

An Investigation on the Mutual Effect between Tax Revenue and Economic Growth

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Abstract

Purpose – Taxes cover all aspects of society, especially in terms of resource allocation and economic growth. In reality, the tax revenue is often used to measure the quality of a country's economy. The relationship between tax revenue and economic growth has been paid much attention by academic circles. Due to this background, this paper attempts to investigate the mutual effect between tax revenue and economic growth.

Research design, data, and Methodology – The annual datum from 1980 to 2017 are employed to conduct an empirical analysis under the vector error correction model. In this paper, the GDP is treated as an independent variable. The tax revenue is treated as a dependent variable. Furthermore, a menu of statistic approaches will be used to testify the mutual effect between tax revenue and economic growth.

Results – Via the co-integration test, the results report that the tax revenue has a positive effect on economic growth in the long run. Through the vector error correction estimation, the results also report that the tax revenue also has a positive effect on economic growth in the short run.

Conclusions – This paper provides a view that the tax revenue is a kind of a determinant to promote economic growth. Therefore, the China's government should pay much attention to the improvement of tax revenue system so as to maintain a high-speed economic growth.

Keywords: Tax Revenue, Economic Growth, Mutual Effect.

1. Introduction

The tax revenue and the GDP are treated as two important indexes of national economy, the relationship between tax revenue and economic growth has been attracting much attention from academic circles. Theoretically, the tax revenue, as the major source of government's fiscal revenue, is closely related to economic growth. On the one hand, the economic growth is the source of tax revenue. Namely, only when the economy has achieved great growth can it be possible to turn the economic development it has achieved into government's fiscal revenue. Under this condition, the scale of the tax revenue has the opportunity to be enlarged. On the other hand, the tax revenue can adjust the benefits of the market main body via the factors of tax system such as tax rate, tax type and tax reduction. The tax revenue exerts the function of automatic stabilization mechanism and the camera choice mechanism of tax revenue, which can affect the economic growth.

Since the tax system reform in 1994, the scale of tax revenue has been increasing with the economic growth. At the same time, the rapidly increasing tax revenue promotes and regulates the development of the national economy in the form of government expenditure. The rate of economic growth has also accelerated with the tax increases. The gradual development of marketing economy draws the tax revenue and the economic growth increasingly close. The objective of this paper is to explore the mutual effect between tax revenue and economic growth. On the grounds of the Keynesian School, the Laffer curve and the New-Classical theory of economic growth, the tax revenue is regarded as a determinant to impact economic growth. Meanwhile, the annual datum from the year of 1980 to 2017

are employed to conduct an empirical analysis under the vector error correction model. The GDP is treated as an independent variable. The tax revenue is treated as a dependent variable. Furthermore, a menu of statistic approaches such as the Augmented Dicky-Fuller test, the co-integration test, the Granger causality test, the vector error correction estimation, the impulse response function and the variance decomposition will be used to testify the mutual effect between tax revenue and economic growth. The findings of this paper exhibit that both in the long run and in the short run, the tax revenue has a positive effect on economic growth. However, the performance of tax revenue to drive economic growth is less significant than that of long-run performance.

To this end, the rest of this paper will be organized as follows. Part 2 provides the literature review which is a conclusion of the previous studies so as to make a distinction between this paper and others. Part 3 represents the theoretical framework which is treated as a foundation for this paper. Part 4 exhibits the empirical analysis which provides theoretical evidence for this paper. Part 5 presents the conclusion which is regarded as a summary of this paper.

2. Literature Review

With the establishing of market economy in China, the importance of the relation between tax revenue and economic growth is more and more concerned. Due to this, a large number of scholars employ different models, different samples and different countries to exploit the relationship between both of them. Even so, they have not already reached a consensus on this proposition. Their research findings will be listed as the following exhibits.

Cui, Wang & Guan (2010) select a sample from the year of 1985 to 2008 to conduct a multiple regression to demonstrate the relationship between tax structure and economic growth. Their findings show that the circulation tax and the income tax (especially, the individual income tax) have a positive effect on the growth per capita gross domestic product. However, the impact of the property tax on the growth of per capita gross domestic product can not be found. The macro tax burden and the deficit red ink have a negative effect on the growth of per capita gross domestic product. Liu, Li & Zhang (2010) set Shanxi province as an example to analyze the relationship between tax revenue and economic growth from the year of 1994 to 2007. They find that the co-integration between tax revenue and economic growth exists. Specifically speaking, 1% increase in economic growth will lead to 1.287% increase in tax revenue. Meanwhile, the Granger causality test result indicates that the economic growth is reason that promotes a growth of tax revenue. Yuan (2010) starts from the aspects of the tax revenue scale and structure to explore the relationship between tax revenue and economic growth. He finds that the tax revenue system needs to be reformed so as to meet the economic growth. Liu (2010) finds that the tax revenue and economic growth move in the same direction.

Li, Huang & Zhou (2011) use the vector auto-regressive model to study the relationship among tax revenue, tax revenue competition and economic growth. They find that the regional macro tax burden restricts the economic growth. But, the tax revenue competition among regions can promote economic growth. Xie & Li (2011) apply the provincial panel data from the year of 1999 to 2008 to analyze the relationship between regional tax revenue competition and economic growth. They find that the positive effect of regional tax revenue competition on economic growth is greater than that of the negative effect's. In summary, the regional tax revenue competition can promote the economic growth. Hao (2011) finds that the long-run equilibrium relationship between tax revenue and economic growth. However, the impact of economic growth on tax revenue is not significant in the short run in Henan province. Zhang & Zhnag (2011) take Chongqing city as an example to analyze the relationship between tax revenue and economic growth via the time series from 1997 to 2009. They find that the tax revenue has a positive effect economic growth. Concretely, 1% increase in tax revenue can result in 0.865% increase in economic growth.

Tang (2012) employs the spatial dynamic panel data model to analyze the relationship between central tax revenue and economic growth. His findings show that the central total tax revenue, the total enterprises' income tax, the individual income tax, the added-value tax and the business tax have a positive effect on economic growth. Conversely, the central foreign capital income tax, the consumption tax and the refunding export tax have a negative effect on economic growth. Jinjark (2013) studies a relationship between economic openness via financial and trade integration and government revenue from financial repression. The financial repression revenue has declined significantly from the 1980s into the 2000s across the upper-income, the middle-income, and the low-income

developing countries. Bai, Wang & Peng (2013) adopts the vector auto-regressive model to find that the nontax revenue does not have an effect on economic growth. At the same time, the impact of tax revenue on economic growth is not significant. Xie (2013) also finds that the causality between tax revenue and economic is significant.

Abdullah & Morley (2014) examine the causal relationship between environmental taxes and economic growth. Their results suggest some evidence of long-run causality running from economic growth to increase revenue from the environmental taxes, with also some evidence of short-run causality in the reverse direction. Koitsiwe & Adachi (2015) investigate the dynamic relationships between mining revenue and economic growth in Botswana. The quarterly data from 1994 to 2012 are to analyse through the use of unrestricted vector auto-regressive model. Their empirical results suggest that mining revenue causes the economic growth. Liu & Lu (2015) apply a dynamic Computable General Equilibrium model-CASIPM-GE model to explore the impact of a carbon tax and different tax revenue recycling schemes on China's economy. The simulation results show that the carbon tax is effective to reduce carbon emissions with mild impact on China's macro economy. Ro oi u (2015) analyzes the impact of the government revenues on the economic growth in Romania over the period from the first quarter of 1998 to the fourth quarter of 2014. He finds that the government revenues have a positive effect on economic growth. Go, Robinson & Thierfelde (2016) use a recursive dynamic computable general equilibrium (CGE) model to examine the impact of natural resource revenue on economic growth in Niger. Their results show that an increase in the natural resource revenue can lead to an increase in economic growth.

In summary, the previous studies listed above analyze the impact of a component of tax revenue on economic growth. In this paper, all kinds of tax revenue are regarded as a total factor to impact the economic growth. Furthermore, this paper also attempt to exploit the short-run and long-run dynamic relationship between tax revenue and economic growth.

3. Theoretical Framework

3.1. Keynesian School

In Keynesian economics comprises various macroeconomic theories about how in the short run and especially during recessions. The economic output is strongly influenced by aggregate demand (total spending in the economy). In the Keynesian view, the aggregate demand does not necessarily equal the productive capacity of the economy; instead, it is influenced by a host of factors and sometimes behaves erratically, affecting production, employment, and inflation.

Keynesian advocates that the economy market needs intervention and management. Especially in the market regulation malfunction, taxation policy, also called fiscal policy, can be used to keep the market running. Usually, the economic growth is represented by the growth of gross domestic productivity. Therefore, the relation between taxation policy and economic growth can be summarized as the relation between tax revenue and economic growth. In the view of Keynesian school, the income equation gives:

$$Y = C + S + Trans - T \quad (1)$$

Where C represents the consumption; S represents the savings; $Trans$ represents the transfers; T represents the tax revenue.

Also, the expenditure equation gives:

$$Y = C + I + G + BT \quad (2)$$

Where I represents the investment; G represents the government purchase; BT represents the trade balance. Nation identical equation gives:

$$C + S + Trans - T = C + I + G + BT \quad (3)$$

Calculating equation (3) gives:

$$S + Trans - T = I + G + BT \quad (4)$$

Absolution income hypothesis illustrates the consumption can be seen as a function of disposable income. Its equation gives:

$$C = C_a + cYD \quad (5)$$

Where C_a represents the autonomous consumption; C represents the marginal propensity to consume. Due to that the disposable income is equal to the difference of total income to tax revenue. Its equation gives:

$$YD = Y - T \quad (6)$$

Where YD represents the disposable income. Putting equation (5) into equation (1) gives:

$$Y = C_a + D(Y - T) + I + G \quad (7)$$

Transferring equation (7) gives ;

$$Y = \frac{C_a - DT + I + G}{1 - D} \quad (8)$$

Taking derivative of Y to and G :

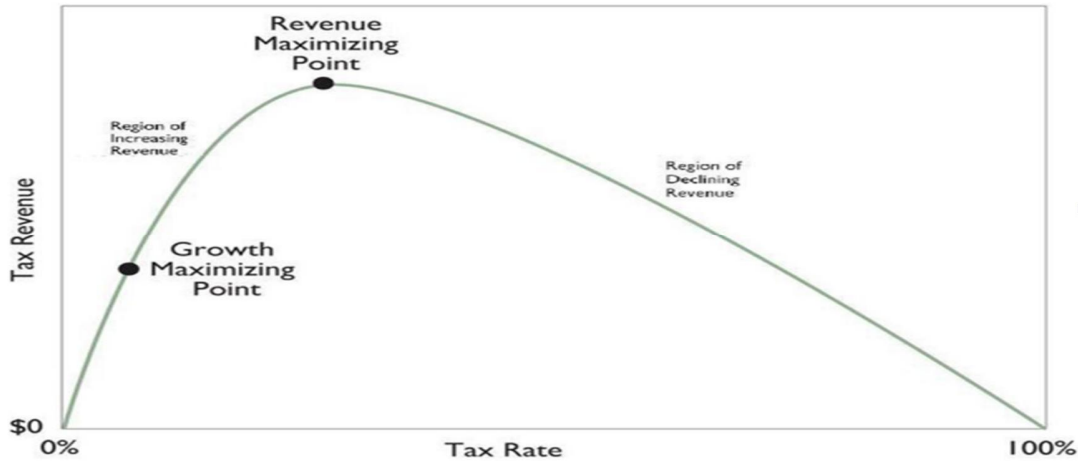
$$\frac{dY}{dT} = -\frac{d}{1 - d} \quad (9)$$

Where the negative value represents that the tax revenue has a negative effect on economic growth. Therefore, when the economy is trouble in a recession, 1% decrease in the tax revenue can result in $\frac{d}{1 - d}$ % increase in the gross domestic productivity. Conversely, when the economy inflates, 1% in increase in the gross domestic productivity will lead to $\frac{d}{1 - d}$ % decrease in the tax revenue. In summary, this fiscal policy can be used to balance the relation between tax revenue and economic growth.

3.2. Laffer Curve

In economics, the Laffer curve illustrates a theoretical relationship between rates of taxation and the resulting levels of government revenue. As a matter of fact, there is a limitation for Keynesian school to explain the relation between tax revenue and economic growth. The reason is that when the tax revenue arrives at a certain scale, it will have a great significant effect on economic growth. Laffer curve illustrates that the high tax rate is not a necessary

condition to lead a high income. Also, the high income may be not indicate a high tax rate. Namely, the magnitude of tax rate can lead two results: One is that the high tax rate can dampen producer and proprietor’s enthusiasm, which will lead to production stagnation or fall. The other is that the low tax rate can encourage worker to work more, saver to save more and investor to invest more, which can promote the economic growth. Therefore, it will be summarized that the relation between tax revenue and economic growth is independent and interactive. In macro economy, the proper negative tax is a vital way to promote economic growth.



<Figure 1> Laffer Curve

3.3. New-Classical Theory of Economic Growth

Neoclassical growth theory is an economic theory that outlines how a steady economic growth rate can be accomplished with the proper amounts of the three driving forces: labor, capital and technology. The theory states that by varying the amounts of labor and capital in the production function, an equilibrium state can be accomplished. The theory also argues that the technological change has a major influence on an economy, and the economic growth cannot continue without advances in technology. Its equation gives:

$$Y(t) = F[K(t) * A(t) * L(t)] \quad (10)$$

Where Y represents the output; K represents the capital; A represents the technology; L represents the labor. Equation (10) demonstrates that the capital, labor and technology input determines output growth. In the short run, the output is mainly determined by the capital and labor input. In the long run, the output growth is determined by three of them. The impact of tax revenue on economic growth is often via the indirect ways such as impact of tax on savings, capital and labor or something else.

4. Empirical Analysis

4.1. Data Description

In this paper, two variables will be involved. They are the tax revenue and economic growth. The annual time series datum from the year of 1980 to 2017 are sourced from the National Bureau of Statistics of China. In order to analyze the dynamic relationship between tax revenue and economic growth more clearly, both of them will be in log. The purpose of taking logarithm is to clear the outliers and the heteroscedasticity out. More intuitively, the variables will be shown in <Table 1>. in details.

<Table 1> Data Description

Variable	Logarithmic form	Definition	Source
GDP	$\log GDP$	Real GDP	National Bureau of Statistics of China
Tax revenue	$\log TR$	Real value of tax revenue	National Bureau of Statistics of China

4.2. Unit Root Test

This paper will be employed the Augmented Dickey-Fuller test to testify the stationarity of $\log GDP$ and $\log TR$. The results of unit root test show in <Table 2>.

<Table 2> Unit Root Test

Variable	t-Statistic	1% test critical value	5% test critical value	10% test critical value	Prob.*	Result
$\log GDP$	-1.751	-3.646	-2.954	-2.616	0.397	Non-reject
$\log TR$	-1.112	-3.627	-2.946	-2.612	0.701	Non-reject
$\Delta \log GDP$	-3.177	-3.633	-2.948	-2.613	0.030	Reject
$\Delta \log TR$	-5.501	-3.627	-2.946	-2.612	0.000	Reject

Note: Δ represents the difference operator.

<Table 2> exhibits that both of them are non-stationary at their own levels. However, If both of them are conducted the first difference. It can be seen that the value of t-Statistic is greater than the 5% test critical value. Namely, After conducting the first difference, both of them become stationary at 5% significant level. Then, the long-run relationship between both of them will be confirmed.

4.3. Engle-Granger Two-step Method

The purpose of co-integration test is to find the long-run relationship between tax revenue and economic growth. There a menu of methods to conduct a co-integration test. In this paper, the Engle-Granger two-step method will employed to perform a co-integration test. The results show in <Table 3> and <Table 4>.

<Table 3> Results of Ordinary Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\log TR$	0.945	0.183	5.157	0.000
C	1.057	0.075	14.091	0.000
$R^2 = 0.867$		Adjusted- $R^2 = 0.827$		$D.W. = 2.284$

<Table 3> reports the long-run relationship between tax revenue and economic growth via the ordinary least squares' estimation. $R^2 = 0.867$ means that the tax revenue has a good explanation to economic growth. Meanwhile, $D.W. = 2.284$ indicates that the model does not exist the auto-correlation. In order to guarantee the co-integration relationship more feasible, the stationarity of the residual in the model must be confirmed. The unit root test result of residual in the model shows in <Table 4>.

<Table 4> Unit Root Test Result of Residual

	t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-3.488	0.016
Test critical values	1% level	-3.689	
	5% level	-2.972	
	10% level	-2.625	

Note: *Mackinnon (1996) one-sided p-values.

<Table 4> reports the unit root test result of residual in the model. It can be concluded that the value of t-Statistic is greater than the 5% test critical value. Namely, the null hypothesis is rejected. Furthermore, it can be confirmed that the residual of the model is stationary.

The co-integrating equation gives:

$$\log GDP_t = 0.945 \log TR_t + 1.057 + \varepsilon_t \tag{11}$$

Equation (11) demonstrates the long-run relationship between tax revenue and economic growth. In the long run, the tax revenue has a positive effect on economic growth. Concretely speaking, 1% increase in tax revenue will result in 0.945% increase in economic growth.

4.4. Granger Causality Test

In the case of time series, the Granger causality between two economic variables X and Y is defined as: If containing the past information of X and Y , the prediction effect of variable Y is superior to separate only by the past information of Y to the prediction effect of Y . Namely, the variables X helps to explain the change of Y in the future. The variable X is regarded as the Granger reason of causing the change of variable Y . The results of Granger Causality Tests report in <Table 5>.

<Table 5> Pairwise Granger Causality Tests

Lags	Null Hypothesis	Obs	F-Statistic	Prob.	Result
2	$\log TR$ does not Granger Cause $\log GDP$	32	4.466	0.006	Reject
	$\log GDP$ does not Granger Cause $\log TR$		1.718	0.171	Non-reject

<Table 5> exhibits that the null hypothesis $\log TR$ does not Granger Cause $\log GDP$ is rejected at 5% significant level. Namely, the $\log TR$ is the reason that can lead to the change of $\log GDP$. It can be concluded that the past value of $\log TR$ can be used to predict the current value of $\log GDP$. However, the null hypothesis that $\log GDP$ does not Granger Cause $\log TR$ is non-rejected at 5% significant level. Namely, the $\log GDP$ is the reason that can lead to the change of $\log TR$. It can be concluded that the past value of $\log GDP$ can be used to predict the current value of $\log TR$.

4.5. Vector Error Correction Estimation

Generally speaking, there are three methods which are most used to perform a vector error correction estimation. They the Granger representation theorem, the Engle-Granger two-step method and the direct estimated method. In this paper, the direct estimated method will be employed to conduct an estimation.

The basic model gives:

$$\Delta \log GDP_t = \beta \Delta \log TR_t - \lambda (\log GDP_{t-1} - \alpha - \gamma \log TR_{t-1}) + \varepsilon_t \tag{12}$$

Where $\log GDP_{t-1} - \alpha - \gamma \log TR_{t-1}$ is represents the error correction term, which is calculated from the co-integration test. β and λ are the coefficients.

More specifically, equation (13) can be written:

$$\Delta \log GDP_t = \beta \Delta \log TR_t - \lambda ecm_{t-1} + \varepsilon_t \tag{13}$$

Where ecm is the error correction term.

Via an estimation, the coefficients of vector error correction model show in <Table 6>.

<Table 6> Coefficients of Vector Error Correction Estimation

Coefficient	β	λ
Value	0.674 (0.074) [9.116] {0.000}	-0.133 (0.034) [3.912] {0.042}

Note: () represents the standard error. [] represents the t-Statistic. {} represents the p-value.

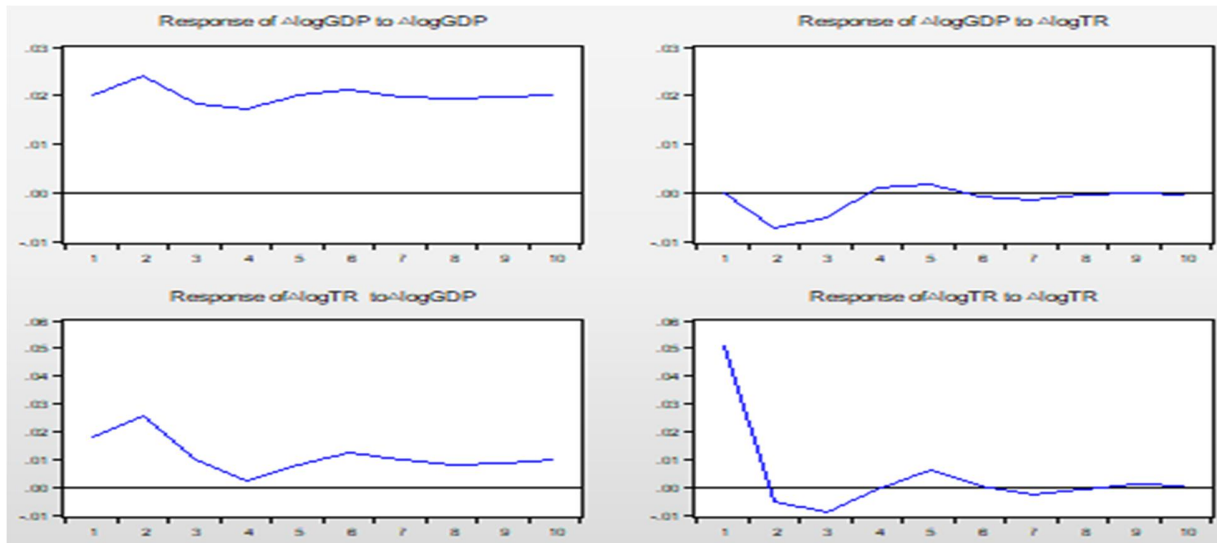
Therefore, the vector error correction equation gives:

$$\Delta \log GDP_t = 0.674 \Delta \log TR_t + 0.133 ecm_{t-1} + \varepsilon_t \tag{14}$$

Equation (14) indicates the short-run relationship between tax revenue and economic growth. In the short run, the tax revenue still has a positive effect on economic growth. More specifically, 1% increase in tax revenue will result in 0.674% increase in economic growth. Furthermore, when the system is suffering from a short-run fluctuation, there will be an error correction operating mechanism that makes the short-run fluctuation back to the long-run equilibrium. The coefficient of error correction term is 0.133, which the ability of short-run fluctuation back to the long-run equilibrium is 0.133% in the positive direction.

4.6. Impulse Response Function

The impulse response function illustrates that the shock of a standard deviation to influence the current and future value of a variable via the the dynamic linkage of variables in the vector error correction model. Namely, the impulse response function exhibits that the system dynamically responds to a shock of a variable. <Figure 2> reports the response to cholesky a standard innovations.



<Figure 2> Response to Chokesky One S.D. Innovations

The short-run mutual effect among $\log GDP$ and $\log TR$ can be examined by estimating a vector error correction model and interpreting it via the impulse response function. The impulse response function is reported for ten years in Figure 2.. As for the response of $\log GDP$ to $\log GDP$, the $\log GDP$ increases slightly in response to one standard deviation shock in itself in the second year. And then, the effect of the shock will become negative. After that, the effect of the shock will become positive again until to sixth year. With a small decrease, the effect of the shock will keep increasing. Considering the response of $\log GDP$ to $\log TR$, the $\log GDP$ will decrease intensively in response to one standard deviation shock in $\log TR$ in the second year.

Then, the effect of the shock will increase until to fifth year. After that, with a small decrease, the effect of the shock will dampen out and fade away by the eighth year. Regarding the response of $\log TR$ to $\log GDP$, the $\log TR$ will increase immediately in response to one standard deviation shock in $\log GDP$. Then, the effect of the shock will decrease until the fourth year. After that the effect of the shock will increase again by sixth year. With a small decrease, the effect of the shock will increase. With respect to the response of $\log TR$ to $\log TR$, the $\log TR$ will fiercely decrease in response to one standard deviation shock in $\log TR$ until to the third year. Then, the effect of the shock will increase. After that, the effect of the shock will decrease and fade away by the tenth year.

4.7. Variance Decomposition

The variance decomposition is a classical statistical method in multivariate analysis for uncovering simplifying structures in a large set of variables. The variance decomposition indicates the amount of information each variable contributes to the other variables in the auto-regression. It determines how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables. The results of variance decomposition show in <Table 7> and <Table 8>.

<Table 7> Variance Decomposition of $\Delta \log GDP$

Period	S.E.	$\Delta \log GDP$	$\Delta \log TR$
1	0.20	100.000	0.000
2	0.032	95.081	4.919
3	0.037	94.389	5.612

4	0.041	95.309	4.692
5	0.046	96.074	3.926
6	0.051	96.733	3.267
7	0.054	97.088	2.912
8	0.058	97.407	2.593
9	0.061	97.680	2.320
10	0.064	97.903	2.097

Considering the variance decomposition of $\Delta \log GDP$, <Table 7> reports the variance decomposition for ten quarters forecast of $\Delta \log GDP$ in which 97.903% of the forecast variance is attributed to $\log GDP$'s shocks, while 2.097% to $\log TR$'s shocks.

<Table 8> Variance Decomposition of $\Delta \log TR$

Period	S.E.	$\Delta \log GDP$	$\Delta \log TR$
1	0.054	11.229	88.772
2	0.060	27.627	72.373
3	0.061	28.896	71.104
4	0.062	29.010	70.990
5	0.062	29.898	70.102
6	0.063	32.464	67.536
7	0.064	34.055	65.945
8	0.065	35.016	64.984
9	0.065	36.116	63.884
10	0.066	37.488	62.512

Taking the variance decomposition of $\Delta \log TR$ into account, Table 8. reports the variance decomposition for ten quarters forecast of $\Delta \log TR$ in which 62.512% of the forecast variance is attributed to $\Delta \log TR$'s shocks, while 37.488% to $\Delta \log GDP$'s shocks.

5. Conclusion

The tax revenue is regarded as an important index of national economy. The relationship between tax revenue and economic growth has been paid much attention by academic circles. Therefore, this paper tries to investigate the mutual effect between tax revenue and economic growth. On the basis of the Keynesian School, the Laffer curve and the New-Classical theory of economic growth, the tax revenue is regarded as a determinant to impact economic growth. Meanwhile, the annual datum from the year of 1980 to 2017 are employed to conduct an empirical analysis under the vector error correction model. Furthermore, a menu of statistic approaches such as the Augmented Dicky-Fuller test, the co-integration test, the Granger causality test, the vector error correction estimation, the impulse response function and the variance decomposition will be used to testify the mutual effect between tax revenue and economic growth.

The results co-integration test reveal that there is a long-run relationship between tax revenue and economic growth. Concretely speaking, the tax revenue has a positive effect on economic growth. The results of Granger causality test indicate that the tax revenue is a driving factor to promote economic growth. However, the economic growth is not a reason to promote the growth of tax revenue. The results of vector error correction estimation show that there is a short-run relationship between tax revenue and economic growth. Specifically, the tax revenue has a positive effect on economic growth, but less than that of co-integration test. The results of the impulse response function and the variance decomposition exhibit that the tax revenue is also a major factor to drive economic growth.

In summary, the tax revenue is treated as an important index of national economy. It has taken a growing role in promoting economic growth. Of course, this paper also presents an empirical evidence to manifest that the tax revenue is driving factor to promote economic growth. Therefore, the China's government should pay much attention to the improvement of tax revenue system so as to maintain a high-speed economic growth.

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