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# An Assessment of the Open Up the West Policy in China Economic Development of the Western Region

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## Abstract

In 1999 the Chinese government initiated a large investment project directed towards the western region of the country in an attempt to boost the economic growth in order for it to catch up with the much more affluent coastal areas. The campaign is called Open Up the West (Xibu da kaifa) and its most prioritized areas have been announced as infrastructure construction, environmental protection, industrial upgrading, human capital accumulation and science & technology research, and finally opening up the economy to foreign direct investments (FDI).

This study examines the economic growth effects of this policy and what the driving forces influencing the economic growth are. Using Jones theoretical model with technology diffusion and infrastructure as the theoretical framework, an empirical model containing the significant variables from the development policy is established. Subsequently, the model is empirically tested with Whites robust standard error model without any effects in order to evaluate the policy outcome thus far. The estimation results partly recognize Jones theoretical model that emphasizes the importance of research in science & technology and opening up in terms of FDI to enhance economic growth. In addition, the environment variable also turned out significant and it will be crucial for the further growth process to pursue a sustainable development. However, given that the results showed that the investments in infrastructure construction and human capital have increased since the policy implementation, the effect of these investments could be seen in a longer time perspective as positive to the economic growth of the region. Finally, the industrial upgrading variable turned out insignificant in the empirical testing,

*Keywords:* Development Policy, Western China, Economic Growth, Regional Investments

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## Summarize

- Title: An Assessment of the Open Up the West Policy in China- Economic Development of the Western Region
- Seminar: 15<sup>th</sup> of August, 2006
- Subject: Macroeconomics
- Author: Frida Wallin
- Tutor: Sonja Opper
- Purpose: To make an assessment of the Open Up the West policy in China in order to evaluate in what direction the large investment initiative is heading. The study explores the growth effects of the policy and what the driving forces influencing the economic growth are.
- Method: Empirical testing of cross-section and time series data using Whites robust standard error model without any effects.
- Keywords: Development Policy, Western China, Economic Growth, Regional Investments
- Conclusions: The empirical testing recognized the importance of science & technology and foreign direct investments in enhancing economic growth. Industrial upgrading turned out insignificant, while the positive effects of infrastructure construction and human capital could be evident in the long run. The environment variable will be central in the ongoing development process in order to obtain sustainable growth.

# 1 Introduction

The past decades economic boom in China has not been evenly distributed across the country, mainly due to the Chinese authority's preferential treatment of the coastal regions in allocating resources. By biasing investment and trade opportunities towards the large cities in the eastern coastal areas Chinese leaders assumed that a "trickle down"-effect would make the rest of the country gradually develop as well. During the 1990's, entering the second decade of the reform period, the effects of the development strategy was made clear and it was obvious that the assumed "trickle down"-effect had not occurred. Instead the income disparities between the coastal provinces and the interior regions were rising in a fast pace that would be neither economically nor socially sustainable in the long run. The share of China's total GNP accounted for by the interior regions fell from 47.5% in 1978 to 39% in 1994, which demonstrates the apparent impact that the unbalanced development has had on the regional economic growth (Chen & Wu 2005: 407).

The Chinese leader Deng Xiaoping, who has been the brain behind both the economical reforms and the biased development strategy, felt an immense pressure from western and central regional leaders to compensate them for the long time of subordination. This resulted in a policy shift in 1995 when the regional development strategy was adjusted to show consideration for the inland regions. Deng Xiaoping stated the turn of the century as a turning point for the central government to start compensating the interior areas by targeted investments to this specific region of the country. Thus, as Jiang Zemin took over the Chinese leadership in 1997 he also had to live up to the promise made by Deng Xiaoping to the interior regions. Accordingly, in 1999 Jiang Zemin announced the campaign to Open Up the West as a great investment strategy to develop the western provinces in order for them to catch up with the already very developed coastal provinces (Holbig 2004: 337).

This thesis analysis the economic growth effects of the Open Up the West strategy in order to assess the economic impacts of the campaign up to now. This issue is important to address considering the position China is heading for in the world economy. China is in need of a balanced economic development within the country in order to continue prospering. Without solving the issue of internal regional disparities China's aspiration of becoming the world's leading economy might be at risk.

## 1.1 Purpose

Seven years has now passed since the large investment strategy to Open Up the West was taking into action. Although it is seen as a long run project it is still not too soon to start examine the economic effects of the campaign. The purpose of this thesis is to make an assessment of the Open Up the West project in China in order to identify in what direction the large investment initiative is heading. It is important at this stage to see if there are any signs of decreasing income gaps between the western and the coastal parts, and if the western regions are experiencing higher economic growth rates. If that is the case there might be chance that the extensive gap that is dividing the country could be overcome and result in a more balanced further development. For a country like China that is on its way to become the leading economy of the world, large divisions in economic development within the country will have a strong negative effect on its further progress since it is not sustainable in the long run.

Furthermore, this thesis aims to examine the driving forces that have influenced the economic growth rates of the provinces included in the campaign by undertaking empirical analysis of these factors. If the strategy to Open Up the West has been successful or unsuccessful up to this point it is interesting to understand why and what factors that have contributed to the development. These results can thereafter be used in further research concerning economic growth and economic convergence between regions and countries.

The key questions that will be answered in this thesis are:

- (i) How has the economic growth of the western region been affected by the Chinese governments campaign to Open Up the West?
- (ii) What are the driving forces influencing the economic growth rates in this region?

## 1.2 Methodology

The thesis is conducted through empirical analysis using cross-section (the western provinces included in the campaign) and time-series data. The time-series data ranges between the years 1995- 2005, which means that it starts some years before the policy to Open Up the West was initiated. This is necessary in order to better distinguish the development before and after the campaign started. The data used in the thesis are acquired from *China Statistical Yearbooks* (1995-2005) provided by the National Bureau of Statistics in China. The empirical testing is carried out using the Whites robust standard error model, where all of the significant independent variables are included. In addition, research based on articles, previous studies and policy documents of the campaign to Open Up the West is also undertaken.

## 1.3 Delimitations

The empirical testing of the thesis is limited to only include the western provinces covered in the Open Up the West policy, excluding Tibet and Chongqing due to the lack of statistical data. The time range of 11 years, 1995-2005, has been chosen since it covers both before and after the policy was implemented. Since the objectives of the Open Up the West policy are not stated very clearly and many various areas of focus have been proclaimed over the years, it would not be fruitful to include every one of them in the analysis. Thus, I have limited the thesis to only comprise the first five priority areas that was stated in 1999, that is; infrastructure construction, environmental protection, industrial upgrading, development of human recourses and science & technology, and opening-up.

## 1.4 Previous Research

Since the policy to Open Up the West was only announced in 1999 there have not been any previous research specifically on the overall economic growth effects of the project. Nevertheless Goodman (2002, 2004) has examined the impacts of the campaign from provincial and local perspectives. Several other studies have also considered the local and provincial-level connections with the campaign by focusing on specific provinces. Some of them are McNally (2004) that discusses the development of Sichuan, Oaks (2004) that considers the situation in Guizhou and Becquelin (2004) that examines the Xinjiang Uighur Autonomous Region.

Wu (2004) has made a study where he analyzes the overall economic growth in western China during the last decades, which also includes some years after the implementation of the

Open Up the West policy. He concludes that growth in western China largely has been driven by factor inputs with little technological progress, and that foreign and human capital tends to contribute relatively more to growth in the western region than in the coastal provinces. Finally, he suggests that the policy makers should address the issue of technological progress as one of the main areas of focus within the Open Up the West policy.

Despite the few previous studies on growth effects of the Open Up the West policy there are still many previous studies on the regional growth disparity and income inequality in China prior to the announcement of the policy. These studies primarily examine the effects of the China's transitional economy since 1978, for example Chen and Fleisher (1996) have conducted research on the regional income inequality and economic growth in China from 1978-1993, furthermore Chen and Wu (2005) have written a research paper on the determinants of regional growth disparity in China's transitional economy during the period from 1988 to 1998. The results from these studies have some common features in terms of pointing out equivalent factors that have positive impact on economic growth in different provinces. These common factors include growth in the employed population and foreign direct investment (FDI). Jian and Fleisher also found that the physical investment ratio, investment in human capital and whether or not a province is located in the coastal region affects the economic growth rates, whereas Chen and Wu discovered that in addition changes in property rights had a positive impact on economic growth.

Furthermore, Sachs *et al.* (2002) have studied the importance of geographical location in regional development in China. They conclude that the higher growth of the coastal provinces has just as much to do with its geographical location as with the preferential policies they have received. In accordance with Wu, they also mention science, technology and education, but also public health, as important factors for growth in the western region.

## 1.5 Disposition

The remainder of the thesis is organized as follows. In the next section the theoretical framework will be presented and examined, thereafter section three analyses the policy implications of the campaign to Open Up the West and the areas of focus in the programme. In the fourth section the empirical model is established and the empirical results of the estimated data are analyzed. The final section presents the conclusions that can be drawn, and also suggests further research.

## 2 Theoretical Framework

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In this section the theory that will constitute the framework of this thesis will be thoroughly examined. The basic assumptions of the theory will be presented and a deeper analysis of the implications of the theory model will be conducted. There will also be an explanation on why this particular theory has been chosen as a basis to the research carried out in this thesis, and how it can contribute to the study of economic growth effects in the western provinces of China included in the Open Up the West policy.

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### 2.1 New Growth Theory

There are two main disciplines within the study of growth theory. First, there is the well-established neoclassical growth theory that Solow helped develop with his renowned neoclassical model in the 1950's. He constructed a simple model that kept diminishing returns to capital and labour but that also included a third factor, technology, which explained the continuous growth of economies. In Solow's model technology was assumed to be determined by forces outside the economy (exogenous) and therefore did not explain what caused technology to improve over time. Instead the emphasis of the model on policy options was on capital accumulation and labour force improvements as sources of growth (Cortright 2001: 3).

The theory that will constitute the theoretical framework for this thesis is the second main discipline within growth theory that is called New Growth Theory, which challenges the neoclassical model in many important aspects. In New Growth Theory technology is not taken as a given but is instead endogenously included in the model and therefore the theory explains how technology and thereby also growth can improve over time. The New Growth Theory is based on the notion of increasing returns related to new knowledge or technology, which is the opposite of the traditional economic models where diminishing returns is the main assumption. In fact, the central ideas behind the New Growth Theory is not really new at all since the thinking about the effects of increasing returns dates back to at least the early days of the 20<sup>th</sup> century (Cortright 2001: 2-4).

Nevertheless, the theory is “new” in the sense that it did not become debated or seen as a significant part of the growth literature until Romer's article “Increasing Returns and Long-Run Growth” was published in 1986 and ignited the intellectual attention. In his article, Romer presents a model of long run growth where knowledge is assumed to be an input in production and have an increasing marginal product. Other essential elements of the model is

that investment in knowledge creates positive externalities since knowledge cannot be perfectly patented or kept secret, and that new knowledge is assumed to be the product of research technology that exhibits diminishing returns since doubling the inputs into research will not double the amount of new knowledge produced (Romer 1986: 1002-03).

The Romer model emphasizes the central role of new ideas as the economic force underlying technological progress and the increasing returns to knowledge as driving the economic growth. Although it is designed to explain the sustained growth of the advanced countries of the world as it concentrates on the formation of new ideas and innovations, its basic assumption that new knowledge is critical for continuous growth has contributed to the establishment of other endogenous models that could be applied to less-developed countries, provinces or communities.

## 2.2 The Endogenous Growth Model

Even though the Romer model pioneered the development of endogenous growth models, New Growth Theory consists of a wide range of various different models with the common feature that they are not seeing technology as a given in the model but as something that can be affected through economic policies.

The endogenous growth model that will function as the basis for the research made in this thesis has been developed by Jones where he addresses the questions of how technologies transmit across countries, and why different technologies is used in different countries. Jones plainly calls the model “a simple model of growth and development”, but the main idea behind the model is to explain the differences in growth rates between countries, or in this case provinces, by the differences in the level of human capital. His model has been strongly influenced by the early work of Nelson and Phelps (1966) where they created a model describing the importance of human capital and the implications of technological diffusion on economic growth.

Since the emphasis of Jones model is on the diffusion of technology, and not on the creation of new technology, it is more suitable for explaining the situation in less-developed countries rather than in more advanced countries. For this reason the model is well applicable on the Chinese western provinces since they are not innovators themselves of new technology but to a great extent are using the technology already at hand, transmitted from the more advanced coastal provinces of China or from the outside world.

The model has the same basic structure as the Romer model addressed earlier but with an addition of a channel for technology transfer. The production function has the following appearance:

$$Y = L^{1-\alpha} \int_0^h x_j^\alpha d_j \quad (2.1)$$

The integral can be thought of as a sum.  $Y$  is the homogenous output good that countries produce,  $L$  is the labour used producing the output, and  $x_j$  is a range of capital goods, where the workers skill level,  $h$ , determines how many capital goods the workers can use. The basic assumptions of the production function is that the more skilled the workforce is the more advanced technology can they use, and to use more advanced technology is the same as using a greater amount of different capital goods.

The production function can be simplified into a familiar Cobb-Douglas form by assuming that the total supply of raw capital is equal to the total quantity of capital goods of all types used in production<sup>1</sup> (Jones 2002: 125):

$$Y = K^\alpha (hL)^{1-\alpha} \quad (2.2)$$

The capital accumulation equation follows the assumption that a certain amount of production goes into savings and is used for investments in new capital,  $s_k$ , while some of the capital,  $K$ , depreciates,  $d$ , at a constant exponential rate greater than 0.

$$\dot{K} = s_k Y - dK$$

In the model, the accumulation of human capital has the same meaning as an individual's ability to use more capital goods or more advanced technology. This can be presented in the following equation:

$$\dot{h} = \mu e^{\psi u} A^\gamma h^{1-\gamma} \quad (2.3)$$

In the equation,  $\mu$  denotes the overall productivity in the attainment of human capital,  $\psi$  is the quality of the education,  $u$  is the years of schooling and  $A$  denotes the world technology frontier, i.e. the most advanced capital good invented up to now, where  $\gamma$  shows how

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<sup>1</sup>  $K = \int_0^h x_j d_j \Leftrightarrow K = hx \Leftrightarrow x = \frac{K}{h} \Rightarrow Y = L^{1-\alpha} \int_0^h x_j \left(\frac{K}{h}\right)^\alpha d_j = L^{1-\alpha} h \left(\frac{K}{h}\right)^\alpha = L^{1-\alpha} h^{1-\alpha} K^\alpha = K^\alpha (hL)^{1-\alpha}$

important the world technology is in relation to human capital. The following assumptions holds;  $\mu > 0$  and  $0 < \gamma \leq 1$ . The growth rate in human capital can be demonstrated through rewriting the equation by dividing both sides by h (Jones 2002: 126):

$$\frac{\dot{h}}{h} = \mu e^{\gamma \mu} \left( \frac{A}{h} \right)^{\gamma} \quad (2.4)$$

The ratio A/h exhibits the assumption that it is more difficult to learn to use an intermediate good close to the technology frontier, thus the amount of human capital that is attained during a certain period of time depends on how close the labour's skill level is to the technology frontier. If the ratio A/h is big it means that the individual's skill level or human capital, h, is far from the frontier, A.

The model assumes that there are a certain amount of innovations in the world that moves freely across countries that are capable of using them and that the technology frontier grows at a constant rate, g (Jones 2002: 127):

$$\frac{\dot{A}}{A} = g$$

Additionally, the population and thereby also the labour force is assumed to grow at a constant, exogenous rate, n:

$$\frac{\dot{L}}{L} = n$$

### 2.2.1 Steady State in the Model

The elementary condition for balanced growth is that the growth rate in human capital, h, must be constant. We can see that this is the case by looking at equation (2.4) where h/h only can be constant if A/h is constant, i.e. h and A must grow at the same rate ( $g_h = g_A$ ). In steady state the growth rate in y is the same as the growth rate in k ( $g_y = g_k$ )<sup>2</sup>, and also the same as

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<sup>2</sup>  $\frac{\dot{K}}{K} = \frac{s_K Y - dK}{K} = s_K \frac{Y}{K} - d \Rightarrow$  Must be constant in steady state, i.e.  $\left( \frac{Y}{K} \right)$  is constant so that  $g_y = g_k$ .

the growth rate in  $h$  ( $g_y = g_h$ )<sup>3</sup>, which means that the following conclusion can be drawn about the growth rates in steady state (Jones 2002:128):

$$g_y = g_k = g_h = g_A = g$$

Now that we know that the growth rate of the economy in steady state is given by the growth rate of human capital that in turn is bound by the growth rate of the world technological frontier, the next step is to solve for the income level in steady state. The following expression of the capital per worker in steady state can be derived from the capital accumulation equation:

$$k^* = \left( \frac{s_K}{n + g + d} \right)^{\frac{1}{1-\alpha}}$$

By rewriting the production function in equation (2.2) in terms of output per worker and then substituting the above expression into the equation we have;

$$y^* = \left( \frac{s_K}{n + g + d} \right)^{\frac{\alpha}{1-\alpha}} h^* \quad (2.5)$$

By substituting for human capital,  $h$ , in equation (2.4), where  $\frac{\dot{h}}{h} = g$ , we get this expression;

$$h = \left( \frac{\mu e^{\nu t}}{g} \right)^{\frac{1}{\gamma}} A^*$$

Finally, by substituting the above expression of human capital in steady state into the model (2.5) gives us the final equation for output per worker along the balanced growth path (Jones 2002: 129):

$$y^* = \left( \frac{s_K}{n + g + d} \right)^{\frac{\alpha}{1-\alpha}} \left( \frac{\mu e^{\nu t}}{g} \right)^{\frac{1}{\gamma}} A^* \quad (2.6)$$

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<sup>3</sup>  $y = k^\alpha h^{1-\alpha} \Rightarrow \ln y = \alpha \ln k + (1-\alpha) \ln h \Rightarrow \frac{d \ln y}{dt} = \alpha \frac{d \ln k}{dt} + (1-\alpha) \frac{d \ln h}{dt}$   
 $\Rightarrow g_y = \alpha g_k + (1-\alpha) g_h \Rightarrow g_y = \alpha g_y + (1-\alpha) g_h \Rightarrow g_y = g_h$

It is important to understand the implications of this expression and what the significant factors contributing to increasing income levels are. Hence, I will now explain each aspect of the equation one by one.

### **2.2.2 Physical Capital**

The initial term of equation (2.6) states that economies can become richer by investing more in physical capital while rapidly growing populations and high rate of depreciation of capital is negative for the level of income. This is very similar to the neoclassical assumptions of the Solow model where high savings/investments through capital accumulation is the primary method for economies to grow rich.

### **2.2.3 Human Capital**

The second term is what characterizes this particular endogenous growth model since it reflects the accumulation of human capital. The implication is that economies that spend more resources on accumulating human capital will be closer to the technological frontier and thus be richer. There are several ways in which an economy can accumulate skills; it can make the educational system more productive in general ( $\mu$ ), for example through a greater openness to new ideas by increasing the possibilities for exchange with other Universities or by simply opening up the economy to attract foreign investments, it can increase the quality of the education ( $\psi$ ), or prolong the time spent in education within the economy ( $u$ ). This means that economic policies should be directed towards the accumulation of skills so that the labour force's ability to use more advanced capital goods increases.

### **2.2.4 Technology**

The last term of the equation is the world technological frontier and reflects the importance of available technology in the world. The more advanced technology there is to learn, the higher will the economies income levels be. Technologies are available worldwide for anyone to use through technological diffusion, but the differences in technology between countries or regions can be explained by the differences in skill level of individuals. Besides the individuals skill levels in different economies there are also other limitations to technology transfer, such as adaptation and licensing costs (Jones 2002: 131).

### **2.2.5 Transition Dynamics**

In the traditional Solow model large variations in growth rates across countries is explained by transitional dynamics due to diminishing returns to capital, which affects the accumulation of capital in the economy. In the technological diffusion model presented above capital accumulation is not the only reason for diverging growth rates, but also the accumulation of human capital is of great significance when it comes to technology transfer, since it is easier to learn how to use basic technology than more advanced. Although there is no difference across countries in the steady state growth rate, the principle of transition dynamics states that growth rate variations occurs due to the fact that countries, or regions, are changing their position within the long run income distribution (Jones 2002: 132).

Here the conditional convergence hypothesis explains why some countries grow faster than others. According to the hypothesis, countries that are “below” their steady state balanced growth paths should grow faster than the long run growth rate ( $g$ ), and countries that are “above” their steady state should grow more slowly. One example of what could cause the economy to be away from its long run growth path is a policy reform that increases the investment in capital and human capital accumulation (Jones 2002: 133). This means that the policy reform introduced in China to Open Up the West could shift the western provinces steady state levels upwards so that they now should grow faster than the steady state growth rate if the right actions are being taken. Whether this is the case or not will be analyzed later on in the thesis.

### **2.2.6 Adding Infrastructure**

The technological diffusion model presented above incorporates one significant weakness, namely that it cannot explain the differences in total factor productivity (TFP) across countries. That is, why countries with the same  $K$ ,  $h$ , and  $L$  may still produce different amounts of output. The two fundamental questions to answer are why some countries invest more than others, and why individuals in some countries spend more time learning new technology. According to Jones, the answer to these questions is the difference in social infrastructure. A country that exhibits good social infrastructure in terms of institutions and laws that favour production, openness in the economy and stable economic institutions will in a much greater extent attract investments by firms in physical capital, investments by foreign entrepreneurs, and human capital. Furthermore, it also encourages domestic entrepreneurship of innovation and production in the economy.

In order to include this important component of social infrastructure into the model we modify the production function in (2.2) by adding infrastructure,  $I$  (Jones 2002: 147):

$$Y = IK^\alpha (hL)^{1-\alpha} \quad (2.7)$$

The only thing that changes from the model explained earlier is that it now in addition takes infrastructure into account in order to explain the differences in TFP across countries. Thus, social infrastructure is a very important factor contributing to economic growth. Governments should thereby place great emphasis on the importance of good infrastructure for long run economic success in economic policy formulations.

### **2.2.7 Summing Up the Model**

Jones endogenous growth model of technological diffusion elucidates the important aspects that a less-developed economy should focus on in order to experience higher income levels and growth. The model tells us that in a world of technological diffusion it is the level of human capital that determines if the economy will grow rich or not. As in traditional neoclassical models, investments in physical capital are of great importance for a country's well being, but it is not a sufficient condition. The economy needs a high level of skilled individuals that possess the ability to use more advanced technology in order to grow. But the skilled individuals will not be able to use their ability without the existence of proper social infrastructure.

In conclusion, according to this model policy makers should focus on large investments in physical capital, attaining a high level of human capital in order to make use of the available technology and in the long run be able to develop technology of their own, and finally to put great emphasis on investments in good infrastructure.

### 3 The Policy to Open Up the West

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This chapter presents the background and the implications of the Chinese governments policy to Open Up the West. I will thoroughly explain the main objectives of the investment initiative and which areas that have been given priority in the project. Challenges of the western development strategy will also be examined.

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#### 3.1 Background

The Open Up the West policy (Xibu da kaifa) was presented in mid-1999 by the former Chinese leader Jiang Zemin as a strategy of socio-economic development of China's western provinces to reduce the gap with the affluent coastal areas. Since the regional disparities between the poor interior provinces and the rich coastal regions was again rising in a fast pace during the 1990s after a slight decrease in the 1980s the policy to Open Up the West was seen as a necessary measure to deal with this increasing gap (Holbig 2004: 340).

This was nevertheless the first time the idea of developing the inland regions of China was formulated. All Chinese leaders during the 20<sup>th</sup> century have issued some kind of development of the interior provinces, although with different agendas. The origin of the latest Open Up the West campaign dates back to Jiang Zemins predecessor Deng Xiaoping that in the latter half of the 1980s articulated the importance of regional development in China. He clarified the crucial role that the central government has to play in order to uphold a co-ordinated development of the whole country. The policy formulation of Deng Xiaoping was albeit biased towards the coastal regions since his strategy of two stages of development meant that the coastal areas were first to be given support. Not until they had reached an adequate level of development, the interior areas would receive support (Holbig 2004: 336; Goodman 2002: 132).

This strategy of development was challenged by various provincial jurisdictions in interior provinces that pressured the central government under Deng Xiaoping to shift its priorities of regional development. The lobbying of western and central regional leaders resulted in a policy shift in 1995 when the regional development strategy was adjusted to show consideration for the inland regions. Deng Xiaoping stated the turn of the century as a turning point for the central government to compensate the interior areas for the long time of subordination. Thus, as Jiang Zemin took over the Chinese leadership in 1997 he also had to live up to the promise made by Deng Xiaoping to the interior regions, and that is what he did by announcing the campaign to Open Up the West in 1999 (Holbig 2004: 337).

During this time China was also preparing for its entrance as a member of the WTO, which could even more increase the internal regional disparities if the country did not intervene drastically enough. The underdeveloped western provinces would suffer most of the international competition, hence timely state intervention was therefore needed. The policy of western development can thereby also be seen as a strategic preparation for China's accession into the WTO (Holbig 2004: 341).

### 3.2 The Western Region

Since there is neither a clear boundary nor identity that identifies the “west” the provinces included in the programme have been chosen on the basis of their economic development levels, geographic locations and ethnic minority regions. The twelve provinces, autonomous regions and municipalities that the programme shall cover is Chongqing Municipality, Sichuan Province, Guizhou Province, Yunnan Province, Tibet Autonomous Region, Shaanxi Province, Gansu Province, Qinghai Province, Ningxia Hui Autonomous Region, Xinjiang Uygur Autonomous Region, Inner Mongolia Autonomous Region and Guangxi Zhuang Autonomous Region (Western Region Development 2002). Figure 1 illustrates the map of China with the western region clearly marked in grey.

**Figure 1: Map of China and the Western Region**



Source: Wu 2004

Despite their differences all of these provinces together comprise the western region. The central provinces were not included in the development program but were instead meant to act as a development “bridge” between the east and the west. Thus, they were not to receive any funds or preferential treatment despite the fact that many central provinces have the same characteristics as some of the provinces included in the western region .

To further explain on what grounds the western region was chosen the State Development Planning Commission (SDPC), that is in charge of the implementation of the policy, mentions four crucial advantages for development in these provinces. First, the enormous reserves of natural resources, rich culture and tourist resources. Second, the great market potential due to low-cost labour resources. Third, that the provinces borders on more than a dozen countries and regions and thus have a geographic advantage for economic cooperation and trade. Finally fourth, its position to carry out industrial development due to the built up of traditional industrial bases, national defence enterprises and research institutions over a long period of time (Western Region Development 2002).

Furthermore, senior CCP leaders have stressed that the two special goals of the Open Up the West programme are to overcome ecological problems and the economic development of minority nationalities to maintain political stability and social harmony. These goals can also be seen as reasons to exclude the central region since the west have been identified as an ecological problem zone and since the country’s minority nationalities are concentrated in the western region (Holbig 2004: 352).

### 3.3 Policy Implications

SDPC has formulated the core parts of the Open Up the West agenda. In its 2000 implementation plan five key fields of focus in the development process were mentioned. These fields included accelerated infrastructure development, ecological development and environmental protection, industrial upgrading, development of human resources and science and technology (S&T), and opening-up to attract foreign capital and capital investment from the eastern region of the country (Zeng 2000). The emphasis has primarily been on infrastructure construction, while the focus of the other fields has shifted over the years.

The development of the western provinces of China is planned to take place over half a century in three different phases. In the first phase, 2000-2010, the focus will be on massive infrastructure investment, ecological construction and environmental protection with the aim

of tackling environmental deterioration, improving the investment climate and initiating economic development on a good foundation. In the second phase, 2011-2030, the west will enter a stage of rapid growth through rural corporatization, marketization, regional specialization and a rural-urban transfer of labour, and the standard of living will approach national levels. Finally, in the last phase, 2031-2049, the western region will have achieved modernization and be economically prosperous, ecologically balanced and socially progressive (Yueng & Jianfa 2004: 20-21).

In a shorter perspective the policy to Open Up the West was explained in more detail in 2002 when the SDPC together with the Western Region Development Office presented their *“Overall Plan of Western Region Development During the Tenth Five-Year Plan Period”* where guiding principles, goals and policy measures were articulated. However, this attempt to better clarify the main objectives of the policy conversely resulted in an even more general agenda where further targets were added. These additional targets included improved market competitiveness of local products, promoting urbanization, accelerated reform of state-owned enterprises (SOEs) and increased proportion of foreign enterprises, and reduced rural poverty and regional income disparities (Western Region Development 2002).

Altogether these main objectives comprise an extensive range of various economical, social, environmental, political and ideological goals that in some aspects even can be seen as conflicting, for example the policies concerning state intervention and market-led growth as well as large-scale infrastructure construction and environmental protection. It seems like the policy to Open Up the West has been designed to suit many different regional interests without one distinct plan to follow in order to make it easily adjustable to various provincial conditions.

However, this thesis will focus on the first five clearly stated priorities of investment, and they will now be explained more in depth one by one.

### **3.3.1 Infrastructure Construction**

The importance of good infrastructure is clearly stated in Jones model with technology diffusion and infrastructure. The level of proper infrastructure is a determining factor when it comes to attracting foreign capital, accumulating human capital and encouraging innovation. In accordance with the theoretical model the most emphasized area of focus within the Open Up the West Policy is the development of infrastructure. Inadequacy of infrastructure is a great obstacle that hinders the economic development of the west. Considering the geography of the western region with vast distances of high mountains and grasslands, the importance of

efficient infrastructure could not be more relevant in order to achieve economic growth. Despite this, the transport system of the western parts of China is much less developed than in other parts of the country, which places serious constraints on the economic and social development. Thus, the acceleration of infrastructure construction has had first-rate priority in the policy document (Onishi 2001: 37, ADB 2002: 124).

Within the western development strategy the Chinese government therefore intends to concentrate on speeding up the construction of infrastructures for transportation, telecommunications, water supply and energy. As for transportation infrastructure, improvements in construction of highways, railroads and air transport are all of great importance. In 1999 the western region had highways comprising 37,9% of the national total. The current strategy is to develop a national highway system that will link all cities with populations over 500,000. This highway network could be seen as a way to connect the remote inland areas with the coastal provinces and port cities. However, this emphasis on a national highway system might risk placing too little attention on the significant local roads that are linking villages and townships to provincial centers and main roads. At the end of 1999, less than 80% of western villages had road access (Onishi 2001: 44, ADB 2002: 128).

Despite that the western railways system is already relatively new, the latest railway was completed only in 1999, the emphasis will be laid on the construction of railroads linking the west to the east, improving transportation routes between western provinces as well as international routes. Railways are the most economical means of transportation in the western region due to its vast distances to markets (Onishi 2001:44, ADB 2002: 126).

Air transport is becoming increasingly important for the western provinces in their development process. Since many provinces in the west are difficult to reach using other transportation, the improvement of air transport, such as construction of airports, is essential for opening up the region to the outside world and enhancing development (ADB 2002: 129).

### **3.3.2 Environmental Protection**

Despite the essential issue of attaining a sustainable development when establishing models of economic growth, Jones endogenous model does not directly include the important environment variable. Nevertheless, it can be seen as indirectly included considering that the use of more advanced technology in most cases results in a better environment due to less polluting. As for China's west the aspect of environmental protection is crucial.

The western provinces of China suffer more than the rest of the country from serious natural disasters due to their rather fragile ecological environment. The ecological

environment of the west is constantly deteriorating, which seriously affects the areas economic development. Therefore, the issue of environmental protection has become one of the main thrusts of the Open Up the West policy. There are particularly three important initiatives on the agenda. These initiatives include a ban on felling in natural woodlands, promotion of “ecological” forestation in arid desert areas, and gradually turning arable lands slopes into grassland and cover them with trees (Onishi 2001: 38). The Chinese government will also intensify the construction of nature preservation zones in the western region. By the year 2010 the state and local governments will newly create 270 nature preservation zones in a total of 14 provinces and cities (Onishi 2001: 45).

Considering its total industrial output, the problem of polluting industries is more serious in the western region than in the eastern parts. In the west, industrial waste water volumes per yuan of industrial output are above national average, and so is the pollution of air. The basic reasons why the situation is worse in the west is due to the fact that most investment in pollution control goes into making new industrial projects comply with emission regulations, but most new industrial investment is not in the western region. Furthermore, the financial penalties for polluting are too low, which results in that it pays to pollute (ADB 2002: 343-344).

### **3.3.3 Industrial Upgrading**

As with environmental protection, the industrial upgrading factor is not either directly mentioned in Jones theoretical model, but it could also be seen as indirectly included since a higher level of human capital and technology naturally calls for a restructuring of industries. The industrial structure of the western region is to a great extent primitive and out-of-date, thus industrial policy is needed in order for the region to compete with the rest of the country and the world. The primary industry is the main industry sector of the west, where it is 7% higher than the national average. Conversely, both the secondary and tertiary industries are relatively weak in the region. There are particularly two industries where its weakness in the tertiary industry becomes evident, that are in finance and insurance, and real estate trade. Both are several percentages below the national average (ADB 2002: 198).

Other noteworthy features of the western industrial sector is the lack of business experience and expertise, the use of outdated technology and low investment in research & development (R&D), low labour productivity due to surplus labour, and bad environmental impact through waste of natural resources because of inadequate controls. The western region has the greatest competitive advantage in the primary sector. This advantage is though in

some ways being challenged due to China's accession to the WTO since the competitive advantage in the production of rice, cooking oil, sugar and cotton is being lost. The region has no competitive advantage in the secondary sector but some in the tertiary sector, albeit not as strong as in the primary sector (ADB 2002:205).

One of the largest tertiary sector competitive advantage is in the tourism industry, which is regarded as an industry with no diminishing returns. Although China's entry into the WTO is having a good impact on this competitive advantage since information spreads more easily in a globally integrated market, there are still some weaknesses of the western tourism industry that could hinder the enhancing of this advantage. Its weaknesses are mainly that the tourist market is controlled by SOEs with little knowledge of the market that results in misuse of tourist resources, the neglect of maximizing long term benefits by protecting tourist resources, the ignoring of multiplier effects of tourism on other industries such as hotels and restaurants, transportation and entertainment, and finally the lack of marketing skills needed to create a dynamic tourist market (ADB 2002: 206, 208).

Within the policy to Open Up the West the principles of combining market orientation and competitive advantages works as the guidelines towards a new industrial policy. The policy emphasis of the industrial strategy is to strengthen agriculture, develop industries with distinctive features, intensify development and processing of natural resources with competitive advantage, and accelerate development of the tourism industry. The policy states that efforts should be made to develop tourism and related services into one of key industries that support the economy of the western region (Onishi 2001: 46).

#### **3.3.4 Human Capital and Science & Technology (S&T)**

The New Growth Theory states the very importance of human capital in the economic development process. It is also the most significant variable in Jones endogenous growth model. Well-educated and skilful workers are essential for the accumulation of knowledge and economic growth. The western parts of China have abundant human resources but deficient human capital due to low levels of education that in turn leads to backwardness in science & technology. Although the differences within the western region are relatively large, and not to mention between urban and rural areas, in total the educational attainment skills in the West lag behind the national average. China has been successful in establishing a universal nine-year compulsory education and to eliminate youth illiteracy, but the figures from the eastern and the western parts of the country still differ significantly. While 100% of the youth in the developed eastern region attained at least nine-year education and were

literate by the end of 2000, the figure in the western region was only 71%. Also the professional education lags behind with only a 40% or less enrollment rate to universities and colleges in some western provinces, while it is about 56% in China as a whole (Yeung & Jianfa 2004: 135-136).

The low level of education is a factor that hinders social development and economic growth of the West. A higher degree of education makes it easier to find employment and leads to more choices in jobs. Workers with a higher educational level are also more productive, which positively affects GDP per capita. Moreover, education plays a vital role in the development of science & technology, where research acquires skilful workers. In the Western provinces the science & technology sector is so weak that it cannot support economic development. Although there are many industrial bases, which were established during the years of the centrally planned economy, they are not as advantageous in a market economy. Many of these centres of innovation are progressing too slowly in science and research to uphold the economic development. There is also an uneven distribution of technical workers, where almost all are found in the largest cities such as Chengdu, Chongqing, Xi'an and Lanzhou, while only a few are working in small cities and towns (Yueng & Jianfa 2004: 138-139).

The main reason behind the western provinces backwardness in science & technology is the lack of investment in the sector. The investment rate has only been a tenth of that in the eastern region, but this is something that the western development strategy is supposed to change (Yueng & Jianfa 2004: 140). As for education the strategy aims to actively spread nine-year compulsory education and to accelerate the campaign to eliminate youth illiteracy. Special attention will also be given to support the education in remote areas with the use of modern information technology. The level of human capital will be increased through improved university education and the construction of universities. In order to improve the west's development in science & technology, more resources will be placed on fostering technology-oriented human resources. Furthermore, the Open Up the West policy promotes technical support and personnel exchange between the east and the west, for example by easing the family registration transfer policy (hukou-system) in order to encourage human resources to move to the west (Onishi 2001: 46-47). As for now, the hukou-system limits free mobility since people lose their social welfare and rights when they leave their place of registration. It is not easy to change place of registration, and it is particularly difficult to change from a rural to an urban registration.

Up till now the stream of talented people have gone in the opposite direction and emigrated from the western areas. Highly skilled people are moving out at twice the rate of those moving into the region. Most of these people are high-level technicians with great capabilities and high achievements, and many are involved in scientific research and R&D. Thus, it is of utmost importance to improve the status of education and science & technology in the western provinces in order to stop the "brain drain" and boost the economic development (Yueng & Jianfa 2004: 141).

### **3.3.5 Opening-Up**

In order to accomplish the above set priorities of investment, the final area of focus is aimed at raising the flow of investments into the western region through opening-up strategies both domestically and internationally. In the theoretical model with technology diffusion and infrastructure an open economy is central in attracting foreign (and in this case domestic) capital and increasing the level of human capital by accumulating knowledge from the outside world, and other regions.

When China as a whole started to open-up to the outside world about three decades ago, nearly all of the international investments went directly to the coastal cities and provinces of the country. In the meantime, the western areas were left out from the market entry of the international firms, and not many new investments from outside were directed towards the region (ADB 2002: 7-8). The basic reasons for underdevelopment in the west have been identified as the lack of openness and of external trade and investment. Between 1985 and 2000, the eastern areas consistently accounted for more than 85% of the FDI of the country, while the western parts only managed about 4% (Yeung & Jianfa 2004:20).

The policy to Open Up the West is said to attract more investments to the interior areas by opening-up the market to foreign capital in the sectors of agriculture, water conservancy, transportation, energy supply, urban construction, environmental protection, development of mineral resources and tourism. This will be done through preferential treatment for foreign firms investing in the west, such as tax reductions, extended loan repayment periods and a clearly stated legal basis for the management of foreign-funded enterprises and foreign financial institutions (Yeung & Jianfa 2004: 99; Onishi 2001: 39).

Meanwhile, China's accession to WTO has pushed for changes in the investment environment, laws and regulations and the protection of intellectual property rights, which can further attract more foreign capital to the inland areas. Nevertheless, the FDI not only attracts needed capital into the provinces, but it also brings in new technology and know-how

that is essential for the further economic and social development of the west. However, the mobilization of domestic capital is equally important as the mobilization of FDI. In an ever more globalized world foreign capital is highly mobile and can disappear fast, thus the foreign resources cannot replace domestic resources. Too much reliance on foreign capital to finance the western projects will make the development of the region vulnerable to external shocks. Domestic and foreign sources of funding should therefore complement each other. Hence, effective use of domestic capital from rich provinces is just as important in assembling financial resources for the projects of the western development strategy (Yeung & Jianfa 2004: 20, 174).

As for the domestic market, the Open Up the West policy mentions that various forms of co-operation between enterprises in the western region and those in the central and eastern regions should be encouraged. It also states that mutual opening of markets and economic co-operation between China and its neighbouring countries should be promoted through favourable border trade policies (Yueng & Jianfa 2004: 99).

### 3.4 Challenges to the Policy

Despite the optimistic objectives of the Open Up the West policy, it still faces a wide range of challenges before they can be successfully attained. China's west is ecologically vulnerable, poverty is widespread and infrastructure is undeveloped. These are factors that are difficult to overcome, and it will take a long time before the economic and social development can progress on a virtuous circle without these problems.

However, the west also suffers from other challenges in terms of its geographical location with long distances to coastal ports, which make external trade more difficult and expensive, something that can affect the aspiration of a higher level of FDI into the region negatively. Moreover, the labour productivity is lower than the national average for most industries in the inland areas, mainly due to low levels of technology and industrial equipment, and poorly educated and trained labour force (Onishi 2001: 33-34). Another problem concerning geographical conditions is that about 355 million people inhabit the west, although large areas are comprised of mountains and deserts that are inhospitable to settlement. This has led to the assessment that one-fifth of the land area is overloaded in terms of carrying capacity (Yueng & Jianfa 2004: 42).

One contributing factor to the gap between the western and the coastal areas of China is the large difference in economic institutional structure. While the private sector accounts for a

great majority of the industrial output in the coastal provinces and has promoted the rapid growth of this region, the state-owned sector still occupies more than half of the western regions economy. Thus, the lack of private involvement in the economy of the west is something that could challenge the further economic development (Yueng & Jianfa 2004: 44).

However, as China entered the WTO in 2001 pressure from the organization to reform China's institutions has made Chinese leaders to reduce the state-owned sector's share in the economy. Yet, China's accession to the WTO also brings with it several challenges to the development of the western provinces. The increased global competition will make it harder for the region to move forward as it will seriously affect the situation for employment. Although employment is likely to increase in the sectors with a competitive advantage, the agricultural sector that is the largest economic sector in the west is shrinking. This results in a large number of unemployed farmers, with little education and few skills that are in demand in non-agricultural industries, something that will not only affect the economic development negatively but even more will lead to serious social problems that will pose as a great challenge for the future (Yueng & Jianfa 2004: 44-45).

There are several aspects that have to be considered when addressing the different challenges that China's west is facing. As for infrastructure construction it is important to consider demand when constructing expressways or airports, since these projects otherwise might be left with insufficient uses upon completion. This is important since infrastructure requires big investments, and, generally, the return on these investments is low. Thus, if demand is insufficient, the investment return period will be very long, if recouped at all, which leads to a great waste of scarce capital that could have been put into something of much greater importance for the progress of the economic development in the region. While capital is the scarcest resource for the western provinces in the short run, the scarcest resource for the western region in the long run is human capital. The lack of basic education and high-skill knowledge is one of the most significant factors that block the development of China's west. It is therefore crucial for the development of the west to overcome the challenge of a backward educational system and of poor access to elementary education (Lu & Neilson 2004: 335-342).

The challenges to the Open Up the West policy are immense. The examples presented above are only a few, nevertheless some of the most important challenges. One could also mention the cultural challenges of all the various minorities living in the western region that has to be a part of the development project, and be able to enjoy the fruits of economic and

social development. As for now, many minority people are discriminated in education and employment. If they are not included it could lead to social unrest and discontent, and more importantly to serious social problems were the minorities are condemned as second-class citizens. Despite all of these challenges there are also great opportunities with the Open Up the West policy that hopefully might lead the way for a more prosperous social and economic development of China's west.

## 4 Policy Assessment

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In this section, I will make an assessment of the Open Up the West policy in order to evaluate in what direction the development is heading. This will be done through a regression analysis of the empirical model. I will begin by establishing the empirical model, and then report the results of my empirical analysis.

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### 4.1 Empirical Model

It seems like the Chinese policy makers have been influenced by the New Growth Theory's ideas when formulating the policy document as they emphasize the same areas. Since the purpose of this study is to assess the strategy to develop the western region of China by analyzing the economic growth effects of the initiative, the establishment of the empirical model is based on the five prioritized areas in the policy. Thus, the independent variables of the empirical model consist of infrastructure construction, environmental protection, human capital, science & technology, industry upgrading, and foreign direct investments (FDI). The empirical model can be written as follows:

$$\begin{aligned} GRPY_{it} = & \beta_0 + \beta_1 infrastructure_{it} + \beta_2 environment_{it} + \beta_3 industry_{it} + \beta_4 human\ capital_{it} \\ & + \beta_5 science\ \&\ technology_{it} + \beta_6 FDI_{it} + \varepsilon_{it} \end{aligned} \tag{4.1}$$

where  $GRPY$  represents the provincial real growth rate of per capita GDP,  $i$  indexes the provincial cross-section data, and  $t$  indexes provincial time-series data.  $\varepsilon$  denotes the error term of the model. The real term of provincial per capita GDP is calculated by using the general retail price index (1978=100) as the price deflator. The provincial real growth rate of per capita GDP is derived from the following expression:

$$GRPY_{it} = \ln PY_{it} - \ln PY_{it-1} \tag{4.2}$$

where  $PY$  is provincial real per capita income.

According to Jones endogenous model with technology diffusion and infrastructure, the infrastructure variable can explain the differences in total factor productivity between countries and regions. The construction of infrastructure thereby plays a vital role in economic growth. The indicator for infrastructure construction in the empirical model is

investment in construction within the province as a percentage of provincial GDP. Infrastructure construction is expected to relate positively to economic growth, thus  $\beta_1 > 0$ .

One of the strongest emphasized priorities of the Open Up the West policy has been environmental protection. Functioning as the environmental indicator in the empirical model is the growth in the emission of industry waste gas within the province. Since industries waste gas harm the environment and in the long run has a negative impact on the economic development, the expected coefficient sign is negative so that  $\beta_2 < 0$ .

In advanced economies the tertiary industry is the leading industry sector of the economy, while the primary industry sector is minimal. The western region in China has the opposite industry structure where the primary industry dominates, and the tertiary industry is still quite small. A large and strong tertiary industry sector is a sign that the developing process of an economy has reached a high stage, hence it has good impact on the provincial economy. This is the reason why the policy makers behind the Open Up the West policy have made industrial upgrading one of the most prioritized areas of the project. Accordingly, the measurement for industry upgrading in the empirical model is defined by the tertiary sector, and the indicator is the percentage share of the tertiary industry sector in provincial GDP. The expected positive impact of a larger tertiary industry means that  $\beta_3 > 0$ .

The main difference between the neoclassical growth theories and the new growth theories is that technology is seen as endogenous by the latter, but not by the former. This means that the technology level, and thereby also economic growth, can be improved by spending more resources on accumulating a higher degree of human capital and investing more in S&T research. In turn this will lead to a higher economic growth and a more affluent country or region. In the empirical model, the indicator for human capital is the number of people in the province enrolling in regular secondary schools as a percentage of the total provincial population. The indicator for S&T is the number of personnel working in S&T institutions within the province as a percentage of the province's total employed population. Both human capital and S&T are expected to have a positive impact on economic growth, hence  $\beta_4 > 0$  and  $\beta_5 > 0$ .

Openness and foreign investments are positive factors to the economic development of a country or region. The western provinces of China have unfortunately existed as a shadow behind the large cities and richer provinces by the coastline. Apart from the adverse geographical location of the west, in addition the investment climate has had more to wish for and it is not near to compete with that of the east. The Open Up the West policy has albeit opened up a door to foreign investors, and through institutional transformation and

preferential treatment it tries to attract needed capital into the region. The indicator for foreign direct investments (FDI) in the empirical model is the realized amount of FDI in the province as a percentage of total provincial GDP. Since FDI has a positive impact on economic growth the expected sign is also positive,  $\beta_6 > 0$ .

Table 1 summarize the explanation and expected signs of the variables used in the empirical model.

**Table 1: Variables and Their Expected Signs**

<b>Dependent Variable</b>	<b>Explanation</b>	<b>Expected sign</b>
GRPY	Provincial real growth rate in per capita GDP (%)	
<b>Independent Variables</b>		
Infrastructure	Share of construction investment in provincial GDP (%)	+
Environment	Growth rate in industry waste gas emissions (%)	-
Industry	Share of tertiary industry in provincial GDP (%)	+
Human Capital	Share of secondary school enrollment in population (%)	+
Science & Technology	Share of S&T personnel in the employed population (%)	+
FDI	Share of FDI in provincial GDP (%)	+

*Source: Author's own construction, structural influence from Ding & Haynes 2004.*

## 4.2 Data

The empirical analysis is based on cross-section data from all of the western provinces included in the Open Up the West Policy, with the exception of Chongqing and Tibet due to the lack of statistical data. This means that the total number of cross-sections used in this study is ten. The time-series data ranges between the years 1995-2005, which all-in-all count up to eleven years. Thus, the total number of panel data observations analyzed is 110.

All data is collected from the National Bureau of Statistics of China's annual Statistical Yearbooks (1995-2005). The data must be viewed with caution since the National Bureau of Statistics is an institution operating under the control of the Chinese government. Consequently, there might be a risk of manipulated data, but since the empirical analysis would not have been possible to carry out without this data there are no alternatives but to use it. The original data taken from the China Statistical Yearbooks has been derived into growth and share figures before utilized in the regression analysis (see Appendix: A).

### 4.3 Dummies

As the time-series data ranges over the years 1995-2005, there are a few years included before the Open Up the West policy was put into action. Since the purpose of this thesis is to evaluate the effects of the policy, it is necessary to compare the economic development before and after the policy implementation. By doing so it is easier to observe the effects and to draw accurate conclusions in the analysis.

Thus, in order to differentiate between the period before and after the implementation of the policy, dummies are included in the empirical model. One dummy is added for each independent variable in the model in order to be able to distinguish the different effects of the variables. Consequently, the empirical model used when doing inference has the following appearance:

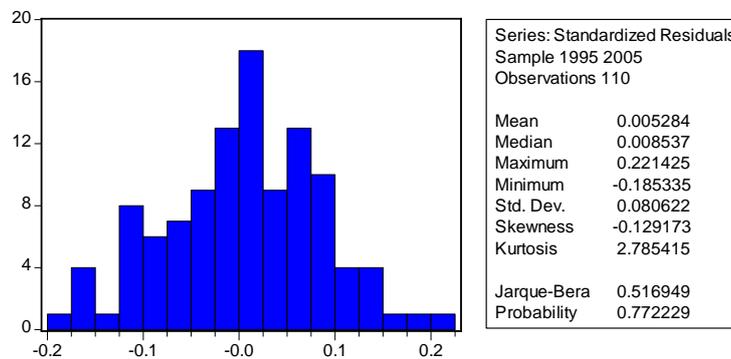
$$\begin{aligned} GRPY = & \beta_0 + \beta_1 infrastructure_{it} + \delta_1 infrastructure + \beta_2 environment_{it} + \delta_2 environment \\ & + \beta_3 industry_{it} + \delta_3 industry + \beta_4 human\ capital_{it} + \delta_4 human\ capital \\ & + \beta_5 science\ \&\ technology_{it} + \delta_5 science\ \&\ technology + \beta_6 FDI_{it} + \delta_6 FDI + \varepsilon_{it} \end{aligned} \quad (4.3)$$

where  $\delta$  is the dummy coefficient. Every dummy has been given the number 0 for the period before the initiating of the Open Up the West policy, i.e. between the years 1995-1999, and the number 1 for the period after, i.e. between the years 2000-2005. This way it will be easy to distinguish the changes between the two periods and if the situation in the region is improving or not.

#### 4.4 Empirical Results

Since the empirical model contains pooled observations of cross-section data over several time periods, it is referred to as “panel data” (Baltagi 2002: 1). Before initiating the actual inference of the empirical model there are several issues regarding the suitability of the model that has to be taken into account. In order to see how well the model fits the observations, a Jarque-Bera test is conducted where the normality of the residuals is tested. The test tells us that the residuals probability distribution is similar to that of a normal distribution, as shown in Figure 2. Hence, the issue of normality will not be a problem when making inference.

**Figure 2: Normality**



*Source: E-views (2006)*

To test the significance of the variables in the empirical model a Wald test is carried out. The null hypothesis that any of the variables are not significant ( $\beta_{1-14} = 0$ ) can be rejected since the probability of the F-statistic is 0.0000 (see Table 2). Thus, the included variables of the model are valid.

**Table 2: Validity**

Wald Test			
	Value	df	Probability
F-statistic	6.35E+11	(14, 96)	0.0000

*Source: E-views (2006)*

It is also important to test the correlation of the independent variables to see if it exists any problems of multi-collinearity. The outcome of the correlation test is shown in Table 3.

**Table 3: Correlations**

	Infrastructure	Environment	Industry	Human Capital	S & T	FDI
Infrastructure	1.000000	0.196308	0.667366	0.606846	0.399413	-0.200465
Environment	-	1.000000	0.143488	0.300315	0.083952	0.153510
Industry	-	-	1.000000	0.543088	0.200491	-0.042777
Human Capital	-	-	-	1.000000	0.313791	-0.010053
S & T	-	-	-	-	1.000000	-0.252378
FDI	-	-	-	-	-	1.000000

*Source: E-views (2006)*

The correlation of the variables ranges between  $-0.010$  and  $0.667$ , where human capital and FDI has the lowest correlation, and infrastructure construction and industrial upgrading has the highest. The general rule of thumb says that if the correlation is  $0.8$  or higher one should take precautions (Westerlund 2005: 160). Since none of the variables exhibits a correlation as high as  $0.8$ , there exist no problems of multi-collinearity within the independent variables in the model.

A frequently discussed issue in the econometrics literature is whether to apply random, fixed or no effects when doing inference on panel data (see Baltagi 2002: 20). One view is that fixed effects are a better approach. This approach is relevant when one expects that the averages of the dependent variable will be different for each cross-section, or each time period, but the variance of the errors will not. Consequently, it assumes that the independent variables are fixed. Another view is that it is best to apply random effects, i.e. the random error component model, which means that inference is made from a larger number of observations than the particular values of the independent variables used in the study, thus, it assumes that the independent variables are random (Newsom 2006). There is also a choice of using no effects when doing inference on the model. In general, the most common method to use is the fixed effects approach, since it typically produces smaller standard errors (Newsom 2006).

A Hausman test can be carried out in order to determine whether to apply random effects or not. The null hypothesis of the Hausman test states that random effects are efficient to use. Thus, if the null hypothesis is rejected it means that another method is more suitable for the model. The result of the Hausman test is shown in Table 4.

**Table 4: Test on Random Effects**

<b>Hausman Test</b>	
Probability	0.0169

*Source: E-views (2006)*

Since the null hypothesis can be rejected at the 5% level, the Hausman test indicates that random effects are not efficient to apply on the empirical model. In order to determine whether to apply fixed effects or no effects when doing inference, a test regression on both approaches is carried out. The test regression of the model using no effects gave a significantly better result, than when applying fixed effects. Hence, the empirical model in this study will be estimated without any effects (see Appendix: B for fixed effects results).

Due to the small amount of time-series observations (11), the risk of unitroot existence within the variables is diminutive. Typical signs of non-stationarity are deceptive  $R^2$ -,  $DW^4$ - and  $t$ -statistics, and it is the cause of nonsense regression. In other words, if the  $R^2$ - and  $t$ -statistics are extraordinary large, and the  $DW$ -statistic is considerable small, it is very likely that the model suffers from non-stationarity (Westerlund 2005). Since the empirical model of this study does not show any of these signs, and in addition contains a very small number of time-series observations, there exists no problem of unitroots that would impinge on the inference of the model. To eliminate the risk of heteroskedasticity and autocorrelation I have chosen to use Whites robust standard error method, which means that correct inference can be made despite the undesirable existence of heteroskedasticity and autocorrelation.

According to the estimation results presented in Table 5, most of the independent variables are significant at the 1% level, and the variable for environmental protection is significant at the 5% level. Only the variable for industrial upgrading is estimated as highly insignificant with a probability value of 59.07%. I will return to discussing this matter later on, but I will begin with by looking at the infrastructure variable.

As shown in Table 5, the estimated coefficient of the infrastructure construction variable is negative. This is contrary to the predictions of a positive impact on the provincial GDP growth rate. One reason for this result could be that it takes a long time before the effects of infrastructure construction investments are seen in the growth figures, but it can also be an effect of poorly planned projects.

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<sup>4</sup>The Durban-Watson (DW) statistic is used when testing the model for autocorrelation.

**Table 5: Estimation Results**

<b>Variables</b>		
<i>Intercept</i>	0.4219	(0.0745)**
Infrastructure	-2.0945	(0.7402)**
Dinfrastructure	3.0920	(0.8884)**
Environment	-0.3044	(0.1283)*
Denvironment	0.4094	(0.1089)**
Industry	-0.1955	(0.3623)
Dindustry	-1.0321	(0.2816)**
Human Capital	-5.8904	(1.9603)**
Dhuman capital	7.2572	(1.9233)**
Science & Technology (S&T)	6.0910	(1.3251)**
Dscience & technology	-7.9333	(1.5190)**
Foreign Direct Investments (FDI)	3.1528	(0.6361)**
Dforeign direct investments	-2.7572	(0.7033)**
R <sup>2</sup>	0.4402	
Log likelihood	116.03	
Durban-Watson statistic	1.9125	
Prob(F-statistic)	0.0000	

**Note:** Standard deviations in parentheses, \*\* indicates significance at the 1% level;  
\* indicates significance at the 5% level. Number of observations: 110

*Source: E-views (2006)*

There might be a risk that the decision makers rather invest in a few grand projects that will be easy to show off but that is not as demanded, than in several smaller projects that would benefit a larger number of people. An example of this is the world's highest railway between Qinghai and Tibet that was completed in the summer of 2006. Although it can be seen as an improvement in communications for the remote Tibetan region, it will take a tremendously long time before the enormous amount of money that has been put in the project will pay off. For the many poor Tibetans living in distant villages it might have been better if the money had been invested in good quality roads that could take them from the village to the nearest town. As discussed in chapter 3, it is very important to assess the demand of the projects that are being initiated in order to not waste scarce resources, such as capital.

Nevertheless, the estimated infrastructure dummy coefficient is positive, which indicates that the investments in infrastructure construction have increased between the periods 1995-1999 and 2000-2005. This could be a cause of the Open Up the West policy that appointed investments in infrastructure as its first priority.

A finding that is consistent with the prediction of the model is the negative sign on the estimated coefficient for the environment variable. Since this variable measured the growth in the emission of industrial waste gas, something that clearly has a negative effect on the environment, it should also have a negative impact on the economic growth. However, the

estimated dummy coefficient is slightly positive, which means that the emission of industrial waste gases have increased between the two periods. This could be an effect of the higher investments in infrastructure construction or be caused by the industries increasing output-level. It reveals one very significant weakness of the Open Up the West policy, mentioned in the Policy Implication section of chapter 3, namely the inconsistency of the objectives.

The only independent variable that did not have a significant impact on the economic growth was the industrial upgrading variable that measures the percentage share of tertiary industry in provincial GDP. It could be because the tertiary industry still makes up a rather small share of GDP. Furthermore, it is interesting to note that the estimated dummy coefficient for industrial upgrading is negative, which signifies that the situation is not improving despite the policy to develop the Western region.

The expected sign of the human capital coefficient was positive, but the estimated sign ended up negative. The reason for this could be explained by looking at the dummy coefficient that shows the highest positive figure of all the independent variables. It means that the secondary school enrollment level has increased considerably after the Open Up the West policy was initiated. Yet, it also means that less people in the region has been working and directly contributed to GDP, hence, it has resulted in a negative impact on the economic growth rates and thereby explains the negative sign on the human capital coefficient.

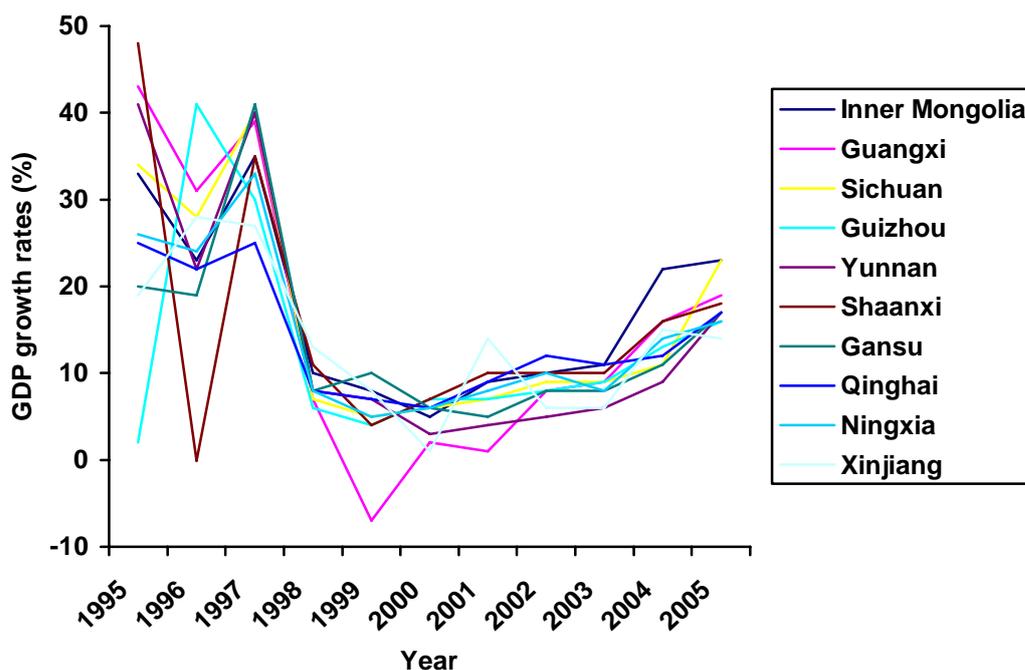
Both the variable of science & technology and its dummy turned out to be highly significant in the estimation, with a probability value of 0.0000. This specifies the important impact that S&T has on the economic growth. As predicted, the estimated S&T coefficient is positive since a higher level of investments in S&T makes it easier for the region to take advantage of the technology that is transferred from other parts of China and abroad. It will impinge positively on the economic growth since more advanced technology increases productivity. However, despite the positive impact of S&T, the estimated coefficient of its dummy is highly negative, indicating that the share of personnel working with S&T has decreased notably since the period before the policy was implemented. It can be explained by the fact that during this period the growth in the total employed population has been higher than the growth in the number of S&T personnel in the region. Since the share of S&T personnel that way becomes smaller it is reflected in the empirical results.

Finally, the sign of the estimated coefficient for foreign direct investments also corresponds to the predictions as being positive. The positive impact of FDI on economic growth is thereby confirmed. Still, there is no indication that the Open Up the West policy has resulted in a higher degree of foreign investments in the region since the estimated dummy

coefficient of FDI is negative. On the contrary, it implies that the foreign investments have declined since the policy was put into action. This can be seen as an unfortunate failure of one of the main objectives of the policy.

It is noteworthy to look at the development of the economic growth figures between the years 1995 and 2005. Figure 3 illustrates quite clear the economic development in this period.

**Figure 3: Provincial GDP growth figures 1995-2005**



*Source: E-views (2006)*

The high growth rates prior to 1998 are certainly striking. Since the western provinces has lagged behind the coastal provinces in terms of growth rates it is extremely surprising that the western growth rates exhibits such high figures in the mid-1990's. It could be a cause of overestimated GDP statistics in the China Statistical Yearbooks, or it is simply an effect of the overall high growth rates that China demonstrated during this period. The radical downturn in the growth rates after 1997 can best be explained by the Asian economic crisis that hit many of the new larger economies of East Asia in this specific year. The crisis particularly affected the agricultural export sector in China since the larger importing countries suffered from the crisis (Huang *et al* 2003: 3). This had a very negative impact on the Western region due to its dominating primary sector. Thus, it explains why the economic growth rates suddenly declined drastically.

The negative development shifted in early 2000 when the growth figures once again started to rise. The positive growth rates have continued ever since, and they were over 10% for all of the provinces in 2005. The recent years positive development could be an effect of the Open Up the West policy that has boosted investments in all the various areas discussed in this study. Whether the economic growth figures would have looked differently if the western development strategy had not been implemented is difficult to say, but there is a great risk that it would have taken a longer time for the western region to exhibit rising growth figures again without the investments originating from the Open Up the West policy.

## 5 Conclusions

The importance of adequate infrastructure, skilled human capital, science & technology, and openness in the economy to facilitate economic growth is clearly stated in Jones theoretical model of technology diffusion with infrastructure. The policy makers behind the Open Up the West strategy have to a great extent adhered to the ideas of the New Growth Theory when formulating the areas of focus within the western development policy. However, they also added a long run factor in terms of environmental protection for a sustainable economic development, and industrial upgrading in order to improve the structure of the economy.

The empirical testing of a model containing these independent variables resulted in a relatively mixed outcome of the growth effects. Table 6 summarizes the estimation results.

**Table 6: Summary of Estimation Results**

<b>Independent Variables</b>	<b>Outcome of Coefficient Sign</b>	<b>Significance</b>
Infrastructure	-	H <sub>0</sub> rejected
DInfrastructure	+	H <sub>0</sub> rejected
Environment	-	H <sub>0</sub> rejected
DEnvironment	+	H <sub>0</sub> rejected
Industry	-	H <sub>0</sub> accepted
DIndustry	-	H <sub>0</sub> rejected
Human Capital	-	H <sub>0</sub> rejected
DHuman Capital	+	H <sub>0</sub> rejected
Science & Technology	+	H <sub>0</sub> rejected
DScience & Technology	-	H <sub>0</sub> rejected
FDI	+	H <sub>0</sub> rejected
DFDI	-	H <sub>0</sub> rejected

*Source: Author's own construction*

The predictions of Jones theoretical model, and thus the empirical model, did not fully correspond to the estimation results shown in Table 6. In the theoretical model infrastructure is assumed to have a very positive effect on economic growth since it increases the total factor productivity level and improves investment conditions. On the contrary, the estimation results when testing the effect of infrastructure on economic growth during the Open Up the West policy turned out negative, despite the increasing investment rate on infrastructure in the region after the policy implementation. Furthermore, human capital that is one of the most significant contributing factors to economic growth in Jones endogenous model also appeared negative. At first sight, these outcomes might seem surprising but as the effects of these variables usually only are detected in the long run, since infrastructure takes a long time to build up and human capital is not immediately accumulated, the estimation results of these two variables could turn out positive in the future.

Despite the fact that environment is not included in Jones theoretical model it is still a significant variable according to the estimation results, and thus has an effect on the economic growth in western China. The reason why Jones has not included environment as a contributing factor to economic growth in his theoretical model could be because of the difficulties to quantify the environment variable. But it could also be due to the fact that it is hard to see the direct link between environmental protection and economic growth, since it is more indirect in terms of a sustainable development and better use of resources. As expected, the estimation results showed that the emission of industrial waste gases has a negative effect on economic growth, but it also showed that the emissions have increased since the policy implementation, something that augurs ill for the future of the western development policy.

Moreover, Jones does not mention the aspect of industrial upgrading in his theoretical model, and as this variable turned out to be insignificant in the estimation results its effect on economic growth could be seen as minor.

The two variables that did correspond to Jones theoretical model are science & technology and foreign direct investments. These variables have a positive effect on economic growth both according to the theoretical model and the estimation results. Regrettably, the estimation results also demonstrate that both variables have declined over the years, which means that the policy has not lived up to its proclaimed objectives in this aspect.

In conclusion, the theoretical model with technology diffusion and infrastructure has partly been recognized by the estimation results from the empirical testing of the Open Up the West policy. It recognizes the importance of science & technology and foreign direct investments to boost economic growth. Thus, these variables have been the driving forces influencing the

economic development in the western region of China in the short run. However, in the long run it might just as well be infrastructure and human capital that are driving the growth since the effects of these investments are apparent after a longer period of time. In addition, the investments in environmental protection will also take a longer time before its effects will become evident, but investments in this area is crucial for a sustainable development in a fragile ecological environment as that of China's western region. The future success of the development project will thereby depend on how well the infrastructure investments are organized and the accumulation of human capital, which are the same factors that are central in Jones theoretical model. The economic growth of the western region must continue to rise in order to achieve a balanced internal development of China, and it is crucial that it is sustainable and evenly distributed among the provinces and its people. Several more assessments of the Open Up the West policies effects are needed in order to evaluate the definite effects of the campaign.

Consequently, this study suggests further research of the future economic and social effects of the Open Up the West policy. It is especially interesting to investigate the effects *within* the western provinces to see how the conditions have changed as a consequence of the development strategy. It is also important to look beyond the economic growth figures to see if the new investments have reached ordinary people and not only helped boost the economy of the region at a macro level.

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## Appendix:

### A. Data

Provinces and Years	Variables							
	GRPY	Infrastructure	Environment	HumanCapital	S & T	Industry	FDI	Dummy
<b>Inner Mongolia</b>								
1995	0,330278	0,060	0,053177	0,046	0,042	0,280	0,0108	0
1996	0,234996	0,067	-0,12321	0,048	0,041	0,310	0,0058	0
1997	0,346098	0,066	-0,12683	0,049	0,036	0,289	0,0061	0
1998	0,096611	0,065	0,173986	0,050	0,036	0,298	0,0056	0
1999	0,080256	0,067	0,051714	0,050	0,038	0,311	0,0063	0
2000	0,051195	0,069	0,109061	0,052	0,040	0,323	0,0042	1
2001	0,093099	0,072	-0,0521	0,055	0,041	0,353	0,0063	1
2002	0,095898	0,077	0,039277	0,059	0,041	0,363	0,0057	1
2003	0,113666	0,088	0,190222	0,063	0,041	0,364	0,0084	1
2004	0,214684	0,117	0,283129	0,065	0,044	0,352	0,0034	1
2005	0,230802	0,117	0,529468	0,066	0,046	0,322	0,0192	1
<b>Guangxi</b>								
1995	0,432413	0,031	0,149909	0,039	0,025	0,300	0,0612	0
1996	0,311041	0,044	0,188088	0,043	0,025	0,321	0,0377	0
1997	0,386773	0,045	0,307658	0,047	0,024	0,310	0,0294	0
1998	0,065212	0,044	-0,01075	0,051	0,024	0,310	0,0365	0
1999	-0,06767	0,057	0,066467	0,054	0,025	0,342	0,0386	0
2000	0,018738	0,060	0,057332	0,057	0,026	0,360	0,0270	1
2001	0,040398	0,063	0,046654	0,064	0,026	0,372	0,0212	1
2002	0,077707	0,064	0,170055	0,060	0,026	0,393	0,0143	1
2003	0,088314	0,067	0,041605	0,062	0,026	0,405	0,0141	1
2004	0,157535	0,071	0,153272	0,062	0,025	0,393	0,0127	1
2005	0,186946	0,073	0,473614	0,063	0,023	0,368	0,0074	1
<b>Sichuan</b>								
1995	0,343087	0,061	-0,01907	0,031	0,023	0,280	0,0177	0
1996	0,275044	0,061	0,115866	0,033	0,023	0,296	0,0129	0
1997	0,402546	0,077	-0,11431	0,033	0,020	0,300	0,0087	0
1998	0,068302	0,063	-0,29281	0,033	0,024	0,306	0,0062	0
1999	0,045131	0,071	-0,04375	0,034	0,021	0,311	0,0086	0
2000	0,054704	0,071	0,014013	0,039	0,023	0,327	0,0076	1
2001	0,071924	0,076	0,022858	0,047	0,023	0,340	0,0090	1
2002	0,092951	0,079	0,149567	0,050	0,023	0,381	0,0109	1
2003	0,093751	0,088	0,272294	0,053	0,023	0,382	0,0095	1
2004	0,107128	0,091	-0,09388	0,055	0,025	0,378	0,0063	1
2005	0,234361	0,080	0,118151	0,056	0,023	0,377	0,0089	1
<b>Guizhou</b>								
1995	0,024475	0,030	-0,02666	0,030	0,023	0,280	0,0071	0
1996	0,406754	0,036	0,073625	0,031	0,023	0,272	0,0076	0
1997	0,29841	0,046	-0,21048	0,032	0,020	0,280	0,0036	0
1998	0,056654	0,054	0,102064	0,034	0,021	0,287	0,0052	0
1999	0,038526	0,063	0,380386	0,035	0,021	0,298	0,0045	0
2000	0,072462	0,071	0,138709	0,037	0,023	0,324	0,0037	1
2001	0,072837	0,074	0,009577	0,045	0,022	0,337	0,0021	1
2002	0,083907	0,078	-0,06739	0,049	0,023	0,360	0,0022	1

2003	0,085369	0,088	-0,03192	0,055	0,023	0,362	0,0027	1
2004	0,133412	0,090	-0,01087	0,061	0,023	0,353	0,0028	1
2005	0,156883	0,088	0,18462	0,064	0,021	0,341	0,0034	1
Yunnan								
1995	0,407961	0,035	0,093332	0,032	0,025	0,250	0,0086	0
1996	0,21614	0,040	0,093461	0,032	0,025	0,315	0,0068	0
1997	0,400096	0,052	-0,23124	0,033	0,023	0,305	0,0036	0
1998	0,084361	0,060	0,115654	0,035	0,021	0,306	0,0084	0
1999	0,068597	0,072	0,005314	0,037	0,025	0,311	0,0067	0
2000	0,028017	0,078	0,18391	0,040	0,026	0,333	0,0069	1
2001	0,040714	0,074	0,192339	0,043	0,027	0,346	0,0054	1
2002	0,048205	0,076	0,196528	0,047	0,027	0,358	0,0026	1
2003	0,06234	0,077	0,089424	0,050	0,027	0,363	0,0042	1
2004	0,089165	0,080	0,13718	0,052	0,023	0,362	0,0028	1
2005	0,173244	0,088	0,162995	0,053	0,019	0,352	0,0040	1
Shaanxi								
1995	0,476072	0,049	0,036604	0,039	0,034	0,310	0,0247	0
1996	-0,00128	0,058	0,248834	0,041	0,033	0,365	0,0272	0
1997	0,345995	0,068	-0,23707	0,044	0,024	0,372	0,0230	0
1998	0,112369	0,075	0,135609	0,047	0,024	0,376	0,0393	0
1999	0,03603	0,089	-0,01983	0,051	0,026	0,384	0,0180	0
2000	0,064978	0,104	-0,06622	0,056	0,028	0,389	0,0135	1
2001	0,103677	0,110	0,017812	0,064	0,029	0,391	0,0144	1
2002	0,099319	0,114	0,183442	0,070	0,030	0,402	0,0158	1
2003	0,094695	0,115	0,180687	0,076	0,029	0,396	0,0147	1
2004	0,159799	0,125	0,120117	0,080	0,027	0,394	0,0115	1
2005	0,179875	0,122	0,124752	0,082	0,023	0,372	0,0152	1
Gansu								
1995	0,196928	0,041	0,007282	0,037	0,027	0,328	0,0023	0
1996	0,184922	0,045	0,123455	0,038	0,031	0,329	0,0097	0
1997	0,41013	0,054	-0,14258	0,039	0,025	0,296	0,0105	0
1998	0,078211	0,072	0,078968	0,041	0,026	0,318	0,0044	0
1999	0,096266	0,081	0,051065	0,043	0,027	0,328	0,0037	0
2000	0,060114	0,103	-0,04162	0,047	0,028	0,340	0,0037	1
2001	0,045305	0,113	0,051669	0,051	0,029	0,356	0,0053	1
2002	0,081285	0,116	-0,0025	0,057	0,030	0,358	0,0058	1
2003	0,076285	0,120	0,062119	0,062	0,030	0,359	0,0044	1
2004	0,111308	0,121	0,305275	0,067	0,029	0,353	0,0015	1
2005	0,172919	0,117	-0,08888	0,070	0,024	0,333	0,0014	1
Qinghai								
1995	0,249482	0,070	0,021414	0,040	0,045	0,340	0,0020	0
1996	0,219285	0,073	0,071532	0,040	0,044	0,349	0,0008	0
1997	0,253069	0,096	-0,13044	0,040	0,036	0,395	0,0005	0
1998	0,081437	0,105	0,126484	0,041	0,036	0,409	0,0010	0
1999	0,073018	0,114	0,153868	0,039	0,037	0,409	0,0009	0
2000	0,063767	0,117	0,028454	0,041	0,036	0,419	0,0016	1
2001	0,087244	0,127	0,001649	0,043	0,037	0,421	0,0021	1
2002	0,119899	0,143	0,331991	0,047	0,038	0,419	0,0101	1
2003	0,113765	0,158	0,102164	0,051	0,034	0,417	0,0115	1
2004	0,124366	0,163	0,06707	0,055	0,036	0,410	0,0054	1
2005	0,167741	0,147	0,211499	0,058	0,033	0,388	0,0629	1

Ningxia								
1995	0,261187	0,047	-0,08586	0,053	0,047	0,340	0,0076	0
1996	0,234851	0,058	0,066691	0,053	0,046	0,360	0,0019	0
1997	0,328996	0,062	-0,09467	0,053	0,040	0,365	0,0024	0
1998	0,075849	0,069	0,099263	0,053	0,039	0,372	0,0026	0
1999	0,047073	0,079	-0,046	0,053	0,041	0,373	0,0068	0
2000	0,058461	0,091	0,056945	0,054	0,040	0,376	0,0177	1
2001	0,078649	0,102	0,270983	0,057	0,041	0,375	0,0054	1
2002	0,098518	0,108	-0,09656	0,059	0,042	0,384	0,0047	1
2003	0,083322	0,111	0,217641	0,063	0,042	0,380	0,0056	1
2004	0,142216	0,126	0,057192	0,065	0,041	0,358	0,0038	1
2005	0,163565	0,115	0,30291	0,066	0,035	0,338	0,0121	1
Xinjiang								
1995	0,192575	0,082	0,011161	0,044	0,066	0,320	0,0068	0
1996	0,282551	0,091	0,286572	0,045	0,066	0,327	0,0056	0
1997	0,267817	0,107	-0,39181	0,048	0,048	0,358	0,0058	0
1998	0,133338	0,105	0,04166	0,051	0,050	0,340	0,0020	0
1999	0,07973	0,117	0,056896	0,055	0,052	0,354	0,0016	0
2000	0,011816	0,122	0,027006	0,060	0,055	0,376	0,0017	1
2001	0,143719	0,121	0,055526	0,059	0,055	0,359	0,0012	1
2002	0,057612	0,121	0,190943	0,065	0,057	0,382	0,0011	1
2003	0,05758	0,125	0,065388	0,070	0,056	0,388	0,0010	1
2004	0,146039	0,120	0,155287	0,075	0,054	0,356	0,0007	1
2005	0,143699	0,120	0,260212	0,077	0,059	0,339	0,0017	1

Source: National Bureau of Statistics of China (1995-2005)

## B. Estimation results with Fixed Effects

Variables	
Intercept	1.0005 (0.3308)***
Infrastructure	-3.1729 (0.9713)***
Dinfrastructure	3.2355 (1.4436)**
Environment	-0.2528 (0.0905)***
Denvironment	0.3590 (0.0928)***
Industry	-0.8929 (0.9339)
Dindustry	-0.9686 (0.5049)*
Human Capital	-7.1870 (3.5360)**
Dhuman capital	9.4584 (3.3676)***
Science & Technology (S&T)	-0.7340 (3.2622)
Dscience & technology	-9.9507 (2.7129)***
Foreign Direct Investments (FDI)	2.6458 (1.4199)*
Dforeign direct investments	-4.2359 (1.5670)***
R <sup>2</sup>	0.5099
Log likelihood	123.33
Durban-Watson statistic	1.9616
Prob(F-statistic)	0.0001

**Note:** Standard deviations in paranteses, \*\*\* indicates significance at the 1% level; \*\* indicates significance at the 5% level; \* indicates significance at the 10% level.

Source: E-Views (2006)