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Effective Tax Rates, Spatial Spillover, and Economic Growth in China: An Empirical Study Based on the Spatial Durbin Model

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Fiscal decentralization and political centralization in China have led to the strategic interaction of tax policies across provinces. By estimating the spatial Durbin model for panel data on 31 Chinese provinces from 2007-2013, we investigate the robust relationship between effective tax rates and economic growth in China from a spatial econometric perspective. We find that labor income tax rates are significantly negatively related to growth within a province, and insignificantly related to growth in neighboring provinces because the vote with one's feet mechanism is inapplicable in China. A decrease in capital income tax rates significantly enhances growth. Capital income tax competition characterized as race to the bottom induces neighboring provinces to also cut capital income tax rates to promote local economic growth. Consumption taxes are non-distorting.

Key Words: Effective tax rates; Economic growth; Spillover effects; Tax competition; Spatial Durbin model.
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1. INTRODUCTION

China's 1994 tax-sharing reforms constitute a critical component of the country's economic reform and have played a significant role in its remarkable growth (Jin et al., 2005). With China's economy entering a "new normal" phase, shifting gear from the high speed to medium-to-high speed growth, there have been widespread calls for the tax regime to evolve accordingly to ensure that it promotes rather than impedes the next stage of economic development. In the ongoing tax reform discussions, one key view holds that the current distortionary taxation needs to be corrected and that reform of the tax structure should be the priority because different types of taxes affect economic growth in different ways.

The design of a tax structure that simultaneously promotes economic growth and maintains fiscal stability is particularly appealing (Huang and Xie, 2008). It is thus surprising that only a small number of empirical studies have compared the growth effects of different types of taxes, and they have reached different conclusions. For example, Lee and Gordon (2005) find that corporate tax rates are more distortionary than personal tax rates. Angelopoulos et al. (2007), in contrast, show labor income and corporate income tax rates to be negatively and positively related to growth, respectively. Arnold (2011) suggests a growth-friendliness ranking for taxes, with property taxes at the top, followed by consumption taxes, personal income taxes, and corporate income taxes. Xing (2012), however, challenges that ranking, finding no robust ranking using slightly different specifications and performing robustness tests.

The existing literature on the growth effects of different types of taxes uses traditional macro-econometric models, thereby neglecting the spillover effects of taxes. However, fiscal policy in one jurisdiction may have beneficial or detrimental effects on nearby jurisdictions (Case et al., 1993). Hence, the estimates of the growth effects of the fiscal variables considered in these studies may suffer from systematic biases arising from ignorance of the spillover effects. To address this issue, this paper reconsiders the relationship between tax rates and economic growth in China from a spatial econometric perspective.

A key reason to pay attention to spatial correlation in examining fiscal policy and economic growth is that the tax rate chosen by one jurisdiction affects the budget constraints of another. Wildasin (1988) reports that capital is perfectly mobile across jurisdictions: when the tax rate in a given jurisdiction is raised, the net return on capital in that jurisdiction falls, prompting capital to relocate to another jurisdiction. Local governors who want to maximize the welfare function have strong incentives to compete with each other to attract mobile capital, which leads to strategic interactions in local tax setting (commonly known as tax competition). It should be noted that the mobility of labor is also deserving of attention. Tax competition is associated with the taxation of mobile factors. In China, the setting of tax tables is solely controlled by the central government, with statutory tax rates generally the same across provinces. Nevertheless, the tax-sharing system grants provincial governments authority over local fiscal administration by reassigning tax revenues between the central and provincial governments and splitting tax bureaus into national and local tax offices. The system allows local governors to collect tax revenues in their provinces in a relatively unrestricted manner by, for example, formulating preferential tax policies. As a result, China's effective tax rates vary considerably from province to province. It is thus clear that in the context of the China's fiscal decentralization, there is considerable room for local governments to engage in tax competition.

The strategic horizontal interaction among jurisdictions may also result from political yardstick competition, a concept proposed by Salmon (1987) and further developed by Besley and Case (1995). In the presence of asymmetric information between voters and governors, the voters in a given jurisdiction who do not know the cost of providing local public services and are unaware of the need to raise local taxes will use information on the tax burden in similarly situated jurisdictions as a benchmark to evaluate the performance of their incumbent governor. Therefore, governors who want to increase their chances of reelection are concerned with their relative performance on taxation, and tend to mimic the tax setting behavior of neighboring governors. In the case of China, the governance structure is centralized, with strong top-down mandates. Local governors are appointed by the central government in Beijing. Hence, the system of electoral representation underpinning political yardstick competition does not exist at the provincial level in China, and applying political yardstick competition to China is thus controversial. Some scholars believe that it is not particularly informative in the Chinese context. Following Caldeira (2012), however, we argue that political centralization in China can induce interprovincial competition. Due to information asymmetry, the central government rewards or punishes local governors based on their province's relative economic performance. Local governors have incentives to compete with one another to protect the local tax base and attract business investment to promote economic growth. It seems reasonably clear that the central government spurs tax interactions among local governors in the way that voters do in democratic countries. More precisely, the yardstick competition in China is not from the bottom but from the top, as the principal party is the central government, not local voters.

In this study, we apply the spatial Durbin model (SDM) to panel data on 31 Chinese provinces from 2007 to 2013 to compare the effects of different types of tax on economic growth. To the best of our knowledge, the study constitutes the first attempt to test the growth effects of tax rates with the spillover effects of fiscal policy in China taken into account. To elucidate the effects of cross-province tax interactions in China's spatial economy, the best strategy appears to be the inclusion of a spatially lagged dependent variable, spatially lagged independent variables, and a spatially autoregressive error term simultaneously. Manski (1993) suggests that at least one interaction effect be excluded, as otherwise the parameters will be unidentified. Hence, we exclude the spatially autoregressive error term from the spatial econometric model because, as LeSage and Pace (2009) note, the coefficient estimates of an SDM are unbiased even if the true data generation process is a combined spatial lag-spatial error model. In addition, we also test the robustness of the SDM results to various changes in specification.

Our dataset includes data on capital income, labor income, and consumption tax rates because different types of taxes may affect economic growth differently. As noted, statutory tax rates are identical across provinces in China, whereas effective tax rates vary widely. The latter are thus believed to be a better proxy for the real tax burden. Following Mendoza et al. (1994), we define the effective tax rate as the ratio between the revenues from particular types of taxes and the corresponding tax base. Most of the empirical literature in this area focuses on the effective tax rates in developed countries, with assessments in China still in their infancy. Due to data limitations, there are differences between China and developed countries in distinguishing capital income, labor income, and consumption taxes. Hence, this study makes an important contribution to the literature on effective tax rates.

The remainder of this paper is organized as follows. Section 2 presents the theoretical frameworks for deriving the econometric specification. Section 3 develops the empirical model and describes the construction of the variables. Section 4 discusses the empirical results and reports the results of robustness checks. Concluding remarks and policy implications are given in Section 5.

2. THEORETICAL FRAMEWORKS

In this section, we introduce the theoretical frameworks that form the basis of our subsequent empirical analysis: an endogenous growth model and spatial econometric models.

2.1. Endogenous Growth Model

The theoretical model of fiscal policy and economic growth that we present here is a variant of Barro's (1990) well-known model. We classify total public expenditure into two types: productive public expenditure and non-productive public expenditure. Productive public expenditure can be entered into the private production function as productive input, whereas non-productive public expenditure can be entered into the household utility function. The public expenditure is financed by raising labor income, capital income, and consumption tax rates.

2.1.1. Households

We assume that the economy is populated by a large number of infinitely lived, identical households. The representative household maximizes overall utility:

$$U = \int_0^{\infty} u(c_t, l_t, h_t) e^{-\rho t} dt, \tag{1}$$

where $\rho > 0$ is the discount rate, and $u(c_t, l_t, h_t)$ is the instantaneous utility at time t. $u(c_t, l_t, h_t)$ is derived from private consumption c_t, leisure l_t, and non-productive public expenditure h_t, as given by

$$u(c_t, l_t, h_t) = \left[(c_t l_t^{\nu} h_t^{\delta})^{1-\theta} - 1\right] / (1-\theta), \quad \theta > 0, \tag{2}$$

where ν and δ are the weights given to leisure and non-productive public expenditure, respectively, relative to private consumption, and θ is the reciprocal of the elasticity of intertemporal substitution.

We define the return to capital as r_t at time t. A household rents its predetermined capital k_t to a firm, and then receives interest $r_t k_t$ and profits π_t. Further, the wage rate is set as w_t, and labor income is thus $w_t(1 - l_t)$. Hence, the household's budget constraint can be written as

$$k_{t+1} = (1 - \tau_{k,t})(r_t k_t + \pi_t) + (1 - \tau_{w,t}) w_t (1 - l_t) - (1 + \tau_{c,t}) c_t, \tag{3}$$

where $\tau_{k,t}$, $\tau_{w,t}$, and $\tau_{c,t}$ are the capital income tax rates, labor income tax rates, and consumption tax rates, respectively. For simplicity, we assume full capital depreciation. The initial capital stock k_0 is given.

When prices, tax rates, and non-productive public expenditure are given, the household acts competitively by allocating time between work and leisure and allocating income between savings and consumption. The Hamilton function is

$$H = \frac{(c_t l_t^{\nu} h_t^{\sigma})^{1-\theta} - 1}{1-\theta} + \lambda[(1-\tau_{k,t})(r_t k_t + \pi_t) + (1-\tau_{w,t}) w_t (1-l_t) + (1+\tau_{c,t}) c_t], \tag{4}$$

where λ is the Hamiltonian multiplier. The first-order optimization conditions with respect to work and consumption are

$$\frac{\partial H}{\partial l} = (c_t l_t^\nu h_t^\sigma)^{-\theta} c_t \nu l_t^{\nu-1} h_t^\sigma - \lambda(1-\tau_{w,t})w = 0 \quad \text{and} \tag{5a}$$

$$\frac{\partial H}{\partial c} = (c_t l_t^\nu h_t^\sigma)^{-\theta} l_t^\nu h_t^\sigma - \lambda(1+\tau_{c,t}) = 0. \tag{5b}$$

The motion equation of λ is

$$\dot{\lambda} = \beta\lambda - \frac{\partial H}{\partial k} = \rho\lambda - \lambda r(1-\tau_k). \tag{6}$$

2.1.2. *Firms*

The representative firm maximizes profits π_t:

$$\pi_t = Y_t - r_t K_t - w_t L_t, \tag{7}$$

where Y_t is output at time t, K_t and L_t are respectively capital and labor input at time t. The production function takes the Cobb-Douglas form[1]:

$$Y_t = AK_t^\alpha L_t^{1-\alpha} g_t^{1-\alpha}, \tag{8}$$

where A is technological efficiency, $\alpha \in (0,1)$ is the capital share in output, and g_t is productive public expenditure at time t. When prices and productive public expenditure are given, the firm acts competitively by choosing capital and labor input. The first-order conditions of the firm's problem require the capital and labor input to satisfy the following.

$$K_t = \frac{\alpha Y_t}{r_t}. \tag{9a}$$

$$L_t = \frac{(1-\alpha)Y_t}{w_t}. \tag{9b}$$

2.1.3. *Government*

The government runs a balanced budget by taxing capital income, labor income, and consumption. Thus, its budget constraint must satisfy

$$h_t + g_t = \tau_{k,t}(r_t k_t + \pi_t) + \tau_{w,t} w_t (1-l_t) + \tau_{c,t} c_t. \tag{10}$$

[1]The firm is modeled as in Barro and Sala-i-Martin (2004) and Angelopoulos et al. (2007).

Without loss of generality, we assume that a share $b \in (0,1)$ of total tax revenues finances productive public expenditure g_t, with the rest $(1-b_t)$ financing non-productive public expenditure h_t. Hence, equation (10) is decomposed into the following.

$$g_t = b_t[\tau_{k,t}(r_t k_t + \pi_t) + \tau_{w,t} w_t (1-l_t) + \tau_{c,t} c_t]. \tag{11a}$$

$$h_t = (1-b_t)[\tau_{k,t}(r_t k_t + \pi_t) + \tau_{w,t} w_t (1-l_t) + \tau_{c,t} c_t]. \tag{11b}$$

2.1.4. Competitive Decentralized Equilibrium

A competitive decentralized equilibrium is defined as a sequence of fiscal policy instruments $\{\tau_{k,t}, \tau_{w,t}, \tau_{c,t}, b_t\}_{t=0}^{\infty}$, allocations $\{c_t, l_t, K_t, L_t\}_{t=0}^{\infty}$, and prices $\{r_t, w_t\}_{t=0}^{\infty}$ such that the following hold true.

(i) Households maximize utility by choosing $\{c, l\}$ with prices, tax rates, and non-productive public expenditure held fixed.

(ii) Firms maximize profits by choosing $\{K, L\}$ with prices and productive public expenditure held fixed.

(iii) Household budget constraint equation (3) is satisfied.

(iv) Government budget constraint equation (10) is satisfied.

(v) Labor market clear, the market-clearing condition is $L = 1 - l$.

(vi) Capital market clear, the market-clearing condition is $K = k$.

Along the balanced growth path, output, consumption, and capital grow at the same rate φ. Combining equation (5b) and equation (6), we have

$$\varphi = \frac{\dot{C}}{C} = \frac{(1-\tau_{k,i})r_t - \rho}{\theta(1+\delta) - \delta}. \tag{12}$$

The profits made by firms is equal to zero, that is, $\pi_t = 0$. By substituting equations (9a) and (9b) into equation (11a), we can write productive public expenditure as

$$g_t = b_t Y_t[\alpha\tau_{k,t} + (1-\alpha)\tau_{w,t} + \frac{c_t}{Y_t}\tau_{c,t}]. \tag{13}$$

Plugging equation (13) into equation (8) then gives us

$$Y_t = A^{\frac{1}{\alpha}} k_t (1-l_t)^{\frac{1-\alpha}{\alpha}} \} b_t[\alpha\tau_{k,t} + (1-\alpha)\tau_{w,t} + \frac{c_t}{Y_t}\tau_{c,t}]\}^{\frac{1-\alpha}{\alpha}}. \tag{14}$$

Hence, the return to capital is now

$$r_t = \alpha A^{\frac{1}{\alpha}}(1-l_t)^{\frac{1-\alpha}{\alpha}}\{b_t[\alpha\tau_{k,t} + (1-\alpha)\tau_{w,t} + \frac{c_t}{Y_t}\tau_{c,t}]\}^{\frac{1-\alpha}{\alpha}}. \quad (15)$$

Further, the steady-state growth rate is now

$$\varphi = \frac{(1-\tau_{k,t})\alpha A^{\frac{1}{\alpha}}(1-l_t)^{\frac{1-\alpha}{\alpha}}\{b_t[\alpha\tau_{k,t} + (1-\alpha)\tau_{w,t} + \frac{c_t}{Y_t}\tau_{c,t}]\}^{\frac{1-\alpha}{\alpha}} - \rho}{\theta(1+\delta)-\delta}. \quad (16)$$

Equations (9a), (9b), and (3) together imply that

$$\frac{c_t}{Y_t} = \frac{1}{1+\tau_{c,t}}\left[1 - \alpha\tau_{k,t} - (1-\alpha)\tau_{w,t} - \frac{\alpha(1-\tau_{k,t})\varphi}{\alpha(1+\delta)\varphi - \delta\varphi + \rho}\right]. \quad (17)$$

Equations (5a), (5b) and (9b) together imply that

$$\frac{l_t}{1-l_t} = \frac{\nu(1-\tau_{c,t})}{(1-\alpha)(1-\tau_{w,t})}\frac{c_t}{Y_t}. \quad (18a)$$

Based on equation (17), equation (18a) can be expressed as

$$\frac{l_t}{1-l_t} = \frac{\nu}{(1-\alpha)(1-\tau_{w,t})}\left[1 - \alpha\tau_{k,t} - (1-\alpha)\tau_{w,t} - \frac{\alpha(1-\tau_{k,t})\varphi}{\alpha(1+\delta)\varphi - \delta\varphi + \rho}\right]. \quad (18b)$$

Focusing on equations (16), (17), and (18b), we find that fiscal policy affects the steady-state growth rate. Moreover, our theoretical framework motivates the empirical testing of two related ideas. First, the appropriate specification for testing the relationship between tax rates and economic growth needs to take into account both the structure and level of public expenditure[2], and the theoretical model highlights the positive role of the share of productive public expenditure on economic growth. Second, different types of taxes affect economic growth differently. Income tax rates can influence labor-leisure and consumption-savings choices, and thus ultimately affect the equilibrium factor ratios, whereas the consumption tax rate is not directly related to the labor-leisure choice.

2.2. Spatial Econometric Models

[2]Kneller et al. (1999) emphasize that if the focus is exclusively on one side of the government budget, with the other ignored, the bias in the parameter estimates of the fiscal variables can be substantial.

The following is a general specification for spatial econometric models.

$$y = \rho W y + X\beta + WX\theta + \nu \tag{19a}$$
$$\nu = \lambda W \nu + \varepsilon, \tag{19b}$$

where y is the dependent variable, X is a matrix of independent variables, ν is the spatially autoregressive error term, ε is a stochastic error term with $\varepsilon \sim N(0, \sigma^2 I_n)$, W is the spatial weight matrix, β refers to the regression parameters, θ refers to the parameters of the spatial lags of the explanatory variables, ρ is the spatial autoregressive parameter, and λ is the spatial error autoregressive parameter.

If $\theta = 0$ and $\lambda = 0$, we can modify the model to a spatial autoregressive model (SAR). If $\theta = 0$, we can modify it to an SAR with autoregressive disturbance (SAC). If $\lambda = 0$, we can modify the model into an SDM, as follow.

$$y = \rho W y + X\beta + WX\theta + \varepsilon \tag{20a}$$
$$(I_n - \rho W) y = X\beta + WX\theta + \varepsilon \tag{20b}$$
$$y = (I_n - \rho W)^{-1} X\beta + (I_n - \rho W)^{-1} WX\theta + (I_n - \rho W)^{-1}\varepsilon \tag{20c}$$
$$y = \sum_{r=1}^{K} S_r(W) x_r + V(W)\varepsilon, \tag{20d}$$

where $S_r(W) = V(W)(I_n\beta_r + W\theta_r)$, $V(W) = (I_n - \rho W)^{-1} = I_n + \rho W + \rho^2 W^2 + \rho^3 W^3 + L$ Equation (20d) can be re-written as

$$\begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix} = \sum_{r=1}^{K} \begin{pmatrix} S_r(W)_{11} & S_r(W)_{12} & \cdots & S_r(W)_{1n} \\ S_r(W)_{21} & S_r(W)_{22} & \cdots & S_r(W)_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ S_r(W)_{n1} & S_r(W)_{n2} & \cdots & S_r(W)_{nn} \end{pmatrix} \begin{pmatrix} x_{1r} \\ x_{2r} \\ \vdots \\ x_{nr} \end{pmatrix} + V(W)\varepsilon. \tag{21}$$

From equation (21), we have

$$\partial y_i / \partial x_{jr} = S_r(W)_{ij}, \tag{22a}$$

which measures the effect on the dependent variable, observation i, of a change in the explanatory variable, observation j. Assume that the explanatory variable changes in all regions, and the effects on the dependent variable, observation i, is called the total effect, that is, $\sum_{j=1}^{n} S_r(W)_{ij}$. The average total effect is computed as $n^{-1} \sum_{i=1}^{n} \sum_{j=1}^{n} S_r(W)_{ij}$. When

$j = i$, we have

$$\partial y_i/\partial x_{ir} = S_r(W)_{ii} \tag{22b}$$

which measures the effect on the dependent variable, observation i, of a change in the explanatory variable, observation i (called the direct effect). $trace[S_r(W)]$ denotes the trace of $S_r(W)$, and the average direct effect is computed as $n^{-1}trace[S_r(W)]$. The average indirect effect equals the average total effect minus the average direct effect.

3. EMPIRICAL MODEL

3.1. Spatial Durbin Model

The following SDM is derived from the foregoing theoretical frameworks.

$$\begin{aligned} y_{i,t} &= \rho\sum_{j=1}^{N} w_{i,j}y_{j,t} + \delta_1\text{gov}_{i,t} + \delta_2\text{beta}_{i,t} + \sum_{p=1}^{P}\tau_{i,t,p}\beta_p \\ &+ \sum_{p=1}^{P}\sum_{j=1}^{N} w_{i,j}\tau_{j,t,p}\theta_p + \sum_{m=1}^{M} Z_{i,t,m}\phi_m + u_i + \varepsilon_{i,t}, \end{aligned} \tag{23}$$

where $i = 1, \ldots, N$ is an index for the cross-sectional dimension; $t = 1, \ldots, T$ is an index for the time dimension; $y_{i,t}$ is the log of per capita GDP in province i in year t; $w_{i,j}$ is the $(i, j)th$ element of the spatial weight matrix W that quantifies the structure of spatial dependence between observations; gov is the share of total government expenditure in GDP; beta is the log of productive public expenditure; τ is a set of effective tax rates, including the effective tax rates on labor income (denoted as τ_w), capital income (denoted as τ_k), and consumption (denoted as τ_c); Z is a set of control variables that affect economic growth, including the log of investment, which is denoted as inv, the log of working age population, which is denoted as lab, and the average years of education, which is included as a proxy for the human capital stock[3] and denoted as hum; and u_i is regional effects.

In estimating equation (23), we are confronted with an important econometric issue. The lagged dependent variable is introduced on the right-hand side of the model. When the spatial autocorrelation is modeled, the ordi-

[3]Educational attainment is categorized as no schooling (educated for 0 years), primary school (educated for 6 years), junior secondary school (educated for 9 years), senior secondary school (educated for 12 years), and college and higher (educated for 16 years). Multiplying the percentage of the population with a particular level of education by the years of educational attainment gives the average years of education.

nary least squares estimation of the parameters is inconsistent. In this case, maximum likelihood (ML) estimation and instrumental variable estimation are widely used. We estimate our SDM using ML.

3.2. Data and Variables

Here, we describe some of the key variables in greater detail. First, the spatial weight matrix is based on a contiguity matrix, where a value of one is assigned if two provinces share a border, and zero otherwise. The contiguity matrix is chosen for two reasons. First, information on nearby provinces' tax policies can be observed more easily than that on distant provinces. Second, geographical neighbors are more likely to experience a similar tax base and/or business cycle shocks. The weight matrix is standardized to ensure that the elements of a row add up to one.

Following Barro (1990), we define productive public expenditure as general public service expenditure, defense expenditure, education expenditure, health expenditure, housing expenditure, and transportation and communication expenditure, denoted by beta1. There is some disagreement over whether general public service and housing expenditure constitute productive expenditure, and we thus also define productive public expenditure by beta2 with these two types of expenditure removed.

The effective tax rate on labor income is computed as the ratio of tax revenues from labor income taxes to the sum of labor income tax revenues and employee compensation in the income approach to GDP. Individual income tax, which is the most important component of labor income taxes, is levied on the following categories of income: income from wages and salaries; income from production or business operations derived by individual industrial and commercial households; income from the contracted or leased operation of enterprises or institutions; income from remuneration for personal services; income from authors' remuneration; income from royalties; income from interest, dividends, and bonuses; income from the lease of property; income from the transfer of property; contingent income; and other income specified as taxable by the Finance Department of the State Council. Individual income tax data do not distinguish between taxes paid on labor income and capital income. We deal with this problem by assuming income from wages and salaries, remuneration for personal services, and authors' remuneration to be subject to labor income taxes, and the remainder to capital income taxes. Social security contributions are also included in the tax revenues from labor income.

Following the general concept of effective tax rates, we define the effective tax rate on capital income as the ratio of tax revenues from capital income taxes to the sum of capital income tax revenues and operating surplus in the income approach to GDP. Tax revenues from capital income taxes include individual income tax revenue derived from capital income, value-added tax revenue derived from capital income, business tax, company income tax, resource tax, fixed assets investment orientation regulation tax, urban maintenance and development tax, property tax, stamp duty, urban land use tax, land appreciation tax, tax on the use of vehicles and vessels, tax on the use of arable land, and tax on contracts. Value-added tax in most counties is treated as a consumption tax. China, however, adopts a production type of value-added tax, and thus revenue from such tax based on business assets should be treated as capital income taxation. Because the value-added tax data do not provide a breakdown of the tax revenue derived from capital income and that from consumption, we calculate the former by multiplying provincial purchases of equipment and instruments by the standard statutory tax rate of value-added tax, which is 17%, and then dividing by $(1 + 17\%)$.

Finally, the effective tax rate on consumption is measured as the ratio of tax revenues from consumption taxes to household final consumption expenditure. Consumption tax, tobacco tax, and value-added tax revenue derived from consumption, which is equal to value-added tax revenue minus value-added tax revenue derived from capital income, are assumed to be tax revenues from consumption taxes. Household final consumption expenditure is a component of the GDP expenditure approach.

Our dataset covers 31 provinces in China for the period 2007-2013. Because the classification of government revenues and expenditures changed in 2007, data for 2007 and after are not comparable with those for previous years. Our data on provincial taxes are collected from the Tax Yearbook of China for various years, those on provincial public expenditure come from the Finance Yearbook of China for various years, and other data come from the China Statistical Yearbook for various years. Descriptive statistics for the variables are given in Appendix A. See Appendixes B, C, and D for details of the provincial differences in the effective tax rates on labor income, capital income and consumption, respectively.

4. EMPIRICAL RESULTS

4.1. Spatial Dependence

Before adopting the spatial econometric regression models, we need to test the spatial dependence between observations. Moran's I is the most commonly used test statistic for spatial autocorrelation.

$$\text{Moran's}I_t = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij,t}(x_{i,t}-\overline{x}_t)(x_{j,t}-\overline{x}_t)}{S_t^2\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij,t}}, \tag{24}$$

where $S_t^2 = \sum_{i=1}^{n}(x_i - \overline{x})^2/n$ is the variance of sample. The Moran's I statistics for the log of per capita GDP in the 31 provinces are presented in Table 1. Significance at the 1% level is indicative of a strong spatial association between economic growth in one province and the economic growth rates of neighboring provinces.

TABLE 1.

Moran's I statistics

Year	2007	2008	2009	2010	2011	2012	2013
Moran's I	0.338^{***}	0.331^{***}	0.322^{***}	0.315^{***}	0.304^{***}	0.294^{***}	0.286^{***}
	(3.462)	(3.392)	(3.303)	(3.232)	(3.128)	(3.032)	(2.950)

Notes: t-statistics are shown in parentheses below the estimated coefficients. * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.

4.2. Results and discussion

Table 2 reports the estimation results of the fixed-effects (FE) model, SAR, SAC, and SDM.[4] The eight regressions include regional fixed effects.[5] The adjusted R^2, log-likelihood, and Akaike Information Criterion (AIC) achieved for these models are also reported for model selection. The spatial lag of the dependent variable is added as an explanatory variable in columns 3-8 because of spatial dependence, and the estimates for parameter ρ are all positive and significantly different from zero. The results confirm that the spatial econometric regression model is more appropriate than the FE model. The coefficient λ associated with the spatial autocorrelation error term in column 5 is insignificant, which suggests that SAC is not the best candidate for explaining the data. The empirical evidence in favor of SDM is stronger than that for SAR. The estimates for spatially lagged explanatory variable $w^*\tau_k$ in columns 7-8 are significantly different

[4]The estimates of the spatial econometric regression model are obtained using the STATA xsmle procedure.

[5]Regional fixed effects control for province-specific, time-invariant variables that are not accounted for by the set of control variables and whose omission could bias the estimates. In our empirical model, the number of provinces (N) is 31, and the number of time periods (T) is 7. N is large relative to T, and we thus focus only on the unobserved heterogeneity in the cross-sectional dimension.

from zero. In addition, the log-likelihood of SDM equals 442.8 in column 7 and 445.2 in column 8, whereas the equivalent figures for SAR are 434.3 and 433.9, respectively. In the following, we focus exclusively on the SDM estimates.

As noted, the SDM estimates cannot be interpreted as partial derivatives in the usual regression model fashion. A change in a given province that is associated with any of the explanatory variables directly affects the province itself (a direct effect) and potentially affects all other provinces indirectly (an indirect effect). To assess the signs and magnitudes of the effects arising from changes in the explanatory variables in columns 7-8, we turn to the summary measures of direct, indirect, and total effects presented in Table 3.

It can be seen form Table 3 that the coefficients of are positive and insignificant. All of the coefficients of productive public expenditure are highly significant (with $p < 0.01$) and positively related to growth, as the theoretical model predicts. This empirical evidence shows that productive public expenditure not only improves economic growth in the province itself but also has beneficial effects on nearby provinces, which provides strong support for the predictions of Case et al. (1993). It is important to note that the spillover effect of productive public expenditure is as large as its direct effect.

Looking at the effective tax rate on labor income, we find the direct effect of that rate to be significantly negative, meaning that a rise in the labor income tax rate in a province significantly reduces that province's economic growth rate, implying that the labor income tax rate may be too high in China. The rate's indirect effect is positive but insignificant, which seems intuitively plausible. According to Tiebout (1956), individuals can vote with their feet to allocate themselves according to their preferences for a package of local public goods and taxes. A rise in the labor income tax rate in one province can boost employment in neighboring provinces, thereby stimulating local economic growth in theory. In essence, Tiebout's model assumes full factor mobility, an assumption that is often too stringent in China. Despite controls on migration being loosened in recent years, obstacles to labor mobility between provinces still exist, most notably the hukou system of permanent registration. Such social services as housing, healthcare, and education are available only to citizens with a valid hukou registration, which means that migrants receive no health benefits and cannot purchase property in the provinces in which they work. As a result, the hukou system operates as a barrier to interprovincial labor migration. The limited freedom to transfer provincial social security also increases labor

TABLE 2.

Estimation results

	FE		SAR		SAC		SDM	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
gov	-0.0037^{*}	-0.0028	-0.0012	-0.0007	0.0008	0.0017^{*}	0.0003	0.0009
	(-1.930)	(-1.176)	(-1.186)	(-0.700)	(0.922)	(1.734)	(0.271)	(0.898)
beta1	0.3732^{***}		0.1774^{***}		0.3174^{***}		0.1813^{***}	
	(9.547)		(6.535)		(12.29)		(6.770)	
beta2		0.3243^{***}		0.1522^{***}		0.2670^{***}		0.1697^{***}
		(9.302)		(6.462)		(10.976)		(7.177)
τ_w	0.0062	0.0088^{**}	-0.0049^{*}	-0.0038	-0.0037	-0.0043^{*}	-0.0077^{***}	-0.0070^{***}
	(1.560)	(2.526)	(-1.788)	(-1.382)	(-1.519)	(-1.660)	(-2.844)	(-2.603)
τ_k	0.0011	0.0007	-0.0006	-0.0008	0.0002	0.0003	-0.0008	-0.0011
	(0.747)	(0.421)	(-0.628)	(-0.903)	(0.219)	(0.401)	(-0.897)	(-1.216)
τ_c	0.0009	0.0023	0.0012	0.0019	0.0020^{*}	0.0029^{**}	0.0004	0.0009
	(0.449)	(1.193)	(0.902)	(1.374)	(1.688)	(2.261)	(0.301)	(0.695)
$w^{*}\tau_w$							0.0036	0.0060^{*}
							(0.921)	(1.635)
$w^{*}\tau_k$							-0.0050^{***}	-0.0057^{***}
							(-3.604)	(-4.135)
$w^{*}\tau_c$							0.0009	0.0006
							(0.448)	(0.301)
inv	0.1703^{***}	0.1769^{***}	0.1142^{***}	0.1161^{***}	0.0705^{***}	0.0711^{***}	0.0962^{***}	0.0904^{***}
	(3.315)	(3.562)	(4.604)	(4.690)	(3.573)	(3.254)	(3.998)	(3.786)
lab	-0.0380	-0.1558^{**}	-0.1061^{**}	-0.1623^{***}	-0.3286^{***}	-0.3145^{***}	-0.1139^{***}	-0.1718^{***}
	(-0.463)	(-2.060)	(-2.583)	(-3.968)	(-4.653)	(-4.650)	(-2.856)	(-4.340)
hum	-0.0191	-0.0023	-0.0084	-0.0005	0.0323^{***}	0.0309^{**}	-0.0110	-0.0048
	(-0.928)	(-0.128)	(-0.643)	(-0.040)	(2.717)	(2.402)	(-0.870)	(-0.398)
ρ			0.4939^{***}	0.5006^{***}	0.8111^{***}	0.6975^{***}	0.5653^{***}	0.5713^{***}
			(10.229)	(10.475)	(11.809)	(8.862)	(11.707)	(12.301)
λ					0.0326	0.1540^{**}		
					(0.370)	(2.189)		
region	YES	YES	YES	YES	YES	YES	YES	YES
Adj.R^2	0.965	0.964	0.967	0.967	0.943	0.953	0.965	0.965
$\log L$	395.218	393.233	434.346	433.862	450.473	444.011	442.798	445.246
AIC	-774.436	-770.466	-848.691	-847.723	-878.946	-866.022	-859.595	-864.493

Notes: t-statistics are shown in parentheses below the estimated coefficients. * denotes significance at the 10%, ** at the 5% level, and *** at the 1% level.

mobility costs. These factors render the vote with one's feet mechanism inapplicable in China. The total effect of the labor income tax rate on economic growth is negative and composed primarily of the direct effect. Focusing exclusively on the insignificant total effect of that rate hides its negative and statistically significant direct effect, leading to the wrong conclusion that it is not significantly associated with economic growth, as some studies that do not use spatial econometric models have done.

The direct effect of the capital income tax rate is significant and has the expected sign, that is, negative, suggesting that raising revenue from higher taxes on capital income is associated with lower per capita GDP. An interesting result is that the indirect effect of the capital income tax rate is also significantly negative. We interpret this negative spillover effect as the result of strategic horizontal interaction among provinces with regard to tax. Under China's decentralized fiscal structure and centralized merit-based governance structure, local governors have strong incentives to compete with one another to attract mobile capital. A decrease in the capital income tax rate in one province induces neighboring provinces to also lower their tax rates. Hence, capital income tax competition, which can be characterizedas race to the bottom, creates a pro-business environment that promotes local economic development. The coefficient of the indirect effect shows clear dominance over the direct effect, indicating that a decrease in the capital income tax rate promotes overall economic growth, primarily through tax competition. The total effect estimates of that rate can be interpreted as elasticities. Based on the estimates of two SDMs with different productive public expenditure variables, we find that a 10% decrease in the capital income tax rate ultimately increases the economic growth rate by 0.134 and 0.159 percentage points, which are quite large relative to the estimates of the labor income tax rate. This finding shows capital income taxes to be more growth unfriendly than labor income taxes.

Neither the direct nor the indirect effect of the consumption tax rate on economic growth is statistically significant at the 10% level, and consequently we cannot reject the possibility that the rate has zero influence on growth. These results confirm earlier findings that consumption taxes are non-distorting, whereas taxes imposed on labor and capital income are growth-distorting (Kneller et al., 1999; Angelopoulos et al., 2007). They are thus of particular importance to policymakers considering whether to shift the tax base from income to consumption.

Turning to the control variables, we note that all of the coefficients of inv are highly significant and exhibit the expected sign, that is, positive, indicating that capital investment is an important engine of long-term growth in China. In particular, the lab variable is negatively related to growth. Similar results are reported in Kneller et al. (1999) and Angelopoulos et al. (2007). In addition, the coefficients of hum are also negative but not statistically significant. This is consistent with the findings of Angelopoulos et al. (2007) who show that their results are robust to using the growth rate or the level of the average years of education. A potential explanation is the multiple attributes of human capital, which embraces a complex set of human attributes. Average years of education at best constitute a rough proxy for the human capital stock, as the measure does not take into account skills and experience gained after formal education.

TABLE 3.

Cumulative effects

	SDM-(7)			SDM-(8)		
gov	0.0003 (0.249)	0.0004 (0.284)	0.0006 (0.269)	0.0010 (0.878)	0.0011 (0.863)	0.0021 (0.875)
beta1	0.1993*** (7.425)	0.2176*** (6.407)	0.4169*** (8.347)			
beta2				0.1818*** (7.863)	0.2029*** (6.458)	0.3847*** (8.532)
τ_w	−0.0077** (−2.541)	0.0006 (0.073)	−0.0071 (−0.661)	−0.0067** (−2.230)	0.0044 (0.503)	−0.0023 (−0.219)
τ_k	−0.0018* (−1.743)	−0.0116*** (−2.972)	−0.0134*** (−2.872)	−0.0022** (−2.187)	−0.0137*** (−3.373)	−0.0159*** (−3.304)
τ_c	0.0006 (0.413)	0.0024 (0.558)	0.0030 (0.609)	0.0011 (0.794)	0.0024 (0.553)	0.0035 (0.709)
inv	0.1058*** (4.108)	0.1159*** (3.670)	0.2217*** (4.097)	0.0997*** (3.887)	0.1159*** (3.670)	0.2111*** (3.921)
lab	−0.1240*** (−2.830)	−0.1384** (−2.353)	−0.2624*** (−2.619)	−0.1882*** (−4.289)	−0.1384** (−2.353)	−0.4009*** (−3.877)
hum	−0.0114 (−0.803)	−0.0126 (−0.774)	−0.0240 (−0.792)	−0.0046 (−0.338)	−0.0126 (−0.774)	−0.0100 (−0.339)

Notes: t-statistics are shown in parentheses below the estimated coefficients. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

4.3. Robustness tests

In this sub-section, we examine the robustness of the SDM results in several ways.[6] Because the previous literature shows that estimation results are often fragile and sensitive to the choice of conditioning variables, we first re-estimate the SDM by omitting the control variables as a robustness check (see columns 9 and 10 of Table 4). As can be seen, the estimated

[6]In fact, the different specifications of productive public expenditure in the foregoing regressions can be viewed as a robustness check.

coefficients of gov remain positive and insignificant. Compared to the initial results reported in Table 3, the exclusion of the control variables results in a higher estimated coefficient for beta1 and beta2. In other words, failure to adequately control for the conditioning variables in the regression increases the estimated coefficient of productive public expenditure. Also note that there is an upward bias in the absolute values of the estimated direct effects of the labor income tax rate. Nevertheless, τ_w remains significant at the 10% level in the direct effect, and insignificant in the indirect effect. Of greatest interest are the results on the capital income tax rate. The indirect effect of τ_k retains its significance, whereas its direct effect loses it. With respect to the variable τ_c, the direct, indirect, and total effects continue to be insignificant.

TABLE 4.

Robustness check with control variables excluded

	(9)			(10)		
gov	0.0010 (1.004)	0.0013 (0.956)	0.0023 (0.983)	0.0010 (0.899)	0.0012 (0.863)	0.0022 (0.884)
beta1	0.2470^{***} (11.557)	0.2933^{***} (8.973)	0.5403^{***} (17.076)			
beta2				0.2166^{***} (11.118)	0.2630^{***} (8.869)	0.4795^{***} (16.567)
τ_w	-0.0114^{***} (−4.265)	0.0018 (0.208)	−0.0096 (−0.955)	-0.0079^{***} (−2.933)	0.0153 (0.823)	0.0074 (0.756)
τ_k	−0.0012 (−1.214)	-0.0118^{***} (−3.070)	-0.0131^{***} (−2.856)	−0.0008 (−0.810)	-0.0116^{***} (−2.937)	-0.0124^{***} (−2.653)
τ_c	−0.0014 (−1.012)	−0.0014 (−0.282)	−0.0028 (−0.506)	−0.0014 (−0.971)	−0.0026 (−0.528)	−0.0040 (−0.708)

Notes: t-statistics are shown in parentheses below the estimated coefficients. * denotes significance at the 10%, ** at the 5%, and *** at the 1% levels.

The estimated coefficients of hum, which is defined as the average years of education in the foregoing regressions, are not statistically significant at the 10% level. As a next step, it seems reasonable to make use of a more sophisticated measure of human capital. Unfortunately, the skills and experience accumulated by individuals are difficult to measure with precision in quantitative form. For simplicity, we use an educational attainment proxy for the stock of human capital. We re-estimate the regression with the alternative variable newhum, measured by the percentage of the population that has successfully completed college and higher-level schooling, with the results presented in Table 5. The positive coefficients of newhum are highly significant, implying that individuals do indeed attain significant quantitative skills and knowledge at college and higher levels of education that in turn contribute to economic development. More importantly, the robustness check with the alternative specification for human capital does not induce significant changes in the estimated coefficients of the variables of key interest, that is, the growth effects of productive public expenditure and effective tax rates are robust to it. The main differences between Tables 3 and 5 are that the significance level for the direct effect of τ_w decreases to 10%, and there is a downward bias in the absolute values of the estimated coefficients.

TABLE 5.

Robustness check with alternative specification for human capital

	(11)			(12)		
	Direct	Indirect	Total	Direct	Indirect	Total
gov	0.0005 (0.600)	0.0005 (0.614)	0.0011 (0.610)	0.0010 (1.072)	0.0010 (1.040)	0.0020 (1.061)
beta1	0.1624*** (7.437)	0.1526*** (7.307)	0.3150*** (8.833)			
beta2				0.1426*** (7.188)	0.1444*** (7.017)	0.2870*** (8.271)
τ_w	−0.0049* (−1.957)	0.0051 (0.780)	0.0002 (0.030)	−0.0039* (−1.794)	0.0091 (1.354)	0.0052 (1.635)
τ_k	−0.0016* (−1.945)	−0.0074** (−2.548)	−0.0090*** (−2.581)	−0.0019*** (−2.273)	−0.0090*** (−2.863)	−0.0110*** (−2.909)
τ_c	0.0017 (1.415)	0.0040 (1.190)	0.0057 (1.483)	0.0021 (1.588)	0.0044 (1.249)	0.0065 (1.330)
inv	0.0759*** (3.470)	0.0715*** (3.318)	0.1474*** (3.521)	0.0771*** (3.483)	0.0781*** (3.379)	0.1552*** (3.551)
lab	−0.0306 (−0.912)	−0.0301 (−0.888)	−0.0607 (−0.904)	−0.0970*** (−2.901)	−0.0995*** (−2.576)	−0.1964*** (−2.786)
newhum	0.2084*** (9.950)	0.1980*** (5.589)	0.4063*** (8.132)	0.1987*** (9.252)	0.2033*** (5.488)	0.4020*** (7.608)

Notes: t-statistics are shown in parentheses below the estimated coefficients. * denotes significance at the 10%, ** at the 5%, and *** at the 1% levels.

As a final robustness check, we design an alternative spatial weight matrix to analyze the connectivity among the observations. Various weight matrices based on geographical proximity are traditionally used in the spatial econometrics literature, and they seem particularly relevant in China where the heterogeneity of provincial economic structures is widely spatially distributed. We thus design the second interaction matrix, W_d, using a decreasing function of pure geographical distance to quantify the structure of the spatial dependence between provinces. The $(i,j)th$ element of spatial weight matrix W_d is defined as follows: if $i \neq j$, then $w_{i,j} = 1/d_{ij}$, where d_{ij} is the geographical distance between two provincial capital cities; if $i = j$, then $w_{i,j} = 0$. Spatial weight matrix W_d is standardized to normalize the outside influence on each province. Table 6 reports the SDM results with spatial weight matrix W_d. Ignoring the differences in the magnitudes of the estimated coefficients between the initial and robustness check results, the results can be summarized as follows. A larger share of productive public expenditure is associated with a higher level of economic growth. A decrease in the labor income tax rate significantly enhances economic growth in a given province (direct effect). A decrease in the capital income tax rate not only improves economic growth in the province itself but also has major beneficial effects on nearby provinces (indirect effect). The effective tax rate on consumption in China is non-distorting. In summary, these estimates provide overall confirmation of the results reported in Table 3.

TABLE 6.

Robustness check with alternative spatial weight matrix

	(13)			(14)		
	Direct	Indirect	Total	Direct	Indirect	Total
gov	0.0010 (1.256)	0.0026 (1.078)	0.0036 (1.143)	0.0013 (1.599)	0.0036 (1.282)	0.0050 (1.382)
beta1	0.1043^{***} (4.084)	0.2359^{***} (3.389)	0.3401^{***} (3.993)			
beta2				0.0847^{***} (3.613)	0.2115^{***} (3.043)	0.2962^{***} (3.468)
τ_w	-0.0059^{**} (−2.174)	−0.0461 (−1.340)	−0.0520 (−1.445)	-0.0056^{**} (−2.031)	−0.0438 (−1.185)	−0.0495 (−1.281)
τ_k	-0.0028^{***} (−2.849)	-0.0299^{*} (−1.923)	-0.0326^{**} (−2.009)	-0.0030^{***} (−2.924)	-0.0336^{*} (−1.912)	-0.0366^{**} (−1.995)
τ_c	0.0012 (1.044)	0.0206 (1.362)	0.0218 (1.414)	0.0015 (1.348)	0.0222 (1.347)	0.0238 (1.413)
inv	0.0753^{***} (3.459)	0.1746^{**} (2.472)	0.2500^{***} (2.873)	0.0781^{***} (3.534)	0.2001^{**} (2.478)	0.2782^{***} (2.867)
lab	-0.1598^{***} (−3.681)	-0.3888^{*} (−1.919)	-0.5486^{**} (−2.278)	-0.2037^{***} (−4.609)	-0.5401^{**} (−2.157)	-0.7437^{***} (−2.591)
newhum	0.2468^{***} (11.767)	0.5772^{***} (3.190)	0.8240^{***} (4.300)	0.2454^{***} (11.241)	0.6349^{***} (3.098)	0.8803^{***} (4.059)

Notes: t-statistics are shown in parentheses below the estimated coefficients. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

5. CONCLUSION

In an endogenous growth model, tax rates affect the long-run growth rate. We test the robust relationship between effective tax rates and economic growth systematically using a panel dataset for 31 provinces in China over the period 2007-2013. An important feature of our empirical model is that it takes full account of the spatial correlation relationship in China's regional economic growth and the spatial spillover effects of effective tax rates.

We find labor income tax rates to be significantly negatively related to economic growth in a given province, and insignificantly related to growth in neighboring provinces because the vote with one's feet mechanism is inapplicable in China due to obstacles to interprovincial labor mobility such as the hukou system. We believe that greater labor mobility would improve the country's economic productivity. We also find that a decrease in the capital income tax rates significantly enhances growth in a given province, and induces neighboring provinces to also cut their capital income tax rates to promote local economic growth. This cross-province capital income tax competition, which can be characterizedas a race to the bottom, creates a pro-business environment that in turn promotes overall economic growth. Our results suggest that consumption taxes are non-distorting, whereas taxes imposed on labor income and capital income are growth-distorting. The Chinese government could consider switching the burden of taxation more toward consumption. Because high tax rates on luxury goods with elastic demand may create an incentive for cross-border shopping, we recommend higher targeted excise duties on such goods as alcohol and cigarettes, for which demand is relatively price inelastic, to raise more revenue.

APPENDIX A

Summary statistics of major variables (2007-2013)

Variable	rgdp	gov	beta1	beta2	τ_w	τ_k	τ_c	inv	lab	hum
Obs.	217	217	217	217	217	217	217	217	217	217
Mean	10.13	24.34	6.76	6.36	11.37	29.41	11.41	8.44	9.97	8.52
Median	10.08	20.32	6.86	6.45	10.79	27.25	9.68	8.63	10.13	8.52
Max	11.33	129.14	8.35	8.01	25.70	66.89	45.18	10.03	11.29	12.03
Min	8.91	8.70	4.66	4.14	5.94	14.74	0.99	5.57	7.52	4.37
Std.dev	0.52	18.37	0.75	0.78	3.66	9.62	7.88	0.92	0.86	1.15

APPENDIX B

Effective tax rate on labor income in China (2007-2013)

	2007	2008	2009	2010	2011	2012	2013
Beijing	16.84	16.59	17.00	18.22	19.51	20.11	21.14
Tianjin	17.91	14.12	13.83	13.03	12.66	12.90	12.85
Hebei	8.95	6.98	7.43	7.45	7.91	8.24	8.79
Shanxi	15.35	12.98	12.81	14.15	13.85	14.17	14.84
Inner Mongolia	10.33	8.46	7.62	8.31	8.98	8.96	9.12
Liaoning	14.79	12.45	12.94	12.39	13.31	13.28	14.78
Jilin	11.82	11.39	11.76	11.33	11.69	11.60	12.23
Heilongjiang	15.27	15.09	16.91	16.26	16.21	16.03	16.57
Shanghai	21.74	21.68	22.43	22.52	23.81	25.44	25.70
Jiangsu	10.88	10.45	9.83	10.13	10.79	11.46	11.32
Zhejiang	10.08	10.36	10.85	11.14	12.15	13.68	12.40
Anhui	9.08	8.10	8.50	8.25	8.78	8.75	9.86
Fujian	7.62	6.43	6.10	5.94	6.48	6.50	7.09
Jiangxi	7.47	7.79	8.88	7.79	8.09	9.39	9.15
Shandong	9.21	7.32	7.69	8.73	9.73	9.89	9.68
Henan	6.87	6.14	6.27	6.38	6.56	6.90	7.29
Hubei	10.06	8.82	9.36	9.76	10.19	9.46	9.68
Hunan	8.92	7.99	8.45	7.86	7.96	8.01	8.43
Guangdong	9.19	9.58	9.57	10.24	10.90	10.99	11.33
Guangxi	7.93	6.37	7.38	7.26	6.58	6.90	7.95
Hainan	13.02	10.50	12.11	11.25	12.74	11.86	10.71
Sichuan	10.72	9.64	11.94	10.74	11.36	13.12	16.03
Chongqing	11.18	10.30	13.30	13.20	14.94	14.26	15.82
Guizhou	10.58	9.16	9.87	10.11	10.44	9.81	9.29
Yunnan	10.10	9.25	9.92	10.31	10.97	9.73	9.67
Tibet	7.04	7.19	7.28	8.59	11.27	16.98	11.64
Shaanxi	10.96	9.31	9.89	11.14	11.10	11.92	11.49
Gansu	11.01	9.71	11.96	10.65	12.83	12.03	11.58
Qinghai	12.23	11.25	11.91	12.55	13.87	13.09	12.90
Ningxia	12.22	10.29	10.22	11.71	13.29	12.60	12.98
Xinjiang	14.69	13.69	13.70	14.34	15.22	14.65	15.02

APPENDIX C

Effective tax rate on capital income in China (2007-2013)

	2007	2008	2009	2010	2011	2012	2013
Beijing	56.92	66.89	66.65	58.46	61.85	64.94	65.12
Tianjin	25.64	25.87	25.42	27.24	29.48	28.18	28.29
Hebei	15.23	22.95	25.13	26.04	25.28	27.88	29.85
Shanxi	20.61	23.98	29.26	23.65	27.63	32.12	36.73
Inner Mongolia	17.04	18.61	22.36	22.14	23.79	24.21	25.27
Liaoning	25.62	31.54	35.30	35.24	35.76	42.16	34.38
Jilin	19.80	23.01	24.37	24.61	25.21	27.25	27.61
Heilongjiang	15.50	16.60	18.63	18.26	20.07	22.76	25.31
Shanghai	48.20	46.35	42.80	41.97	42.85	43.64	44.41
Jiangsu	21.03	22.73	25.66	24.66	27.77	28.52	28.40
Zhejiang	23.27	24.02	22.68	23.14	26.43	27.96	30.80
Anhui	20.69	27.25	28.39	28.14	28.63	30.63	30.73
Fujian	19.90	26.81	26.78	24.57	26.24	28.81	30.61
Jiangxi	17.62	26.30	28.65	27.88	27.60	29.79	28.98
Shandong	16.58	20.09	20.90	19.04	21.82	22.64	23.79
Henan	14.74	17.67	22.44	22.74	22.60	26.64	27.84
Hubei	18.63	24.23	23.10	20.08	23.79	25.66	26.97
Hunan	16.13	19.71	18.75	20.40	20.90	22.44	23.95
Guangdong	30.44	28.63	26.93	23.23	30.08	31.86	31.22
Guangxi	15.27	28.22	33.17	27.74	34.48	30.18	30.39
Hainan	24.68	41.60	41.32	45.10	46.26	50.44	49.31
Sichuan	22.32	23.52	24.28	27.49	29.99	29.92	26.48
Chongqing	22.58	30.28	27.62	26.57	25.39	25.83	25.87
Guizhou	25.54	33.83	36.35	35.40	38.03	41.98	42.73
Yunnan	28.94	37.44	35.28	34.54	36.41	41.10	38.76
Tibet	18.56	19.16	27.42	34.25	40.90	45.31	43.71
Shaanxi	20.71	21.56	24.00	21.68	23.54	24.61	26.76
Gansu	19.71	25.52	23.66	30.70	29.49	30.87	32.30
Qinghai	21.74	23.86	35.92	26.01	30.93	29.80	34.70
Ningxia	27.02	35.91	32.58	33.58	34.39	38.78	39.70
Xinjiang	21.23	28.04	35.83	32.39	37.80	42.86	43.94

APPENDIX D

Effective tax rate on consumption in China (2007-2013)

	2007	2008	2009	2010	2011	2012	2013
Beijing	12.74	11.58	13.25	13.38	12.94	12.96	16.82
Tianjin	35.62	36.37	33.32	38.50	37.34	35.44	36.40
Hebei	8.11	8.21	7.32	8.36	8.14	6.51	6.86
Shanxi	18.71	22.84	17.69	16.87	16.70	14.45	10.42
Inner Mongolia	10.74	10.63	8.19	9.29	9.56	7.56	5.59
Liaoning	12.15	11.64	12.69	14.48	13.14	11.46	12.03
Jilin	7.32	6.06	5.43	4.65	8.69	6.05	7.36
Heilongjiang	10.37	9.86	8.23	8.27	9.95	8.80	7.07
Shanghai	31.74	31.49	33.31	36.39	38.79	40.74	45.18
Jiangsu	10.69	10.10	9.90	9.68	7.07	6.34	11.90
Zhejiang	11.66	13.43	11.15	11.24	10.03	9.29	19.18
Anhui	5.81	6.06	6.35	6.71	6.60	4.28	5.55
Fujian	6.45	6.22	5.91	6.67	5.98	5.64	13.64
Jiangxi	4.93	3.46	3.98	4.47	4.56	2.78	4.07
Shandong	9.84	10.25	9.54	11.39	10.32	10.38	11.18
Henan	4.86	4.33	2.96	2.42	2.58	1.47	0.99
Hubei	7.58	7.12	7.25	7.76	6.58	6.53	7.19
Hunan	7.09	6.95	6.89	7.18	7.47	6.79	7.30
Guangdong	13.61	13.16	13.44	13.76	12.20	12.09	19.71
Guangxi	6.77	6.39	5.80	5.91	7.51	7.03	5.59
Hainan	14.37	16.98	17.79	18.71	20.14	17.25	13.73
Sichuan	7.15	5.58	7.19	8.01	6.71	6.00	7.90
Chongqing	5.79	5.67	5.11	5.55	6.21	6.23	6.55
Guizhou	9.78	10.81	10.53	10.98	11.38	11.67	11.48
Yunnan	19.03	22.90	18.62	19.18	18.87	17.48	16.32
Tibet	2.43	3.60	2.91	2.44	4.74	5.10	5.70
Shaanxi	12.76	12.90	12.33	14.01	14.80	13.40	11.92
Gansu	11.24	8.80	11.59	11.27	11.14	11.06	9.36
Qinghai	9.58	9.31	10.51	11.14	9.94	9.84	7.57
Ningxia	7.54	7.22	8.04	7.96	6.15	7.56	7.35
Xinjiang	15.81	15.95	15.71	16.37	15.38	13.37	11.65

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