



## China's Macroeconomy Forecasting

### Research during 2008-2012

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#### Abstract

According to the latest statistical data from the “*China Statistical Yearbook-2007*” and “*Statistical Communique of the People's Republic of China on the 2007 National Economy and Social Development*”, the optimal grey model with logarithm new development coefficient is established by filtrating, to analyse and forecast China's macroeconomy development during 2008-2010. The results show that Chinese GDP in 2008 will reach RMB 28695.01 billion, it will arrive at RMB 39064.59 billion at the end of 2010, which is about 3.94 times of 2000. The expected goals planned by eleventh five-year will be achieved successfully.

**Keywords:** China's macroeconomy, Grey modeling, Optimal grey model with logarithm new development coefficient (GMLNDC), Forecast

#### 1. Introduction

China has enjoyed rapid economic growth since reform and opening up to the outside world. She has attracted the world's attention. In the past 20-plus years, China created the world miracle that the GDP increased by 9.6% per year. This rate is not only higher than the one 6.1% per year from 1952 to 1978, but also higher than most of the countries in the same stage. At present, China's total amount of GDP ranks the fourth of the world and the speed of economic growth is 2 times higher than the average. The rapid growth of national economy not only enhances China's comprehensive power greatly, but also improves people's living standard significantly and increases China's international status further.

2007 is the second year of the eleventh five-year plan. The national economic keeps the good situation with rapid economic growth, excellent structure, increased benefit and improved livelihood. The GDP reached RMB 24661.9 billion, which increased by 11.4% of the previous year. It was 1.96 times of 2000. China achieved the goal; the first ten-year's total amount of GDP was doubled of 2000 in the 21 century, ahead of three years. The GDP growth rate keeps 10% or a little more five-year continuous, and the per capial growth rate keeps 10.6%. The national financial revenue, grew rapidly, reached RMB 5130.403 billion, which increased by 32.4% of the previous year and was 116.4% of the budget. The construction of new countryside has achieved new progresses. The expenditure for the problem of “Peasant, Countryside and Agriculture” was about RMB 431.8 billion, which increased by RMB 80.1 billion of the precious years. The adjustment of economic structure has strided a new step and the adjustment of industrial structure has made a significant achievement. The basic industry and infrastructure such as energy and traffic have got considerable development. The raw coal output was 2.54 billion ton, which increased by 6.9%. On the basis of increasing the input of “Peasant, Countryside and Agriculture”, we China strengthened financial macro-control further and perfected the relevant measures of robust financial policies for the prominent problems, to promote economic development fast and well. The per capial GDP of 2007 had reached 2456 dollar. China was transferring into the consumption-type country, as the per capial of GDP was over 2000 dollar, and the overall space of domestic consumption market was enlarged further. The SZ-6(*Shen Zhou 6*) manned spacecraft was successfully launched and landing in October 2005. Only two years later, the CE-1(*Chang'e 1*) lunar exploration satellite was successfully launched again on October 24<sup>th</sup> 2007, which was composed a marvelous chapter in the history of Chinese aerospace once more. It indicates that China is going forward with a definite target and its social economy is very prosperous.

It was fixed world's eyes upon whether China would be an engine of world economic development and be the third economic nation, under the situation of America Subprime Lending Crisis and economic recession in America, Japan and some countries of Europe. According to the latest revised data of main economic indicators from 1993 to 2007 in

table 1 and table 2, we try to analyse the current situation of China's macroeconomy, and we try to do the prediction, through screening and constructing the optimal grey model with logarithm new development coefficient, to provide an important basis for the eleventh five-year plan and its implement.

## 2. Establishment of grey model with logarithm new development coefficient

Grey prediction is the basic content of grey system theory (Deng, 1990). It probes the law of the things' development and change by establishing the dynamic model GM (1, 1). The model GM (1, 1) deals with inenarrable comprehensive quantities as the grey quantities, weakens random factors' interference by generating and developing the data, and extracts the useful information, to correct understand and effective control its running orderliness (Liu et al., 2004). The model GM (1, 1) has been widely applied in the fields of social science and natural science because of few data, flexible and convenient moderling, high prediction accuracy and strong

Table 1. The current price of Chinese GDP (unit 100 million)

Year	GDP	Primary industry	Second industry	Tertiary industry	GDP increment
1993	35333.9	6963.8	16454.4	14188.0	/
1994	48197.9	9572.7	22445.4	19480.7	12864.0
1995	60793.7	12135.8	28679.5	24950.6	12595.8
1996	71176.6	14015.4	33835.0	29447.6	10202.9
1997	78973.0	14441.9	37543.0	32921.4	7796.4
1998	84402.3	14817.6	39004.2	34018.4	5429.3
1999	89677.1	14770.0	41033.6	35861.5	5274.8
2000	99214.6	14944.7	45555.9	40033.6	9537.5
2001	109655.2	15781.3	49512.3	43580.6	10440.6
2002	120332.7	16537.0	53896.8	47431.3	10677.5
2003	135822.8	17381.7	62436.3	54945.5	15490.1
2004	159878.3	21412.7	73904.3	65210.0	24055.5
2005	183867.9	23070.4	87364.6	77230.8	23989.6
2006	210871.0	24737.0	103162.0	91310.9	27003.1
2007	246619.0	28910.0	121381.0	96328.0	35748.0

**Note:** The data are from the "China Statistical Yearbook-2007", Beijing: China statistical press, 2007.09. The data of 2007 are from the "Statistical Communique of the People's Republic of China on the 2007 National Economy and Social Development", 2008-02-28 [http:// www.stats.gov.cn/](http://www.stats.gov.cn/)

Table 2. The main indicators of China's macroeconomy during 2000-2007

Main economic indicators	unit	2000	2001	2002	2003	2004	2005	2006	2007
1) QSHGDZC	YY	32917.7	37213.5	43499.9	55566.6	70477.4	88773.6	109998.2	137239.0
2) SHXFPLSZE	YY	39105.7	43055.4	48135.9	52516.3	59501.0	67176.6	76410.0	89210.0
3) CZSRZE	YY	13395.2	16386.0	18903.6	21715.3	26396.5	31649.3	38760.2	51304.0
4) SSSRZE	YY	12665.8	15165.5	16996.6	20466	25723	30867	37637	49449
5) JCKZE	YMY	4727.9	5096.5	6207.7	8509.9	11545.5	14219.1	17604.0	21738.0
6) NYXFZL	WDBZM	138553	143199	151797	174990	203227	224682	246270	265480
7) XJMRJKZPSR	Y	6280	6860	7703	8472	9422	10493	11759.5	13786
8) NCJMEJCSR	Y	2253	2366	2476	2622	2936	3255	3587	4140
9) RJGDP	Y	7858	8622	9398	10542	12336	14103	16084	18665

**Note:** 1) The data are from the "China Statistical Yearbook-2007", Beijing: China statistical press, 2007.09. The data of 2007 are from the "Statistical Communique of the People's Republic of China on the 2007 National Economy and Social Development", 2008-02-28 [http:// www.stats.gov.cn/](http://www.stats.gov.cn/)

2) QSHGDZC means social fixed-assets investment; SHXFPLSZE means total retail sales of consumer goods; CZSRZE means total amount of financial revenue; SSSRZE means total amount of tax revenue; JCKZE means total amount of import and export; NYXFZL means total energy consumption; CXJMRJKZPSR means per capital disposable income of urban and rural residents; NCJMEJCSR means per capital net income of rural residents; RJGDP means per capital GDP; YY means 100 million yuan; YMY means 100 million dollars; WDBZM means 10 thousand

ton standard coal; Y means yuan. Following are the same.

practicality. The economic growth is the result of many complicated factors mutual restriction and harmonious development in the social economic system, so it is suitable to study and excavate this system's internal rules with grey models. This article is based on the grey model with new development coefficient in the literatures (Yu et al., 2008; Men et al., 2004, 2005). We are trying to establish a new grey prediction model with higher precision and more stability.

We assume the original time sequence

$$P^{(0)} = [p^{(0)}(1), p^{(0)}(2), L, p^{(0)}(n)]$$

We don't establish a prediction model on total amount of GDP sequence, but take logarithm for the original time sequence. That is  $x^{(0)}(k) = \log[p^{(0)}(k)]$ . Then we get  $x^{(1)}$  by 1<sup>st</sup>-order accumulating generator operator on  $x^{(0)}$ , namely

$$x^{(1)}(k) = \sum_{i=1}^k x^{(0)}(i) \quad (k = 1, 2, L, n)$$

We let the initial value be

$$a_0 = \ln \left\{ \frac{1}{n-1} \left[ \sum_{k=2}^n \frac{x^{(0)}(k-1)}{x^{(0)}(k)} \right] \right\} \quad (k = 1, 2, L, n),$$

$$\lambda_0 = \frac{1}{a_0} - \frac{1}{e^{a_0} - 1}.$$

The grey differential equation is

$$x^{(0)}(k) + a_1 z^{(1)}(k) = b_1,$$

and  $a_1, b_1$  are the undetermined coefficients.  $z^{(1)}(k)$  is the background value, which is

$$z^{(1)}(k) = \lambda_0 x^{(1)}(k-1) + (1 - \lambda_0) x^{(1)}(k).$$

We apply least square method to get the solution.

$$\hat{a} = (a_1, b_1)^T = (B^T B)^{-1} B^T Y$$

in which,

$$B = \begin{pmatrix} -\lambda_0 x^{(1)}(1) - (1 - \lambda_0) x^{(1)}(2) & 1 \\ -\lambda_0 x^{(1)}(2) - (1 - \lambda_0) x^{(1)}(3) & 1 \\ \dots & \dots \\ -\lambda_0 x^{(1)}(n-1) - (1 - \lambda_0) x^{(1)}(n) & 1 \end{pmatrix}$$

$$Y = (x^{(0)}(2), x^{(0)}(3), \dots, x^{(0)}(n))^T$$

We let  $\hat{x}^{(0)}(n) = x^{(0)}(n)$ , and the solution is the time response function in the form

$$\hat{x}^{(0)}(k) = x^{(0)}(n) \cdot e^{-a(k-n)} \quad (k = 1, 2, L, n).$$

Then the result is retrieved to the total by means of  $p^{(0)}(k) = \exp(x^{(0)}(k))$ . The model presented here is called Optimal grey model with logarithm new development coefficient (GMLNDC). This model ensures that the initial values are close to the actual values, which is favor of reducing iteration times. It makes calculation easy and effective, and improves the fitting accuracy and prediction accuracy. So this model has extensive application space.

### 3. Prediction and empirical analysis of China's economic development

#### 3.1 Test prediction of chinese GDP in 2007

Based on the actual condition of China's economic development in the recent years, we single out 5~9 dimensions short series to construct general-type GM (1, 1) model, DGIM, GMNDC and GMLNDC after comprehensive analysis to select a suitable model for test prediction of Chinese GDP from 2005 to 2007. Test shows that the 6-dimension model gives the closest result, which is thus taken for use, with the values from all the grey prediction models summarized in Table 3 and 4.

Comparison of tests from table 3 to 4 indicates that grey model with logarithm new development coefficient has higher prediction accuracy and it is also reliable and stable than other models. The one-step predictions of Chinese GDP in 2006 and 2007 are up to 99.87% and 99.02% respectively, which is very satisfied.

Table 3. The comparison of test prediction about Chinese GDP in 2006 with some models (unit 100 million)

model	statistics	prediction	residual difference	relative error (%)
GM(1,1)	210871	208329.8	2541.2	1.21
DGIM	210871	211206.1	335.1	0.16
GMNDC	210871	209335.7	1535.3	0.73
GMLNDC	210871	210606.5	264.5	0.13

Table 4. The comparison of test prediction about Chinese GDP in 2007 with some models (unit 100 million)

model	statistics	prediction	residual difference	relative error (%)
GM(1,1)	246619	242956.6	3662.4	1.49
DGIM	246619	240165.6	6453.4	2.62
GMNDC	246619	243167.1	3451.9	1.40
GMLNDC	246619	244196.4	2422.6	0.98

### 3.2 The prediction of chinese GDP from 2008 to 2012

From the above comparison, we select grey model with logarithm new development coefficient on a 6-dimension basis by data from 2002 to 2007,

$$\hat{x}^{(0)}(k) = 12.415600 e^{0.01212565gk-6}$$

By comparison, we know that the standard deviations' ratio of model parameter  $C=0.0324$ , small error probability  $p=1$ , and the average fitting accuracy  $\bar{q} = 99.94\%$ . Therefore, the model is past with great accuracy. We calculate the prediction values of Chinese GDP from 2008 to 2012, based on this model. The results are listed in Table 5.

Table 5. The main indicators' forecasting table of China's macroeconomy during 2008-2012 (unit 100 million)

indicators	2008	2009	2010	2011	2012
Total amount of GDP	286950.1	334494.3	390645.9	457088.1	535857.0
The first industry	32579.6	36766.1	41548.9	47020.7	53289.8
The proportion of GDP	0.1135	0.1099	0.1064	0.1029	0.0994
The second industry	144214.8	171779.4	205140.2	245620.9	294870.6
The proportion of GDP	0.5026	0.5135	0.5251	0.5374	0.5503
The tertiary industry	111892.8	130227.0	151865.8	177455.8	207779.8
The proportion of GDP	0.3899	0.3893	0.3888	0.3882	0.3878
The error	0.0060	0.0127	0.0203	0.0280	0.0374

With the same method, we establish models and do prediction on the three industries respectively. The results are also listed in Table 5. The last line of table 5 is the error checking line. The sum of proportion the three industries accounted for GDP should be 1. The relative error in 2008 is only 0.0060. As the error increases gradually following the year, the relative error in 2012 is only 0.0374 as well as. It proves in another way that this model has high prediction accuracies and reliable prediction results.

### 3.3 Main economic indicators' prediction from 2008 to 2012

China is still in the opportunity period of a rare international strategy at present. The economic society has a nice development stance, especially with its improved stability of economic operation and coordination of economic development, the breakthrough in the reform of important fields and key links, which lay a solid foundation for taking a big stride forward. We will establish grey model with logarithm new development coefficient with the data of main macroeconomic indicators from 2000 to 2007, and calculate the prediction values from 2008 to 2012. The results are listed in table 6.

## 4. Conclusion and discussion

(1) On the basis of grey model with new development coefficient, we put forward the grey model with logarithm new development coefficient. It weakens interference factors greatly and reveals the operation law of the system, which makes the model more stable. Thus, this model has higher prediction accuracy. It indicates from empirical analysis that this model is a new ideal tool in economic predictions for their absoluteness, facility and easy control, and this model has a greater prediction effect on time sequences increased quickly in the short time than other grey models.

Table 6. The main indicators' forecasting table of China's macroeconomy during 2008-2012 (unit 100 million)

Main economic indicators	unit	2008	2009	2010	2011	2012
1)QSHGDZC	YY	173839.1	221238.1	282920.8	363583.4	469591.3
2)SHXFPLSZE	YY	102107.8	117063.2	134426.7	154618.9	178139.3
3)CZSRZE	YY	62018.8	80381.6	101314.6	128306.0	163276.6
4)SSSRZE	YY	62018.8	78153.5	98964.2	125937.9	161075.0
5)JCKZE	YMY	27710.5	35533.7	45841.8	59507.6	77738.6
6)NYXFZL	WDBZM	294699.9	327419.9	364093.1	405233.4	451426.2
7)CXJMRJKZPSR	Y	15603.2	17688.5	20085.2	22844.4	26026.1
8)NCJMRJCSR	Y	4647.2	5224.6	5883.3	6636.0	7497.5
9)RJGDP	Y	21598.9	25048.3	29112.4	33911.8	39591.8

(2) The prediction results show that GDP in 2008 will exceed RMB 28000 billion, be up to RMB 28695.01 billion, which will increase by 16.35% of the previous year in anticipation (The results are calculated with current price in 2007, without deducting the factors such as price rising, following are the same). The national fixed assets investment will reach RMB 17383.91 billion, which will increase by 26.67% of the previous year. The total retail sales of consumer good will reach RMB 10210.78 billion, which will increase by 14.46%. The total amount of financial revenue will reach RMB 6407.08 billion, which will increase by 24.9% of the previous year. The total amount of tax revenue will reach RMB 6201.88 billion, which will increase by 25.4% of the previous year. The total amount of import and export will reach 2771.05 billion dollars, which will increase by 27.47% of the previous year. At the end of 2010, the total amount of GDP will reach RMB 39064.59 billion, which is 2.12 times of 2005 and about 3.94 times of 2000. The per capital GDP in 2010 will reach 29112.4 yuan, which is 2.08 times of 2005. However the anticipated indicator in 2010 that the eleventh-five year planned will be 19270 yuan. It means that the prediction result will exceed the anticipated indicator 9842.4 yuan. The goal that the total amount of GDP will be double of 2000 was achieved in 2006. The goal that the total amount of GDP will be quadrupling of 2000 will be achieve in 2011. Hai Wen(2006), the famous economist, thought that the economic growth at high speed would last ten or twenty years at least and the key lay in system reform. At the speech in the Nanjing University on Mar 26<sup>th</sup> 2008, "Father of Europe Currency" Robert Alexandar Mundell predicted that the total amount of GDP would catch up with Japan in 2020, and the time would be short. Thus, the prediction results in this article are reasonable and reliable under the situation of maintaining economic rapid growth.

(3) As we all know, the reasonable three industrial structures will maximize the contribution of economic development. The change of three industrial structures is fit for the general law of industrial structure evolution in the world. The ratio of proportion that the three industries accounted for GDP in the period of the tenth five-year was 13.12: 45.90: 40.98. The ratio in 2007 was 11.72: 49.22: 39.06. If it keeps current operation condition of economic system, the ratio will be 10.64: 52.51: 38.88 at the end of 2010 (The ratio of proportion in the period of the eleventh five-year will be 11.07: 50.45: 39.83), from the prediction results in table 5. That is, the ratio of the first industry decreases, the ratio of the second industry uplifts, and the ratio of the tertiary industry weakens year by year. At present, the proportion of agriculture in GDP is quite large, but the proportion of the tertiary industry is lower than the developed countries in the same stage. The prominent problem that will affect sustained economic growth is employment deficiency, which is caused by the unreasonable industrial structures and weak competitive power. We should enforce the adjustment of industrial structures and focus on lifting the proportion of the three industries, aiming at the problems such as the low agricultural productivity, the big but not strong industry and the less development of service industry. In addition, the industrial distribution has been optimized, to some extend. New pattern of the regional industrial structure is being formed on the basis of comparative advantages, which is helpful to control repeated construction with low level and is beneficial to distribute resources effectively and optimize the industrial structures.

(4) At present, China is entering into a new stage with its sustained and stable economy. China has been enjoyed fast and stable economic development for five years. The speed of economic growth keeps 10% or a little more five-year continuous with small ripple among years and seasons. What's more, the quality and benefit of economic operation has been greatly enhanced, economic structure has been constant improved and people have got more material benefit. To the question of current price situation, Ma Kai, the director of development and reform commission, answered we had confidence, conditions and measures to inhibit the fast growing speed of general price level. Ma Kai also said the south snow disaster at the beginning of 2008 would not change the basic trend of China's economy. At the opening year of the eleventh five-year plan, China was entering into a stage with its stable and healthy economy, and the fiscal policy had been turned into robust one. Xie Xuren, the minister of finance, said that we were going to maintain the robust fiscal policy. We would focus on the structure adjustment and harmonious development, and we would strengthen the

coordination among fiscal policy, monetary policy and industrial policy. We were trying to prevent economic growth from overheating and prevent price from inflation by controlling the total amount of GDP, stabilizing commodity prices, adjusting structure and promoting balance. In a word, we would promote economic development fast and well.

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