

Büttner, Thiess

Conference Paper

Commercial Land Use and Interjurisdictional Competition

Beiträge zur Jahrestagung des Vereins für Socialpolitik 2016: Demographischer Wandel -
Session: Invited Session Finanzwissenschaftlicher Ausschuss / Committee on Public Economics,
No. E17-V3

Provided in Cooperation with:

Verein für Socialpolitik / German Economic Association

Suggested Citation: Büttner, Thiess (2016) : Commercial Land Use and Interjurisdictional Competition, Beiträge zur Jahrestagung des Vereins für Socialpolitik 2016: Demographischer Wandel - Session: Invited Session Finanzwissenschaftlicher Ausschuss / Committee on Public Economics, No. E17-V3, ZBW - Deutsche Zentralbibliothek für Wirtschaftswissenschaften, Leibniz-Informationszentrum Wirtschaft, Kiel und Hamburg

This Version is available at:

<https://hdl.handle.net/10419/145955>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Commercial Land Use and Interjurisdictional Competition

Thiess Buettner[‡]

August 2016

Preliminary

Abstract

This paper considers effects of local public finances on land use. A theoretical analysis explores the trade off faced by a local government deciding about the amount of land made available for commercial use. While more commercial land tends to attract mobile factors, its expansion is assumed to have adverse effects on the quality of life. A distortion of the decision is shown to arise in an environment with tax competition, where a fiscal incentive arises to expand commercial land use. Fiscal redistribution through equalization grants, however, reduces this incentive. Based on the theory, the effect of tax competition and fiscal redistribution on commercial land-use is investigated empirically using a large dataset of German municipalities. In order to identify differences in the degree of fiscal redistribution, I exploit institutional characteristics of the system of fiscal equalization to which these municipalities are subjected. The results confirm that the amount of land dedicated to commercial land-use, tends to be higher in municipalities that are exposed to more intense tax competition.

JEL-Classifications: H77, H71, C31

Keywords: *Land Use; Zoning; Natural Amenities; Fiscal Competition; Tax Competition; Fiscal equalization; Local Business Taxation*

[‡]Thiess Buettner
Address: Friedrich-Alexander-University
Lange Gasse 20
D-90403 Nuremberg
Germany
thiess.buettner@fau.de

1 Introduction

In the public debate, expanded land use for settlements, including residential land use, traffic and commercial areas, is often feared to eat up space for recreation and to exert adverse effects on the environment. The urban economics literature has emphasized that land use is only one dimension of local economic development and efficient land use will have to trade off environmental and other concerns against the economic benefits of urban expansion (*e.g.*, Brueckner, 2000). Since land use is typically regulated by local governments, this suggests that local governments need to find a balance between the conflicting interests in the electorate. On the one hand, local governments face demands to attract firms in order to enhance employment opportunities and to expand the provision of public services, which requires to attract tax payers. On the other hand, residents seek to maintain natural amenities, and there is pressure by environmental groups to restrict land use. Finding a balance between these different demands might prove difficult in practice and political economy consideration may give rise to concerns that local land-use might be inefficient. Yet such concerns apply at all levels of government. At the local level, one could argue that competition between governments might actually support the efficiency of public policy as has been emphasized by many writers in the Tiebout (1956) tradition.

The urban public finance literature has emphasized, however, that a key precondition for efficient local policies is a sufficiently rich set of policy instruments. This includes various tax instruments that allow the decentralized allocation to provide an efficient level of public services and to meet what is known as locational efficiency condition (see Wildasin, 1991). In practice, local governments often face limitations in the set of available policy instruments. A large literature has evolved, in particular, around the limitations regarding tax instruments and has emphasized that in a setting

where local governments have only taxes on mobile factors at their disposal, local decisions exert fiscal externalities which challenge the normative view on efficient decentralization in the public sector. More precisely, it is well noticed in the literature that interjurisdictional competition with a restricted set of tax instruments results in inefficient tax competition (for a survey, see Wilson, 1999). The literature mainly discusses underprovision of local public goods (e.g., Zodrow and Mieszkowski, 1986) and distortions on the expenditure side (Keen and Marchand, 1997). Against this background, the current paper explores the implications of tax competition for land-use regulation.

The starting point for the analysis in this paper is a standard tax-competition model, where local governments are restricted in the set of available tax instruments and levy only a tax on mobile capital. The model is augmented by land as an input to production. The total amount of land available for commercial land-use is determined by the local government. In this model, I discuss the trade-off faced by a local government when deciding on the share of land assigned to commercial land-use. Whereas land not used commercially serves as a natural amenity, more commercial land results in higher income and tax revenues. The model shows that the optimal decision of a local government depends on tax competition and on the degree of fiscal redistribution.

The empirical testing ground is commercial land-use in Germany. German municipalities offer a promising case for studying local tax competition, since a main revenue source of local municipalities is a business tax, which is a tax levied on profits of local firms and establishments. Moreover, municipalities also decide on local land-use patterns including commercial land-use, which may be particularly important to attract firms. In order to identify differences in the competitive environment of jurisdictions, I exploit institutional characteristics of fiscal redistribution among

municipalities which tends to shield municipalities from interjurisdictional competition. The empirical analysis confirms that the amount of land dedicated to commercial use tends to be higher in municipalities that are exposed to more intense interjurisdictional competition.

The contribution of this paper is threefold. The first contribution is to provide empirical evidence on interjurisdictional competition as a driving force behind land-use patterns. The urban economics literature has emphasized the role of commuting cost where public roads and infrastructure provision as well as public transit play an important role (for surveys see, Glaeser and Kahn, 2004; Nechyba and Walsh, 2004). The literature has also discussed the role of taxation (e.g., Brueckner and Kim, 1993; Voith, 1999). A large strand of the literature has focused on the key role of the government as regulator of land use through zoning and various restrictions. In the latter context, the strategic nature of those restrictions in a competitive environment where population is mobile has been noted by Brueckner (1995) and Helsley and Strange (1995). Brueckner (1998) provides empirical evidence on strategic interaction among local governments in zoning regulations. However, what is behind this interaction has been left unexplored. In particular, there is no literature testing whether land use is affected by interjurisdictional competition arising from mobility of factors (for a discussion of the limits of the models of strategic interaction see Brueckner, 2003, and Revelli, 2005).

A second contribution is to provide empirical evidence on the incentive effects of fiscal equalization and revenue sharing on government policies. While those effects are discussed in the theoretical literature in fiscal federalism (e.g, Bucovetsky and Smart, 2006; Koethenbuerger, 2006), empirical evidence so far has mainly been concerned with tax policy (Dahlby and Warren, 2003; Buettner, 2006; Egger, Koethenbuerger, and Smart, 2010; Dahlby and Ferede, 2016).

The third contribution is to ascertain the role of business tax competition as a driver of land use in Germany. While the German context allows us to provide the first systematical empirical analysis of the role of incentives arising from tax competition and fiscal redistribution for commercial land-use regulation, the role of business tax competition has been critically discussed by observers of land use in Germany. Particular scepticism is held against growing fractions of land dedicated to commercial use. Critics include the German federal government, whose environmental agency condemns the expansion of land use for residential and commercial settlements for substantial environmental damage and proposes counteractions (see Umweltbundesamt, 2004).

While the empirical evidence provided in this paper shows that business tax competition exerts significant effects on commercial land-use, the results also show that municipal fiscal equalization substantially curtails these effects in Germany. Thus, business tax competition is not a major driver of the expansion of land use in Germany.

The paper is organized as follows. The next section provides the theoretical background by augmenting a tax competition model with land as an input of production, where the supply of land is fixed by the government. Section 3 discusses the methodology of the empirical approach. Section 4 describes the data and the institutional background. Section 5 discusses the empirical results. Section 6 summarizes the main findings and concludes.

2 Theoretical Analysis

This section develops a model of the local economy that allows me to discuss optimal public policies with regard to land use.

2.1 The Local Economy

I consider a local economy using labor, capital, and land. Assuming linear homogeneity of the production function firm profits π_i per unit of labor in jurisdiction i are

$$\pi_i = f(l_i, k_i) - r_i k_i - q_i l_i - w_i,$$

where l_i and k_i denote land and capital intensity of labor. r_i is the gross rate of return on capital, w_i is the local wage rate, and q_i is the land rent. I focus on a simple symmetric setting, where population size n and total supply of land per capita a are equal across jurisdictions. Land is assumed to be used either for production, where l_i is the land intensity of labor, or serves as an amenity. Assuming that each resident supplies one unit of labor, land per-capita not used commercially is $h_i = a - l_i$. The decision on how much land is assigned to commercial purposes by the local government and, thus, l_i is treated as a policy parameter.

The net rate of return differs from the gross rate of return to capital by the tax-wedge associated with a per-unit tax on capital

$$r_i = \tau_i + \rho, \tag{1}$$

where τ_i is the tax rate and ρ is the net rate of return on capital. Due to capital mobility, the latter

is common to all jurisdictions and determined on the national capital market. As labor supply corresponds to the size of the population, the capital market equilibrium condition requires that employment of capital in all M jurisdictions obeys

$$\sum_{i=1}^M nk_i = K, \quad (2)$$

with K being the fixed capital supply. Profit maximization implies

$$f_l(l_i, k_i) = q_i, \quad (3)$$

$$f(l_i, k_i) - l_i q_i - k_i r_i = w_i, \quad (4)$$

and

$$f_k(l_i, k_i) = r_i.$$

The last condition can be rearranged to obtain the capital demand function

$$k_i = \varphi(l_i, r_i), \quad (5)$$

which is increasing in l_i and decreasing in r_i . Formally, $\frac{\partial \varphi}{\partial l_i} = \frac{f_{kl_i}}{-f_{kk_i}} > 0$ and $\frac{\partial \varphi}{\partial r_i} = \frac{1}{f_{kk_i}} < 0$.

With supply of labor n and land a given for each jurisdiction, equations (3)-(5) together with the definition of the gross rate of return on capital (1) and the capital market equilibrium condition (2) can be used to solve for the endogenous variables ρ, r_i, k_i, q_i and w_i , $i = 1, \dots, M$. In the following, I focus on the effects of local government choices of the policy parameters l_i and τ_i . To this end, I follow Wilson (1991) and consider the equilibrium net rate of return on capital a function of the

policy parameters in all jurisdictions $\rho = \rho_i(\tau_1, \tau_2, \dots, l_1, l_2, \dots)$. The effects of the choices of the policy parameters in jurisdiction i on the land rent, the wage-rate and the capital intensity of a jurisdiction are derived using a total differential of the system.

With regard to the equilibrium employment of capital, an increase of the tax rate of jurisdiction i holding constant all other policy parameters exerts an effect

$$\frac{dk_i}{d\tau_i} = \frac{1}{f_{kk_i}} \left[1 + \frac{\partial \rho_i}{\partial \tau_i} \right] < 0,$$

which is negative. This results from the interjurisdictional mobility which ensures that the tax burden is not fully shifted to the capital owner ($0 \geq \frac{\partial \rho_i}{\partial \tau_i} > -1$).¹ If land and capital are complements $f_{lk_i} > 0$, an increase in land intensity exerts a positive effect on capital

$$\frac{dk_i}{dl_i} = \frac{f_{lk_i}}{-f_{kk_i}} \left[1 + \frac{\partial \rho_i}{\partial \tau_i} \right] > 0.$$

With complementarity the effect of the tax rate on the land rent is negative

$$\frac{dq_i}{d\tau_i} = f_{lk_i} \frac{dk_i}{d\tau_i} < 0.$$

An expansion of land also reduces the land-rent

$$\frac{dq_i}{dl_i} = f_{ll_i} + f_{lk_i} \frac{dk_i}{dl_i} < 0,$$

¹Differentiation of equation (2) results in

$$\frac{\partial \rho_i}{\partial t_i} = \frac{n_i \frac{\partial \varphi}{\partial r_i}}{-\sum n_j \frac{\partial \varphi}{\partial r_j}}.$$

which holds under the usual regularity condition $f_{ll_i}f_{kk_i} > f_{lk_i}f_{kl_i}$.

The effect on the wage rate is determined by the total differential of the wage equation

$$dw_i = f_l(l_i, k_i) dl_i - dl_i q_i - l_i dq_i + f_k(l_i, k_i) dk_i - dk_i r_i - k_i dr_i.$$

Taking account of the conditions for profit maximization this can be simplified to

$$dw_i = -l_i dq_i - k_i dr_i.$$

Accordingly, a higher land rent as well as a higher gross rate of return on capital exert negative direct effects on the wage rate.

An increase in the tax rate that causes a decline of the land-rent exerts a positive effect on wages – the higher gross-return on capital results in lower wages. The total effect

$$\frac{dw_i}{d\tau_i} = \left(-l_i \frac{f_{lk_i}}{f_{kk_i}} - k_i \right) \left[1 + \frac{\partial \rho_i}{\partial \tau_i} \right]$$

is ambiguous. With a Cobb-Douglas production function, however, the latter effect dominates and

$$\frac{dw_i}{d\tau_i} < 0.^2$$

An increase in commercial land l_i causes a decline of the land-rent that exerts a positive effect on

²With a Cobb-Douglas production function $f(k_i, l_i) = Ak_i^\alpha l_i^\beta$, the wage effect is

$$\frac{dw_i}{d\tau_i} = \left(-l_i \frac{f_{lk_i}}{f_{kk_i}} - k_i \right) \left[1 + \frac{\partial \rho_i}{\partial \tau_i} \right] = -k_i \left(\frac{1 - \alpha - \beta}{1 - \alpha} \right) \left[1 + \frac{\partial \rho_i}{\partial \tau_i} \right] < 0.$$

wages – the higher return on capital, however, results in lower wages. The total effect

$$\frac{dw_i}{dl_i} = -l_i f_{ll_i} \left(1 - \frac{f_{lk_i} f_{kli}}{f_{ll_i} f_{kk_i}} \right) + \frac{\partial \rho_i}{\partial \tau_i} \left(l_i \frac{f_{lk_i} f_{kli}}{f_{kk_i}} + k_i f_{kli} \right)$$

is ambiguous. However, with a Cobb-Douglas production function, the positive effect dominates and $\frac{dw_i}{dl_i} > 0$.³

2.2 Public Policy

Rather than using a local land tax or a tax on residents, the local government only imposes a tax on mobile capital. In addition, the local government is subject to a system of fiscal equalization grants provided by an upper level government.⁴ More specifically, I assume that municipality i receives a grant per resident reflecting some level of fiscal need per capita g_i . At the same time, it has to pay an implicit revenue sharing contribution proportional to its tax capacity $\vartheta_i k_i$, which depends positively on the tax base k_i . ϑ_i denotes the marginal contribution rate. Note that the parameters of the fiscal equalization system g_i and ϑ_i are both indexed with the municipality implying that the system treats individual jurisdictions differently. Hence, net of contributions the municipality

³With a Cobb-Douglas production function $f(k_i, l_i) = A k_i^\alpha l_i^\beta$, the wage effect is

$$\begin{aligned} \frac{dw_i}{dl_i} &= -l_i f_{ll_i} \left(1 - \frac{\alpha\beta}{(1-\alpha)(1-\beta)} \right) + \frac{\partial \rho_i}{\partial \tau_i} k_i f_{lk_i} \left(1 - \frac{\beta}{1-\alpha} \right) \\ &> -l_i f_{ll_i} \left(1 - \frac{\alpha\beta}{(1-\alpha)(1-\beta)} \right) - k_i f_{lk_i} \left(1 - \frac{\beta}{1-\alpha} \right) \\ &= (1-\beta) f_{l_i} \left(1 - \frac{\alpha\beta}{(1-\alpha)(1-\beta)} \right) - \alpha f_{l_i} \left(1 - \frac{\beta}{(1-\alpha)} \right) \\ &= f_{l_i} (1 - \alpha - \beta) > 0 \end{aligned}$$

⁴For simplicity, the theoretical analysis focuses on revenue-neutral policy changes. As a consequences, repercussions through the funding of equalization grants need not to be modelled.

receives a grant

$$z_i = g_i - \vartheta_i k_i.$$

Public policy is assumed to aim at maximizing a quasi-linear welfare function

$$V = w_i + u((\tau_i - \vartheta_i) k_i + g_i) + v(a - l_i), \quad (6)$$

where u is utility from public consumption and v captures the utility derived from the part of land that is not used commercially. Hence, welfare is determined by wages, by the per-capita revenues from capital taxation and the fiscal equalization scheme, and by the share of land not used for commercial purposes. Note that income from the land-rent does not enter the local government's objective function which is equivalent to assuming that all land is owned by absentee landlords. This simplifying assumptions helps me to focus on wage and revenue effects of land use.

Optimization with regard to the capital tax rate implies

$$\frac{dw_i}{d\tau_i} + u'((\tau_i - \vartheta_i) k_i + g_i) \left(k_i + (\tau_i - \vartheta_i) \frac{dk_i}{d\tau_i} \right) \stackrel{!}{=} 0.$$

This can be expressed in the form of the familiar Samuelson condition

$$u'((\tau_i - \vartheta_i) k_i + g_i) = \left(-\frac{dw_i}{d\tau_i} \right) \frac{1}{k_i + (\tau_i - \vartheta_i) \frac{dk_i}{d\tau_i}}, \quad (7)$$

requiring that the marginal benefit of public good provision equals the marginal cost of public funds. Note that the latter term is a declining function of the parameter ϑ_i that reflects the degree of fiscal redistribution.

Optimization with regard to the supply of land requires

$$\frac{dw_i}{dl_i} + u'((\tau_i - \vartheta_i)k_i + g_i)(\tau_i - \vartheta_i) \frac{dk_i}{dl_i} - v'(a - l_i) \stackrel{!}{=} 0.$$

Rearranging terms yields

$$v'(a - l_i) = \frac{dw_i}{dl_i} + u'((\tau_i - \vartheta_i)k_i + g_i)(\tau_i - \vartheta_i) \frac{dk_i}{dl_i}. \quad (8)$$

This expression states that the optimal land use requires the marginal benefit from land as an amenity to be equal to its opportunity cost. The latter consists of the marginal increase in the wage rate and the marginal benefit from higher tax revenues if an additional unit of land is made available for commercial use. Note that the latter term depends on the net revenue effect of the larger tax base.

In this setting, the following proposition holds:

Proposition 1:

In a decentralized economy characterized by equations (1)-(5) and with Cobb-Douglas technology, a benevolent local government aims at maximizing utility of immobile labor according to equation (6). The optimal land use policy requires that the benefit from land not used commercially is equal to the opportunity cost. An individual jurisdiction has a higher optimal share of commercial land if it is exempted from rather than being subjected to fiscal redistribution.

Proof: The optimal tax and land use policies of jurisdiction i are given by equations (7) and (8).

In a situation where jurisdiction i is not subject to fiscal redistribution, the parameters of the

equalization system are $g_i^0 = 0$ and $\vartheta_i^0 = 0$ for this jurisdiction. The optimal policy is characterized by l_i^0 and τ_i^0 and the resulting supply of public goods is $k_i^0 \tau_i^0$. A revenue neutral change in the equalization system is characterized by

$$\vartheta_i^1 = \tau_i^0$$

and

$$g_i^1 + (\tau_i^0 - \vartheta_i^1) k_i^0 = \tau_i^0 k_i^0.$$

Keeping the tax rate at the initial level, the jurisdiction can therefore provide the same amount of public services without the need to adjust the supply of land. However, with policy choices unchanged, the amount of land not used for commercial purposes has lower opportunity cost since

$$\begin{aligned} v' (a - l_i^0) &= \frac{dw_i}{dl_i} + u' (\tau_i^0 k_i^0) \tau_i^0 \frac{dk_i}{dl_i} \\ &> \frac{dw_i}{dl_i} + u' (g_i^1) (\tau_i^0 - \vartheta_i^1) \frac{dk_i}{dl_i} \\ &= \frac{dw_i}{dl_i}. \end{aligned}$$

If the second-order conditions for an optimum are fulfilled in the initial equilibrium, the optimal amount of land made available for commercial use is reduced $l_i^1 < l_i^0$. ■

The intuition behind this statement follows from the condition (8) which characterizes the optimal land use. If fiscal redistribution is at a maximum, the marginal effect of land on tax revenues is fully compensated by equalization grants $\tau_i = \vartheta_i$. In this case, an increase in the tax base through the expansion of land does not generate any (net-)revenue effect. Hence, the second term of the optimality condition does not add to the opportunity cost of land use. With lower opportunity cost of land not used for commercial purposes, the amount of land available to generate amenities

$a - l_i$ is increased and the share of land assigned to commercial use l_i is reduced.

3 Empirical Methodology

The empirical analysis examines determinants of commercial land-use using data for local jurisdictions. In particular, it aims to test whether a higher share of land is assigned to commercial land-use by jurisdictions that are operating under business tax competition. To identify differences in the strength of tax competition faced by the individual jurisdictions I rely on fiscal institutions in Germany. More specifically, I exploit the fact that equalization grants,⁵ the key instrument for fiscal redistribution among German municipalities, are not paid to all municipalities. Municipalities which have tax capacity or are deemed to have low fiscal need are exempted. While the details vary by region, the basic set-up of equalization is the same for all regions in our data. Jurisdictions with low fiscal capacity relative to fiscal need receive equalization grants that are inversely related to fiscal capacity. As a consequence, they face a high degree of fiscal redistribution. An additional Euro of own revenues, generated through the expansion of commercial land, for instance, results in much lower fiscal equalization grants (Buettner, 2006). Consequently, the impact on net revenues is substantially reduced to about 20 cents out of an additional Euro of own revenues. Jurisdictions that have fiscal capacity above a certain level of fiscal need marked are considered “abundant” and do not receive equalization grants. Hence, these jurisdictions face a much lower degree of fiscal redistribution. An additional Euro of own revenues, generated through the expansion of commercial land, would show up in much higher revenues.

⁵In German these grants are formally called *Schlüsselzuweisungen nach der mangelnden Steuerkraft*.

The identification of the degree of fiscal redistribution faced by the individual jurisdictions utilizes the fact that equalization grants are formula based and determined mainly by tax capacity (k_i) and population size (n_i).⁶ More specifically equalization grants per capita are determined by a function

$$z_i = f(n_i, k_i; g_i, \vartheta_i),$$

where g_i, ϑ_i represent parameters of fiscal redistribution. The distinction between high- and low tax-capacity jurisdictions implies that the function is discontinuous. More specifically, for jurisdictions that have tax capacity exceeding fiscal need, a change in tax capacity has no effect on the equalization grant. If tax capacity is below fiscal need, an increase in tax capacity results in a lower equalization grant. Formally, using the above notation, for jurisdictions with tax capacity below fiscal need $\vartheta_i k_i < g_i$, equalization grants are paid and $\frac{\partial z_i}{\partial k_i} < 0$. For jurisdictions that have tax capacity exceeding fiscal need $\vartheta_i k_i \geq g_i$, consequently $\frac{\partial z_i}{\partial k_i} = 0$.⁷

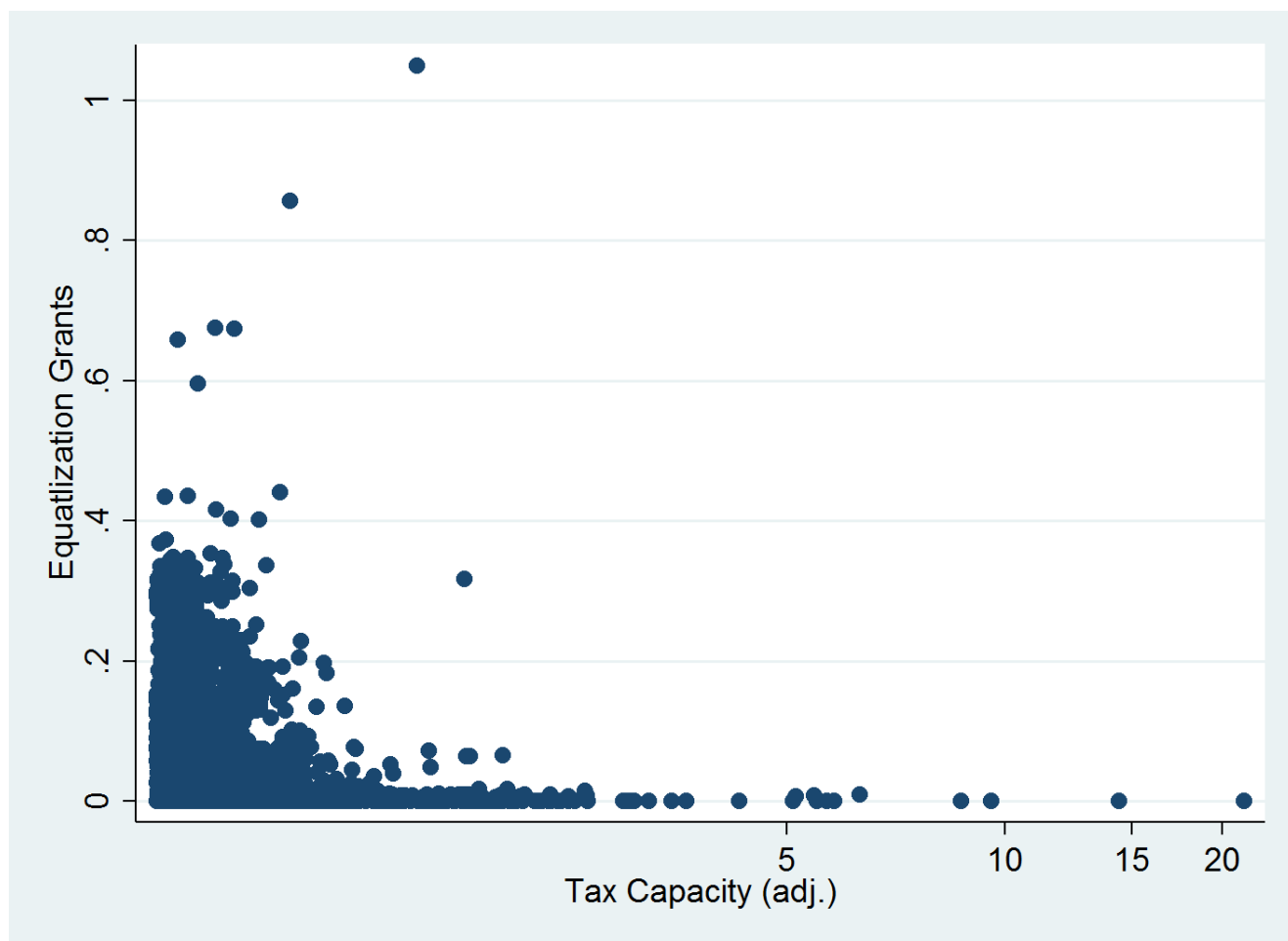
To illustrate the discontinuity graphically, Figure 1 provides a scatter plot of equalization grants against tax-capacity employing the dataset used below. While there is substantial variation in equalization grants capturing differences in fiscal need across jurisdictions, at high levels of tax capacity, changes in the tax capacity do not show up in the equalization grants.

Municipal fiscal equalization does not rely on a single indicator to determine whether a municipality receives fiscal equalization or not. It rather considers a set of indicators that capture the tax capacity

⁶Also density plays an important role and it therefore included in the analysis below. To keep the discussion of the methodology simple, this further determinant is suppressed in the following exposition.

⁷Actually, there are more discontinuities in the system, as in many states jurisdictions with particularly low tax capacity are subject to (even) higher fiscal redistribution (see Buettner, 2006).

Figure 1: Fiscal Equalization Grants and Tax Capacity



Note: The figure reports tax capacity and equalization grants both in per capita terms for the estimation sample excluding observations from Lower-Saxony. Note that the tax capacity is standardized at state level such that the mean values for the different states are identical.

and various dimensions of fiscal need. This makes it extremely difficult to construct a single variable that determines the assignment to fiscal redistribution. For this reason, the empirical analysis does not follow a regression discontinuity design. However, given the crucial importance of tax capacity and population size of municipalities, in order to empirically identify the causal effects of fiscal equalization, it is of key importance to take account of the differences among jurisdictions with regard to tax capacity k_i and population size n_i . By using appropriate control variables, the empirical analysis focuses on a variation in the equalization grants that cannot be assigned to differences in tax capacity and population size. To take account of non-linearities in the grants formula, for instance, differences in the treatment of large vs small municipalities, the analysis includes controls also for quadratic, cubic, etc. terms of population size and tax capacity. With a rich set of controls for tax capacity, population size and density, identification rests in effect on the discontinuities of the equalization system that treats individual jurisdictions differently even if they show high similarities.

Given the institutional background I estimate the following equation for the share of land assigned to commercial use by municipality i :

$$\Delta l_i = l_{i,t+1} - l_{i,t} = \alpha + \beta_0 l_i + \beta_1 I(z_i = 0) + \sum_{j=1}^p \beta_{3,j} n_i^j + \sum_{j=1}^p \beta_{4,j} k_i^j + \beta_5 X_i + \varepsilon_i, \quad (9)$$

where $\Delta l_{i,t+1}$ denotes the change in the share of land assigned to commercial use between periods $t + 1$ and t . The right-hand side conditions on the amount of land assigned to commercial use in period t . Hence, the regression considers the growth relative to the amount of land already assigned to commercial activities. There are two reasons for using a specification that conditions on the current share of commercial land. First, land assigned to commercial purposes often cannot

be easily transformed into other uses. Second, residents in municipalities with large fractions of commercial land may perceive the further expansion of such areas as more problematic. To capture the amenities associated with land, I include controls for other types of land use in X_i . I also add a full set of state dummies, to capture possible institutional differences in land-use regulations and grant levels.

β_1 captures the effect of fiscal redistribution. In the light of the above analysis a positive coefficient is expected: if a jurisdiction does not receive equalization grants, the indicator function has unit value $I(z_i = 0) = 1$. This indicates the absence of fiscal redistribution through equalization and, hence, the higher should be the amount of land assigned to commercial use. By allowing for arbitrary non-linear effects of population size and tax capacity, the estimation approach ensures that only discontinuous differences in equalization grants are used to identify the effect of fiscal equalization.

To distinguish possible income effects of equalization grants from the incentive effect associated with being exempted from fiscal equalization, I also provide results from specifications that include not only an indicator of whether a municipality is “abundant” and receives zero equalization grants but also the level of equalization grants.

$$\Delta l_i = \alpha + \beta_0 l_i + \beta_1 I(z_i = 0) + \beta_2 z_i + \sum_{j=1}^p \beta_{3,j} n_i^j + \sum_{j=1}^p \beta_{4,j} k_i^j + \beta_5 X_i + \varepsilon_i, \quad (10)$$

where z_i is the level of equalization grants per capita. To allow for non-linear income effects, I also run regression with the equalization grants squared.

4 Data

The empirical analysis is based on data provided by the German Federal and State Statistical Offices. The statistics on land use are provided quadrennially. The land use is reported at the level of municipalities who have the basic responsibility in land-use regulation. The municipalities in Germany form the lower tier of governments in the German federation. In 2005, which is the base year of our analysis, there were about 11000 municipalities in Germany.

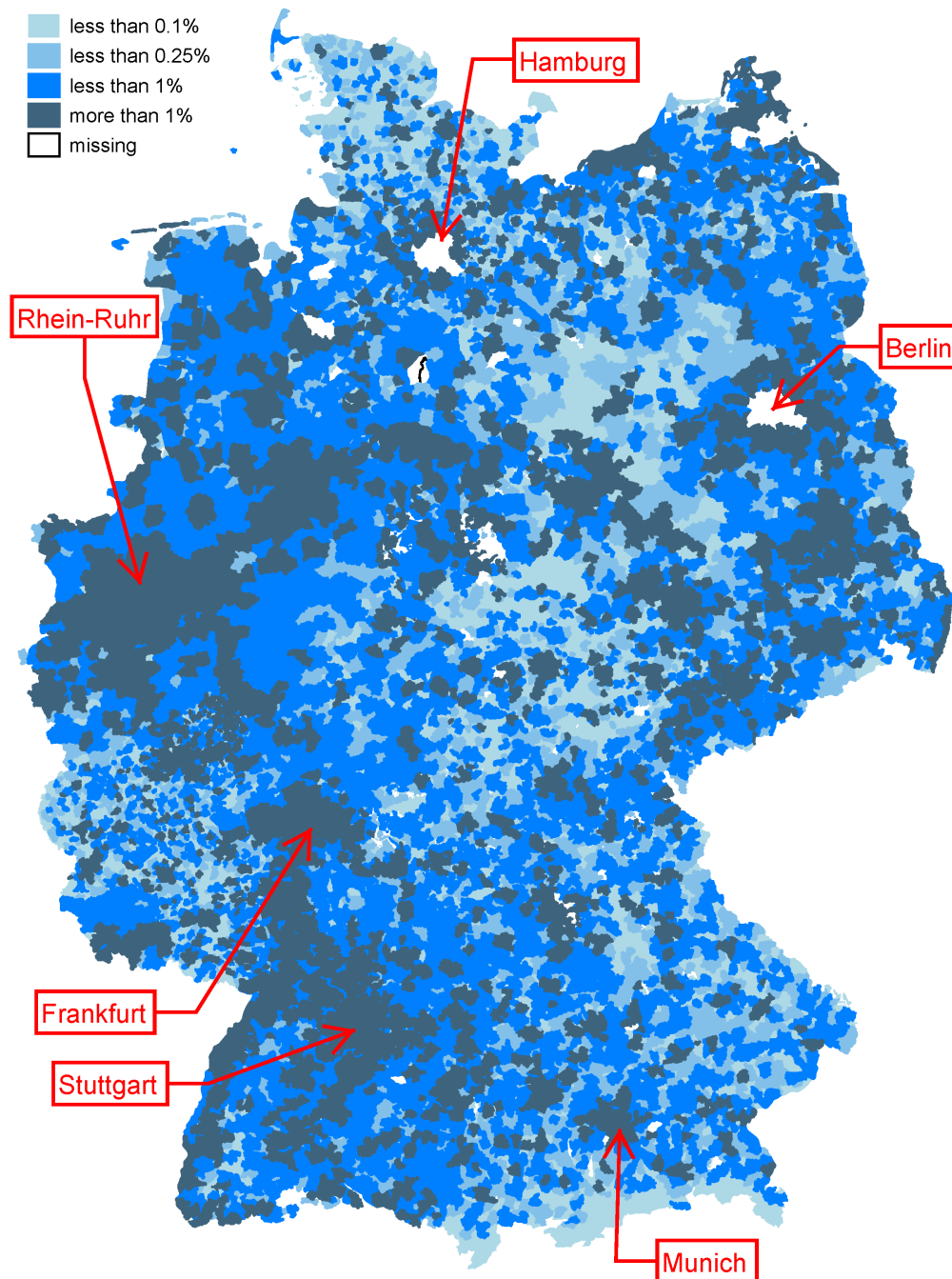
Following the classification of the land use statistics I focus on commercial land, which includes buildings and areas used for industrial production and other commercial purposes.⁸ To obtain land shares I relate the commercial land to the total area of each municipality.

Figure 2 shows a map of commercial land use as a share of total area for the German municipalities. The map shows the intensity of commercial land use using four categories which roughly follow the quartiles of the empirical distribution of the share of commercial land use. Some missing data are encountered for the city states (Hamburg, Berlin, Bremen) and some other jurisdictions. Metropolitan regions and the neighboring regions of the cities display high levels of intensity. But also the Rhein-Valley as well as various spots in the southern part depict higher intensity of commercial land-use.

Figure 3 depicts the change in the intensity of commercial land use between 2009 and 2005. The map classifies the change in four groups with declining shares, no change, modest increases and strong increases. The middle eastern part of Germany displays a larger number of missings that stem from reforms of the administrative structure where municipalities were split up and fused into larger

⁸The definition is “Gebäude- und Freiflächen, die vorherrschend gewerblichen und industriellen Zwecken dienen.”

Figure 2: Commercial Land Use as a Share of Total Area (in %)



Note: The figure reports the share of land assigned to commercial purposes for about 11000 municipalities in 2005 in %. Due to reforms of the administrative structures in particular in the eastern part of Germany there are missing values.

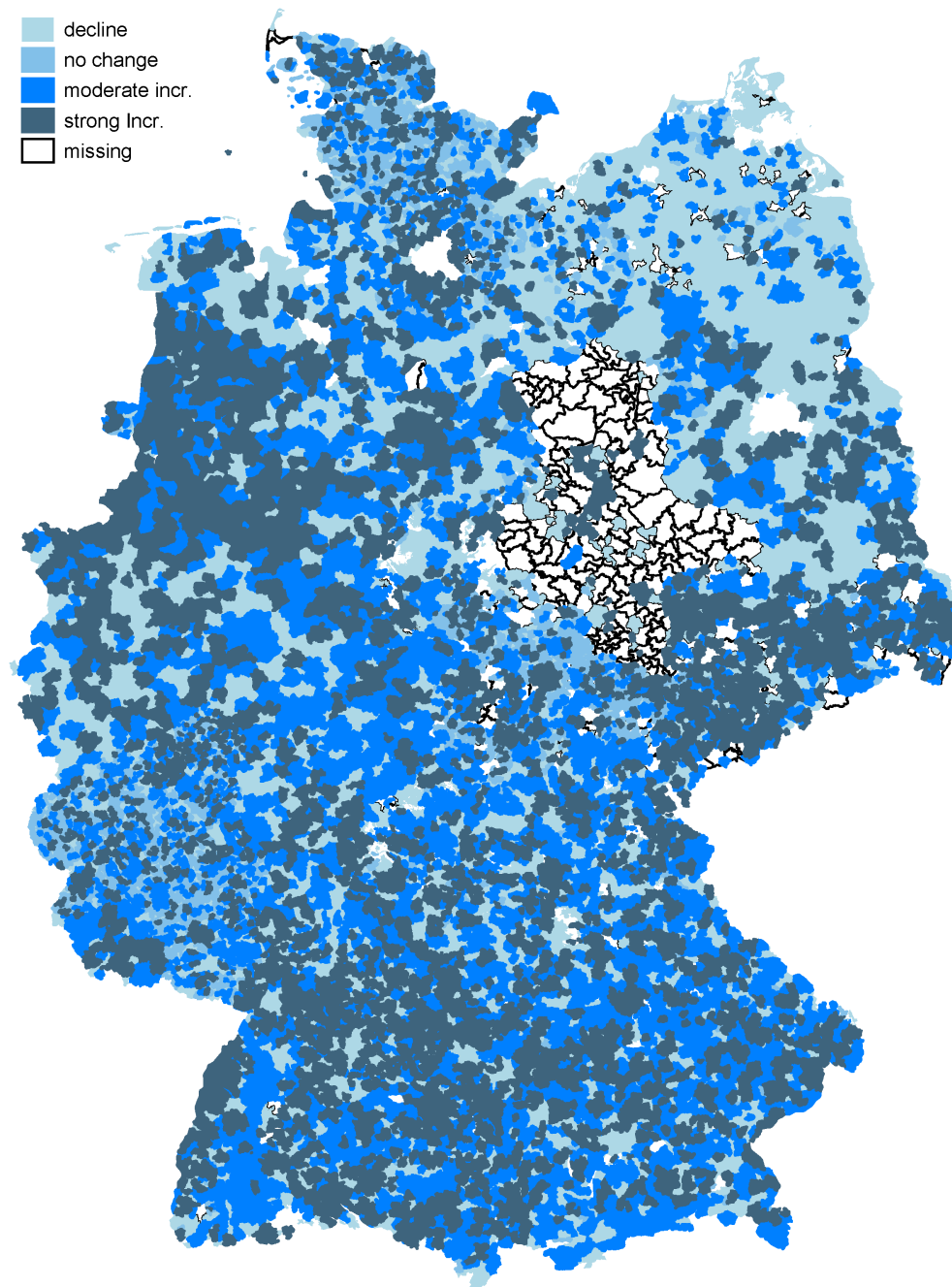
units. The figure shows that across the map there are municipalities that have increased the share of land used for commercial purposes. Much activity is reported in the south of Germany (Bavaria, Baden-Wuerttemberg). Also some peripheral areas in the North-West (Northrhine-Westfalia) and in the South East (Saxony) report relatively strong increases.

With missing data on the change of land use, the basic estimation sample comprises 7929 municipalities, if we include grants the sample is reduced to 7168 observations. Descriptive statistics for the size of municipalities and their commercial land use are provided by Table 1. The municipalities in the dataset comprise a total size of 202,318 squared kilometers which is about 57% of the total size of Germany.

The mean share of land assigned to commercial uses as defined in the statistics is rather small. In 2005 this share is about 0.6% of total area. For the total dataset this amounts to commercial land use in an amount of 1,226 km². The table also provides figures for alternative land uses. The dominant categories are agriculture (56.5%) and forests (28.1%). Land use for traffic (5.1%) is the third most important category followed by residential land use (2.9%). The average change of the share of land assigned to commercial use over the four years from 2005 to 2009 is 0,02. Relative to the share in 2005 this amounts to an increase by 3.7%. For the dataset as a whole this amounts to an increase in commercial land use by 46.5 km². However not all municipalities have increased commercial land use – some have reduced it.

The table also shows the descriptive statistics on municipalities' characteristics such as population, and population density. Average jurisdiction size is about 5,000 residents, the largest city included has about 645,000 residents. As changes in municipal borders are more likely to be encountered with large municipalities, various large cities are excluded. The key explanatory variable is the

Figure 3: Change in Commercial Land Use



Note: The figure reports the change in the share of land assigned to commercial uses between 2009 and 2005.

Table 1: Descriptive Statistics

Variable	Mean	Std.Dev.	Min	Max
Total size of municipalities (in 100 m^2)	2325.3	2695.3	45	35750
Commercially used land (in % of total size)	.59970	1.1224	0	19.946
Change of commercially used land 2009 vs 2005	.03682	.29911	-7.8520	11.765
Population	5046.7	16676.	5	645415
Density (residents per 100m ²)	1.8698	2.5165	.01106	33.309
Equalization grants in 1,000 Euro per cap. ¹	.16397	.11069	0	1.0502
Abundancy (zero equalization grants)	.07681	.26630	0	1
Tax capacity in 1,000 Euro per cap.	.44165	.43405	.00536	21.287
Other shares of land use (in %)				
– residential land	3.0618	3.3762	0	47.826
– waste disposal	.20291	.76380	0	37.861
– recreation area	.83378	1.1745	0	31.467
– burial ground	.06983	.14426	0	7.2897
– traffic area	5.2381	2.3917	0	27.950
– agricultural land	55.811	20.331	.30075	95.187
– forests	28.599	20.394	0	95.204
– water area	1.7507	3.4316	0	56.581
– mining/extraction area	.32878	1.4942	0	36.623

Sources: Own computations based on statistics provided by the German State and Federal Statistical Offices. 7929 Observations. All figures for 2005, if not otherwise indicated. ¹ observations from Lower-Saxony are removed due to data problems. In this case statistics refer to 7168 observations.

equalization grant per capita. The average grant in the sample is about 151 Euro per capita but the maximum figure is about 1,050 Euro. The table also reports a binary indicator for “abundant” jurisdictions receiving zero equalization grants. In the dataset, about 8% of municipalities fall in this category.

As discussed above, identification of fiscal redistribution requires to include controls for the determinants of equalization grants. Besides population and density this refers to the tax capacity per-capita. In order to compute this indicator I employ the tax revenues obtained by each municipalities. Tax revenues include the municipal shares of income tax and value added taxes as well as the revenues from three own taxes: local business tax, land tax on residential land, land tax on agricultural land. Following the equalization laws in the respective state, the tax capacity is calculated using standard levels of tax effort.⁹ The descriptive statistics point at the characteristic cross-sectional variation in tax capacity. On average the tax capacity is calculated with 442 Euro per capita. For some jurisdictions revenues are almost zero and the maximum value amount to 21,287 Euro per capita.

Though the empirical analysis is concerned with the change in commercial land use, the current structure of land use could possibly be associated with differential trends towards more or less

⁹More precisely, tax capacity is the sum of the municipal shares of value added and income taxes (which are federal taxes) as well as by lagged values of standardized business tax revenues. All German states (excluding city states) operate systems of equalization grants that employ the same concept of tax capacity. See Buettner (2009) for an exposition of the German municipal fiscal equalization system. As a result of the system, a non-abundant municipality loses a fraction of an additional Euro earned through taxation because of a compensating change in grants. The absorption of own tax revenues through the equalization system varies across states. In Northrhine-Westphalia the absorption rate reached 90% in 2006. Since abundant municipalities do not receive grants they keep all or most of additional tax revenues. Thus, abundant municipalities face substantially different incentives to engage in fiscal competition than their non-abundant counterparts. Information on state specific parameters are used for standardization are taken from Lenk and Rudolph (2004) and updated using the equalization laws of the respective states.

commercial land-use. As a robustness check, the estimation below controls for various other types of land use. More specifically, the analysis below considers whether the inclusion of a full set of indicators, that capture current land-use patterns, exerts effects on the key parameters of interest.

5 Empirical Results

Table 2 reports the results from a first set of specifications. Column 1 reports the results of a basic regression including only the level of population, the tax capacity per capita, the density as well as a full set of state dummies. The absence of fiscal equalization grants shows a positive significant effect. Specifications (2), (3) and (4) add 3rd order polynomials for population, tax-capacity and density to ensure that the remaining effect of grants is not driven by these variables. Specifications (5) and (6) include higher order polynomials.

In the absence of fiscal equalization grants, the implied marginal contribution rate to the system of fiscal equalization is zero. Hence, for municipalities not receiving this grants there is no fiscal redistribution through the equalization system. According to the above theoretical analysis, I expect commercial land-use to be larger for this group of municipalities. The empirical results confirm this expectation. In all specifications the absence of equalization grants exerts a positive significant effect. Across specifications, a robust increase in the share of commercial land use by about 7-8% over the four years from 2005 to 2009 is encountered. Relative to the average size of commercial land, this points to an expansion of about 10-12% over four years.

Table 3 presents further results from specifications that include a full set of controls for the land use in the initial period of 2005. Though some of the indicators for land use show significant effects,

Table 2: Estimation Results for Basic Specifications

	(1)	(2)	(3)	(4)	(5)	(6)
Share of commercial land	-0.0399 (0.0256)	-0.0402 (0.0257)	-0.0420 (0.0255)	-0.0440* (0.0256)	-0.0444* (0.0257)	-0.0436* (0.0250)
Zero equalization grants	0.0793** (0.0351)	0.0793** (0.0352)	0.0797** (0.0369)	0.0759** (0.0358)	0.0737** (0.0346)	0.0731** (0.0325)
Population ¹	-0.0000	0.0000*	0.0000**	0.0000	0.0000	-0.0000
Population ²		-0.0000*	-0.0000*	-0.0000	-0.0000	0.0000
Population ³		0.0000*	0.0000*	0.0000	0.0000	0.0000
Population ⁴					-0.0000	-0.0000
Population ⁵						0.0000
Tax-capacity ¹	-0.0339	-0.0370	-0.0394	-0.0415	-0.0543	-0.0653
Tax-capacity ²			0.0000	0.0000	0.0000	0.0000
Tax-capacity ³			-0.0000	-0.0000	-0.0000	-0.0000
Tax-capacity ⁴					0.0000	0.0000
Tax-capacity ⁵						-0.0000
Density ¹	0.0193**	0.0169**	0.0164**	0.0414***	0.0617***	0.0544**
Density ²				-0.0020*	-0.0068***	-0.0037
Density ³				0.0000	0.0004**	-0.0000
Density ⁴					-0.0000**	0.0000
Density ⁵						-0.0000
R^2	0.0342	0.0408	0.0442	0.0506	0.0538	0.0547

Dependent Variable: Change in share of commercial land (in %) between 2005 and 2009. Inference is based on a heteroscedasticity robust variance-covariance matrix. *** denotes significance at 1% level (** at 5%, * at 10%). For the first two variables the table reports the standard errors in parentheses. 7929 observations. All estimates include a full set of state dummies

Table 3: Estimation Results Including Controls for Land-Use Patterns

	(1)	(2)	(3)	(4)	(5)	(6)
Share of commercial land	-0.0525* (0.0272)	-0.0526* (0.0273)	-0.0544** (0.0271)	-0.0550** (0.0271)	-0.0553** (0.0272)	-0.0545** (0.0265)
Zero equalization grants	0.0764** (0.0336)	0.0764** (0.0337)	0.0769** (0.0352)	0.0754** (0.0346)	0.0734** (0.0335)	0.0727** (0.0314)
Other shares of land use (in %)						
– residential land	-0.0091	-0.0092	-0.0093	-0.0146*	-0.0153*	-0.0152*
– waste disposal	0.0179	0.0184	0.0186	0.0177	0.0175	0.0174
– recreation area	-0.0068	-0.0063	-0.0063	-0.0080	-0.0093*	-0.0092*
– burial ground	-0.0256	-0.0144	-0.0157	-0.0039	-0.0108	-0.0135
– traffic area	0.0084**	0.0083**	0.0084**	0.0077**	0.0075**	0.0077**
– agricultural land	-0.0049**	-0.0047**	-0.0047**	-0.0042**	-0.0042**	-0.0043**
– forests	-0.0048**	-0.0047**	-0.0047**	-0.0041**	-0.0040**	-0.0041**
– water area	-0.0067***	-0.0066***	-0.0067***	-0.0066***	-0.0065***	-0.0065***
– mining/extraction area	-0.0034	-0.0036	-0.0035	-0.0034	-0.0034	-0.0035
Population ¹	-0.0000	0.0000*	0.0000**	0.0000	0.0000	-0.0000
Population ²		-0.0000*	-0.0000*	-0.0000	-0.0000	-0.0000
Population ³		0.0000*	0.0000*	0.0000	0.0000	0.0000
Population ⁴					-0.0000	-0.0000
Population ⁵						0.0000
Tax-capacity ¹	-0.0330	-0.0361	-0.0407	-0.0423	-0.0549	-0.0669
Tax-capacity ²			0.0000	0.0000	0.0000	0.0000
Tax-capacity ³			-0.0000	-0.0000	-0.0000	-0.0000
Tax-capacity ⁴					0.0000	0.0000
Tax-capacity ⁵					-0.0000	-0.0000
Density ¹	0.0183*	0.0158	0.0154*	0.0516**	0.0761***	0.0663***
Density ²				-0.0023*	-0.0077***	-0.0040
Density ³				0.0000	0.0004**	-0.0001
Density ⁴					-0.0000**	0.0000
Density ⁵						-0.0000
R^2	0.0485	0.0549	0.0586	0.0648	0.0680	0.0690

Dependent Variable: Change in share of commercial land (in %) between 2005 and 2009. Inference is based on a heteroscedasticity robust variance-covariance matrix. *** denotes significance at 1% level (** at 5%, * at 10%). 7929 observations. For the first two variables the table reports the standard errors in parentheses. All estimates include a full set of state dummies

the effect of equalization grants proves robust.

Table 4 provides results of specifications that include both the binary indicator of “abundant” municipalities as well as the level of equalization grants. As noted above, this helps to test for possible income effects associated with equalization grants. The results are consistent, qualitatively, with the above results. They indicate that abundant municipalities pursue an expansion of commercial land use. In addition, municipalities that receive more equalization grants seem to be less active in this regard. This points to negative income effect on the supply of commercial land. However, the pure incentive effect which arises from being exempt from fiscal redistribution is found to give rise to an increase in the share of commercial land by about 6%. This figure is slightly below the total effect obtained above. In order to test whether this result is robust against allowing for non-linear income effects Table A-1 in the Appendix report results of regressions where also the square of the level of equalization grants is included. This terms shows no significant effect, however.

The above regressions include a large number of municipalities, most of which receive relatively large equalization grants. Since these jurisdictions may be less useful as comparison groups for those municipalities that are exempt from equalization, I ran further regressions that are excluding jurisdictions receiving high levels of equalization grants. Table A-2 in the Appendix excludes observations of municipalities with grants above the median of all grant receiving jurisdictions. Even though the number of observations is reduced substantially the results confirm the positive effect of being exempt from redistribution both in terms of the significance as well as in terms of the magnitude of the effect. Note that in the reduced set of observations, the share of abundant municipalities is about twice as large (0.162) as in the basic sample. Table A-3 in the Appendix excludes observations of municipalities with grants above the first-quartile of all grant receiving

Table 4: Estimation Results: Controlling for Level of Eq.Grants

	(1)	(2)	(3)	(4)	(5)	(6)
Share of commercial land	-0.0569** (0.0287)	-0.0566** (0.0288)	-0.0585** (0.0286)	-0.0586** (0.0285)	-0.0589** (0.0287)	-0.0580** (0.0280)
Zero equalization grants	0.0463* (0.0246)	0.0500** (0.0248)	0.0511* (0.0264)	0.0541** (0.0264)	0.0535** (0.0260)	0.0525** (0.0253)
Equalization grants	-0.3243** (0.1414)	-0.2936** (0.1419)	-0.2935** (0.1393)	-0.2462* (0.1333)	-0.2360* (0.1321)	-0.2416* (0.1244)
Other shares of land use (in %)						
– residential land	-0.0100	-0.0100	-0.0101	-0.0146*	-0.0151*	-0.0150*
– waste disposal	0.0179	0.0184	0.0186	0.0179	0.0176	0.0175
– recreation area	-0.0073	-0.0068	-0.0069	-0.0083	-0.0094*	-0.0092*
– burial ground	-0.0198	-0.0102	-0.0116	-0.0019	-0.0081	-0.0108
– traffic area	0.0082**	0.0082**	0.0082**	0.0077**	0.0075**	0.0077**
– agricultural land	-0.0048**	-0.0046**	-0.0047**	-0.0042**	-0.0042**	-0.0043**
– forests	-0.0047**	-0.0046**	-0.0046**	-0.0041**	-0.0041**	-0.0041**
– water area	-0.0067***	-0.0066***	-0.0067***	-0.0066***	-0.0065***	-0.0065***
– mining/extraction area	-0.0034	-0.0036	-0.0036	-0.0035	-0.0034	-0.0035
Population ¹	-0.0000	0.0000*	0.0000**	0.0000	0.0000	-0.0000
Population ²		-0.0000	-0.0000*	-0.0000	-0.0000	0.0000
Population ³		0.0000	0.0000*	0.0000	0.0000	0.0000
Population ⁴					-0.0000	-0.0000
Population ⁵						0.0000
Tax-capacity ¹	-0.0517	-0.0529	-0.0577	-0.0565	-0.0687	-0.0814
Tax-capacity ²			0.0000	0.0000	0.0000	0.0000
Tax-capacity ³			-0.0000	-0.0000	-0.0000	-0.0000
Tax-capacity ⁴					0.0000	0.0000
Tax-capacity ⁵						-0.0000
Density ¹	0.0157	0.0131	0.0124	0.0423*	0.0642***	0.0531**
Density ²				-0.0019	-0.0062**	-0.0016
Density ³				0.0000	0.0003*	-0.0003
Density ⁴					-0.0000**	0.0000
Density ⁵						-0.0000
R ²	0.0586	0.0635	0.0673	0.0719	0.0751	0.0764

Dependent Variable: Change in share of commercial land (in %) between 2005 and 2009. Inference is based on a heteroscedasticity robust variance-covariance matrix. *** denotes significance at 1% level (** at 5%, * at 10%). 7168 observations, observations from Lower-Sayony are removed. For the first three variables the table reports the standard errors in parentheses. All estimates include a full set of state dummies

jurisdictions. Here, the number of observations is reduced even more. However, the positive effect of being exempt from redistribution gets even stronger in this reduced sample, where the share of abundant municipalities is about 24%. Table A-4 in the Appendix focuses on municipalities with (state-adjusted) tax-capacity above the median grants. Again, the basic finding of higher growth in commercial land-use of municipalities exempted from fiscal redistribution is confirmed.

6 Summary and Conclusion

The theoretical analysis in this paper provides a tax competition model augmented by land as an input to production and by fiscal redistribution. The analysis shows that a local government, which aims at maximizing the utility of immobile workers, equates the marginal benefit from land that serves as an amenity with its opportunity cost. The latter is determined by the wage increase that results from a higher share of commercial land as well as by the marginal benefits from an expansion of public services. This expansion results from the increase in tax revenues associated with the inflow of capital. This link between land use and taxation gives rise to concerns about an inefficient expansion of commercial land use by jurisdictions competing for mobile capital. The theoretical analysis also shows, however, that fiscal redistribution among local governments tends to mitigate the fiscal incentive to expand commercial land use.

As empirical testing ground for the analysis of the fiscal incentive to expand commercial land the paper considers the land use among municipalities in Germany. The German municipalities offer a promising case for studying land use under conditions of tax competition, since the main tax revenue source of local municipalities is a tax on local business. In order to identify differences

in the competitive environment faced by the municipalities, I exploit institutional characteristics of municipal fiscal equalization system. In particular, I make use of the discontinuities in the system that involves heavy redistribution among the majority of municipalities, but at the same time, exempts municipalities with high levels of tax capacity from the redistributive grant system. This causes strong institutional variation in the degree of fiscal redistribution. However, due to the complexity of local fiscal equalization, the analysis does not apply a regression discontinuity design.

The empirical results utilize a large dataset comprising the development of commercial land-use between 2005 and 2009 for a large fraction of all German municipalities. The results confirm a robust significant effect of fiscal redistribution on commercial land use. More specifically, I find that commercial land-use tends to be higher in municipalities that are exempted from fiscal equalization and, thus, are exposed to more intense interjurisdictional competition. The empirical results show that municipalities exempt from fiscal redistribution have an average increase in the share of land assigned to commercial use by about 10-12% between 2005 and 2009, whereas the average expansion in the dataset is reported with 3%. While this significant difference proves robust across various alternative specifications, since the vast majority of the 11000 municipalities are not exempt, the results suggest that the strong degree of fiscal redistribution associated with municipal fiscal equalization severely curtails the fiscal incentive to expand commercial land use in Germany. I conclude that business tax competition is not a major force behind the expansion of land use in Germany.

References

- BRUECKNER, J. (1995), Strategic control of growth in a system of cities, *Journal of Public Economics* 57, 393–416.
- BRUECKNER, J. (1998), Testing for Strategic Interaction Among Local Governments: The Case of Growth Controls, *Journal of Urban Economics* 44, 438–467.
- BRUECKNER, J. (2000), Urban Sprawl: Diagnosis and Remedies, *International Regional Science Review*, 23(2), 160 – 171.
- BRUECKNER, J. K. (2003). Strategic interaction among governments: An overview of empirical studies. *International regional science review*, 26(2), 175-188..
- BRUECKNER, J. K., KIM, H. A. (2003). Urban sprawl and the property tax. *International Tax and Public Finance*, 10(1), 5-23.
- BRUECKNER, J., E. MILLS, M. KREMER (2001), Urban Sprawl: Lessons from Urban Economics, *Brookings-Wharton Papers on Urban Affairs*, 65 – 97, the Brookings Institution.
- BUCOVETSKY, S., and SMART, M. (2006). The efficiency consequences of local revenue equalization: Tax competition and tax distortions. *Journal of Public Economic Theory*, 8(1), 119-144.
- BUETTNER, T. (2009), The contribution of equalization transfers to fiscal adjustment: Empirical results for German municipalities and a US-German comparison, *Journal of Competitive Economics*, 37, 417 – 431.

Table A-1: Robustness: Non-linear Income Effects of Eq. Grants

	(1)	(2)	(3)	(4)	(5)	(6)
Share of commercial land	-0.0571* (0.0288)	-0.0578** (0.0288)	-0.0584** (0.0286)	-0.0585** (0.0285)	-0.0586** (0.0288)	-0.0588** (0.0281)
Zero equalization grants	0.0454 (0.0245)	0.0461** (0.0245)	0.0487** (0.0260)	0.0516** (0.0260)	0.0518** (0.0264)	0.0532** (0.0247)
Equalization grants	-0.3328** (0.1433)	-0.3377** (0.1442)	-0.3247** (0.1459)	-0.2828* (0.1414)	-0.2608* (0.1296)	-0.2358** (0.1467)
Equalization grants, squared	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
Other shares of land use (in %)						
– residential land	-0.0100	-0.0097	-0.0098	-0.0141*	-0.0148*	-0.0148*
– waste disposal	0.0179	0.0179	0.0183	0.0175	0.0174	0.0173
– recreation area	-0.0074	-0.0066	-0.0068	-0.0081	-0.0092*	-0.0091*
– burial ground	-0.0201	-0.0146	-0.0134	-0.0038	-0.0094	-0.0121
– traffic area	0.0082**	0.0082**	0.0082**	0.0077**	0.0075**	0.0077**
– agricultural land	-0.0048**	-0.0045**	-0.0046**	-0.0042**	-0.0042*	-0.0042**
– forests	-0.0047**	-0.0045**	-0.0046**	-0.0041**	-0.0040*	-0.0041**
– water area	-0.0067***	-0.0066***	-0.0067***	-0.0065***	-0.0064***	-0.0065***
– mining/extraction area	-0.0034	-0.0036	-0.0036	-0.0035	-0.0034	-0.0035
Population ¹	-0.0000	0.0000**	0.0000**	0.0000	0.0000	-0.0000
Population ²		-0.0000*	-0.0000*	-0.0000	-0.0000	-0.0000
Population ³		0.0000	0.0000*	0.0000	0.0000	0.0000
Population ⁴					0.0000	-0.0000
Population ⁵						0.0000
Tax-capacity ¹	-0.0455	-0.0492	-0.0556	-0.0543	-0.0632	-0.0746
Tax-capacity ²			0.0000	0.0000	0.0000	0.0000
Tax-capacity ³			-0.0000	-0.0000	-0.0000	-0.0000
Tax-capacity ⁴					0.0000	0.0000
Tax-capacity ⁵						-0.0000
Density ¹	0.0167*	0.0134	0.0129	0.0413**	0.0644***	0.0518**
Density ²				-0.0015	-0.0064**	-0.0016
Density ³				0.0000	0.0003**	-0.0003
Density ⁴					-0.0000**	0.0000
Density ⁵						-0.0000
R^2	0.0587	0.0672	0.0685	0.0732	0.0757	0.0792

Dependent Variable: Change in share of commercial land (in %) between 2005 and 2009. Inference is based on a heteroscedasticity robust variance-covariance matrix. *** denotes significance at 1% level (** at 5%, * at 10%). 7168 observations, observations from Lower-Sayony are removed. For the first four variables the table reports the standard errors in parentheses. All estimates include a full set of state dummies

Table A-2: Robustness: Focus on Low Grant Receiving Municipalities (Median)

	(1)	(2)	(3)	(4)	(5)	(6)
Share of commercial land	-0.0656* (0.0393)	-0.0672* (0.0369)	-0.0662* (0.0380)	-0.0669* (0.0380)	-0.0634* (0.0363)	-0.0622* (0.0352)
Zero equalization grants	0.0523** (0.0241)	0.0552** (0.0246)	0.0585** (0.0265)	0.0617** (0.0267)	0.0621** (0.0261)	0.0677** (0.0265)
Equalization grants	-0.3346 (0.2345)	-0.3140 (0.2300)	-0.2771 (0.1832)	-0.2343 (0.1792)	-0.2087 (0.1690)	-0.2073 (0.1648)
Other shares of land use (in %)						
– residential land	-0.0002	-0.0001	0.0008	-0.0032	-0.0032	-0.0024
– waste disposal	0.0206	0.0214	0.0215	0.0203	0.0204	0.0205
– recreation area	-0.0056	-0.0056	-0.0059	-0.0068	-0.0081	-0.0079
– burial ground	-0.1322***	-0.1316***	-0.1352***	-0.1295***	-0.1404***	-0.1557***
– traffic area	0.0131***	0.0129***	0.0129***	0.0126***	0.0125***	0.0127***
– agricultural land	-0.0025	-0.0025	-0.0026	-0.0023	-0.0022	-0.0022
– forests	-0.0024	-0.0025	-0.0025	-0.0022	-0.0021	-0.0021
– water area	-0.0053*	-0.0055*	-0.0056*	-0.0057**	-0.0055**	-0.0054**
– mining/extraction area	0.0007	0.0006	0.0005	0.0005	0.0005	0.0002
Population ¹	0.0000	0.0000***	0.0000***	0.0000**	0.0000**	0.0000***
Population ²		-0.0000***	-0.0000*	-0.0000	-0.0000	-0.0000***
Population ³		0.0000***	0.0000	0.0000	0.0000	0.0000**
Population ⁴					-0.0000	-0.0000**
Population ⁵						0.0000**
Tax-capacity ¹	-0.0489	-0.0513	-0.0802	-0.0785	-0.1067	-0.1415
Tax-capacity ²			0.0000	0.0000	0.0000	0.0000
Tax-capacity ³			-0.0000	-0.0000	-0.0000	-0.0000
Tax-capacity ⁴					0.0000	0.0000*
Tax-capacity ⁵						-0.0000*
Density ¹	0.0082	0.0045	0.0024	0.0245	0.0391**	0.0212
Density ²				-0.0009	-0.0053**	-0.0021
Density ³				-0.0000	0.0003**	0.0001
Density ⁴					-0.0000**	0.0000
Density ⁵						-0.0000
R ²	0.1144	0.1200	0.1240	0.1316	0.1469	0.1540

Dependent Variable: Change in share of commercial land (in %) between 2005 and 2009. Inference is based on a heteroscedasticity robust variance-covariance matrix. *** denotes significance at 1% level (** at 5%, * at 10%). Estimation includes only observations for municipalities with level of grants below the median of the grant distribution among receiving jurisdictions. 3611 observations, observations from Lower-Sayony are removed. For the first three variables the table reports the standard errors in parentheses. All estimates include a full set of state dummies

Table A-3: Robustness: Focus on Low Grant Receiving Municipalities (1st.Quartile)

	(1)	(2)	(3)	(4)	(5)	(6)
Share of commercial land	-0.0783* (0.0448)	-0.0806* (0.0450)	-0.0792* (0.0430)	-0.0801* (0.0428)	-0.0768* (0.0410)	-0.0727* (0.0398)
Zero equalization grants	0.0519** (0.0255)	0.0580** (0.0265)	0.0601** (0.0273)	0.0651** (0.0277)	0.0668** (0.0274)	0.0732*** (0.0278)
Equalization grants	-0.3296 (0.3270)	-0.3296 (0.3270)	-0.2124 (0.2475)	-0.1282 (0.2399)	-0.0898 (0.2360)	-0.1194 (0.2391)
Other shares of land use (in %)						
– residential land	-0.0011	-0.0009	0.0001	-0.0053	-0.0049	-0.0052
– waste disposal	0.0386	0.0389	0.0392	0.0371	0.0370	0.0377
– recreation area	-0.0058	-0.0064	-0.0067	-0.0085	-0.0103	-0.0088
– burial ground	-0.1267**	-0.1295***	-0.1335***	-0.1272***	-0.1408***	-0.1537***
– traffic area	0.0183***	0.0179***	0.0180***	0.0177***	0.0176***	0.0173***
– agricultural land	-0.0023	-0.0024	-0.0024	-0.0021	-0.0021	-0.0021
– forests	-0.0020	-0.0022	-0.0022	-0.0018	-0.0017	-0.0018
– water area	-0.0054	-0.0057*	-0.0058*	-0.0059*	-0.0057*	-0.0053*
– mining/extraction area	0.0009	0.0008	0.0007	0.0007	0.0007	0.0001
Population ¹	0.0000	0.0000***	0.0000	0.0000	0.0000	0.0000
Population ²		-0.0000*	-0.0000**	-0.0000	-0.0000**	-0.0000***
Population ³		0.0000*	0.0000	0.0000	0.0000*	0.0000***
Population ⁴					-0.0000	-0.0000**
Population ⁵					0.0000**	0.0000**
Tax-capacity ¹	-0.0467	-0.0491	-0.0802	-0.0778	-0.1041	-0.1641
Tax-capacity ²			0.0000	0.0000	0.0000	0.0000
Tax-capacity ³			-0.0000	-0.0000	-0.0000	-0.0000
Tax-capacity ⁴					0.0000	0.0000*
Tax-capacity ⁵					-0.0000*	-0.0000*
Density ¹	0.0110	0.0056	0.0039	0.0349*	0.0496**	0.0394
Density ²				-0.0015	-0.0062*	-0.0053
Density ³				0.0000	0.0004*	0.0004
Density ⁴					-0.0000**	-0.0000
Density ⁵					0.0000	0.0000
R ²	0.1381	0.1427	0.1491	0.1544	0.1621	0.1843

Dependent Variable: Change in share of commercial land (in %) between 2005 and 2009. Inference is based on a heteroscedasticity robust variance-covariance matrix. *** denotes significance at 1% level (** at 5%, * at 10%). Estimation includes only observations for municipalities with level of grants below the 1st. quartile of the grant distribution among receiving jurisdictions. 2424 observations, observations from Lower-Sayony are removed. For the first three variables the table reports the standard errors in parentheses. All estimates include a full set of state dummies

Table A-4: Robustness: Focus on High Tax Capacity Municipalities

	(1)	(2)	(3)	(4)	(5)	(6)
Share of commercial land	-0.0791** (0.0349)	-0.0802** (0.0349)	-0.0804** (0.0347)	-0.0816** (0.0347)	-0.0820** (0.0343)	-0.0806** (0.0333)
Zero equalization grants	0.0459* (0.0259)	0.0498** (0.0254)	0.0509* (0.0271)	0.0538** (0.0272)	0.0525** (0.0268)	0.0510** (0.0252)
Equalization grants	-0.4451** (0.2000)	-0.4476** (0.2082)	-0.4367** (0.1906)	-0.4147** (0.1887)	-0.3962** (0.1790)	-0.3913** (0.1713)
Other shares of land use (in %)						
– residential land	-0.0151	-0.0145	-0.0142	-0.0186	-0.0193	-0.0192
– waste disposal	0.0169	0.0174	0.0177	0.0168	0.0164	0.0158
– recreation area	-0.0127	-0.0121	-0.0122	-0.0140	-0.0155*	-0.0153*
– burial ground	-0.0039	-0.0016	0.0004	0.0053	-0.0015	-0.0080
– traffic area	0.0190***	0.0185***	0.0184***	0.0178***	0.0177***	0.0179***
– agricultural land	-0.0061*	-0.0061*	-0.0061*	-0.0057*	-0.0057*	-0.0057*
– forests	-0.0058*	-0.0059*	-0.0059*	-0.0054*	-0.0052*	-0.0053*
– water area	-0.0091**	-0.0091**	-0.0091**	-0.0091**	-0.0089**	-0.0093**
– mining/extraction area	0.0009	0.0008	0.0008	0.0009	0.0012	0.0010
Population ¹	-0.0000	0.0000*	0.0000*	0.0000	-0.0000	-0.0000
Population ²		-0.0000	-0.0000	-0.0000	0.0000	-0.0000
Population ³		0.0000	0.0000	0.0000	-0.0000	0.0000
Population ⁴					0.0000	-0.0000
Population ⁵						0.0000
Tax-capacity ¹	-0.0479	-0.0495	-0.0578	-0.0543	-0.0629	-0.0887
Tax-capacity ²			0.0000	0.0000	0.0000	0.0000
Tax-capacity ³			-0.0000	-0.0000	-0.0000	-0.0000
Tax-capacity ⁴					-0.0000	0.0000
Tax-capacity ⁵						-0.0000
Density ¹	0.0197*	0.0150	0.0138	0.0511	0.0822**	0.0636*
Density ²				-0.0024	-0.0083**	-0.0034
Density ³				0.0000	0.0004**	-0.0001
Density ⁴					-0.0000*	0.0000
Density ⁵						-0.0000
R ²	0.0822	0.0888	0.0894	0.0933	0.0972	0.1019

Dependent Variable: Change in share of commercial land (in %) between 2005 and 2009. Inference is based on a heteroscedasticity robust variance-covariance matrix. *** denotes significance at 1% level (** at 5%, * at 10%). Estimation includes only observations for municipalities with state adjusted levels of tax-capacity below the median. 3047 observations, observations from Lower-Saxony are removed. For the first three variables the table reports the standard errors in parentheses. All estimates include a full set of state dummies

- DAHLBY, B., FEREDÉ, E. (2016). The stimulative effects of intergovernmental grants and the marginal cost of public funds. *International Tax and Public Finance*, 23(1), 114-139.
- DAHLBY, B., WARREN, N. (2003). Fiscal incentive effects of the Australian equalisation system. *Economic Record*, 79(247), 434-445.
- EGGER, P., KOETHENBUERGER, M., SMART, M. (2010). Do fiscal transfers alleviate business tax competition? Evidence from Germany. *Journal of Public Economics*, 94(3), 235-246.
- GLAESER, E. L., and KAHN, M. E. (2004). Sprawl and urban growth. *Handbook of regional and urban economics*, 4, 2481-2527.
- HELSLEY, R. W., and W.C. STRANGE (1995). Strategic Growth Controls, *Regional Science and Urban Economics* 25(4) 435-460.
- KEEN, M., MARCHAND, M. (1997). Fiscal competition and the pattern of public spending. *Journal of Public Economics*, 66(1), 33-53.
- KOETHENBUERGER, M. (2002). Tax competition and fiscal equalization. *International Tax and Public Finance*, 9(4), 391-408.
- LEHMANN-GRUBE, U. and W. PFÄHLER (1998), Gewerbeflächenpolitik im Standortwettbewerb – Theorie und praktische Evidenz, *Wirtschaftsdienst*, 1998/I, 55 – 64.
- LENK, T. and H.-J. RUDOLPH (2004), *Die kommunalen Finanzausgleichssysteme in der Bundesrepublik Deutschland – Die Ermittlung der Finanzkraft*, Universität Leipzig, Arbeitspapier 26.
- NECHYBA, T. J., WALSH, R. P. (2004). Urban sprawl. *The Journal of Economic Perspectives*, 18(4), 177-200.

- REVELLI, F. (2005). On spatial public finance empirics, *International Tax and Public Finance*, 12(4), 475-492.
- TIEBOUT, C. M. (1956). A pure theory of local expenditures. *The journal of political economy*, 416-424.
- UMWELTBUNDESAMT (2004), *Hintergrundpapier: Flächenverbrauch, ein Umweltproblem mit wirtschaftlichen Folgen*, Berlin.
- VOITH, R. (1999). Does the federal tax treatment of housing affect the pattern of metropolitan development?. Federal Reserve Bank of Philadelphia, Business Review, March/April.
- WILSON, J. D. (1991). Tax competition with interregional differences in factor endowments. *Regional Science and Urban Economics*, 21, pp. 423-451.
- WILSON, J. D. (1999). Theories of tax competition. *National tax journal*, 269-304.
- ZODROW, G. R., and MIESZKOWSKI, P. (1986). Pigou, Tiebout, property taxation, and the underprovision of local public goods. *Journal of Urban Economics*, 19(3), 356-370.