Fiscal Competition and the Composition of Public Spending: Theory and Evidence

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ABSTRACT

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In this paper, we consider fiscal competition between jurisdictions. Capital taxes are used to finance a public input and two public goods, one which benefits mobile skilled workers and one which benefits immobile unskilled workers. We derive the jurisdictions' reaction functions for different spending categories. We then estimate these reaction functions using data from German communities. Thereby we explicitly allow for a spatially lagged dependent variable and a possible spatial error dependence by applying a generalized spatial two-stage least squares (GS2SLS) procedure. The results show that there is significant interaction between spending of neighbouring counties in Germany.

JEL Classification: H77, J24, J61

Keywords: tax competition, capital skill complementarity, public spending, spatial econometrics

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1 Introduction

The early literature on fiscal competition claimed that competition for mobile factors would drive down taxes to inefficiently low levels (Zodrow and Mieszkowski, 1986). While the basic model has been extended in various ways (see Wilson, 1999, for a survey), the one we focus on here is the effect of fiscal competition on the composition of spending. Keen and Marchand (1997) found that jurisdictions will spend too much on public infrastructure, which attracts mobile capital, and too little on consumption goods, which benefit immobile workers. We will use a similar model and also look at jurisdictions' choices of different spending categories under fiscal competition.[1]

The early literature also assumed that jurisdictions are so small that they treat the net return to mobile capital as given. The basic models have been extended to allow for strategic interaction among communities (Wildasin, 1988). Strategic interaction among jurisdictions has also provided the basis for most of the empirical work on fiscal competition (see Brueckner, 2003, for a survey). The empirical papers estimate reaction functions, where, for instance, one jurisdiction's property tax rate is related to the tax rates of neighboring jurisdictions.[2]

This paper extends the literature on fiscal competition in two ways. First, we incorporate two types of labor: skilled and unskilled. In addition we assume that skilled labor is mobile while unskilled labor is not, and that capital and skilled labor are complements. This is referred to as capital skill complementarity (Griliches, 1969).[3] Second, we allow for three public goods: a public input, and two public consumption goods, one benefiting skilled labor and the other benefiting unskilled labor. Borck (2005) uses this type of model to study the composition of public spending in a model with small jurisdictions. By contrast, in this paper we focus on strategic interaction. We also focus on the positive implications of the theory rather than the welfare implications of fiscal competition. The paper models jurisdictions' decisions on the different types of spending and derives their reaction functions. We then estimate reaction functions for German communities using spatial regression techniques.

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[1]See also Fuest (1995) who studies the effects of tax coordination when governments provide a public consumption good as well as a public input.

[2]This literature is by now fairly large, see, e.g., Case *et al.* (1993), Brueckner (1998), Brueckner and Saavedra (2001), Büttner (1999) and Buettner (2001).

[3]Strictly speaking, CSC holds if the elasticity of substitution between capital and skilled workers is smaller than that between capital and unskilled workers.

We believe that these extensions are significant for two reasons. First, on the empirical side, neglecting the interaction between different spending categories may blur the mechanisms by which communities try to attract mobile factors and by which they interact with neighboring communities. Second, as far as the modelling side and its policy implications are concerned, we would stress that capital skill complementarity and the greater mobility of skilled than unskilled workers seem to be well documented.[4] Hence, jurisdictions may find that to attract capital, they also need to attract skilled workers, and to do so they may also use public goods which differentially benefit this group of workers.

Within this framework, we proceed as follows. In Section 2, we present our model and derive the jurisdictions' reaction functions, where the different spending categories are related to spending of the other jurisdictions. In Section 3, we describe our empirical framework for estimating the reaction functions. Section 4 describes our dataset and the results of our spatial regressions are presented in Section 5. The last section concludes.

2   The model

Our model is based on Keen and Marchand (1997) and Borck (2005) who used Zodrow and Mieszkowski's (1986) basic model to study the composition of spending under fiscal competition.[5] Unlike Keen and Marchand (1997) and Borck (2005) who studied small jurisdictions, we explicitly focus on large jurisdictions and the strategic interaction among them.

There are 2 jurisdictions, called regions, each with independent taxing and spending power. Similar to Huber (1999), we assume that there are four factors of production: capital, k, skilled labor (or human capital), h, unskilled labor, l, and a public input, p. In each region, output is produced with the same production function, which is written in intensive form as $f(k, p, h)$. The production function is assumed to be factor-augmenting, i.e., homogeneous of degree one in private inputs: if private inputs double, output also doubles [6]. Denoting partial derivatives by subscripts, the production function satisfies

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[4]See e.g. Griliches (1969), Bergström and Panas (1992), and Krusell *et al.* (2000) for evidence on CSC. For evidence on the mobility of skilled versus unskilled workers, see Mauro and Spilimbergo (1999), Hunt (2000) and Giannetti (2001).

[5]To save space, we limit the exposition of the model to its main ingredients; additional derivations can be found in Borck *et al.* (2005).

[6]This assumption is made here for convenience. See Matsumoto (1998) for a discussion of factor-augmenting versus firm-augmenting public inputs

$f_k, f_h, f_p > 0, f_{kk}, f_{hh}, f_{pp} < 0$. Assume that capital and skilled labor are mobile while unskilled labor is immobile. The unskilled wage rate is $R \equiv f(k, p, h) - k f_k(k, p, h) - h f_h(k, p, h)$. We assume that there is capital skill complementarity (CSC) in the sense that $f_{kh} > 0$. In addition, we assume that public infrastructure is complementary to private capital and skilled labor so that $f_{kp}, f_{hp} > 0$, and that $f_{kk} + f_{kh}, f_{hh} + f_{kh} \leq 0$.

There is a unit tax on capital at rate t, which is used to finance the public input and two public consumption goods, one benefitting skilled labor, g^H, and one benefitting unskilled labor, g^L. For example, one might think of theaters or opera houses which primarily benefit the upper classes versus housing assistance or social assistance to the poor. The basic argument would not be changed if jurisdictions could also tax labor, provided that skilled and unskilled labor were taxed at the same rate (Borck, 2005).

An individual with skill level $j \in \{H, L\}$ who lives in jurisdiction $i \in \{1, 2\}$ has a quasiconcave utility function $u(g_i^j, x_i^j)$, where x is private consumption. Each individual is assumed to inelastically supply one unit of labor. Individuals receive income from wages and from their capital endowment, $\bar{k}_i$, which is the same for each individual. Therefore, the budget constraints of a skilled and unskilled individual can be written:

$$x_i^H = w_i + r\bar{k}_i \tag{1}$$
$$x_i^L = f(k_i, p_i, h_i) - (r + t_i)k_i - w_i h_i + r\bar{k}_i, \tag{2}$$

where w_i is the skilled wage in jurisdiction i. The government budget constraint is:

$$p_i + g_i^H + g_i^L = t_i k_i. \tag{3}$$

Firms are assumed to maximize profits under perfect competition. Capital and skilled labor are mobile between regions, which implies that in equilibrium, the net return to capital, and the utility (not necessarily the net wage) of skilled workers must be equalized across jurisdictions. This implies that the endogenous variables, k_i, h_i, w_i, r for $i = 1, 2$, are functions of tax rates, t_i and spending levels, g_i^H, p_i for $i = 1, 2$. Capital-skill complementarity implies that increases in the capital tax rate in a jurisdiction drive out capital and skilled labor. Further, increasing public goods benefitting skilled labor will attract both capital and skilled labor; spending on public inputs also attracts capital and may attract skilled labor.[7] The effects on factor prices are generally ambiguous, but we can show that the return to capital decreases with the capital tax rate, the high skilled wage falls and the low skilled wage rises with g^H (see Borck *et al.* (2005)).

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[7] In fact this holds in a symmetric equilibrium; see Borck *et al.* (2005).

Each government is assumed to maximize the utility of immobile unskilled workers:

$$\max_{t_i, g_i^H, g_i^L, p_i} u(g_i^L, x_i^L)$$

subject to (1)–(3) and taking account of the effect of taxes and spending on factor prices and the allocation of mobile factors.

The first order conditions to this problem define jurisdiction i's reaction functions vis-a-vis jurisdiction j for $i = 1, 2, i \neq j$:

$$q_i = f(q_j), \tag{4}$$

where $q \equiv (g^H, g^L, p)$. Differentiating the first order conditions gives the slopes of the reaction functions, i.e., the response of the different spending categories in i to changes of all spending categories in j. It is easily seen that the theory gives no restrictions on the signs of the reaction functions. This comes as no surprise, since the simpler models of tax competition with only one tax rate and one public good also do not provide restrictions on the slope of the reaction function (e.g. Brueckner and Saavedra, 2001). In general, however, we would expect that reaction functions differ for different spending categories, depending on how these enter into citizens' utility functions and how they affect the allocation of mobile labor among jurisdictions.

We should also note that there are different mechanisms which yield strategic interaction among jurisdictions (see Brueckner, 2003; Revelli, 2005, for an overview): fiscal competition – as considered here –, budget spillovers, and yardstick competition. In spillover models, one jurisdiction's policies directly provide benefits (or impose costs) on other jurisdictions' residents. This would be the case with public goods such as spending on the environment or crime prevention. Jurisdictions' policies are therefore interdependent. For instance, if one jurisdiction spends money on theaters, neighboring jurisdictions might reduce their spending to take advantage of this spill-in. In general, however, reaction functions might be negatively or positively sloped, as shown by Case *et al.* (1993).

Yardstick competition models assume that citizens use neighboring jurisdictions' policies (or their effects) to judge the efficiency of their own government's policies. Citizens can observe spending and taxes, but not how much spending is due to waste. By observing the ratio of spending to taxes in other jurisdictions, they can draw inferences about the amount of waste in their own jurisdiction and can punish the incumbent by not reelecting her. Here, there is some presumption that reaction functions are positively sloped: if one jurisdiction raises its tax rate, then citizens would infer that their own government tends

to waste resources. Hence, in order to insure reelection the incumbent government would also have to raise spending. However, the incumbent might also reduce spending on public goods, raise waste and forego reelection. Hence, reaction functions might also be negatively sloped (Revelli, 2005).

In summary, various types of models generally yield ambiguous predictions on the slope of reaction functions. For an example how to assess the mechanism behind the strategic interaction, see Baicker (2005). She finds that interaction is best captured by focussing on states between which there is strong mobility, which is consistent with the idea of fiscal competition.

In the next sections, we will estimate reaction functions empirically to get a sense of the signs and significance of parameters. This approach is of some relevance for a number of reasons. First, the empirical literature on fiscal competition has focussed almost exclusively on the tax side, and if spending is analyzed it is usually aggregate spending, with the notable exception of Case *et al.* (1993) who analyze different spending categories. Second, politically, it is of some interest to know whether there is strategic interaction and in what direction it goes. Suppose for instance the central government wants to provide incentives to local governments by providing grants to increase spending on some public good. As is well known from the literature on oligopoly, the comparative statics depend on whether strategic variables are complements or substitutes. Therefore, if strategic interaction exists, knowing the slopes of reaction functions is an important issue.

3 Estimation

We now want to estimate reaction functions as characterized by (4) based on a cross section of German jurisdictions. Before describing our dataset in the next section, we set out the empirical model used to estimate the reaction functions.

The hypothesized shape of the reaction function for spending category $k = 1, ..., K$ of jurisdiction i will be:[8]

$$q_i^k = x_i \beta + \lambda \sum_{j \neq i} w_{ij} q_j^k + \epsilon_i, \tag{5}$$

where β and λ are parameters to be estimated, x is a vector of control variables, ϵ is an error term, and the w_{ij}'s are weights to be used in the estimation. These weights are based

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[8]We assume for the moment that jurisdiction i reacts to changes in category l by its neighbors only by adjusting spending on its category l, not by changing other categories $k \neq l$.

on geographical contiguity (with row-standardized elements $w_{ij} = 1/n_i$ for each of the n_i neighboring jurisdictions and $w_{ij} = 0$ otherwise).[9]

Two main issues have to be addressed when estimating (5): endogeneity of the q_j's and possible spatial error dependence. To make things clear, let us rewrite the system of equations in (5) as

$$q = x\beta + \lambda Wq + \epsilon. \tag{6}$$

Clearly, q on the RHS of (6) is endogenous, since the dependent variable in each cross-sectional unit depends on a weighted average of that dependent variable in neighbouring cross-sectional units. Solving (6) for the equilibrium values of the q_i yields

$$q = (I - \lambda W)^{-1}x\beta + (I - \lambda W)^{-1}\epsilon \tag{7}$$

which shows that each element of x depends on all the ϵ (Brueckner, 2003). The spatially lagged dependent variable in (5) is then correlated with the disturbance term leading to inconsistency of the ordinary least squares estimator (see e.g., Anselin, 1988).

Additional problems arise if the disturbance term is assumed to be spatially autoregressive, i.e.:

$$\epsilon = \rho M\epsilon + \xi, \tag{8}$$

where M is a weighting matrix which we take to be the same as our weighting matrix W, ρ is a parameter to be estimated and ξ is a well-behaved error term. Solving (8) yields

$$\epsilon = (I - \rho M)^{-1}\xi \tag{9}$$

which shows that each element of ϵ is a linear combination of the elements of ξ, implying that ϵ_i is correlated with ϵ_j for $i \neq j$. Ignoring spatial error dependence may lead to false evidence of strategic interaction when estimating (5). Hence we seek an estimator that is able to deal with both sources of spatial correlation.

Kelejian and Prucha (1998) suggest a computationally simple three-step procedure to estimate models with spatially lagged dependent variables and spatially autoregressive disturbances based on a set of instruments H. They refer to their estimation procedure as a generalized spatial two-stage least squares (GS2SLS) procedure and we will use this approach for the following analysis.

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[9]See Brueckner and Saavedra (2001) for a discussion and comparison of weighting schemes in the estimation of property tax competition.

The basic idea is to use the instruments H in a first step to estimate equation (6) by 2SLS, where H consists of the linearly independent columns of (X, WX, W^2X). That is, one regresses Wq on X and WX and uses the fitted values $\widehat{Wq}$ as instruments for Wq. Note that this procedure involves regressing the weighted linear combination of the q_js on X_i and on the same linear combination of the X_js. In effect, each of the q_js is thus viewed as depending on its associated X_j vector and on X_i (Brueckner, 2003).

In a second step, the residuals obtained via the first step are used in a 'generalized moments' procedure suggested in Kelejian and Prucha (1999) to estimate the autoregressive parameter ρ. And finally, (6) is reestimated by 2SLS after transforming the model via a Cochrane-Orcutt type transformation to account for spatial correlation:

$$q_* = x_*\beta + \lambda Wq_* + \epsilon, \tag{10}$$

where $q_* = q - \tilde{\rho}Wq$, $x_* = x - \tilde{\rho}Wx$, and $\tilde{\rho}$ is the estimate of ρ from the second step.

Before presenting our estimation results, we describe the dataset used for the analysis in the next section.

4   Data

We test our model using a cross section of German communities in 2002. There are about 13,000 communities in Germany, which are further grouped into 439 counties (*Landkreise*) and 16 states (*Länder*). We use the counties as unit of analysis; excluding the four counties belonging to city states we are left with a sample of 435. The communities receive revenues from shared tax sources and intergovernmental grants, as well as from levying their own taxes, mainly a business tax (*Gewerbesteuer*) and a property tax (*Grundsteuer*). Communities are granted the right of self administration by the Constitution, but their spending rights are limited by national and state laws. Large parts of the local budgets are devoted to mandated expenditures. For some spending categories such as social assistance, the communities basically just execute federal law. For others such as fire departments or sewerage, the communities have to maintain these functions but have some autonomy over spending levels. Still other categories are discretionary spending, for instance culture and recreational spending. In sum, while local spending autonomy is limited by higher level government intervention, there remains a part of the budget over which the communities have discretion. Hence, we can test for strategic interaction in the discretionary part of local spending.

As dependent variables, we will use per capita spending in the following nine categories:

1. General administration

2. Public safety

3. Schools

4. Science, research and culture

5. Social benefits

6. Health, sports and recreation

7. Construction and housing, transport

8. Public facilities, business development

9. Business enterprises, general property and special assets.

As independent variables, we use a number of typical covariates used in empirical analyses of government spending: GDP per capita, population density, population aged 65 or older, population aged 15 or younger, rate of unemployment, and grants from higher levels of government. We also include dummy variables for the 16 German 'states' (*Länder*) and dummies for the 'type' of county. There are 9 types in total, ranging from low density rural counties to core cities.[10] Variables and summary statistics are displayed in table 1.

5 Results

We now discuss the results from our regressions. We follow Kelejian and Prucha (1998) and estimate the model by the GS2SLS procedure described in section 3. We first present the results on aggregate spending in Table 2, where we include the estimates of λ, ρ and the coefficients for our covariates (except regional type dummies and state dummies). The results for the separate spending categories are in Table 3. To economize on space, for the different categories, we only present the coefficients on the spatial lag λ and the spatial error ρ.[11]

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[10]See `http://www.bbr.bund.de` for a detailed description.
[11]Full estimation results are available on request.

Table 1: Descriptive statistics

Variable	Mean	Std. Dev.
Population (in 1,000)	176.456	136.243
Population Density (Population per km^2)	492.554	627.933
Number of		
Foreigners	6.900	4.733
Social Benefit Recipients	28.140	15.019
Employed	50.685	16.434
Unemployed	10.781	5.396
Share of Young People (< 15 years)	0.149	0.024
Share of Old People (> 65 years)	0.248	0.024
GDP per capita (in 1,000 Euro)	23.329	9.966
Grants per capita (in Euro)	540.74	154.13
Regional Type[a]		
Core cities in agglomerated regions	0.092	0.289
Very dense counties in agglomerated regions	0.101	0.302
Dense counties in agglomerated regions	0.090	0.286
Rural counties in agglomerated regions	0.053	0.224
Core cities in urbanized regions	0.064	0.246
Dense counties in urbanized regions	0.209	0.407
Rural counties in urbanized regions	0.156	0.364
Rural counties of high density	0.136	0.343
Rural counties of low density	0.099	0.299
Per capita spending on (in Euro)		
General administration	87.635	40.015
Public safety	43.424	34.246
Schools	72.899	48.303
Science, research, culture	39.566	41.760
Social benefits	182.340	177.025
Health, sports, recreation	49.726	37.443
Construction, housing, transport	137.322	58.438
Public facilities, Business development	120.956	69.472
Business enterprises, property and special assets	63.896	56.579
Total	1227.300	583.325

N=435 observations. [a] See `http://www.bbr.bund.de` for an exact definition.

	Step 1		Step 2		Step 3	
	Coeff.	s.e.	Coeff.	s.e.	Coeff.	s.e.
Constant					-204.732	464.343
GDP	23.165	2.635**			22.730	2.545**
Population Density	0.030	0.061			0.036	0.058
Share of Foreigners	8.833	8.085			7.841	7.384
Unemployment Quota	-2.931	7.976			-0.754	7.112
Share of Young People	-1737.272	2014.106			-1558.595	1886.580
Share of Old People	-841.856	1042.180			-366.697	963.693
Grants	0.001	0.000**			0.001	0.000**
λ	0.178	0.101†			0.222	0.093**
ρ			-0.320	0.007**		

N=435 in all regressions.

* significant at 5%; ** significant at 1%, † significant at 10%.

Estimations are based on the GS2SLS procedure by Kelejian and Prucha (1998). Additional explanatory variables included: Federal state and regional type.

Table 2 presents the results in three parts. The first part shows the first stage results, the second part the second step results, i.e., the estimate of ρ, while the third part shows the final step, that is, the GS2SLS estimator.[12] Looking further at the Table, we see that among the covariates, only GDP per capita and intergovernmental grants are significant. Both positively affect aggregate spending per capita, a typical finding in empirical studies on government spending. Finally, the table shows that aggregate spending levels seem to be strategic complements, i.e., jurisdictions react to increases of their neighbors' spending by increasing their own spending. As can be seen from the table, the first and third stage yield relatively similar results. However, the estimate of λ becomes much more significant when we allow for spatial correlation of the errors. This shows that it is important to control for spatial correlation in the errors. The intuition here is that the errors are negatively correlated, so disregarding this correlation tends to underestimate λ.

Let us now look at the results for our separate spending categories. Apart for spending on public safety and health, sports and recreation, we find significant λs for all other categories (the coefficient for social benefits is significant at 10%). What seems to be of

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[12]Note that first stage here refers to the 2SLS regression. Considering the first stage of this regression, i.e., the regression of the endogenous spending variable on the instruments, we find an R^2 of 0.90 and a highly significant F-test. Results for the other spending categories are broadly similar. Hence, the endogenous variables are indeed highly correlated with the instruments.

Table 3: Spatial 2SLS results

Variable	λ	Std. Error	ρ	Std. Error
General administration	.540	.113**	-.430	.009**
Public safety	.059	.102	-.143	.008**
Schools	.273	.116*	-.217	.006**
Science, research, culture	-.573	.118**	.117	.008**
Social benefits	-.146	.087†	-.117	.008**
Health, sports, recreation	.047	.167	-.098	.014**
Constr. Hous.	.230	.113*	-.098	.007**
Business development	.641	.121**	-.516	.008**
Business enterprises	.468	.149**	-.287	.005**

N=435 in all regressions.
* significant at 5%; ** significant at 1%, † significant at 10%.
Estimations are based on the GS2SLS procedure by Kelejian and Prucha (1998). Additional explanatory variables included as summarised in table 1.

particular interest are the coefficients for public facilities/business development and science, culture and research (see Table 3). While we find a strong positive reaction for the first category (0.641), the coefficient for the second category is significantly negative (−0.573). The positive reaction for public facilities and business development indicates that there is competition between counties, i.e. if neighbouring counties expand their spending on, e.g., sewage or waste disposal, there is a strong incentive to do the same in order to stay competitive. This may be due to competition for mobile factors or to yardstick competition, as noted in section 2.

On the other hand, expenditures on science and culture seem to be strategic substitutes, i.e., counties decrease their spending in response to increased spending by their neighbors. While our theory did not exclude negatively sloped reaction functions, another possibility is that any positive incentive to match other communities' spending is swamped by spill-overs from investment of neighbouring counties e.g. in theatres.[13] Since the regional distance between counties in Germany is in general not very large, inhabitants of one county will in general have access to the amenities of neighbouring counties.

Spending on infrastructure such as construction, housing and transport is typically also seen as a category where counties compete with each other. Thus we would expect strategic interaction here, too, and indeed we find a positive and significant coefficient ($\lambda = 0.230$).

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[13]In spillover models too, reaction functions may slope either up or down. Indeed Case *et al.* (1993) find positively sloped reaction functions for state spending in the US and interpret this in a spillover framework.

We also find significantly positive coefficients for the categories general administration and schools. For schools, communities have limited discretion over spending levels, since education in Germany is a state affair. However, communities have original competencies, for instance in maintenance and extra-curricular activities. Hence, given that we control for common state trends through dummies and for spatial error dependence, the results may indicate strategic interaction even in this highly regulated category.

Finally, we find a negative relation for expenditure on social benefits (-0.146), which is, however, significant at 10 % only. While the largest spending item in this category, namely social assistance (*Sozialhilfe*), is regulated by national law, once again communities do have some discretion in other areas such as assistance to youths, supplements to housing and the support of local welfare organizations. Again, the literature has often implicitly assumed positively sloped reaction functions for welfare spending, but as Brueckner (2000) shows, reaction functions may slope down and indeed, some studies have found negative coefficients. Thus, our estimate here is also consistent with welfare competition.

Overall, the results show that there is significant interaction between spending of neighbouring counties in Germany. This is not only true for aggregate expenditure but also for most of the analysed sub-categories. As some of the previous literature, we also find positively reaction functions for most spending items, except for social benefits and science/research and culture. While a variety of explanations is possible for these results, the negative coefficients are compatible with our theory; another explanation might, however, be the existence of spillovers.

6   Conclusion

We have presented a general framework of strategic interaction of governments in different spending categories. Using a cross-section of German counties from 2002, we empirically estimate reaction functions at the county level. Thereby we explicitly allow for a spatially lagged dependent variable and a possible spatial error dependence by applying a generalized spatial two-stage least squares (GS2SLS) procedure. We start by estimating the reaction function for aggregate expenditures and find a statistically significant positive relation of 0.22. That means, that a one Euro increase in neighbours' spending leads to a 0.22 Euro increase in own county spending. However, as theory suggests that the reaction functions differ for different spending categories, we have also estimated the model for several spending categories, e.g. public safety, schools or social benefits. We find significant

interaction in almost all spending sub-categories as well. While counties' expenditures are complementary, we also find a few spending categories which are substitutes. Fiscal competition among local governments for mobile factors is one possible explanation for the effects of strategic interaction that we identify.

It is interesting to note that we find these significant effects despite the fact that the German local government sector is highly regulated by state and national law. However, some discretion remains at the community level and communities seem to use this discretion.

Acknowledgments

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