



# Changes in Local Government Tax Collection Efforts after Tax and Fee Reductions

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**Abstract.** As a key measure to deepen the supply-side structural reform, tax and fee reduction policies to help enterprises and boost the upgrading of industrial structure. In order to ease the local financial pressure, the central government has borne the main cost of tax reduction and fee reduction. Local governments may change their tax collection behavior during this period to attract high-quality tax sources to promote economic development. The panel data of 31 provinces in China from 2012 to 2020 was selected as the sample, and the random frontier model was used to calculate the changes of local government tax efforts after tax reduction and fee reduction. The study found that in the past ten years since the implementation of the tax and fee reduction policy, local governments have improved their overall tax revenue efforts, with a significant downward trend in the period of "replacing business tax with VAT" and "large-scale tax and fee reduction".

**Keywords:** tax reduction and fee reduction; tax effort; random frontier analysis

## 1 Introduction

Since the 18th National Congress of the Communist Party of China, China has continued to implement tax reduction and fee reduction policies, and its scale continues to expand. The long-term and lasting reduction in taxes and fees, while encouraging private entrepreneurs to "enhance their confidence, travel lightly and develop boldly", has also increased the financial pressure on local governments. In view of the affordability of local governments, the central government has increased transfer payments to local governments and borne the main cost of tax and fee cuts<sup>1</sup>. Local governments have the incentive to intervene in the allocation of market resources during this structural transition period, and to give substantial tax incentives to attract enterprises to enter.

This paper hopes to study whether and how the tax efforts of local governments have changed in the context of tax reduction and fee reduction. The panel random frontier analysis method is used to calculate the tax efforts of local governments, consider the changes and current situation of local government tax behavior, and put forward corresponding policy suggestions for the sustainability and accuracy of tax reduction and fee reduction policies.

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## 2 Literature review

Tax efforts were proposed by the International Monetary Fund (IMF) experts in the 1960s to measure the government's ability to actually use the tax base, that is, the deviation of the statutory tax payable from the actual tax levied<sup>2</sup>. Lu Bingyang and Guo Qingwang used the formula to express the ratio of real tax revenue to potential tax revenue, and believed that the tax sharing reform has an incentive effect on the tax department, and the tax raising efforts have promoted the rapid growth of tax revenue<sup>3</sup>. Chinese scholars commonly use the tax handle method to estimate the tax efforts by selecting the economic variables related to tax revenue. Zhao Zhiyun and Yang Chaofeng selected per capita GDP, economic openness and industrial structure level as explanatory variables to calculate the tax efforts at the provincial level from 1995 to 2006<sup>4</sup>. The representative tax law is mainly used to estimate the tax capacity of specific tax types. Yang Dexin adopted the representative tax law to calculate the degree of corporate income tax efforts in 29 provinces in China from 2002 to 2011, among which the eastern region had the highest tax effort and the central region had the lowest<sup>5</sup>. Stochastic frontier analysis method (SFA) is one of the important methods to study the productivity measure in recent years, which has been used by many scholars to measure government tax efforts<sup>6</sup>.

To strongly support the implementation of the policy of tax and fee cuts, transfer payments from the central government to local governments increased substantially. Hines and Thaler proposed the sticky fly paper effect, pointing out that the central government subsidy income will stick to the local sector, increase the local government financial expenditure, its expenditure effect is greater than the local government tax revenue, local governments have to strengthen tax collection and management to cope with the larger public expenditure<sup>7</sup>. Inman believes that the substitution effect of transfer payments will restrain the tax efforts of local governments. Local governments prefer to replace the local taxes with the free income given by the central government. Increasing the tax efforts will lead to the reduction of central subsidies and reduce the overall income, so the transfer payments will restrain the tax efforts of local governments<sup>8</sup>. Domestic scholars have carried out a large number of empirical analysis, and the research results mostly support the latter one. Based on the county-level data of China from 1997 to 2011, Bao Shuguang et al. empirically analyzed the impact of transfer payments on local income behavior, and believed that transfer payments have a significant inhibitory effect on local financial efforts, and there are differences in different regions<sup>9</sup>.

## 3 Calculation method, model setting, and data source

### 3.1 Calculation method

The explanatory variable in this paper is tax effort (*TE*), and its common calculation methods are representative tax system method, tax handle method and random frontier analysis method. This paper selects the stochastic frontier analysis method which is

widely used at present. Li Guofeng and Liu Liming believe that SFA method has a good basis for economic mathematical demonstration, and the tax effort index is more reasonable<sup>10</sup>. The theoretical model of the stochastic front production function for the panel data is:

$$Y_{it} = \beta X_{it} + v_{it} - u_{it} \quad (1)$$

$Y_{it}$  denotes the tax revenue of region  $i$  in the  $t$ th year,  $X_{it}$  for a series of control variables,  $v_{it}$  for external influencing factors and statistical data errors, and follow the standard normal distribution;  $u_{it}$  represents the efficiency loss of tax collection and administration, obeying the truncated semi-normal distribution.  $Y_{it}$  and  $v_{it}$  together constitute the stochastic front function,  $u_{it}$  reflect the gap between theoretical tax revenue and actual tax revenue.  $TE_{it}$  represents the tax effort of region  $i$  in the  $t$ th year.

$$TE_{it} = \frac{\text{Actual tax revenues}}{\text{Forecast tax revenues}} = \exp(-u_{it}) \quad (2)$$

### 3.2 Model setting

This paper draws on existing research to construct a tax beyond the log front production function model<sup>11</sup>:

$$\ln tax_{it} = \beta_0 + \beta_1 \ln fir_{it} + \beta_2 \ln sec_{it} + \beta_3 \ln tir_{it} + \beta_4 T + \beta_5 (\ln fir_{it})^2 + \beta_6 (\ln sec_{it})^2 + \beta_7 (\ln tir_{it})^2 + \beta_8 T^2 + \beta_9 \ln fir_{it} \times \ln sec_{it} + \beta_{10} \ln fir_{it} \times \ln tir_{it} + \beta_{11} \ln sec_{it} \times \ln tir_{it} + \beta_{12} T \ln fir_{it} + \beta_{13} T \ln sec_{it} + \beta_{14} T \ln tir_{it} + v_{it} - u_{it} \quad (3)$$

$i$  represents the province ( $i=1,2,\dots, 31$ ), and  $t$  represents the time.  $tax_{it}$  for the proportion of local government tax revenue in regional GDP,  $fir_{it}$ ,  $sec_{it}$  and  $tir_{it}$  represent the proportion of the first, secondary and tertiary industries in the local GDP respectively, taking the natural logarithm  $\ln$ ;  $T$  represents the technology, the improvement and update of tax collection and management system and daily technology can improve the efficiency of tax collection and administration. The time variable  $T$  versus  $fir_{it}$ ,  $sec_{it}$  and  $tir_{it}$  interaction terms represent the tax production front model as technically non-neutral.

According to the existing studies<sup>12</sup>, collection and management inefficiency term factors are shown in Table 1, and the specific regression model is established as follows formula (4):

$$u_{it} = \delta_0 + \delta_1 pgdp + \delta_2 open + \delta_3 emp + \delta_4 exp + \delta_5 urb \quad (4)$$

**Table 1.** Variable definitions and calculation formula

variable symbol	Variable meaning	computational method
pgdp	Per capita GDP (ten thousand yuan / person)	The GDP of each region / the total population of the region
open	Degree of openness to the outside world, (%)	Total import and export volume / GDP
emp	employment rate (%)	Number of employed persons in urban non-private units / permanent resident population
exp	Government spending scale is (%)	General public budget expenditure / GDP
urb	Urbanization level is (%)	Urban population of each region / the total population of the area

### 3.3 Data sources and statistical characteristics

The data used in this paper is the provincial panel data of 31 provincial administrative regions (excluding Hong Kong, China, Macao and Taiwan) from 2012-2020, all the raw data involved in the paper are from China Statistical Yearbook, China Finance Yearbook, China Trade Foreign economic statistical Yearbook, China macroeconomic database and China regional economic database, of which the total import and export volume from 2012-2015 is calculated according to the RMB market exchange rate in China Trade Foreign Economic Statistical Yearbook. Descriptive statistics for the specific variables are shown in Table 2.

**Table 2.** descriptive statistics of the variables

Variables and symbols	mean	standard deviation	least value	crest value
Tax revenue (tax)	0.083	0.029	0.044	0.200
Share of primary industry in GDP (fair)	0.096	0.051	0.003	0.251
Share of secondary industry in GDP (sec)	0.423	0.085	0.158	0.577
Share of the tertiary industry in GDP (tir)	0.481	0.094	0.309	0.839
GDP per capita (pgdp)	5.718	2.709	1.910	16.490
Degree of Openness (open)	1.959	3.035	0.039	14.020
Employment rate (emp)	0.130	0.057	0.072	0.374
Scale of government expenditure (exp)	0.352	0.348	0.054	2.524
Urbanization (urb)	58.700	12.850	22.870	89.600

## 4 Empirical results and analysis

### 4.1 Stochastic front model

The parameters of the random front model were estimated using Frontier4.1 software, and the results are shown in Table 3. The t-value of  $\gamma$  11.512 is significant at the 1% level, indicating that there are technical inefficiency factors between the actual tax revenue and potential tax revenue, namely the non-efficiency of tax collection and administration. From the estimation results of the original model,  $\gamma = 0.8794$  indicates that technical efficiency occupies a large proportion in the error terms, and 87.94% is caused by technical efficiency, and the influence of efficiency on tax revenue, so the random error model is reasonable.

**Table 3.** Results of parameter estimation of the random front model

variable	parameter	t checkout	variable	parameter	t check-out
$\beta_0$	-2.582	-0.636	$T \ln \sec$	-0.272***	-6.324
$\ln \text{fir}$	-2.483***	-4.459	$T \ln \text{tir}$	-0.416***	-5.430
$\ln \sec$	3.983	1.270	$\delta 0$	0.843	1.137
$\ln \text{tir}$	-14.752***	-2.848	$\text{pgdp}$	0.151*	1.717
$T$	-0.547***	-5.297	$\text{open}$	-0.151***	-8.051
$(\ln \text{fir})^2$	0.087**	2.456	$\text{emp}$	-0.210***	-2.727
$(\ln \sec)^2$	3.099***	4.305	$\text{exp}$	-0.800***	-9.844
$(\ln \text{tir})^2$	-6.296***	-3.396	$\text{urb}$	-0.292	-1.603
$T^2$	-0.003*	-1.900	$\delta 2$	0.019***	8.688
$\ln \text{fir} \times \ln \sec$	-1.619***	-7.377	$\gamma$	0.879***	11.512
$\ln \text{fir} \times \ln \text{tir}$	-3.436***	-7.163	Maximum likelihood value	194.930	
$\ln \sec \times \ln \text{tir}$	-5.261**	-2.565	$LR$	193.750	
$T \ln \text{fir}$	-0.027***	-3.773			

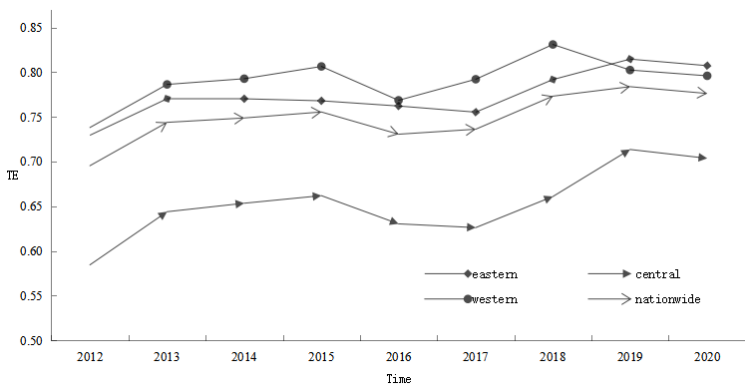
The choice of model form will interfere with the reliability and accuracy of the measurement results. This paper uses the likelihood ratio test to evaluate the rationality of the model. The statistics are:  $\chi^2 = -2 [L(H_M) - L(H_0)] / (M - 1, 2, 3)$ , where  $L(H_0)$ ,  $L(H_M)$  are the likelihood function values under the original hypothesis and the alternative hypothesis, respectively. There are three model tests:  $H_1$  test for technological changes;  $H_2$  check whether the technical change is neutral;  $H_3$  test the function form. The specific test results are shown in Table 4. The results show that when all items of the time variables  $T$  are zero, the test statistic is 80.496, and the hypothesis  $H_1$  is rejected at the 1% significance level. That is, the local government tax effort will change over time and there is technological progress; assuming that the coefficient of the time variable  $T$  and the three industry interaction terms is zero, the test statistic is 41.262, and the hypothesis  $H_2$  is rejected at 1% significance level, local government tax effort is not techni-

cally neutral; assuming the quadratic term coefficient is zero, the test statistic is 117.736, rejecting the hypothesis  $H_3$  at the significant level of 1%, Explain that the model should be beyond the log production function.

**Table 4.** Results of the random front model hypothesis test

presupposition	Log-Likelihood Value (LM)	$\chi^2$	free degree	The cut-off value was 1%	conclusion
$H_0$ : The original hypothesis	194.926				
$H_1$ : There is no technological progress	154.678	80.496	5.000	15.086	refuse
$H_2$ : Technical neutral	174.295	41.262	3.000	11.345	refuse
$H_3$ :C-D production function	136.058	117.736	10.000	23.209	refuse

In order to more clearly demonstrate the changes in local tax efforts from 2012 to 2020, this paper divides the country into eastern, central and western regions according to the regional differences in economic development level. For further analysis, the tax efforts of each region take the arithmetic average of the tax efforts of the region including provinces. From the time change trend in Figure 1, the change law of tax effort has a strong correlation with the national macro policy. Since 2016, the comprehensive replacement of business tax with VAT has been implemented, and tax revenue efforts in all regions have shown a significant downward trend. In 2018, the merger of state and local taxes formed a unified management system, which weakened the influence of local governments on tax collection behavior and significantly increased the degree of tax efforts of local governments, which is consistent with the existing studies<sup>13</sup>. Since the large-scale tax and fee cuts in 2019, tax revenue efforts across the country and the three major regions have been reduced.



**Fig. 1.** 2012- -2020 Local tax efforts in China and the three major regions

## 5 Conclusion

Based on the panel data of 31 provinces in China from 2012 to 2020, this paper uses the stochastic frontier model to calculate the tax efforts of local governments, and tests the impact of tax reduction and fee reduction policies on the tax efforts of local governments. The empirical results show that since the implementation of the tax reduction and fee reduction policy, local governments have made overall efforts to improve the tax revenue, while the tax reduction "and" large-scale tax reduction and fee reduction ". In order to have a negative impact on tax reduction and fee reduction policy on tax collection and administration of local governments, the following suggestions are put forward based on the conclusions of this paper:

First of all, raising the tax efforts of local governments is an important means to ensure the sustainability of the tax reduction and fee reduction policies. Tax reduction and fee reduction is an important measure to promote the supply-side structural reform in China, and maintaining the balance of local government fiscal revenue and expenditure is the premise of the long-term and stable effect of policies. To improve the tax efforts of local governments is not to squeeze out the policy effect of tax reduction and fee reduction, but to achieve the collection of taxes, to create more space for the further implementation of the policies. At the same time, it can give better play to the ability of tax regulation and distribution, transfer funds to enterprises in real need, and realize the accuracy of the policies.

Second, we need to formulate tax and fee reduction policies suitable for local economic and social development. A series of tax and fee reduction measures introduced in recent years are aimed at tax types and enterprise types, without overall consideration of the tax capacity and economic and social development of different regions, and the effect of policies shows obvious regional differences. Policies should be promulgated in accordance with the actual situation of economic and social development in various regions. Especially for the central and western regions and underdeveloped provinces, "latecomer advantage" can be the theoretical basis, and targeted tax and fee reduction policies should be formulated according to the characteristics of industrial structure, so as to narrow the economic gap between regions.

Finally, the transfer payment system needs to consider the degree of tax effort of local governments. The determination of the transfer payment scale should not only to the local economic development level, demographic factors based on objective conditions, and should also consider the local government tax efforts, the local government tax collection level to set up a scientific evaluation system, in the objective, fully understand the local government finances and tax dynamics, on the basis of reasonable control of transfer payment scale.

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