

# *Comparing the Determinants of Economic Growth of 5 Developed Countries and China*

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**Abstract:** Many previous empirical study make contributes on figure out determinants of economic continually growth. This paper chooses data from five developed countries (France, Germany, Japan, UK and USA) and one developing country (China), using regression models to test the real difference between two groups. The test result shows capital, education and labor force gives positive effects on 5 developed economics; labor force, research and development and saving make China's economic grow up. The analysis of the result will focus on the concretely detail of each model. This paper also shows the relationship between these independent variables and dependent variable by graphs and tables.

## **1. Introduction**

Economic growth is an attractive topic for a long time. It consisted with countries' long-term development, people's living standard, and the social welfare. Long times ago, politics, scholars and people interested in made great efforts on figuring out the factors that can determine the growth of economic.

This paper introduces three important theories: classical, neoclassical and endogenous economic growth theories; two important empirical studies from Barro (1995) and Mankiw (1992) and many other studies from scholars. From these prior studies, this paper build up two regression model tests on the data from five developed countries and one developing country. In these two models, independent variables are capital, education, labor force, research and development, and saving; the dependent variable is GDP growth. The five developed countries here are France, Germany, Japan, United Kingdom and United States. The developing country is China. By the test, this paper is going to find out the specific determine of each group, and the common determines of two groups. Then this paper makes a discussion on the test results, and analysis on details of them.

## **2. Literature Review**

## 2.1 Classical Growth Theory and the Harrod-Domar Model

As the founder of classical economic system, Adam Smith (1772) believed that the economic growth of one country is mainly depending on labor division, capital accumulation, and technological progress. The market makes a huge influence on the social division of labor. The wealth comes from labor that can be divided into productive and non-productive labor. Productive labor can create value and increase social wealth. Adam Smith's non-productive labor view appears to be controversial now. He thought non-productive labor does not increase social wealth. This is caused by historical limitations. With the development of modern times, non-productive labor made more distribution and play a very important role in economic growth now.

Adam Smith believes that national productivity is affected by labor quantitative and proficiency. On the one hand, it depends on whether labors have skills, judgment and familiar with them or not; on the other hand, it depends on whether the ratio of productive labor to non-productive labor is increased or not. Capital accumulation can come from employing more producers to engage in production process. An increase in number of producers in turn promotes the division of labor and the proficiency of producers, then leading to further economic growth. The division of labor makes the technical level increase, resulting in an increase in production efficiency. In short, the drive force for economic growth is the increase in the input of production factors and the increase in production efficiency.

Harrod(1939)-Domar(1946)'s economic growth model is a model proposed by economists Harrod and Domar on economic growth. This model is the first mathematical model of economic growth, which has promoted the data analysis of economic growth. The assumption is that the number of people in the society has a fixed growth rate and the same savings rate. There is no technological progress or capital depreciation. The production of a product only has two factors: capital and labor. The capital output rate remains unchanged. The basic model is:

$$G=S/V$$

In the model, G is the economic growth rate, S is the saving ratio, and V is capital to output ratio. From the formula, we can see that when a country's saving rate is equal to the amount of investment, and its capital to output ratio remains the same, the economy can maintain a balance growth.

## 2.2 Endogenous Growth Theory

Endogenous growth theory can be divided into two phases. The first stage focuses on the importance of labor and knowledge under the assumption of completely competition. Endogenous human capital means to improve the quality of workers' skills through the spillover of knowledge. The second stage is under the premise of monopolistic competition. Under the conditions of monopolistic competition, there are many external factors that affect economic growth, including institutions, government behavior, and investment in research and development. It is believed that government intervention is necessary. There are three main types of endogenous economic growth models: the first is the AK model (cumulative knowledge model), in which the accumulated capital in production represents the level of knowledge; The second is the R&D model (research and development model), and it is believed that technological progress depends on the input of the research and development department. The third type is the model which studies economic growth based on the perspective of specialization and division of labor.

The assumption of AK model is very simple. Generalized capital is the only factor that determines production. It includes human capital and material capital. The form of the AK model can be expressed as

$$Y=AK$$

Where A is the technical level and K is the generalized capital. The material capital and human capital are all included in generalized capital K. The capital per output and marginal output are about the technical level A. The AK model integrates the input factors of production into one. In AK model, capital and the marginal remuneration of capital are constant. With the accumulation of capital, the economy will maintain growth.

A representative of the R&D model was Romer (1990)'s <<Inherent Technology Change>>, which proposed the economic growth model. Unlike the previous AK model, the technical level is not integrated in the generalized capital, but requires input in R&D to make production progress. The assumption of the model premise is that technology is endogenous. How the technology is endogenous is considered that the market-driven behavior is the technological progress. Knowledge is a commodity once it is produced; it is costly to use it and can be reused for free later. The Romer model is based on the Cobb-Douglas production function, assuming that the level of human capital is fixed. Its four input elements are capital K, labor L, human capital H, and technical level A. Capital here is tangible capital inputs for continuous interval

$$K = \int_0^A X(i) di$$

Where x(i) denotes the number of ith inputs in the production process. The increase in investment in production leads to an increase in the amount of capital; the increase in the level of technology results from the specialization of inputs in production factors, which is manifested in the strengthening of social division of labor. The production function is expressed as:

$$Y(H, L, X) = H_1^\alpha L^\beta \int_0^A X(i)^{1-\alpha-\beta} di$$

### 2.3 Barro's Empirical Study

Barro (1996) made an empirical study on determinants of economic growth based on a cross-country data. The panel data of 100 countries is from 1960 to 1990. The study is concentrate on figuring out the relationship between real per capital GDP and some independent variables. The whole study separates to three parts. The first part is about economic growth and convergence. This part of study is based on neoclassical and endogenous growth theory. The model is

$$Dy = f(y, y^*)$$

In this equation, Dy is the growth rate, y is the current output, y\* is long-term output. In the regression model, the independent variables are initial level of GDP, initial level of human capital, fertility rate, government consumption, the role-of-law index, trade terms, regional variables, and investment ratio. The result of this regression is: low fertility rate, low government consumption, higher role-of-law index, more trade terms can help with economic growth. But initial level of GDP has a negative relationship with economic growth.

The second part of this study is about the political factors with economic growth, it discusses the relationship between economic freedom and effects of democracy with economic growth. The equation is

$$DEMOC_{it} = a_0 + a_1 Z_{i,t-T} + a_2 DEMOC_{i,t-T} + u_{it}$$

T is time lag, t is time period, i is the country, DEMOC is indicator of democracy, Z is variables. In the regression model, the independent variables are democracy, life expectancy, school attainment, urbanization rate, natural resource, population, and income distribution. The test result shows: democracy and political freedom have very little effect on economic growth, but when the country in a low level of political rights, the increase of political rights can accelerate economic growth.

The third part of this study is to make sure inflation makes an influence on economic growth or not. The database used here is from consumer price indexes. The theory is endogenous theory, and the equations used in this study are:

$$\pi_t = \mu_t - g_t + v_t$$

$\mu_t$  is the money growth rate,  $\pi_t$  is the inflation rate,  $g_t$  is the output growth rate,  $v_t$  is an independent shock to velocity.

$$g_t = -\alpha\pi_t + \varepsilon_t$$

$\varepsilon_t$  is an independent shock,  $\alpha$  is the estimated coefficient.

In this OLS regression, the relationship between coefficients is:

$$\hat{\alpha} = - \left\{ \frac{\alpha * [VAR(\mu) + VAR(v)] + VAR(\varepsilon)}{VAR(\mu) + VAR(v) + VAR(\varepsilon)} \right\}$$

### 3. Methodology

#### 3.1 First Regression Model

The first regression model test is using panel data. Panel data has both cross-sectional elements and time series. Here, the time space is from 1996 to 2015, and objects are five independent variables from five developed countries. In here, this paper uses a pooled regression to estimate the equation on all data together. [4]. By panel data, the cross-sectional elements and time-series observations are stacked up, then using OLS to estimate the result. Using panel data can deal with a larger range of problem, this paper put all the data of five developed countries together to estimate the relationship. When make the regression test, this paper also made fixed effect. The equation using in this regression model is:

$$y_{it} = \alpha + \beta x_{it} + \mu_{it}$$

In here,  $y$  is the dependent variable annually GDP growth,  $\beta$  is the parameter of independent variable  $x_{it}$ ,  $x$  is the independent variables of five developed countries, and  $\mu_{it}$  is the error.

#### 3.2 Second Regression Model

In second model, all data is about one developing country-China. The period in here is from 1997 to 2016, it is 20 years as the first dataset. In this model we use OLS (ordinary linear square) method to estimate the unknown parameters. In this linear regression model, we use the same function like in the first regression model:

$$y_{it} = \alpha + \beta x_{it} + \mu_{it}$$

$y$  is the dependent variable annually GDP growth,  $\beta$  is the parameter of independent variable  $x_{it}$ ,  $x$  is the independent variables of five developed countries, and  $\mu_{it}$  is the error. [5].

The equations used in two regression models are the same. The first model has the data from 5 countries, and the second model only have one country. So the first model have 25 independent variables and the second model only has 5. So we use panel data for the first test and OLS for the second test.

### 4. Data

#### 4.1 Data in First Regression Model

The data in first regression model is from five developed countries; they are France, Germany, Japan, United Kingdom and United States. The time period of this data group is form 1996 to 2015, it is 20 years to make sure that enough data included in making an accurate result. The five independent variables in this model test are: the gross rate of net capital in current US dollar; government expenditure on education in percentage of GDP; labor force participation rate percentage of total population ages 15+; research and development expenditure percentage of GDP;

adjusted gross rate of savings in current US dollar (including particulate emission damage). In addition, the dependent model is annually GDP growth. All these data are from World Bank.

When choosing variables, following elements were considered: “Annually GDP” is more important than monthly or quarterly data. “The percentage of government expenditure to total GDP” can more effectively reflect the relationship between education and GDP. “People participated in social production that older than 15 years old” represent the useful labor force of one country. When choose the data can reflect one country’s investment in research and development, this paper use the “expenditure of research and development percentage to GDP” as a percentage value. Saving is in current US dollar.

## 4.2 Data in Second Regression Model

In this model, all data is about one developing country-China. The period in here is from 1997 to 2016; it is 20 years as the first dataset. The dependent variable in here is GDP growth rate; the five independent variables are: the gross rates of net capital used in domestic transaction, the gross rates of state budgetary funds for education, the percentage of participation in total population of economic activity, the gross rate of research and development expenditure, the gross rate of urban and rural residents year-end saving deposits. All data is from National Bureau of statistics of the People’s Republic of China. The raw data this paper gets from National Bureau statistics of the People’s Republic of China is annually number. Because GDP growth is in percentage, this paper translated data into gross rate as well. National Bureau of statistics of the People’s Republic of China offers the official source of regional data of the main land of China.

## 5. Result

### 5.1 The First Regression Model Result:

Regression for five developed countries GDP growth with fixed effect	
Dependent variable:	GDP growth
Independent variable	
Constant	6.946 (1.023)
Capital	4.031 2.481
Education	(-0.271) 0.059
Labor force	(-0.010) 0.006
Research and development	(-1.935) (0.298)
Saving	3.131 (4.361)
R <sup>2</sup>	0.1499
Number of observations	430

In the test result, capital, education, and labor force all make an influence on economic growth. This paper wills an analysis on each of these factors.

Developed countries have knowledge stock and talent reserve advantage comparing to developing countries. Studies has proved that modern economic growth is increasingly dependent on the creation and knowledge growth of technology and society, and the creation of various inventions depends on the amount of scientific knowledge and the quality of the population. From this free academic environment give the land of research and development; high quality education has trained a large number of high skilled workers. Then research and development help the progress of science and technology, high skilled workers improved the efficiency and effectiveness.

Finally, the developed countries have sustained rapid economic growth and economic growth structure. Education gives the continually power of creation and technology progress. The sufficient input into education guarantee the basic knowledge level of whole population and provide skilled labor for the market. On the other hand, high level education help with college to support high technology development which make sure the future advantage of economic growth. Labor force is the one of most basic factors in production process. Although machines can help people do make jobs in production, high-skilled labor force can never be replaced by machines at all.

When talking about the advantage of capital in developed countries, scholars focus on the optimal allocation of capital in these countries. After the primitive accumulation of capital, counties try to use market to increase GDP growth with capital. The developed countries have been implementing the market economic system and the market mechanism to play a fundamental role in the allocation of resources. The optimal allocation of resources is mainly achieved through the market. In the process of economic growth in developed countries, the production efficiency problem is mainly solved by market mechanism. Because under the market economy condition, the market main body is in the fierce competition because of the market mechanism function, and the fierce competition is the most important impetus to promote the production efficiency. Under the influence of market mechanism, the intrinsic motivation of pursuing profit and the external pressure of competition force every enterprise to strengthen management and improve production methods and invest heavily in development and research to promote technological progress. In this way, capital is invested in the most profitable industry and made more return to investors, and thus great more wealth for the whole society.

## 5.2 The First Regression Model Result:

Regression for China's GDP growth	
Dependent variable:	GDP growth
Independent variable:	
Capital	3.791
Education	2.151
Labor force	2.341
Research and development	3.051
Saving	0.001
R <sup>2</sup>	7.591
Number of observations	(-0.003)
	0.001
	5.731
	1.421
	0.0063
	80

In the test result, labor force, research and development, and saving all make an influence on economic growth. This paper wills an analysis on each of these factors. The graphs of the each independent variable with dependent variable are showing in appendix II.

Labor force is one of the most important determines of China's economic growth. In the process of changing the age structure of the population, the reduction of the burden of labor force has formed an extremely important "structural bonus" - a demographic dividend, which is beneficial to economic growth. Demographic dividend is the driving force for China's Leaping Development in twenty-first Century. The reason for China's success in obtaining the demographic dividend is that it combines the opening of the outside world, the economic globalization and the superiority of its own labor resources, fully utilizing the advantages of the age structure change brought by the demographic dividend, and this advantage has created a series of other advantages to provide a strong economic development. The successful absorption and utilization of the demographic

dividend makes China to become a country which has big export, large foreign investment, labor-intensive industrial base and processing and manufacturing center.

From the international background, the “fitness” of demographic dividend in time determines that China's demographic dividend has a comparative advantage. In 1893, the industrialized developed countries have entered an aging society at this time; the age structure advantage of the population is lost compared with China. China created opportunities and possibilities through demographic dividend. At the same time, compared with the developing countries, China has the lowest parenting burden; even compared with the “BRIC countries”, the advantage of China's population dividend is very significant.

From the domestic background, China's extremely crucial “reform and opening up” strategy is one of the important reasons for obtaining demographic dividends. The demographic dividend effect is essentially a combination of demographic advantages and economic development. An important premise for this combination is that the structural advantages of population age can be assimilated by the economy. “Reform and opening up” policy has created extremely favorable conditions for the use of demographic dividends. Under the background of “reform and opening to the outside world”, the flow of population has created conditions for the combination of demographic dividend and economic combination. The separation of rural labor and land elements has prompted the transfer of employment for the surplus labor force. The reform of state-owned enterprises and the rapid development of private enterprises have brought opportunities for the allocation of labor resources, and the diversified development of enterprises has prompted the labor force.

Demographic dividend is closely related to the international industrial transfer after the “reform and opening up”, and the development of domestic manufacturing industry. From the perspective of the law of global economic development, the low end manufacturing industry always looks for the lowest cost. In 1970s, Japan, Singapore and South Korea, which used to be the international manufacturing base, make full use of the demographic dividend. With the disappearance of the demographic dividend in these countries, the international manufacturing industry has begun to research for new acceptance bases, and the famous Chinese demographic dividend has provided support for its own “international manufacturing base”. With the “reform and opening up” in 1979, economic globalization has gradually shifted the international manufacturing industry to the first open coastal areas. Significant demographic dividend, abundant labor resources and low labor cost have become an important basis for undertaking international industrial chain transfer and the world's manufacturing base.

There are two ways to achieve technological progress: to invest in research and development, or to imitate other countries. The investment in developing cutting-edge new technologies is large and the probability of failure is very high. Relatively speaking, the cost of imitation and purchase of technology is much lower. China has a large gap in technology with developed countries, so it has a post advantage in the way of selecting technological progress, and adopts the way of imitation and purchase to achieve technological progress. In terms of introducing technology, China has fully played the advantage of backwardness, and continuing to play the advantage of backwardness is an important part of maintaining sustained economic growth in China. If the introduction of technology is used to achieve technological progress, this progress is usually carried out at the same time as the introduction of machine equipment or the purchase of patent technology, which is embedded in the growth of capital investment. With the growth of wealth, China is becoming more and more aware of the importance of protecting intellectual property rights. This is not only a respect for knowledge creators, but also a game rule for WTO. Especially when China can become the creator of intellectual property, it has more positive significance to protect intellectual property rights. Through the protection of intellectual property rights and the full incentive to the innovation

of management and technology, the creativity will be released greatly, and China will gradually complete the transformation from the manufacturing center of the world to the R&D center.

Compared with other countries, China has always been a high savings rate country. The increase in the savings rate will lead to an increase in the economic growth rate in the future. This is because the increase in the savings rate provides more capital input to economic growth and development, thus the increase in economic growth and the relative increase of household income. The increase of income level has increased the consumption level and further promoted the further development of the economy. Since China's high-speed economic development since 1980, the Chinese people's income has been raised. The ancient savings habits of the Chinese people have kept the high savings rate and further helped the economic development. Like developed countries, adequate savings rate guarantees the implementation of the government's macroeconomic regulation and control policy. Chinese savings habits stem from the preparation for uncertainty in the future and can be used as capital for investment to earn more income. As a decisive factor of economic growth, savings rate has promoted economic development.

## 6. Conclusion

This paper made a lively discussion of determines of economic growth. From the prior empirical study and theories, scholars made efforts to find out the determines of economic growth by figuring the relationship between GDP growth and many different elements like: capital, investment input, human capital, labor force, population, education level, saving rate, research and development ability, technology development level, population factor, etc. This paper chose 5 independent variables capital, labor force, education, R & D and saving rate in the data from 5 developed countries (France, Germany, Japan, UK and USA) and 1 developed country China. By build up two regression model tests, the result shows that education, R & D, and saving determines the economic growth in 5 developed countries, and labor force, R & D, and saving determines the economic growth in China. By analysis the different situation in developed countries and developing country, this paper explain how these determines help with the economic growth in these countries. In conclusion, R & D and saving can make a stimulation in both developed and developing countries, education give more help for developed countries, labor force cause demographic dividend stimulate China's economic growth more.

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