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Strategic interactions in corporate tax between Chinese local governments

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Yang Chen and Paulo José Regis

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# Strategic interactions in corporate tax between Chinese local governments

Yang Chen International Business School Suzhou Xi'an Jiaotong-Liverpool University Paulo José Regis\* International Business School Suzhou Xi'an Jiaotong-Liverpool University

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# Abstract

Within the time framework of this study (1998–2012), the institutional settings of intergovernmental relations may constrain any strategic behavior of local governments since provincial tax rates are set by the central government. However, attracting business is an important measure of public officials' performance. Government officials have created alternative channels for tax competition. Our findings are consistent with this view that competition in corporate tax is relevant between provinces. As expected, the positive coefficient on the neighbor's tax variable indicates provinces respond by changing around 0.73% of GDP to changes in neighboring jurisdictions of 1%.

**Keywords:** Strategic interaction; average effective corporate tax; panel data; spatial regression model

JEL Classifications: C23, H25, H77, R12

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<sup>\*</sup>Corresponding author: paulo.regis@xjtlu.edu.cn

Xi'an Jiaotong-Liverpool University 111 (BB440), Ren'ai Road, Dushu Lake Higher Education Town, Suzhou 215123, China

# **1. Introduction**

This paper studies strategic corporate tax setting behavior among Chinese local governments (referred to as provinces herein). This relates to an interesting debate on whether, to what extent, and through which channels local governments in China have the fiscal autonomy to conduct independent fiscal policy. It aids our understanding of how much of the variation of the average capital tax burden can be attributed to strategic tax behavior.

The literature surveyed by Brueckner and Saavedra (2001) provides rich evidence of strategic interactions in setting tax rates on capital among local units in the United States and other industrialized countries, while empirical studies in developing countries are scarce, largely due to the lack of data. In China, studies of local tax competition behavior are rare because local governments lack the authority to set the official *de jure* tax rate, which is identical across the nation.

However, most China observers are well aware of gaps between the national policies and their practical implementation at local levels. China is still in transition from a centrally-planned economy to a market economy, and its tax system contains many tax incentives.<sup>1</sup> China has provided a wide range of corporate tax preferences, especially to foreign firms, and new firms in particular. For example, special economic zones provide various preferential tax treatments. Local officials pursue to further broaden tax preferences to attract investment. Based on a series of interviews in 2003, 2004 and 2008 with government officials, Chinese scholars, managers and company owners, Choi (2009) finds that tax refunds of corporate tax and *de facto* preferential tax by local government are practices that have persisted, although the central government has attempted to eliminate them.<sup>2</sup> This is true for both foreign and local firms, especially if they are large in size. Some investors have declared informal preferential taxes as being the compelling reason to move their investment from one province to another. Choi (2009) suggests that tax refunds represent 20% to 30% of local revenue.

<sup>&</sup>lt;sup>1</sup> There is no shortage in the Chinese literature on the use of tax incentives, although most is descriptive and normative. Most of this literature emphasizes the effectiveness of tax incentives and, when a particular tax incentive is criticized, it is usually because it has not been well designed.

<sup>&</sup>lt;sup>2</sup> If asked whether local governments still provide tax refunds, local government officials answered that they did not use the term "tax refunds" (先徵後返) but instead called them "tax encouragements" (稅收 獎勵). In 2003, one government official from Hangzhou confirmed the local government returns 100% of the corporate income tax.

In fact, the officials' evaluation system in place in China may create incentives for tax competition behavior. The promotion of cadres depends on such key economic indicators as attracted investment, economic growth rates and tax revenues. Local officials are motivated to provide tax incentives to capital to achieve the above goals in a balanced matter, since capital is relatively scared and more mobile compared to labor. In a unified tax system with centralized merit-based governance and a decentralized fiscal structure, the average effective tax rates may nonetheless vary because of varied local discretional efforts in collecting taxes. The logic of this discretional behavior has been attributed to the regionally decentralized authoritarian regime defined by Xu (2011), which establishes and transforms the institutional foundations for Chinese government governance.

Although discretional evidence has been widely documented in many case studies (e.g. Bahl, 1999; Choi, 2009, and Gao, 2015), it has not formally been examined from the perspective of spatial interaction in tax policy to answer how and to what degree sub-national economies are self-contained and influence or even direct economic resources combined with political centralization. This papers contributes to providing evidence to support and interpret the conceptual framework proposed by Xu (2011).

Figure 1 applies absolute beta convergence to corporate tax revenue. Convergence would be consistent with strategic interactions in tax policy among local governments, since competition would push for harmonization. Beijing and Shanghai, with the highest revenues, stand as different from the other provinces, since the other provinces find it difficult to catch up. However, the general pattern among the rest of the provinces is of beta convergence: provinces with low initial revenue tend to catch up with provinces at the other end. When Beijing and Shanghai are excluded, the negative slope of the regression line is statistically significant, showing a speed of convergence of 4.4%. It also indicates the direction of the competition, which shows a race to the top rather than to the bottom in the long term, since all provinces increase their corporate taxes between 0 and 1.5% of GPP.

We contribute to the tax competition literature as follows. First, we find evidence in favor of the existence of simultaneous tax setting behavior in China rather than the leader-follower type of competition. Second, we provide an economic geography framework to analyze competition in corporate tax within an agglomerated economy. Our theoretical framework, which assumes an uneven industry distribution among various-sized regions, compares with other empirical studies (Zodrow and Mieszkowski, 1986; Wilson, 1999; Brueckner, 2003, among others). A few other studies by Krugman (1993), Ludema (2000), Forslid (2003), Baldwin and Krugman (2004) and Chen et al. (2014) build a theoretical framework with "lumpiness"; however, these did not take the role of the public good into account and explicitly identify the tax reaction function among sub-national jurisdictions. In large countries, such as China, the analysis of tax competition within an agglomerated economy provides a more solid foundation than the existing studies (Shen and Fu, 2008; Wang and Ren, 2008; Yao and Zhang, 2008), which give mixed and ambiguous results.



Figure 1: Beta convergence of corporate tax (% of GPP)

The empirical results show a change in neighboring corporate tax revenue of 1% of their GPP would be generally associated with a change of 0.7–0.9% of GPP in the province of interest. It seems local governments in China, although constrained by the unified statutory tax regime, conduct independent fiscal policy through the inventive means. The remainder of the paper is organized as follows. Section 2 provides the theoretical framework and establishes the estimable tax reaction function. Section 3 discusses the data and the estimation strategy. Section 4 reports the main regression

results for horizontal tax competition with sensitivity analysis and further discusses whether there is Stackelberg-type strategic behavior among Chinese local governments. Section 5 briefly concludes the paper.

# 2. The simultaneous tax game in an agglomeration economy

The theoretical framework extends the work by Borck and Pflüger (2006) considering publicly provided consumption goods for households. Assume that within one region there are two open economies, two production inputs and three sectors— a perfectly competitive agricultural sector (*A*), a public sector (*G*)and a monopolistically competitive manufacturing sector (*M*). The economies have symmetrical preferences, technologies, endowments and trade costs. Low-skilled workers (*L*) are free to move among sectors but are immobile across regional borders, while the entrepreneurs (*K*) are fully mobile. The manufactured products have an iceberg trade cost *k* ( $k \ge 1$  and only 1/k products will reach the destination). Agricultural products are costless in trade and publicly provided goods are non-tradable.

The type of agent is indexed by *h*. Either type is characterized by the Dixit-Stiglitz's preference consisting of a CES sub-utility over *n* variables of manufacturing goods ( $C_M$ ) as well as the consumption of agricultural goods ( $C_A$ , treated as the numeraire<sup>3</sup>) and public goods ( $C_P$ ), where symmetry is imposed for analytical tractability.

$$\max_{c_i,c_i} U_h = \alpha \ln C_M + C_A + \beta C_P^2 / 2 \tag{1}$$

s.t. 
$$C_A + g(\tau)C_P + P_M C_M = Y_h$$
 (2)

Equation (2) is the budget constraint where  $P_M = (\sum_i^n p_i^{1-\sigma} + \sum_j^m kp_j^{1-\sigma})^{-(1-\sigma)}$ and  $C_M = (\sum_i^n c_i^{(\sigma-1)/\sigma} + \sum_j^m c_j^{(\sigma-1)/\sigma})^{\sigma/(\sigma-1)}$  with  $P_M$  as the perfect CES price index. It depends on the elasticity of substitution  $\sigma$  among varieties in the M sector. Individual firms set  $p_i(p_j)$ , the price of different varieties of manufactured goods, and the amount of local (neighboring) variety i(j) in the manufactured goods consumed is denoted by $c_i(c_j)$ .  $\alpha$  and  $\beta$  are positive, indicating different expenditure preferences. The nonnegativity of the trade cost requires  $\sigma > 2$ . The number of varieties in each jurisdiction is denoted by n and m, respectively.  $g(\tau)$  is the cost for the local government to

<sup>&</sup>lt;sup>3</sup> Agricultural production technology exhibits constant returns to scale, with intensive use of immobile workers  $C_A = L$ . Since the agricultural product is the numeraire and is traded freely,  $W_A = W_A^* = 1$ .

provide public goods as a function of a lump sum tax  $\tau$ .  $Y_h$  denotes the income for the *h*-type representative individual (*h*=*L*,*K*). Their incomes are given by  $Y_L = W$  and  $Y_k = R$ , respectively. Utility maximization gives the aggregate demand function:

$$C_M = \alpha P_M^{-1}, C_P = g(\tau)/\beta, C_A = Y_h - \alpha - g(\tau)^2/\beta$$
(3)

as well as the demand function for each variety:

$$c_i = \alpha P_M^{\sigma} p_i^{-\sigma}, c_j = \alpha P_M^{\sigma-1} (kp_j)^{-\sigma}$$
(4)

The indirect utility function is thus:

$$V = Y_h - \alpha + \alpha \ln \alpha / P_M - g(\tau)^2 / 2\beta$$
(5)

The production cost in the manufacturing sector is  $C(x_i) = R + \delta x_i$ , where  $\delta$  is the marginal production cost. *R* is the fixed cost as a reward paid to the entrepreneur. Each firm supplies a single variety of good and competes within and outside its jurisdiction. In the long-run monopolistically competitive equilibrium, the marginal firm sets the price as a markup over the marginal cost and breaks even, i.e.,  $(p_e - \delta)x^s = R + \tau$ , The gross quantity of supply by a representative manufacturing firm is derived as  $x^s = (\sigma - 1)(R + \tau)/\delta$ .

As argued by Borck and Pflüger (2006), the relocation decision of mobile entrepreneurs is controlled by the (indirect) utility differential given the capital stock in the short run. Imposing the market clearing condition for each variety (\*denotes the neighboring jurisdiction), we have:

$$x_i^{\ s} = c_i(L+K) + kc_j(L^*+K^*) \tag{6}$$

$$x_i^{\ s} = kc_i(L+K) + c_i(L^*+K^*) \tag{7}$$

After plugging (4) into (6) and (7), the capital reward for entrepreneurs in the home and its neighboring jurisdiction is respectively:

$$R = \frac{\alpha}{\sigma} \left[ \frac{\rho + s}{s + (1 - s)\varphi} + \frac{\varphi(\rho^* + 1 - s)}{s\varphi + 1 - s} \right]$$
(8)

$$R^* = \frac{\alpha}{\sigma} \left[ \frac{\varphi(\rho+s)}{s+(1-s)\varphi} + \frac{\rho^*+1-s}{s\varphi+1-s} \right] - \tau^*$$
(9)

where the trade cost is denoted by  $\varphi = k^{1-\sigma} \in (0,1)$  and  $\rho = \frac{L}{K+K^*}$ ,  $\rho^* = \frac{L^*}{K+K^*}$ ,  $s = \frac{K}{K+K^*}$ . The trade cost decreases (increases) when  $\varphi$  converges to 1(0). Defining  $\Omega_A$  as the utility differential for the footloose capital and imposing symmetry ( $\alpha = \alpha^*, \beta = \beta^*, \sigma = \sigma^*$ ), the mobility equation is given by:

$$\Omega_{A} = V - V^{*} = \frac{\alpha}{\sigma - 1} \ln \frac{s + (1 - s)\varphi}{s\varphi + 1 - s} + \frac{\alpha}{\sigma} (1 - \varphi) \left[ \frac{\rho + s}{s + (1 - s)\varphi} - \frac{\rho^{*} + 1 - s}{s\varphi + 1 - s} \right] - \frac{1}{2\beta} [g(\tau)^{2} - g(\tau^{*})^{2}] - (\tau - \tau^{*}) = 0$$
(10)

where  $\alpha, \sigma, \varphi, \rho, \rho^*, \beta$  are exogenous parameters and  $\alpha > 0, \beta > 0, 0 < \varphi < 1, \sigma > 2, g'(\tau) > 0$ . The long-run equilibrium<sup>4</sup> is characterized by  $\Omega_A = V - V^*$  where the supply linkage as the agglomerative factor is shown in the first item of equation (10) and the demand linkage with both the home market effect and the competition effect is shown in the second item. The tax effect appears in the last two items. If the equilibria are first characterized without tax, assuming  $\tau = \tau^* = 0$  and normalizing the endowments of immobile factors such that  $\rho = \rho^* = 1$ , Figure 2 illustrates four types of equilibria for different levels of trade costs given  $\alpha = 0.3$  and  $\sigma = 6$ . The blue line indicates a dispersed symmetric equilibrium (s = 1/2). The green line shows the case of full agglomeration with all industries clustering in one jurisdiction (s = 1). The black (red) line indicates that the agglomeration rent accrues to mobile entrepreneurs in a partial core-periphery equilibrium when the trade cost is  $\varphi = 0.17(\varphi = 0.25)$ .





<sup>&</sup>lt;sup>4</sup> It is not necessarily stable or unique since the model contains both convergent and divergent forces.

# 2.1. The simultaneous tax game

For analytical tractability, we normalize the endowment factors in the region such that  $K + K^* = 2$ ,  $\rho = \rho^* = 1$ ,  $\alpha = 0.3$  and  $\sigma = 6$ . To analyze the simultaneous game, a simple reduced form of the government objective function of Baldwin and Krugman (2004) is adopted in the quadratic form  $W(\tau, s) = G - \tau^2/2$  where  $G = 2s\tau$  and  $W^*(\tau^*, s) = G^* - (\tau^*)^2/2$  where  $G^* = 2\tau^*(1 - s)$ .<sup>5</sup> In the objective function, the total tax proceeds  $\tau(\tau^*)$  enter in a linear way and tax collection involves a quadratic loss. The optimal tax rate  $\tau(\tau^*)$  is chosen by the home (foreign) jurisdiction to maximize their government welfare  $W(W^*)$ . We take the choice of the home jurisdiction as an example. The optimal home tax must be given by:

$$2s + 2\,\partial s/\partial \tau - \tau = 0\tag{11}$$

From equation (10), we find:

$$\frac{\partial s}{\partial \tau} = \frac{-1 - s + 0.5\tau}{-\tau - \tau^* - 0.05(\varphi - 1)\left[\frac{2\varphi - 1}{(s + \varphi - s\varphi)^2} + \frac{2\varphi - 1}{(s\varphi - s + 1)^2}\right] - \frac{0.06(\varphi - 1)(\varphi + 1)}{(s + \varphi - s\varphi)(s\varphi - s + 1)}}$$
(12)

Under a balanced government budget constraint, government spending on public goods equals the net tax revenue, i.e.  $g(\tau)^2/\beta = 2s\tau - \tau^2/2$ . Under these parameters and government objective function specifications, the utility differential of the mobile factors with tax is given by:

$$\Omega(s,\tau,\tau^*,\varphi) = \frac{0.06\ln\frac{s-\varphi(s-1)}{s\varphi-s+1} - 0.05(\varphi-1)\left[\frac{s-2}{s\varphi-s+1} + \frac{s+1}{s-\varphi(s-1)} - \tau + \tau^*\right]}{-s\tau + \frac{\tau^2}{4} + (1-s)\tau^* - \frac{(\tau^*)^2}{4}}$$
(13)

We now discuss the strategic tax setting behavior,<sup>6</sup> which allows jurisdictions to choose their taxes simultaneously. Four cases of equilibria are considered, adopting the four different trade costs as used in Figure 2, which results in either a dispersed equilibrium, an equilibrium with partial agglomeration, and a core-periphery outcome with full agglomeration. To identify the tax reaction function, equations (11) and (13) can be simultaneously solved for both  $\tau$  and s assuming that the foreign jurisdiction is

<sup>&</sup>lt;sup>5</sup> Here,  $s=s(t,t^*)$ . For simplicity, the dependence of s on other parameters is omitted.

<sup>&</sup>lt;sup>6</sup> Discussion of the Nash equilibrium is out of the scope. We focus on the tax reaction function for empirical estimation.

motivated to change the tax rate to attract more footloose capital. All simplifications notwithstanding, it is difficult to obtain closed-form solutions. Therefore, we adopt numerical simulations to illustrate the strategic game in tax setting using the parameters mentioned above. Solving for the simultaneous equation system produces the best tax response curve for the home jurisdiction, as shown in Figure 3. The right plot in the figure shows a positive correlation between the home and foreign tax and the left panel indicates how the share of entrepreneurs evolves with the changes in the home tax.



Figure 3: Best response curve

#### 3. Empirical test of the theory

The above reaction function informed by the theory needs to be modified to fit our empirical framework. A vector X with k control variables is added to the tax reaction function:  $\tau = F(\tau^*, X)$ . Expanding the number of economies to N, each economy *i* has its own reaction function  $\tau_i = F_i(T, X)$ , where the vector T groups the tax rates of all the provinces other than *i*. It is common in the empirical literature when estimating reaction functions to assume the reaction function depends on the average tax rate in the rest of the economies  $(\overline{\tau_i})$ , rather than other N-1 tax rates, simplifying the dimensionality of the problem:

$$\tau_i = F_i(\overline{\tau}_i, X) \tag{14}$$

where  $\overline{\tau}_i$  is computed as a weighted average where the weights  $\omega_{ij} > 0$  are constant over time. The weights to compute the neighbor's tax rate are given by the inverse driving distance  $1/d_{ij}$  between capital cities in 1998.

Assuming a linear reaction function and introducing time and an error term  $\varepsilon_{it}$ , the equation to be estimated is:

$$\tau_{it} = \theta_{0i} + \theta_1 \overline{\tau_{it}} + \Theta' X_{it} + \theta_2 t + \varepsilon_{it} \quad i = 1, \dots, N; t = 1, \dots, T$$
(15)

where fixed effects  $(\theta_{0i})$  are considered, since the agglomeration factor tends to be historically determined and fixed, but heterogeneous across regions. Our theory predicts a positive sign of  $\theta_1$  if the initial neighboring tax is low.

A measure of provincial capital tax burdens that can be compared across space and over time is needed. Among the three choices—the statutory, the average and the marginal effective tax rates, the statutory tax is not a feasible option since local governments do not have the authority to set their own statutory rates. Firm-specific marginal tax rates, although a conceptual advance, are not generally available across regions. Further, it may not account for how the tax system is actually enforced by local authorities. The average tax rate is available, but admittedly, faces limitations. Defined as the corporate tax revenue as a percentage of GPP, the higher rate may be due to an increased number of incorporated organizations or a recession in the business cycle, undermining its comparability. However, it comprehensively examines the corporate income tax base, including the availability of tax credits, inflation adjustments and other preferential tax treatments used by local governments.

The coefficient of the time trend is  $\theta_2$  and  $\Theta$  is a  $k \times 1$  vector of the coefficients of the control variables. The control variables are the individual income tax, the value-added tax, the average business tax, the size of the public sector, trade costs (all of them as a percentage of GPP), economic size (i.e. GPP as percentage of GDP), the percentage of young and old people in the population, the dependency rate of the young and old populations, as well as the employment rate and the urban employment share over the labor force.

Slemrod (2004) suggests that a corporate tax may impose some limits to individual income tax since a high income tax could be avoided by retaining earnings. We were thus interested to test whether there is a strong tax burden association between corporations and individuals. Value-added tax and business tax are also included, since they are part of the government inter-temporal budget constraint. Likewise, the

government size is included since it also belongs to the budget constraint. Instead of exploring the determinants of government size at the provincial level as per Wu and Lin (2012), we wished to find evidence of whether the corporate tax is insulated from the desire to expand the public sector. In addition, theory (Bucovesky and Wilson, 1991) suggests that large countries impose higher capital tax rates than small countries because the erosion of their base is smaller in per capita terms. Small countries face a more elastic tax base and will choose a lower rate in equilibrium. Whether these results could be equally applied to the sub-national level needs further examination, therefore, the size factor is measured by the GPP to GDP ratio.

Openness is also considered, as it is common in empirical studies in both the political science (Quinn, 1997; Swank, 1998) and economics (Rodrik, 1997, Bretschger and Hettic, 2002) literature. We adopt foreign direct income (FDI) inflow and the sum of exports and imports as proxies of the degree of openness. The proportions of the young and old populations as well as three dependency ratios are controlled demographic variables. We also consider the employment-related variables suggested by Ogawa, Sato, and Tamai (2006). Since it is difficult to find a reliable measure of unemployment (see Liu, 2011), it is replaced by the employment rate while urban employment takes into account the massive migration process from rural to urban areas.

### 3.1 Econometric issues

The parameter of interest is  $\theta_1$ ; however,  $\overline{\tau_u}$  may raise the issue of endogeneity since it is jointly determined by local governments if the strategic behavior exists. Therefore, we implement the two-step efficient generalized method of moments (GMM) estimator for panel data. As suggested by the spatial econometric literature, instruments may be available if spatial lags of the independent variables are exogenous. Equation (15) can be interpreted as the spatial lag model and  $\theta_1$  is usually referred to as the spatial parameter. This model is usually implemented in two-stage least squares (2SLS), as in Anselin (1990) and Kelejian and Robinson (1993). The efficiency gains of the GMM estimator relative to 2SLS come from the use of the optimal weighting matrix, the overidentifying restrictions of the model, and the relaxation of the i.i.d assumption.

Stock and Watson's (2008) main recommendation is that the cluster-robust estimator should be the preferred choice. For fixed effects models, they show both heteroskedasticity-robust and other heteroskedasticity and autocorrelation-robust estimators are inconsistent. However, a reasonable number of clusters is required.

Monte Carlo simulations have shown that both the number of clusters (N) and the degree of unbalanceness across clusters are key factors for biasness. Kezdi (2004) considers balanced panels of N=10, 50 and 500, and concludes that 50 clusters is large enough for good performance while this is not the case when N=10. Nichols and Shaffer's (2007) simulations show that clustered standard errors work very well with 50 balanced panels, but particularly poorly when N=10. Rogers (1994), who considers both unbalanceness and the number of clusters, concludes that no cluster should contain more than 5% of the sample, suggesting more than 20 clusters may be large enough but only if the panel is balanced. With a balanced panel of 31 provinces, we should be cautious since the threshold of 50 clusters has not been achieved; however, Rogers' (1994) results are supportive of the use of the clustered estimator since N>20.

Instrumental variables requires a larger number of clusters to be valid than ordinary least squares. With 31 clusters, parsimony of regressors and instruments becomes the only option to improve the performance of our GMM estimator. This limitation is common to all other studies of the Chinese provinces with fixed effects. Estimation strategies that may lead to instrument proliferation are commonly implemented in the literature. Consider the panel data GMM estimator of Arellano and Bond (1991) and extensions, based on the same two-step GMM estimator with lags as instruments. Roodman (2009) explores the potential problems with large sets of instruments dynamic panel data estimation. The case is made against the dangers of automated sophistication and the potential small sample problems. Windmeijer (2005) makes the same point. This also applies to the case of an excessive number of spatial lags as instruments. Likewise, it is common practice to use not only the first order but also their second order spatial lags, as suggested by Kelejian and Prucha (1998). In our estimations with up to seven regressors, we would make use of up to 14 instruments. It would be sensible to reduce the number of instruments to a reasonable compromise.

# 4. Results

This study deals mainly with a balanced panel from 1998 to 2012.<sup>7</sup> Data definition, sources, and summary statistics are given in Table 1. Equation (15) is estimated implementing the two-step GMM with fixed effects and clustered standard errors. As argued previously, instrument proliferation may be an important concern given the

<sup>&</sup>lt;sup>7</sup> The panel is unbalanced when either any employment-related variables (17 missing values) or FDI (6 missing values) are included. Tables 3 and 4 deal with balanced panels.

number of clusters. Exploratory analysis using diagnostic tests suggested constraining the number of instruments to three. The three instruments considered in Table 2 are the spatial weighted averages of openness, income tax and the size of the economy, while openness is replaced by government size in Tables 3 and 4. Demographic variables are excluded.<sup>8</sup> In Tables 3 and 4, income tax and government size could be replaced by either VAT or business tax without greatly changing the results. Three instruments would be more than enough to have an over-identified IV regression, making available differences in Hansen J statistics when necessary. This may also improve the performance of our endogeneity and exogeneity tests (see Windmeijer, 2005).

Tabl	le 1	Sum	mary	stati	stics
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	Obs	Mean	StDev	Min	Max
Corporate tax rate (% GDP)	465	0.92	0.65	0.25	4.48
Income tax rate (% GDP)	434	0.43	0.33	0.00	3.40
Value added tax (% GDP)	434	1.21	0.40	0.48	3.31
Business tax rate (% GDP)	434	2.13	1.05	0.91	6.59
Gov. consumption expenditure (% GDP)	434	20.18	29.89	5.68	584.3
FDI inflow (% GDP)	429	2.67	3.90	0.00	68.67
Exports plus imports (% GDP)	434	15.89	19.00	1.48	90.53
Size gross provincial product (% of GDP)	434	3.37	2.72	0.11	12.29
Young population (% of population)	434	19.67	5.17	7.56	35.14
Old population (% of population)	434	8.37	1.94	4.05	16.37
Dependency rate of young population	434	27.80	8.66	9.65	57.82
Dependency rate of old population	434	11.60	2.52	6.12	21.89
Dependency rate of young and old populations	434	39.40	7.90	19.27	64.54
Employment rate (% of labor force)	403	36.96	5.58	23.78	56.73
Urban employment (% of employment)	403	31.83	15.79	11.50	97.03

Notes to Table 1:

1- Corporate, individual income, VAT and business tax revenues, as well as GPP, government consumption expenditures, and GDP are from the China Statistical Yearbooks.

2- FDI (USD mn) and exchange rate are from China Data Online (www.chinadataonline.com).

3- Exports and imports (USD mn) are from National Bureau of Statistics China (NBSC).

4- Total population is from the China Statistical Yearbook. The numbers of people above 65 and below 14 are calculated by authors using the sampling fraction from CEIC (<u>www.ceicdara.com</u>).

5- The urban employment and the number of employees are from CEIC, NBSC and China Data Online.

The diagnostic tests of the instrumental variables are presented at the bottom of Tables 2–4. The rejection of the null of the Kleibergen and Paap (2006) test indicates the absence of weak identification. In all specifications, the rk-statistic is often over 100 and always larger than the usual rule of thumb of 10. We consider two more weak instruments tests from Stock and Yogo (2005): the maximal IV relative bias and maximal IV size distortion tests. They are based on the same rk-statistic but have different critical values. This statistic fails to reject the null of weak identification only once in 21 regressions. This is Regression (13), in Table 3, which fails to reject the null

<sup>&</sup>lt;sup>8</sup> The difference in Hansen J-statistics (not reported) suggests they can be excluded.

of 10% maximal IV size distortion but rejects the 5% maximal IV relative bias. Overall, weak identification does not seem to be a problem. Second, the exogeneity of the instruments are tested using the Hansen J-statistic. The performance of the J test is very satisfactory, since it fails to reject the null at the 10% significance level in all regressions.

#### 4.1. The simultaneous corporate tax game

The estimation results of equation (15) are presented in Tables 2 and 3. The endogeneity test<sup>9</sup> of  $\overline{\tau_{tt}}$  is important because the null implies that  $\overline{\tau_{tt}}$  can actually be treated as exogenous, and therefore, there is no strategic corporate tax setting interaction. Most of the evidence suggests endogeneity, although this is not clear cut. The statistic is always significant at either the 1% or 5% level in Table 2. This is also the case in the first three regressions in Table 3; however, the significance level increases to 10% in Regressions (10) and (11) once the business tax is included among the regressors. The last four regressions are robustness checks of Regression (11), some of which shows no endogeneity (Regressions 12 and 14) but also has two cases that support endogeneity at 10% (Regression 13) and even 1% (Regression 15). These results at least partially confirm the strategic interaction in corporate tax setting in China.

Table 2 presents the benchmark results. Across all regressions, the coefficient of  $\overline{\tau_{tt}}$  is always positive and significant at 1%. This is consistent with the hypothesis of a spatially strategic tax interaction among provinces. A tax cut of one percentage point in the neighboring jurisdiction is associated with a decrease of approximately 0.72–0.9 percentage points in own taxes, which is of the same range of magnitude found in similar cross-country studies of interdependent corporate tax setting (Devereux et al., 2008; Redoano, 2014; and Chen et al., 2014).

The individual income tax is statistically significant and positively associated with corporate tax, as expected. The coefficient of the size of the economy is statistically significant but negative, which shows the local governments in the rich regions are more active in tax cuts in the informal means compared with the poor regions. The first column considers FDI as measure of openness, which is replaced by trade from Column (2) onwards. The coefficient of the openness degree is significant and positively related with corporate tax when measured by international trade. However, it is mostly significant at 10%. In Columns (3) and (4), the two variables related to employment are

<sup>&</sup>lt;sup>9</sup> Based on the difference in Hansen J-statistic where the J-statistic is computed for two models where the variable is considered first as endogenous and second as exogenous.

not statistically significant. The coefficients on the demographic variables are not statistically significant, except for the share of the old population, which shows that the aging population in China may drive the downward trend in tax setting. Intuitively, the strategic corporate tax setting is not generated from redistribution needs. Local governments pay more attention to economic factors, such as the amount of investment, than to social stability and security, linking to the cadre responsibility system. Furthermore, local provinces could possibly have more resources to support the social security system than within-budget revenues.

	(1)	(2)	(3)	(4)	(5)	(6)
Neighbor's corp. tax $(\bar{\tau}_{it})$	0.722***	0.786***	0.733***	0.734***	0.899***	0.778***
	(0.085)	(0.107)	(0.093)	(0.091)	(0.084)	(0.110)
Economy size	-0.146**	-0.176***	-0.174***	-0.171***	-0.178**	-0.179***
	(0.061)	(0.061)	(0.064)	(0.062)	(0.084)	(0.059)
Openness (FDI)	-0.003					
	(0.003)					
Openness (trade)		0.007*	0.006**	0.006*	0.006	0.006*
		(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
Young population (%)	0.011	0.011	0.014	0.012		
	(0.017)	(0.019)	(0.018)	(0.017)		
Old population (%)	-0.050*	-0.059**	-0.056**	-0.051*		
	(0.027)	(0.027)	(0.025)	(0.026)		
Income tax	0.493**	0.263***	0.445**	0.451**	0.336***	0.265***
	(0.208)	(0.093)	(0.203)	(0.223)	(0.065)	(0.092)
Employment (% of L force)			0.003			
			(0.011)			
Urban employment (%)				0.003		
				(0.005)		
Dependency rate (total)					-0.004	
					(0.008)	
Dependency rate (young)						0.011
						(0.011)
Dependency rate (old)						-0.040**
						(0.019)
Observations	459	465	448	448	465	465
Adj. R squared	0.425	0.445	0.430	0.429	0.390	0.450
Weak instrum. test (rk-stat)	366.1+	$404.0^{+}$	357.1+	354.6+	$448.0^{+}$	406.5+
Exogeneity test (J-stat)	2.044	0.648	0.448	0.658	0.857	0.745
Endogeneity test	7.034***	6.157**	6.162**	5.925**	7.165***	6.352**

Table 2: The benchmark model

Notes to Tables 2, 3 and 4:

1- Clustered standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. All regression considers provincial fixed effects and a time trend (not reported).

2- The weights are the inverse of the driving distance from the capital city, except for Regression 11 (simple average of provinces with common borders) and Regression 12 (the simple average).

3- List of instruments: the weighted averages of the economy size, openness and income tax in Regressions 1–6; while openness is replaced by government size in the rest of the regressions.

4- The endogeneity and exogeneity test statistics are distributed as Chi-squared. The second endogeneity test in Table 3 considers whether the additional public sector variable introduced in the relevant regression is endogenous. 5- The weak instrument test is the first stage F-statistic and three set of critical values are considered. The symbol + indicates that the statistic is larger than 10 (the 5% critical value in Staiger and Stock, 1997) and both the 5% maximal IV relative bias and 10% maximal IV size distortion critical values tabulated in Stock and Yogo (2005). Notice the F-statistics of the three tests are the same but the critical values are not.

# 4.2. Robustness to additional endogeneity and spatial correlation issues

Two further extensions of the spatial lag model are explored. First, additional control variables are considered, a real concern for other variables belonging to the public sector. Since they all belong to the government budget constraint, the government size and all other taxes may be set at the same time, leading to endogeneity. This is formally addressed with the second endogeneity test available in Table 3. The test is applied to income tax, government spending, VAT and business tax individually in Regressions (7) to (10), respectively. In all cases, the variables were found to be exogenous. Therefore, the coefficients in Table 3 are estimated considering  $\overline{\tau_{tt}}$  as the only endogenous regressor.

Second, the introduction of spatial correlation of general form in the error term is considered. A second spatial parameter ( $\rho$ ) may be introduced:

$$\varepsilon_{it} = \rho \overline{\varepsilon_{it}} + u_{it} \tag{16}$$

where  $\overline{\varepsilon_{tt}}$  is the spatial lag<sup>10</sup> of the disturbance term in equation (15) and  $u_{it}$  is an error term free of spatial correlation. Therefore, the augmented model consists of equations (15) and (16) with two spatial parameters. Kelejian and Prucha (1998) have proposed a three-step GMM procedure to obtain consistent estimates of this model. In the first step, equation (20) is estimated by 2SLS. The residuals of the first step are utilized in the second step to estimate  $\rho$  by the GMM estimator described in Kelejian and Prucha (1999) and Kapoor, Kelejian and Prucha (2007). In the third step, the GMM estimate for  $\rho$  is used to account for the spatial correlation in the disturbance, using a Cochran-Orcutt-type transformation, a standard transformation in spatial analysis, and the estimate for  $\theta_1$  is obtained by estimating the transformed model by 2SLS again.

The three-step procedure of Kelejian and Prucha (1998) was performed in Regression (12) but replacing the 2SLS estimator of the first and third steps by the more efficient two-step GMM estimator. Notice the first step estimation is the same as our Regression (11). The second step estimate of  $\rho$  is 0.112, which magnitude is rather small, although it is not possible to perform hypothesis testing since the distribution of this estimator under the null is not known. Unsurprisingly, the third step estimates of equation (15) in Regression (12) are very close to the first step estimates (Regression 11), including the

<sup>&</sup>lt;sup>10</sup> The weights are the same as in  $\overline{\tau_{ut}}$ .

endogeneity statistic, which is significant at 10%. Therefore, we argue that our results are supportive of our simplified framework in equation (15), which neither consider additional variables as endogenous nor add spatial correlation in the error term.

	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Neighbor's some toy $(\bar{z})$	0.764***	0 702***	0.752***	0 607***	0.722***	0 707***	0.704***	0 5 7 9 * * *	0 050***
Neighbor's corp. tax $(t_{it})$	(0.104)	(0.087)	(0.086)	$(0.097^{++++})$	(0.081)	(0.002)	(0.082)	(0.100)	(0.081)
<b>F</b> .	(0.104)	(0.087)	(0.080)	(0.084)	(0.081)	(0.095)	(0.082)	(0.199)	(0.081)
Economy size	-0.151**	-0.155***	-0.164***	-0.132***	-0.144***	-0.141***	-0.143***	-0.191***	-0.109***
	(0.062)	(0.055)	(0.049)	(0.043)	(0.037)	(0.038)	(0.032)	(0.047)	(0.035)
Young population (%)	0.007	0.006	0.025*	-0.001	0.016	0.017	0.017***	0.023*	0.012
	(0.019)	(0.018)	(0.014)	(0.016)	(0.013)	(0.014)	(0.004)	(0.013)	(0.010)
Old population (%)	-0.052*	-0.049**	-0.074***	-0.039*	-0.063***	-0.067***	-0.066***	-0.039	-0.058***
	(0.027)	(0.023)	(0.023)	(0.020)	(0.018)	(0.019)	(0.009)	(0.029)	(0.013)
Income tax	0.336***	0.551***	0.279**	0.729***	0.464***	0.464***	0.469***	0.669***	0.436***
	(0.096)	(0.153)	(0.141)	(0.154)	(0.126)	(0.130)	(0.128)	(0.129)	(0.096)
Government size	. ,	-0.002**	-0.001	-0.004***	-0.003***	-0.003***	-0.003***	-0.004***	-0.003***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
VAT		(,	0.417***	(	0.446***	0.449***	0.439***	0.343***	0.456***
			(0.084)		(0.079)	(0.082)	(0.077)	(0.124)	(0.079)
Business tay			(0.001)	0 272***	0 333***	0 345***	0 335***	0.266***	0 326***
Dusiness tax				(0.039)	(0.039)	(0.040)	(0.035)	(0.060)	(0.036)
				(0.037)	(0.037)	(0.040)	(0.030)	(0.000)	(0.030)
Observations	465	465	465	465	465	465	465	465	465
Adj. R-squared	0.433	0.445	0.487	0.524	0.582	0.523	0.583	0.441	0.615
Weak instr. test (rk-stat)	630.1+	392.3+	364.4+	$404.2^{+}$	376.2+	354.5+	376.2+	21.94	1389+
Exogeneity test (J-stat)	0.928	0.794	1.234	2.105	0.0469	0.0672	0.0966	4.410	0.342
Endogeneity test	7.185***	8.119***	7.575***	3.090*	2.731*	3.308*	1.652	0.625	7.062***
Endogeneity test (2)	0.928	0.0330	0.455	1.205					
Error spatial parameter						0.112			

Table 3: Additional public sector variables

Notes: See Table 2.

Regressions (13) to (15) consider some robustness checks. First, clustered standard errors are replaced by Heteroskedasticity, and Auto and Spatial Correlation consistent (HASC) standard errors in Regression (13). HASC are robust to spatial correlation of general form. The coefficients and significance levels are similar (if anything, the correlations are stronger), except that the endogeneity statistic is not significant, even at 10%. However, HASC standard errors require clustering at the time dimension, an assumption that is more restrictive than provincial clustered standard errors, since our sample period lasts for 15 years, affecting the performance of the test of endogeneity.

We also consider two other measures of the weights to compute spatial lags. First, weights from a contiguity matrix where a neighborhood is defined as sharing a common border in Regression (14). Second, homogeneous weights to obtain the simple average of all other 30 provinces in Regression (15). The magnitude and significance levels of the coefficients are similar to the previous results. Likewise, the endogeneity statistic is significant at 1% when using simple averages. However, when using the contiguity

matrix, the endogeneity of  $\overline{\tau_u}$  is rejected. Overall, the results are still consistent with the hypothesis of strategic interactions occurring between local governments, although it seems that restricting our attention to common borders may not be appropriate.

	(11)	(16)	(17)	(18)	(19)	(20)
	0.720***	0.044***	0 501***	0.014***	0 725***	0.710***
Neighbor's corp. tax $(\tau_{it})$	$0.732^{***}$	$0.844^{***}$	0.581***	0.814***	0.735***	$0.712^{***}$
F	(0.081)	(0.070)	(0.120)	(0.064)	(0.080)	(0.071)
Economy size	-0.144	-0.119	-0.104	$-0.182^{++++}$	$-0.143^{+++}$	-0.139****
	(0.037)	(0.074)	(0.037)	(0.041)	(0.034)	(0.043)
Young population (%)	0.016	0.012	0.017	0.006	0.012	0.018
	(0.013)	(0.010)	(0.012)	(0.012)	(0.012)	(0.013)
Old population (%)	-0.063***	-0.040**	-0.055***	-0.043**	-0.049**	-0.062***
_	(0.018)	(0.019)	(0.021)	(0.018)	(0.024)	(0.018)
Income tax	0.464***	0.240	0.476***	0.559***	0.569***	0.451***
	(0.126)	(0.180)	(0.129)	(0.136)	(0.160)	(0.116)
VAT	0.446***	0.414*	0.479***	0.474***	0.440***	0.457***
	(0.079)	(0.227)	(0.075)	(0.093)	(0.097)	(0.079)
Business tax	0.333***	0.215**	0.328***	0.296***	0.341***	0.330***
	(0.039)	(0.091)	(0.039)	(0.049)	(0.042)	(0.042)
Government size	-0.003***	0.002	-0.003***	-0.003***	-0.003***	-0.002***
	(0.001)	(0.005)	(0.001)	(0.001)	(0.001)	(0.001)
Corp. tax, central gov. (lag)			-0.102			
			(0.068)			
Corp. tax, Beijing (lag)				0.024		
				(0.017)		
Corp. tax, Shanghai (lag)					0.026	
					(0.023)	
Corp tax, Guangdong (lag)						0.022
						(0.025)
			10.1	100	100	100
Observations	465	217	434	420	420	420
Adj. R-squared	0.582	0.591	0.588	0.678	0.542	0.576
Weak instrum. Test (rk-statistic)	$376.2^{+}$	399.2+	$160.6^{+}$	$481.2^{+}$	425.7+	$440.4^{+}$
Exogeneity test (J-statistic)	0.047	4.234	0.422	2.926	0.187	0.072
Endogeneity test	2.731*	3.828**	1.009	2.399	5.281**	2.686*

Table 4: The Stackelberg model

Notes: See Table 2.

Regressions (8) to (15) show that the size of the local public sector is negatively related to the corporate tax rate, suggesting the strategic tax setting behavior among local governments is not primarily driven by a need for expansion in the public sector. The expenditure needs for local government could possibly be financed by alternative means, such as off-budget and extra-budget revenues. VAT and business tax are introduced separately in Regressions (9) and (10), while Regression (11) includes both. The coefficients are positive and statistically significant, the same as the individual income tax. The other control variables are from Regression (2), except for openness, since it would become statistically insignificant if included for most of the specifications of Table 3. This suggests that the inclusion of other taxes weakens the

role of trade costs. The coefficient on the share of the old population is still significantly positive, while the share of the young population remains insignificant. Moreover, the richer the province is, the lower the capital tax burden offered to the footloose capital.

#### 4.3. Further discussion: Is there a leader?

Table 4 presents the results based on a modified econometric framework where there is a leader in the tax rate setting of Chinese provinces:

$$\tau_{it} = \theta_{0i} + \theta_1 \overline{\tau_{it}} + \delta' X_{it} + \theta_2 t + \theta_3 \tau_{Lt-1} + \varepsilon_{it}$$
(17)

The new variable  $\tau_L$  denotes the corporate tax rate set by the Stackelberg leader. The leader could be the central government, who imposes the corporate tax policy on local governments. The spatial correlation of tax could be attributed to the mandate from the center. Alternatively, the leader could be one of the 31 provinces, such as Beijing, Shanghai and Guangdong, with the others to follow suit. These three regions are among the frontrunners of economic reform. The first two seemed to be outliers in Figure 1, while Guangdong is among the economies with the largest corporate tax revenue but the lowest corporate tax revenue growth. Endogeneity is still an issue since the estimation requires  $\tau_L$  to be exogenous. Therefore, equation (17) will be considered with a lagged value of  $\tau_L$ .

In Table 4, Regression (11) from Table 3 is reproduced as a benchmark case. First, Regression (16) fits equation (11) again, but only for 2001–2007, a period within two fiscal reforms when there was no major change in the tax regime. The main results regarding corporate tax are not qualitatively different from Regression (11), although the coefficients of the income tax, VAT, business tax and government size become statistically insignificant. The endogeneity test results and the signs of the spatial lag of the corporate tax rate are the same, which suggests the previous results on strategic behavior were not driven by changes in statutory tax rates by the central government.

The next column introduces the central government corporate tax (as percentage of GDP). Regression (17) would be consistent with a theoretical framework where the center sets the corporate tax policy to be followed by the provinces. However, the new coefficient is not significant. Whether the leading role is played by Beijing, Shanghai or Guangdong, the predicted results are similar. The coefficients on  $\tau_{Lt-1}$  in Regressions (18) to (20) are not statistically significant. Therefore, models with

horizontal, rather than vertical, interactions among local governments seems to better fit the case of corporate tax among the Chinese provinces.

# 5. Conclusions

The theoretical literature by Zodrow and Mieszkowski (1986) and others has inspired many empirical studies of strategic tax setting behavior. In the Chinese context, the main driver of the spatial interaction in tax would not be a reduction in the statutory tax rates, but rather, alternative measures to reduce the tax burden of enterprises to influence their location decision. That is, although local governments cannot decide their own corporate tax rate, they have other methods in place to reduce the corporate tax burden, such as tax rebates.

This paper has found evidence that supports the existence of strategic interactions in corporate tax policies among the provinces in China. The endogeneity of our proxy for the neighbors' corporate tax and its positive and statistically significant coefficient is congruent with the prediction of spatial tax interdependence between local regions in China. The evidence favors the horizontal tax competition interpretation of this strategic behavior over other alternative hypotheses, such as vertical tax competition. Our estimations of the slope of the tax reaction function suggest provinces adjust 0.73% for a 1% change in neighboring provinces (Regression 11). Results from the uniform weighted spatial lag variables (Regression 15), which do not depend on a definition of geographical closeness, increase this magnitude to 0.86%. This magnitude is similar to previous results from cross-country studies: 0.75% in the Asia and Pacific countries (Chen et al., 2014), 0.86% in European Union countries (Redoano, 2014), and 0.78% in OECD countries (Devereux et al., 2008, based on uniform weights).

The data suggests that in rich regions the local government tends to cut the tax burden more actively compared with the poor regions, and that the aging population in China drives the downward trend in corporate tax rate setting. The theoretical model also suggests integration with the world economy should increase the response of local governments to their neighbors; however, trade integration only sometimes has a significant effect (even at the 10% level in Table 1).

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