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Time series analysis-based chinese economic reformation and growth research

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ABSTRACT

Chinese economic reformation impels economic rapidly development, but some policies of them also intensifies some internal contradictions, therefore our country economic reformation should comply with the aspirations of the people, take laboring people's interests into consideration, Chinese market-oriented reformation not only breaks through original balanced laboring relations, but also causes antagonism appear between labors interests and capital, if the balance of the two powers are seriously imbalanced, it will intensify internal contradictions, and such kinds of contradictions are increased due to institution and globalization, so it should strengthen low-class labors rights to speak, establish fair industrial relations, which are the foundation to improve economic development. Research shows that on the premise of our country comprehensively deepen reformation, per capita GDP increases by year, from time series analysis, our country economic growth shows the rising trend, and per capita GDP growth is relatively rapid after year 2000.

KEYWORDS

Time series;
Economic reformation;
Internal contradictions;
Economic system;
Mathematical model.

INTRODUCTION

Since China implemented opening up and reform, main target is to develop the productivity. From the 18th CPC National Congress and the 18th Third Plenary Session, it is known that our country should take the road of comprehensively deepen reformation, comprehensively deepen reformation means the transformation of our country government functions, "fiscal decentralization" is an extremely important content that distinguishes local government and central government fiscal relations, one of important contents in our country's economic reformation implementation is "fiscal decentralization".

From 1970s to now, our country economic system has gone through long term and tortuous development but overall development is good, until now our country economic system reformation can roughly divide into three phases. Their specific corresponding phases' contents are as TABLE 1.

From above three phases' analysis, we get that our country economic development has not been smoothly but gone through a series of reformation and then come to this situation, it makes analysis here of central fiscal

TABLE 1 : Economic system reformation experienced phases

Time frame	Content
Phase one (Year 1978~1984)	Economic growth reformation phase that was major in planned economy. Deng Xiao-Ping summarized our country economic system, he presented that Chinese economic system was dominated by planned economy while it also had market economy, and highlighted that market economy was not capitalistic market economy but socialistic market economy.
Phase two (Year 1985~1992)	Economic overall transformation phase that was major in commodity economy. With phase one achieved results in the small and midsize ranges, rural reformation also achieved good results, and then our country stated to make economic system reformation on cities. With reforming range was expanded and deepen, market economy didn't appear as complementary role any more but gradually came up in economic development.
Phase three (Year1993 to now)	Comprehensively coordinative reformation phase that dominated by socialistic market economic system. After entering in 1990s, Deng Xiao-Ping pointed out in the relations between planned economy and market economy, socialism and capitalism, whether our country economic system should be dominated by market or plan was not the problem that decided our country society nature, because socialism still had market, so it should follow market rules if market was existing, and implemented market economy.

(Data source: Xing Ya-Ping. "Understanding about Chinese economic system reformation process")

revenues proportion (%), year 1970—2009 per capita GDP data as well as world economy relative time developmental periods.

MODEL ESTABLISHMENT

The paper's analysis of time series is listing events change situations according to chronological orders and then constructing an analytical time series. We make effective observation and researches on time series, find out its corresponding change and development rules, predict its future trend that is corresponding time series analysis.

Time series analysis brief introduction

For time series analysis, firstly comprehend following model

①AR (p) model:

$$\begin{cases} x_t = \Phi_0 + \Phi_1 x_{t-1} + \Phi_2 x_{t-2} + ... + \Phi_p x_{t-p} + \varepsilon_t \\ \Phi_p \neq 0 \\ E(\varepsilon_t) = 0 \ , \ Var(\varepsilon_t) = \sigma_\delta^2, E(\varepsilon_t \varepsilon_s) = 0, s \neq t \\ Ex_s \varepsilon_t = 0, \forall s < t \end{cases}$$

Model with above structure is called p order auto regression model, we record it as AR(p) here.

MA(q)model:

$$\begin{cases} x_t = u + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \theta_2 \varepsilon_{t-2} - ... - \theta_q \varepsilon_{t-q} \\ \theta_q \neq 0 \\ E(\varepsilon_t) = 0, Var(\varepsilon_t) = \sigma_\delta^2, E(\varepsilon_t \varepsilon_s) = 0, s \neq t \end{cases}$$

Model with above is called q order auto regression model, record it as MA(q) here.

ARMA(p, q) model:

$$\begin{cases} x_t = \Phi_0 + \Phi_1 x_{t-1} + \Phi_2 x_{t-2} + ... + \\ \Phi_p x_{t-p} + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \theta_2 \varepsilon_{t-2} - ... - \theta_q \varepsilon_{t-q} \\ \Phi_p \neq 0, \theta_q \neq 0 \\ E(\varepsilon_t) = 0, \ Var(\varepsilon_t) = \sigma_\delta^2, E(\varepsilon_t \varepsilon_s) = 0, s \neq t \\ Ex_s \varepsilon_t = 0, \forall s < t \end{cases}$$

Time series analysis of the model with above structure is called p q order autoregression model, record it as ARMA (p, q).

Stationary sequence modeling

(1) Modeling steps:

According to our country 39 years from 1970 to 2009, Chinese statistical yearbook's China's per capita GDP as initial data, it lists following flow: The correla-

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tion coefficient calculation sample, The model is not, And number of estimates, Model test, model optimizing, Series Forecast as Figure 1 Model of the process.

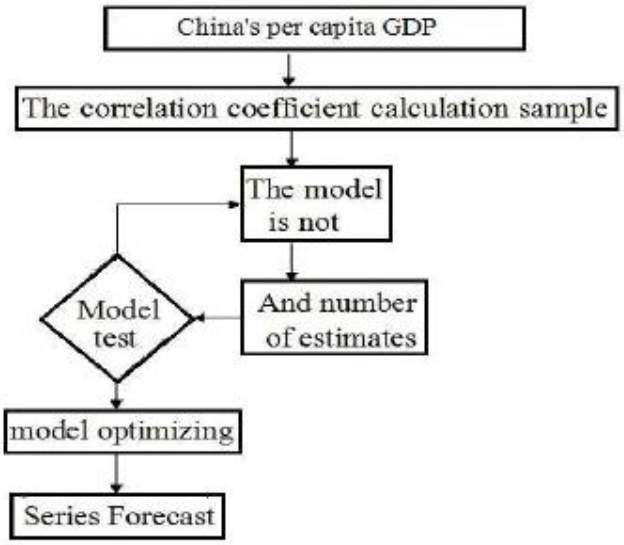

Figure 1 : Model of the process

(2) Calculate sample correlation coefficient:
Sample autocorrelation coefficient:

$$\hat{\rho}_k = \frac{\sum_{t=1}^{n-k}(x_t - \bar{x})(x_{t+k} - \bar{x})}{\sum_{t=1}^{n}(x_t - \bar{x})^2}$$

Partial correlation coefficient (sample):

$$\hat{\Phi}_{kk} = \frac{\hat{D}_k}{\hat{D}}$$

(3) Model recognition basic principle is as TABLE 2:

TABLE 2 : Basic principle

$\hat{\rho}_k$	$\hat{\Phi}_{kk}$	Select model
Tailing	P order tailing	AR(p)
q order tailing	Tailing	MA(q)
Tailing	Tailing	ARMA(p, q)

(4) Sample correlation coefficient approximate distribution:

Barlett: $\hat{\rho}_k \sim N(0, \frac{1}{n}), n \to \infty$

Quenouille: $\hat{\Phi}_{kk} \sim N(0, \frac{1}{n}), n \to \infty$

(5) Parameter estimation:

Parameters to be estimated have $p + q + 2$ pieces unknown parameters, and the common used estimation methods are : moment estimation, maximum likelihood estimation, 6 models significance testing:

Purpose: test model's validness (whether sufficiently extract information or not)

Test objects: Residual sequence

Evaluation principle: A good fitting model should be able to extract observed value sequence samples correlation information that residual sequence should be the data that needs to discuss, on the contrary, it needs to distinguish according to cases.

Null hypothesis: Per capita GDP data in Chinese statistical yearbook.

$$H_0 : \rho_1 = \rho_2 = ... = \rho_m = 0, \forall m \geq 1$$

Alternative hypothesis: Corresponding residual sequence is data that needs to discuss

H_1: At least it has some $\rho_k \neq 0, \forall m \geq 1, k \leq m$

Test statistics:
LB statistics

$$LB = n(n+2)\sum_{k=1}^{m}(\frac{\hat{\rho}_k^2}{n-k}) \sim \chi^2(m)$$

Parameters significance testing:

Purpose: Test corresponding every unknown parameter value is zero or not. Delete these insignificant parameters.

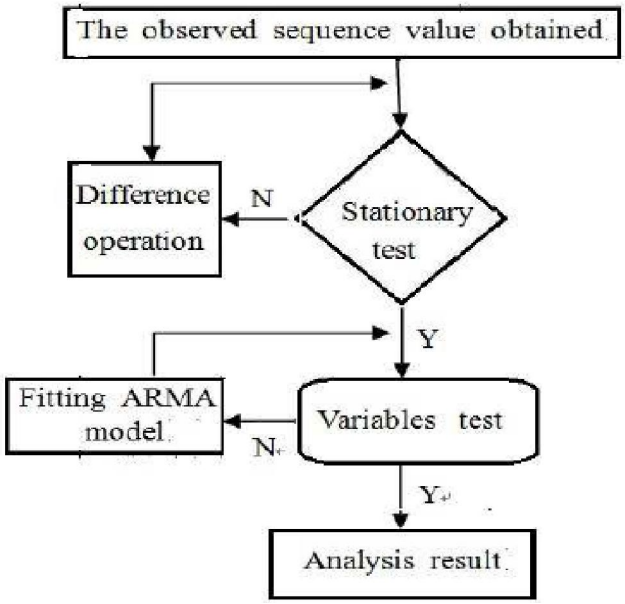

Figure 2 : Non stationary sequence modeling flowchart

TABLE 3 : Partial workers collective actions records

Time	Address	Action way	Appeal
February, 2000	Huludao city, Liaoning Province	Yangjiazhangzi molybdenum minerals above 20000 workers and families demonstrated in the street	Put forward that laid-off severance pay is too low, and required to punish corrupted and degenerated enterprises operators
Year 2001	Yancheng city, Jiang Su Province	Thousands of workers demonstrated in front of municipal government agency	Required to solve survival problems
August, 2001	Chongqing City	Hundreds of laid-off worker blocked road to demonstrate	Required to keep economic compensation policy that only converts into 280 RMB for working age every year.
March, 2002	Daqing City, Liaoning Province	More than 50 thousand laid-off oil workers demonstrated	Protested enterprise party reorganizing seniority buy-outs protocol
March, 2002	Liaoyang city, Liaoning Province	Ferroalloy Factory and others six factories in Liangyang city nearly ten thousand workers demonstrated in municipal government agency	Protested government officers and factory principals' corruption and degeneration, asked to release back pay and solve recognized life issues
April, 2002	Lanzhou city, Gansu Province	Lanzhou Chemical headquarter above 100 workers blocked the road	Expressed dissatisfaction with seniority buy-outs.
From April to July, 2002	Songyang City, Jilin Province	Jilin oil field above 5000 early retired and seniority buy-outs laid-off workers carried out 100 days petition	Required to return to work or improve economic compensation criterion
July, 2002	Baotou city, Inner Mongolia	Baotou city long march brickyard above 2000 workers presented a petition in municipal government, and subsequently several hundred workers occupied factory	Fought for rights to work and required to improve basic cost of living allowances standard
September, 2002	Yushu City, Jilin Province	Yushu city diesel engine plant 1400 workers presented a petition	Required to refuse the decision that let Changchun city to take over diesel engine plant
October, 2002	Xi'an city, Shanxi Province	Above 500 laid-off workers protested	Protested ordnance factory to be sold to private person and required laid-off compensation
January, 2003	Suizhou City, Hubei Province	Nearly above 1000 retired workers from ironwood textile group, Suizhou City, they blocked railway from Wuhan to Xiangfan for over two hours	Protested enterprises cancelling pension allowances
February, 2003	Wuhan City, Hubei Province	Wuhan iron and steel company's above 300 retired workers gathered to present a petition	Protested enterprises cancelling pension allowances
July, 2003	Zaoyang City, Hubei Province	Zaoyang city Chemical fertilizer plant above 1800 workers went on a strike	Required government to make arrangement of seniority buy-outs for workers
August, 2003	Suizhou City, Hubei Province	Suizhou City oil pump plant above 500 workers presented a petition	Required to improve seniority buy-outs economic compensation criterion
August, 2003	Shaoguan City, Guangdong Province	Shaoguan City cement plant above 400 workers went to government to present a petition	Protested government seniority buy-outs unreasonable behaviors
February, 2004	Suizhou City, Hubei Province	Ironwood textile group nearly 2000 workers blocked railway and national roads nearby	Protested manufacturer bankruptcy liquidation group decisions that couldn't full cash enterprise internal stocks, stopped workers' living expenses, as well as stopped retired workers' pensions
From September to October, 2004	Xianyang City, Shanxi Province	Xianyang the seventh cotton mill above 5000 workers went on a strike	Dissatisfied with China Resources merger and acquisition conditions and workers' economic compensation arrangement

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$H_0 : \beta_j = 0 \qquad H_1 : \beta_j \neq 0$

Test statistics:

$$T = \sqrt{n-m}\,\frac{\hat{\beta}_j - \beta_j}{\sqrt{a_{jj}Q(\tilde{\beta})}} \sim t(n-m)$$

Model optimization:

Problem posing: Here, we assume that model passes corresponding tests, which shows data is in certain feasible intervals, the model can effective get corresponding results.

Optimization purpose: Select relative optimal model

Sequence forecasting:

Linear forecasting function: $x_t = \sum_{i=0}^{\infty} C_i x_{t-1-i}$

Minimum forecasting variance principle: $Var_{\hat{x}_{t(l)}}[e_t(l)] = \min\{Var[e_t(l)]\}$

Take it as factor in next model analysis.

Non-stationary sequence modeling

Firstly, it needs to do stationary operation on data, and furthermore we establish ARIMA (p, q) model to solve the process, in the following it introduces the model.

Model structure usage occasion is difference stationary sequence fitting, model structure:

$$\begin{cases} \Phi(B)\nabla^d x_t = \Theta(B)\varepsilon_t \\ E(\varepsilon_t) = 0, Var(\varepsilon_t) = \sigma_\varepsilon^2, E(\varepsilon_t \varepsilon_s) = 0, s \neq t \\ Ex_s\varepsilon_t = 0, \forall s < t \end{cases}$$

Modeling steps: The observed sequence value obtained, Stationary test, Difference operation, Variables test, Fitting ARMA model, Analysis result as Figure 2 Non stationary sequence modeling flowchart.

Model application and corresponding data processing

Chinese economic reformation status

To Chinese economic reformation, laboring people also accordingly have taken partial workers collective actions to stand up for themselves; thereupon it makes records on partial workers collective actions status as TABLE 3.

For above workers collective actions, they are mainly about seniority buy-outs problems, China should consider low class laboring people when implements economic reformation such aspect.

Chinese economic growth status data processing

Firstly analyze central fiscal revenues proportions, and sort the data in the article "Contemporary Chinese economic system reformation" that Wu Jing-Lian and others published, as TABLE 4.

Correspond to above data; it draws "black-white bar chart" as Figure 3.

From above analysis, we can see that in central fiscal revenue proportions, year 1996 occupies the largest proportions, overall is in fluctuation.

TABLE 4 : Central fiscal revenues proportions(%)

Year	Percentage occupies in whole fiscal revenues	Percentage occupies in gross domestic product
1990	15.52	4.85
1991	20.18	5.73
1992	24.52	6.3
1993	26.46	6.4
1994	28.61	6.55
1995	35.85	8.26
1996	40.51	9.28
1997	38.39	8.59
1998	36.68	7.63
1999	33.48	6.15
2000	32.87	5.19
2001	30.86	4.86
2002	33.79	3.53
2003	29.79	4.34
2004	28.12	3.68

(Data source:Wu Jing-Lian : "Contemporary Chinese economic system reformation", Shanghai Far East Publishers, the version 2004)

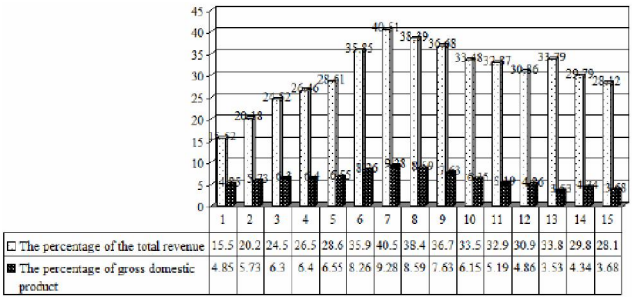

Figure 3 : The proportion of the central fiscal revenue

TABLE 5 : National per capita GDP data Unit (Yuan)

Year	Per capita GDP	Year	Per capita GDP	Year	Per capita GDP
1970	276.3	1984	695	1998	6796
1971	289.5	1985	858	1999	7159
1972	293.5	1986	963	2000	7858
1973	309.9	1987	1112	2001	8622
1974	411.4	1988	1366	2002	9398
1975	328.8	1989	1519	2003	10542
1976	318.2	1990	1644	2004	12336
1977	341.4	1991	1893	2005	14053
1978	381	1992	2311	2006	16165
1979	419	1993	2998	2007	20169.5
1980	463	1994	4044	2008	23707.7
1981	492	1995	5046	2009	25575.5
1982	528	1996	5846		
1983	583	1997	6420		

(Data source: "Chinese statistical yearbook")

Then combine with Chinese per capita GDP data to sort, its sorting result is as TABLE 5.

Correspond to above data, it makes time series analysis, its result is as Figure 4.

Correspond to above time series analysis; it is clear that Chinese economic growth is in the rising trend, per capita GDP growth is relative rapid since 2000.

Then correspond to economic development with time changes to analyze, its analysis result is as Figure 5.

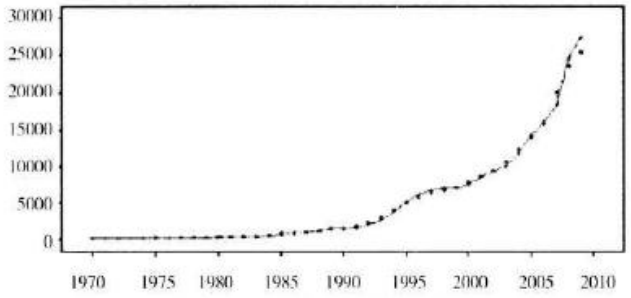

Figure 4 : Time series analysis

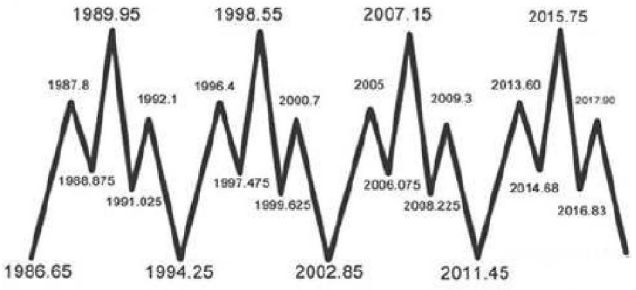

Figure 5 : Global economic development with the time change

From time series analysis result about global economic development as Figure 5, we can clearly see that world economic development have a periodical change, "one global economic period is roughly 8.6 years".

CONCLUSION

Our country economic reformation should comply with the aspirations of the people, take laboring people's interests into consideration, Chinese market-oriented reformation not only breaks through original balanced laboring relations, but also causes antagonism appear between labors interests and capital, if the balance of the two powers are seriously imbalanced, it will intensify internal contradictions, and such kinds of contradictions are increased due to institution and globalization, so it should strengthen low-class labors rights to speak, establish fair industrial relations, which are the foundation to improve economic development.

On the premise of our country comprehensively deepen reformation, per capita GDP increases by year, from time series analysis, our country economic growth shows the rising trend, and per capita GDP growth is relatively rapid since year 2000.

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