the contribution of the independent variables to economic growth turn positive but in the case of urbanization in the regression with two lags (3). The most accurate *coefficient of determination* is found in the regression with two lags (3), where the effect on GDP growth is delayed two years. Under this particular case, that assumes that the variables yield their effect after two years, highway density is statistically significant at a level of 99,9% and contributes to growth, but only in a insubstantial way. In fact, one unit increase in highway density is associated with an increase of real GDP growth equal to 0,000916%. Elaborating, we would need 1091,7 (1/0,000916) km of highway density to increase the growth rate of 1%. However, the values of density in the PPRD range from 54 to 107 (km per sq.km) adding to growth values ranging, respectively, between 0,049% and 0,098%: not a big contribution.

¹¹ $G_{it} = \alpha_i + \eta_t + \beta \ln(y_{it-1}) + \gamma X_{it} + \phi Z_{it} + \psi W_{it} + u_{it}$

Another important result of the regression with the statistics from 2000 until 2010, is represented by the evident and constant statistical significance of the value of the Share of GDP Invested throughout the regressions with and without lags. However, the result is somewhat alarming because it yields a capital on output ratio equal to 6,97 (1/0,144), well below the value of 4 hypothesized by Naughton (2007, page 146) before the global financial crisis in 2007. This result indicates the low return on the investments and/or the easy access to credit.

Table 4: Regression analysis with statistics from 2000 until 2010

The regression has been computed with the addition of the effects of lags on the value of Real GDP growth (L= lag; L2 = 2 lags; L3 = 3 lags)

	(1) Real GDP Growth	(2) L. Real GDP Growth	(3) L2. Real GDP Growth	(4) L3. Real GDP Growth
Population Density	0.000118 (1.35)	0.0000553 (0.65)	-0.00000103 (-0.01)	0.0000569 (0.60)
FDI	-8.41e-09 (-0.64)	2.50e-09 (0.20)	9.92e-09 (0.81)	5.65e-09 (0.44)
GDP Share Invested	0.165*** (5.59)	0.167*** (6.02)	0.144*** (5.08)	0.147*** (4.72)
urbanization	0.148 (1.85)	0.0638 (0.84)	-0.00651 (-0.08)	0.0493 (0.57)
Highway Density	0.00000602 (0.02)	0.000526* (2.31)	0.000916*** (4.01)	0.000674** (2.74)
Railway Density	-0.00462 (-0.29)	0.00372 (0.25)	0.00623 (0.43)	0.00119 (0.08)
_cons	-0.00273 (-0.10)	-0.00383 (-0.15)	0.0110 (0.39)	-0.0151 (-0.48)
<i>N</i>	99	90	81	72
<i>R</i> ²	0.3996	0.5430	0.5807	0.5335

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Author's elaboration

In the other regression operated with the statistics collected from 1992 to 2010 (table 5), we lose accuracy in the coefficient of determination, probably in compliance with the lack of data reliability. Nevertheless, the share of GDP invested loses statistical significance, in any given lag, in lieu of the positive effect of Foreign direct investments on GDP growth figures. Interestingly, the negative effect of Urbanization oddly keeps a strong negative effect on Real GDP growth throughout the different lags.

Table 5: Regression analysis with statistics from 1992 until 2010

The regression has been computed with the addition of the effects of lags on the value of Real GDP growth (L= lag: L2 = 2 lags: L3 = 3 lags)

	(1) Real GDP Growth	(2) L. Real GDP Growth	(3) L2. Real GDP Growth	(4) L3. Real GDP Growth	(5) L4. Real GDP Growth
Population	-0.000230	-0.000126	-0.00000348	0.000145	0.000214
Density	(-1.55)	(-0.80)	(-0.02)	(0.79)	(1.12)
FDI	7.12e-08*** (4.14)	5.62e-08** (3.06)	4.68e-08* (2.17)	1.90e-08 (0.75)	9.41e-09 (0.33)
GDP Share Invested	0.0600 (1.02)	0.0561 (0.89)	0.0550 (0.87)	0.0165 (0.24)	-0.0210 (-0.30)
Urbanization	-0.335** (-3.21)	-0.381*** (-3.41)	-0.529*** (-4.51)	-0.427** (-3.24)	-0.600*** (-4.04)
Highway Density	-0.0000900 (-0.18)	0.000289 (0.54)	0.000605 (1.12)	0.000309 (0.53)	0.000574 (0.96)
Railway Density	0.0516 (1.97)	0.0436 (1.58)	0.0457 (1.61)	0.0243 (0.78)	0.0415 (1.25)
_cons	0.223*** (5.62)	0.210*** (4.85)	0.213*** (4.62)	0.209*** (4.06)	0.241*** (4.42)
<i>N</i>	150	144	138	132	125
<i>R</i> ²	0.1644	0.1355	0.1661	0.1069	0.1749

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Author's elaboration

7. Conclusion

After having introduced the background of the research in terms of geography, economics and politics, through a positivist enquiry, this study has been developed with the collection of statistics from various Chinese Statistical Bureaus of the provinces of Guangdong, Guangxi, Guizhou, Hainan, Hunan, Jiangxi, Sichuan and Yunnan. The collection of this information yielded a unique dataset of statistics for the Pan Pearl River Delta: an economic cooperation started by the aforementioned provinces in 2004. Consequently, in order to understand where to position China in the context of economic growth theories, the aim has been to chronologically review the evolution of these theories starting from the more simplistic exogenous growth theories with Harrod-Domar and Solow, to end with the endogenous growth theories of Barro. The theories differ in the endogenization of technology and the selection of variables that are considered responsible for the Economic Growth pattern of the country under analysis. After having acknowledged the importance of the government, in the economic growth theories framework, the empirical analyses focused on the analysis of investments as a share of GDP and the value of infrastructure provision. One of the most alarming results of this analysis is the level of indebtedness of the 9 provinces that all, but Fujian, register deficits in their account balances that in the years from 2000 until 2010 record a cumulative deficit ranging from 15% up until 205% of the Gross Provincial Product for the province of Guizhou. After the descriptive statistics analysis I operated a regression analysis that yielded other disturbing results. In fact, despite the small sample, composed of 99 observations, I found high coefficients of determination (R^2) that indicate the unproductivity of investments in general. In fact according to the regression's results the contribution of GDP share invested to GDP growth is only 0,14% to 1%, which translated in a capital to output ratio measures 6,97, well below the values argued by Naughton before the global financial crisis. In addition, Highway Density is also statistically significant but its contribution to Real GDP growth is almost irrelevant. This irrelevance indicates that further investments in highways would increase economic capacity but would not yield positive effects on real GDP growth and position China on the descending side of the U-shaped Barro Curve (Figure 9, page 18).

During the time from 2000 until 2010, The Pan Pearl River Delta was able to increase its density of both highways and railways in all of the provinces under investigation, setting the conditions for future development because of the increase in the region's economic capacity. However, the provinces urge to ameliorate the local governments' budgets to reduce the increasing weight of deficits on local governments planning. Moreover, also in regards of the regression results, some of the investments made during this time frame, especially on a local level, might have been un-economic. This condition could continue to worsen if the dynamics of the exports to Europe, US and Japan continue to decrease as a consequence of the global financial crisis. Conversely, China, already exporting about half of its economy to Europe, Us and Japan hit by the global financial crisis, to sustain its growth pattern should shift from exporting to third countries on building upon its own market of 1,3 billion potential consumers.

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Appendix

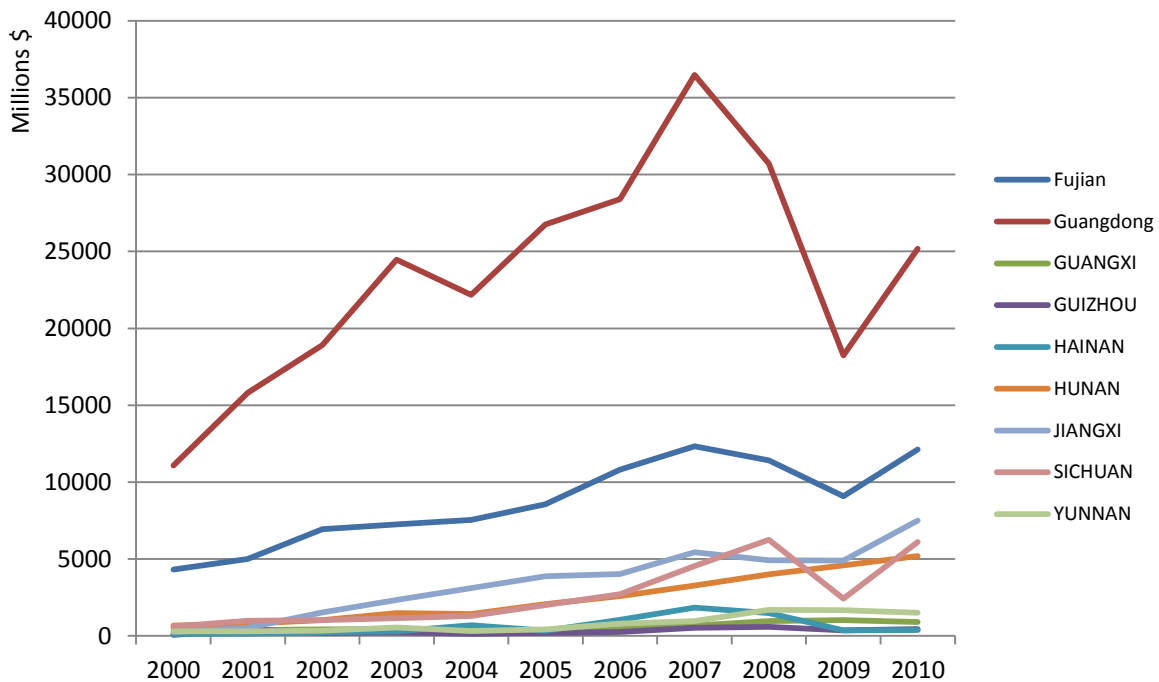
This section complements some of the information provided in the thesis.

Statistics in support of figure 4: Average GDP per capita in the PPRD:

Region	Average GDP per capita					
	2005 年	2006 年	2007 年	2008 年	2009 年	2010 年
Total National	15236,88	17711,64	21171,46	25098,58	27368,94	32621,77
Fujian	18542,29	21314,78	25826,58	30030,52	33737,25	39948,82
Guangdong	24534,91	28576,74	33630,01	38554,80	40965,55	44114,74
Guangxi	8549,57	10057,64	12213,51	14578,49	15978,58	20791,99
Guizhou	5376,41	6225,41	7666,40	9390,60	10302,00	13244,97
Hainan	10845,41	12498,80	14842,60	17600,70	19145,83	23812,00
Hunan	10426,97	12123,46	14853,82	18111,29	20386,67	24416,95
Jiangxi	9410,35	11109,70	13279,08	15843,41	17272,56	21205,43
Sichuan	8993,06	10638,02	12996,68	15484,39	17289,31	21370,14
Yunnan	7779,10	8896,05	10572,66	12529,39	13497,70	15716,27
Pan-PRD	11606,45	13493,4	16209,04	19124,84	20952,83	24957,92

Foreign Direct Investments in the Area of the Pan Pearl River Delta: graph in support of the empirical analysis of chapter 6

Foreign Direct Investments



Trade balance surpluses in support of figure 17:

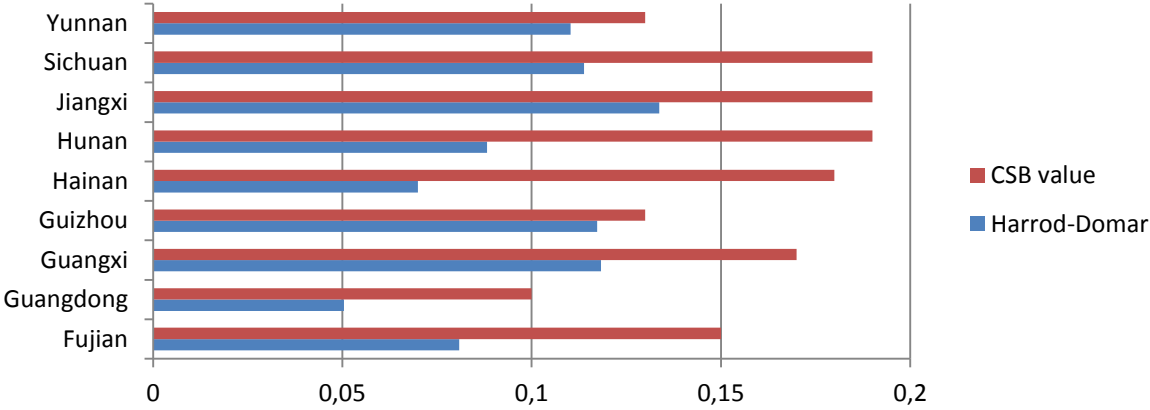
	Fujian	Guangxi	Guizhou	Hainan	Hunan	Jiangxi	Sichuan	Yunnan	Guangdong
2000	10,10%	3,77%		11,70%		3,19%		2,21%	10,58%
2001	10,61%	2,45%		9,79%		2,08%		1,93%	9,87%
2002	11,75%	1,92%		8,92%		1,38%		2,27%	9,70%
2003	11,52%	2,20%		8,10%		1,43%		2,22%	11,58%
2004	16,17%	1,21%		8,22%		1,10%	1,42%	1,96%	11,41%
2005	19,09%	1,16%	1,28%	7,41%		1,66%	1,66%	1,29%	17,55%
2006	20,64%	0,87%	1,51%	8,39%	4,93%	2,18%	2,02%	1,09%	22,73%
2007	20,91%	1,22%	1,56%	6,74%	4,92%	1,91%	2,04%	1,10%	24,99%
2008	18,71%	1,42%	0,84%	2,85%	4,69%	1,84%	2,30%	0,46%	23,57%
2009	15,07%	2,23%	0,72%	3,61%	2,52%	1,75%	1,97%	1,12%	18,48%
2010	15,71%	1,05%	1,03%	3,76%	2,94%	3,74%	1,93%	1,73%	17,87%

Full transport statistics of the nine provinces during the economic agreement of the PPRD: years 2004-2010. The statistics are in support of figure 18, they compare the statistics of the PPRD with the whole of China.

		Transport Statistics for the Pan-PRD in comparison to Total							
YEAR	Region	Length of railways in operation	Length of navigable inland waterways	Total Length of Highways	Expressway and Class I to IV Highways	Express way	First Class	Second Class	Highway below Class IV
2010	Pan-PRD	25,54%	44,30%	34,92%	32,23%	30,60%	27,36%	24,70%	47,55%
2009	Pan-PRD	25,99%	44,22%	34,22%	31,05%	30,16%	28,15%	24,60%	46,25%
2008	Pan-PRD	24,75%	44,53%	33,82%	29,91%	30,36%	28,12%	23,78%	45,24%
2007	Pan-PRD	25,27%	44,26%	33,48%	28,67%	30,65%	28,69%	23,86%	45,11%
2006	Pan-PRD	25,14%	44,22%	33,25%	27,56%	30,68%	30,21%	23,94%	44,31%
2005	Pan-PRD	25,70%	44,26%	38,15%	33,56%	31,95%	29,75%	24,82%	59,72%
2004	Pan-PRD	25,60%	44,24%	38,71%	33,75%	33,39%	32,43%	25,34%	59,90%

Comparisons of the values of Real GDP growth of the Chinese Statistical Bureau with the application of the Harrod-Domar Model with an estimated capital on output = 6,97

Under the Harrod Domal model framework, the graph evidences how all of the values for the Chinese Economy are overestimated



Summary statistics of the dataset computed with the statistics collected in the nine provinces of the Pan Pearl River Delta from the year 1992, until the year 2010.

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Year	171	2001	3,178371	1992	2010
Real GDP growth	171	0,1725	0,0868	0,0241	0,6047
Population Density	163	249,3129	103,1276	97	581
FDI in US\$	150	474609,3	759637	8098	3646583
GDP share invested	163	0,4048	0,1495	0,2181	0,9282
Urbanization	163	0,3091803	0,1034575	0,14	0,57
Highways in Kilometers	165	83453,12	57083,39	12937	266000
Railways in Kilometers	165	1928,491	822,2251	214	4000
Land area	171	2220,978	1278,981	354	4841
Highway Density	165	42,51614	21,91855	15,66977	107,6224
Railway Density	165	1,00087	0,3531424	0,4131	2,608204