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The Law of Diminishing Return: An Empirical Study of China's Economic Growth

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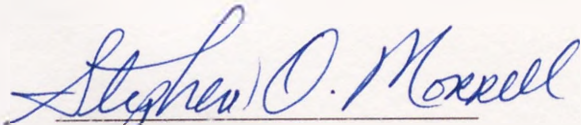

By

Raul Ballester

May, 2011

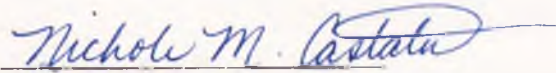Barry University
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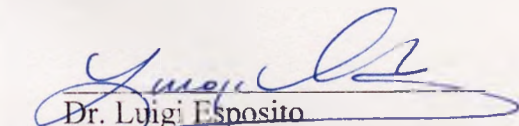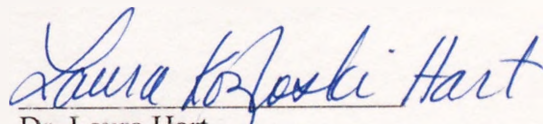Honors Thesis Written by

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An Empirical Study of China's Economic Growth

China's economy grew at an average annual real growth rate of 9 percent over the last three decades. There has been debate over the sources of the Chinas economic growth. Growth accounting model, such as, the Solow Growth Model at the aggregate level suggests diminishing returns in Total Factor productivity in China. The non-agricultural sector has been in doubt about the contribution of TFP improvements to growth. For the period between 1978 and 1998, demonstrates a deepening role for labor, including the reallocation of workers from agriculture, while more recent analysis points to the role of rising rates of Foreign Direct Investment (FDI).

This paper develops three ideas to quantify the sources of China's economic growth. The sectors include agriculture, and within non-agriculture, the state and non-state components, for example, Township Villages. The data also shows significant misallocation of capital: The less efficient state sector continues to absorb more than half of all fixed investment and the contraction of FDI. In order to quantify the true growth potential and future possibility of Chinas economy, the Solow growth Model was used to prove diminishing returns. Finally, in light of important concerns over data, other studies were compared to prove Total Factor Productivity results and diminishing returns in Chinas economy.

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INTRODUCTION

The Problem

In the last 30 years, the economic system in China has gradually been transformed from an exclusively centrally-planned economy to more of a market-oriented economy (in certain designated areas). Rapid expansions of private enterprises, increased trade activity and investments have generated substantial economic growth since the first economic reform (Nilsson & Sundqist, 2010). In 2010, the export sector of China totaled a massive $1.435 trillion.

In the late 1970s, China implemented a number of structural reforms that liberalized markets, increased autonomy for certain state-owned enterprises, and created a diversified banking system. It also created a stock market, therefore joining the rapid growth of global financial markets that transpired during the 1980s and 1990s.

In the last 25 years, the average annual real GDP growth rate for China has increased approximately 9.4%, per annum. Today, China is the second largest economy (GDP $5.74 trillion) in the world (see Table 1) after the US ($14.62 trillion) (Nilsson & Sundqist, 2010). All these facts seem to support the general, widely-believed idea by many economists that China will become the largest economy in the world during the 21st century. However, there is a possibility that the Chinese economy could experience diminishing returns from investment, and hence experience decreased economic growth. Two other countries, which have experienced this phenomenon, were Russian and Japan.

China has enormous economic growth during the last three decades, primarily since China's 1978 experienced economic liberalization reforms. Since these reforms were established, China's per capita income has increased approximately eightfold

between1978-2010, but other issues such as property rights and institutional rights have not met textbook ideologies. Behind China's strong economic growth lies a long- term strategy of higher quality education, an export orientated economy and a high savings rate as key ingredients to this growth. Not all aspects of this growth have been positively viewed by the world, such as China's attempt to preserve an undervalued currency to promote growth in their export industry.

Growth and economic transition in China are very similar to those seen in the Soviet Union and Japan's economic boom in the 1950s and 1960s. The term "extensive growth" is widely used among Chinese economist and the Chinese media. The main factors of this growth are mostly generated by inputs such as capital and labor, but only a small percentage by growth is due to productivity. Some recent studies have reported a prolonged slowdown in Total Factor Productivity growth (Zheng & Hu, 2006; OECD, 2005).

Table 1: GDP World Ranking by Countries

Rank	Country	GDP (Millions of USD)
———	World	62,220,000
1	United States	14,620,000
2	People's Republic of China	5,745,000
3	Japan	5,391,000
4	Germany	3,306,000
5	France	2,555,000
6	United Kingdom	2,259,000
7	Italy	2,037,000
8	Brazil	2,024,000
9	Canada	1,564,000
10	Russia	1,477,000

Many economists currently believe that China will overtake the United States as the world's largest economy by or sometime after 2020. These assumptions have been made before; even worldwide institutions such as the World Bank estimated in 1994 that China would be 30% larger than the US by 2010. If the US economy continued to grow 2.5% each year and China could continue to grow 10% annually, by the year 2010 in its economy would be a third larger than ours (Krugman, 1994). Today, the United States is still the largest economy in the world with annual GDP of $14 trillion followed by China with $5 trillion in annual GDP, only 40% of the US economy.

Before the 1990s China's high growth and productivity can be traced to improvements in economic – political policy. China economy is fast-growing not because of the quality of its institutions, but because the country has improved these institutions in the last two decades. If it is not reformed further, its per capita income growth might slow down (Klenow, 2001). Dr. Paul Krugman in his article: *The Myth of Asia's Miracle*, studied historical examples of nations whose rapid economic growth did not lead to long-term sustainability. Prime examples were the East Asian Tigers: economies with modest growth, output inefficiency and growth driven solely by inputs due to Cultural Revolution. Japan on the other hand managed to grow faster than other countries for a certain period, but the country's growth began to shrink and now is more stable. Japan, unlike the East Asian Tigers, seemed to have grown both through high rates of inputs and high rates of TFP growth (Krugman, 1994).

In 1978 China's official economic – political reform began. Post 1978 China has experienced three major waves of reform (see Figure 1); the first was the reform of

collective farming with a household responsibility system and the upper price adjustment for agricultural products, which resulted in a rapid increase in agricultural productivity and output for several years. Further study showed increased levels in TFP at the regional and national levels. In the 1980s China experienced both higher productivity growth and a period of stagnation. Followed by another period of growth in efficiency, which lead to a slowdown in the 1990s (Mead, 2003). These fluctuations in TFP were during China's second wave of reforms. This reform focused on improving productivity in China, during which managers and workers in federal enterprises were driven by incentives to increase productivity. This helped shift much of the rural labor force to manufacturing because Township Village[*] organizations experience higher level of efficiency than the incentive driven state firms (Zheng & Liu, 2003).

Figure 1: Percentage Growth in labor, Capital, GDP, and TFP for China 1952-2005
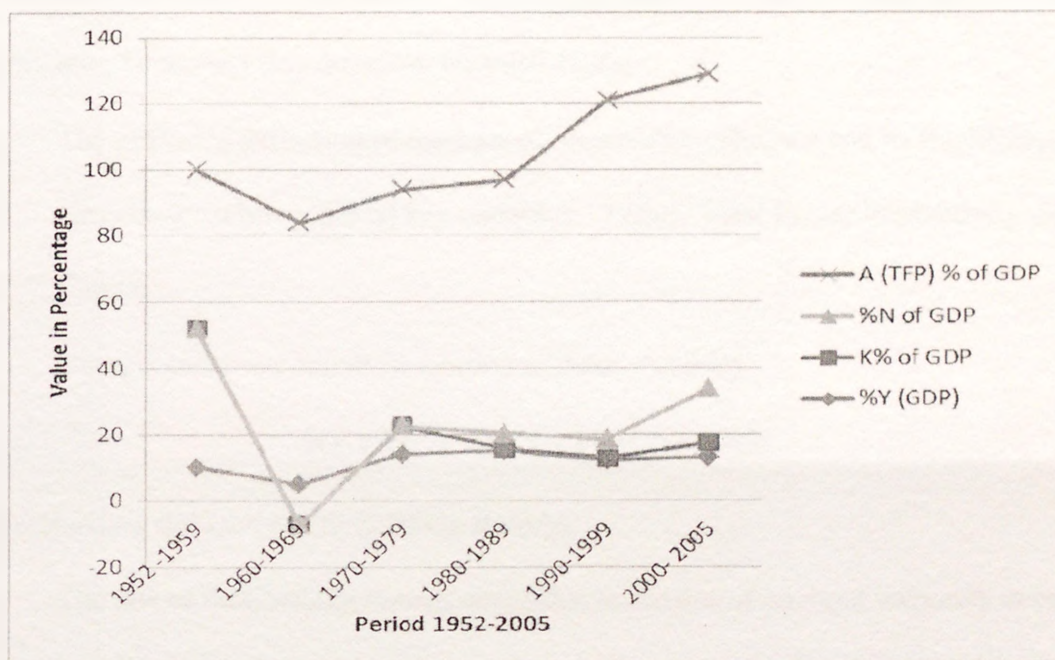
Source: Authors calculations see appendix for PENN World Tables 2005.

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[*] These are market orientated public enterprise under the local government jurisdiction. Most Township Villages emerged during the Reform period in the 1980s.

During the period of 1978 – 1995 China experienced high economic growth due to productivity improvements. China's growth was not focused on inputs such as capital and labor but rather their GDP grew much faster than their inputs suggesting other factors were important determinants of GDP growth during those years (Krugman, 1994).

Problem Statement

Despite the rapid rate of China's economic growth, the country could eventually be affected by diminishing returns in the future just like Japan and Russia because of its economic policies in relation to utilization of current resources.

Research Question

The purpose of this research is to find a correlation between China's economic growth based on the three key variables of growth accounting and the law of diminishing returns in economics, with the aim of discovering whether or not China will be affected by this law. To answer this question, we must explore:

- The extended definition of the Law of Diminishing Returns and its implications

- Growth accounting and its key variables – Labor, Total Factor Productivity and Capital

- China's economic trends in relation to these variables

REVIEW OF LITERATURE

Understanding the Law of Diminishing Returns

The law of diminishing returns states that as the use of an input increases in equal increments (while other inputs remain fixed), a point will eventually be reached at which the resulting additions to output decrease (Pindyck & Rubinfeld, 2005). Taking the example of a factory, if the number of workers increases with capital remaining fixed,

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output will increase initially because of increased labor and specialization. As this number continues to increase, however, the marginal increase in productivity of this factory will begin to decline because some workers will become ineffective, and the costs of production will increase.

Another simple example that can be used is a group of children organizing and stapling papers. If these children (workers) increase from one to two, then to three and so on, the number of papers that are stapled will increase as the number of children increases. However, these children share one stapler, and a point will come where the number of papers stapled per child will decrease as the number of children increase. The table below shows productivity as the number of children fluctuates.

Table 2: Performance Illustrating Diminishing Returns

Children	No. of stapled papers	Marginal Increase	Productivity per child
1	7	-	7
2	15	8	7.5
3	21	7	7
4	25	4	6.25
5	28	3	5.6
6	30	2	5
7	31	1	4.4

Source: Authors Calculations

As seen in Table 2 above, as the number of stapled papers increases, the marginal increase is not as big as it was when there were only two or three children. This is because when there were only two children, one child organized the papers while the other stapled them. However, as the number grows, the other workers are not as effective

since they have no way of speeding up the production with only one stapler available. The graph below illustrates how productivity per worker is affected with increase in labor as other factors (the stapler) remain constant (see Figure 2).

Figure 2: Graph Showing Productivity per Worker
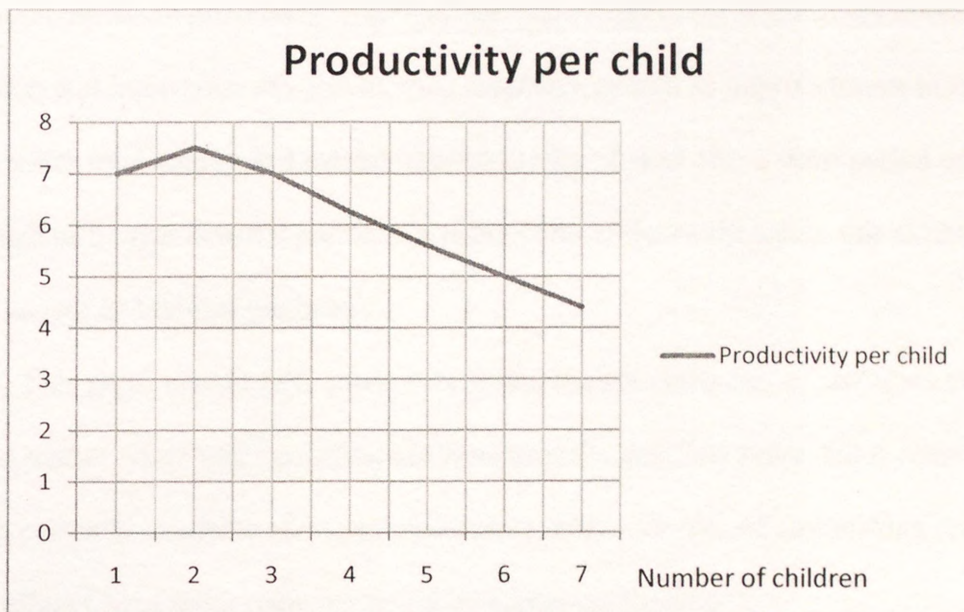
Source: Authors Calculation

When studying the law of diminishing returns, it is assumed that the variable considered (workers, as in the case above) is of equal quality. This is hypothetical, of course, since it is not possible to find a scenario where factors are exactly the same. Referring to the factory example above to illustrate this, it is not possible to find workers of equal skills in any market.

The law of diminishing returns is usually not relevant in the long run (O'Sullivan & Sheffrin, 1998) since it is assumed that in the long run other variables will change. Having said that, it can be used to predict what would happen in the long run under short-term circumstances (Pindyck & Rubinfeld, 2005). When predicting economic factors in the long run, it is important to consider other changes that could happen in the future.

Thomas Malthus (1766-1834)[*] predicted that the land available for food production would not sustain an increasing population, even though the increase in population meant an increase in the amount of labor available in the market. Based on the available facts at that time (in the short term), he was completely right. However, he did not anticipate the improvement in technology that would occur in the years to come. The invention and innovation of earth moving machines as well as improvements in research led to better seed quality and increased productivity of land over a short period of time. Although as hunger is still a problem in many parts of the world today, this situation is not as severe as Malthus predicted.

This paper cannot fully predict the technological changes—or any other changes for that matter—that will take place in China over the next few years, but it considers the factors currently available and attempts to analyze how the law of diminishing returns could affect China as an economy based on expert predictions.

Diminishing Returns in China

When a billionaire hedge fund investor gave his speech in the London School of Economics, he cited China as a classic case of overinvestment. He said that the country had invested billions of dollars particularly in real estate. The problem, however, is that there are now many empty shopping malls and New Ordos. He says Chinese developers seem to follow a "Field of Dreams" approach where they say "if we build, they will come".

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[*] Thomas Malthus was a British Economist who authored an essay called *an essay on the Principle of Population, 1798* (Pindyck & Rubinfeld, 2005).

However, as the results in this research will demonstrate, China focuses too much on investing in inputs rather than increasing output per unit input. As Paul Krugman states after analyzing and reviewing the miraculous growth of Asian economies, he said with skepticism: "Economic growth that is based on expansion of inputs, rather than on growth in output per unit of input, is inevitably subject to diminishing returns" (Krugman, 1994).

When President Hu Jintao was in Washington, several politicians and lobbyists from the United States and abroad raised the ever-pressing issue of China's currency manipulation. They wanted the United States to apply pressure to the Chinese government and urged China to stop intentionally undervaluing its currency. It has been rumored that China undervalues her currency by as much as 40% (Rowley & Blackden, 2011). By doing so, China gained a huge price advantage on its competitors. If the lobbyists and politicians eventually succeed in doing so, Chinese exports could lose their competitive edge, and China could end up losing billions of dollars in reduced exports and, consequently, reduced FDI. It is no secret that companies prefer investing in China because of this competitive advantage.

Understanding Growth Accounting

Growth accounting is a theory that was developed by Robert Solow in an effort to understand economic growth and the consequences of long-term growth in the economy and other changes in the economic environment and economic policy. The original concept of growth accounting, as presented by Solow; has been slightly modified by economists today to correctly measure economic growth and accurately predict future economic trends based on available statistics.

There are three main variables used in growth accounting: Labor, Capital and the economy's Total Factor Productivity. These are denoted by L, K and A respectively. The Cobb-Douglas production function is as follows:

Equation 1: Cobb-Douglas Production Function

$$Y_1 = A_1 \times (K_1)^{\alpha} (L_1)^{\beta}$$

Y represents for output, α and β stand for output elasticity of labor and capital respectively. This formula is proposed by Knut Wicksell and tested by Charles Cobb and Paul Douglas using statistical data (Bao Hong, 2008). By no means, does this formula try to suggest that these are the only factors that affect economic performance. The function is only widely used in calculating economic growth because it has been proven to be remarkably accurate. The hypothesis and research questions will therefore be based loosely on these three variables.

Assumptions

Since both labor and capital are variables in the production function, it can be stated—according to Bao Hong (Cobb Douglas Production Function)—that Cobb and Douglas made the following assumptions:

1. If either labor or capital vanishes, then production will vanish, too.

2. The definition of the marginal productivity of labor/capital is the rate at which production changes with respect to the amount of labor/capital and is proportional to the amount of production per unit of labor/capital.

The Solow Growth Model

Robert Solow an American economist, graduate of the Massachusetts Institute of Technology, and Nobel Prize winner in 1990, developed a production function applicable

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to growth accounting. This model, called the Solow Growth Model (SGM) or neoclassical model, is because it focused on supply side economics. National economic growth has been dynamic in it of itself; hence the SGM indirectly assumed that the supply of inputs in an economy sustained economic growth in a dynamic model. Solow Began with the Cobb-Douglas equation:

Equation 2: Cobb-Douglas Function Simplify

$$Y = A \, K^a \, L^b$$

Where:

A is a multifactor productivity or Total Factor of Production (TFP)

Y is the economic growth or GDP

K is fixed capital investments

L is Labor (savings functions)

^{a} is the exponential variable describing how much GDP is paid to capital

^{b} is the amount of GPD paid to capital

*If ($^{a\,+\,b}$ = 1) we can expect constant return to scale and if the sum of ^{a} and ^{b} are less than one we can assume diminishing return to scale.

According to the Solow Growth Model (SGM) an increase in Y (GDP) is caused by one of the following:

Solow Growth Model Assumptions

1. Capital (K) – an increase of a country's capital stock leads to an increase in the output/labor ratio (Y / L), as well as overall output (Y).

2. TFP (F) – an increase in total factor productivity could also increase the output/labor ratio (Y / L) or efficiency per worker.

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a. Solow concluded nothing is produce in the economy if no capital (K) or

Labor (L) has been utilized (equal to 0). e.g.

b. $F(0.L) = F(K.0) = F(0.0) = 0$

3. Labor (L) – an increase in labor would lead to inefficiency in output per worker, thus diminishing output/labor ratio (Y / L).

a. $\frac{dY}{dK} > 0. \frac{dY}{dL} > 0. \frac{d^2Y}{dK^2} < 0. \frac{d^2Y}{dL^2} < 0.$

For example, let's view a production function and see how the assumptions above prove constant return to scale. The following production function is given:

$$Y = K^{0.5}L^{0.5}$$

Equation 3: Solow Growth Equation (Labor and Capital)

Because,

$$\frac{dY}{dK} = 0.5K^{-0.5}L^{0.5} > 0. \frac{dY}{dL} = 0.5K^{0.5}L^{-0.5} > 0. \frac{d^2Y}{dK^2} = -0.25K^{-1.5}L^{0.5} < 0$$

So, we can then take:

$$\frac{d^2Y}{dL^2} = -0.25K^{0.5}L^{-1.5} < 0$$

Equation 4: Increase in Labor, Decrease Output per Worker

This proves the 3rd assumption as well as constant return to scale. Because a relative increase in each input leads to a proportional increase in output, constant return is achieved. This can be shown by taking all input factors (K, L) and multiplying by:

$$\alpha > 0 : (K\alpha)^{0.5}(L\alpha)^{0.5} = K^{0.5}L^{0.5}\alpha^{0.5}\alpha^{0.5} = \alpha K^{0.5}L^{0.5} = \alpha Y^{-s}$$

Hypothesis Development

In this paper, my hypotheses are formulated based on the economic concept of diminishing returns. These hypotheses are based on the variables that are used to measure growth.

Labor and the Law of Diminishing Returns

China's population, of just over 1.3 billion (Krugman, 1994), provides a huge boost to the nation's demand for labor. However, as seen in the preceding productivity per worker graph, labor alone is not enough to develop a country's economy.

Hypothesis 1: China's giant population and the dynamic potential—and complications—it brings could be one of the main factors that will lead to diminishing returns in China.

Total Factor Productivity (TFP)

Total Factor Productivity (TFP) refers to the efficiency for all inputs in production process. The improvement in TFP in any economy is almost always the result of technological innovation and improvement.

Hypothesis 2: Given the huge investment in technology by both local and foreign investors, it is feared that Chinese marginal returns in technological investment may not be as high as it is right now due to domestic challenges faced by the country. These challenges could have negative effects in the future. However, if fully utilized, and the variables change, the growth in returns is potentially explosive.

Capital: Foreign Direct Investment (FDI)

Foreign Direct Investment (FDI) in China over the last 30 years has steadily grown, with marginal increase in both investment and the utilization of foreign investment growing steadily. FDI is a major source of capital in China for both local and foreign investors.

Hypothesis 3: If foreign investment continues to pour into China as it has over the last decade, a time could come when the rate at which these investments are made is less than the returns they yield.

Organization of the Study

This study is organized into four chapters: Introduction, Method, Results and Discussion. The study will also have a conclusion at the end.

Chapter 1 Introduction

Chapter 1 contains a brief introduction to the problem, the research question and the literature review. This chapter concludes with a brief explanation of the significance of this study.

Chapter 2: Method

Chapter 2 gives a detailed analysis of the method used in this chapter. It provides the research method used in the paper, an explanation of some of the key variables used in the paper and how research data were collected and analyzed. Finally, it shows how I intend to use the data to draw favorable conclusion.

Chapter 3: Results

Chapter 3 reports the results of the data collected in an organized and corrigible manner for easy interpretation. The results are given based on the research methodology explored in Chapter 2.

Chapter 4: Discussion

Chapter 4 discusses the results. It answers the research question given in Chapter 1 using relevant inferences and conclusions. This chapter also discusses the limitations of the study and the future of China based on my analysis.

This paper concludes with chapter summaries and results.

METHOD

This chapter discusses in detail the methods used in this paper to collect information, conduct research and reach conclusive answers to the research questions.

The data of this research are sourced from credible and verified sources. This data is current cited for further investigation and replication.

This paper uses a quantitative approach to answer the research questions. The data needed to answer these questions is derived from electronic storage devices as well as the Internet, books, reports and all other forms of literature, preferably from academic sources. All the data analyzed will be in the form of tables and graphs as well as percentages and other significant figures.

The Variables

As mentioned in the introduction, there has to be a dependent Gross Domestic Product (GDP) variable, in order for diminishing returns to be measured. For effective economic development, certain key variables have to exist and utilized in a certain manner for it to function. It is the development and improvement of one or more of these independent variables that makes an economy grow at a faster rate. The three key variables that will be used in this thesis to discuss the rate of economic returns in China are discussed below.

Labor

The effect of labor on productivity based on Cobb-Douglas production function is as follows.

Assume that the labor force, L_1, increases to $(L_1 + \Delta L)$. This would mean an increase in the capital stock by a proportional amount $\Box K/K$. Based on Assumption 2 in Chapter 1; $\Delta Y/Y_1$ is directly proportional to $\Delta L/L_1$.

$$\Delta Y/Y_1 = \beta\ (\Delta L/L_1)$$

This means that if β 0.5 and the increase in labor 1%, the increase in labor productivity would be:

$$\Delta Y/Y_1 = (0.5) \times 1\% = 0.5\%.$$

Labor Productivity

Another variable that will be used in this study is labor productivity. This refers to the average product of labor for an entire industry, or for the economy as a whole, (Pindyck & Rubinfeld, 2005). This is calculated by dividing total output by total labor input.

Labor Productivity = (Total Output) ÷ (Total Labor Input)[*]

The Chinese economy, with the largest population in the world, has one of the lowest labor productivity levels in the world. In 1988, for example, the labor turnover was at 0.8% (Lardy, 1992). This may not reflect very positively on the true strength of the economy because the country's population is over 1.3 billion. This variable simply demonstrates how much labor the country has available and how underutilized it is.

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[*] US & China production function (Dr. Charles I. Jones-PowerPoint)

Figure 3: Total Factor Productivity for U.S. and China

China and the U.S.

Output per person, y

U.S. production function
$y = \bar{A}_{US}\, k^{1/3}$

U.S.

China with U.S. TFP

China's production function
$y = \bar{A}_{China}\, k^{1/3}$

China

Capital per person, k
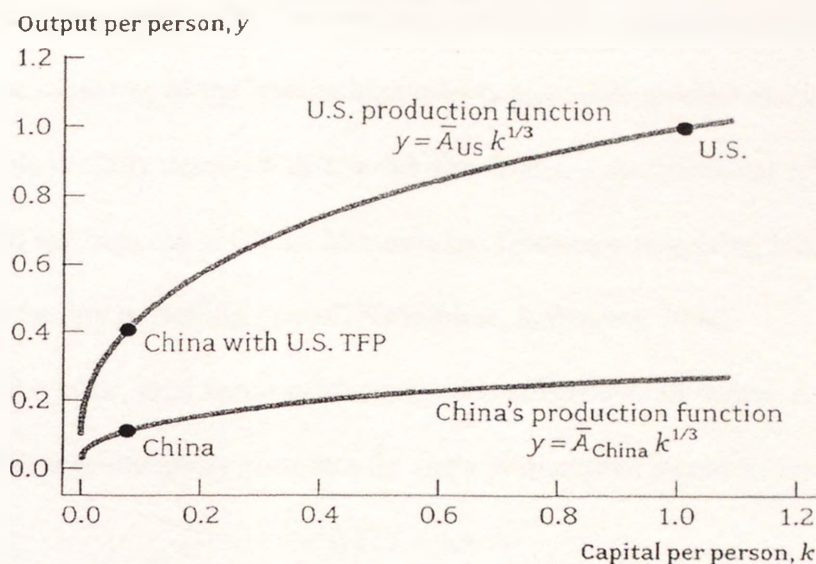
Source: Dr. Charles Jones- PowerPoint Presentation

An increase in labor could have a positive impact on the economy as it could increase production. The main focus of this subsection is productivity per worker. An increase in labor could actually reduce the data shown (see Figure 3).

Cost of Labor

One of the reasons many foreign companies invest in China is the low cost of labor (Jianxun, 2010). Some experts predict that this is about to change as the Chinese government begins to formulate policies that will increase worker income throughout China. However, until that change is made, what will be the cost of hiring in China? This paper will closely analyze the cost of labor and how any changes or lack thereof, might lead to the law of economies of scale affecting the country in the future.

Total Factor Productivity (TFP):

China's technological advancement has grown significantly over the past 50 years. From being an average advanced country technologically half a century ago, it has

grown exponentially into one of the leading technological hubs, especially in the telecommunication and manufacturing sectors. Initially, China was known for manufacturing low quality electronic products. This fact has changed dramatically as the country has become one of the leading high-quality electronic product manufacturers in the world. This is easily demonstrated by the Ten-thousand multinational companies currently with investments in China. Motorola has invested a staggering billion dollars into an R&D facility in Beijing (Yusuf, Nabeshima, & Perkins, 2007).

Just like labor, total factor productivity also affects overall output. A proportional increase in factor productivity generates the same proportional increase in output.

$$\Delta Y / Y = \Delta A / A$$

So if the proportional change in TFP is 1.5%, then

$$\Delta Y / Y = 1.5\%.$$

TFP explains almost 30 – 55% of China's economic growth, however accurate data is hard to acquire. Krugman stated in 1994; "China's economic numbers are not reliable, it was recently revealed that official Chinese statistics on foreign investment have been overstated by as much as a factor of six" (Krugman, 1994). According to Krugman, China's corrupt government has offered tax and regulatory incentives to foreign investors to start fictitious organizations. But it is hardly surprising that a major recovery in economic efficiency occurred as the countries emerge from the chaos of Mao Zedong's reign. If one instead measures growth from before the Cultural Revolution, say 1964, the picture looks more like the East Asian Tigers: only modest growth inefficiency with most growth driven by inputs (Krugman, 1994).

Direct Foreign Investment

In the 1970s, China implemented a number of reforms in its economic structure, with foreign investors being allowed to increase investment in the country. The global marketplace realized the huge potential of China and investments slowly flowed into China. The rate of investment increased in the early 1990s, with total foreign investment in 1992 jumping to $58 billion from $12 billion the previous year (Chinability, 2010).

Since then foreign investment has become quite high, with the figure fluctuating yearly above the $50 billion mark. Every year, however, not all the money contracted by the country has been utilized. Table 3 to the right shows how foreign investors have contracted in China and how monetary capital has been utilized from 1984 to 2008.

Table 3: Foreign Investment, China

Year	Contracted*	Utilized*
1984	2.7	1.3
1985	5.9	1.7
1986	2.8	1.9
1987	3.7	2.3
1988	5.3	3.2
1989	5.6	3.4
1990	6.6	3.5
1991	12	4.4
1992	58.1	11
1993	111.4	27.5
1994	82.7	33.8
1995	91.3	37.5
1996	73.3	41.7
1997	51	45.3
1998	52.1	45.5
1999	41.2	40.4
2000	64.2	42.1
2001	71.1	48.8
2002	84.8	55
2003	115.1	53.5
2004	153.5	60.6

Source: Chinability (2010)

This research chooses to focus on FDI as a major source of capital for two main reasons:

1. It is an increasing source of capital thanks to increased global interest in the Chinese industry and their resources.

2. It is most likely foreign investment that could lead to the onset of diminishing returns, because it is increasing each year, thanks to increased interest in Chinese resources by investors all over the world. Two, because it is most

likely that capital from foreign sources could lead to the onset of diminishing
returns.

Equation 5: Change in Capital is Proportional to a Change in Output

$$\Delta Y/Y_1 = \alpha \, (\Delta K/K_1)^{*}$$

Equation 5 above illustrates changes in capital from a capital investment point of view.
For example, a capital stock with a current value (K_1) to a value of $(K_1+\Delta K)$ - this shows
a relative rate of $(\Delta K/Kt)$, where α is diminishing marginal return, our rule of thumb, for
the growth rate proportional to a change in output as displayed in equation 5.

Equation 6: Growth Rate proportional to Change in Output

$$\frac{\Delta Y}{Y_t} = \alpha \, \frac{\Delta K}{K_t}$$

For example, if the diminishing marginal return parameter $\alpha = 0.90$, with a relative
change in foreign investment of 6%, the output is:

$$\frac{\Delta Y}{Y_t} = (.90)(6\%) = 5.4\%$$

Data Sources, Collection, and Interpretation

The data used in this thesis is derived mostly from published sources, both
electronic and hard copy. The sources are academic or official documents. All data in this
paper are as accurate as in the source documents, with their interpretation done by the
researcher's inductive reasoning (see Figure 4).[4] This interpretation is done based on the
researcher's understanding of the facts.

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[*] α is also referred to as the diminishing-returns-to-scale parameter (BradfordDelong.net, 2010).

[4] Inductive reasoning is a technique used by researchers in which information collected from different
sources is used to form corresponding concepts and theories.

Figure 4: Inductive Reasoning
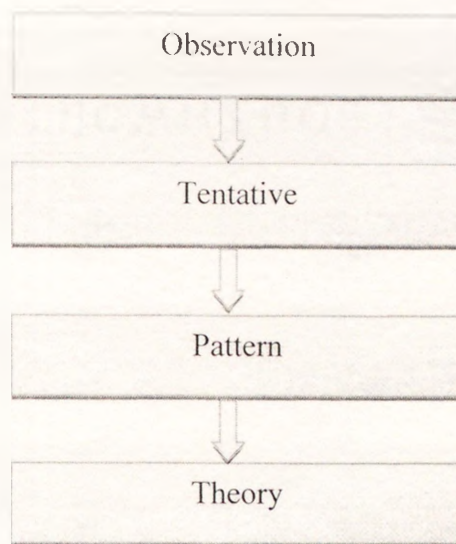
Source: Trochim (2001)

The other economic growth factors in this research that are mentioned briefly but were not discussed at length are GDP, income levels per capita and China's local capital stock. This chapter provides a breakdown of the variables to be used in this study as well as how the data used in this research will be analyzed.

RESULTS

This section of the paper will focus on analyzing the available statistics based on the variables with more depth in relation to the law of diminishing returns.

Hypothesis 1: Labor Productivity- In Detail

The table below further illustrates how China's labor productivity compares to select countries on the Asian continent.[5]

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[5] It is important to note the working and living conditions of workers in China. Workers, who live in poverty with only the basic necessities to live, may be less productive than workers with higher standard of living. However, from our perspective the extreme poverty of rural China is detrimental compare to a higher quality living in the industrialize regions.

Table 4: Worker Productivity (output) in China Compared to Productivity in Other Countries

COUNTRY	AGRICULTURAL SECTOR	NON-AGRICULTURAL SECTOR	CUMMULATIVE PRODUCTIVITY
China	476	2,519	2,995
Indonesia	160	614	774
Korea	2,368	5,857	8,225
Malaysia	1,122	2,694	3,816
Philippines	295	900	1,195
Taiwan	2,181	8,622	10,803

Source: Yang & Lahr (1999)

Using the data in Table 4, it is clear that China is not utilizing its labor resources as well as some of its neighbors. Not all parts of China, however, have the same productivity levels. Eastern China, for example, has a much higher productivity rate than the Western part, thanks mainly to legislation that created economic zones starting in 1978 (Yang & Lahr, 1999). Studies by these two authors also show that increased productivity means decreased employment levels because of the fear of diminishing returns.

An increase in the country's labor force in the short run means more workers are employed into the country's numerous sectors, and returns could increase. China, however, is known to have relatively low income levels—despite growing over 16 times in the last two decades according to (Guo, 2007)—with the average worker earning about $0.25 per hour in the manufacturing sector. This means that no matter how many workers are employed, the current poor standards of employment could cause poor worker

performance. Other factors that could lead to reduced productivity per worker are as follows:

- Low employee morale – Poor working conditions and low wages are all major causes of low employee morale. The lower worker morale is the worse workers will perform. If the number of workers increases under these conditions, productivity per worker will decrease because of increased dissatisfaction among workers.

- Rise of independent worker unions – China does not have a sufficient number of independent worker unions. According to Guo (2007), China has the largest network of trade unions in the world because of the Trade Union Act of 1992. Current union membership to these unions exceeds 30 million, however, these unions must be members of the 'semi-official All-China Federation of Trade Unions (ACFTU); meaning the government continues to exercise control over "private" unions. Other stringent measures include Article 35 of the 1982 constitution, this mandated that China's workforce would be 90% unionized and it removed of the laborers' right to strike. An increase in the labor force could cause more workers to push for reform and preempt the rise of independent labor unions.

- Increased representation – According to Chan and Senser (1997), workers in China are not adequately represented in the National People's Congress (see Table 5). The representation figures since 1978 are as follows.

Table 5: Percentage Representation of Workers in the National People's Congress of China

Year	Percentage of worker representatives
1978	27
1983	15
1988	12
1997	11

Source: Chan & Senser (1997)

As the labor force rises and more workers are employed, this figure could rise in the future. This increase will mean a rise in awareness of worker rights and therefore a higher probability of worker dissatisfaction.

Capital in China

China's economic investment policies have spurred the growth in their economy. China's large populations along with the low levels of education are constraining their economy. Investment in both physical capital and human capital are important for the long-term growth. China's economy throughout the 1980s and 1990s has been subject to economic recessions, market reforms, surging inflation, and accession to the World Trade Organization (WTO). As the investments in fixed capital such as factories and construction projects, mainly dealing with infrastructure, rose to extraordinary levels: "about two thirds of China's investment have been in construction of infrastructure such as roads, dams, public buildings, and other facilities. Most of the remainder machinery and equipment, mostly manufacturing; agriculture, which produces 50% of GDP, is only getting 2% of investment (Zheng, Bigsten, & Hu, 2006).

These unprecedented levels of investment and capital formations of 36% in 2000 increasing to 43% 2003- fueled a 9% growth in China GDP since 1995. However these large investments came at a price. At the macroeconomic level the side effect was the buildup of excess capacity which brought about to deflation (Zhang, 2006). The accumulation of manufactured goods, specifically in the automobile industries left a surplus supply which started driving the prices down. Those diminished profit margins and increased debt ravaged their industries. As secondary proof, the Standard & Poor's rating agency estimated that China's banks had approximately 40% of their outstanding loans as bad debt, an estimated $650 billion (Ward, 2005).

Another side effect of the large investment in capital-wise is the current real estate bubble in China's major cities. China's export-based economy with the world's largest trade surplus, approximately $900 billion, has been currently experiencing excessive growth both the credit and monetary supply sides. Although many believe China's export-based economy has been at the heart of its economic growth, it is dependent on artificially low fixed exchange rates. The depreciation of Chinas currency (Yuan) in order to maintain a competitive advantage for the export based economy has raised several red flags to other developed nations.

Finally the transition of China from a state owned (planned economy) to a market economy has generated additional problems. The large domestic savings rate in China has been a main factor in China's investment strategy. However individual household savings have not accounted for China's savings rate as a whole. Corporations have held half of the national savings. "Corporations have an incentive to retained earnings in order to self-finance their investments with high public savings (Zheng, Bigsten, & Hu, 2006).

China's high capital – output ratio are for the most part not comparable with previous Asian economies, such as Japan. In addition, China has not been investing in long-term research and development (R&D) in terms of technology, unlike Japan who did in the 1970s and 1980s allocated a large amount of capital in R&D. Chinese firms tend to import foreign technology by either purchasing the finish goods themselves or holding ownership positions in corporations.

Hypothesis 2: Growth Accounting, TFP Values

More and more of Chinas economic growth can be attributed to social and political reforms. According to the Development Research Center of the State Council, TFP is forecasted to grow by urbanization and capital inputs, economic reform, and technological innovation. One thing is clear from Table 6 and Figure 5 below, China's GDP growth is driven by capital inputs, subjecting TFP to diminishing returns.

Table 6: Growth Accounting Contribution to GDP Growth[6]

Period	Capital	Labor	TFP
1979-1997	37*	16*	47*
2000-2005	32*	12*	56*
	37	10	53
2006-2010	32*	10*	58*
	37	9	54
2010-2015	32*	8*	60*
	37	7	56

Source: Song & Li (2000)

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[6] As cited in (Zheng, Bigsten & Hu, 2006) TFP is forecasted after 1998 and GDP growth estimated by a 7% growth. * indicates a cost of capital share was used as weight for K. (Capital) while the other used accumulation as weights.

Figure 5: Counter Balancing Business Cycles in China
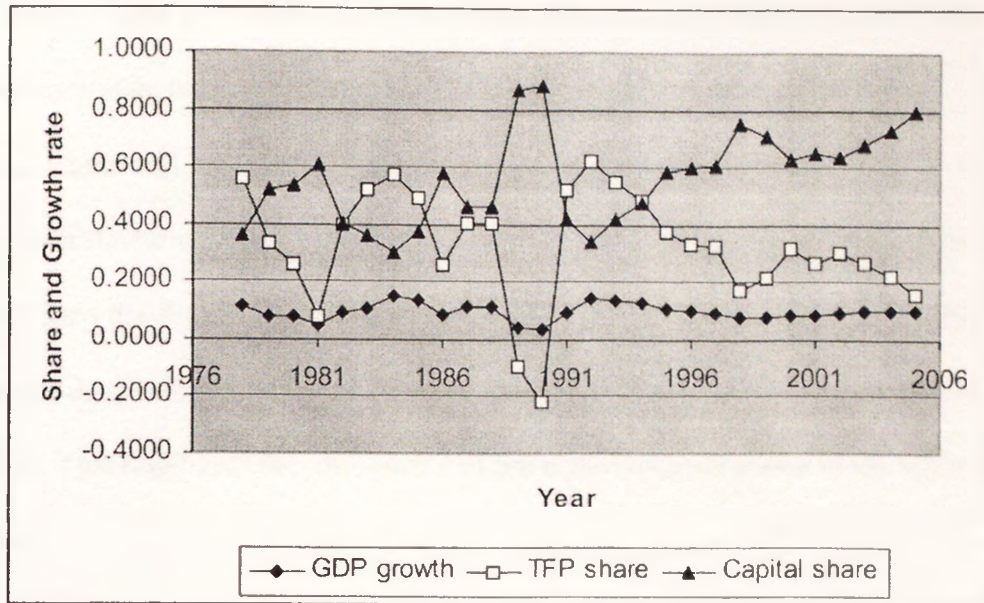
Source: Zheng, Bigsten & Hu (2006)

Technology in China

The telecommunication and manufacturing industries are definitely the leading industries in China, due to technological investment in China for the last 30 years (see Figure 6).The figure below shows the increase in revenue in the manufacturing and telecommunication industries as compared to other industries.

Figure 6: Increase in Sales Revenue of Key Sectors in the Chinese Economy
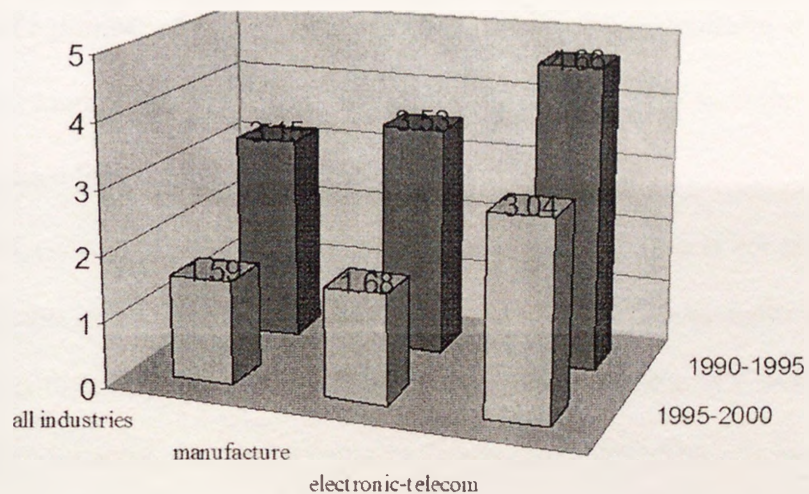
Source: World Trade Organization

The manufacturing sector in China is the fourth largest in the world after the United States, Japan and Germany, respectively Chinas manufacturing growth according to EconomyWatch, owes its success to technological advancement in the sector. However, China still lags behind technologically compared to its competitors. In spite of this, the manufacturing industry in China has made steady progress, especially since the country joined the World Trade Organization (WTO). With the sector contributing 35.3% to the gross domestic product, its registered trade value it was USD$1.15 trillion in the year 2004. This highlights the importance of the manufacturing sector to the Chinese economy.

The telecommunications industry has a remarkably similar story. The use of the Internet in China has increased over the last decade exponentially; with the number of people able to access the Internet second highest in the world after the United States (Ward, 2005). Low taxes, improvement in technology, and increased investment in the 1990s caused the sector to expand to the current level of 20 to 30 million new connections per year, compared to 10 million new connections in the United States.

The technological advancement of the Chinese economy has led to the inevitable fall in the growth of a number of other Chinese sectors, mostly the agricultural sector. TFP has led to labor market barriers in the Chinese economy from 1978 to 2006, even though action to reduce these barriers has been taken.

First, a hukou (system of residency permits) in small towns and cities is not as attractive to rural migrants as a hukou in large and medium cities (that provide better services), where reforms have not been as far reaching. Second, the ownership of a residence is a demanding condition for most +rural migrants to meet, given their relatively low income. Third, localities will likely resist reducing fees applied to migrants, given the potential

loss of revenue. Fourth, those who obtain an urban hukou can only give birth to one
child, while in many rural areas; two children are permitted (Wikipedia).

Figure 7 below shows how TFP has led to labor market barriers in the Chinese economy
from 1978 to 2006.

Figure 7: Labor Market Barriers

Source: Mark Ward (2005)

Unfortunately, not all things are as rosy as the figures quoted above show. The Internet
community in China is extremely censored by the 'Great Firewall of China' (Ward,
2005). Chinese authorities have found ways of making sure the public only accesses what
the Chinese government allows them access. Websites containing sexual content,
inflammatory information and 'taboo' content like Tibet, Tiananmen Square and SARS
are not accessible within mainland China. According to Wards' article for the BBC, the
consequences of breaking these laws are quite severe. In 2004, more than 47,000 Cyber
Cafes were shut down and several people arrested for violating Internet censorship laws.

So, as much as there is tremendous success in this sector, it still is a heavily censored realm.

Another major issue for China is foreign direct investment (FDI). China has been criticized in favoring FDI over domestic investor. This can be seen as a political move in order to prevent a rising entrepreneurial middle class, which may challenge the social political status quo.

Hypothesis 3: Direct Foreign Investment in China: Utilization and Potential

Based on the information given in Table 3, Figure 8 below shows how direct foreign investment has been utilized by China since 1984.

Figure 8: China's FDI - Contracted and Utilized
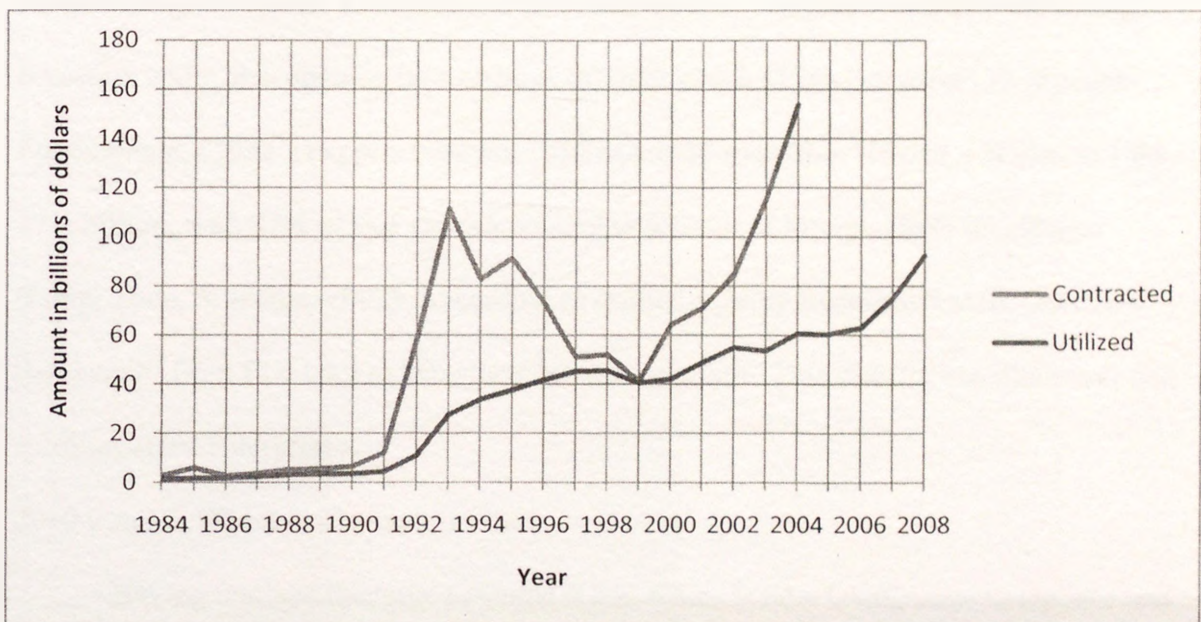
Source: Chinability (2010)

Advantages of Foreign Direct Investment

Foreign Direct Investment (FDI) is vital for the growth of any economy, and this is especially true in China. The utilization of this FDI capital once it has penetrated the

country is usually what determines whether or not a country can successfully benefit and develop.

FDI brings a number of advantages to the Chinese economy. First, the profits made by foreign companies as a result of investing in the country are taxed, and revenue generated from those taxes can be used to develop the country further and increase its GDP (EconomyWatch, 2006). FDI is partially responsible for the growth of China's GDP at an average of 9.5% annually between 1978 and 2000 (Fung, Tong, & Iizaka, 2002). Also, the country benefits from the technology imported to it. Most foreign investors import their own technology and then train the local personnel within China how to use the technology. The Chinese labor force learns how to use the foreign technology without the need to go overseas. In addition, China benefits from the jobs created by the foreign investors while also opening up a channel through which China can export its products. , For example, China's exports between 1980 and 1985 rose from US$ 18.1 billion to US$ 27.4 billion, with 97% of that growth coming as a result of foreign direct investment (Fung, Tong, & Iizaka, 2002). According to studies done by EconomyWatch, countries that benefit from FDI tend to keep their interest rates low. This directly benefits small and medium-sized enterprises.

2010 Foreign Direct Investment in China

Having realized the huge potential it has, China is now taking steps to tap into and expand certain sectors to further attract FDI. In order for these laws to be formulated and implemented, China must first undergo a number of reforms, both politically and socially. China is generally considered by the Western world as dictatorial, a fact reiterated recently when the Chinese president Hu Jintao visited the United States (2011).

China also does not have the best human rights record in the world, with the number of state executions carried out in China higher than those carried out by any other country in the world. The Dui Hua Foundation estimates that in 2007, between 5,000 and 6,000 people were executed in China (Fan & Cha, 2008). The exact number of people executed is kept secret by the state, making it hard to defend China's position on human rights. The country needs to become more liberal and democratic as well as improve its human rights scorecard for it to become more attractive to foreign investors.

Nevertheless, half of the Chinese exports today are produced by companies owned by foreign investors manufacturing in China (Yadav, 2010)—this number is expected to rise. FDI in China has grown by 24.7% in April 2010 as compared to April 2009. This amounts to $7.35 billion in a month. The increase is 12.1% in the foreign direct investment in March 2010 (Yadav, 2010). Such explosive growth can only help increase output, as seen when illustrating the Cobb-Douglas function.

Total FDI in China is concentrated in factories, manufacturing, real estate and other assets, foreign investments in the stock market and other financial bodies are only starting to appeal to foreign investors. The Chinese government is also determined to encourage FDI in high-tech and a renewable energy industry because of China's deteriorating environmental conditions. This is a result of China's 2009 pledge in Copenhagen to reduce its carbon emissions.

This chapter presents a summary of the findings from the different sources of data with a brief analysis of what the results mean in relation to the core theme of economic growth. The next section discusses the impact of these statistics on China's economic growth, using growth accounting as guiding theme.

DISCUSSION

Table 7 below summarizes how the variables of growth accounting have

accounted for the various sources of growth in major sectors in the Chinese economy.

Table 7: Sources of Growth by Major Sector (agricultural & services), 1978-2004 (% Growth periodically)

| Period | Output | Employment | Output per worker | Contribution of | | | |
				Physical capital	Land	Education	TFP
AGRICULTURE							
1978-04	4.6	0.3	4.3	2.3	0.0	0.2	1.8
1978-93	5.2	0.9	4.3	2.5	-0.2	0.2	1.8
1993-04	3.7	-0.6	4.3	2.1	-0.2	0.1	1.8
INDUSTRY							
1978-04	10.0	3.1	7.0	2.2		0.2	4.4
1978-93	9.3	4.4	4.9	1.5		0.2	3.1
1993-04	11.0	1.2	9.8	3.2		0.2	6.2
SERVICES							
1978-04	10.7	5.8	4.9	2.7		0.2	1.9
1978-93	11.3	6.5	4.7	1.8		0.2	2.7
1993-04	9.8	4.7	5.1	3.9		0.2	0.9

Source: Accounting for Growth: Comparing China and India (2007)

Growth in the industrial sector is not a surprise. Results show how China has invested

heavily in its industrial sector. According to Fung, Tong and Iizaka (2002) the growth

trend is expected to continue at the same rate. However, the agricultural sector seems to

be facing a different problem. There is a reduction of agricultural labor occurring, since

most of the populations are moving to urban areas in search of work. The populations left in rural areas are old and incapable of coping with the pressures of food production. Based on the results seen of Chapter 3, this research has come up with the following conclusions.

- Since China's labor productivity, per-capita GDP and income levels are still low, the country still has the potential to grow and maintain its rapid growth rate of approximately 10% per annum. The continued FDI and increases in technological advancement will go a long way in influencing this increase.

- China needs to utilize its labor as well as its FDI more efficiently in order to sustain its growth. If the country fails to do so, then with time it will be affected by diminished returns.

China and Diminishing Returns

Whether China will become the largest economy or not is a matter of huge debate among economists. While some schools of thought hope that this will happen, others believe China will become victims of diminishing returns like Japan and Russia. Over the last decades (especially in the late 1980s and early 1990s), Japan experienced unprecedented economic growth which had not been seen before in any other developed or developing country. With a booming manufacturing industry, a population with the majority in their prime age for work and excellent policies, Japan was slowly becoming the largest economy in the world and had been predicted to surpass United States by 2010. Russia, with the second largest oil and gas reserves in the world, was also affected hugely by diminishing returns.

Japan's economy was devastated by the bursting of the real estate bubble that crippled most sectors of the economy. At the peak of the bubble, values of most assets were grossly overvalued, unemployment was at an all-time low, and the country enjoyed tremendous prosperity. The government was very confident in the economy. Its confidence was demonstrated by it issuing 100 year bonds (Gao, 2001). However, by 1992, the bubble burst, and the house of cards began to fall. In January 1993, the government, under Prime Minister Kiishi Miyazawa, finally conceded that the end of economic prosperity was looming and that it was time for Japan to begin restructuring its economic and financial system.

The problem in the Japanese economy was a classic case of diminishing returns. Despite the investment that had been pumped into the country, the output that resulted from capital investment in technology and businesses was not as high as had been anticipated. The returns were not proportional to the input. Unemployment rose due to companies downsizing after the massive overstaffing which occurred during the bubble (Gao, 2001). Loss of morale, with the number of people unemployed reaching 3.42 million in 1999, decreased productivity in Japan compared to the productivity levels of its major competitors like the US, Germany, and China.

The Russian economy experienced diminished returns much similar to Japan's. However, the decline of the Russian economy was more a result of political influence than anything else. Russia was greatly affected by the Cold War, the dissolution of the Soviet Union and negative economic pressure was a result. Foreign investors could not cope with the changing political, social, and financial environments. Many pulled out

their investments from the Russian economy. The increased lack-of-confidence in the West—Russia's main market— resulted in loss of national income (Dyker, 1992).

Compared to Japan, China currently does not have an economic bubble somewhat in real estate. The Chinese government raised interest rates and purchased mortgages to slow down real estate purchases, and most of its policies are extremely conservative. In addition, the cost of production in China is much lower compared to Japan. This allows China to remain competitive in the world market, as witnessed by the number of items that are exported out of the country each year as well as the number of investors turning to China as a center of manufacturing. Additionally, China is allowing more foreign and domestic investment in both public and private institutions each year. For these reasons, China may not experience diminishing returns, at least based on current available statistics.

Politics in China, much like Russia, could be a stumbling block to development. The laws in the country, especially laws linked to freedoms and human rights, are still viewed as abysmal and unfair by Western countries. In addition, the country's environmental conservation scorecard is one of the worst in the world. In Copenhagen 2010, it was revealed that China is the most environmentally unfriendly country after the United States. Although China may claim it is still a developing country, if it does not change the perception other countries—especially in the West—it could be negatively affected.

Total Factor Productivity

An empirical study by Young Xu in 1999 showed Chinese growth in the agricultural sector during the period of reform. The studies found growth similar to those found in other fast-growing economies—even after adjusting for the large increase in the labor force. After adjusting for a rise education and transition of labor out of the agricultural sector, Young Xu found non-agricultural labor productivity grew 2.6% and TFP growth of 1.4% a year. Studies of China's TFP capture similar results with mild differences. Reform in 1970s and 1980s from the agricultural sector surge improved efficiency from state owned firms and Township Village organizations. With incentives, the population migrated out of agriculture due to better educational attainment. This resulted in an increased labor force. Because of all the factors behind China's political reforms, it is hard to dispute that the long-term growth potential will not be sustained at current rates nor levels seen in the past, save the Chinese economy and government undertaking further reforms.

The following are conclusions by related studies; concluding diminishing returns in China's TFP (see Figure 9 & 10).

1. Zhang (2002) found a downward trend of cumulative economic growth from 1993 to 1998, stating that it was becoming increasingly difficult to sustain such high GDP growth for a fixed increase in investment.

2. Jefferson, Gary. (2000) found long-term productivity growth persisted amid decay rates during the 1990s in his studies of industrial productivity from the 1980 to 1996.

3. The Organization for Economic Co-operation and Development (OECD) estimated annual TFP growth slowed down in 2005 from previous period. From 1978 to 2003 average TFP growth in China was 3.7%, but it diminished to 2.8% by the end of the period (OECD, 2005), indicating diminishing returns in TFP from 1993.

4. Zheng and Hu (2006) discovered in their study of China's growth, TFP diminished during 1995 – 2001, accounting for 7.8% of national GDP. Whereas TFP had risen by 3.2 – 4.5% per year before 1995, it rose only 0.6 – 2.8% per year after that (Zheng, Bigsten, & Hu, 2006).[7]

Figure 9: GDP & TFP Values from 1952-2005
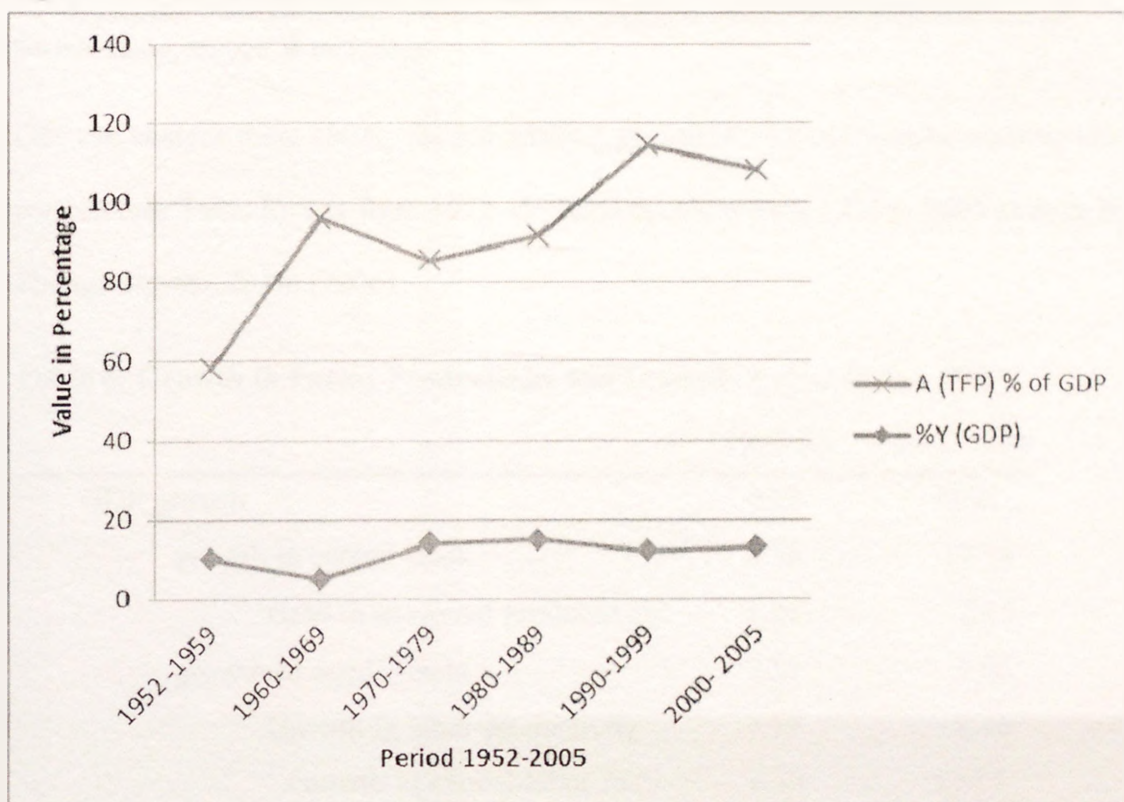
Source: Authors calculations

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[7] Empirical study of Chinas labor and capital formation from 1952-2005 using the Solow Growth Model, show similar results for China TFP compared to GDP. Results attest to diminishing returns in China's TFP. The diminishing returns on TFP are mainly due to the inefficiency and sluggish income growth in rural areas. But the economy has not shown signs of slowing down, a more concrete comparison of the factors affecting the economic growth: capital, labor, TFP among other things.

Figure 10: TFP Values from Numerous Studies
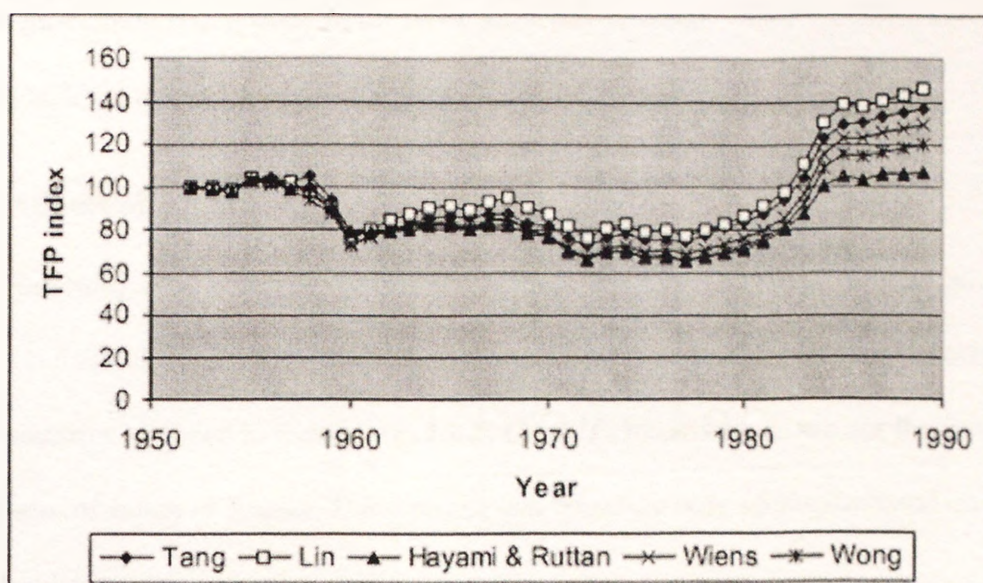
Source: Zheng, Bigsten, & Hu (2006)

One can analyze more clearly the diminishing growth of TFP in China by viewing two periods (see Table 8): one from 1978-1993 and the other from 1993 to 2005 as done by Zheng, Bigsten, & Hu (2006).

Table 8: Growth in Factor Productivity and Capital / Labor Ratios (%)

	1978-93	1993-2004
GDP growth	9.88	9.91
growth in capital stock	8.76	12.34
Growth in capital productivity	1.01	-2.15
growth in employment	2.51	1.06
Growth in labor productivity	7.19	8.76
Growth in capital-labor ratio	6.10	11.17

Source: Zheng, Bigsten, & Hu (2006)

GDP, the primary driver of growth from 1993- 2004 was by a 12.34% growth in capital stock, which leads to the high growth in capital / labor ratio, this allowed labor

productivity to spike. The growth in TFP was mostly due to capital injection and some labor movement but, growth in the labor force has declined. Other variables are not fully being utilized to sustain high TFP growth in the economy.

Limitations of the Study

This study is not completely conclusive because of the following limitations.

- It is difficult to predict the future of an economy based on the progress of other countries. As seen in Subsection 4.1.1, China's circumstances are not the same as those of Japan or Russia. The research can therefore only speculate based on currently available data.

- The extent of this study is extremely wide, and therefore it cannot fully integrate all the aspects of growth accounting to determine a completely airtight study.

China: The Future

The growth of the Chinese economy is not as promising as it sounds. There are many factors to consider (see Figure 11) and as Gordon Chang sates in his book, The Coming Collapse of China. The country cannot have a $123-trillion dollar economy as predicted by Goldman Sachs, and there are several reasons why.

- First, the education system in China is not competent enough for modern society. Therefore, China cannot compete in the future with other countries.

- The role of consumer spending in China is not high because the government, according to Chang, concentrates too much on industrial and economic development. At its root, China is still not a market-driven economy.

- According to Chang, the economy of China cannot sustain its population growth, and according to the research he has done, the country will not be able to provide enough water for its population by 2025.

- Demographically, China also has problems of its own. After the one-child policy was enforced, the country's birth rate fell 42% between 1990 and 2007. This means that by 2025, the country will have a population of some 25% over the age of 60. This means that there could be a great decrease in labor supply.

These factors point to the fact that China could be affected by diminishing returns.

Figure 11: Growth in Input, Output and TFP (1978-2004)
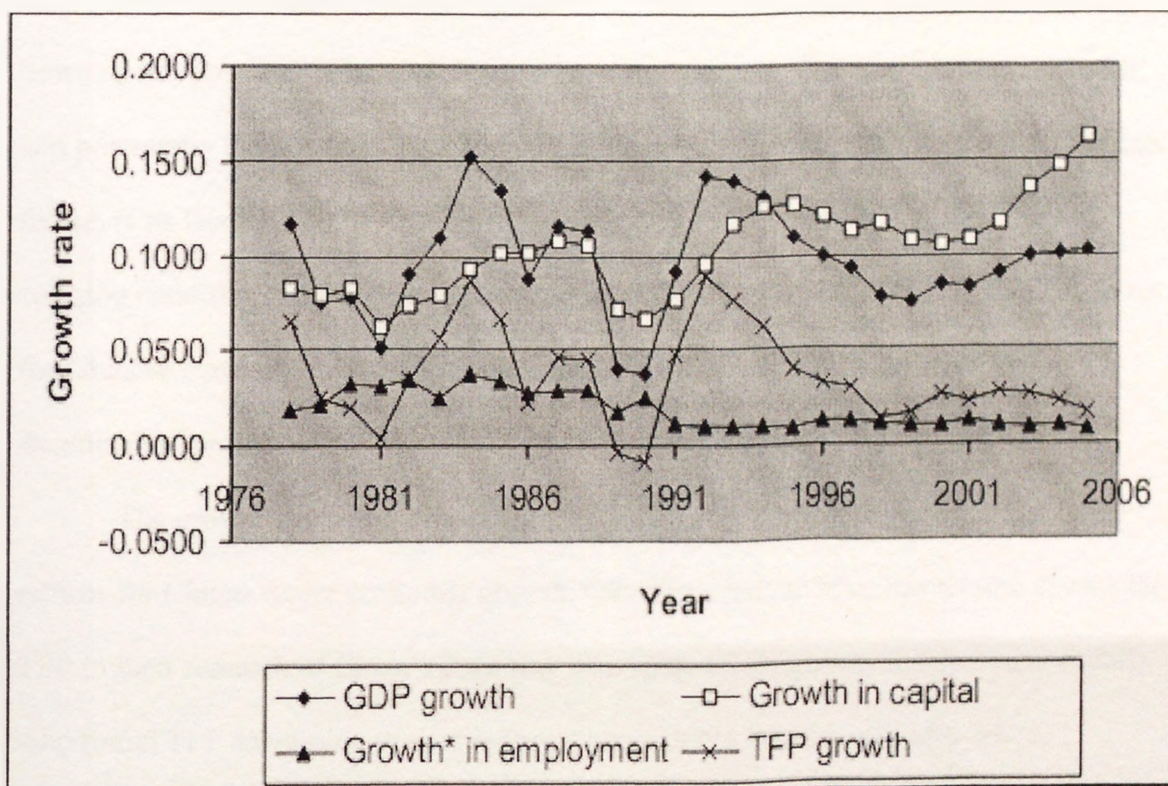
Source: Source: Zheng, Bigsten & Hu (2006)

CONCLUSION

This paper's aim is to find out whether or not, based on the growth accounting variables, China will be affected by diminishing returns in the future. The paper has looked at the variables, discussed how they operate in China, and how they affect its economy.

China has the potential to become the largest economy in the world based on its current economic climate. The room for growth is enormous, and conventional wisdom states that China has barely scratched the surface in reaching its full productivity potential.

However, as witnessed in every economy in the world, growth rates tend to slow down as full potential is reached due to diminishing returns. The thorn in China's thigh, and potentially the greatest threat to its economy overtaking the Unites States' in the near future, is its labor issues. If China's people begin to demand better wages and better working conditions; and the international community begins to have greater influence on the Chinese currency, then the Chinese economy will definitely be affected by diminishing returns.

The growth accounting results and decreasing TFP values indicate diminishing returns for Chinas future economic growth. Other economists have had similar results for TFP in their research of China's economy (see Table 9). Originally it was Zhang (2002) who found TFP decreasing in post reform China (1989). Specifically after 1992, economists have estimated a diminishing trend of TFP. Table 9 shows the estimates from other scholarly studies.

Table 9: Diminishing Return of China's TFP in Various Studies

Source	Period	TFP Growth (%)
Zhang and Shi (2002)	1977-88	4.1
	1989-98	2.1
	1992-98	3.6
Zheng and Hu (2004)	1978-95	4.64
	1995-2001	2.28
OEDC (2005)	1979-96	4
	1997-2002	3.2
Kuijs and Wang (2005)	1978-93	3.7
	1993-2004	2.7
Jefferson, Rawski and Zhen (1996)	1984-88	3.68 (4.52)
	1988-92	1.58 (2.98)
Zheng, Bigsten, Hu (2006)	1978-93	4.27
	1993-2005	3.21
Raul Ballester (2011)	1970-1979	1.33
	1980-1989	2.43
	1990-1999	2.96
	2000-2005	0.86

Source: Zhang (2006) and authors calculations

As mentioned previously, China has maintained a high growth rate (approximately 9%) in the 30 year post reform period, which was fueled by political and economic reforms. The Chinese economic growth is similar to that of the Soviet Union and East Asian Tigers. The relationship between growth and political stability is never a linear one, such growth under a decentralized authoritarian system is costly (Zhang, 2006). Figure 12 shows how TFP shows diminished returns from 1987 to 2001, but China's GDP growth has not shown signs of decreasing. If China is to achieve long term economic growth it must lower corruption, establish a sound market-based financial system, promote domestic innovation and entrepreneurship, and invoke future institutional, economical, and political reforms. Externalities of China's disparity among

regional income, macro-disruption, and inflation have begun to affect the potential future growth of GDP (Chang, 2001).

Figure 12: China's TFP and GDP Growth
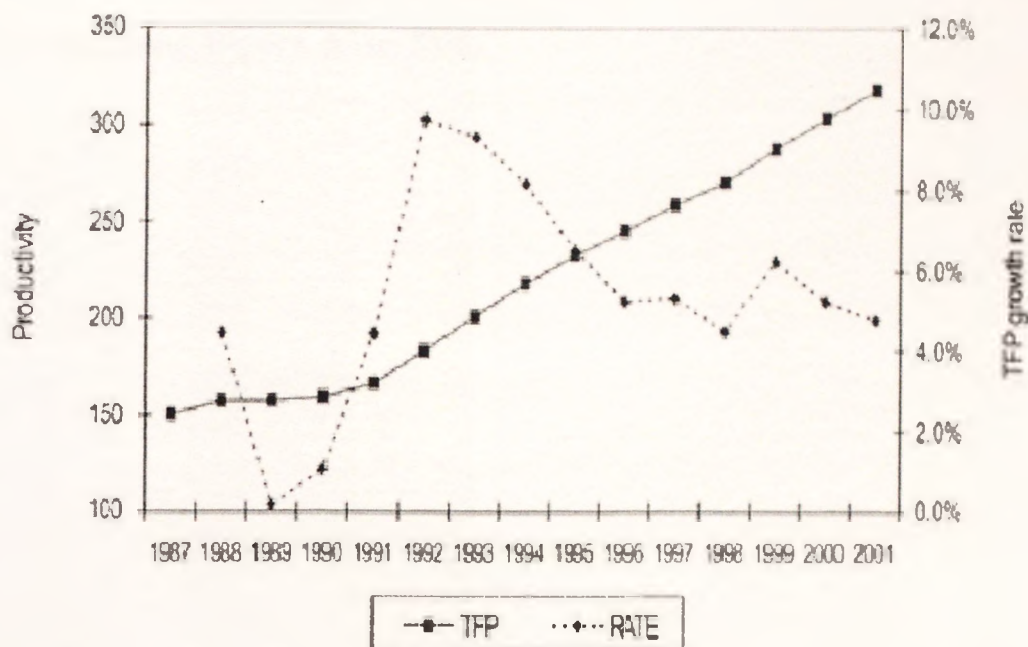
Source: Adopted from Zhang, Wan, & Jin (2007)

China's dependency on exports for economic growth alongside political reform is an unsustainable long term growth strategy. Dunaway and Prasad, 2006 argued the same. As Chinese companies have improved their performance, and corporate savings have risen and now accounts for almost half of national saving, domestic production and demand is a more sustainable model for China. The short-run gains of economic growth China has experienced since 1995 has focused on capital inputs while sacrificing output.

Ultimately this model has failed; China resembles the Soviet Union. Under Stalin a nation growing by a massive mobilization of inputs instead of output. The Soviet Union could only sustain a Gross National Product (GNP) growth of 4-5% a year, while China

maintains 9% growth rate.[8] Technological access and globalization have given China a

competitive advantage by making information more easily available at a cheaper price.

China has experienced 2-3% yearly growth compared to the East Asian Tigers of about

1% growth (Zheng, Bigsten, & Hu, 2006).

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[8] This is mainly attributed to Chinas political reform- moving from a planned economy to a market economy, reaffirming China's economic growth is based on short term mobilization of inputs and/or political- economic reforms.

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APPENDIX A

The main variables in this study of China's economic growth were the components of growth accounting: capital, labor, GDP. The main sources of these numbers were PENN World Tables 2005. Although data up to 2005 was measure in some areas, this was for comparison and accuracy purpose with other research.

Labor we can define as the number of employed workers. This figure was very complicated to calculated and be accurately applicable to the Solow Model. The China World Statistical Book shows a large increase of the labor force in 1990. Roughly a 16.7% increase from 1989 to 1990. There is a lot of mystery in Chinas employment numbers. Data was taken from the World Bank Data.

Capital is the accumulated investable capital at a constant price (Chinas capital stock). Data for fixed capital investment was taken from Zheng, Bigsten, and Hu (2006) who updated their research from Kuijs (2006), who based his research on Wang and Yao (2003). Data was also cross reference with numbers from Statistical Yearbook 2009.

GDP was measure for aggregate output at a fixed price for the Chinese economy. Figures were taken from PENN World Tables and The World Bank which were accurately compared to Zheng, Bigsten, and Hu (2006).

PENN WORLD TABLES

country	year	Population	ppp/GDP	total real gross GDP	total real GDP per capita	Investment Share of GDP	Real GDP per capita	Investment share of real GDP per capita	growth rate of real GDP per capita
China Version 1	1952	574536	2.79982112	24625.66831	42.86181644	17.704011	285.3104914	15.89979207	
China Version 1	1953	584191	3.1015197	26837.67345	45.9398676	20.60731313	300.2897504	19.1014233	5.46065956
China Version 1	1954	594725	3.108050501	28059.98385	47.18145564	22.17612349	304.4165866	20.94805676	1.681664145
China Version 1	1955	606730	3.053426032	30270.19432	49.89074478	20.28995742	311.2813413	19.4457092	2.14216916
China Version 1	1956	619136	3.038361942	34332.90702	55.45293838	21.89365977	344.1980986	19.87922291	10.65107232
China Version 1	1957	633215	2.905971667	37298.08931	58.90276724	22.89710064	352.6246176	20.74590829	2.526455682
China Version 1	1958	646703	3.033898884	43460.29179	67.20285305	30.20737763	391.7954831	27.81414775	11.74974692
China Version 1	1959	654349	3.078443618	46344.97236	70.82603	40.92712847	404.6690126	37.08105733	3.789585349
China Version 1	1960	650661	3.106510361	45945.60261	70.61378659	38.00792477	401.4346225	34.40857492	-1.064318412
China Version 1	1961	644670	3.274074067	37644.16392	58.39292645	21.29188166	331.7086325	19.62554758	-18.14661855
China Version 1	1962	653302	3.14673921	37744.91133	57.77558514	14.24166117	326.1443486	13.02267937	-1.926317779
China Version 1	1963	674249	3.020729481	41488.93713	61.53358047	19.17475545	342.2205816	17.50185293	5.152463744
China Version 1	1964	696065	3.078348132	47852.39653	68.74702927	22.49758968	373.7895047	20.54314894	9.377430511
China Version 1	1965	715546	3.131991075	54963.35923	76.81312459	25.36737434	407.6643984	23.8881299	9.242758485
China Version 1	1966	735904	3.012057662	61881.83299	84.08957008	28.33695067	426.7194101	27.1072294	4.747822819
China Version 1	1967	755320	2.9471357	61371.72937	81.25260778	22.16052351	402.0258806	21.12224405	-6.0259335
China Version 1	1968	776153	2.830932027	61952.70496	79.82024519	22.66727702	380.5346296	21.71619439	-5.329316478
China Version 1	1969	798641	2.724719149	71910.22583	90.04079446	23.34406794	407.4500768	22.38732434	7.192593633
China Version 1	1970	820403	2.658563838	84733.71916	103.2830085	31.24722193	440.6584902	30.3361417	8.317583929
China Version 1	1971	842456	2.532333261	95816.77132	113.7350888	31.76994438	460.9103244	30.84246107	4.573414623
China Version 1	1972	863439	2.457419075	102469.2976	118.6757739	30.02494935	461.8487014	28.74041515	0.181527313
China Version 1	1973	883020	2.288821781	118877.7569	134.6263829	31.7665427	501.3583956	29.61636461	8.60921102
China Version 1	1974	901318	2.08426882	133855.0902	148.5103821	31.70491112	502.3336441	29.88545139	0.183481802
China Version 1	1975	917899	1.919609661	156141.1208	170.1071682	33.44063326	527.2163878	31.34384091	4.998358594
China Version 1	1976	932589	1.763015772	166969.5736	179.0388076	31.16432072	525.5735808	28.811229	-0.401733848
China Version 1	1977	946094	1.703823342	187924.4099	198.6318975	31.79504561	546.8102048	29.89019774	4.086627245
China Version 1	1978	958835	1.580302062	227808.6855	237.5889981	35.62681664	613.4447363	32.88800294	12.25741064
China Version 1	1979	972137	1.496032243	272398.8376	280.2062596	33.67753232	665.7309279	31.04499486	8.4148565
China Version 1	1980	984736	1.40708947	326275.7691	331.3330849	33.05874523	715.435883	30.21325119	7.45817016
China Version 1	1981	997001	1.315709872	381276.3448	382.4233402	30.40910391	760.3921538	27.84888298	6.186588759
China Version 1	1982	1012490	1.24533634	450720.1064	445.1598427	29.3428679	836.4055926	27.06815521	9.977645664
China Version 1	1983	1028357	1.2101827	514332.7782	500.1502501	29.71589865	900.7004676	27.90303158	7.691335532
China Version 1	1984	1042756	1.218448316	603830.3464	579.0715349	30.69748178	999.511931	28.74092836	10.95915745
China Version 1	1985	1058008	1.275761443	711206.37	672.212838	34.50723239	1104.61919	32.87883576	10.62402317
China Version 1	1986	1074523	1.33156901	786322.7642	731.7880436	34.29080048	1168.203308	32.54657708	5.744220397
China Version 1	1987	1093726	1.363511855	899364.4789	822.294355	33.49247825	1264.823585	31.58721798	8.284081548
China Version 1	1988	1112866	1.51789343	1010110.427	907.6654862	34.71576386	1343.56409	33.02834971	6.320648808
China Version 1	1989	1130729	1.611284243	1075157.193	950.8527693	34.45388782	1351.349451	32.8569933	0.544288961
China Version 1	1990	1148364	1.620023694	1202930.331	1047.516152	32.15787174	1413.0026	31.02865694	4.486631696
China Version 1	1991	1163607	1.674940441	1357590.094	1166.708169	31.19647199	1514.085525	30.47598677	7.030536526
China Version 1	1992	1177482	1.784624959	1555728.664	1321.233978	31.28355272	1676.694628	30.81381554	10.70073282
China Version 1	1993	1190571	1.95632538	1885422.955	1583.629624	36.74041161	1971.870397	36.01903163	17.8234262
China Version 1	1994	1203434	2.3254324	2169902.788	1803.093217	36.62846742	2161.928982	37.08929146	9.738415546
China Version 1	1995	1215787	2.588754978	2455315.26	2019.526713	38.39269532	2352.931935	38.69183574	8.944088836
China Version 1	1996	1227767	2.724118569	2722481.566	2217.424458	37.27799143	2555.547175	38.26347856	8.587033651
China Version 1	1997	1239459	2.809670823	2906336.903	2344.842934	34.45697807	2640.107253	36.13124489	3.26011111
China Version 1	1998	1250366	2.793370223	3097749.066	2477.47481	33.84459853	2805.535314	35.5400372	6.266361302
China Version 1	1999	1260107	2.686335576	3386177.84	2687.215081	34.68473583	3004.228856	36.00660649	7.076607251
China Version 1	2000	1263638	2.684789879	3678090.445	2910.715288	34.58327243	3199.741875	34.95288488	6.513736142
China Version 1	2001	1270744	2.684994498	4060641.468	3195.483487	35.18067743	3447.836456	35.84974958	7.775904274
China Version 1	2002	1277595	2.647260539	4550953.645	3562.125435	36.31881115	3760.726333	36.8493091	9.087876679
China Version 1	2003	1284303	2.677119988	5103798.135	3973.98288	38.35082129	4150.46053	38.94370464	10.41798155
China Version 1	2004	1291002	2.782457199	5779068.23	4476.420819	39.51187395	4592.823734	39.69359182	10.66993328
China Version 1	2005	1297765	2.779051001	6733640.367	5188.643835	38.74122861	5188.643835	38.74122862	12.97607407

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THE WORLD BANK DATA

Country Name	Time	Unemployment, total (% of total labor force)	GDP growth	GDP per capita growth
China	1990	3.0%	4	2
China	1991	2.0%	9	8
China	1992	2.0%	14	13
China	1993	3.0%	14	13
China	1994	3.0%	13	12
China	1995	3.0%	11	10
China	1996	3.0%	10	9
China	1997	3.0%	9	8
China	1998	3.0%	8	7
China	1999	3.0%	8	7
China	2000	3.0%	8	8
China	2001	4.0%	8	8
China	2002	4.0%	9	8
China	2003	4.0%	10	9
China	2004	4.0%	10	9
China	2005	4.0%	11	11
China	2006	4.0%	13	12
China	2007	4.0%	14	14
China	2008	4.0%	10	9
China	2009	NA	9	9

Country Name	Time	Labor force, total	Stocks traded, total value (current US$)	FDI, net inflows (% of GDP)
China	1990	643,917,506	NA	1
China	1991	654,571,388	820,000,000	1
China	1992	663,144,360	16,714,999,808	3
China	1993	671,118,115	43,394,998,272	6
China	1994	679,208,236	97,525,997,568	6
China	1995	687,521,021	49,774,000,000	5
China	1996	695,235,431	256,008,000,000	5
China	1997	703,319,447	369,573,870,000	5
China	1998	710,801,655	284,769,620,000	4
China	1999	718,587,712	377,098,900,000	4
China	2000	725,958,180	721,537,720,000	3
China	2001	734,043,256	448,928,420,000	3
China	2002	741,714,317	333,368,700,000	3
China	2003	748,423,535	476,813,030,000	3
China	2004	754,509,378	748,273,990,000	3
China	2005	760,627,001	586,300,810,000	4
China	2006	766,465,176	1,635,120,600,000	3
China	2007	771,078,938	7,791,702,080,000	4
China	2008	776,880,961	5,470,529,157,182	3
China	2009	NA	8,956,187,659,298	2