Race to the Top and Race to the Bottom:

Tax Competition in Rural China

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Abstract

Fiscal federalism has been argued to intensify regional competition and promote economic growth in the literature. This paper is the first, to our knowledge, to empirically assess the extent of strategic tax competition between geographically neighboring governments in the context of China. Using a panel data set containing 2094 counties from 1993 to 2005, we apply Anselin's (1995) local indicator of spatial association (LISA) to statistically test the existence of local capital tax competition and examine their determining factors. We find heterogeneous tax competition behaviors across regions. Counties in the coastal areas with favorable endowment tend to race to the bottom by lowering tax rates, while counties within a poorly endowed neighborhood in the interior region have a greater propensity to run a 'race to the top tax rate', implying that they are more motivated to compete for central transfers instead of mobile private capital.

1. Introduction

Fiscal federalism or fiscal decentralization has been widely called for to promote economic growth in both developed and developing countries. One key argument is that fiscal competition creates disciplinary pressures to preserve market incentives (Qian and Roland, 1998). The model by Qian and Roland (1998) has a crucial assumption that all the regions are identical. In the real world, in particular in spatially large countries, such as China, resource endowment does differ across regions.

A few studies on tax competition have taken the heterogeneity into account. As shown by Kanbur and Keen (1993) and Wilson (1991), most two-agent competition models suggest an inverse relationship between jurisdictions' incentives for tax rate reduction and their tax base sizes—when tax competitors differ in size, the one with a larger tax base is less willing to participate in tax competition, hence resulting in a higher tax rate. Recently, Cai and Treisman (2005) proposed an alternative model which provides opposite predictions. Their capital competition model has multiple competitors with different size of endowment. They argue that when the endowment difference is large, seeing little hope of winning the capital competition, poorly-endowed units tend to invest less in infrastructure and take part less actively in capital competition, which in turn can widen the gap in initial endowment. Most strikingly, Cai and Treisman's hypothesis seems to justify regional economy polarization in the presence of endowment inequality, in spite of the canonical convergence growth theory.

While the literature has rich evidence for the presence of tax competition among states or counties in the United States or local units in other industrialized countries (Bartik 1991, Case et al 1993, Brett and Pinkse 2000, Buettner 2001, Oates 2002, Hendrick et al 2005), the empirical studies in developing or transition countries have been more scant in large due to lack of data (Bardhan, 2002). In particular, there are few studies examining whether the tax competition behavior is homogenous or not in developing countries with large regional difference in resource endowment.

China provides a good ground to empirical test the above question. Since the economic reforms, China has decentralized its fiscal system by devolving a large portion of expenditure responsibilities to the state and local governments but also ensuring local governments' authority over the locally sourced revenues. Jin *et al*. (2005), for example, demonstrate that in the period of 1995-1999 the provincial governments in China faced much stronger fiscal incentives and fiscal decentralization enhances growth. They argue that reform has created self-finance pressure on local officials such that they have to compete with each other to protect the local tax revenue base and attract business investment so as to prompt economic development. However, they assume the effect of fiscal decentralization is the same for all the provinces in their analysis. Considering its sheer size and large regional variation, it is highly likely that the regional fiscal competition behavior and consequence may vary as suggested by the rising regional inequality in the past several decades.

By making use of a panel data set at the county level covering a longer and more recent period, we attempt to empirically test whether tax competition exists or not, and if yes, whether competition behavior is subject to their underlying endowment. In particular, we develop an empirical framework that is not only able to test the presence of intergovernmental tax competition within a country but also flexible enough to reflect the variation of the degree of tax competition in different regions. In addition to presenting the pattern, this study empirically relates the endowment heterogeneity to various degrees of tax competition incentives.

In specific, we examine whether poor units have been disciplined by capital competition in the same way as rich units. For this purpose, we compare the counties in two distinct clusters: each is essentially a spatial cluster of similarly endowed counties, though the sizes of endowments are remarkably different between clusters. It is noted that within the cluster, counties are homogeneous in both the endowment and the geographic location dimension, which should ensure perfect competition equilibrium. Our finding does verify the existence of tax competition among neighboring counties. Furthermore, we find a difference between these two types of clusters: in the cluster with large endowments, competition is in a "race to the bottom", while in the cluster with small endowments, it is in a "race to the top".[1] The negative relationship between the tax rate and the cluster-specific endowment size implies rich clusters are more motivated to compete for capital than poor ones. Initial endowment matters to whether spatially clustered counties will run a race to the bottom or a race to the top in tax rate settings. In particular the poor counties are less disciplined by capital competition. This lends support to the hypothesis of Cai and Treisman.

The rest of this paper will continue as follows. Section 2 introduces the theoretical background for tax competition behaviors and proposes a new measure to detect tax competition at a local level. Section 3 describes the data and presents the spatial and temporal patterns of local tax competition behaviors in China. Section 4 applies a

[1] Many previous studies use "race to the bottom" and "race to the top" to address the welfare concerns of intergovernmental competition. In this paper, we borrow the terms to simply refer to the action of reducing tax rates or raising tax rates in the process of neighborhood competition. The welfare implications of these actions, however, will be discussed separately.

regression approach to examine how endowment and other factors affect tax competition choices. Finally, section 5 assesses implications of our empirical results and concludes this paper.

2. Rethinking the Measure of Tax Competition

2.1 A simple capital-flow model for tax competition

We begin by presenting a simple model of county government behaviors. In this paper, we focus on a specific type of intergovernmental competition—capital tax competition—where counties with immobile labor impose a tax rate on mobile capital. This type of strategic interaction has been formalized by Zodrow and Mieszkowski (1986), Wilson (1986), Wildasin (1988) and others, and reviewed by Wilson (1999) and Brueckner (2003). In the simplest framework for capital tax competition, a county chooses the tax rate to maximize its objective function (*Vi*), which also depends on the amount of capital that resides within its borders (K_i). The distribution of capital among competing counties is affected by the tax rate that it chooses (t_i) and that its competitor chooses (t_{-i}). Thus, the county's tax rate, t_i, is partially determined by t_{-i}.

Consider a county that has only one revenue source from capital taxes. We assume that it maximizes a combined utility deriving from both the tax revenue and a representative citizen's welfare. Its objective function can be written as

$$V(t_i, K_i) = U[c_i(K_i), G(t_i, K_i)] + t_i K_i, \tag{1}$$

where c_i denotes the representative citizen's private consumption in county i and G the consumption of public good or services. The private consumption is affected by K_i through the income effect in which more capital raises the marginal productivity of workers and thus the wage rate for each worker. Meanwhile, the public good provision is assumed to be fully financed by tax revenues (no government debts), and thereby G_i is a function of both t_i and K_i.

The final distribution of capital across counties has to satisfy the no-arbitrage condition, that is, the after-tax return to capital should be equalized in every county. Suppose k_i represents capital per worker in county i, and $f(k_i)$ is the production function. This condition can be given by

$$r = f'(k_i) - t_i = f'(k_{-i}) - t_{-i} \tag{2}$$

where $f'(k_i)$ is the marginal product of capital, or pre-tax return, in county i, and r is the equalized after-tax return. When competing units are sufficiently small, they are all price takers who regard the after-tax return as given. Equation (2) depicts the relationship between k_i and t_i— the rise in t_i causes a decrease in capital so that the marginal product of the capital stock can rise to the point where the after-tax return equals r.[2] Similarly, an increase in t_{-i} decreases the level of k_{-i}, thus causing k_i to increase.

[2] A formal proof for the statement that k_i and t_i are negatively correlated other things being equal, is given as follows. Taking derivatives with respect to *ti* on the first two items in (2) gives $\frac{\partial r}{\partial t_i} = f_{kk}^i \cdot \frac{\partial k_i}{\partial t_i} - 1$, where f_{kk}^i denotes the second derivative of production function $f(k_i)$ with respect to k_i. It is noted that $\frac{\partial r}{\partial t_i} = 0$, because r is assumed as a constant when the number of competitors is large. Thus, $\frac{\partial k_i}{\partial t_i} = \frac{1}{f} < 0$.

The tax-induced capital flow depends on how the marginal product of capital changes in response to the change in capital stock, which can be denoted by [3]

$$\frac{\partial k_i}{\partial t_i} = \frac{1}{f_{kk}^i} \qquad (3)$$

It is worth noting that f_{kk}^i is affected by the size of capital stock and other exogenous characteristics of county *i*. Therefore, the capital mobility implies that the capital stock in a particular county, K_i (note: $K_i = n_i \cdot k_i$), depends on the tax rates in all the competing counties, exogenous characteristics of *i* (X_i), as well as exogenous characteristics of all other competitors (X_{-i}). Then, K_i is given by

$$K_i = K(t_i, t_{-i}, X_i, X_{-i}) \qquad (4)$$

Substituting equation (4) into (1) yields

$$V(t_i, t_{-i}, X_i, X_{-i}) = U[c_i(K(t_{i,} t_{-i}, X_i, X_{-i})), G(t_i, K(t_{i,} t_{-i}, X_i, X_{-i}))] + t_i K(t_{i,} t_{-i}, X_i, X_{-i}) \quad (5)$$

which indicates that the optimal tax rate, t_i, is an implicit function of t_{-i} The solution to (5) reflects a Nash equilibrium in which county *i* chooses the tax rate that maximizes its utility function given a tax rate t_{-i}, which meanwhile is the best choice for its competing county given t_i。 Such a solution can be described by a tax reaction function as follows

$$t_i = h(t_{-i}, X_i, X_{-i}) \qquad (6)$$

3 Same as 1.

This tax reaction function does not explicitly reveal whether or not t_i is positively related to t_{-i}. Brueckner and Saavedra (2001) show that the slope of this function can be positive or negative depending on which specific functional form is used. They attribute tax rate variation to the differences in production technology or consumer preferences. On the other hand, even though the function forms are identical, the level of X_i and X_{-i} may affect the pre-tax returns $f'(k_i)$ and $f'(k_{-i})$, which in turn affects how t_i reacts to the change of t_{-i}. Therefore, without restrictive assumptions that reduce the complexity in the setting of this type of model, any attempt to obtain a unique relationship between t_i and t_{-i} will turn infertile even under the idealistic condition of perfect capital mobility.

Most theoretical literature is based on one key assumption that all the counties are identical and choose the same optimal tax rates (Wilson 1999). This case clearly suggests that a positive correlation of tax rates should occur for counties with similar endowments. Another prominent feature of this case is that capital mobility imposes a potential revenue penalty on any single county that attempts to raise the tax rate alone. Therefore the equilibrium tax rate is lower than it would be without capital competition. Simply put, tax competition would yield the clustering of low tax rates among counties that are rather alike. This prediction has spurred a wave of new empirical studies in testing the presence of tax competition or interactions in tax rate settings. As indicated before, the empirical studies on the test of heterogeneous tax competition behavior are much rarer.

2.2 Empirical Tests for Tax Competition

The method that many empirical studies have applied to test the hypothesis of tax competition relies on a key parameter which describes how a government unit's tax rate changes in response to a change in its competitors' tax rate (Bartik 1994). Most often this parameter has been estimated based on a rather stringent assumption that all the units in the sample share the same responsiveness, and therefore has failed to reflect the intrinsic heterogeneity of competition incentives. Another problem with this method that has yet to be solved is that it tends to reject the hypothesis of competition when it actually should not, especially when only a few of the governments in the sample have significant tax competition behaviors. The approach we adopt for avoiding the specification bias is the local indicators of spatial association (LISA), also called local Moran's I, which was originally developed by Anselin (1995) and studied by Bao and Henry (1996) and many others. In our definition, the localized tax rate correlation coefficient ρ_i is estimated by using an extended version of local Moran's I

$$\hat{\rho}_i = \frac{(t_{1i} - t_1^*)\sum_k w_{ik}(t_{0k} - t_0^*)}{\sum_i (t_{1i} - t_1^*)^2 / n}, \tag{7}$$

where the subscripts 1 and 0 represent the current and last year respectively, t_i is the observed value of t at location i, t^* is the mean of t, w_{ik} is the spatial weight between i and k, and n is the number of observed units. This localized statistic fits into our research for several reasons. First, it is conveniently computable even by using a cross-sectional data set. Second, it has direct and rich implications for the spatial distribution of data. A positive value of $\hat{\rho}_i$ indicates a positive correlation. Given this result, if t_{1i} is also greater than t_1^*, then high values are located near to each other; otherwise, low values are clustered. On the other hand, a negative value of $\hat{\rho}_i$ indicates a negative spatial autocorrelation. Depending on whether t_{1i} exceeds t_1^* , a pattern of the spatial outlier can be determined as either a high valued unit in contrast to low valued neighbors or the opposite. Third, this statistic reflects the relationship between unit *i*'s tax rate and the lagged tax rates of its neighbors. This is a device that enables us to avoid a serious endogeneity problem, caused by the simultaneity of neighboring units' tax rate setting behaviors. Reasonably speaking, we assume that the lagged tax rates of neighbors are exogenous to unit *i*'s current tax rate.

It is worth noting that the statistical test for the significance of local Moran's *I* should be implemented with great caution. As shown by Anselin and many others, when the sample size is relatively small, the asymmetric distribution of I_i deviates away from normal, suggesting that a distribution-based test is largely unreliable. In this paper, we follow the suggestion of Anselin (1995) to take a conditional randomization or permutation approach (as described on page 96, Anselin 1995) to calculate pseudo significance levels.

Another important concern for estimating the tax rate correlation is about how to define competitors. In this paper, we consider the geographic proximity as the primary standard in the definition of competitors. The study units of this paper are rural counties in China, which are the smallest administrative unit to have local autonomy of fiscal policies. Its size also makes it vulnerable to the influence of its geographic neighbors. In addition, there are several theoretical arguments to explain that geographical proximity matters for capital tax competition. If a business were planning to set up in a certain jurisdiction in order to minimize transportation cost to its consumers, only jurisdictions within a small distance could be viewed as good substitutes for such a business. From the information cost point of view, small-sized governments are better informed of the tax policies imposed by their neighbors than by others located at a distance. An extreme case of information-induced tax competition is the yardstick competition, illustrated by Besley and Case (1995), which reveals that local units, even without the constraint of capital mobility, tend to mimic their neighbors' tax policies because officials are disciplined by voters who use neighboring units as benchmarks to judge local achievement.

In the spatial econometrics literature, there is no consensus about how to define geographic neighbors. Several choices, as reviewed by Brett and Pinkse (2000), include the common boundary neighbors, great-circle neighbors and nearest-distance neighbors. Since our results are generally robust to any of these measures, the rest of this paper will focus on the 'four-nearest' neighbor concept under which unit j is a neighbor of i if it is one of the four closest units to i. Applying this concept, we can test a spatial tax competition hypothesis that a county unit i's tax rate is positively affected by the tax rate of its geographic neighbors. This conclusion is particularly consistent with the perfect competition model.

3. The Existence and Pattern of Tax Competition Behaviors

3.1 Data

To provide a broad view of intergovernmental competition behaviors among grassroots administration units, we construct a panel dataset, consisting of 2094 rural counties in the period from 1993 to 2005. Our sample covers all the rural counties and county level municipalities as of 1993 except a small portion with missing tax or income information. Technically, we have employed two procedures to ensure the temporal and spatial consistency of the dataset. First, considering that in almost every year some county units have experienced boundary changes either by merging or splitting, the data after 1993 have been aggregated to match the county definition as of 1993 so that the analytical outcome will be comparable intertemporally. Second, in order to combine the economic and geographic data, we create a geocoding system which links the records of various years to the county-level base map at the end of 1993, which is derived from a 1990 China county-level administration map (provided by CITAS) by utilizing publications on administrative coverage changes posted on the website of the Ministry of Civil Affairs.

As a measure of tax burdens on capital investment, we follow the method used in Knight (2002) to calculate the effective tax rate by first adding up all the taxes imposed on firms or business, and then dividing by the non-agriculture GDP, a proxy for the tax base.[4] The numerator includes two types of locally-sourced taxes: VAT and business taxes. For these two tax revenues, which are shared between the local and the central governments, only the proportion of the actual collection that eventually belong to local control—usually 25 percent— are included in our calculation. Since in rural areas these taxes are mostly borne by non-agricultural production or services, we partition the GDP between agriculture and non-agriculture in proportion to the magnitudes of the county-specific gross value of industrial output (GVIO) and gross value of agriculture output (GVAO), and use non-agriculture GDP to approximate the tax base of capital stock.

In theory, the effective tax rate should be identical across jurisdictions since the associated tax tables have been uniquely determined by the central government. In reality, even in the context of a unified tax system, spatial variations in effective tax rates still exist because of difference in local discretional efforts in collecting taxes. Such discretional activities have been widely observed in China by many case studies (Bahl

[4] The computation of GDP in the period of 1993-1996 is based on a linear approximation method, which is explained in Yao (2006).

2000), indicating that intergovernmental tax competition is a practical issue deserving serious concern. As presented in figure 1, the county-level tax rates for capital vary remarkably across the nation. The Gini coefficient rose to 0.73 in 1994 and slowly decreased to 0.57 from 1996 to 2002. In the period between 2001 and 2005, this coefficient stabilized at an even lower level around 0.36. In a similar pattern, the nationwide average effective tax rate has continued decreasing at an annual rate of 9.08% since 1994. The fact that both the mean and variation of the tax rate for capital decreased in the rural area seems to suggest a converging trend toward the bottom. Even so, the trend at the global is still likely to disagree with some local trends, in light of the sizable variation in county level tax rates.

3.2 Identification of Local Spatial Tax Competition

To lessen the impact of autocorrelation at the temporal dimension, we take six discontinued years to examine spatial tax competition: 1994, 1996, 1998, 2000, 2002 and 2004. Counties are assumed to take into account their neighbors' tax rates in the previous year and neglect the potential impact that their own choices may impose on their neighbors' future choices. Using Geoda, the spatial analysis software developed by Luc Anselin, we calculate local Moran's I, defined by equation (7), and its *p*-value for each county unit year by year. The estimates not only indicate which unit's tax choice is significantly related to its spatial neighbors', but also enable us to further classify the units with significant correlated tax choices into four tax strategy groups: high-high (the description before the hyphen refers to unit *i* and the one after the hyphen refers to its neighbors), low-low, low-high and high-low tax rate clusters. Among them, the clusters of low tax rates identify the counties in a race to the bottom; the clusters of high tax rates are the counties in a race to the top; and the clusters of dissimilar values are spatial outliers, contradicting the spatial tax competition hypothesis.

In Figure 2, we compare the national distribution of tax competition strategy choices in the beginning and end years of the study period, 1994 and 2004. In both years, the majority of the sample counties, 70.2 and 63.8 percent for 1994 and 2004 respectively, did not yield significant tax rate correlation, implying that local tax rate decision is not responsive to the decision of spatial neighbors. On the other hand, out of the 1994 sample, there were 25.0 percent with a significant spatial clustering of low tax rates, 2.4 percent with a significant clustering of high tax rates and 2.4 percent with a clustering of dissimilar tax rates. Comparison between the two years reveals an interesting trend toward more counties in a ‘race to the top’ and fewer counties in a ‘race to the bottom’, as the percentage of H-H units increased to 9.7, and the percentage of L-L units decreased to 23.3 in 2004.

What causes the sharp difference in counties tax competition behaviors? In this paper, we investigate three factors: regional or provincial location, time, and relationship between competitors’ endowments.

3.3 Spatial and Temporal Changes

Table 1 reports how counties with different tax competition strategies were distributed in coastal and inland areas. It is observed, for instance, that in 1994, 301 of 524 clusters of low tax rates were located in the eastern coastal areas and accounted for 46.1 percent of coastal counties, while 49 of 51 clusters of high tax rates in the western inland areas. Generally speaking, table 1 suggests that the regional location—for example whether the county is located in a certain province or a region—can affect its tax competition strategy. We examine the provincial and regional effect by applying the Chi-square test for a pair of categorical variables, which hypothesizes that one categorical variable, the tax strategy choice, is independent of the other categorical variable, provincial or regional location. The results, as reported in the first two columns of Table 2, suggest that the hypothesis of no provincial and regional effect is not significantly supported by our data. The conclusion is robust across various years.

When it comes to the temporal effect, we conduct a number of pair wise chi-square tests for the differences in the distributions of tax competition strategy choices between the two different years. The test results all indicate the same significant temporal changes.

3.4 Endowments

Here, the concept of endowment is defined in a general term, which can reflect a combination of economic development levels, capital stocks, natural resource endowment, and labor skills. Although a further breakdown into different classes of endowments may reveal more interesting and reasonable behaviors, the lack of data at the county level only allows us to use per capita income as a proxy for general endowments. It is hypothesized that whether a county unit and its representative competitor have large and closely related income, small and closely related income, or extremely different income will affect their choice among the five tax competition strategies.

Similar to Section 3.2, four groups of significant spatial clusters as well as a group of insignificant ones are identified for county-level economic endowments, measured by real per capita GDP. The spatial clusters of economic endowments are examined in a different set of years, including 1993, 1995, 1997, 2001 and 2003, which are one year ahead of those used in the tax competition analysis. It is worth noting that endowments and tax rates are studied in different periods. The purpose of using per capital GDP (a proxy for endowment) in preceding years is to reduce the causal impact of tax rate on it. For simplicity, endowment clusters will be labeled in accordance with the tax year in the rest of this paper.

It is observed that the clusters of high economic achievements mainly showed up in coastal areas, and clusters of low economic achievements largely concentrated in western and central areas. In 1994, L-L GDP clusters accounted for 23.1 percent of the population, while H-H GDP clusters only 8.3 percent. Moreover, 87.4 percent of H-H clusters were in coastal region, while 85.9 percent of L-L clusters in inland. The percentages did not change much in 2004. However, it is worth noting that the proportion of the population that exhibited a significant and positive spatial correlation in GDP rose continuously in the study period, increasing from 31.4 percent in 1994 to 34.2 percent by 2004. One implication that we can derive from these results is that these counties, either explicitly or implicitly, should have connections to the neighborhood strong enough to trigger economic convergence at the local level.

The majority, however, does not possess such a strong connection to their neighbors. There are 66.5 and 63.7 percent of the population, in 1994 and 2004 respectively, not significantly correlated to their neighbors' economic development. A small portion, on the other hand, was found to exhibit a significant and negative correlation to their spatial neighbors in terms of economic development. Their share in total population was 2.06 percent in 1994 and fell slightly to 2.05 in 2004.

To test the null hypothesis in which spatial tax rate competition is free of influence from endowment clusters, we construct frequency tables for each tax year using the endowment cluster type as the row category variable and the tax rate cluster type as the column category variable, and apply the chi-square test to see if there is a dependent relationship between the two category variables. The last five rows in table 1 present the frequency tables in 1994 and 2004, indicating that the tax competition choices are distributed in substantially different patterns among different endowment clusters. The results of chi-square tests, as shown in column (3) of Table 2, also suggest that the hypothesis of independence should be rejected, therefore supporting the presence of a statistically significant endowment cluster effect.

4. The Choice Model of Tax Competition Strategy

In this section, we adopt a multinomial logistic regression approach to examine the factors that underlie the variation of tax rate competition behaviors. From a game theory perspective, the five types of tax rate clusters that have been identified in section 3.2 reflect five potential equilibriums as to how the county government chooses the optimal tax rate strategy in response to its spatial neighbors' tax choices. Suppose the five types of equilibriums are exhaustive in the game outcome domain. Let π_{ij} denote the probability for unit i to choose the j^{th} strategy so that $\pi_{i0}+\pi_{i1}+\pi_{i2}+\pi_{i3}+\pi_{i4}=1$, where j equals 0, 1,…or 4. The probabilities are estimated by using a logistic density function, which is described as follows

$$\Pr ob(y_i = j) = \pi_{ij} = \frac{\exp(V_{ij})}{\sum_{j=0}^{4}\exp(V_{ij})}, \qquad (8)$$

where y_i is the choice variable for unit i and V_{ij} is a linear combination of variables that explain choice j.

As for the determinant factors in the choice decisions, Sections 3.3 and 3.4 provide strong evidence for the regional, temporal, and endowment effects. Although being straightforward, the tests before this section share a common shortcoming in that they do not allow for more than one explainable variable to be taken into account. The regression approach will include all these variables to explain the choices of tax strategies so that it is able to sort out how each factor affects the unit's choice among the five competition behaviors given that other factors have been controlled for. Therefore, to fit in our data, we use the following specification:

$$V_{ij} = \sum_{k=1}^{4} \beta_j^k E_i^k + \gamma_j R_i + \delta_j T + \varphi_j X_i + \varepsilon_{ij} \qquad (9)$$

where subscripts i and j denote observation and choice category respectively; k denotes the endowment category; β_j, γ_j, δ_j and φ_j represent choice-specific coefficients, and ε_{ij} represents the disturbance term associated with choice j. The explanatory variables include dummy variables for the endowment cluster types, denoted by E^k, a dummy variable for the coastal region, denoted by R, and a vector of dummy variables for various years, T.

In addition, also included in equation (9) is a vector of other economic variables, X, which comprises agriculture share in GDP (*AGSH*) and share of the population that is employed or financially supported by local governments (*GEPOPSH*), measures for industrial structure and government fiscal burden respectively. Table 3 summarizes the means and standard deviations for all the variables to be used in the estimation. In regard to these two new variables, it shows that as an average of the six tax years, the agricultural sector accounted for 40.8 percent of the total GDP in rural counties, and out of every 100 residents, about 3 worked for the governments or depended on local fiscal funding.

We adopt a maximum likelihood method to estimate the tax strategy choice equations and report the results in Table 4. In each determination equation, we report the exponentiated coefficients, which have an informative interpretation of relative risk ratios (RRR)[5] — the ratio of the relative risk for a one-unit increase in the explanatory variable *x* to the relative risk when *x* is unchanged. The RRRs are relative to the base category, here corresponding to the no-response-to-neighbors strategy, which is indicated by insignificant tax rate correlations. In such a setting, we focus on how the unit-specific factors affect their preference for an active tax rate reaction strategy in comparison with the passive no-response strategy. It can be exactly captured by RRR. For instance, if an explanatory variable came with a RRR greater than one, then a marginal increase in this variable would make the associated choice more preferable than the base category choice.

Table 4 includes two models with or without *AGSH* and *GEPOPSH*. Compared with Model (1), which excludes the two variables, Model (2) significantly improves the estimation efficiency by reducing the AIC statistic from 18,559 to 16,270 and increasing the log likelihood ratio from -9,235 to -8,083. This suggests that including these economic variables gives a better fit to our data. Even so, there are no extreme changes in the estimated effects for endowments, coastal location and time between these two models. Most variables that are significant in model (1) still have a significant effect in model (2), while a few dummies for years become significant in model (2) though not in

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[5] Gould (2000) provides a definition for RRR used in the STATA environment. It is expressed as

$$RRR = \frac{P(y=1/x+1)/P(y=base\ category/x+1)}{P(y=1/x)/P(y=base\ category/x)}.$$

model (1). In terms of magnitude, no change as the result of adding the new variables is large enough to convert the implication for influence directions, as it is observed that no RRR estimate above one falls below one or vice versa. For instance, in the H-H tax rate strategy equation, the RRR of the L-L GDP cluster declines from 2.71 in model (1) to 1.63 in model (2). In spite of the magnitude difference, both of them being greater than one suggest that a switch into the L-L GDP cluster generally causes a county to prefer more to the H-H tax rate strategy than the no-response strategy. Because of the above reasons, we focus on model (2) to discuss the implications of tax competition behaviors.

As indicated by the first column in model (2), several variables, H-H, L-L and H-L GDP clusters, *AGSH* and *GEPOPSH*, significantly increase the relative risk (preference) for the choice of the H-H tax strategy over the base choice. Among them, the estimates for *AGSH* and *GEPOPSH* both take remarkably large values, implying that the change in the relative preference is extremely sensitive to even a marginal change in one of these variables. The only variable significantly depressing the preference for the H-H tax strategy over the no-response strategy is coastal dummy, with an estimated RRR of 0.31.

It is more enlightening to compare the first two columns in model (2). On the one hand, all the variables that increase the relative preference for the H-H tax strategy significantly lower the relative preference to the L-L tax strategy except for the H-H GDP cluster. On the other hand, the variables that significantly raise the relative preference for the L-L tax strategy also include those that lower the relative preference for the H-H tax strategy. Examples are the L-L GDP cluster and coastal region dummy, respectively. Simply put, the first group of variables particularly supports the H-H tax rate competition but does not support L-L tax rate competition; the second group behaves in a converse manner. A noteworthy variable is the H-H GDP cluster, whose RRR estimate is greater than 1 in both H-H and L-L tax strategy functions, suggesting that both tax strategies are preferable over no-response for the counties in this endowment cluster. But which of the two strategies would be more preferable for the H-H GDP cluster?

To make this point clear, we rerun the multinomial logsitic regression using the H-H tax competition strategy as the basic choice. Table 5 reports the results for three different periods: 1994-2004, 1994-2002, and 2004[6], from which we find a striking difference in behaviors of H-H GDP clusters in the two sub-periods. Unlike in the period between 1994 and 2002, when they preferred L-L tax strategy to H-H tax strategy (as indicated by a RRR estimate of 4.41), the H-H GDP clusters changed to like H-H tax strategy more than L-L tax strategy in 2004 (RRR estimate drops to 0.13).

According to table 5, the H-H GDP cluster was a stark contrast to the L-L GDP cluster during 1994-2002: the H-H GDP cluster belongs to the group supporting the L-L competition behaviors, while the L-L GDP cluster belongs to the other. This implies that the racing-to-the-bottom tax behaviors largely apply to homogeneous competitors with relatively large endowments, rather than all the homogeneous competitors. More importantly, this also implies that the existence of homogeneous competitors with small endowments seems to constitute one of the driving forces behind the emergence of races to the top, indicating that they might have a penchant for high tax rates over capital inflows.

[6] Splitting the population into two sub-periods has two reasons. Firstly, in the equation of H-H tax strategy, the estimate for the year dummy of 2004 takes extremely large value but the estimates for other years don't. Secondly, a chi-square test for the hypothesis of identical coefficients in the two periods strongly supports rejection of the hypothesis.

In 2004, however, the H-H GDP cluster fell into the same tax strategy preference as the L-L GDP cluster did. The reason why spatial neighbors with rich endowments would take the risk of losing relatively huge size of tax base by switching to prefer a race to the top, and the reason why the change took place in 2004 are still uncertain. Due to lack relevant data, we are unable to provide rigorous interpretation for this phenomenon. It is likely "the race to the top" in rich areas to be a short-term response to the implementation of a new fiscal reform "export VAT rebate sharing scheme", which was announced in the early of 2003 and effective since January 1, 2004. As the most important feature of the new scheme, the local government, who used to pay nothing for export VAT rebate, is requested to shoulder a responsibility of 25 percent of the increment above the export VAT rebate in 2003. Considering the fact that most rich rural counties in China are located in coastal area and highly dependent on export-oriented industries, this export rebate reform, therefore, would have affected them much more greatly than the poor ones. From strategic economics' point of view, the policy may distort the rich counties' tax behaviors in two ways. Firstly, as expecting 2003's export VAT would serve as a deductible basis for locally financed rebate in all the years to follow, local governments would intentionally raise effort to enlarge the size of VAT in local export industries. Secondly, the newly-added financial burden of export rebates would constrain local governments with relatively large export industry from engaging in tax reduction competition. As a consequence, rich clusters are likely to raise VAT both in 2003 and 2004, leading to a seemingly changed taste for H-H tax rate competition.

Also shown in tables 4 and 5, both *AGSH* and *GEPOPSH* are in the club of factors that induce the H-H-competition behaviors. Figures 3 (a) and (b) depict how the increase in *AGSH* affects the probability of choosing the H-H and L-L tax competition for the H-H and L-L GDP clusters in the period of 1994-2002. In general, no matter whether a county belongs to H-H GDP clusters or L-L GDP clusters, a rise in the agriculture share of GDP increases its probability of choosing the H-H tax competition, but decreases its probability of choosing the L-L tax competition. In a striking threshold pattern, both the H-H competition probability curves, though remaining flat at zero until the agriculture share in GDP reaches 60 percent, begin to rise steeply afterward. This suggests that counties that have reached certain industrialization degree tend to care more about capital flow and dislike the option of the H-H tax competition, even when they are in a cluster of poor endowments. Also observed in figure 3, the curve for L-L GDP clusters takes a steeper slope than that for H-H GDP clusters in (a), but a less steep slope in (b). This indicates a substantial difference in economic structure effect on different GDP clusters. The impact of *GEPOPSH* on the probability of choosing H-H and L-L tax competition behaviors, as shown in Figure 4, is similar to that of *AGSH* except that the probability curves for L-L tax competition behaviors (See figure 4 (b)) exhibit a threshold pattern in which a government employee share greater than 0.09 would prevent both clusters from taking part in L-L tax competition.

Last but not the least , it is surprising to find, in the last two columns in model (2), that the homogeneous GDP clusters can also increase the relative risks of choosing substantially dissimilar tax rates. What drives the similarly situated competitors to adopt diverging tax decisions is a question that we are unable to empirically sort out with the current data set in which the observations for heterogeneous tax rate strategies are too few.

5. Conclusion

In order to provide explanations for the spatial patterns of localized tax rate correlations, this paper has developed an empirical approach combining a state-of-the-art geographic statistical method, LISA, and a sequence of rigorous statistical tests. The approach emphasizes the possibility of heterogeneous local behaviors by allowing for an estimation of spatial tax rate correlations at every individual location. As most studies in the empirical literature of tax competition, we take into account the nearest neighborhood effect of local tax rate determination. Applying LISA to our data, we find strong evidence for spatial clustering of tax rates in some regions, but weak or no tax competition in others. In particular, the relationships between neighboring tax rates are found to vary across five distinct groups. These results conform to our intuition that tax competition behaviors are not globally uniform.

In the second step of the empirical study, we examine the determinants of location specific competition behaviors. The regional effect is statistically significant, either in a univariate or multivariate model. The other factor, probably of greater importance, is the relationship of endowments between competitors. As suggested by theories, the different endowment levels can trigger strategic tax rate settings rather than a unique equilibrium. According to our results, the tax competition behaviors not only differ between symmetrically endowed units and asymmetrically endowed units, but also differ between symmetric units at different endowment levels. In a rather long period of 1994-2002, the clustered rich units were in a competition to reduce tax rates, while the clustered poor units in a competition to raise tax rates.

Although few theoretical studies to date have recognized, let alone interpreted, the 'race to the top' behaviors among poor counties, these behaviors can be reasonably explained by several simple intuitions. First of all, in China, poor counties are faced with much tighter budget constraints than rich counties, so the pressure to self-finance the basic spending needs probably has prevented them from taking active actions on tax reduction. Instead of creating enabling investment environments, the poor counties may be involved in predatory tax practices against the industrial and business sectors. To a large extent, the fixed cost to run a local government is rather similar across regions. Under fiscal decentralization, the burden to finance the fixed cost compared to local revenue bases in the poor reasons is heavier than that in the rich regions. As shown in Zhang (2006), the rigid governance structure coupled with fiscal decentralization forces force some local governments in the lagging regions to impose higher average tax rates on capital investment.

Second, it is inevitable that regions comprised of poor counties in clusters are likely to encounter low average income, poorly-maintained public facilities, and weak consumption demand. The adverse investment environment in the neighborhood can exert a negative externality on the business development for the counties inside the region, thereby discouraging these counties from being involved in capital competition. Last but not least, because the intergovernmental transfer policies in general favor poor regions (Yao 2006), poor counties may devote more of their energies in securing central transfers instead of engaging in competition for direct investment, which usually exposes them to the risk of failing to complete the mandatory fiscal tasks and of losing the trust of their supervisors—the governments at upper levels—and only brings marginal and uncertain increases in future tax revenues.

The divergent behaviors between rich and poor counties might have important implications for development policies. The higher tax rate in the poor counties will prevent them from attracting more capital investment, which in turn will further widen the gap with the rich counties in the coast. At this point, our finding supports the theoretical predictions in Cai and Treisman (2005). In addition to endowment effect, we also find that government fiscal burden also matters to the tax competition behavior. Therefore the central and provincial governments that attempt to unleash competitive incentives within the poor regions should also consider reforming the governance structure and subsidizing the fixed cost of running a government in the poor areas.

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Table 1 Distribution of tax competition strategies in the nation, regions and endowment clustering groups

	observation		H-H		L-L		L-H		H-L		No response	
	1994	2004	1994	2004	1994	2004	1994	2004	1994	2004	1994	2004
Nation	2094	2094	51	202	524	487	29	55	21	15	1469	1335
Coastal	647	647	2	30	301	233	1	11	10	5	333	368
Inland	1447	1447	49	172	223	254	28	44	11	10	1136	967
E1 (H-H)	175	215	0	27	106	59	0	5	1	1	68	123
E2 (L-L)	484	502	29	71	9	47	7	14	1	3	438	367
E3 (L-H)	33	22	0	2	11	1	0	0	0	1	22	18
E4 (H-L)	10	21	1	2	1	3	0	7	0	0	8	9
E0 (No GDP correlation)	1392	1334	21	100	397	377	22	29	19	10	933	818

Note: numbers indicate frequency.

Table 2 The chi-square test of independence for tax competition choices and spatial location variables

Year	(1) Provinces			(2) Regions			(3) Endowment Clusters		
	D.F.	χ2	P value	D.F.	χ2	P value	D.F.	χ2	P value
1994	120	2500	0.000	4	249.8927	0.000	16	292.77	0.000
1996	120	2700	0.000	4	257.4119	0.000	16	382.40	0.000
1998	120	2400	0.000	4	173.1465	0.000	16	539.90	0.000
2000	120	2000	0.000	4	121.6528	0.000	16	332.44	0.000
2002	120	1900	0.000	4	45.2078	0.000	16	154.19	0.000
2004	120	1600	0.000	4	99.9056	0.000	16	174.74	0.000

Table 3 Summaries for tax strategy choices and the explanatory variables

	Description	Mean	Std. Dev.
Dependent Variables			
Y=H-H	Dummy for the H-H tax cluster	0.052	0.222
Y=L-L	Dummy for the L-L tax cluster	0.245	0.430
Y=L-H	Dummy for the L-H tax cluster	0.016	0.125
Y=H-L	Dummy for the H-L tax cluster	0.008	0.091
Y=insignificant correlation	No tax rate correlation	0.679	0.467
Explanatory Variables			
E1 (H-H)	Dummy for the H-H endowment cluster	0.106	0.308
E2 (L-L)	Dummy for the L-L endowment cluster	0.236	0.424
E3 (L-H)	Dummy for the H-L endowment cluster	0.010	0.100
E4 (H-L)	Dummy for the L-H endowment cluster	0.009	0.092
E0 (insignificant correlation)	No endowment clustering	0.639	0.480
Coastal	Dummy for the coastal region	0.309	0.462
year=1994 (or any other)	Dummy for a specific tax year	0.167	0.373
AGSH	Agricultural share in GDP	0.408	0.225
GEPOPSH	Share of the population that are employed or financially supported by local governments	0.033	0.023

Table 4 Multinomial logistic estimates for the tax strategy choice

	(1)				(2)			
	Y=H-H	Y=L-L	Y=L-H	Y=H-L	Y=H-H	Y=L-L	Y=L-H	Y=H-L
E1 (H-H)	3.40	1.83	2.56	3.79	7.67	1.23	3.22	4.82
	(0.000**)	(0.000**)	(0.005**)	(0.000**)	(0.000**)	(0.005**)	(0.001**)	(0.000**)
E2 (L-L)	2.71	0.11	2.50	0.27	1.63	0.15	2.40	0.23
	(0.000**)	(0.000**)	(0.000**)	(0.006**)	(0.000**)	(0.000**)	(0.000**)	(0.002**)
E3 (L-H)	1.02	0.75	0.00	2.95	0.67	0.67	0.00	2.96
	(0.98)	(0.14)	(0.000**)	(0.14)	(0.58)	(0.07)	(1.00)	(0.14)
E4 (H-L)	1.98	0.20	8.22	0.00	4.12	0.14	10.58	0.00
	(0.10)	(0.000**)	(0.000**)	(0.000**)	(0.004**)	(0.000**)	(0.000**)	(1.00)
Coastal	0.18	1.85	0.46	1.37	0.31	1.46	0.66	1.30
	(0.000**)	(0.000**)	(0.003**)	(0.23)	(0.000**)	(0.000**)	(0.13)	(0.37)
AGSH					1761.09	0.08	4.71	5.84
					(0.000**)	(0.000**)	(0.000**)	(0.032*)
GEPOPSH					1.2E+11	0.00	1.9E+11	0.00
					(0.000**)	(0.000**)	(0.000**)	(0.41)
Observation	12564				12564			
AIC*n	18559.945				16270.685			
Log Likelihood Ratio	-9235.972				-8083.343			

Notes: (1) year dummies omitted.
(2) p values in parentheses, * significant at 5%; ** significant at 1%

Table 5 Tests for factors that support choosing the L-L over H-H tax strategies

	1994-2004		1994-2002		2004	
Variable	RRR(L-L vs. H-H)	P-value	RRR(L-L vs. H-H)	P-value	RRR(L-L vs. H-H)	P-value
E1 (H-H)	0.159	0.000	**4.412**	0.230	0.129	0.000
E2 (L-L)	0.089	0.000	0.051	0.000	0.284	0.000
E3 (L-H)	1.001	0.999	1.024	0.991	0.137	0.117
E4 (H-L)	0.034	0.000	0.015	0.000	0.320	0.229
Coastal	4.707	0.000	3.0E+09	0.000	5.112	0.000
AGSH	0.000	0.000	0.000	0.000	0.054	0.000
GEPOPSH	0.000	0.000	0.000	0.000	0.000	0.000

Figure 1 Dynamic patterns of county-level tax rates: GINI and mean in the Nation

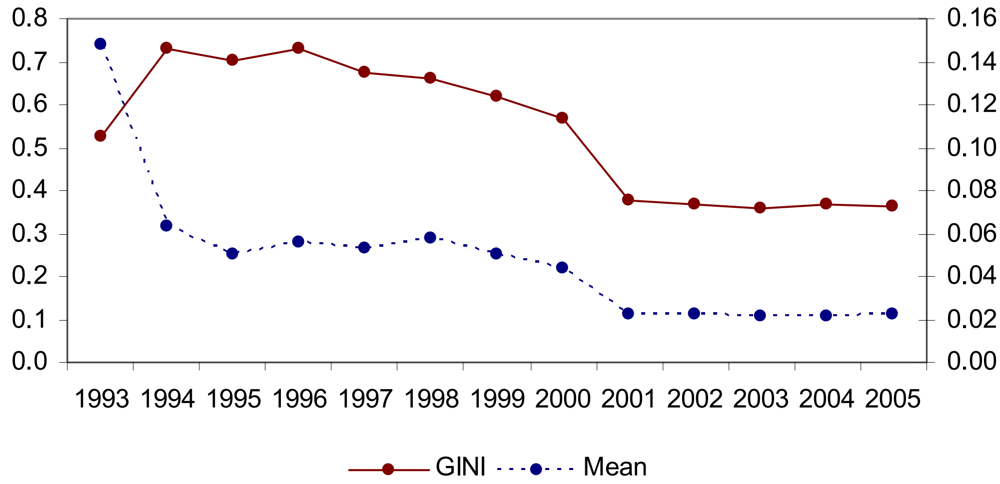
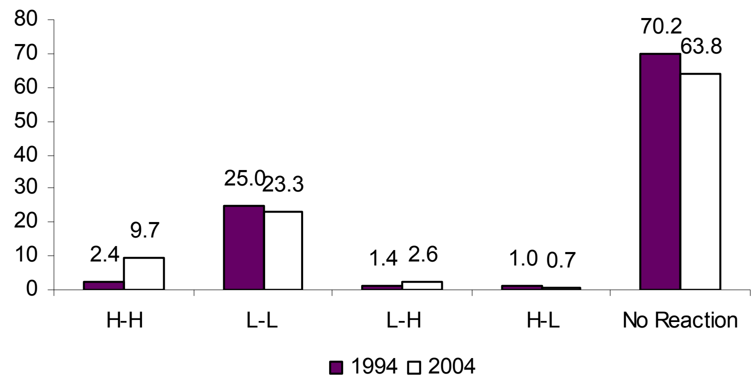


Figure 2 Tax strategy distribution among 2094 rural counties in China

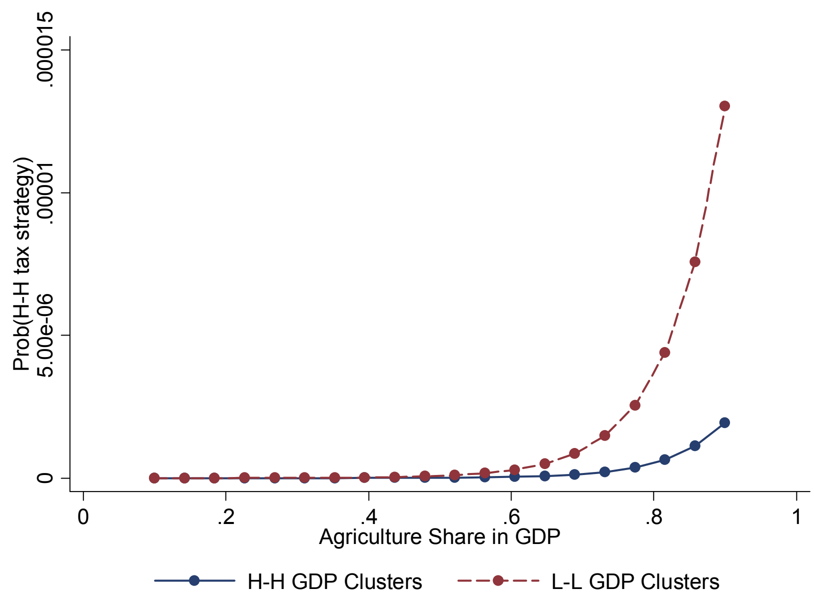


Note: relative frequency labeled above the bar and expressed in percentages.

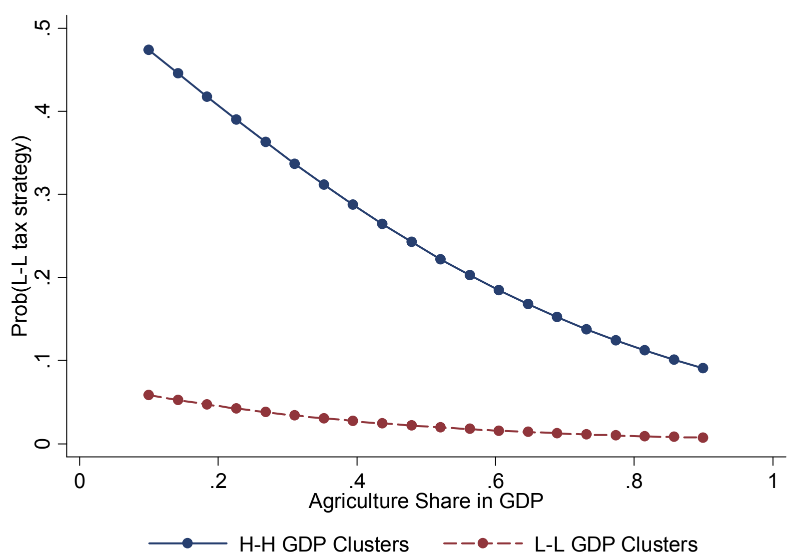
Figure 3 The impact of agriculture share in GDP on tax competition behaviors

(a) The impact on choosing H-H tax strategy

(b) The impact on choosing L-L tax strategy



(a)



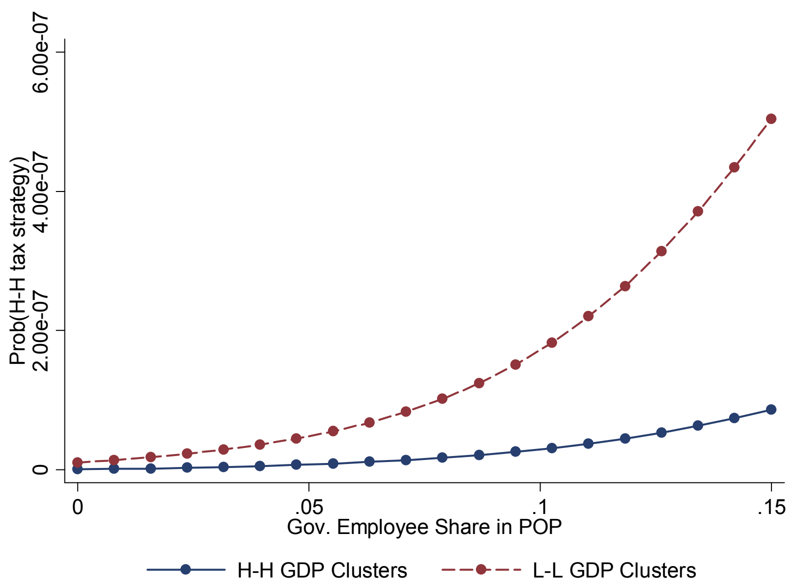
(b)

Note: All the other explanatory variables at means.

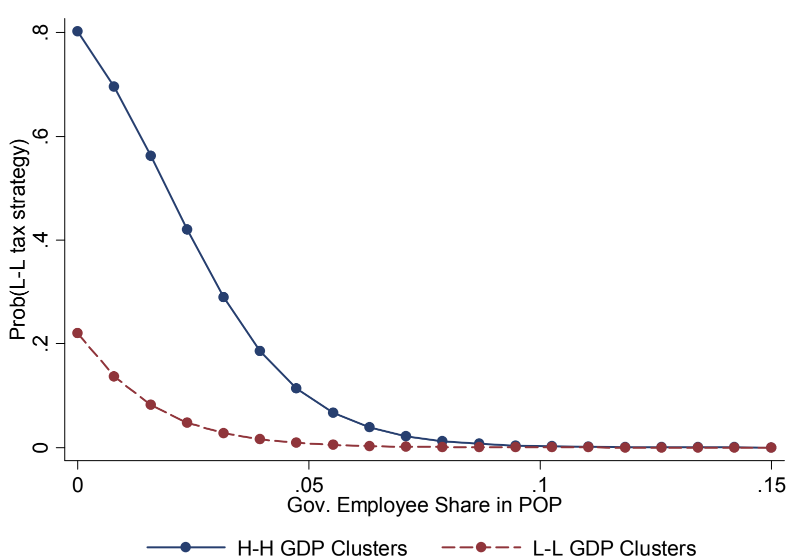
Figure 4 The impact of government employment size on tax competition behaviors

(a) The impact on choosing the H-H tax rate competition

(b) The impact on choosing the L-L tax rate competition



(a)



(b)

Note: All the other explanatory variables at means.