CHAPTER 5. EMPIRICAL RESULTS AND MODEL TEST

The purpose of this study probes whether the fiscal decentralization significantly influences he tax effort of the local government and what its sign is. Meanwhile, the study includes the other variables to explain the factors which represent the economic, industry structure and the growth of population. Moreover, the study adds two dimension fixed effects in order to interpret the individual and time effect. Thus, this study will express the empirical results and fixed effect. Furthermore, several tests are conducted to ascertain whether the empirical results can provide accurate conclusions.

5.1 Empirical Results

Since there are four types of tax effort indices used in the literature, this study estimates four specifications of empirical models with different definitions of tax effort as the dependent variable. Models 1-4 use *TE-PI*, *TE-GRP*, *TE-TTR*, and *TE-RTS/R* as the dependent variable in the empirical model, respectively. The estimation results of all the specifications are presented in Table 9. Prior to the discussion of the empirical results, several tests are conducted to ascertain whether the empirical results can provide accurate conclusions.

According to Table 9, the Hausman test provides strong evidence that all four specifications should be estimated using the fixed-effects model instead of the random-effects model. In addition, since all specifications are found to have a heteroskedasticity problem (the χ^2 statistics based on the Breusch-Pagan test all reject the critical value in α=0.01), the corrected covariance matrix proposed by White (1980) is used instead.[30] The *F*-statistics in the four models all reject the null hypothesis which assumes that the coefficients are all zero in α=0.01. Based upon

[30] In fact, the usual set of OLS results is given, but with a revised robust covariance matrix.

some tests for econometric issues, such as model misspecification, autocorrelation, and multicollinearity, it is implied that the conclusions provided by this study are very reliable.[31]

The empirical results presented in Table 9 show that the degree of fiscal decentralization has a positive and significant impact on the local government's tax effort at a 1% significance level for all model specifications. That is to say, raising the degree of fiscal decentralization of a region will improve the region's degree of tax effort because fiscal decentralization provides more incentives to the local government for tax collection. This conclusion is consistent with previous expectations and is very robust regardless of what measurements are used to calculate the tax effort index. It further supports the assertion of Oates (1972). Although previous studies cannot find a significant influence of fiscal decentralization on the tax effort, this study supports the existence of this influence in the case of China after 1994.

With respect to the per capita GRP, Table 9 indicates that there is no consistent conclusion in all of the models. The coefficient of per capita GRP is significant and negative in Model 2, but positive in Model 4. However, per capita GRP has no significant influence on the tax effort in Models 1 and 3. Since Bird, Martinez-Vazquez and Torgler (2004) suggested the possibility of a non-linear relationship between per capita GRP and the tax effort, this study has also added the square of per capita GRP to all specifications, but has still been unable to obtain a consistent and significant result that is similar to the conclusion obtained by Bird, Martinez-Vazquez and Torgler (2004).

[31] In order to test the hypothesis of model misspecifications, the RESET (Regression Specification Error Test) test is adopted and the results indicate that the models in this study do not have this problem. Finally, none of the pairwise correlation coefficients are greater than 0.8 and it is thus concluded that there is no multicollinearity in the empirical models.

Table 9: Estimation Results of Two-Way Fixed-Effect Model

Variables	Model 1: *TE-PI*	Model 2: *TE-GRP*	Model 3: *TE-TTR*	Model 4: *TE-RTS/R*
α_0	0.0342 ** (2.221)	0.0354 *** (6.27)	-0.002 * (-1.665)	-0.07 (-0.511)
FD	1.50×10^{-3} *** (7.856)	6.37×10^{-4} *** (9.742)	1.27×10^{-4} *** (7.647)	4.30×10^{-3} *** (2.639)
PCGRP	-1.26×10^{-2} (-1.279)	-7.43×10^{-3} ** (-2.053)	-1.45×10^{-3} (-1.600)	3.36×10^{-1} *** (3.781)
IND	7.36×10^{-2} * (1.957)	-1.56×10^{-2} (-1.133)	1.19×10^{-2} *** (3.449)	7.84×10^{-1} ** (2.318)
TRADE	4.29×10^{-3} (0.632)	2.18×10^{-3} (0.878)	7.86×10^{-4} (1.262)	1.73×10^{-3} (0.028)
Sample Size	279	279	279	279
Adjust R^2	0.96688	0.96967	0.95841	0.96165
B-P Statistic: χ^2	62.2611***	71.3476***	172.3952***	2.2992
One vs. Two-Way: *F*-Statistic	40.436***	17.226***	10.918***	7.578***
Hausman Test	68.8***	42.66***	17.56***	48.38***
RESET Test	0.7882	0.1254	0.3814	0.3703

Notes: 1. Symbols ***, **and * denote that null hypothesis of estimated parameter equal to zero is rejected at 1%, 5%and 10% significance level.
2. The numbers in the parentheses are *t*-value.

With regard to the regional industrial structure, based on Table 9, the coefficient of $IND_{i,t}$ is positive and significant in Model 1, Model 3 and Model 4, but is statistically insignificant in Model 2. This implies that industry enterprises are easier to tax because business owners typically keep better books and records. Therefore, industrialization can generate large taxable surpluses. That is to say, an increase in a region's industrial share could improve its tax effort and this conclusion is consistent with that of Piancastell (2001).

Finally, the coefficient of *TRADE* is not statistically significant in any of the models. This means that the openness does not influence the tax effort. In other words, the openness does not induce the provincial government to make much effort to collect the tax. The reason for this conclusion might be that the trade taxes are collected by the central government, and not by the local government. Therefore the local government has no right to collect trade taxes in China. As in the case of the influence of openness on the tax effort at the provincial level, it is reasonable to find that the influence of openness on the tax effort is quite insignificant.

5.2 The Regional- and Time-Specific Effects

After this estimation with the two-way fixed effect model, the regional- and time- specific effects are obtained. The regional- and time- specific effects are important results to observe the regional- and time- characteristics. this study will discuss them in more detail in the following sections.

5.2.1 Regional-Specific Effects

In two way fixed effects model, this study can obtain the regional- and time- specific effects. The 31 regional-specific effects in the four models have complex expressions in Table 10. Keeping the other variables constant, the regional-specific effect refers to the tax effort of China's local government. The effect represents the characteristics from each province, such as the tax attitudes of each of the provinces. In Model 1, according to the regional-specific effect, the five provinces with a higher tax effort are Shanghai, Beijing, Tianjin, Yunnan and Guangdong. In contrast, the three provinces counted from the end are Henan, Hebei and Hubei, but they have a negative effect to the tax effort. Furthermore, similar results can be obtained in Models 2 and 3.

Table 10: The Regional-Specific Effect α_i

Regions	Model 1: *TE-PI*			Model 2: *TE-GRP*			Model 3: *TE-TTR*			Model 4: *TE-RTS/R*		
Beijing	0.16264	***	(2)	0.08168	***	(1)	0.08168	*	(1)	-0.09793		
Tianjin	0.05181	***	(3)	0.01871	***	(4)	0.01871	***	(3)	-0.41033	***	
Hebei	-0.04962	***		-0.02228	***		-0.02228			-0.20491	***	
Shanxi	-0.02561	***		0.00048			0.00048	***		0.14673	**	
Inner Mongolia	-0.00754			0.00134			0.00134	***		0.10976	***	
Liaoning	0.03658	***	(3)	0.00474	**		0.00474	***	(5)	-0.26327	***	
Jilin	-0.02415	***		-0.00506	***		-0.00506	***		-0.17448	***	
Heilongjiang	-0.01881	**		-0.00656	**		-0.00656	***		-0.17010	***	
Shanghai	0.20847	***	(1)	0.06778	***	(2)	0.06778			-0.29068	*	
Jiangsu	-0.01581	**		-0.01260	***		-0.01260	***		-0.30778	***	
Zhejiang	0.00890	*		-0.00137			-0.00137	**		-0.39198	***	
Anhui	-0.04599	***		-0.01539	***		-0.01539			0.05950		
Fujian	-0.02602	***		-0.02211	***		-0.02211	***		-0.36439	***	
Jiangxi	-0.04369	***		-0.01824	***		-0.01824	***		0.02975		
Shandong	-0.03833	***		-0.02362	***		-0.02362	***		-0.24804	***	
Henan	-0.05209	***		-0.02297	***		-0.02297	***		-0.11519	***	
Hubei	-0.04883	***		-0.01841	***		-0.01841			-0.31397	***	
Hunan	-0.04201	***		-0.02241	***		-0.02241	***		-0.14958	***	
Guangdong	0.03685	***	(5)	0.00407			0.00407	***		-0.32373	***	
Guangxi	-0.04242	***		-0.01370	***		-0.01370			-0.00634		
Hainan	-0.00580			-0.00723	*		-0.00723	***		0.14101		
Chongqing	-0.01968	***		-0.00665	***		-0.00665	***		-0.03814		
Sichuan	-0.04530	***		-0.01566	***		-0.01566	***		-0.02495		
Guizhou	-0.02211	***		0.01074	***		0.01074			0.95690	***	(1)
Yunnan	0.03964	***	(4)	0.02140	***	(3)	0.02140	***	(2)	0.89252	***	(2)
Tibet	0.01800			0.00311			0.00311			0.21392		
Shaanxi	-0.00505			-0.00055			-0.00055			0.16930	***	
Gansu	-0.01318	**		0.00097			0.00097	***		0.28554	***	(4)
Qinghai	0.01560	**		0.00472	*		0.00472	***		0.28084	***	(5)
Ningxia	0.01724	**		0.01482	***	(5)	0.01482	***	(4)	0.38200	***	(3)
Xinjiang	-0.00369			0.00024			0.00024	***		0.22800	***	

Notes: 1. Symbols***, **and * denote that statistics located in the rejection area at 1%, 5%and 10% significant level.

2. The number in the parentheses represents the provincial order in the significant individual effect provinces.

In Model 2, the five provinces occupying the the top positions in order are Beijing, Shanghai, Yunnan, Tianjin and Ningxia. The three provinces counted from the end are Shandong, Henan and Huan, and they are a negative effect to the tax effort. Shandong and Hunan replace Hebei and Hubei which are in the top five in Model 1. Similarly, Model 2 and Model 3 do not have obvious changes, except Liaoning and Shanghai.

Therefore, this study can obtain several conclusions that Beijing, Tianjin and Shanghai have higher tax effort than the others. In addition, Shandong, Henan and Hunan have lower tax effort and the efforts are negative. However, Model 4 expresses different results from Model 1-3. The five provinces occupying the top positions are Guizhou, Yunan, Ningxia, Gansu and Qinghai. However, the regional-specific effects of Guizhou, Gansu and Qinghai are not noticeable in Model 1-3. Moreover, the three provinces counted from the end are Tianjin, Zhejiang and Fujan. This result is different from Models 1-3.

From the above-mentioned cases, this study can comprehend two points. First, Yunan obviously has a higher tax effort which keeps the other variables constant in the four models and exhibits a positive performance. Second, Shandong, Henan and Hunan have a lower tax effort which keeps the other variables constant, and their tax performance is inferior. Furthermore, the negative tax efforts are very acute problems that are worthy to be enforced.

5.2.2 Time- Specific Effects

The time-specific effects express similar results with the regional-specific effect in Table 11. Keeping the other variables constant, the time-specific effects indicate the tax effort of each year. The effect represents the characteristics belonging to each year.

Table 11: The Time-Specific Effect θ_t

	Model 1: *TE-PI*	Model 2: *TE-GRP*	Model 3: *TE-TTR*	Model 4: *TE-RTS/R*
1996	-0.01338 ***	-0.00471 ***	-0.00123 ***	0.17420 ***
1997	-0.01240 ***	-0.00560 ***	-0.00133 ***	0.08060 ***
1998	-0.01911 ***	-0.00814 ***	-0.00165 ***	0.00635
1999	-0.01038 ***	-0.00332 ***	-0.00073 ***	-0.00793
2000	-0.00392 **	-0.00024	-0.00025	-0.01496
2001	0.01514 ***	0.00639 ***	0.00102 ***	0.00853
2002	0.00743 ***	0.00400 ***	0.00071 ***	-0.06067 ***
2003	0.01701 ***	0.00633 ***	0.00206 ***	-0.03387
2004	0.01961 ***	0.00529 ***	0.00141 ***	-0.15226 ***

Note: Symbols***, **and * denote that statistics located in the rejection area at 1%, 5%and 10% significant level.

The time-specific effects are all significant in Model 1. The tax efforts are negative from 1996 to 2000 and the trend is improving. Under the improving trend, the tax effort in 1998 is intensively lower during the period from 1996 to 2000. In addition, the tax efforts start to appear positive from 2001 to 2004. The trend of tax effort is increasing, but the particular tax efforts appear in 1998 and 2002. However, an intensively negative tax effort appears in 1998. The tax effort in 2002 is slight under the increasing trend. Similarly, the intensively negative tax effort appears in 1998 in Model 2. The tax efforts are negative from 1996 to 2000, but the coefficient in 2000 is not significant. Moreover, the tax efforts are positive from 2001 to 2004. In Model 3, the situation of the tax effort is similar with Model 2. They both generate a negative effect from 1996 to 1999 and a positive one from 2001 to 2004.

In summary, the tax efforts of Model 1-3 are significantly negative from 1996 to 1999 and the range is negative and decreasing. The tax effort appears positive from 2001 and the range is positive and increasing. Therefore, this study can find that the time-specific effect on tax effort is gradually improving. However, to keep an eye on Model 4, it expresses different results from the former studies. The time-specific effects are significant in 1996, 1997, 2002 and 2004. The effect in 1996 and 1997 is positive, but is negative in 2002 and 2004. Model 4 shows positive effects in the early years and negative effects in the recent period.

5.3 Specification Tests

5.3.1 Testing for Model Misspecification: The RESET Test

To test model misspecification, this study adopts the RESET test. The RESET test (Regression Specification Error Test) is designed to detect omitted variables and incorrect functional form. It examines whether the functional form of models suffered from misspecification errors and omitted variable bias. Moreover, it also is a general test for the correlation between independent variables and the error terms caused by measurement error in the independent variables, simultaneity considerations, or the combination of a lagged dependent variable with autocorrelated error terms.

RESET is computed by regressing the residuals on the independent variables and the square of the fitted dependent variable. It proceeds as follows. First, let the predicted values of the *TE* be

$$T\hat{E} = \beta_{0i} + \sum_{k=1}^{K} \beta_k X_{kit} \tag{5-1}$$

where k represents the k'th explanatory variables, i and t represent respectively i'th province and t'th year. Further, add the predicted values of *TE* to the regression model:

$$T\hat{E} = \beta_{0i} + \sum_{k=1}^{K} \beta_k X_{kit} + \gamma_1 T\hat{E}_{it}^2 + \varepsilon_{it} \tag{5-2}$$

In equation (5-2), a test for misspecification is a test of H_0: $\gamma_1 = 0$ against the alternative hypothesis, H_1: $\gamma_1 \neq 0$.

Rejection of H_0 implies that the original model is inadequate and can be improved. A failure to reject H_0 implies that the test has not been able to detect any misspecifications. Overall, the general philosophy of the test is: if this study can significantly improve the model by artificially including powers of the predictions of the model, then the original model must have been inadequate. Adding squares of the *TE* predictions to estimate models, the RESET test results indicate that their corresponding *p*-values of 0.79, 0.13, 0.38 and 0.37 are well above the conventional significance level of 0.1. There is insufficient evidence from the RESET test to suggest that the models are inadequate. The lack of significance of the RESET statistic suggests that the models which are adopted in this study are appropriate.

5.3.2 Testing for Model Mutilcollinearity

Many variables may move together in systematic ways. Such variables are known as collinear variables. The problem of collinearity would lead to incorrect conclusions which are called collinearity or multicollinearity. Multicollinearity is a common problem in the analysis of the regression method. A simple test for multicollinearity is to look at the correlation coefficients among explanatory variables. All of the explanatory variables do not exceed 0.85 in the four models. Therefore, this study can claim the conclusion that there is no multicollivearity occurring in this study. From the regression and the correlation coefficients, this study can draw the conclusion that multicollinearity is not a problem.

5.3.3 Testing for Model Heteroskedasticity: Breusch Pagan Test

In statistics, the Breusch-Pagan test is used to test for heteroskedasticity in a linear regression model. Breusch and Pagan have devised a Lagrange multiplier test of the hypothesis that $\sigma_i^2 = \sigma^2 f(\alpha_0 + \alpha' z_i)$, where z_i is a vector of independent variables. This test can be applied to a variety of models. Under normality, this modified statistic will have the same asymptotic distribution as the Breusch Pagan statistic, but in the absence of normality, there is some evidence that it provides a more powerful test. In this study, the chi square of Models 1-4 respectively are 62.26, 71.35, 172.40 and 2.30. The chi square of Models 1-3 exceed $\chi^2_{3,0.05} = 7.81$, except the chi square of Model 4. Therefore, this study asserts that there is no heteroskedasticity in Model 4, but the problem exists in Models 1-3. White's correction constructed by White (1981) has been used for correcting heteroskedasticity in Models 1-3.