Tax Revenue and Economic Growth of China: Test and Correction of the Tax Multiplier Effect

Feng Yi and Eko Suyono

In general, tax revenue maximization is incompatible with the maximization of the GDP. But this principle has not been certified in China. According to the recent economic data, both of China's tax revenue and GDP grow rapidly and are in the ascendant. At the same time, the growth rate of tax revenue is always far greater than the growth rate of GDP per year. In China, whether the traditional tax multiplier effect has a special transmission mechanism? Are there some problems in tax revenue and GDP of China? Based on these problems, this paper tests this hypothesis that the change of the tax revenue is not necessarily to influence the GDP. we use the 2000—2010 economic data of Hebei province as a sample to analyse and test the internal relationship between tax revenue and economic growth of China. We found that the unscientific structure of tax revenue leads to the problem. This suggests that tax reduction and reform of current tax system should be implemented.

Keywords: Tax revenue; Economic growth; Multiplier effect; Test and Correction

1. Introduction

Tax revenue which has become an important part of the market economy is the basic method in the obtaining of government revenue and the allocation of resources. The change of tax revenue will influence consumption, investment and saving and thus affect the GDP. For this reason, many countries, especially developing countries and regions, attach great importance to tax revenue on economic growth. Tax revenue is not a direct effect on the change of GDP, but depends on the multiplier effect and the crowding-out effect. If government increases tax revenue, it will reduce the GDP growth. The national economy is the source of tax revenue. Increase of GDP determines the tax revenue growth. In the scientific tax system, the tax revenue can promote economic development and optimize the structure of national economy. Conversely, it will impede economic development and tax revenue growth. Tax revenue loses the function of macroeconomic adjustment.

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2. Literature Review

There are many economists to make further efforts in empirical research and almost of them get similar conclusions at last. Plosser (1992) compared the growth rate of per capita GDP in the 24 OECD countries in 1960-1989 and the proportion which is the tax revenues of profits in GDP and calculated the correlation coefficient is -0.52. If government increases 0.05% the average tax rate, the economic growth rate would be reduced 0.4%. Peden (1991) has used inspection of relationship between macro productivity and tax revenue of American in 1929-1986 find when government expenditure accounts for less than 17% of GDP, it can improve the productivity of the U.S, but raising proportion which is more than 17% will reduce the growth rate of productivity. When proportion is growing beyond a point, the government has the positive contribution to the economic growth rate, but the marginal growth rate has declined. Ma Shuanyou (2001), researcher of the World Economics and Politics Institute of CASS, has taken regression analysis of relationship between tax revenue and economic growth on the basis of statistic data in 1979-2009 and thus concluded: when tax revenue increases $160.51 every time, the decline of GDP is about $369.16. Wang Shuyao (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.

The above studies are basis on the traditional tax multiplier theory to take theoretical and empirical research. The issue is whether traditional theory tax multiplier needs to be expanded and corrected, which improves it to be more compatible with the developing economy of China. Thus, we regard the impact of tax revenue to economic growth as a starting point and research the effect and transmission mechanism of tax revenue to economic growth of China in accordance with the tax revenue and economic growth theory, especially analyse and correct the traditional tax multiplier which depends on expanding general equilibrium model of economic growth.

3. The Methodology and Model

3.1 Correction, analysis and comparison of the Tax Multiplier

3.1.1 The correction of the traditional tax multiplier

In this paper, there are two methods to correct formula of traditional tax multiplier. The one is the mathematical derivation method. The other is theoretical derivation method. We can get the same tax multiplier formula by two methods.

3.1.1.1 The mathematical derivation method

According to the government transfer payment, the tax base of proportional taxation,
and distinction between income and disposable income, we optimize the national income formula \((Y = C + I + G)\) and use partial derivative to calculate the tax multiplier.

\[
Y = C + I + G = a + b \left( Y - T + t \frac{Y}{1 - t} \right) + I + G
\]

\[
= a + b \left( 1 - t \right) Y - b \left( 1 - t \right) T + b \left( 1 - t \right) t r + I + G
\]

Where \(t_r\) is the government transfer payments, \(T_o\) is the fixed income and \(t\) is the marginal tax rate.

Thus, we can get the formula: \(Y = \frac{a - b(1 - t) T + b(1 - t) t r + G}{1 - b(1 - t)}\)

Then, we calculate \(Y\) on the \(T_o\) partial derivative. The tax multiplier is \(K = \frac{-b(1 - t)}{1 - b(1 - t)}\)

### 3.1.1.2 The theoretical derivation method

The theoretical derivation method is from the microscopic analysis. Based on definition of the tax multiplier, we change \(T\) to affect \(Y\) and use a simple mathematical model to calculate the tax multiplier.

The amount of total expenditure isn’t affected directly from the tax revenue. The tax revenue changes residents’ disposable income and thus it affects consumption and the total expenditures.

The government decided to implement tax reduction \(\Delta T\). On the surface, it seems that tax reduction will make residents’ disposable income increase \(\Delta T\) immediately. \(\Delta T\) is just for consumption to affect the total expenditure. In fact, it is impossible in real life. We assume \(t\) is the marginal tax rate in the government. Implementing the tax reduction, residents’ income will be increased \(\Delta T\), but the increase of disposable income isn’t \(\Delta T\). This part of the increased revenue includes the taxation \(t \Delta T\), so residents’ disposable income should be \((1 - t) \Delta T\), which means that the first resident who achieves tax reduction (fixed tax and proportional tax are not considered here) also need to pay taxes to the government. The disposable income \((1 - t) \Delta T\) will increase consumer spending \(b(1 - t) \Delta T\) by marginal propensity to consume \(b\). This is the first round of GDP growth after the tax reduction.
After the first round, the first person as the consumer spends $b(1-t)\Delta T$ and the second person as a seller obtains income $b(1-t)\Delta T$, $b(1-t)\Delta T$ is still the income, which is not disposable income. The disposable income is $b(1-t)^2\Delta T$ after tax. This disposable income will also create consumer spending $b^2(1-t)^2\Delta T$ by marginal propensity to consume $b$.

The increase $b^2(1-t)^2\Delta T$ is the aggregate expenditure (aggregate revenue) in the second round. By that analogy, the increase of GDP and taxes will continue from transition between consumption and income, which produces the multiplier effect. Therefore, the total increase of the aggregate expenditure (aggregate revenue) is $\Delta Y$ by $\Delta t$ in the $n$ round.

The above process can be deduced by a simple mathematical model:

We assume the function is $Z=b_n(1-t)^n\Delta T$ (n is the number of rounds)

\[
\Delta Y = b(1-t)\Delta T + b_2(1-t)^2\Delta T + b_3(1-t)^3\Delta T + \cdots + b_n(1-t)^n \Delta T \\
= [b(1-t) + b_2(1-t)^2 + b_3(1-t)^3 + \cdots + b_n(1-t)^n] \Delta T \\
= \frac{b(1-t)[1-b(1-t)^n]}{1-b(1-t)} \Delta T
\]

\[
\lim_{x \to \infty} \frac{b(1-t)[1-b(1-t)^n]}{1-b(1-t)} = \frac{b(1-t)}{1-b(1-t)}
\]

Tax and aggregate expenditure (aggregate revenue) are negative correlation, so the revised tax multiplier is $\Delta y/\Delta t = -\frac{b(1-t)}{1-b(1-t)}$.

3.1.2 Comparative analysis between Traditional and Revised Tax Multiplier

The absolute value of the revised tax multiplier is smaller than the traditional tax multiplier. It illustrates that the effect of government’s tax policy changes is small than the traditional expectation in the GDP. We calculate the first and second order derivative of two tax multiplier on independent variable $t$ for further analysis.

At first, we need to explain some points: First one is the marginal tax rate $t$. According unchanged, rise or fall marginal tax rates by changing amount of object of taxation, the
tax can be divided into the proportional tax, the progressive tax and the regressive tax. In the system of proportional tax, the marginal tax rate is equal to the average tax rate. If tax revenue is unchanged or negative growth, the marginal tax rate may be zero or negative. This article assumes that the marginal tax rate is between 0 and 1 (0 < t < 1). t is an incremental ratio. The faster growth of economy may mask the heavy tax burden.

Secondly, marginal propensity to consume b whose value is usually between 0 and 1 is the marginal propensity to consume is the slope of the consumption curve, which indicates that consumption is be increased by the increase of income. However, the range of the marginal propensity to consume isn’t always 0-1. When consumer expenditure and income change in the same direction, the marginal propensity to consume is the positive number. On the contrary, the marginal propensity to consume is the negative number. If consumer expenditure is 0, no matter how much income will change, the marginal propensity to consume is 0. This article assumes the marginal propensity is between 0 and 1 (0 < b < 1).

Thirdly, \[ \Delta T = \frac{T_n - T_{n-1}}{Y_n - Y_{n-1}}, \quad K = \frac{\Delta Y}{\Delta T} = \frac{-b(1-t)}{1-b(1-t)}. \] Both represent the change in the proportion of tax and total revenue. t is the link relative ratio of the difference between tax revenue and national income. Kt is the ratio of national income change caused by tax revenue in the same period.

\[ K_t = \frac{-b(1-t)}{1-b(1-t)} = 1 - \frac{1}{1-b(1-t)} \]

Where t is the independent variable, \( K_t \) is the dependent variable and b is the constant. (0 < t < 1, 0 < b < 1)

we calculate the derivation of \( K_t \), then, \[ K'_t = \frac{b}{[1-b(1-t)]^2}, \quad b > 0, \quad [1-b(1-t)]^2 > 0. \] So \( K'_t > 0 \) and \( K_t \) increases monotonically in the open interval (0, 1). Calculating the derivation of \( K_t \) again, we can get \[ K''_t = \frac{-2b^2}{[1-b(1-t)]^3}, \]

b>0, 0<b(1-t)<1, and \([1-b(1-t)]^3 > 0. \] \( K_t = \frac{-2b^2}{[1-b(1-t)]^3} < 0. \) Therefore, The graph is upward convex curve in open interval (0, 1).

Calculating the derivation of the \( k_t \), we get \[ k'_t = \frac{b^2}{[1-b(1-t)]^2}, \text{ where } b^2 > 0 \text{ and } [1-b(1-t)]^2 > 0. \] Because \( k'_t > 0 \), \( k_t \) increases monotonically in the open interval (0, 1).

After calculate the derivation of the \( k'_t \), we get \[ k''_t = \frac{-2b^3}{[1-b(1-t)]^3}. \] It is less than 0. Therefore, The graph is upward convex curve in open interval (0,1).
we calculate and analyse the revised tax multiplier is still in the traditional framework of assumptions. For example, we only consider the proportional income tax and do not consider changes of interest rate and exchange rate, the dynamic research, the crowding-out effect of multiplier and so on. Therefore, the revised tax multiplier is a simple static description. However, in the same assumption, the revised tax multiplier not only calculates results more accurate than before, but also highlights the marginal tax rates in the tax multiplier effect.

Follow the above analysis, we can make the following conclusions: First and the foremost is the revised tax multiplier is smaller than the traditional tax multiplier. The impact of the changes in the tax revenue to the national economy is small than traditionally expect. The second significant point is marginal propensity to consume b is greater, more difference between the two tax multiplier. Thirdly, growth rate of revised tax multiplier is more sensitive than traditional tax multiplier. So, the government implement tax reduction and adjust structure of tax are more effective. Fourthly, if b value is in stable point, two tax multipliers will change in the same direction with t values. When t value is closer to 0, the absolute value of tax multiplier is greater. The tax reduction will make the absolute value of the tax multiplier increase. So the tax reduction will improve the growth of GDP. Fifthly, the revised tax multiplier is estimated under the system of proportional tax, so everyone has to pay taxes. If it is calculated in the system of progressive tax, the zero bracket amount and threshold will decline t value. Reforming indirect tax as the main tax is conducive to the growth of national economy. In short, government should implement tax reduction and adjust the tax structure to reduce the impact of the tax multiplier effect on the economy, which is contribute to national economic growth.

Then, we use revised and traditional tax multiplier to compare and analyse fiscal revenue, GDP and the tax multiplier effect of Hebei Province which is in the midland of China in 2001 -2010.

3.2 Analysis of tax multiplier effect in Hebei province

3.2.1 The current national economy and tax revenue of Hebei province

In 2001, Hebei province has begun to implement the construction of “The 10th Five-Year Plan for National Economic and Social Development” which was completed successfully in 2005. In 2006, Hebei province has begun to implement the construction of “The 11th Five-Year Plan for National Economic and Social Development” which was also completed successfully in 2010. In 2010, the province’s GDP has achieved 327,400 million dollars and the average annual growth was 11.7%.

In the decade of “The 10th&11th Five-Year Plan for National Economic and Social Development”, the GDP and tax revenue of Hebei province have made great progress (Table 1). From the general point of view, GDP and tax revenue always maintain the stable development trend (Chart 1). Having suffered the global economic crisis in 2009,
Hebei province also kept 16 billion dollars in national economy growth and 1.45 billion dollars in tax revenue growth.

Table 1 The GDP and tax revenue of Hebei province (2000-2010)$^2$

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP</th>
<th>Tax revenue</th>
<th>△Y</th>
<th>△T</th>
<th>△Y/Y</th>
<th>△T/T</th>
<th>Tax elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>817</td>
<td>25</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>2001</td>
<td>895</td>
<td>27</td>
<td>78</td>
<td>2</td>
<td>0.10</td>
<td>0.08</td>
<td>0.88</td>
</tr>
<tr>
<td>2002</td>
<td>983</td>
<td>33</td>
<td>87</td>
<td>6</td>
<td>0.10</td>
<td>0.22</td>
<td>2.28</td>
</tr>
<tr>
<td>2003</td>
<td>1,139</td>
<td>36</td>
<td>157</td>
<td>4</td>
<td>0.16</td>
<td>0.11</td>
<td>0.71</td>
</tr>
<tr>
<td>2004</td>
<td>1,361</td>
<td>43</td>
<td>221</td>
<td>6</td>
<td>0.19</td>
<td>0.18</td>
<td>0.91</td>
</tr>
<tr>
<td>2005</td>
<td>1,621</td>
<td>53</td>
<td>260</td>
<td>10</td>
<td>0.19</td>
<td>0.24</td>
<td>1.24</td>
</tr>
<tr>
<td>2006</td>
<td>1,848</td>
<td>62</td>
<td>228</td>
<td>9</td>
<td>0.14</td>
<td>0.18</td>
<td>1.28</td>
</tr>
<tr>
<td>2007</td>
<td>2,201</td>
<td>99</td>
<td>352</td>
<td>37</td>
<td>0.19</td>
<td>0.59</td>
<td>3.11</td>
</tr>
<tr>
<td>2008</td>
<td>2,599</td>
<td>120</td>
<td>398</td>
<td>21</td>
<td>0.18</td>
<td>0.21</td>
<td>1.17</td>
</tr>
<tr>
<td>2009</td>
<td>2,766</td>
<td>135</td>
<td>168</td>
<td>14</td>
<td>0.06</td>
<td>0.12</td>
<td>1.86</td>
</tr>
<tr>
<td>2010</td>
<td>3,274</td>
<td>172</td>
<td>507</td>
<td>38</td>
<td>0.18</td>
<td>0.28</td>
<td>1.53</td>
</tr>
</tbody>
</table>

From the growth rate of view, the GDP and tax revenue maintain the high growth rate. Tax revenue average growth rate is 22% and national economy average growth rate is 15% in decade. It is less 7% than tax revenue. The growth rate of GDP was higher than tax revenue before 2004, except for 2002. Since 2004, the growth rate of tax revenue has been always higher than the GDP. Economic development and adjustment of consumption tax rates and policy in 2006 has leaded to the differences in the growth rate which is 40% in 2007.

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$^2$ Date Source: 2011 Economic Statistical Yearbook of Hebei Province
From the tax elasticity of view, the tax revenue was basically in the high-elastic range. Tax elasticity is the percentage of tax revenue (T) change to GDP (Y) change under the current tax rates and tax laws. In 2001-2010, there are 7 years’ tax elasticity more than 1 and the average of tax elasticity is 1.5. It shows that the tax revenue grows faster than the national economy development.

### 3.2.2 Tax multiplier effect of Hebei Province

According to the data of 2001-2010, we calculate the traditional and revised tax multipliers. Tax multiplier effects on the national economy from tax revenue growth are called \( \Delta Y_1 \), \( \Delta Y_2 \) and \( \Delta Y_3 \). \( \Delta Y_1 \) which is in fixed tax system and \( \Delta Y_2 \) which is in proportional tax system are calculated by traditional tax multiplier. \( \Delta Y_3 \) is calculated by revised tax multiplier. We can conclude that the influence of tax revenue growth to GDP is small. \( \Delta Y_1 \) accounts for an average 7% of GDP, \( \Delta Y_2 \) and \( \Delta Y_3 \) accounts for an average 7% of GDP. The growth of each tax multiplier effects in 2010 is about 8 times than 2001 (Table 2).
Table 2 Comparison in traditional and revised tax multiplier effect (100 million; %)

<table>
<thead>
<tr>
<th>Year</th>
<th>(\Delta Y_1)</th>
<th>Percent of (\Delta Y_1) in GDP</th>
<th>(\Delta Y_2)</th>
<th>Percent of (\Delta Y_1) in GDP</th>
<th>(\Delta Y_3)</th>
<th>Percent of (\Delta Y_3) in GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>21</td>
<td>0.02</td>
<td>20</td>
<td>0.11</td>
<td>20</td>
<td>0.11</td>
</tr>
<tr>
<td>2002</td>
<td>148</td>
<td>0.15</td>
<td>113</td>
<td>0.71</td>
<td>105</td>
<td>0.75</td>
</tr>
<tr>
<td>2003</td>
<td>77</td>
<td>0.07</td>
<td>73</td>
<td>0.06</td>
<td>72</td>
<td>0.06</td>
</tr>
<tr>
<td>2004</td>
<td>63</td>
<td>0.05</td>
<td>61</td>
<td>0.04</td>
<td>59</td>
<td>0.04</td>
</tr>
<tr>
<td>2005</td>
<td>251</td>
<td>0.15</td>
<td>212</td>
<td>0.13</td>
<td>204</td>
<td>0.13</td>
</tr>
<tr>
<td>2006</td>
<td>111</td>
<td>0.06</td>
<td>104</td>
<td>0.06</td>
<td>99</td>
<td>0.08</td>
</tr>
<tr>
<td>2007</td>
<td>169</td>
<td>0.08</td>
<td>143</td>
<td>0.07</td>
<td>128</td>
<td>0.06</td>
</tr>
<tr>
<td>2008</td>
<td>135</td>
<td>0.05</td>
<td>127</td>
<td>0.05</td>
<td>121</td>
<td>0.05</td>
</tr>
<tr>
<td>2009</td>
<td>135</td>
<td>0.05</td>
<td>124</td>
<td>0.04</td>
<td>113</td>
<td>0.04</td>
</tr>
<tr>
<td>2010</td>
<td>161</td>
<td>0.05</td>
<td>150</td>
<td>0.05</td>
<td>139</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Since 2006, the difference has been gradually obvious among three tax multiplier effects (Chart 2). From the total GDP of Hebei Province, the difference is not very obvious. But from the counties and cities in Hebei Province of view, the impact of the difference is serious. For example, in 2010, \(\Delta Y_3\) is less 2.15 billion dollars than \(\Delta Y_1\), which is the sum of GDP from the top four counties in Hebei Province. \(\Delta Y_3\) is less 1.11 billion dollars than \(\Delta Y_2\), which is the sum of GDP in four counties of Zhang Jiakou city\(^3\). So, the revised tax multiplier is conducive to reflecting the fact accurately and analysing the change of tax revenue on GDP, which has great practical significance.

Chart 2 Trend and comparing of different tax multiplier effects (100 million)

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\(^3\) Zhang Jiakou city is a poverty-stricken area of Hebei province.
3.2.3 Correlation analysis of tax revenue and economic growth

3.2.3.1 Variable stable test

Before the empirical Analysis, we implement the ADF test on tax revenues (LNTAX) and GNP (LNGDP).

The model is  
\[ \Delta y_t = a + \delta t + \gamma y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_i \]

Where \( a \) is the intercept, \( \delta t \) is the time trend, \( u_i \) is the white noise, \( \Delta \) is the first-order differential of the variable and the optimal lag phase which depend on the AIC.

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. The test results are shown in Table 3.

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF test</th>
<th>Test type (c, t, k)</th>
<th>Critical value (5%)</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNGDP</td>
<td>-2.542368</td>
<td>(c, t, 2)</td>
<td>-3.99825</td>
<td>non-stable</td>
</tr>
<tr>
<td>LNTAX</td>
<td>-1.054318</td>
<td>(c, t, 0)</td>
<td>-3.85461</td>
<td>non-stable</td>
</tr>
<tr>
<td>DLNGDP</td>
<td>-4.205166</td>
<td>(c, 0, 0)</td>
<td>-4.00257</td>
<td>Stable</td>
</tr>
<tr>
<td>DLNTAX</td>
<td>-5.278453</td>
<td>(c, 0, 0)</td>
<td>-3.14698</td>
<td>Stable</td>
</tr>
</tbody>
</table>

From Table 3, LNGDP and LNTAX don’t pass the unit root tests in 5% level. It shows that GNP and tax revenues of Hebei province are non-stationary data. But the first-order differential of LNGDP and LNTAX pass the ADF test in 5% level. So LNGDP and LNTAX are first-order single integration sequence.

3.2.3.2 Correlation test

The time sequence of LNGDP and LNTAX are non-stationary. It becomes stable by first-order difference. The stable linear combination is called co-integration equation. Whether the equation has long-term stable equilibrium relationship must depend on the co-integration test. The Granger causality test is used commonly.

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4 DLNGDP and DLNTAX are the first-order difference of LNGDP and LNTAX. (C, T, K) are constant term of unit root test equation, time trend and lagged order, where C = 0 is without constant term, T = 0 is without time trend.
Granger causality test essentially use F-test to test the following joint test:

$$H_0: a_{12}^q = 0, q = 1, 2, ..., p$$

$$H_1:$$ There exists at least one q to make $$a_{12}^q \neq 0$$

In a binary P-order VAR model:

$$
\begin{pmatrix}
  y_t \\
  x_t
\end{pmatrix} =
\begin{pmatrix}
  a_{01} \\
  a_{20}
\end{pmatrix} +
\begin{pmatrix}
  a_{11}^{(1)} & a_{12}^{(1)} \\
  a_{21}^{(1)} & a_{22}^{(1)}
\end{pmatrix}
\begin{pmatrix}
  y_{t-1} \\
  x_{t-1}
\end{pmatrix} +
\begin{pmatrix}
  a_{11}^{(2)} & a_{12}^{(2)} \\
  a_{21}^{(2)} & a_{22}^{(2)}
\end{pmatrix}
\begin{pmatrix}
  y_{t-2} \\
  x_{t-2}
\end{pmatrix} +...+
\begin{pmatrix}
  a_{11}^{(p)} & a_{12}^{(p)} \\
  a_{21}^{(p)} & a_{22}^{(p)}
\end{pmatrix}
\begin{pmatrix}
  y_{t-p} \\
  x_{t-p}
\end{pmatrix} +
\begin{pmatrix}
  \epsilon_{1t} \\
  \epsilon_{2t}
\end{pmatrix}
$$

The statistics is

$$S_1 = \frac{(RSS_0 - RSS_1) / p}{RSS_1 / (T-2p-1)}$$

If $$S_1$$ is greater than the F-critical value, we reject the null hypothesis. Otherwise, we accept the null hypothesis.

(A) Correlation analysis of the influence of tax revenue to economic growth in Hebei Province

We use the co-integration test in LNGDP and LNTAX by the EG. The first step is we regard LNTAX as independent variable and implement OLS on LNGDP and LNTAX. The regression coefficient are $$\alpha = -0.047$$ and $$\beta = -7.142$$.

The regression equation is

$$\ln gdp = -7.142 - 0.047 \ln \text{tax} + \epsilon_t$$

Then, we calculate residual value $$\epsilon_t$$.

The sequence is

$$\epsilon = \ln gdp - 7.142 - 0.047 \ln \text{tax}$$

In second step, we test whether the residual sequence $$\epsilon_t$$ is stable.

<table>
<thead>
<tr>
<th>The check sequence</th>
<th>ADF statistic</th>
<th>Confidence level (%)</th>
<th>Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>The residual sequence</td>
<td>-1.0057</td>
<td>1</td>
<td>-4.4718</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>-3.6273</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>-4.5774</td>
</tr>
</tbody>
</table>

From Table 4, the statistic of residual sequence is -1.0057 by ADF test, which is less than the critical value of significance level 1%, 5%, and 10%. So the residual sequence is stable. It shows that when the tax revenue is regarded as the independent variable, there is co-integration relationship between tax revenue and GDP of Hebei Province. The statistic is negative shows the effect of tax revenue to local economic growth is negative.
(B) Correlation analysis of the influence of economic growth to tax revenue in Hebei Province

In the same way, we use the co-integration test in LNGDP and LNTAX by the EG. The first step is that we regard LNGDP as independent variable and implement the OLS on LNGDP and LNTAX. The regression coefficient are $\alpha = 1.557$ and $\beta = 5.014$.

The regression equation is $\ln tax = 5.014 + 1.557 \ln GDP + \epsilon$.

Then, we calculate residual value $\epsilon_t$.

The sequence is $\epsilon_t = \ln tax_t - 5.014 - 1.557 \ln GDP_t$.

In second step, we test whether the residual sequence $\epsilon_t$ is stable.

Table 5 ADF test of residual sequence

<table>
<thead>
<tr>
<th>The check sequence</th>
<th>ADF statistic</th>
<th>Confidence level (%)</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>The residual sequence</td>
<td>-4.6481</td>
<td>5</td>
<td>-3.6273</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>-4.5774</td>
</tr>
</tbody>
</table>

Table 5 shows that the statistic of residual sequence is -4.6481 by ADF test, which is less than the critical value of significance level 5%. So the residual sequence of significance level 5% is stable. It shows that there is co-integration relationship between tax revenue and the economic growth of Hebei Province. When the GDP is regarded as the independent variable, local economic growth improves tax revenue.

(C) The Granger causality test

Granger (Granger, 1969) 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.

We use the above results to test by the Granger causality test. The significance level is 5% and lagged values are 1 and 2. The test results are shown in Table 6:
Table 6 Granger causality test between tax revenue and GDP in different lag period

<table>
<thead>
<tr>
<th>Lagged value</th>
<th>The null hypothesis</th>
<th>F-statistic</th>
<th>P-value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tax revenue is not Granger cause of economic growth</td>
<td>0.569 22</td>
<td>0.466 42</td>
<td>accept</td>
</tr>
<tr>
<td></td>
<td>Economic growth is not Granger cause of tax revenue</td>
<td>0.309 04</td>
<td>0.589 40</td>
<td>accept</td>
</tr>
<tr>
<td>2</td>
<td>Tax revenue is not Granger cause of economic growth</td>
<td>1.117 16</td>
<td>0.373 3</td>
<td>accept</td>
</tr>
<tr>
<td></td>
<td>Economic growth is not Granger cause of tax revenue</td>
<td>5.645 93</td>
<td>0.029 57</td>
<td>refuse</td>
</tr>
</tbody>
</table>

The result of table 6 shows that there is obvious one-way causal relationship between tax revenue and economic growth in Hebei Province. The increase or decrease of GDP would inevitably affect the tax revenue, but the change of the tax revenue is not necessarily to influence the GDP.

4. Summary and Conclusion

From what has been mentioned above, we can conclude that: Firstly, the national economy, the fiscal income and total tax revenue of Hebei province are growing faster. Economic development is the basis to growth of tax revenue, but growth of tax revenues is faster than fiscal revenue and the growth rate of the national economy and the tax elasticity is larger. The growth of tax revenue is too fast isn’t adapt to actual requirements of the economy.

Secondly, the tax multiplier effect in is increasing annually. The deviation between traditional and revised tax multiplier effect changes in the same direction with the marginal propensity to consume. The deviation impacts the city and county-level of government to estimate accurately the effect of the tax revenue to the regional economy.

Thirdly, the ability of taxation to regulate the national economy is weak, thus public finance is unable to play the role well in macroeconomic growth. At the same time, we can find the current tax system which implements unscientific transmission mechanism does not match GDP of Hebei province.

We should reform the turnover tax to the income tax as the main tax to improve the current tax system, which reduces the tax burden in the production and circulation and solves the problem in unscientific structure of tax revenue which leads to the growth rate of tax revenue is always far greater than the growth rate of GDP. But there are so many difficulties to implement directly the reform of tax system in a short time. 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, government reduce appropriately the tax burden will decline impact on the national economy from the negative effect of tax multiplier, stimulate economic growth, improve the enthusiasm of consumers, promote production and consumption and boost the business investment and production efficiency.
There are two ways to reduce the tax burden. The first one is tax reduction. Government reduces the tax revenue directly by declining tax rates, narrowing scope of the tax collection and so on. The second way is to optimize the structure of the tax system. From the theoretical point of view, the simple tax reduction will impact the quality of social management in accordance with the Wagner’s law and thus it occurs opposite impact on economic development. From the practical point of view, China is in a period of economic restructuring and economic construction. So, it don’t adapt to requirements of China’s economic development that government reduces the tax revenue directly.

Proper tax reduction does not mean that extensive tax reduction, but optimizing structure of the tax system to complete the structural tax reduction. Finally, we can achieve scientific growth of the GDP and tax revenues.

References