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## Vertical Grants and Local Public Efficiency

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## **Vertical Grants and Local Public Efficiency**

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# Vertical Grants and Local Public Efficiency

## Abstract

This paper analyses the impact of vertical grants on local public sector efficiency. First, we develop a theoretical model in which the bureaucrat sets the tax price while voters choose the quantity of public services. We use a very simple theoretical model to show that grants reduce efficiency even if voters do not suffer from fiscal illusion. Second, we use the model and the fact that vertical financial equalization systems often reduce differences in fiscal capacity to argue that empirical studies based on cross-sectional data may yield a positive relationship between grants and efficiency even when the underlying causal effect is negative. Third, we perform an empirical analysis for the German state of Saxony-Anhalt, which has implemented such a fiscal equalization system. The empirical patterns we observe support the argument that the fiscal equalization system may have this inference-disturbing effect.

Keywords: vertical grants, local public finance, efficiency, DEA, bureaucracy

JEL Classification: H11, H72



## 1. Introduction

Since the beginning of the economic analysis of federalism, the effects of vertical grants have been a main subject (e.g. Oates 1972, LeGrand 1975, Bradbury et al. 1984). The early literature focused on their effect on the amount of public goods and services and found the well-known “flypaper effect” (e.g. Hines and Thaler 1995 for an overview). Following Silkman and Young (1982), a number of studies have emphasized the impact of vertical grants on the efficiency of local public service production. Most papers are empirical contributions that do not provide theoretical models to derive their central hypothesis. Kalb (2010) is an exception in this respect. He adapts the model on fiscal illusion and bureaucratic power by Moesen and van Cauwenberge (2000) and shows that vertical grants reduce local efficiency.

The existing empirical studies on global local government efficiency find only limited support for this hypothesis. Kalb (2010) finds negative effects on cost efficiency caused by the German local government fiscal equalization grants in Germany (Baden-Württemberg). Balaguer-Coll et al. (2007) and Balaguer-Coll and Prior (2009) report a significantly negative effect of current grants from higher levels of government on the technical efficiency of Spanish (Valencian) municipalities. The same goes for Vanden Eeckaut et al. (1993) and De Borger and Kerstens (1996) and the cost efficiency effect of general purpose grants on Belgian municipalities. Loikkanen and Susiluoto (2005) find a negative impact of state block-grants on technical efficiency in Finland. In contrast, according to Worthington (2000), the general purpose grants to the Australian local governments have no effect on efficiency. Grossman et al. (1999) analyze U.S. central cities and find no effect of state grants of federal grants on the technical efficiency. Finally, Geys and Moesen (2009) report a significantly positive impact for Flemish municipalities.

Our paper contributes to the literature on vertical grants and local public sector efficiency in three ways. First, we provide a simple, alternative model to analyze the interaction of voters and their local public administration. We introduce this model to show that, contrary to the model by Kalb (2010), we do not need to assume fiscal illusion to arrive at the conclusion that vertical grants have a negative impact on public sector efficiency.

Second, we use this model to propose an explanation for the contradictory empirical results on the relationship between grants and efficiency. In essence, the argument goes as follows. Starting point is the fact that vertical grants in many countries are designed to reduce the differences in fiscal capacity between municipalities. If a grant scheme discriminates in favour of financially weak municipalities but preserves the initial ordering in fiscal capacities among municipalities, high per capita grants coincide with low fiscal capacity even after fiscal equalization and thus, less leeway for slack and inefficiency. Consequently, municipalities that receive high per capita grants face – on average – stricter fiscal constraints and thus, are (forced to be) technically more efficient. This

does not imply any causal relationship between high vertical grants and high levels of efficiency. Instead, a third variable – the municipality’s fiscal capacity before grants – drives both the amount of per capita grants and the fiscal capacity after grants and thereby the degree of efficiency.

Our third contribution is an empirical analysis that backs our argument. For this purpose, we use municipal-level data from the German state Saxony-Anhalt in 2004. To estimate the effect of grants per capita and grant dependency on technical efficiency, we perform an input-oriented non-parametric efficiency analysis (DEA) and test for the impact of several environmental variables on efficiency scores using the bootstrap approach suggested by Simar and Wilson (2007). Our results show that global municipal efficiency rises in the degree of grant dependence and vertical grants per capita but decreases in the fiscal capacity per capita. The - at first glance - efficiency-enhancing effect of grants in our study is likely to be a purely statistical effect because the grant schemes implemented in many countries make grants per capita a negative function of the fiscal capacity per capita and hence, cause a strong negative correlation between grants and fiscal capacity.

The paper proceeds as follows. In section 2, we present a simple model to analyze the role of grants for public service production and efficiency. Section 3 builds on this model to show how fiscal equalization systems that aim at reducing fiscal stress influences the correlation between vertical grants and efficiency and thus provides an explanation for the contradictive evidence on the causal relationship between them. The empirical part of our paper starts with section 4. This section describes the institutional background in Saxony-Anhalt, outlines the estimation method, and summarizes the data underlying our empirical analysis. The results are presented in section 5 and discussed in section 6. Section 7 concludes.

## **2. A Simple Model of Local Service Production, Vertical Grants and Efficiency**

The seminal piece on the theory of bureaucracy of Niskanen (1971) provides the starting point for many papers that analyze local public service production. In this model, public services are provided by the local authorities controlled by the bureau head. His utility is assumed to depend on the amount of the public services his bureau provides and the fiscal residual – i.e. the difference between his budget and the minimum costs necessary to produce the demanded amount of public services. The so-called sponsor represents the local population’s interest and negotiates the budget and the amount of public services with the bureau head. The bureaucrat knows the sponsor’s preferences and the minimum costs while the sponsor does not know the latter (for a review, see e.g. Moe, 1997; Wintrobe, 1997; Mueller, 2004, chapter 16).

Kalb (2010) uses a model of bureaucracy to assess the impact of vertical grants on the efficiency of local public service production. He follows Niskanen (1971) in assuming an extremely strong position for the bureaucrat: He can make a “take it or leave it”-offer dictating both the budget and the quantity of public services. Kalb (2010) builds on an argument by Moesen and van Cauwenberge (2000), according to which a soft budget constraint promotes fiscal illusion, that is it makes voters underestimate the tax price of public services. Applying this argument to local public sector production, he argues that vertical grants lead voters to underestimate the tax price of public services and thus accept higher amounts of public services and larger budgets than they would without grants. He assumes that the degree of underestimation increases in the amount of grants and shows that the amount of public services produced and the fiscal residual the bureaucrat claims increase in the amount of grants. The latter result leads Kalb (2010) to conclude that vertical grants reduce efficiency in local public service production.

In this section, we develop a very simple, alternative model to analyze the impact of vertical grants on local public sector efficiency. Our model deviates from the one by Kalb (2010) in three important aspects: First, we assume that public services are normal goods. Second, we assume fully informed voters who do not suffer from fiscal illusion. Third, we do not use a take-it-or-leave-it model in the tradition of Niskanen (1971). Instead, we follow Migué and Bélanger (1974) and Bendor et al. (1985) who draw on the standard model of monopoly and assume that the bureaucrat uses his monopoly power to set the tax price while the sponsor chooses the quantity.<sup>1</sup> Note, however, that the third assumption is not essential for the main result.

Consider a certain municipality  $M$  with  $N$  inhabitants situated in a federalist country with two layers of government – a federal and a municipal level. For reasons of simplicity, we assume that the federal level does not produce public services but merely collects taxes and provides municipalities with vertical grants. We also assume that the overall amount of federal revenues is fixed but the government can decide how to distribute these funds among municipalities. The citizens living in municipality  $M$  derive utility from the amount of private goods ( $x$ ) they consume and from the amount  $Q$  of non-rival public services provided on the local level. The bureaucrat heading the local public authorities sets the price  $p_Q$  at which his bureau provides local public services. We assume that the sponsor is equivalent to the median voter in municipality  $M$ . Given the price  $p_Q$  and the tax schedule that determines the share of  $p_Q$  that he has to bear, the local median voter chooses the amount of local public services  $Q$  that maximizes his utility.

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<sup>1</sup> The main difference between the models is the following: The bureaucrat claims the entire consumer’s surplus in the take-it-or-leave-it model. In the price-setting model, voters receive some of the consumer’s surplus and thus their welfare increases albeit by less than it could. Wyckhoff (1990) argues that the sponsor may reject the offer if he is not left with some positive reservation utility from public services. Even in this case, however, voters’ welfare in the end does not depend on the amount of public services produced.



Figure 1:  
Structure of the game

Stage	Activities
1	The local bureaucrat announces a tax price $\tau$ for the local public services.
2	The local median voter chooses the quantity $Q$ that maximizes his utility.
3	Public services are produced and consumed. The local bureaucrat uses up the fiscal residual.

Source: Authors' compilation.

Before local bureaucrats and sponsors make their choices, the federal government decides about the grant-distribution scheme. This specifies the amount of grants  $G$ , that municipality  $M$  receives.<sup>2</sup> The local bureaucrat and the local median voter take the decisions made on the federal level as given. Hereafter, we drop the specification “local” when referring to the local median voter and bureaucrat and their activities. Figure 1 captures the sequential game in which these two agents interact and determine the public budget and the amount of public services. Given his informational advantage, the bureaucrat can solve the game by backward induction. He anticipates the median voter's reaction to the price  $p_Q$  and chooses the price that maximizes his own utility.

In stage 2, the median voter takes the price  $p_Q$  as given and votes for the amount of local public services that maximize his utility subject to his budget restriction.

$$y + \sigma^{med} G = p_x x + \sigma^{med} p_Q Q \quad (1)$$

Here,  $y$  stands for the median voter's income (net of federal taxes) and  $\sigma^{med}$  denotes the share of the total supply price that the median voter has to bear either through higher taxes or through foregone transfers. For reasons of simplicity, we assume the share to be invariant in  $p_Q$  or  $G$ . If  $\sigma^{med} = 1/N$ , the median voter bears the same tax burden respectively receives the same transfers as the average voter.

We assume a very simple linear function for the median voter's demand for public services:

$$Q^{med} = \frac{a(\sigma^{med} \cdot G, y) - \sigma^{med} p_Q}{b} \quad (2)$$

This function is identical to the one used by Kalb (2010) except for one feature. In our model, an increase in available funds – be it from vertical grants or by income – increases the median voter's willingness to pay for public services (i.e.  $\partial a / \partial y > 0$  and  $\partial a / \partial G > 0$ ).

<sup>2</sup> A substantial share of vertical grants in many countries is formula-based.

We assume that the bureaucrat's utility function is given by

$$U^B = Q^\alpha FR^{1-\alpha}, \quad 0 < \alpha < 1 \quad (3)$$

The fiscal residual  $FR$  is given by

$$FR = p_Q Q - C(Q) \quad (4)$$

We follow the literature by assuming a quadratic cost function:

$$C(Q) = cQ + dQ^2, \quad c, d > 0 \quad (5)$$

Having these preliminaries settled, we can return to the main question of the model: How do vertical grants influence the efficiency of local public service production? We use the ratio of fiscal residual and quantity of public services in equilibrium ( $FR^*/Q^*$ ) and ask whether vertical grants raise or reduce this ratio.<sup>3</sup>

Anticipating the median voter's reaction to the supply price  $p_Q$ , the bureaucrat chooses the supply price  $p_Q$  that maximizes his utility. This leads to the following amount of public services in equilibrium:

$$Q^* = \begin{cases} \frac{\frac{a(\sigma^{med} \cdot G, y)}{\sigma^{med}} - c}{(2-\alpha)\left(\frac{b}{\sigma^{med}} + d\right)} & \text{if } \frac{a(\sigma^{med} \cdot G, y)}{\sigma^{med}} > c \\ 0 & \text{else} \end{cases} \quad (6)$$

If in equilibrium the resulting expenditures on municipal level is lower than the grant municipality  $M$  received (i.e.,  $p_Q Q < G$ ), every voter receives a transfer from the local government. For the median voter, this amounts to  $\sigma^{med}(G - p_Q Q)$ . If  $p_Q Q > G$ , every voter has to pay local taxes. The median voter has to pay local taxes amounting to a total of  $\sigma^{med}(p_Q Q - G)$ .

In all cases where  $Q^* > 0$ , the average inefficiency is given by  $FR^*/Q^*$ . Differentiating this ratio with respect to  $G$  yields:

$$\frac{\partial(FR^*/Q^*)}{\partial G} = \frac{\partial a}{\partial G} \frac{1}{\sigma^{med}} \left[ 1 - \frac{1}{2-\alpha} \right] > 0 \quad (7)$$

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<sup>3</sup> The amount  $Q$  that maximizes the median voter's utility is  $Q^{opt} = (a(\sigma^{med} G, y) / \sigma^{med} - c) / (b / \sigma^{med} + 2d)$ .

Thus, vertical grants reduce relative efficiency. The effect is stronger the lower the share  $\sigma^{med}$  the median voter contributes to local taxes and receives from transfers. Thus, our model predicts that a negative effect of grants on efficiency can be assumed even if voters do not suffer from fiscal illusion. This result differs from that of Kalb (2010) who argues that fiscal illusion is the driving force behind the negative impact of vertical grants on efficiency. The difference in conclusions results from the fact that Kalb (2010) implies that the amount of grants has no impact on the median voter's willingness to pay for public services (i.e.,  $\partial a / \partial G = 0$ ) while we assume that public services are normal goods and thus  $\partial a / \partial G > 0$ . In Kalb (2010), an increase in vertical grants increases only the consumption of private goods unless they cause i) the bureaucrat to offer a different supply price  $p_Q$ , or ii) change the perceived supply price  $p_Q = p(Q)$  due to fiscal illusion. In our model, vertical grants elevate the median voter's willingness to pay for public services even if the (perceived) price is unchanged. The bureaucrats skim a substantial part of the consumers' surplus to increase the fiscal residual while the increase in output  $Q^*$  is only moderate. As a result, the ratio  $FR^*/Q^*$  increases in  $G$ . It is important to note that the same effect emerges if we follow Kalb (2010) and assume that the bureaucrat can claim the full consumers' surplus from public service production by making a take-it-or-leave-it offer.

### **3. Vertical Grants as Part of a Fiscal Equalization System and their Impact on Efficiency**

In section 2, we assumed vertical grants to be unrelated to all other variables that determine the quantity of public services, the budget and the fiscal residual. This assumption helps to emphasize the isolated impact of an increase in grants on efficiency in a certain municipality  $M$ . This is why the theoretical considerations in many other studies use a similar *ceteris-paribus* assumption when deriving their central hypothesis. In their empirical analyses, these authors generally use cross-sectional data on municipalities within a certain country or state to test for the impact of vertical grants on efficiency. In this section, we will argue that this type of cross-sectional data may not provide an adequate basis for testing the *causal impact* of grants on efficiency. Our argument builds on the fact that supra-ordinate governments do not distribute vertical grants randomly among municipalities but follow formulae or legally defined procedures which discriminate deliberately between them. In many cases, vertical grants are part of a fiscal equalization system. Fiscal equalization systems account for vertical fiscal imbalances by distributing substantial amounts of funds on a per-capita basis. These transfers are intended to cover a normalized fiscal need of municipalities (e.g. Boadway and Shah 2009). Many fiscal equalization systems also account for horizontal fiscal imbalances and discriminate in favor of financially weak municipalities. These receive higher per capita grants than financially strong municipalities. In some countries, financially strong municipali-

ties even have to contribute parts of their own revenues to the fiscal equalization system.

Such procedures produce an important regularity: The amount of vertical grants per capita  $g_i = G_i/N_i$  municipality  $i$  receives is likely to be higher the lower the private and public means per capita in this municipality. In the context of the model in section 2, we did not differentiate between different sources of means that the median voter can use to buy private goods and public services. Instead, these means are captured by his income  $y$ . In real-life situations, the means comprise the private income (net of national or other local taxes) as well as the tax revenues from local business taxes, land taxes etc. Hereafter, we will refer to the sum of these means as own resources. Using this broader concept, the regularity produced by fiscal equalization systems can be phrased as follows: There is a negative correlation between the grants per capita  $g_i$  municipality  $i$  receives and the own resources per capita ( $y_i'$ ) available to the representative (median) voter before grants in this municipality (i.e.  $\rho(g_i, y_i') < 0$ ). Hence, we expect that for most pairs  $i, j$  the following relationship holds:

$$g_i > g_j \quad \text{if} \quad y_i' < y_j' \quad (8)$$

The essential question now is: How are grants per capita and the amount of own resources available after grants correlated? To answer this question, it is important to note that in the model in section 2 an increase in private income reduces efficiency just like an increase in per capita grants does:

$$\frac{\partial(FR^*/Q^*)}{\partial y} = \frac{\partial a}{\partial y} \left[ 1 - \frac{1}{2-\alpha} \right] > 0 \quad (9)$$

Thus, if the correlation is negative (i.e.  $\rho(g_i, y_i' + g_i) < 0$ ), municipalities that receive high per capita grants are still – on average – financially weaker than municipalities receiving lower per capita grants. As both income and vertical grants have a negative effect on efficiency, these financially weak municipalities are more efficient than financially strong municipalities. Nevertheless, the direct correlations between the degree of inefficiency ( $FR^*/Q^*$ ) and the amount of grants received per capita will be positive and thus point at an efficiency-enhancing effect of vertical grants. In other words, the fiscal equalization system may have an inference-disturbing effect for empirical studies that test for the impact of vertical grants on efficiency using cross-sectional data from within one federation. This argument holds even if panel data from more than one time period is used. The strength of the inference-disturbing effect of the fiscal equalization system increases the stronger the correlation  $\rho(g_i, y_i' + g_i)$  becomes in absolute terms.

One way to control for the impact of average own resources ( $y_i'$ ) on both vertical grants and efficiency is to include proxies for this variable in the regression. While the empirical studies that find a negative relationship between grants and efficiency generally in-

clude such controls, this is not the case for the studies by Worthington (2000) or Grossman et al., (1999) who find no effect of vertical grants on efficiency.<sup>4</sup> Thus, Worthington (2000) and Grossman et al. (1999) may observe a non-significant relationship between grants and efficiency even if the (marginal) impact of grants on efficiency is negative.

In this paper, we perform an empirical study to learn more about the inference-disturbing effect. We use data from the German state Saxony-Anhalt. In Saxony-Anhalt, formula-based vertical grants – so-called “Schlüsselzuweisungen” account for a substantial share of the municipal budget. The intra-state distribution of these unconditional block grants is intended to reduce fiscal shortage in municipalities with limited own revenues. At the same time, it largely preserves the initial ordering in fiscal capacity. The amount of grants an individual municipality receives is exogenous to the grant-receiving municipality. In Saxony-Anhalt the vast majority of municipalities rely heavily on formula-based grants, and the correlation  $\rho(g_i, y_i + g_i) < 0$  is strongly negative (Haug 2013). Thus, Saxony-Anhalt is a highly suitable laboratory for our purposes. We test for the impact of vertical grants on efficiency using a) grant dependency and b) grants per capita as our central exogenous variable in one data set. Furthermore, we provide a direct test for the presence of the inference-disturbing-effect by using a proxy variable for the own resources available. If the effect is present, we expect a positive relationship between vertical grants per capita as well as grant dependency and efficiency, but a negative relationship between our proxy variable and efficiency.

## 4. Data and Method

### 4.1 Method

Our empirical analysis involves two steps. First, we estimate the relative efficiency in public service provision for all municipalities in our sample. Second, we run a regression analysis to explain the inter-municipal differences in relative efficiency using a set of so-called environmental variables. Among them, our variables for vertical grants and for the own resources available are of primary interest.

In step 1, we apply the concept of the input-distance function (Shepard 1970). The input-distance function describes the ratio between the actual input quantity to the technically achievable minimum input quantity for a given output quantity. The fiscal residuum can be easily interpreted in terms of relative efficiency: If we assume identical and exogenous factor prices as well as constant and identical factor intensities for all municipalities, then the cost embody a “composite input” valued in monetary units. Hence, the (minimum) cost function  $C(Q)$  represents the (minimum) input-requirement function for

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<sup>4</sup> Only Geys and Moesen (2009) control for household income and find a positive relationship.

any given output quantity and the fiscal residuum is the excess input quantity over the minimum input requirement. Assuming identical “portfolios” of local public services in all municipalities,  $Q$  is a composite bundle of local public outputs. Hence, the input-distance function for the one-input-one-output case can be written as

$$\delta(C, Q^*) = \frac{C_{act}(Q^*)}{C_{min}(Q^*)} = \frac{C_{min}(Q^*) + FR(Q^*)}{C_{min}(Q^*)} = 1 + \frac{FR(Q^*)/Q^*}{C_{min}(Q^*)/Q^*} \geq 1 \quad (10)$$

with  $C_{act}$  as the actual spending and  $C_{min}$  as the minimum cost.

In the multi-input-multi-output case, we have to allow for varying input and output mixes. Thus, the interpretation is less straight forward. In this case, according to the idea of the radial distance at which decision making units are located to the production frontier, the fiscal residuum of each municipality can be interpreted as the vector of the excess (in physical units) by which all actual input quantities  $\mathbf{x}$  (for the input-oriented case) could be reduced proportionally to reach the production frontier for a given output vector  $\mathbf{y}$  of local public goods:  $FR(\mathbf{y}) = (1 - \delta^{-1}(\mathbf{x}, \mathbf{y}))\mathbf{x}$  or  $\mathbf{x} - \mathbf{x}^*(\mathbf{y}) = (1 - \delta^{-1}(\mathbf{x}, \mathbf{y}))\mathbf{x}$  with  $\mathbf{x}^*$  as the vector of minimum input requirement given the production technology and the output  $\mathbf{y}$ . For each input  $x_i$  the input distance-function can be written as  $\delta = \frac{x_i}{x_i^*(\mathbf{x}_{j \neq i}, \mathbf{y})}$ .

In order to estimate the unknown municipal production frontier empirically and measure relative efficiency  $\delta_i$  for each municipality, we chose a non-parametric approach, the DEA-model suggested by Banker, Charnes, and Cooper (1984). The main advantage of this linear-programming based method is that no production or cost function has to be pre-specified. Due to our assumption of identical factor prices for all municipalities it is possible to replace the (unobservable) physical input quantities with cost data (Färe and Primont 1988) in the DEA-program.

In step 2, given the DEA measures that inform us about the relative efficiency of the municipalities in our sample, we go on to analyze the impact of vertical grants on relative efficiency. We assume that grants as well as the other chosen environmental variables do not alter the production technology. In other words, the environmental variables are neither a substitute for regular inputs nor undesired outputs that need additional inputs. They merely change the incentives of the bureaucrats to produce with minimum inputs because of the induced changes in their power to skim the fiscal residuum.

Consequently, the expected overall effect of grants on the DEA-measure  $\delta$  depends on the effect of an increase in grants allocated to the median voter ( $\sigma^{med}G$  or simply per capita grants  $g$  if  $\sigma^{med} = 1/N$ ) on  $Q^*$  and its effect on the relation of average fiscal residuum to average cost. From equations (6) and (7) we can see that in our model  $Q^*$  as well as  $FR(Q^*)/Q^*$  rise with increasing grants. The total effect in expression (10) then depends on the production technology: For constant or increasing returns to scale, relative inefficiency  $\delta$  increases and only in case of decreasing returns to scale a decrease in  $\delta$  is pos-

sible if and only if the grant-induced increase in  $FR(Q^*)/Q^*$  is lower than the increase in average cost  $C(Q^*)/Q^*$ . Hence, for most cases we could expect that  $\delta$  is higher the higher the (per capita) grants the municipality has received.

To account for the interdependence between step 1 and step 2, we apply the two-stage procedure suggested by Simar and Wilson (2007). Essentially, it consists of a truncated regression of the input distance measures with a vector of environmental variables  $\mathbf{z}$ .<sup>5</sup> The method involves a bootstrap procedure that remedies the severe problems of unmodified two-stage approaches (e.g. serial correlation of the dependent variables, general upward-bias of non-parametric efficiency measures because the true production possibility set and the true production frontier are unobservable (Bogetoft and Otto 2011: 156-157) or the correlation between error term and the environmental variables).

## 4.2 Data: Saxony-Anhalt in 2004

### 4.2.1 Local Government Structure

Saxony-Anhalt consists of more than 1,000 mostly small municipalities. Only few of them provide the whole bundle of public goods and services on their own. The overwhelming majority of municipalities are organized in municipal associations (“Verwaltungsgemeinschaft”). The single municipality is not free to decide whether to join a municipal association or remain independent. Instead, it has to follow different state regulations. The main purpose of municipal associations is to provide public goods and services to the citizens in their member municipalities. The members of a municipal association pool their resources in order to realize economies of scale without giving up their status as (legally, not necessarily fiscally or economically) autonomous municipalities. At the same time, the main political decisions with regard to the whole association are made by a council formed of the mayors of the member municipalities. Thus, although there is no directly elected council or mayor at the association level, there is a strongly institutionalized decision-making process. By forming a municipal association, the member municipalities give up a substantial part of their autonomy with respect to the amount of public services provided to their citizens and the decisions that determine the efficiency of public service production. Therefore, it is necessary to treat a municipal association as one single budget and production unit.

In the empirical analysis to follow, we assess the efficiency of municipal associations and those municipalities that provide the whole bundle of public goods and services on their own (hereafter independent municipalities). Below, we use the generic term municipal units when referring to independent municipalities and/or municipal associations. We use data for the year 2004 – the last year before a local government reform that brought a fundamental change in the structure of local government entities and re-

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<sup>5</sup> Supplementary material with further methodological details can be provided by the authors on request.

duced the number of municipalities from 1118 to 218 in 2010. This leaves us with 203 observations for 2004: 46 independent municipalities and 157 municipal associations.<sup>6</sup>

#### 4.2.2 Fiscal Equalization System

In Saxony-Anhalt, as in most other German states, the fiscal equalization system uses the largest share of its grants – in a formula-based fiscal equalization system – to reduce the fiscal gap. The fiscal gap in municipality  $i$  is defined to be the positive difference between municipality  $i$ 's standardized fiscal need  $FN_i$  and its fiscal capacity  $FC_i$ . Municipalities with  $FN_i - FC_i \leq 0$  (so-called abundant municipalities) do not receive formula-based grants (so-called “Schlüsselzuweisungen”). Formula-based grants are only intended to fill up the fiscal gap in municipalities where  $FN_i - FC_i > 0$ . Most fiscal equalization systems use a fill-up rate (“Ausgleichssatz”) of less than 100 percent (e.g., Lenk and Rudolph, 2004). Thus, a certain degree of fiscal shortage remains even after key grants have been distributed. The fiscal need is basically calculated by multiplying a standardized base amount  $BA$  for all municipalities with the sum of the “weighted” inhabitants  $W(i)$  (weights per inhabitant increase with total population of the municipality). The fiscal capacity is calculated as follows:

$$FC_i = \sum_{r=1}^R TB_i^r \cdot \bar{t}^r \quad (11)$$

Here,  $TB_i^r$  represents the tax base of local tax  $r$  ( $r = 1, 2, \dots, R$ ) in municipality  $i$ . For every local tax  $r$ , this tax base is multiplied by the same tax rate for all municipalities  $\bar{t}^r$ . Summing up across all  $R$  local taxes yields a standardized measure for the fiscal capacity for municipalities operating with different local tax rates.

It seems reasonable to assume that the tax bases  $TB_i^r$  and hence, the fiscal capacity in municipality  $i$  are positively correlated with the average or median income in this municipality. Given that the fill-up rate is less than 100 percent, higher grants per capita coincide with lower overall funds before and after fiscal equalization on average, i.e.  $\rho(g_i, y_i) < 0$  and  $\rho(g_i, y_i + g_i) < 0$ . This holds for the relationship between abundant and non-abundant municipalities as well as for the relationship between municipalities within these categories.

The fiscal equalization system in Saxony-Anhalt follows the general lines sketched in the previous section. The fill-up rate for the unconditional formula-based grants is 70 % and thus aims at reducing the fiscal stress in financially weak municipalities while leaving the initial ordering in municipalities intact. These formula-based grants dominate the total amount of vertical grants and make up for 36 percent of all municipal revenues in

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<sup>6</sup> See Haug (2013) for further details on the local government structure of Saxony-Anhalt.



2004 on average. The vast majority of municipalities in Saxony-Anhalt suffer from fiscal stress and 97% of them receive unconditional formula-based grants.<sup>7</sup>

The correlation between unconditional formula-based grants per capita (resp. overall grants for current expenditures per capita) and total municipal tax revenues is -0.65 (-0.51).<sup>8</sup> This implies that the correlation between grants per capita and total means per capita  $\rho(g_i, y_i + g_i)$  is negative even for the unlikely case that municipal tax revenues and per capita household income on the municipal level should be uncorrelated.<sup>9</sup>

### 4.2.3. Inputs, Outputs and Environmental Variables

As information on the physical amount of inputs employed by the municipalities is not available<sup>10</sup>, we use costs to approximate physical inputs. Since all municipalities within Saxony-Anhalt are parties to the same collective wage agreement and have access to the same capital market, we assume that the unobserved input prices are the same for all municipalities in our data set. To approximate inputs, we construct three categories of input costs: labor costs, capital costs, and costs for resources and intermediate inputs. Labor costs comprise of the expenditures for staff. The sum of interest payments and expenditures for rent and lease make up capital expenditures. Resources and intermediate inputs consist of all other current expenditures.<sup>11</sup>

The outputs correspond to the municipalities' tasks and are very similar to those used in other global municipal efficiency studies (e.g., Geys and Moesen 2009; Geys et al. 2007; Kalb 2010). A large expenditure block is social security with most of all funds being spent on childcare. Therefore we use the number of approved places in childcare centers as output measure.<sup>12</sup> Similarly, the students in elementary school are used as a

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7 For a more detailed description of the fiscal equalization system and the situation of municipalities in Saxony-Anhalt, refer to Haug (2013).

8 The coefficients are calculated using the method of Spearman. In contrast to the current grants hardly any correlation can be found between the investment grants and the local tax revenues per inhabitant (-0.07).

9 Due to the lack of adequate data the correlation between municipal tax revenues per capita and the average household income cannot be tested at the municipal level. However, for 2004 we find a strong positive correlation (Spearman rho +0.84) between these two variables at the level of the districts and district-free towns in Germany (438 observations).

10 That physical input quantities as well as input prices are not available is a problem common to most studies analyzing global efficiency at the municipal level, e.g. Kalb et al. (2012), Geys et al. (2010), and Kalb (2010).

11 A few exceptions are made to ensure that all expenditures included contribute to measurable municipal output. Expenditures for financial management (except interest payments) and expenditures recorded for book-keeping purposes like internal offsets are excluded. Finally, expenditures are corrected for double cost counting which mainly results from the aggregation of the budgets of the member municipalities and their municipal association. These aggregation and adjustment procedures are closely related to the calculation formula of the Statistical Office of Saxony-Anhalt (2009).

12 These numbers are available at the municipal level only for 2006. The aggregated statistics at district level show that the number of available/approved places has increased somewhat over the period

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proxy for municipal tasks related to schools. Other municipal tasks are local public health, sport, and recreation facilities and municipal streets. These outputs are approximated with the recreational and traffic area.

While these tasks and the corresponding outputs can be measured fairly well, a number of public consumption goods for private households and public inputs for the private enterprise sector cannot be measured properly (or adequate data has not been published). This problem arises for services like public safety, economic development or business-related infrastructure. Here, some rough proxies have to be used. Following the literature (e.g., De Borger and Kerstens 1996, Balaguer-Coll et al. 2007, Geys et al. 2010, Kalb 2010), we assume that these outputs are correlated with the size of the population (public consumption goods) and the number of employees subject to social security contribution (public inputs). Finally, a number of service categories like sewage disposal and water or energy supply are excluded entirely because these services are frequently outsourced to municipal enterprises outside the core budget and thus corresponding output as well as input measures are not available.

The main purpose of our empirical study is to identify municipal characteristics that are related to the municipalities' efficiency scores. In particular, we are interested in the relationship between efficiency scores and vertical grants. While the existing studies use only one of the following measures to capture the impact of vertical grants, we use both: grant dependency, measured as percentage of formula-based grants of the total adjusted current income, and (formula-based) grants per capita. Furthermore, as the formula-based grants are a function of the fiscal capacity (see section 4.2.2) and significantly negatively correlated with it, we also use the fiscal capacity per capita to replace the grant variables in one model specification.

We also account for the impact of differences in the institutionalized decision making processes between independent municipalities and municipal associations. The Public Choice literature tells us that controlling the local bureaucracy (or government) is a municipal-wide public good (e.g., Besley and Case, 1995). Thus, other things equal, democratic control by voters is more intensive in the 46 independent municipalities than in municipal associations.

On the other hand, there is an additional institution that controls public service production in municipal associations: While the local authorities are only controlled by a large number of voters with small individual stakes, the municipal association is also and primarily controlled by the politicians of the member municipalities. These have substantial incentives to control production in municipal associations regardless of their motivation: Benevolent politicians will control to pursue public interest and opportunistic politicians will control to prevent unnecessary transfer payments to the associations

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2002 to 2006 and also afterwards. No information on the actual number of children in childcare centers is available before 2006 (Statistical Office Saxony-Anhalt 2010).

that reduce their own funds. To test for the impact of municipal associations, we introduce a dummy variable for them. We also use the number of member municipalities in municipal associations as explanatory variable. For independent municipalities this variable takes on the value one. The larger the number of municipalities, the less intensive is the degree of democratic control – other things equal.

Table 1:  
Descriptive statistics Saxony-Anhalt 2004 (N=203)

<b>Variable</b>	<b>Mean</b>	<b>Std. dev.</b>	<b>Min</b>	<b>Max</b>
<i>Inputs:</i>				
Labor (in €)	2,894,448	2,894,205	460,538	17,700,000
Capital (in €): interest and rent expenditures	428,926	502,415	48	3,222,858
Capital (in 1,000 €): aggregated real investment expenditures 1995-2004	34,370	24720.86	4,185	147,400
Resources and intermediate inputs (in €)	2,212,260	2,430,012	347,249	17,800,000
<i>Outputs:</i>				
Population	9,615.13	7,833.50	2,229.00	45,737.00
Approved childcare places	443.08	340.29	102.00	2,046.00
Children in elementary school	235.81	194.76	0	1,179.00
Traffic and recreational area (hectare)	465.15	219.86	67.00	1,191.00
Employees s.t. social security contribution (at place of work)	2,508.83	3,169.39	213.00	17,918.00
<i>Environmental variables:</i>				
Grants as share of total adjusted current income	0.31	0.09	0	0.48
Grants per capita (in €)	246.7	53.98	0	315.8
Fiscal capacity per capita (in €)	369.1	473.5	162.6	5,145.0
Debt per capita (in €)	942.90	657.11	24.14	4,041.48
Municipal association	0.7734	0.4197	0	1
Number of member municipalities in municipal associations	5.49	4.00	1.00	22.00
Population density	141.90	169.63	21.16	1,216.41
Share of senior citizens	0.20	0.02	0.13	0.27
Relative population change 1995-2004	-0.04516	0.1029	-0.3527	0.5530
Unemployment rate (unemployed divided by population between 15 and 64)	0.10	0.02	0.01	0.15

Source: Authors' calculations.

Finally, we introduce a number of other control variables. Debt per capita and unemployment rate are used to capture municipalities' fiscal stress respectively additional information about private household income. Demography is controlled for by a number of variables. First, we introduce population density and its square as explanatory variables. The share of senior citizens is used to account for the impact of the age composi-

tion on democratic control and composition of public services. We also account for the impact of overall population decline by using the relative population change between 1995 and 2004. Descriptive statistics of all variables are presented in table 1.

## 5. Results

In step 1 of our empirical analysis, we calculated the bias-corrected relative (global) input efficiency measures for the municipalities in Saxony-Anhalt. We find a median value of 1.18 (mean: 1.23), meaning that the median municipal unit could reduce its inputs by 15.25% while keeping output constant. We found that the vast majority of municipalities operate at a nearly scale-efficient level (median value of relative scale efficiency: 1.02). Only some larger municipalities (over 20,000 inhabitants) operate under decreasing returns to scale.

In step 2 of our empirical analysis, we use the bias-corrected technical efficiency scores to evaluate the impact of environmental variables on municipal efficiency (see table 2) by a truncated regression analysis. Our baseline models (model I and II) use grant-dependency and grants per capita, respectively, as primary variables of interest. To test for the robustness of the results, we estimate two additional model specifications. In models Ia and IIa, the interest and rent expenditures are replaced by the aggregate real investments since 1995 as an alternative proxy for the capital input. In models Ib and IIb, we restrict the sample in the baseline model to municipalities with less than 20,000 inhabitants to further improve homogeneity in outputs and to deal with the potential problem of decreasing returns to scale.

We find a negative coefficient for the grant variable on inefficiency regardless of the model specification and for both grant dependency and per capita grants (though not significant for model II and IIb). This indicates a positive relationship between efficiency and the amount of grants. The coefficient of the dummy for municipal associations is negative (though not always significant) in all six models. Hence, other things equal, the two-stage decentralized decision making in municipal associations leads to higher efficiency in public service production. Efficiency tends to decrease with the number of member municipalities in municipal associations, though the corresponding coefficient is not significant for all specifications. Furthermore, we find a positive effect of population density. The coefficient of the squared population density is positive and also significant in some models, indicating a u-shaped relationship between efficiency and population density. The share of senior citizens and debt per capita exert a negative influence on efficiency. The coefficients of the unemployment rate and the relative population change are not significant in most model specification except for a negative effect of unemployment in model Ia and a negative effect of relative population change in model Ib and IIb.

Table 2:  
Results of the second-stage truncated regression

	Model I	Model Ia	Model Ib	Model II	Model IIa	Model IIb	Model III
Variable	Coefficients						
Constant	0.5763 *	0.8039 *	0.6552 *	0.5529 *	0.7983 *	0.6335 *	0.5206 *
<b>Grant dependency</b>	<b>-0.5405 *</b>	<b>-0.7582 *</b>	<b>-0.5402 *</b>	-	-	-	-
<b>Grants per capita</b>	-	-	-	<b>-0.0003</b>	<b>-0.0008 *</b>	<b>-0.0003</b>	-
<b>Fiscal capacity p.c.</b>	-	-	-	-	-	-	<b>0.0001 *</b>
Dummy municipal association	-0.1057 *	-0.0502	-0.1188 *	-0.1171 *	-0.0631	-0.1282 *	-0.0820
Number of municipalities	0.0101 *	0.0022	0.0088	0.0100 *	0.0026	0.0086	0.0091 *
Population density	-0.0009 *	-0.0016 *	-0.0015 *	-0.0009 *	-0.0015 *	-0.0014 *	-0.0010 *
Population density squared	0.0000004 *	0.000001 *	0.000002	0.0000004	0.000001 *	0.000001	0.000001
Share of senior citizens	4.1055 *	2.2754 *	4.1663 *	3.8448 *	2.1514 *	3.9608 *	3.1966 *
Debt per capita	0.0001 *	0.0001 *	0.0001 *	0.0001 *	0.0001 *	0.0001 *	0.0001 *
Unemployment rate	0.2536	1.9169 *	-0.0254	0.0035	1.6816	-0.2807	0.0748
Relative pop. change	0.3525	0.4087	0.4312 *	0.3806	0.4345	0.4721 *	0.0289
	N=203	N=203	N=181	N=203	N=203	N=181	N=202

Notes: \* indicates significance at the 5% level based on the 95% confidence intervals calculated by Efron's percentile method. - In model a, the capital input variable is replaced by aggregated real investment expenditures; in model b, the sample is restricted to municipal units with less than 20,000 inhabitants. - For the interpretation of the results it should be kept in mind that a negative sign of the coefficient indicates a reduction of the relative distance to the estimated production frontier, i.e. an efficiency improvement.

Source: Authors' calculations.

Our argument in section 3 states that the positive empirical relationship between grants and efficiency cannot be taken as empirical evidence for a positive causal effect of vertical grants on efficiency but instead may be driven by the fact that both depend on the own resources that the median voter can use to buy private goods and public services (i.e. his own income, means that come from local business taxes, land taxes etc.). This raises the question why we do not test for the influence of this variable directly? As data

on the median (or even average) household income on municipal level is not available, we use the fiscal capacity per capita as a proxy.<sup>13</sup>

In model III we also took into account that by construction of the underlying formula-based grant system, fiscal capacity and the grants (per capita) are significantly negatively correlated. Using both variables simultaneously in one regression model is thus likely to cause severe multicollinearity problems. Therefore, we replace the grant variable in the baseline models with the fiscal capacity per capita (see model III in table 2).<sup>14</sup> We find the expected significant positive sign for the fiscal capacity variable.<sup>15</sup> The coefficient of the fiscal capacity captures the net effect of the two opposing effects of an increase in fiscal capacity on the overall means ( $y_i + g_i$ ) and hence, on efficiency: a) the gross increase in overall means caused by the increase in fiscal capacity and b) the decrease in overall means caused by the decrease in formula-based grants.

## 6. Discussion

In our regressions, we find a stable positive relationship between vertical grants and public sector efficiency. While part of the empirical literature report an insignificant or significantly positive relationship only for grant dependency but not for grants per capita, we find it for both variables. This result seems to be at odds with the theoretical model of Kalb (2010) and our theoretical model. However, these empirical findings are likely to result from the fact that the fiscal equalization system concentrates grants in financially weak municipalities. Even after fiscal equalization, these municipalities face a tighter budget constraint and thus waste fewer resources per unit output. The negative relationship between fiscal capacity and efficiency (see table 2) supports this view. Thus, it is possible that grants *cause* local authorities to reduce efficiency even though our regressions produce a coefficient that hints at an efficiency-enhancing effect.

The results support our main argument in section 3: The negative correlation between fiscal capacity and grants caused by the fiscal equalization systems makes it impossible to interpret a positive relationship between grants and efficiency as an indication for a causal relationship whenever the study is based on cross-sectional data - unless the own resources available to the median voter are controlled for. Similarly, the absence of a

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<sup>13</sup> *FC* is calculated according to equation (10) including the standardized (net) revenues of the local business tax and the property tax as well as the municipality's shares in the national income tax and the national value added tax.

<sup>14</sup> Furthermore, in model III we had to drop one outlier municipality because it reports an extremely high fiscal capacity (5,145.0 € p.c.) for 2004. This obviously resulted from a type error in the official statistical data: During the years before and after 2004 this municipal association has gained only a small fraction of the 2004 fiscal capacity.

<sup>15</sup> We also found significant and positive coefficients for the model specifications IIIa and IIIb. The results are available on request.

significant result cannot be interpreted as an indication that vertical grants do not affect efficiency unless own resources are controlled for. On the other hand, our argument strengthens the conclusions that can be drawn from studies that find a negative relationship even for countries or states with strong fiscal equalization schemes.

Beyond the impact of grants, our results indicate that municipal associations are more efficient than independent municipalities. This supports the notion that politicians in member municipalities are more successful in controlling municipal associations than individual voters in the independent municipalities are in controlling their local authorities. The effectiveness of control may partly result from the fact that municipalities can threaten to reduce the funds and tasks of the municipal association or leave it altogether.

Finally, the negative effect of a high share of senior citizens on efficiency found in most of the model specifications might be explained by the fact that older people do not benefit from the main municipal expenditure categories (childcare, primary schools) and hence are not interested in efficiency to an extent that young citizens are. Alternatively, a high share of senior citizens can be interpreted as indication that the corresponding municipality is shrinking. In this case, the negative relationship results from hysteresis in cost.

## 7. Conclusions

The current paper makes three contributions to the literature on vertical grants and their impact on public sector efficiency. First, we develop a very simple theoretical model of the interaction of voters and bureaucrats in local public service provision. We use this model to analyze the impact of vertical grants on efficiency. Our model differs in a number of features from the only other formal model on this relationship proposed by Kalb (2010). Most importantly, we assume that public services are normal goods and thus vertical grants elevate the median voter's willingness to pay for public services. Once we make this assumption, we no longer need fiscal illusion (i.e. grant-induced misperception of the tax price for local public goods) to arrive at the conclusion that vertical grants have a negative impact on public sector efficiency. In Kalb's model, it is precisely this misperception that causes the negative relationship between grants and efficiency.

Second, we use our model together with a central feature of existing systems of vertical grants to suggest an explanation why the empirical evidence on the relationship between vertical grants and efficiency is mixed: Many fiscal equalization systems concentrate grants in financially weak municipalities but leave the initial ordering in fiscal capacity (largely) intact. Thus, per capita grants are high in municipalities which – before and even after fiscal equalization – face a tighter budget constraint than financially strong municipalities and are thus (forced to be) more efficient. If the regularity is not con-

trolled for, empirical studies may lead to false conclusions concerning the causal impact of vertical grants on efficiency.

To illustrate this point, our paper reports an empirical study for the German state of Saxony-Anhalt. In Saxony-Anhalt, vertical grants are the primary source of municipal revenues and the fiscal equalization system follows the lines sketched above. Therefore, it provides a highly suitable data-base to illustrate the point made above. As predicted, we find a positive statistical relationship between vertical grants and efficiency but a negative one between fiscal capacity and efficiency. This result supports the argument above.



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