

## ANALYSIS OF CHINA BUSINESS CYCLE BASED ON TECHNICAL PROGRESS

ZHU Nanjun  
School of Economics of Peking University  
Beijing, 100871, China  
Email: [zhunanjun@163.com](mailto:zhunanjun@163.com), Tel: 8610-62752844

ZHAI Jianhui  
Hanqing Advanced Institute of Economics and Finance of Renmin University  
Beijing, 100872, China  
Email: [zhaijianhui1987@gmail.com](mailto:zhaijianhui1987@gmail.com), Tel: 86-13581705283

---

### ABSTRACT

*Innovation and technical progress are the key factors of the economy prosperity in long run. Reviewing the long-wave theory and based on Schumpeter's innovation model, we make an analysis of the historical data of technological innovation and economy growth and find that they influence and determine each other. By analyzing the data from 1988 to 2010 of China, we think it is a period of innovation boom and potential growth rate recession at present, which indicates that there is an upswing in next 5 to 10 years because of the positive effect of innovation boom. Besides large R&D input, it is deepening of economic system reform that is also the key to increasing the potential growth rate.*

Keywords: Innovation, Technical Progress, Business Cycle

---

### LITERATURE REVIEW ON BUSINESS CYCLE THEORY

As Robert E. Lucas has defined, "Business cycle is a deviation of the economic variable from the smooth growth trend, which alternates as economic growth rate goes up and down." In 1946, Wesley C. Mitchell and Arthur F. Burns, in their *Measuring Business Cycles*, defined business cycle as "a state of fluctuation as a result of business activities. A cycle incorporate expansions from different economic fields almost the same time, followed by similar general recession, contraction and economic recovery that combined with the following expansion in the next period of cycle. The order of changes happens repeatedly, but not periodically. The length of the business cycle could be over one year, ten years, or twelve years, which cannot be further divided into shorter cycle in terms of similar nature and closer amplitude of vibration." This is a classic definition of business cycle recognized by the western scholars. According to the duration of economic fluctuation, business cycles can be classified as long-term, intermediate and short-term. Typical business cycle include Kitchin cycle, Juglar cycle, Kuznets swing, Kondratiev waves and Schumpeter term.

(1) Kitchin cycle is a short business cycle of 2 to 4 years discovered in the 1920s by Joseph Kitchin (1923). This cycle is believed to be accounted for the change of inventory.

(2) Juglar cycle is a fixed investment cycle of 7 to 11 years identified in 1862 by Clement Juglar.

(3) Kuznets swing is a claimed medium-range economic wave with a period of 15–25 years found in 1930 by Simon Kuznets.

(4) Averaging fifty and ranging from approximately forty to sixty years, Kondratiev waves (also called long waves or the long economic cycle) consist of alternating periods between high sectoral growth and periods of relatively slow growth.

(5) Schumpeter suggested a model in which the four main cycles above can be added together to form a composite waveform. He identified innovation as the critical dimension of economic change.

Schumpeter's theory about the core function of innovation and technological advance in the economic development has great significance. It provides ideological basis for the new growth theory. For example, Romer, as a representative of the academic economist, related innovation and R&D with the endogenous economic growth in the framework of dynamic general equilibrium, and proposed the propelling mechanism that endogenous R&D and innovation may have upon economic growth. Based on Schumpeter's innovation theory, this paper meant to make an empirical analysis of the impact of technological innovation upon business cycle.

### THE INNOVATION THEORY BY SCHUMPETER

1. Economy is an unreachable dynamic trend toward balance

In Schumpeter's view, market economy itself has characteristic of cyclical prosperity and recession. The core problem of economics does not lie in equilibrium, but structural changes. The movement of economy is a trend going toward equilibrium, but can never reach the perfect state. The changes of economic development is not imposed by the external forces, but originated from the internal. It is a disturbance upon the equilibrium, which replaced and absolutely changed the former state of equilibrium. The crisis is a factor that urges the economy to adapt to the new environment.

2. Innovation is the power for the economic development

According to Schumpeter, innovation means the establishment of the new production function, namely, the new combinations of the factors of production made by entrepreneurs. The economy can improve only when it absorbs the outcome of the changes and definitely changes its structure. And innovation is the only possibility which can form society in the dynamic imbalance. Entrepreneurs play a role of hero in this process. They are the source of the profit. While the economic cycle moving downward the bottom from the prosperity, some entrepreneurs would be knocked out of the competition and some would get prepared to innovate for survival. Each recession contains the possibility of technological innovation. Therefore, it is believed that the technological innovation and production reform take supreme role in the development of economy.

3. Innovation emerges in a cluster pattern, not an independent and even distribution

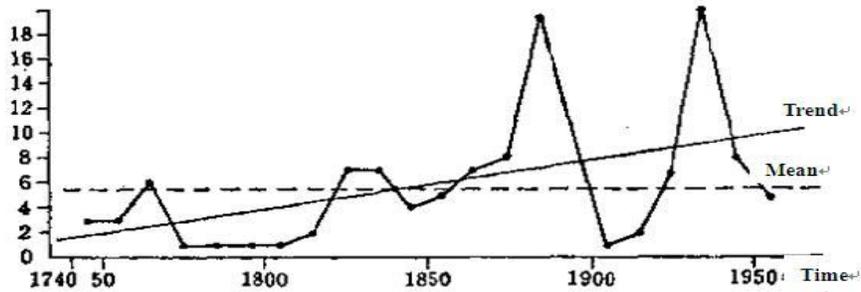
If the new business emerge alone, that is, the entrepreneur and the innovation distribute evenly and separately, then the economy won't appear distinguished prosperity and recession in an independent, regular way. Schumpeter believed, "the existence of the economic cycle just illustrates that innovation activities do not appear independently, or in a constant and even pattern. The emergence of one or more entrepreneur urges others to show up, or increase in a progressive way." Firstly, it means it's difficult to achieve a new product. Only some talents of special traits can make it. Few people succeed when the economy stagnates, and many difficulties would disappear as well. Then other people would like to take efforts to follow the steps of those pioneers. Finally, innovations become commonly acknowledged by people and are free to use.

4. Groups of entrepreneurs may account for the prosperity

Prosperity comes when entrepreneurs appear in groups. Entrepreneurs may have an leaping-type of interference upon the state of the equilibrium if they do not show up in an even and constant way. When it happens, the economy will automatically take in any effects exerted. In this process, the Economic System need to adapt to the new environment, and the innovation activities will decrease, demanding less upon the investment. The decrease in the number of the entrepreneur would be the essence of the cyclical recession. It could be considered as a conflicts competing for new state of the equilibrium in the economic system.

Technological advancement is typical performance of innovation, which directly promotes the economic prosperity. Mensch (1975) acknowledged that the lack of innovation should be main reason for the economic recession. Not until the dying technology bring profit that is unbearably low, would the capital overcome the detest for taking risks and depend upon possible innovation. According to historical data, Mensch recognized, before 1960, basic innovation rising from technological advancement ever clustered in the period of recession.

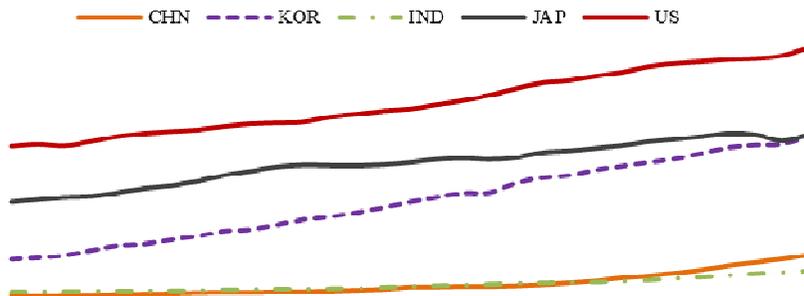
Figure 1: Frequency of Depression and Basic Innovation 1



CHOICE OF INDICATORS OF THE TECHNOLOGICAL PROGRESS

To observe the impact of technological progress upon the economy, it need to choose reliable indicators of statistical data to objectively reflect the advancement. Intuitively, the increase of productivity may directly represent the technological progress, for which may measure the quality of economic growth. In terms of China, per worker GDP is far below that of the developed countries, though it increases rapidly. However, there are some problems if the technological progress and innovation level of China measured by this indicator, the obvious one is the differences among the working hours.

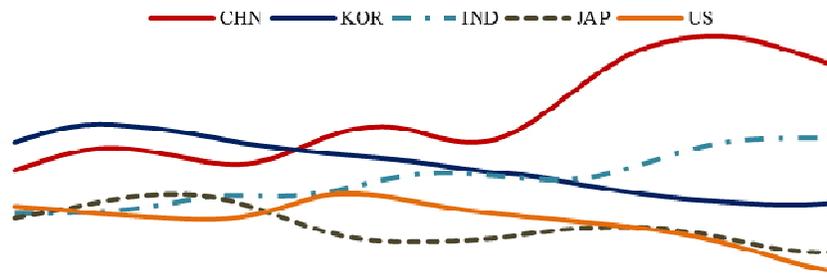
Figure 2: Per Worker GDP (1990 US Dollar) 2



<sup>1</sup> G. Mensch (1975), Requotes from Duijin, Economic Long Wave and Innovation [M], Shanghai: Shanghai Translation Press, 1993, p121

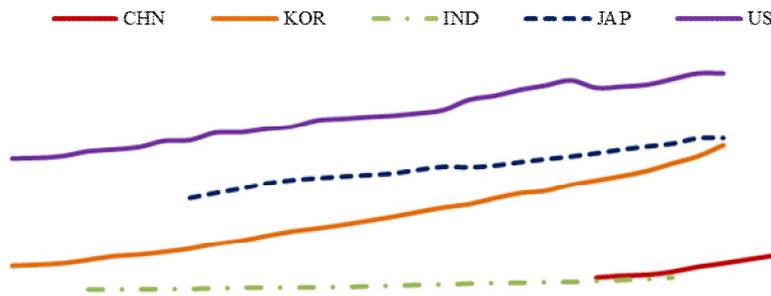
<sup>2</sup> Source: world bank, 1990 US dollar

**Figure 3: Growth Rate of Per Worker GDP (YoY) (1981-2010)**<sup>3</sup>

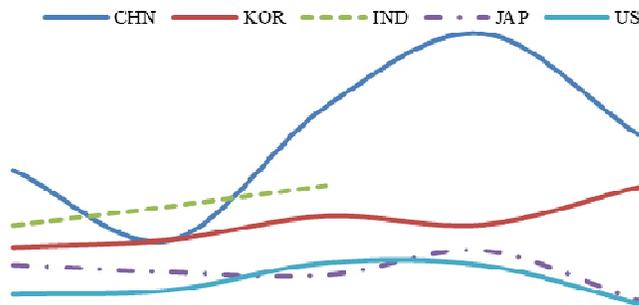


Per worker hourly output should be taken into calculation, since per worker annual GDP could be affected by the number of effective working days within one year. Suppose the labor of each country has the same number of days off work, namely 250 days each year, then productivity of unit of time could be calculated.

**Figure 4: Per Worker Hourly Productivity**<sup>4</sup>



**Figure 5: Growth Rate of Per Worker Hourly Productivity**



In the classic growth theory,  $Y=F(A,K,L)$ . GDP needs the input of capital, labor (and affiliated human capital), technology and some other inexplicable factor, such as system. In case of China, it had remarkable productivity of unit of time over other countries during 2004 and 2008. Great fluctuations happened as well. In short time, the stock of the human capital and the changes of technology are not powerful enough to lead to the dramatic changes of economy. It is capital factor which has a strong impact on the fluctuation of productivity.

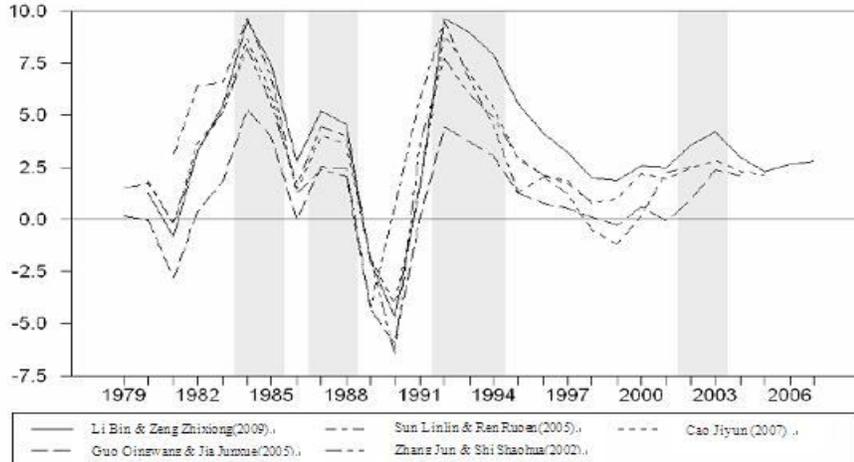
The quality of China's economic growth has been greatly doubted for its excessive dependence on investment. Capital factor can be crowded out by total factor productivity. Krugman definitely concluded in 1994 that there was no miracle in East Asia.<sup>5</sup> He believed that the growth of Southeast Asian economies was promoted by the input of resources, as it was in the former Soviet Union and they would be trapped in the stagnation in the suit of the Soviet Union as well. The expansion of their extensive economies could not continue, since TFP of these countries are low, even negative. When TFP increases, it means more output can be achieved in the same amount of input of resources. If TFP do not grow, the factor accumulation would halt as the result of the diminishing marginal returns. Abundant resources could not save the situation and could not promote the sustainable economy growth.

<sup>3</sup> Source: the author's calculation

<sup>4</sup> Source: <http://laborsta.ilo.org/default.html> and world bank. We use the investigation result of Alliance Zhaopin (one of the largest Headhunter in China) to estimate the 2011 hourly productivity of China

<sup>5</sup> Paul Krugman, The Myth of Asia's Miracle[J], Foreign Affairs, Nov/Dec 1994, Vol.73, Iss. 6, p 62

Figure 6: Estimations on the TFP Development of China (1978-2007)



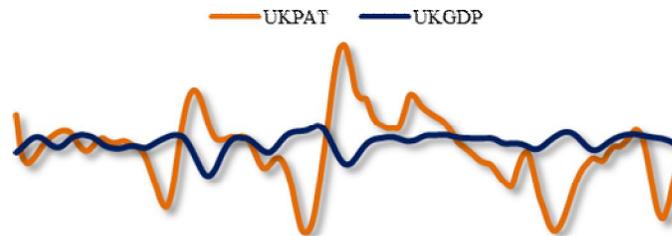
From the estimate of most scholars, China's TFP has been in the lower state since 1992. After 2000, it picked up moderately, but never had a genuine rise. Some studies hold a pessimistic view toward the future of China's economy, judging from the lower TFP in China's economic growth, potential growth rate lying in the downward section, growing pressure against the export and some other reasons. It should be noted that, though TFP measured as a important index for judging the quality of the growth, its calculation itself has many problems. In addition to the matter of gathering statistics, TFP fails to explain why technology changed and how it changed. The function of innovation is unconsciously eliminated. Technological innovation seems to be an element that works automatically, uncontrollable and can never stop.<sup>6</sup> Actually, TFP is a variable from an overall perspective. To have a better understanding how the economy promote the technological innovation in the microeconomic level and conversely, how the innovation impacts on the economy, the patent number could be a more reasonable indicator over TFP.

Patent is the rights granted by law to the innovator or his successor to use invention exclusively in a specified period of time. According to China's Patent Law, the same invention can only be conferred one patent. The innovation granted patent should be novel, inventive, and functional. Patents may represent the technological advancement that are recognized by the authority as original and official. It also has reliable statistic, for which it is used as an explanatory variable in this paper.

**EMPIRICAL ANALYSIS OF THE RELATION BETWEEN INNOVATION AND ECONOMIC DEVELOPMENT**

GDP growth rate could demonstrate the condition of the economic growth, and the increasing rate of patents could show how active the innovation activities are. For the poor record of China's historical data, the following figure uses the well-kept historical data of annual economic growth and patents in UK to show the case.

Figure 7: Historical Statistics of GDP and Innovation Growth Rate of UK (1887-2010)



Source: We get the historical statistics(1887-1994) of UK GDP growth rate from Angus Maddison, the world economy: a millennial perspective[M], Beijing: Reform press,1997, p102-104, which is estimated in 1990 US dollar. World bank provides the rest data(1995-2010) in 2000 US dollar. We make adjustment for the differences and get a reasonable estimation. We get the granted patents data from WIPO Statistics Database, December 2011. Based on the data above, we capture long term trend and eliminate short-term fluctuation with Hodrick-Prescott filter( $\lambda=25$ , which is employed by OECD)

From figure 7, we can have a direct view of the relation between the technological innovation and the economic growth, which interact closely. When the economy is in the recession, it may stimulate the innovation, which in return, forms the basis for a new round of a economic growth. Macro economy functions in such a cycle. Therefore, we can figure out the statistical proof for the theory of this model. Our calculation is based on the following points: GDP growth rate representing the economic growth, while the patent growth rate standing for the active level of technological innovation. They have impacts upon each other. Furthermore, we use VAR model to have a simple analysis. Suppose there is a cause and effect relation between the GDP growth rate and the patent growth rate, as we have previously demonstrated, there must have a Granger relation between them. Though the existence

<sup>6</sup> Duijn, Economic Long Wave and Innovation [M], Shanghai: Shanghai Translation Press, 1993, p103

of Granger relation cannot prove the accuracy of the model, at least, it can demonstrate the correctness of the theory in some sense.

After selecting the model variable, we may choose the lagging number. It can be found that the optimum lagging number is 4.

**Table 1: VAR Lag Order Selection**

VAR Lag Order Selection Criteria						
Sample: 1884 2010		observations:		119		
Lag	LogL	LR	FPE	AIC	SC	HQ
0	530.36	NA	4.77e-07	-8.88	-8.83	-8.86
1	868.19	658.63	1.75e-09	-14.49	-14.35	-14.43
2	1097.47	439.28	3.96e-11	-18.27	-18.04	-18.18
3	1207.17	206.48	6.70e-12	-20.05	-19.72	-19.92
4	1235.99	53.28*	4.42e-12*	-20.47*	-20.05*	-20.29*
5	1237.22	2.22	4.63e-12	-20.42	-19.91	-20.21
6	1238.41	2.12	4.86e-12	-20.37	-19.76	-20.13

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

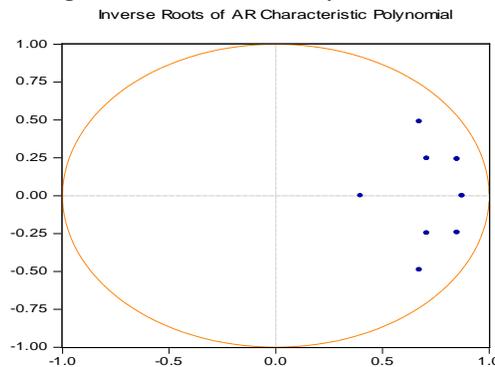
After making the regression analysis of the model, it can be figured out as indicated in the following table:

**Table 2: Regression Results Summary**

		GDP(-1)	GDP(-2)	GDP(-3)	GDP(-4)	PAT(-1)	PAT(-2)	PAT(-3)	PAT(-4)	C
Coefficient	GDP	3.0595	-3.7559	2.2148	-0.5384	-0.0228	0.0858	-0.0927	0.0315	0.00035
	PAT	-1.1387	2.6495	-2.2215	0.6958	2.6792	-2.7575	1.3023	-0.2381	0.00030
Std Error	GDP	-0.0786	-0.2090	-0.2075	-0.0773	-0.0169	-0.0424	-0.0388	-0.0127	-0.00015
	PAT	-0.4219	-1.1211	-1.1131	-0.4148	-0.0908	-0.2276	-0.2081	-0.0683	-0.00079

Checking the stability of VAR model:

**Figure 8: Test for the stability of the model**



It can be noted, all the solutions fall inside the circle, which can prove the stability of the VAR model.

Checking the estimated results of model with the Granger Effects, the result can be found as what indicate in the following table.

**Table 3: VAR Granger Causality/Block Exogeneity Wald Tests**  
**Sample: 1884-2010**

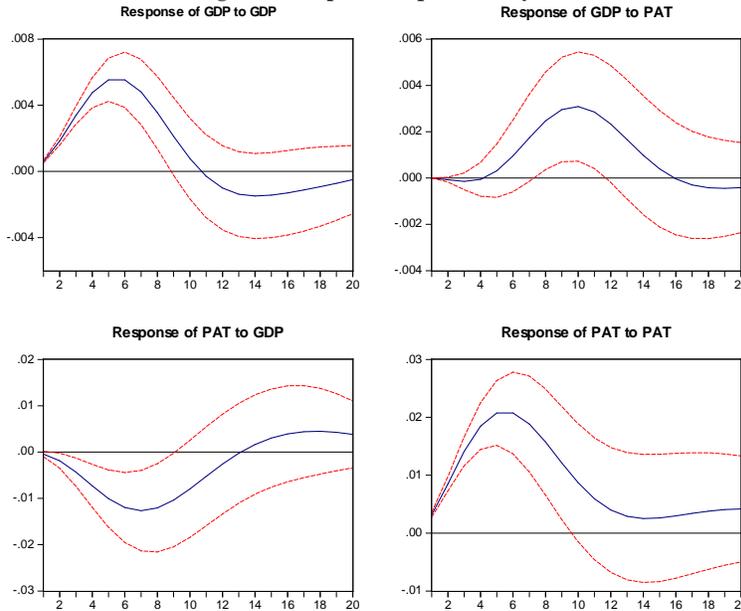
Dependent variable: GDP			
Excluded	Chi-sq	df	Prob.
PAT	13.23215	4	0.0102
All	13.23215	4	0.0102
Dependent variable: PAT			
Excluded	Chi-sq	df	Prob.
GDP	9.558895	4	0.0486
All	9.558895	4	0.0486

Taking GDP growth rate and granted patents growth rate as independent variables respectively, we find that the P value of the former being the Granger cause of the latter is 1.02%. In turn, it is 4.86%. That is to say, GDP growth rate and granted patents growth rate are always Granger cause with each other at 5% level.

It can be concluded from the previous analysis, the regression model we established on the basis of innovation theory model can be valid in the statistical sense, and the VAR model is stable. Secondly, the two variables in the model can be Granger effects for each other, which do not conflict with our model. Theoretical relations between the technological innovation and the economic growth go along with the statistical calculation of the historical data.

In addition, we care for other issues, that is, if one variable had some impacts, what would happen to the other variable? Would the economic prosperity restrain the innovation activities? What impacts will the innovation activities have upon the economy in the long run? We can handle these problems by the analysis of impulse responses.

**Figure 9: Impulse Response Analysis**

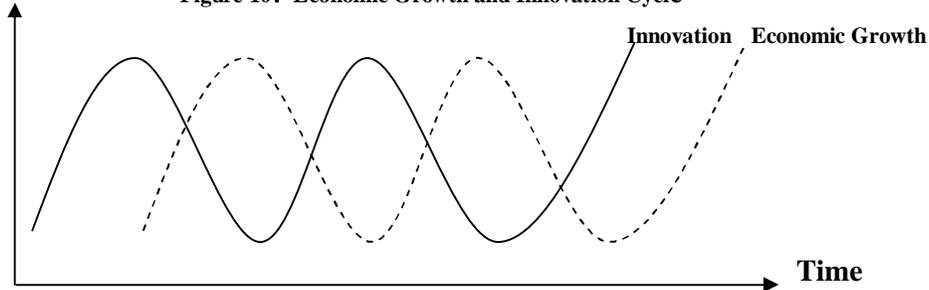


From figure 9, the positive GDP growth impacts in the period 0 plays an active role in for the economic growth and retains for 6 periods before it declines. However, for the technological innovation, it is negative. The GDP growth impacts in the period 0 will restrain the innovation activities in the following 7 years. When GDP growth impacts gradually lose its influences upon the economic prosperity, namely, during the 7<sup>th</sup> and the 10<sup>th</sup> year, the rein of GDP growth impacts gradually cuts back its influence upon the innovation activities, even to the positive. If the innovation activity happens to have positive impacts in the period zero and it doesn't have notable pulling effect in the first 4 years, these impacts could be negative. From the 5<sup>th</sup> year, the pulling effects of innovation upon the economy will appear and come to the peak around the 10<sup>th</sup> year. If the innovation dramatically increases in the period 0, it would play an active role for itself, and the pulling function will continue in the next 5 or 6 years, even in 10 years.

We may conclude, when the economy is in the depression, the overall yield rate decreases will lower the opportunity cost of the innovation, and the capital would like to invest on the innovation activity. As a result, when the economy moves downward,

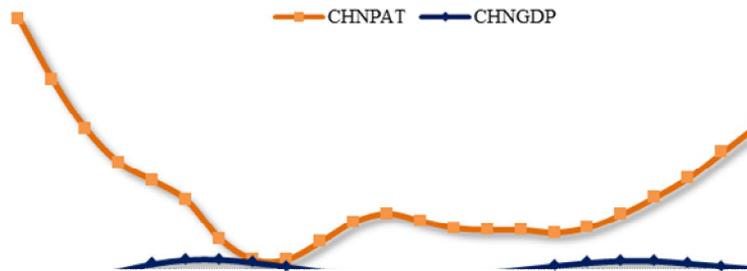
innovation activities become relatively active. The first small size of innovation activities will reduce the obstacles for the innovation and bring more passion for the on-going wave of invention, which probably outburst in a short time. It takes 5 years to start an innovation, get the patent through to produce the economic profits. Usually, the economy will meet its prosperity after the innovation reaches the peak. In the wake of that, there comes the excessive investment, excessive bank credit expansion, and capacity surplus. As the profit margin brought by the technology innovation shrink, the investment slows down. Due to the higher opportunity cost, the driving force for the innovation will be reduced. Meantime, People hold a firm belief about the lasting rich life because of the continuous high-speed economy growth, which changed their attitude toward work and risks. In this sense, the expansion of a long wave is thought to be self-destructed.<sup>7</sup> The businesses cannot realize the expected profits as innovation gradually retreats. They will reduce their investment as a result. Consequently, the economy will fall into a recession and won't welcome the prosperity until the next round of new passion of innovation comes.

**Figure 10: Economic Growth and Innovation Cycle**



Since 1978, China's economy has been maintaining a high-speed of increase of average 10%. It is rare to sustain such an increase for 30 years in the world. However, it encountered an unprecedented difficult situation after the financial crisis in 2008. The growing deterioration of the outer-market makes the foreign trade decline dramatically, casting a great shadow for the economy in a short time.

**Figure 11: Potetial Productivity and Granted Patent of China (1988-2010)<sup>8</sup>**



Seeking for the force of economic growth definitely rest on the technology advancement and innovation. From the figure above, China's innovation was really low in the 1990s, which proved the conclusion of related low TFP rate. In addition, during the prosperous 2000 and 2007, China's innovation has been lingering in the bottom between 2000 and 2005. From 2006, passions for the innovation started level up. Considering the lags of about 5 years we find in the previous article, we expect that innovation boom will gradually took effect on economic growth afert 2011. Judging the tendency of China's economic growth in the future, we should not only pay attention to the current downside of the potential growing rate, but also trust the rapid rising of the innovation, which propels the future growth.

### CONSISTENT POLICY IS KEEN TO HANDLE THE CYCLE

#### 1. Inconsistency of the economic system exposes the biggest problem

In the earlier time, China expressed its industrial strategy as the key point of socialist industrialization, which is the most important mission of the transition period. Heavy industry had the privilege to develop. Limited by some historical reasons, China first chose to develop its heavy industries to catch up with other countries. The reason to choose this strategy lies in the recognition of the great gap between the industrial target set by the mission and the industrial structure required by the endowment. In an open and competitive market economy, it is impossible to get a profit level accepted by the society for an industry having great gap between the capital structure and the endowment structure. Sometimes, it may lose and be negative<sup>9</sup>. To guarantee the smooth catching-up strategy, relative economic systems should be set up, which defined by Lin Yifu (1999) as a trinity system. The system includes the following aspects: In macro-policy level, low interest rate, low exchange rate, low income, low price for energy and raw material, low price for agricultural products, life necessities and services. As to the policy

<sup>7</sup> Duijn, Economic Long Wave and Innovation[M], Shanghai :Shanghai Translation Press, 1993, p237

<sup>8</sup> Source: world bank

<sup>9</sup> Lin Justin Yifu and Guofu Tan, Policy Burden, Accountability and Soft Budget Constraint[J], American Economic Review, Vol.89, No.2,1999

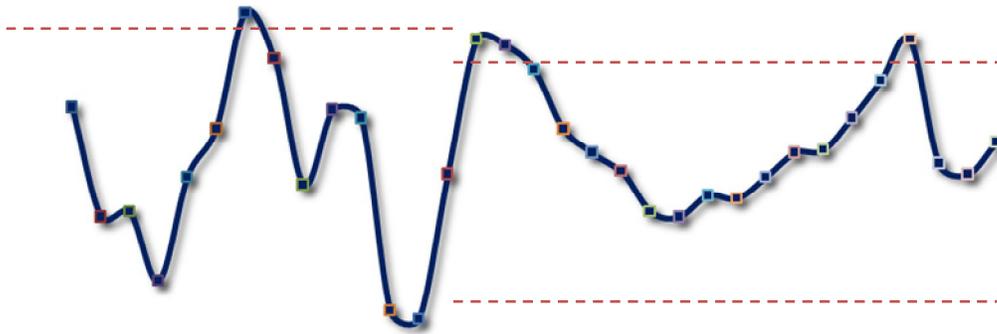
of resource distribution, the function of the market is replaced by the executive plans to allocate the resources. For the micro-operation of the business, micro-operation system is implemented characteristic of nationalization and people's community.

China's reform starts first from the improvement of micro-stimulation by the empowerment on the micro-operation system, which facilitate the creation of new resources and their allocation in the suppressed departments, and in turn, promote the rapid growth in the economy and the adjustment in the industrial structure<sup>8</sup>. After the opening and reforms, new resources controlled by the micro-business, responsible for its own management, became more and more. The policy of allocation of resources was getting looser and looser, which greatly contradicted with the prevailing low level of interest rate, exchange rate and low prices of energy and resources. Meanwhile, the business's expansion was handicapped by the basic industries, such as energy and transportation, which formed into a bottleneck and restrained the economic development.

In the environment of low interest rate, compared with state owned business, non-state owned business has more competition in getting capital. To guarantee the loan for the state-owned business, the government has to issue more money to offset the credit shortage, which leads to an endogenous inflation. When the empowerment effects seriously disturb the operation of the economy, traditional planning-distribution policy will gain its way back, forcing to narrow and limit the expansion of the non-stated-owned businesses. This may cause a revolving movement in the process of the reform. The reason of dramatic fluctuation of China's economy roots in the mismatching policies within the economic system due to the precedence of the reform in some segments. The solution necessarily should focus on the conformity of policies within the system.

2. Carrying out liberalization will play an active role on the technology progress.

Figure 12: GDP Growth Rate of China (1978-2010)<sup>10</sup>



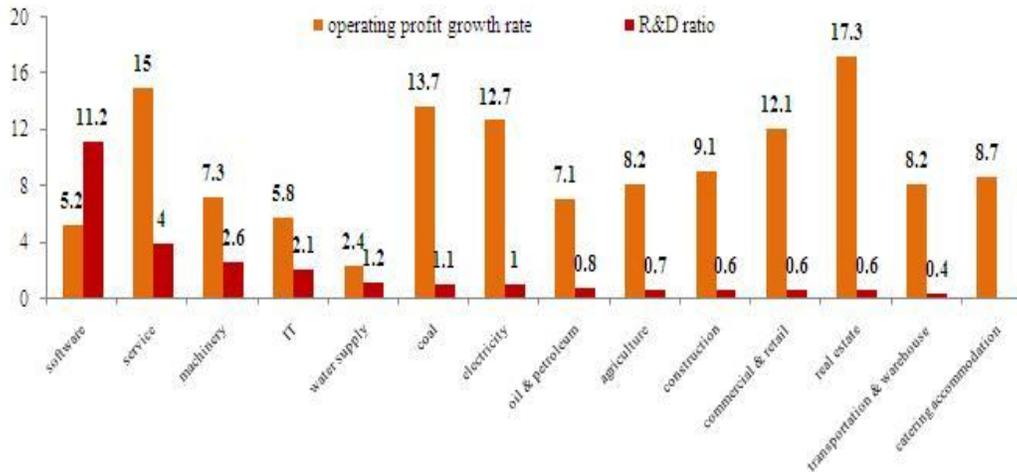
Looking from the Year-on-year growth rate of GDP, since 1978, though China's economy grows fast, it fluctuates greatly, especially the case before 1994. From 1994 till now, the economy amplitude notably narrows, even though it fluctuates now and then. Such a change reflects that China is deepening its structural reform and market shows more function in the allocation of resources. However, the problems caused by the traditional system are not completely solved, which will absolutely influence the direction of the economy in the future.

Currently, the progressive reform inherits the system of catching-up strategy and micro-operation business has more room for its own decision. The price tends to be adjusted by the market. However, distinction still exists between the state-owned business and non-state-owned business in the acquisition of resources, such as credit<sup>9</sup>. In the resource allocation, the government still has the most influential power. For the developing country as China, capital is considered as a valuable resource. In reality, the investment has a good share of 48% in China's GDP, greatly exceeding the highest level of the economic history of all countries in the world. Investment is mainly influenced by the credit policy made by the government. Both the 4 trillion

CNY investments stimulation during the financial crisis and the reduction of the credit after high inflation between 2010 and 2011 further intensify the fluctuation of macro-economy and prices.

<sup>10</sup> Source: China Economic Information Network, We use current price here

Figure 13: Operational Efficiency and R&D Ratio of Different Industries (2010)

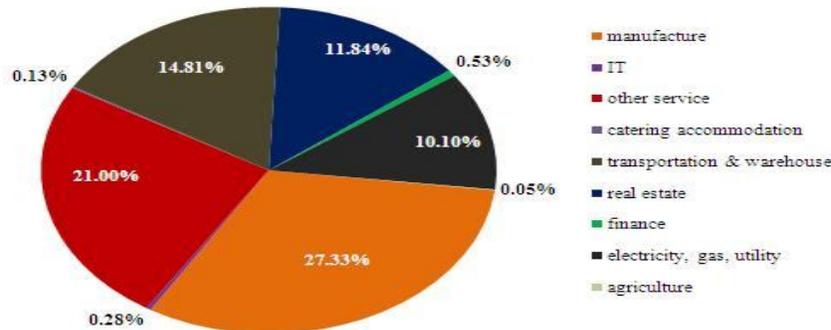


11

Some industries can get production factor in a relatively low price, which will help them achieve better yield return over other industries. They even can maintain a high profitability when the economy going downward. This may increase the opportunity cost of innovation, having the capital flow to the high-yield industries, rather than developing the new innovation.

Obviously, industries with high proportion of R&D, such as computer service, software industry, social service, information technology, cannot have a high growth rate of profit. While industries contributing less in technology progress may have a great business growth rate, for example, real estate, transportation, warehouse and post, building industry, and energy service.

Figure 14: Loans Sector Allocation of Listed Banks in China (1H2011)<sup>12</sup>



From the figure of the bank credit flow, we know industries having bigger share of credit scale are manufacture (27.33%), service industry (21%), transportation, warehouse and post (14.81%), real estate (11.84%), electricity, gas and utility (10.10%). Industries with small size of credit are agriculture (0.05%), catering accommodation (0.13%), information transmission, IT (0.28%), finance (0.53%). Classifying by the business scale, the credit scale of small and medium sized enterprises (SME) is very small. Among all the disclosure made by the listed banks granting loans to the SME, the credit of SME only has a share of 12.93%. According to the report of the big four state-owned banks, in the case of Bank of Agriculture and Bank of China, loans granting to the SME only take up 9.10% and 5.21% respectively of all business loan. The semi-annual report of ICBC and Bank of Construction see no disclosure of such data. By the end of August of 2011, credit loan for SME hold 8.8% of all loan balance. Bank credit flows to big businesses from the manufacture, transportation, warehouse and post, real estate, electricity, gas, utility and supply.

Obviously, traditional industries get supported by the most bank credit, while emerging and innovative industries like computer service and software cannot. For the bank, it would be easier to get stable return by granting loans to the big business of monopoly. Normally, SMEs in emerging industry have a high level of risks in their operation, and banks are not attracted to offer loans to them in a big size. This may result in the phenomenon that bank credit mainly aims at the business that having great monopoly but low investment on R&D, while SMEs in emerging industry getting less loan. Reforms on the constant policy within the economic system, credit allocation, interest rate setting will have profound impact upon the technology innovation for China in the future.

<sup>11</sup> Source: Wind

<sup>12</sup> Source: 2011 Semiannual Reports

## CONCLUSION

Investigating on the historical data of UK, it is found that technology innovation and economic progress have mutual impacts upon each other. The prosperity of the economy will hold back innovation in a short term. On the other hand, when there is an economic recession, the opportunity cost of innovation will be reduced as a result of the declining investment yield, which in turn starts a relatively active period of innovation. Innovation itself could not pull up the economy in the short run, yet it would promote the growth in 5 or 10 years. From a long-term perspective, technology progress and innovation are the keen force for economic development.

Analyzing the data of China, it is noted that the lower TFP rate of China since 1990 is greatly related with depressed innovation in this period. Although China's economy is undergoing through a zone of declining potential growth rate, innovation has regained its increment, which will have great impacts upon China's economy in the next 5 years. Hence, we hold a belief for the prospect of China.

When there is a high investment yield in the economy, innovation of high risks will be restrained because of the high opportunity cost. Currently, China hasn't finished its structural reforms, and there still exists strong administration and plan, some industries still can get undervalued production factors through the distorted market price, which provide basis for the continuous high yield profitability for the business. Innovations are restrained and potential for economic growth will be reduced in the long run.

For China's economy, innovation should be highlighted and encouraged to enhance the potential growth rate. Apart from increasing investment on R&D, there should accelerate the improvement of current economic system. Three aspects are important: first, reducing planning-policy and administration, highlighting the function of the market in allocation of resources; second, reducing distorted administration in the price-setting of production factor, leaving it coordinated on the basis of the market price, having all industries acquire production factors in a possibly fair price; reducing interference, continually expanding the autonomy in micro-operation business. The purpose of the above-said measurements lies in eliminating the abnormal yield in the economy, creating a relatively fair environment for technological innovations. Gratefully, we found such inclination in recent policies. In the beginning of the year, the central bank expressed its idea to further the liberalization of interest rate. The supervising institution announced the experimental measures for private placement bonds of SME in May, 2012. And in June, the central bank announced to expand the floating band of interest rate. Those actions mean that regulatory authorities are undertaking to improve and perfect the mechanism of capital pricing, taking effort to expand financing sources for the business, which will have great significance for the macro-economy in the long-run.

## REFERENCES

- Alwyn Young. (1995). The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience. *The Quarterly Journal of Economics*[J], MIT Press, 110(3):641-680.
- Angus Maddison. (1997). The world economy: a millennial perspective, Beijing: Reform press.
- B.R. Mitchell. (2002). *International Historical Statistics Europe 1750-1993*, Beijing: Economic Science Press.
- Brown, William H. (1957). Innovation in the Machine Tool Industry. *Quarterly Journal of Economics*, 406-425.
- Chen Kunting, Zhou Yan, Gong Liutang. (2004). The Business Cycle in China. *World Economy*, 10.
- Dinopolous, E., F. Sener. (2007). New Directions in Schumpeterian Growth Theory [A], in Hanusch, H., and A. Pyka, Elgar Companion to Neo-Schumpeterian Economics[C]. Edward Elgar: Cheltenham.
- Dinopolous, E. (2006). Growth in Open Economies, Schumpeterian Models[A], in Reneirt, K., and R. Rajan, Princeton Encyclopedia of the World Economy[C], Princeton, NJ: Princeton University Press.
- Duijn. (1993). Economic Long Wave and Innovation[M], Shanghai :Shanghai Translation Press.
- Joseph Kitchin. (1923). Cycles and Trends in Economic Factors[J], *The Review of Economics and Statistics*, Vol. 5(1), pp. 10-16
- Li Bin , Zeng Zhixiong. (2009). Recalculating the Changes in China's Total Factor Productivity. *The Journal of Quantitative & Technical Economics*, Vol.3.
- Lin Justin Yifu and Guofu Tan. (1999). Policy Burden, Accountability and Soft Budget Constraint. *American Economic Review*, Vol.89, No.2.
- Lin Yifu Cai Fang Li Zhou. (1999). The China Miracle: Development Strategy and Economic Reform, Shanghai :Shanghai People Press.
- Mack, Ruth. (1941). The Flow of Business Funds and Consumer Purchasing Power, New York:Columbia.
- N.D. Kondratieff. (1935). The Long Waves in Economic Life. *The Review of Economic Statistics*, Vol.17, Issue6.
- Paul Krugman. (1994). The Myth of Asia's Miracle. *Foreign Affairs*, Vol.73, Iss.6.
- Simon S. Kuznets. (1930). Secular Movements in Production and Prices. Boston: Houghton Mifflin.
- Schumpeter. (1939). Business Cycles:A Theoretical, Historical and Statistical Analysis of the Capital Process, New York and London: McGraw-Hill.
- Schumpeter. (2009). The business cycle, Beijing: China Chang'an Publishing House.
- Schumpeter. (1990). Theory of Economic Development , Beijing: the Commercial Press.
- Wu Jinglian. (2005). The Choice of China's Growth Pattern, Shanghai: Shanghai Far East Press.
- Yongda Yu, Bingyang Lu. (2010). Debate on China's Productivity Deficient Methods and the Uncertain Conclusions, *Journal of Tsinghua University*, Vol.3.
- Zhang Bing. (2006). The Speciality of China's Economic Long Wave, *South China Journal of Economics*, Vol.9.