

The linkage between the taxes and GDP in China

by

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Abstract

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The purpose of this project is to determine the relationship between tax revenue and GDP in China, and any potential problems in China's tax system will be identified. It uses the past 10 years national GDP and tax revenue collected from the Statistical Yearbook of China in order to make a reasonable conclusion whether China's current tax system is appropriate for its economic development. In the study, the VAR model, ADF Unit Root Test and Granger causality test are used. From the output, the tax revenue affects the economic development positively and the growth of tax revenue in China in past years has been so fast that it can't adapt to actual requirements of the national economy.

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Contents

Chapter1: Introduction.....	1
1.1 Purpose of study.....	1
1.2 Background.....	2
1.3 Need for study.....	3
Chapter2: Literature Review.....	4
Chapter3: Methodology.....	9
3.1 Model introduction.....	9
3.1.1 VAR model.....	9
3.1.2 ADF Unit Root Test.....	10
3.1.3 Granger causality test.....	11
3.2 Data selection.....	12
Chapter 4: Empirical Results.....	13
4.1 The overview of the links of taxes and annual GDP.....	13
4.2 The relationship between lnGDP and lntax.....	13
4.3 Establish a stable VAR model.....	14
4.4 ADF test.....	16
4.5 The Granger causality test.....	17
Chapter5: Conclusion.....	20
Chapter 6: Recommendation.....	21
References.....	22

Chapter1: Introduction

1.1 Purpose of study

Taxes are one of the most significant parts of finance. In addition, they are able to have various effects as main indicators of an economy. This paper will use the 2002—2012 economic data of China as a sample to compute the relationship between the taxes and economic growth in China for the past 10 years and examine whether the results are in accord with the traditional principle.

Tax revenue is the basic method for governments to obtain capital to run their operation and allocate resources in the country. The change in tax revenue will affect consumption, investment and saving and therefore influence the GDP. More specifically, tax is one kind of automatic transfer (Temiz, 2008). Throughout history, many countries have collected the taxes revenue in order to carry out their basic functions. At the same time, tax policy became an instrument for some economic and social purposes such as allocation for funds by increasing internal savings, keeping price stability, stimulating the national economic growth and controlling the production and consumption amount.

As previously mentioned, tax revenue is one of the most important sources to provide the public facilities. In order to have enough money to afford national investments, social security services and the other public expenditure, the government can collect taxes or issue the debt. However, the latter is not the main method for countries to collect the capital. Moreover, taxes in an economic system may not only affect the

amount of the goods and services provided, but also the revenue and prices of production factors directly or indirectly (Yılmaz, 1996).

1.2 Background

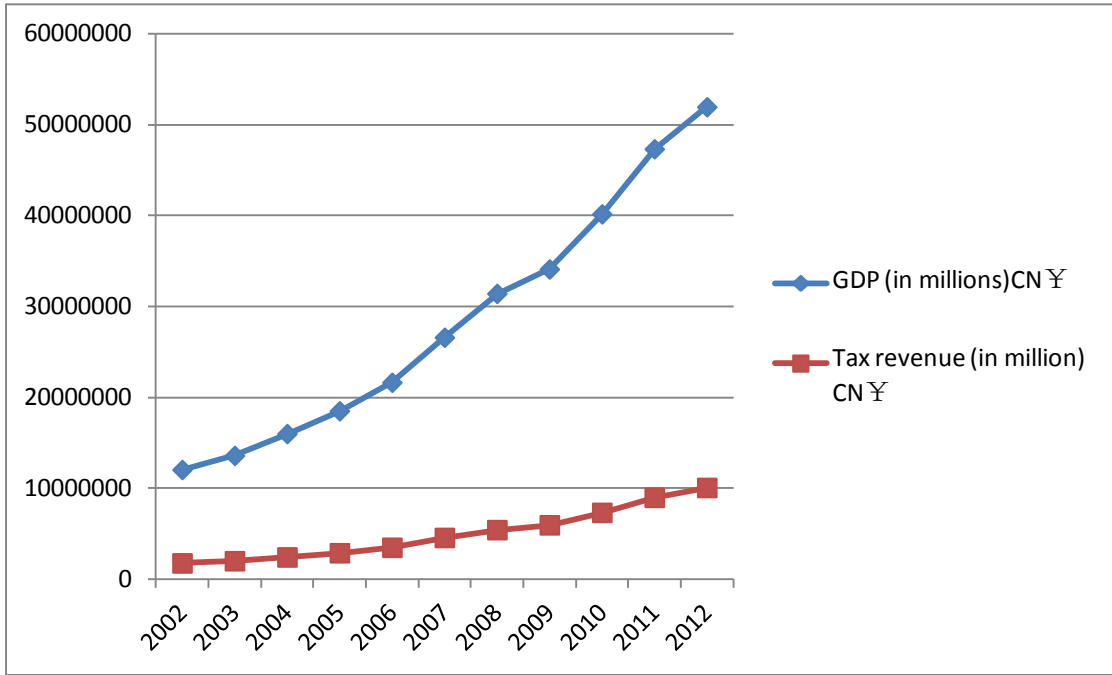
From the last century, China has become one of the world's major economic powers with the greatest potential. Overall living standards have not reached a level of a fairly well-off society. In the years following reform and opening-up in 1979 in particular, China's economy developed at an unprecedented rate, and that momentum has held steady into the 21st century, although growth rates are no longer double digit.

Since the 1994 tax system reform, China's tax revenue has increased at a high speed. Compared to 1994, the tax revenue in 2012 has had a dramatic increase. While providing solid financial security to the stable development of national economy, the sharp leap of tax growth has also attracted economists' attention as to whether this high speed is coordinated with economic growth.

In the last 10 years, both of China's tax revenue and GDP grow rapidly. According to the China Yearbook, the China's GDP rose from Rmb12 trillion, at the start of the 2002, to Rmb51 trillion in 2012. At the same time, the tax revenue in China increased from Rmb1258 billion in 2002 to Rmb10 trillion in 2012. In addition, through these data we can find that the growth rate of tax revenue is always far greater than the growth rate of GDP per year. In other words, in recent years the tax revenue took an

increasing proportion of the total national GDP amount.

Table1.1



1.3 Need for study

According to the multiplier effect and the crowding-out effect, if governments increase tax revenue it, will reduce the GDP growth. In a healthy tax system, the tax revenue can promote the market economic and optimize the structure of national economy. But of course the contrary is possible, and although China has enjoyed remarkable economic growth, it has to pay attention to the tax regime to ensure that it does not impede future growth.

Chapter2: Literature Review

There is a wide literature on the research of the links between the tax revenue and economic growth. Marsden (1983), pointed out that as the increase in tax rates often causes low growth. Skinner (1987), obtained a similar outcome by using corporate and personal's tax rates.

King & Rebelo (1990), observed an approximate 2% decrease in GDP growth per year when the tax rates increased 10%. And in their study, they concluded that, in the long term, income taxes have a decreasing impact on individual earnings. On the other hand, some other people hold the opposite point, Mendoza (1997) stated that in theory people can estimate how the changes of income taxes affect investments and growth. But in practice the tax policy and the changes of direct and indirect taxes are not always an effective instrument to change the economic growth over time.

Peden (1991) has used the data of macro productivity and tax revenue in the USA from 1929 to 1986 to explore the relationship between them. As a result, he found that when government expenditure occupies less than 17% of GDP, it can improve the productivity of the U.S. But when the government expense is more than 17%, it will reduce the performance of productivity.

Plosser (1992) compared the data of per capita GDP and the proportion which is the tax revenues of profits in GDP among the 24 OECD countries from 1960 to 1989. He

calculated the correlation coefficient as -0.52. Which means if the government increases 0.05% the average tax rate, the economic growth rate would be reduced by about 0.4%.

Easterly and Rebelo (1993) extend this analysis by using some different measures of the marginal rate of tax in regressions adding some other determinants of growth, such as initial income, school enrolments, revolutions and war casualties. In order to remove some of the difficulties already noted, four different measures of the marginal tax rate were used: (1) statutory taxes; (2) revenue as a fraction of GDP; (3) income-weighted marginal income tax rates; (4) marginal rates from a regression of tax revenue on tax base. From a vast array of regressions involving these variables, Easterly and Rebelo conclude that the evidence that tax rates matter for economic growth is disturbingly fragile.

Engen & Skinner (1992), who used a data set including about 107 countries from 1970 to 1985, stated that both budget expenses of the country and the taxation have strong and negative effects on its economic growth. They estimated that a 1.4 percent point decrease on long term growth was caused by increases in the budget with a 10 percent in expenses and the taxation. The administrative structure of the tax system was also significant on the evaluation of the influence of the taxation on production,

Leibfritz and the others (1997) found that about a 10 percent point increase on the tax

rates in the last 35 years could induce about 0.5 percent point drop in the OECD annual growth rates. But this calculation had some defects to evaluate the impacts of taxes on the economy so it was necessary to determine other approaches to support these calculations.

Kneller et al (1999), who performed research on whether the evidence for OECD countries are coherent with the estimates of the endogenic growing models, anticipated that public expenditure and the structure of the taxes could affect the stable growth rate by using a data set including 22 OECD countries from 1970 to 1995. And they also obtained an outcome that formal taxation didn't reduce the growth but non-formed taxation decreased the growth, and productive expenses improved the growth but non-productive expenses didn't increased the growth.

Ma (2001), a researcher of the World Economics and Politics Institute of CASS, has taken regression analysis to the relationship between tax revenue and economic growth on the basis data from 1979 to 2009. His results indicated that when tax revenue increases \$160.51, the decline on GDP is about \$369.161.

Demircan(2003) stated that there was a close linkage between growth and economy policies. In addition, growth and development in a country's economy was also closely related with the income tax decreases. In his thesis, he pointed that the tax decrease will increase the production and national income and therefore directly

increase the gross national product rate. Moreover, if there was a political and economic stability in the country, the changes to reform in tax conduct and mechanisms for taxing had positive effects on the national growth and development. Also he stated that the expenditure taxes provide more equality in taxes and affecting the national economic growth and development indirectly in terms of encouraging savings by reducing the luxurious consumption.

Anastassiou and Dritsaki (2005) used direct marginal tax rates and the relationship between savings-income rate and growth rate for Greece. In the study to search for the long term relations they used the Johansen method, and for the short term relations, the Granger causality test was used. The evidence showed the existence of a long term relation between the variables in the study. In terms of short term relations, it was found a one way casual relation from direct marginal tax rates and tax incomes to the growth.

Durkaya & Ceylan (2006) analysed the relationship between 1980–2004 years tax incomes and economic growth with Engle-Granger integration test and causality test and figured out that there was a double sided relation between direct taxes and growth. However, there was no relationship between indirect taxes and the growth. It was stated that if the tax increases to increase the tax incomes had been made upon the indirect taxes, the negative effect of the tax increase on the growth would have been decreased. It was also stated that the change of the current tax items from direct taxes

to indirect taxes would make the same effect.

Wang (2009), who is the professor in Peking University, has used mathematical analysis to prove tax revenue maximization is incompatible with the maximization of the GDP and so forth.

Given the existing research does not confirm the many quantitative outcomes between GDP and taxes revenue, then this provides justification for further study. I have learnt many ideas and much knowledge from the existing literature, and will use the VAR model to test this topic in China. This study will provide a comprehensive outcome of this topic and further clarify the relationship between taxes revenue and GDP.

Chapter3: Methodology

3.1 Model introduction

3.1.1 VAR model

This paper will adopt the VAR model to explore the relationship between taxes revenue and GDP. This is a statistical model used to capture the linear interdependencies among multiple time series. VAR models generalize the univariate autoregression (AR) models by allowing for more than one evolving variable. All variables in a VAR are treated symmetrically in a structural sense. Each variable has an equation explaining its evolution based on its own lags and the lags of the other model variables. VAR modeling does not require as much knowledge about the forces influencing a variable as do structural models with simultaneous equations: The only prior knowledge required is a list of variables which can be hypothesized to affect each other intertemporally.

A VAR model describes the evolution of a set of k variables (called endogenous variables) over the same sample period ($t = 1, \dots, T$) as a linear function of only their past values. The variables are collected in a $k \times 1$ vector Y_t which has as the i^{th} element, $Y_{i,t}$ the time t observation of the i^{th} variable.

The model, (Equation 3.1) is as follows:

$$Y_t = C + A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + e_t \dots \dots \dots 3.1$$

where the l -periods back observation Y_{t-1} is called the l -th **lag** of Y , C is a $k \times 1$

vector of constants (intercepts), A_i is a time-invariant $k \times k$ matrix and e_t is a $k \times 1$ vector of error terms satisfying

$E(e_t) = 0$ —every error term has mean zero

$E(e_t e_t') = \Omega$ — the contemporaneous covariance matrix of error terms is Ω

(a $k \times k$ positive-semidefinite matrix);

$E(e_t e_{t-k}') = 0$ for any non-zero k — there is no correlation across time; in particular, no serial correlation in individual error terms. See Hatemi-J (2004) for multivariate tests for autocorrelation in the VAR models.

3.1.2 ADF Unit Root Test

If time series is not stable, median, variance and covariance are changeable in time. Shocks take place in a term can affect the others and it becomes permanent. The analysis carried out in this case includes fake regression and F and t statistics lose their meaning (Gujarati, 1999:2.712).

The stability levels of series and unit root test have been studied with ADF test.

DF test is carried out based on three regression equation (Dickey and Fuller, 1979).

Simple position:

$$\Delta Y_t = \gamma Y_{t-1} + \mu_t \dots\dots\dots 3.2$$

Intercept:

$$\Delta Y_t = \alpha_0 + \gamma Y_{t-1} + \mu_t \dots\dots\dots 3.3$$

Trend and intercept:

$$\Delta Y = \alpha_0 + \alpha_1 t + \gamma Y_{t-i} + \mu_t \dots\dots\dots 3.4$$

As a result of tests the DF statistic been compared Mac Kinnon critical values zero hypothesis is tested against the alternative hypothesis. Zero hypothesis show that series is not stable alternative hypothesis. If the error correction term is autocorrelated

Equation 3.5 is regulated as:

$$\Delta Y = \alpha_0 + \alpha_1 t + \gamma Y_{t-1} + \beta_i \sum_{i=1}^m \Delta Y_{t-i} + \mu_t \dots\dots\dots 3.5$$

Here m stands for regression length and Δ stands for difference operator. Regression number depends on obtaining model without autocorrelation. A test which is carried out this way is called an ADF test for short.

3.1.3 Granger causality test

The Granger causality test (Granger, 1969) is a technique for determining whether one time series is useful in forecasting another. If a time series is a Stationary process, the test is performed using the level values of two (or more) variables. If the variables are non-stationary, then the test is done using first (or higher) differences. The number of lags to be included is usually chosen using an information criterion, such as the Akaike information criterion or the Schwarz information criterion. Any particular lagged value of one of the variables is retained in the regression if (1) it is significant according to a t-test. And (2) it and the other lagged values of the variable jointly add explanatory power to the model according to an F-test. Then the null hypothesis of no

Granger causality is not rejected if and only if no lagged values of an explanatory variable have been retained in the regression..

3.2 Data selection

This paper will focus on the link between China's taxes revenue and GDP, therefore, all the data used in this article are Chinese. Both national GDP and tax revenue were collected from the Statistical Yearbook of China beginning in 2002 to 2012.

Year	GDP (in millions)CN ¥	Tax revenue (in million) CN ¥
2012	51,932,210	10,060,090
2011	47,310,400	8,973,839
2010	40,151,280	7,321,079
2009	34,090,281	5,952,159
2008	31,404,543	5,422,379
2007	26,581,031	4,562,197
2006	21,631,443	3,480,435
2005	18,493,737	2,877,854
2004	15,987,834	2,416,568
2003	13,582,276	2,001,731
2002	12,033,269	1,763,645

Chapter 4: Empirical Results

4.1 The overview of the links of taxes and annual GDP

I first run a simple regression, the model is:

$$Y(\text{GDP}) = \alpha_0 + \alpha_1 Y(\text{TAX}) \dots\dots\dots 4.1$$

where Y(GDP) is annual GDP

Y(TAX) IS annual tax revenue

Table 4.1

. reg gdp tax						
Source	SS	df	MS			
Model	1.8753e+15	1	1.8753e+15	Number of obs =	11	
Residual	4.2437e+12	9	4.7153e+11	F(1, 9) =	3977.13	
Total	1.8796e+15	10	1.8796e+14	Prob > F =	0.0000	
				R-squared =	0.9977	
				Adj R-squared =	0.9975	
				Root MSE =	6.9e+05	

gdp	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
tax	4.811431	.0762938	63.06	0.000	4.638842	4.984019
_cons	4488914	433009.1	10.37	0.000	3509379	5468448

The P value for tax is 0 which means there is a significant relationship between taxes revenue and annual GDP . The R-squared is 0.9977 and Adjusted R-squared is 0.9975, which means annual taxes revenue can explain the performance of annual GDP as well.

4.2 The relationship between lnGDP and lntax

To remove the heteroscedasticity among the data of GDP and taxes revenue, I will analyse the relationship between lnGDP and lntax, the model is:

$$Y(\ln\text{GDP}) = \alpha_0 + \alpha_1 Y(\ln\text{TAX}) \dots\dots\dots 4.2$$

Table 4.2

```
. reg lngdp lntax
```

Source	SS	df	MS			
Model	2.53158764	1	2.53158764	Number of obs =	11	
Residual	.000786061	9	.00008734	F(1, 9) =	28985.39	
Total	2.5323737	10	.25323737	Prob > F =	0.0000	
				R-squared =	0.9997	
				Adj R-squared =	0.9997	
				Root MSE =	.00935	

lngdp	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
lntax	.8356023	.0049081	170.25	0.000	.8244995	.8467051
_cons	4.298611	.0749698	57.34	0.000	4.129018	4.468205

The P value for lntax is 0 which means there is significant relationship between lntax and lnGDP . The R-squared is 0.9997 and Adjusted R-squared is 0.9997, which means lntax can explain the performance of lngdp.

4.3 Establish a stable VAR model

Before we establish the Unrestricted VAR model we should ensure the the optimal lag of this model.

Run the regression (Equation 3.1)

$$Y_t = C + A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + e_t$$

Table 4.3

```
. var lngdp, lags(1/1)
```

Vector autoregression

```
Sample: 2003 - 2012
Log likelihood = 19.48319
FPE = .0017837
Det(Sigma_ml) = .0011892
No. of obs = 10
AIC = -3.496639
HQIC = -3.563026
SBIC = -3.436122
```

Equation	Parms	RMSE	R-sq	chi2	P>chi2
lngdp	2	.038554	0.9938	1599.122	0.0000

	lngdp	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
lngdp	lngdp L1.	.9813772	.0245412	39.99	0.000	.9332774 1.029477
	_cons	.462479	.416902	1.11	0.267	-.3546338 1.279592

Table 4.4

```
. var lngdp, lags(1/2)
```

Vector autoregression

```
Sample: 2004 - 2012
Log likelihood = 18.03772
FPE = .0021269
Det(Sigma_ml) = .0010634
No. of obs = 9
AIC = -3.341717
HQIC = -3.483587
SBIC = -3.275975
```

Equation	Parms	RMSE	R-sq	chi2	P>chi2
lngdp	3	.039939	0.9930	1272.523	0.0000

	lngdp	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
lngdp	lngdp L1.	.8244266	.3355895	2.46	0.014	.1666832 1.48217
	L2.	.1387302	.3375842	0.41	0.681	-.5229227 .800383
	_cons	.7985742	.4601077	1.74	0.083	-.1032204 1.700369

Table 4.5

Sample: 2005 - 2012	No. of obs	=	8
Log likelihood = 17.28116	AIC	=	-3.32029
FPE = .0023354	HQIC	=	-3.588191
Det(sigma_ml) = .0007785	SBIC	=	-3.28057

Equation	Parms	RMSE	R-sq	chi2	P>chi2
lnngdp	4	.039458	0.9933	1188.595	0.0000

	lnngdp	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
lnngdp						
	lnngdp					
	L1.	.6783518	.3122211	2.17	0.030	.0664097 1.290294
	L2.	-.2967116	.3991721	-0.74	0.457	-1.079074 .4856513
	L3.	.5730295	.2916621	1.96	0.049	.0013823 1.144677
	_cons	1.053487	.485871	2.17	0.030	.1011976 2.005777

4.4 ADF test

Before the empirical Analysis, we implement the ADF test on lnTAX and lnGDP.

The model is:

$$\Delta Y = \alpha_0 + \alpha_1 t + \gamma Y_{t-1} + \beta_i \sum_{i=1}^m \Delta Y_{t-i} + \mu_t \dots\dots\dots 3.5$$

If the ADF-value is less than threshold in significance level, the original sequence is stable. On the contrary, the original sequence is non- stable. We implement the ADF test on first-order difference, second-order difference or higher-order difference to the single integration sequence.

Table 4.6

. dfuller lnngdp, trend lags(1)

Augmented Dickey-Fuller test for unit root	Number of obs	=	9
	Test Statistic	Interpolated Dickey-Fuller	
		1% Critical Value	5% Critical Value
		10% Critical Value	
Z(t)	-1.420	-4.380	-3.600
			-3.240

Mackinnon approximate p-value for Z(t) = 0.8549

Table 4.7

```
. dfuller lntax, trend lags(1)
```

Augmented Dickey-Fuller test for unit root Number of obs = 9

	Test Statistic	1% Critical Value	Interpolated Dickey-Fuller 5% Critical Value	10% Critical Value
z(t)	-1.993	-4.380	-3.600	-3.240

Mackinnon approximate p-value for z(t) = 0.6053

Table 4.8

Variable	ADF test	Test type (c, t, k)	Critical value(5%)	Conclusion
LNGDP	-1.42	(c,t,1)	-3.6	non- stable
LNTAX	-1.993	(c,t,1)	-3.6	non- stable
DLNGDP	-4.265	(c,t,0)	-3.6	stable
DLNTAX	-5.278	(c,t,0)	-3.6	stable

From Table 4.8, LNGDP and LNTAX don't pass the unit root tests at the 5% level. It implies that GNP and tax revenues of China are non-stationary. But the first-order differential of LNGDP and LNTAX pass the ADF test at the 5% level. So LNGDP and LNTAX are a first-order single integration sequence.

4.5 The Granger causality test

This is a technique for determining whether one time series is useful in forecasting another. A time series X is said to Granger-cause Y if it can be shown, usually

through a series of F-tests on lagged values of X (and with lagged values of Y also known), that those X values provide statistically significant information about future values of Y.

I use the above results to test by the Granger causality test. The significance level is 5% and lagged values are 1 and 2.

Table 4.9

```
. gcause lngdp lntax, lags(1)
Granger causality test
Sample: 2003 to 2012
      obs = 10
H0: lntax does not Granger-cause lngdp
      F( 1, 7) =    0.22
      Prob > F =    0.6536
      chi2(1) =    0.31      (asymptotic)
      Prob > chi2 = 0.5754      (asymptotic)
```

Table 4.10

```
. gcause lntax lngdp, lags(2)
Granger causality test
Sample: 2004 to 2012
      obs = 9
H0: lngdp does not Granger-cause lntax
      F( 2, 4) =    3.39
      Prob > F =    0.1376
      chi2(2) =   15.26      (asymptotic)
      Prob > chi2 = 0.0005      (asymptotic)
```

Table 4.11

Lagged value	The null hypothesis	F-statistic	P-value	Result
1	Tax revenue is not Granger cause of economic growth	0.22	0.6536	Accept
1	Economic growth is not Granger cause of tax revenue	3.39	0.1376	refuse

From Table 4.11, we can conclude that the increase or decrease of GDP would inevitably affect the tax revenue. But the change of the tax revenue does not necessarily influence the GDP.

Chapter5: Conclusion

Based on the results from Chapter 4, we can conclude that primarily, both the national economy and total tax revenue in China have shown significant growth. The results of the regression analysis, show that the link between the tax revenue and the economic development is significant, and tax revenue positively affects the economic development. This result is suitable for our economic thought and expectations.

Secondly, while economic development is a major cause of the tax revenue growth, China's tax revenues are growing faster than what would be implied by GDP growth. Thus, the growth of tax revenue in China in past years is so fast that the current tax system cannot adapt to the actual requirements of China's economic development.

Thirdly, the ability of taxation to regulate the national economy can't be satisfactory, therefore public finance is unable to fulfill its function in macroeconomic growth.

Chapter 6: Recommendation

Faced with these problems, we should reform the current tax system by reducing the tax burden on the production side of economy so as to develop a system that promotes the growth rate of GDP. This is an urgent priority of Chinese government. But there are so many challenges and difficulties to reform the tax system in the short-term. So, it is better to improve the structure of the tax system whose main tax is income tax in according with the structural tax reduction. At same time, reducing the tax burden can stimulate economic development, improve the enthusiasm of consumers, which will further promote production and consumption and boost the investment and production efficiency.

The tax burden can be reduced in two ways. The first one is a general tax reduction. In this way, governments decrease the tax revenue directly by some processes such as reducing tax rates. The second way is to optimize the structure of the tax system.

China is in a period of economic restructuring and economic construction. So, if the government simply reduces the tax revenue directly, it can't necessarily adapt to the requirements of China's economic development. However, if the government optimizes the structure of the tax system, China can achieve sustainable growth of the GDP and tax revenues.

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