Competition of Municipalities via Spending Composition: The Case of the Czech Republic

Very preliminary version

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Abstract

Municipalities normally compete for tax revenues only indirectly, via non-taxing decisions. Their main instrument of competition is composition of the public spending, which strategically affects locational decisions of mobile workforce in neighbouring regions. We provide a model and seek evidence of strategic interaction between municipality spending in the case of 205 municipalities in the Czech Republic.

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1 Introduction

Competition between lower levels of governments may enhance efficiency in a number of ways. First and foremost, if competitors are absent, governments behave as monopolies and yardstick competition is impossible.

Oates and Schwab (1988) develop a model showing that under particular conditions the competition among governments improves efficiency. It forces the local government to use its resources in form of tax revenues to provide public goods as effectively as possible in order to attract citizens and firms to settle in their region. In case of no mobility constraints, they would move to the region offering such a combination of tax rate and public services which would bring them higher utility.

On the other hand, the competition among decentralized levels of governments may cause serious allocative distortions. In their effort to encourage economic development, governments tend to hold down tax rates. Low taxes

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mean low costs for business enterprises which should bring new jobs into the region and thus promote economic growth. Local governments compete for potential firms by cutting taxes and, as Oates (1999) argues, this can result in a "race to the bottom" with suboptimal supplies of public goods. However, labour is usually much more immobile than capital, thus under the pressure of competition governments lower the taxes on capital, but at the same time they are forced to tax labour more heavily. As a consequence, the entire "race to the bottom" does not occur in case of public goods.

There is another tool which governments can use for attracting new business enterprises. Cumberland (1979) argues that governments can reduce local environmental standards to lower the costs of pollution control. It is costly not to pollute for firms and if they are allowed to pollute, their total costs of production will be lower. Consequently, firms' decisions about where to do their business are additionally influenced by the environmental regulation. Rational governments decrease the environmental standards until the marginal costs of pollution will be equal to the marginal benefits of inflow of newcomer firms. Inefficiency stems from the negative externalities of higher pollution in other regions, which are not compensated. Competition among regions thus can lead to deterioration of the environment. On the other hand, Glazer (1999) states that local governments raise environmental regulations above the optimal level to discourage polluting firms from entering their region.

Briefly, on one side there are some efficiency-enhancing effects of competition among regions, but on the other side there are allocative distortions caused by competition. Tax harmonization seems to be an appropriate remedy, in which revenues are shared among the regions. Governments do not have to worry about losing the business because of lower tax rates in other regions. Furthermore, the competition through environmental standards can be an argument for harmonization of environmental measures in a centralized system.

As we can see, the arguments emphasizing both advantages and disadvantages of competition among jurisdictions can be found and in normative theory, it is still not clear of what net effects competition has. In real world, there are high mobility constraints, thus competition pressure is limited. Feld, Kirchgasser and Schaltegger (2003) investigate the data for Swiss cantons in order to show the effect of tax competition and they suggest that intensity of tax competition is not harmful for economic growth.

Recently, the literature on competition through jurisdictional spending composition have emerged. Keen and Marchand (1997) were among the first authors who explored this topic. They state that under capital tax competition, the composition of public expenditure is inefficient in that too much is spent on public inputs benefiting local business and too little on public goods benefiting residents, which stems from the labour immobility. Matsumoto (2000) and Borck (2005) further extend this paper theoretically. Kellermann (2006) analyzes special setting in which government provides public inputs creating rents which can be appropriated by the private capital. He shows that benevolent public decision-maker will tax mobile capital and then redistribute income in favor of the immobile factor labor. Boadway, Cuff and Marceau (2002) stress that impossibility to tax firms induces regions to compete by implementing inefficient redistributive policies. Gèrard and Ruiz (2006) model interjurisdictional competition for firms' investment as competition in the expenditure on higher education. They assume that firms make locational investment decisions according to the quality of human capital.

Besides theoretical explanation, several papers analyze these effects empirically. Borck, Caliendo and Steiner (2006) study fiscal competition between jurisdictions via size and structure of public spending. They model reactions functions of jurisdictions on amounts of different public goods provided in neighbouring regions and estimate these functions for German communities. They found out significant positive reactions for facilities encouraging business development, then for general administration and for supporting business enterprises. Spending competition is empirically explored also in Brueckner (1998). He focuses on the adoption of growth-control measures by municipalities in California and seek evidence of policy interdependence. Lundberg (2001) test for effects for recreational and culture expenditure in Swedish municipalities. Revelli (2002) explores neighborhood effects in social service provision. Foucalt, Madiès and Paty (2007) analyze interactions concerning different categories of local public spending among French municipalities. Ermini and Santolini (2007) test public spending interdependence among Italian jurisdictions.

In our paper, we will contribute mainly to the empirical part of this literature. The paper is organized as follows. Section 2 provides with a theoretical model, in which we model jurisdictional spending competition as a non-cooperative game of two districts that are politically dominated by immobile workers and strategically attract high-skilled mobile workers. Section 3 presents empirical analysis of competition via spending composition of 205 municipalities including description of the econometric method, data and estimation results. Section 4 gives some concluding remarks.

2 Model

We model jurisdictional spending competition as a non-cooperative game of two districts. The specific value added to the established models of spending competition (Keen & Marchand 1997, Borck 2004, Borck *et al.* 2006) is that we examine how competition affects equilibrium amounts of local public goods that are consumed *both* by immobile and mobile voters. This effect takes place even in the absence of competition for tax revenues.

2.1 Assumptions

Let $i \in \{1, 2\}$ be two districts populated with immobile low-skilled workers, each at amount $L^i = 1$. Let H^i be the size of mobile high-skilled workers in district i, and let their total amount be $H^1 + H^2 = 1$. Thus, total labor supply is fixed at 3. For convenience, denote $H \equiv H^1$. Each individual pays a non-distortive, exogenous lump-sum tax $t \geq 0$.

The districts are assigned with identical revenues, $\frac{t}{2}(L^1+L^2+H^1+H^2) = \frac{3}{2}t$. The revenues are used to finance three types of goods, local public goods $g^i \geq 0$, (non-taxable) wage subsidies for low-skilled workers $l^i \geq 0$, and wage subsidies for high-skilled workers $h^i \geq 0$. (The subsidy can be either a direct wage subsidy, or an in-kind transfer that decreases disutility of work, such as local transportation or health care.) By balanced budget,

$$g^i + L^i l^i + H^i h^i = \tfrac{3}{2}t.$$

The production function allows for complementarity between low-skilled and high-skilled lavor, so we represent it by a standard Cobb-Douglas production function,

$$F^i = A{L^i}^{\alpha}{H^i}^{1-\alpha}.$$

Firms in each region are competitive and therefore pay workers by the marginal productivity (marginal values are denoted by subscripts), so the labor income of each type of worker, w^{iL} and w^{iH}, writes

$$\begin{aligned} w^{iL} &= F^i_L + l^i = A(1-\alpha){H^i}^{\alpha} + l^i, \\ w^{iH} &= F^i_H + h^i = A\alpha {H^i}^{\alpha-1} + h^i. \end{aligned}$$

Each individual has a quasilinear utility over private and public goods, $u^{iL} = w^{iL} - t + G(g^i)$ and $u^{iH} = w^{iH} - t + G(g^i)$, where $G(\cdot)$ is an increasing and concave C^2-function, with sufficiently high $G_g(0)$. We assume that the government sets policy that is optimal for the median voter.

2.2 Social optimum

By symmetry, $H = \frac{1}{2}$ and we can drop indices. The utilitarian criterion yields

$$W^{SO} = (L^1+L^2)u^L + (H^1+H^2)u^H = (1+\alpha)A2^{-\alpha} + 2l + h + 3G(g) - 3t,$$

$$(l^{SO}, h^{SO}, g^{SO}) = \arg\max W^{SO} \qquad \text{s.t.} \qquad 2l + h + 2g = 3t.$$

Immediately, we can see that the social welfare is constant for any composition of subsidies, provided that total subsidies $2l + h$ are constant. Technically, for any fixed g, we have

$$\frac{dW^{SO}}{dl} = \frac{\partial W^{SO}}{\partial l} + \frac{\partial W^{SO}}{\partial h}\frac{\partial h}{\partial l} = 2 + (-2) = 0$$

Hence, we write just $2l^{SO} + h^{SO} = 3t - 2g^{S0}$. Next, we derive the FOC for an interior optimum for g^{SO}:

$$\frac{dW^{SO}}{d(2l+h)} = \frac{\partial W^{SO}}{\partial(2l+h)} + \frac{\partial W^{SO}}{\partial g}\frac{\partial g}{\partial l} = 1 + 3G_g(g^{SO})(-\tfrac{1}{2}) = 0$$

Hence, $G_g(g^{SO}) = \frac{2}{3}$, or $g^{SO} = G_g^{-1}(\frac{2}{3})$. This interior equilibrium is available if $t \geq \frac{2}{3}g^{SO}$. In such a case, we have $2l + h = 3t - 2g^{SO}$, and subsidies are pure redistribution without any effect on production. Otherwise, a corner solution without subsidies, $l = h = 0$, applies.

2.3 Location decision

The only mobile agents in the model are high-skilled workers, for whom in interior equilibrium, $u^{1H}(H, h^1, g^1) = u^{2H}(H, h^2, g^2)$. This gives us that the location decision of the high-skilled workers can be described by a single variable, $H = H(h^1, h^2, g^1, g^2)$. Notice also that the decision on the location is independent on l^1 or l^2.

From $u^{1H}(H, h^1, g^1) = u^{2H}(H, h^2, g^2)$, we can derive an implicit function evaluated at zero, $I(H, h^1, h^2, g^1, g^2)$, where

$$I(H, h^1, h^2, g^1, g^2) \equiv \alpha A[H^{\alpha-1} - (1-H)^{\alpha-1}] + h^1 - h^2 + G(g^1) - G(g^2) = 0.$$

2.4 The effect of competition

We will see that the Nash equilibrium implies more wage subsidies to mobile workers, h, less subsidies to immobile workers, l, but also more local public goods g than in the social optimum. To start with, derive how the location choice of the high-skilled workers responds to the marginal changes in subsidies and public spending:

$$H_h = -\frac{I_h}{I_H} = -\frac{1}{\alpha A(1-\alpha)[H^{\alpha-2} - (1-H)^{\alpha-2}]}$$

$$H_g = -\frac{I_g}{I_H} = G_g H_h$$

In the social optimum, we have

$$\lim_{H \to \frac{1}{2}^+} H_h = +\infty, H_h(H > \tfrac{1}{2}) > 0.$$

Note that the government controlled by the median voter is effectively controlled by a representative unskilled worker ($H^i < L^i$), unless all skilled workers moved in either of districts. Therefore, we need to examine utilities u_i^L. Specifically, we derive whether the social optimum as a benchmark is sustainable.

Consider the optimal choice of the low-skilled worker in district 1 subject to the fixed spending for the local public good, $g =$ const. The worker compares benefits from a wage increase (stemming from complementarity with skilled workers) with losses from foregone wage subsidies.

$$\frac{du_1^L}{dh^1} = \frac{\partial F_L^1}{\partial H}\frac{\partial H}{\partial h^1} + \frac{\partial l^1}{\partial h^1} = A\alpha(1-\alpha)H^{\alpha-1}H_h - \tfrac{1}{2} > 0.$$

Specifically, we have that such a deviation always pays off,

$$\exists \varepsilon > 0, H \in \left[\tfrac{1}{2}, \tfrac{1}{2} + \varepsilon\right) : \frac{du_1^L}{dh^1} > 0.$$

Next, consider the optimal choice of the low-skilled worker in district 1 subject to the fixed wage subsidy to the skilled workers, $h = \text{const}$. Any additional local public good attracts mobile residents. This is again expected by the unskilled workers who compare benefits of associated wage increase with losses from foregone subsidies.

$$\begin{aligned}\frac{du_1^L}{dg^1} &= \frac{\partial F_L^1}{\partial H}\frac{\partial H}{\partial g} + \frac{\partial l^1}{\partial g^1} + \frac{\partial G(g^1)}{\partial g^1} = \\ &= A\alpha(1-\alpha)H^{\alpha-1}G_g H_h - 1 + G_g = \\ &= A\alpha(1-\alpha)H^{\alpha-1}\frac{2}{3}H_h - \frac{1}{3} > 0\end{aligned}$$

Again, we have that such a deviation always pays off,

$$\exists \varepsilon > 0, H \in [\tfrac{1}{2}, \tfrac{1}{2} + \varepsilon) : \frac{du_1^L}{dg^1} > 0.$$

Notice that we have applied that $G_g(g^{SO}) = \frac{2}{3}$. Finally, in comparison with the social optimum, wage subsidies to immobile workers decrease, wage subsidies to mobile workers increase, and the amount of local public goods decreases.

3 Empirical analysis

3.1 Econometric approach

To test whether spending composition is actually a strategic variable, we aim to estimate general reaction function of municipalities based on cross sectional data on 205 Czech municipalities. Because of spatial dependence we use the spatial lag model. The estimating equation for spending category k, $k = 1, 2, ..., K$ can be written as

$$z_i^k = \beta \sum_{j \neq i} w_{ij} z_j^k + \theta X_i + \epsilon_i \tag{1}$$

where scalar β and vector θ are parameters to be estimated, $\theta = (\theta^1, \theta^2, ..., \theta^n)$, vector $X = (x^1, x^2, ..., x^n)$ represents explanatory variables, ϵ_i is error term, w_{ij} are weights illustrating relevance of spending in neighbouring jurisdiction j for strategic interaction.

Brueckner (2003) emphasizes three issues arising from estimation of this model, endogeneity of the z_j's, possible spatial error dependence, and possible correlation between X_i and the error term.

We can rewrite the system of equations (1) in the matrix form as

$$z = \beta W z + \theta X + \epsilon \tag{2}$$

where z is vector of the z_i's (we skip superscript k as it holds for $\forall k$), X is matrix of jurisdictional characteristics and W denotes the weighting matrix with elements w_{ij}. If neighbouring locations are denoted by i and j, then z_j enters on the right hand side in the equation for z_i, but z_i also enters on the right hand side in the equation for z_j (the neighbour relation is symmetric, possibly with nonsymmetric weights $w_{ij} \neq w_{ji}$). This endogeneity must be considered in the estimation process. By rewriting (2) we get

$$z = (I - \beta W)^{-1}\theta X + (I - \beta W)^{-1}\epsilon \tag{3}$$

where each element of z depends on all the ϵ's. Hence, each z_j in (1) depends on ϵ_i. When spatially lagged dependent variable is correlated with the disturbance term, the ordinary least squares estimator is inconsistent (see Anselin, 1988). This holds irrespective of the properties of the error terms. Therefore, it is necessary to use an alternative estimation method.

In the literature, we can find two main methods how to estimate spatial process models. One is the maximum likelihood estimation which is used by Case, Rosen and Hines (1993), Brueckner (1998), Lundberg (2001), Brueckner and Saavedra (2001), Gosh (2006) and Foucalt, Madiès and Paty (2007). We apply the alternative approach using an instrumental variables. This estimation technique can be found in the analysis of Kelejian and Robinson (1993), Fredriksson and Millimet (2000), Revelli (2001), Borck, Caliendo and Steiner (2006) or Ermini and Santolini (2007).

Estimation of (1) is further complicated by the spatial error dependence arising when ϵ includes omitted variables that are spatially dependent. This effect can be explained by unmodelled shocks that spill over across units of observation and thus result in spatially correlated errors. The spatial error dependence can be tested by Moran's I statistic. In this case, the error vector ϵ satisfies

$$\epsilon = \rho M \epsilon + \xi \tag{4}$$

where M is weighting matrix which is assumed to be the same as W in (2), ρ is a autoregressive parameter to be estimated and ξ is a random error term typically assumed to be $i.i.d.$[1] This specification results in variance-covariance matrix with non-zero off-diagonal elements, $E[\epsilon_i \epsilon_j] \neq 0$ for $i \neq j$. Furthermore, diagonal elements in the variance-covariance matrix are not constant. Hence, errors ϵ are heteroscedastic.

The last problem concerning correlation between X_i and ϵ_i can be reduced by using panel data as Brueckner (2003) argues.

In our estimation, we follow the generalized spatial two-stage least squares procedure (GS2SLS) introduced in Kelejian and Prucha (1998). We firstly compute 2SLS estimates of (2). As is standard in the spatial econometrics literature, we use neighbours' socio-economic covariates as instruments for neighbours' expenditure (e. g. Heyndels and Vuchelen, 1998; Sollè-Ollè, 2005; Geys, 2006;

[1] Kelejian and Prucha (2006) have recently developed new technique how to estimate ρ for heteroscedastic innovations ξ.

Werck, Heyndels and Geys, ????). Although Kelejian and Prucha (1998) propose to include also further spatial lags of these variables (WX^2), the results of the Sargan test suggest that our chosen instruments are valid.

Instrumental variable estimator $\hat{\delta} = (\hat{\theta}, \hat{\beta})$ from the first stage of our estimation procedure is

$$\hat{\delta} = (Z'P_I Z)^{-1} Z' P_I z \tag{5}$$

where $Z = (X, Wz)$, P_I is a projection matrix of instruments $I = (X, WX)$, $P_I = I(I'I)^{-1}I'$. In the second step, we derive residuals ϵ from the first step

$$\epsilon = z - \hat{\delta} Z \tag{6}$$

and estimate ρ in (4) by general moments' method as suggested by Kelejian and Prucha (1999). This estimation method yields consistent estimate $\tilde{\rho}$. In the third step, we reestimate (1) by two-stage least squares procedure after transforming the model via a Cochrane-Orcutt type transformation to account for spatial correlation. By this transformation we get $z^* = z - \tilde{\rho} W z$, $X^* = X - \tilde{\rho} W$, hence the new estimated equation takes form of

$$z^* = \tilde{\theta} X^* + \tilde{\beta} W z^* + \epsilon \tag{7}$$

and $\tilde{\theta}$ and $\tilde{\beta}$ denotes GS2SLS estimators.

3.2 Data

The local institutional structure in the Czech republic currently consists of four tiers of government; the central government, 14 regions (territorial self-governing districts, NUTS 3), 205 municipalities with extended powers, 389 municipalities with authorized municipal office and 6 248 municipalities (basic territorial units, NUTS 5). Until the end of 2002, the structure was different, instead of 14 regions there were 91 districts, which still exist (as territorial districts NUTS 4). The reform of regional public administration dissolved competencies of districts such that around 20 % of competencies shifted from districts to the upper level of government, regions, and 80 % to the lower level of government, i. e. municipalities with extended powers.

For our purpose of measuring interrelationship among spending of local governments we use data on municipalities with extended powers which are responsible for social transfers payment, social care of old and disabled people, water industry, environment protection and infrastructure. If we test the interdependence for upper level of government, regions, we will get only a few observations. For homogeneity reasons, we exclude Prague since the capital city is simultaneously municipality with extended power and region. The Ministry of Finance provides the complete database of municipality budgets ARIS where the total expenditures are decomposed into current and capital expenditures, divided further into various components.[2]

[2]www.mfcr.cz/cps/rde/xchg/mfcr/hs.xsl/aris.html

We aggregated these components into 10 groups of spending: agriculture; industry and infrastructure; education; culture, sports and recreation; health; housing, utilities and regional development; environment protection; social and labour market policy; public safety; and general administration. We disregard expenditures on science and research because they are zero except for three major cities of the Czech republic. Our analysis contents per capita spending in 2005.

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Obs.
Population	23288.66	38402.08	205
Population density (per km^2)	508.07	393.75	205
Share of youth	15.19	0.83	205
Share of elderly	13.98	1.36	205
Unemployment rate	10.34	3.97	205
Average gross wage (in Districts)	16367.25	1221.85	205
Workers' mobility	44.01	12.06	205
Grants per capita	1796.16	1821.42	205
Tax revenues per capita	9913.57	1745.37	205
Per capita spending:			
Aggregate	20532.40	5473.48	205
Aggregate capital	5491.42	3490.65	205
Aggregate current	15040.97	3787.10	205
Agriculture	128.52	162.43	205
Industry and other services	2635.35	1885.26	205
Education	1789.13	841.23	205
Culture, sports and recreation	2223.67	1328.92	205
Health	280.49	595.13	205
Housing, utilities and regional development	3356.75	2941.08	205
Environment protection	1159.14	687.21	205
Science and Research	0	0	205
Social and labour market policy	3616.78	1582.69	205
Public safety	529.29	302.75	205
General administration	4813.25	3154.57	205

The crucial point of study is the construction of a neighbourhood weighting matrix. It is fundamental when dealing with spatial correlation since it introduces the potential spatial correlation among units of observations. Our weighting matrix W is based on geographical specification. The diagonal elements of matrix are zero and off-diagonal elements can be denoted by w_{ij} for jurisdiction i and its neighbour j. We positively weight only direct neighbours and $w_{ij} = \frac{1}{n_i}$ if jurisdiction i shares common border with j and the total amount of its direct neighbours is n_i, otherwise it is zero. So the elements of each row of W are normalized such that they sum to unity for each i.

The model of interaction of local public expenditure includes various socio-economic characteristics of local jurisdictions. They are collected in the X

matrix of the exogenous variables. As economic characteristics, we use average gross wage, unemployment rate, grants and subsidies per capita and tax revenues per capita (both available in ARIS database). Unfortunately, we do not have data on GDP for this level of government. Jurisdictional demographic characteristics can affect the composition of public spending for services because they determine the needs and preferences of population for public goods. Therefore, among the dependent variables we include the share of elederly (more than 65 years) and youth (less than 15 years). We furthermore test impact of the density of population which can represent a measure for the rate of jurisdictional urbanization. Finally, we add the share of people traveling in their jobs representing potential mobility of people in the region. The drawback of this indicator is that the most recent data stem from the census in 2001. Most of these exogenous variables are provided by the Czech Statistical Office.[3] Variables and summary statistics can be found in Table 1. For each expenditure group we present only total expenditures and do not distinguish between capital and current expenditures.

3.3 Testing for Spatial Error Dependence

Before estimating coefficients, we firstly test the spatial error dependence in our data of municipalities' expenditure. If we find significant error dependence, we will be enabled to use proposed three-steps estimation technique with GMM estimation of $\tilde{\rho}$.

A useful way to detect spatial error dependence is by using Moran's I statistic. In the original literature (Moran 1950, Cliff and Ord 1981, Anselin 1988), this test is based on residuals that are obtained from an ordinary least squares regression with only exogenous variables. However as Anselin and Kelejian (1997) argue, it does not provide an indication of the nature of the spatial process that causes the autocorrelation, specifically whether it is due to an error process or an omitted spatially lagged dependent variable. Therefore, they derive the asymptotic distribution of Moran's I statistic using residuals from an instrumental variables procedure such as two stage least squares in a general setting which encompasses endogeneity due to system feedbacks as well as spatial interaction (spatially lagged dependent variables).

Based on the IV residuals ϵ, Moran's I statistic can be expressed as

$$I = \frac{N\epsilon' W\epsilon}{S\epsilon'\epsilon}, \tag{8}$$

where S is normalizing vector $S = \sum_{j=1}^{N}\sum_{i=1}^{N} w_{ij}$, W is spatial weighting matrix and N is number of administrative units. Due to our normalization of the weighting matrix in which rows sum to 1, we get $S = N$, hence (8) simplifies to:

$$I = \frac{\epsilon' W\epsilon}{\epsilon'\epsilon} \tag{9}$$

[3] www.czso.cz

Anselin and Kelejian (1997) show that $N^{\frac{1}{2}}I$ is asymptotically normal with mean zero and finite variance ϕ^2. An asymptotic test can be constructed such that the null hypothesis of no spatial autocorrelation may be rejected at the α level of significance if

$$|\frac{N^{\frac{1}{2}}I}{\hat{\phi}}| > z_\alpha \tag{10}$$

where $\hat{\phi}$ is a consistent estimator of ϕ and z_α is the value of a standard normal variate corresponding to α.[4]

Table 2: Moran's I statistic for spatial error dependence

Variable	Moran's I	$\hat{\phi}^2$	z-value	p-value
Total expenditure	-0.108^{*}	0.709	1.840	0.066
Education	-0.240^{**}	2.468	2.192	0.028
Housing, utilities and regional development	-0.161^{*}	1.496	1.881	0.060
Social and labour market policy	-0.140^{**}	0.837	2.204	0.028
Public safety	-0.242^{**}	2.056	2.420	0.016
General administration	-0.143^{*}	1.195	1.874	0.061
Agriculture (capital)	-0.189^{*}	2.535	1.703	0.089
Industry and other services (capital)	-0.145^{*}	1.184	1.919	0.055
Health (capital)	-0.225^{*}	3.038	1.844	0.065
Culture, sports and recreation (capital)	-0.144^{**}	0.999	2.056	0.040

** significance at the 5 % level
* significance at the 10 % level

Table 2 presents significant Moran's I statistics for all expenditure groups. We present result for groups' total expenditure (capital + current) if it was significant. If not, we show significant Moran's I test for capital expenditures. We do not present here results for current expenditures, for which we did not find any significance in the case of agriculture, housing, utilities and regional development, health and environment protection.

As we can see, except for environment protection expenditures (Moran I was insignificant for both capital and current expenditures on environmental protection) we found significance of spatial error dependence for all the expenditures. Thus we can conclude that estimation technique is relevant for our data and continue with presenting the estimation results.

3.4 Estimation Results

Firstly, we will discuss the estimation results on the aggregate expenditures given in Table 3. Then we present the results for different capital and current

[4]For our model (see Anselin and Kelejian, 1997), $\hat{\phi}$ can be expressed as

$$\hat{\phi}^2 = \frac{1}{2N} tr[(W+W')(W+W')] + \frac{4N}{\epsilon'\epsilon}(N^{-1}\epsilon' WZ)(N(Z'P_I Z)^{-1})(N^{-1}Z'W'\epsilon)$$

spending categories, because we found out that this distinction is important for our estimation results. However, we show only coefficients on the spatial lag $\tilde{\beta}$ and the spatial error ρ and not all the $\tilde{\theta}$s. All interesting results in parameters which are not presented will be emphasized it in the text.

Table 3: Aggregate expenditures (per capita)

Variable	Step 1	(t-value)	Step 3	(Standard error)
Constant	9522	(0.79)	9846	(10373)
Population	0.017	(1.44)	0.015	(0.011)
Population density (per km^2)	-2.81^{***}	(-3.01)	-2.74^{***}	(0.882)
Share of youth	-137.2	(-0.29)	-118.5	(418.0)
Share of elderly	-431.4	(-1.50)	-527.4^{**}	(240.6)
Average gross wage (in Districts)	-0.114	(-0.44)	-0.130	(0.220)
Workers' mobility	88.45^{***}	(2.99)	94.32^{***}	(25.41)
Grants per capita	1.71^{***}	(10.83)	1.70^{***}	(0.153)
Tax revenue per capita	1.26^{***}	(5.92)	1.26^{***}	(0.206)
$\tilde{\beta}$	0.126	(0.84)	0.164	(0.138)

*** significance at the 1 % level
** significance at the 5 % level

Table 3 presents the coefficients obtained in regression of per capita aggregate expenditure in step 1 and in step 3 of estimation, in which we control for spatial error to increase significance of $\tilde{\beta}$. As we can see, only four of control variables are significant. We can conclude that the higher is the population density in a municipality (urbanization), the lower is total per capita spending. This can be explained by fixed costs of running municipality or economies of scale in the supply of public goods, particularly in the biggest Czech municipalities. The similar effect was found by Foucalt, Madiès and Paty (2007), whereas Ermini and Santolini (2007) and Borck, Caliendo and Steiner (2006) show opposite sign.

Intuitively and significantly, the amount of grants from upper levels of government per capita and tax revenues per capita increase total expenditure per capita. Additionally, we found significant positive relation among the mobility of people and the total expenditures. The higher is the share of people traveling to jobs, the higher is the per capita aggregate spending. Thus, more mobile people (people willing to travel to job) are attracted by their domestic region with higher expenditure. Furthermore, we can see that share of old population decreases per capita spending. This part of population is less mobile, thus can be hardly attracted by other regions' spending.

We did not find any evidence that the size of municipality in terms of greater population increases per capita total spending; neither we find that average gross income affects aggregate spending. This result indicates that economic performance of the municipality does not matter in the provision of public goods in the Czech republic. Although we control for the spatial lag, the parameter $\tilde{\beta}$ is not significant, so we cannot reject the hypothesis that total expenditures in municipalities are not interdependent.

The following tables 4 and 5 show the estimated coefficients of expenditure interdependence $\tilde{\beta}$ for different spending categories, as well as ρ from the step 2 of our estimation procedure. Table 4 illustrates results for capital expenditure, representing investment into buildings, investment purchases or investment transfers. Table 5 gives the parameters for current expenditure, corresponding to operational costs as wages for workers, material, energy, financial and network services, rents, public transport expenditure and other non-capital costs.

Table 4: G2SLS estimates for spending categories - capital expenditures

Variable	$\tilde{\beta}$	t-value	ρ	t-value
Agriculture	1.195^{***}	(5.29)	-0.69	(-3.68)
Industry and other services	0.818^{***}	(4.52)	-0.52	(-3.47)
Education	1.066^{***}	(4.01)	-0.53	(-3.61)
Culture, sports and recreation	0.942^{***}	(5.43)	-0.63^{**}	(-18.83)
Health	1.193^{***}	(4.27)	-0.60^{*}	(-10.03)
Housing, utilities, regional development	0.155	(0.87)	-6.54^{*}	(-5.95)
Environment protection	0.084	(0.20)	-0.056	(-1.36)
Social and labour market policy	1.047^{*}	(1.88)	-0.75^{*}	(-6.41)
Public safety	1.115^{*}	(3.97)	-0.73	(-3.43)
General administration	1.052^{**}	(4.64)	-0.79^{*}	(-9.57)

*** significance at the 1 % level
** significance at the 5 % level
* significance at the 10 % level

For capital expenditures, we get positive significant relation for all spending categories except for housing, utilities and regional development and environment protection. Surprisingly, the largest dependence is found for agriculture spending. This does not follow the idea of competition, because virtually immobile workers work in agriculture and benefit more from governmental agriculture spending, so there should be some additional effects behind. We probably omitted some geographic variable which influences neighbouring regions' agriculture spending by the same way. This can be for example fertility of agriculture land or altitude. Similar reasoning holds for the expenditures on health for which we found also very strong effect, because any of other explanatory variables does not significantly effect this type of expenditure.

The positive significant competition was detected for groups of education, public safety, general administration followed by culture, sports and recreation and social and labour market policy. Education and public safety spending represents gain for both mobile and immobile workers. Higher quality schools with better equipment can attract parents and therefore force immobile workers to move with their children to regions with better education facilities. Results for culture, sports and recreation verify our theoretical model introduced above. Mostly mobile and richer people gain from culture events, sports and recreation expenses. Thus we would expect the largest competition effect for this group. Similar effect was expected for industry and other services, however surprisingly we got one of the lowest estimates in this case, therefore competition through this channel is not so strong in comparison with other expenditure groups.

For expenditure on environment protection, we would anticipate larger coefficient as again mobile and high-skilled people value good environment more. However, we got mixed evidence in this case, which can be explained by counter effects of competition and some positive spillover effects arising from this type of expenditure.

On the other hand, expenditure on social and labour market policy is important for low-skilled people who are immobile, hence competition among jurisdictions is almost irrelevant in this case. And in fact, our analysis does not prove this fact, because estimated coefficient is quite large one. Therefore, interdependency among municipalities works also in this case.

Significance of ρ estimates verifies the results acquired out of the Moran's I test. The ρ estimate is significant for groups as health, housing, utilities and regional development, culture, sports and recreation, social and labour market policy and general administration, for which Moran's I statistic was significant as well and spatial error dependence was detected.

Table 5: G2SLS estimates for spending categories - current expenditure

Variable	$\tilde{\beta}$	t-value	ρ	t-value
Agriculture	0.598^{**}	(2.42)	-0.30	(-3.06)
Industry and other services	0.443^{**}	(2.48)	-0.47	(-3.47)
Education	1.011^{***}	(6.58)	-0.80^{**}	(-15.18)
Culture, sports and recreation	0.578^{***}	(2.70)	-0.37^{***}	(-443.6)
Health	0.008	(0.01)	0.019	(0.60)
Housing, utilities and regional development	1.101^{***}	(4.39)	-0.61	(-4.81)
Environment protection	0.996^{**}	(3.25)	-0.65^{*}	(-8.26)
Social and labour market policy	0.953^{***}	(9.76)	-0.56	(-3.16)
Public safety	0.991^{***}	(6.46)	-0.83^{*}	(-7.45)
General administration	0.605^{***}	(3.28)	-0.62	(-5.63)

*** significance at the 1 % level
** significance at the 5 % level
* significance at the 10 % level

Table 5 illustrates the estimation results for current expenditures. We obtain significant coefficients for all categories except health indicating that operating costs on health facilities are absolutely independent among regions. In contrary to the conclusion for capital expenditures, the largest effect was found for housing, utilities and regional development from which all residents benefit. Expenses on this type of public goods are mostly current and capital expenditure represents only very minor amount. Additionally, expenditures on public safety and environment protection are also significantly influenced by these expenditures of neighbouring regions. As we can see, we get opposite result for environment protection in comparison with capital expenditure. Thus, current expenditure verifies our hypothesis that mobile and high-skilled people are attracted by good environment. Unfortunately, our theoretical model is weakened by results for industry and other services, culture, sports and recreation and social and labour market policies, for which we would expect higher, respectively lower coefficients indicating competition.

Therefore, in analysis of competition effects on local government spending, it is necessary to be cautious in selection of the expenditure groups. Current expenditure cover all operating costs which mostly represent costs of service provision. Moreover, these costs are often mandatory for municipalities. Therefore, these expenditures do not provide additional value for residents. Capital spending characterizes better measure for competition among regions, therefore generally, coefficients are larger in case of capital expenditures.

4 Conclusion

In this paper, we provide a model and seek evidence of strategic interaction between local spending in the case of the Czech Republic. In theoretical part, we model jurisdictional spending competition as a non-cooperative game of two districts. We examine how competition affects equilibrium amounts of local public goods that are consumed both by immobile and mobile voters and show that regions increase amount of public goods from which mobile voters benefit (in the model, this is represented by wage subsidy to mobile workers), as well as the amount of public good from which both types of voters benefit.

In the empirical part, we aim to find evidence of competition among regions via spending composition for case of the Czech Republic. We use data on 205 municipalities with extended power and explore following spending categories: agriculture; industry and other services; education; culture, sports and recreation; health; housing, utilities and regional development; environment protection; social and labour market policy; public safety; and general administration. We present results both for capital expenditure and current expenditure of these categories, however we argue that capital expenditure better illustrates the jurisdictional competition.

We found strong positive effects for capital expenditure on agriculture,health, education, public safety and social and labour market policy, sports and recreation. Smaller competition effects were indicated by estimated coefficients for culture, sports and recreation and industry and other services. Hence, the estimation results do not fully correspond to the results of our theoretical model, because mostly immobile and low-skilled people benefit from this spending. However, our model still holds for sports and recreation expenditure, from which mobile and high-skilled individuals benefit.

References

[1] Anselin, L.(1988). Spatial econometrics. Dordrecht, Kluwer Academi Publishers.

[2] Anselin, L., Kelejian, H. H. (1997). Testing for spatial error autocorrelation in the presence of endogenous regressors. *International Regional Science Review*, 20m, 153-182.

[3] Boadway, R., Cuff, K., Marceau, N. (2002). Inter-jurisdictional Competition for Firms. *International Economic Review*, 43, 761-782.

[4] Borck, R. (2005). Fiscal Competition, Capital-Skill Complementarity, and the Composition of Public Spending. Berlin, German Institute for Economic Research (Discussion Paper 504).

[5] Borck, R., Caliendo, M. and Steiner, V. (2006). Fiscal Competition and the Composition of Public Spending: Theory and Evidence. Bonn, The Institute for the Study of Labor 2006. (Discussion Paper No. 2428)

[6] Brueckner, J. (1998). Testing for Strategic Interaction among Local Governments: The Case of Growth Controls. *Journal of Urban Economics*, 44, 438-467.

[7] Brueckner, J., Saavedra, L. A. (2001). Do Local Governments Engage in Strategic Tax Competition? *National Tax Journal*, 54, 215-245.

[8] Brueckner, J. (2003). Strategic Interaction Among Governments: An Overview of Empirical Studies. *International Regional Science Review*, 25, 175-188.

[9] Cai, H. and Treisman, D. (2004). State Corroding Federalism. *Journal of Public Economics*, 88, 819-843.

[10] Case, A.C., Rosen, H. S. and Hines, J. C. (1993). Budget Spillovers and Fiscal Policy Interdependence: Evidence from the States. *Journal of Public Economics*, 52, 285-307.

[11] Cliff, A., Ord, J. K. (1981). *Spatial Processes: Models and Applications.* London, Pion.

[12] Cumberland, J. H. (1979). Interregional Pollution Spillovers and Consistency of Environmental Policy. In: Siebert, H. et al. *Regional Environmental Policy: The Economic Issue.* New York, New Yourk University Press.

[13] Ermini, B., Santolini, R. (2007). Horizontal interaction on local councils expenditures. Evidence from Italy. Presented in Amsterodam, First World Meeting of the Public Choice Society.

[14] Feld, L. P., Kirchgassner, G. and Schaltegger, C. A. (2003). Decentralized Taxation and the Size of Government, Evidence form Swiss Sub-Federal Governments, mimeo, University of St. Gallen.

[15] Foucault, M., Madiès, T. and Paty, S. (2007). Public Spending Interactions and Local Politics. Empirical Evidence from French Municipalities. Presented in Amsterodam, First World Meeting of the Public Choice Society.

[16] Fredriksson, P. G., Millimet, D. L. (2002). Strategic Interaction and the Determinants of Environmental Policy acros US States. *Journal of Urban Economics*, 51, 101-122.

[17] Gèrard, M., Ruiz, M. (2006). Interjurisdictional Competition for Higher Education and Firms. Munich, CESifo (Working Paper 1719).

[18] Geys, B. (2006). Looking across Borders: A Test of Spatial Policy Interdependence Using Local Government Efficiency Ratings. Berlin, Social Science Research Center. (Discussion Paper SP II 2006-03)

[19] Glazer, A. (1999). Local Regulation May Be Excessively Stringent. *Regional Science and Urban Economics*, 29, 553-558.

[20] Heyndels, B., Vuchelen, J. (1998) Tax Mimicking in Belgian Municipalities. *National Tax Journal*, 60, 89-101.

[21] Keen, M., Marchand, M. (1997). Fiscal Competition and the Pattern of Public Spending. *Journal of Public Economics*, 66, 33-53.

[22] Kelejian, H. H., Robinson, D. (1993). A Suggested Method of Estimation for Spatial Interdependent Models with Autocorrelated Errors, and an Application to a County Expenditure Model. *Papers in Regional Science*, 72, 297-312.

[23] Kelejian, H. H., Prucha, I. R. (1998). A Generalized Spatial Two-Stage Least Squares Procedure for Estimating a Spatial Autoregressive Model with Autoregressive Disturbances. *Journal of Real Estate Finance and Economics*, 17, 99-121.

[24] Kelejian, H. H., Prucha, I. R. (1999). A Generalized Moments Estimator for the Autoregressive Parameter in a Spatial Model. *International Economic Review*, 40, 509 - 533.

[25] Kelejian, H. H., Prucha, I. R. (2001). On the asymptotic distribution of the Moran I test statistic with applications. *Journal of Econometrics*, 104, 219-257.

[26] Kelejian, H. H., Prucha, I. R. (2006). Specification and estimation of spatial autoregressive models with autoregressive and heteroskedastic disturbances. Department of Economics, University of Maryland, College Park, MD.(Working paper)

[27] Kellermann, K. (2006). A Note on Intertemporal Fiscal Competition and Redistribution. *International Tax and Public Finance*, 13, 151-161.

[28] Lundberg, J. (2001). A Spatial Interaction Model of Benefit Spillovers from Locally Provided Public Services. Umea, CERUM. (Working Paper 31)

[29] Matsumoto, M. (2000). A Note on the Composition of Public Expenditure under Capital Tax Competition. *International Tax and Public Finance*, 7, 691-697.

[30] Millimet, D. L. (2003). Assesing the Empirical Impact on Environmental Federalism. *Journal of Regional Science*, 43, 711-733.

[31] Oates, W. E. (1999). An Essay on Fiscal Federalism. *Journal of Economic Literature*, 37, 1120-1149.

[32] Oates, W. E. and Schwab, R. M. (1988). Economic Competition among Jurisdiction: Efficiency Enhancing or Distortion Inducing? *Journal of Public Economics*, 35, 333-354.

[33] Revelli, F. (2002) Neighborhood effects in social service provision. Competition or reflection? Torino, Università di Torino (Working Paper 6).

[34] Solè-Ollè, A. (2005) Expenditure Spillovers and Fiscal Interactions: Empirical Evidence from Local Governments in Spain. Barcelona, Institut d'Economica de Barcelona. (Working paper 2005/3)