The Contribution of Equalization Transfers to Fiscal Adjustment: Empirical Results for German Municipalities and a US–German Comparison

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Abstract:

This paper considers the role of fiscal equalization in maintaining fiscal balance. It employs a large panel of German municipalities in order to investigate the dynamic fiscal policy adjustment using a vector error-correction model that explicitly takes account of the intertemporal budget constraint. The results confirm that a substantial part of fiscal adjustment to revenue shocks takes place by offsetting changes in intergovernmental transfers: in present value terms about 34 cents of a permanent one euro decrease in own revenues are compensated by subsequent changes in fiscal equalization transfers. Hence, the contribution of intergovernmental transfers in maintaining fiscal balance is found to be two to three times higher than in the case of US municipalities investigated by Buettner and Wildasin (2006). Despite fiscal equalization, however, expenditures are not found to display smaller fluctuations in the German case.

Keywords: Municipal Fiscal Policy; Dynamic Fiscal Adjustment; Fiscal Equalization

JEL Classification: H74, H72, H77

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1 Introduction

Aside from own revenues raised from local taxes and charges, local governments in most countries rely on intergovernmental revenue obtained from other governmental units, in particular from higher levels of government. The literature on fiscal federalism has justified this kind of intervention as a means to induce the local governments to provide specific types of public goods, to redistribute among lower level governments, and to ensure efficiency under conditions of intergovernmental externalities (*e.g.*, Oates, 1972, and Gordon, 1983).

The literature has also noted that intergovernmental transfers play a role in smoothing spending and tax policy of governments in a setting with uncertainty and limited access to debt. This has been discussed in the context of the European monetary union (*e.g.*, Sala-i-Martin and Sachs, 1992, and von Hagen and Eichengreen, 1996). Subsequently, several papers have investigated the stabilizing effect of fiscal transfers at subnational level (*e.g.*, Asudrubali *et al.*, 1996, von Hagen and Hepp, 2000, Melitz and Zumer, 2002).

Another strand of the literature emphasizes, however, that intergovernmental transfers give rise to important questions of governance, since higher level governments allocate funds on the basis of conditions which are subject to strategic choices of local governments (*e.g.*, Bordignon *et al.*, 2001, for a survey of the recent literature see Oates, 2005). The attempt to provide fiscal assistance in order to smooth revenue and expenditure policies of local jurisdictions may tend to soften the budget constraint with the consequence of possibly serious disincentives for fiscal policy (*e.g.*, Wildasin, 1997, Qian and Roland, 1998). Moreover, if intergovernmental transfers provide some form of insurance against asymmetric shocks a moral hazard problem emerges in the sense that local governments pursue more risky policies (Persson and Tabellini, 1996, and Bucovetsky, 1997).

While most countries assist subnational governments by means of vertical grants, some countries, such as Australia, Canada, Germany, Spain, or Switzerland, entertain redistributive transfer schemes that explicitly aim at equalizing revenue capacities across subnational governments. These systems of fiscal equalization might be quite effective in providing fiscal assistance in case of adverse revenue shocks because they are formally related to the tax capacity of a jurisdiction and

are not subject to the immediate discretion of policy makers. However, little is known about the comparative performance of these fiscal equalization systems and more standard systems of vertical grants in maintaining fiscal balance and about associated governance problems.

Against this background, this paper sheds light on the role of intergovernmental transfers in restoring fiscal balance using a large panel of German municipalities. It builds on a VAR approach that captures the dynamic adjustment to fiscal shocks in a comprehensive way and allows us to quantify the contribution of each budgetary component to overall fiscal adjustment. Buettner and Wildasin (2006) have recently applied this approach to US municipalities and have shown that a significant fraction of revenue shocks is offset by future grants from federal and state governments. This result is remarkable given that US municipal governments are experiencing a considerable degree of fiscal autonomy and are not subject to a fiscal equalization scheme.

The current paper addresses municipalities in Germany that enjoy some autonomy in expenditures as well as in taxation as their US counterparts. In difference to the US case, however, the German municipalities are subject to strongly redistributive systems of fiscal equalization where grants and transfer obligations are tied to the tax capacity. The strong degree of fiscal redistribution is documented by the fact that for a typical German municipality the equalization grants aim at compensating more than two thirds of the difference between what is considered as *fiscal need* and *tax capacity*.[4] However, the extent to which equalization systems are effective in providing fiscal assistance to a municipality facing a revenue shock, for instance, depends on the details of how fiscal capacity is determined and on the timing of transfers. Moreover, as the Canadian case shows, since equalization transfers depend not only on the individual government's fiscal position but on the developments in the whole system it is not necessarily the case that fiscal equalization actually contributes to stabilizing individual governments' budgets (Boadway and Hayashi, 2004, and Smart, 2004).

The empirical results of this paper's analysis support an important role of fiscal equalization for

[4]In typical systems of fiscal equalization *fiscal need* is basically the conceded per-capita level of spending times the number of residents, *tax capacity* is an indicator of revenues at standardized tax rates. See Buettner and Holm-Hadulla (2008) for a brief discussion of municipal fiscal equalization in Germany. The appendix provides an overview of key parameters of municipal fiscal equalization in Germany.

budget balance. The degree of fiscal assistance provided by intergovernmental revenue is much more significant than in the case of US municipalities studied by Buettner and Wildasin (2006). In fact, the contribution of intergovernmental transfers to restoring fiscal balance after a revenue shock is about two to three times higher in the German case.

However, expenditures of German municipalities are not found to display smaller fluctuations than their US counterparts. At the same time, we find larger fluctuations in own revenues. This might be related to the strong reliance of German municipalities on the local business tax (a local profit tax) rather than on the local land tax. While a thorough analysis of the choice of the revenue structure is beyond the scope of this paper, our results are consistent with the view that the large amount of insurance provided by the system of fiscal equalization might induce the municipalities to rely more on the volatile business tax rather than using property taxes as their US counterparts.

The paper is set up as follows. The investigation approach is outlined in Section 2. Section 3 describes the data in greater detail. Section 4 presents results of the empirical analysis for Germany and Section 5 offers some comparisons with the US case. Section 6 provides the conclusions.

2 A Model of Fiscal Adjustment

In order to model budgetary adjustment patterns in a comprehensive way without much prior restrictions an investigation approach pioneered by Bohn (1991) rests on a vector error-correction model that captures the development of budget components like revenues, expenditures, and debt service as well as their interrelationship over time. The error-correction framework is convenient to study the dynamics of fiscal policy as it allows us to take account of the adjustment towards budget balance. Moreover, it has been shown that under certain regularity assumptions budgetary components like expenditures, revenues, and debt service would actually display a co-integrating relationship given the intertemporal budget constraint, and, hence, the deficit will become stationary (*e.g.*, Trehan and Walsh, 1988). Whereas Bohn (1991) is concerned with the analysis of the fiscal policy of the US federal government, Buettner and Wildasin (2006) use a similar approach to study fiscal adjustment in the context of local governments which obtain substantial amounts of

revenue not only from own sources like taxes but also in terms of intergovernmental revenue.

While Buettner and Wildasin (2006) distinguish the primary surplus into three components comprising general government expenditures, own-source revenues, and grants, due to the importance of fiscal equalization in the German context the current paper extends their approach: it distinguishes intergovernmental transfers related to the system of fiscal equalization from other forms of intergovernmental transfers referred to as grants. The distinction between these two types of transfers helps us to discern their specific contribution in the adjustment towards fiscal balance.

Formally, the analysis considers three components of the expenditure side of the budget, *i.e.* general expenditures (G_t), current debt service (S_t) and fiscal-equalization transfers (T_t), as well as two components of the revenue side, *i.e.* own revenues (R_t) and grants (I_t). Whereas grants are strictly non-negative, fiscal-equalization transfers will be positive or negative depending on whether the municipality is a net contributor (positive) or net receiver of transfers (negative). Stacking these five components into a vector

$$Y_t = (R_t, G_t, I_t, T_t, S_t)', \tag{1}$$

the current deficit D_t is determined by a scalar product

$$D_t \equiv b'Y_t \quad \text{where:} \quad b = (-1, 1, -1, 1, 1)'. \tag{2}$$

Following the literature, the empirical model is a vector-error correction model. Its five equations describe the changes of the elements of the vector Y_t as a function of lagged changes of Y_t as well as of the lagged deficit.

$$\Delta Y_t = \gamma\, D_{t-1} + a + \mathbf{A}_1 \Delta Y_{t-1} + \mathbf{A}_2 \Delta Y_{t-2} + ... + \mathbf{A}_p \Delta Y_{t-p} + u_t, \tag{3}$$

where we collect the coefficients into a (5×1) vector of error-correction terms, a (5×1) vector of constants, and p (5×5) matrices of coefficients.

The empirical estimate of System (3) is used to trace the fiscal adjustment to innovations in

the budget components, that are not associated statistically with previous changes in the budget components. Following Bohn (1991), the fiscal adjustment is summarized by computing the *present value* of the impulse-response of each variable with respect to innovations in itself and every other variable (see Appendix for details).

While the basic empirical model captures the fiscal adjustment to unpredicted fiscal innovations in general, further extensions are used to explore the sources of these innovations. More precisely, the analysis below adds various indicators of local shocks to the system and tests whether these indicators have significant predictive power for each of the fiscal innovations.

3 Data

With the exception of the three city states, all German states operate systems of municipal fiscal equalization. The basic motivation is the federal constitution (see Section 106, 7 *Grundgesetz*), which demands that the states share their revenues from income and value-added taxes with municipalities and counties by means of unconditional grants in an equitable way. Hence, in the terminology of Boadway (2002), municipal fiscal equalization in Germany involves gross schemes. While the systems differ among the German states in many details, they share the basic principles that were established in the Prussian fiscal equalization system which served as a benchmark for the states after the formation of the Federal Republic of Germany. Also the East German states which joined the federation in 1990 have installed corresponding systems (see Appendix for a brief description of municipal fiscal equalization in Germany and the differences between German states). However, data availability varies by state. Obviously, only the municipalities of West German states can be observed over a long time period. Moreover, digitized data are often available only for a limited time period. The empirical investigation employs annual data for the complete set of municipalities in a major German state (Baden-Wuerttemberg) which can be traced back until 1972 and where the administrative structure was unchanged.[5]

[5]Even though the basic systems of fiscal equalization are quite similar, the German states show differences in the economic and fiscal performance. Compared to municipalities in other states the municipalities in Baden-Wuerttemberg are characterized by relatively high tax revenues. But, even in Baden-Wuerttemberg, the number

After removing nine municipalities with data problems, the sample consists of 1102 jurisdictions that are observed over a time period of 27 years from 1974 to 2000. In terms of both the cross-sectional and the time-series dimension the dataset complements nicely with the sample of 1270 US municipalities investigated by Buettner and Wildasin (2006) over a time period of 26 years (1972 to 1997).

For the purposes of this study the budget of the municipalities is characterized by five fiscal variables constructed from the official budget statistics which is adhering to a uniform mandatory classification (see Table A.4 in the Appendix for the details). There are two revenue variables, own-source revenues and grants, and three variables on the expenditure side: general expenditures, (net) debt-service, and (net) equalization transfers. The latter variable captures the contributions to county and regional governments and to the equalization fund net of equalization grants received and, hence, may be positive or negative.

Table 1 presents descriptive statistics. Since the data display significant variation in the size of municipalities, fiscal variables are scaled in per-capita terms. On the revenue side of the budget the largest component is own revenues but also grants are quite important. Note that even though the mean of the equalization transfers is positive, the minimum is negative reflecting a municipality with low tax capacity that is a net receiver of fiscal-equalization transfers. The mean difference between expenditures and revenues (*i.e.* the mean deficit) is about minus 51 euro per capita, indicating that on average the municipalities run a small surplus. However, there is marked variation in the sample. This variation in budget outcomes is also reflected in differences in the debt service, where some municipalities show rather large interest expenses whereas others actually report net interest earnings.

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of so called abundant municipalities where tax capacity exceeds fiscal need is very small (*e.g.*, Brachat-Schwarz, 1995) and, hence, most municipalities receive fiscal equalization grants. Moreover, due to the specifics of the federal fiscal constitution one might expect that grants are more important in other states where tax revenues are lower. Available statistics only point at moderate differences among the West German states. Only in the five East German states grants are more important. Based on the statistics for 2002 we find that the ratio of grants to own revenues is 96.7% in Baden-Wuerttemberg and 1.02% in the other West German States but 1.70% in the five East German states (see Destatis, Fachserie 14, 3.3, 2002). Therefore, we should not expect that, due to its specific economic and fiscal conditions, fiscal adjustment in Baden-Wuerttemberg differs a great deal from the other states. Only the role of grants in the fiscal adjustment of municipalities in East German states is expected to be different.

Table 1: Descriptive Statistics

Variables	Mean	Std.Dev.	Min.	Max.
Levels of Budget Components				
Own Revenues	0.593	0.261	-0.117	5.904
General Expenditures	0.984	0.327	0.208	5.668
Grants	0.530	0.205	0.037	4.361
Equal.Transfers	0.057	0.148	-0.687	1.888
Debt Service (net)	0.030	0.042	-0.365	0.434
Deficit	-0.051	0.216	-3.732	2.095
Annual Changes of Budget Components				
Own Revenues	0.004	0.165	-4.117	2.638
General Expenditures	0.003	0.274	-4.362	3.084
Grants	0.012	0.172	-2.474	3.563
Equal.Transfers	0.007	0.074	-1.176	1.039
Debt Service (net)	-0.001	0.019	-0.390	0.373
Control Variables				
Population (in 1,000)	8.727	24.88	0.093	617.4
Employment per Capita	0.240	0.152	0.007	2.874
Unemployment Rate	5.56	1.91	0.80	13.3
Neg. Business Tax Rev.	0.003	0.058	0	1

Statistics for pooled observations. Figures refer to 1102 municipalities in the state of Baden-Wuerttemberg in € 1,000 per-capita and in prices of 2000. Fiscal variables and population are reported annually for the period 1974-2000, figures for employment and unemployment are only available for the period 1980-2000.

Table 1 also provides statistics on the control variables that are used below in order to explore the sources of the fiscal shocks. This includes local employment per capita and the local unemployment rate.[6] The analysis further employs a dummy variable capturing observations where due to tax refunds the current business tax revenue turns negative. Note that despite local autonomy in setting the tax rate, tax collection is centralized at the state level; the local government has no influence on tax administration including the determination of payments, prepayments, and refunds. Large refunds occur, for instance, when a major company went bankrupt such that tax prepayments have to be refunded, or when a major company has appealed against a tax assessment by the state's

[6]The list of control variables does not include income, as correspond data is not available on an annual basis for municipalities.

tax administration at some date, won its case, and received a refund. Occasionally, the amount of refunds is larger than the total amount of current receipts such that total revenue turns negative. About 80 such events are reported in the dataset. Given the nature of these events their occurrence is used as an indicator of the existence of a major revenue shock to the municipality.

4 Specification Choice and Testing

The empirical literature dealing with budgetary revenue and spending data at the macroeconomic level has emphasized that the corresponding time series are typically non-stationary in the form of integration of order one. The empirical model takes account of this possible form of non-stationarity of the individual budgetary components as it is formulated in first differences. Only the deficit is entered in levels, which is, however, stationary if the linear relationship implied is a co-integrating relationship as the macroeconomic literature suggests. In order to check whether the current deficit as well as the other variables employed are stationary, unit-root testing is carried out using a procedure suggested by Pesaran (2007), which is based on the full set of unit-root statistics for each of the individual municipalities and takes account of serial correlation and cross-sectional dependence.[7] Table 2 reports results. The upper part refers to the levels of the budget components where differences between municipalities are taken into account by individual specific intercepts. The lower part refers to the deficit and the first differences of the budget components where individual specific intercepts are eliminated or, in case of the deficit, would conflict with the intertemporal budget constraint.

It turns out that for the own-revenue series non-stationarity cannot be rejected, and the same is true for most other variables.[8] As the lower part of the table shows, non-stationarity can be

[7]This testing procedure is a modified version of the test proposed by Im *et al.* (2003) and includes cross-sectional averages of lagged levels and first-differences in the augmented Dickey-Fuller regressions. While this approach does not capture spatial dependence directly, Baltagi *et al.* (2007) review its properties in the presence of spatial cross-sectional dependence. They find that this test, among others that explicitly allow for cross-sectional dependence, has better performance than standard panel unit root tests.

[8]Note that as in Buettner and Wildasin (2006) the optimal lag length according to the Akaike criterion differs between individual municipalities, but in the majority of cases is not larger than 6.

Table 2: Panel Unit Root Tests

lag order (p)	4	5	6
Own Revenues	-1.69	-1.53	-1.35
Gen. Expend.	-1.84	-1.76	-1.71
Grants	-2.14*	-2.01	-1.92
Eq. Transfers	-1.91	-2.34*	-2.11*
Debt Service	-1.92	-1.75	-1.47
Deficit	-2.44*	-2.04*	-1.84*
Δ Own Revenues	-2.07*	-1.70*	-1.72*
Δ Gen. Expend.	-2.43*	-1.98*	-1.87*
Δ Grants	-2.21*	-1.85*	-1.87*
Δ Eq. Transfers	-1.58*	-1.26	-1.14
Δ Debt Service	-1.90*	-1.72*	-1.76*

Average of individual cross-sectionally augmented Dickey-Fuller statistics. With the exception of the deficit, tests for variables in levels include an intercept. A star denotes significant rejection of non-stationarity at the 5 % level according to critical values tabulated by Pesaran (2007, Tables II(a) and II(b)).

rejected, however, for the deficit and for the first differences of the budgetary components. Only for equalization transfers tests based on higher order serial correlation do not prove significant. This should not be overemphasized, however, since in this case the levels already display non-stationarity. The unit-root testing, therefore, supports the specification of budgetary adjustments along the lines of the vector error-correction model.

Estimation of the VECM (3) requires the specification of the lag length of the model. Given the limited overall time dimension of the dataset (27 years), we begin with a lag of 6 years in the differenced data, subsequently testing for possible reductions in the number of lags. As shown in Table 3 a reduction of the lag length is always rejected. This would suggest to employ a model with six lags. But, since estimates of models with four and five lags did not show major differences in the impulse-response functions the results presented in this paper are obtained from the more parsimonious specification with four lags.

Table 3: Specification Tests

lag length	3	4	5	6
indiv.eff ($\chi^2(5505)$)	2507	2730	3064	3476
lag order reduction ($\chi^2(25)$)	2445	1615	992.0	551.8

Likelihood ratio statistics on cross-equation restrictions.

The large cross-sectional dimension of the dataset enhances opportunities for empirical modeling by pooling observations for individual municipalities. Typically, panel-data studies allow for individual effects capturing differences in the characteristics of individual units.[9] The analysis in this paper deals essentially with first differences of fiscal flow variables; only the deficit variable is entered in levels. Thus, the presence of individual effects would imply that the jurisdictions converge to different (per-capita) deficit levels.

Comparing estimation with and without fixed individual effects it turns out that joint tests reject the presence of individual effects, regardless of lag length (see Table 3), indicating that municipalities are commonly converging towards the same level of deficit in per-capita terms.[10] Since no indication of individual effects is found, the set of regressors is the same across equations. Therefore, it is appropriate to estimate individual equations of the system (3) separately with OLS; joint estimation would not improve efficiency (Avery, 1977, and Baltagi, 1995:103pp).

[9]The literature on dynamic panel data has emphasized biasedness of standard panel data approaches in samples with relatively short time series in the presence of lagged endogenous variables and suggests the use of instrumental variable techniques (*e.g.*, Holtz-Eakin *et al.*, 1991). But, with 27 years of observation in our sample, the Nickell (1981) bias should not be a significant problem, and it is neglected in the tests for the presence of individual effects.

[10]Because innovations in budgetary components may share a common effect across jurisdictions one might also be thinking of employing time-specific effects. But this would imply conditioning on common shocks and modeling only adjustments to idiosyncratic innovations, although the intertemporal budget constraint requires adjustments to all innovations.

Table 4: Deficit Effects (Error-Correction Terms)

Equation	γ	(Std.err.)
Own Revenues	.061	(.019)
Gen. Expend.	−.453	(.021)
Grants	.053	(.012)
Transfers	−.080	(.005)
Debt Service	.032	(.002)

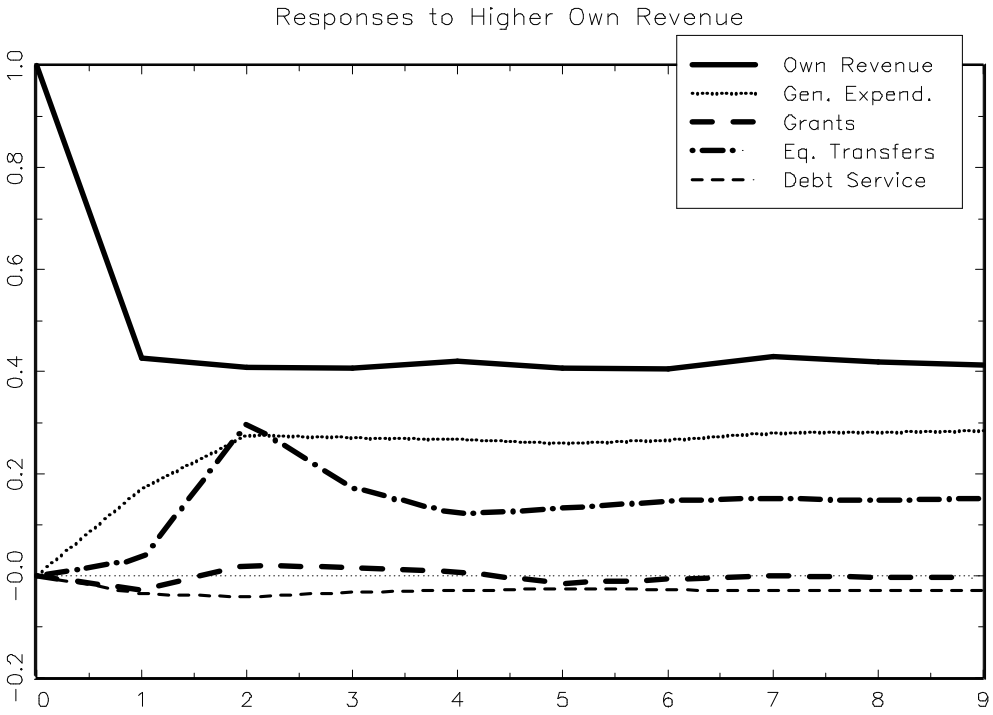
Heteroscedasticity robust standard errors in parentheses.

5 Estimation Results

While the detailed parameter estimates are reported in the Appendix (see Table A.2), Table 4 reports results for the parameter vector γ of System (3). Since a higher deficit exerts a positive impact on own revenues and on grants received, whereas it has a negative impact on general expenditures or (net) transfer obligations related to the fiscal equalization system, the error-correction mechanism is confirmed. The positive impact on the debt service is consistent with the fact that the deficit results in a rise in debt and thus creates higher debt service in the subsequent period. Given a constant rate of interest, and in the absence of population growth, the coefficient of the deficit in the debt-service equation should reflect the interest rate. Since the average population growth rate is below one percent in our data, the figure of around 0.03 seems broadly consistent with this view.

The dynamic adjustment patterns can be traced out by impulse-response functions. To provide an example, Figure 1 depicts the response to an innovation in own revenues by € 1 per capita. It shows that in the period following an unpredicted increase revenue drops strongly, suggesting that more than half of the variation in own revenues is only temporary. Nevertheless, some significant adjustment takes place in other components of the budget. First of all, general expenditures start to grow consistent with a "tax and spend" sequence. In addition, equalization transfers show a strong increase, in particular, in the second period after the revenue shock. This reflects a specific detail of the fiscal-equalization system: the tax capacity, which is decisive for fiscal-equalization

Figure 1: Impulse Response to an Innovation in Own Revenue



transfers, is actually calculated based on tax revenue (adjusted for tax effort) two years ago.[11]

To obtain a comprehensive view of fiscal adjustment it is instructive to calculate the total fiscal responses in present-value terms (see Appendix for the details). For this purpose, following Bohn (1991) and Buettner and Wildasin (2006), and consistent with the deficit coefficient in the debt service equation, the discount rate is fixed at 3%. The columns of Table 5 show the long-run impact of innovations in per-capita values of the fiscal variables, expressed in present-value terms.[12] For instance, the results in the first column show how fiscal balance is maintained if there is an increase in own revenue by one euro that results in a reduction of the deficit (or in an increase of the surplus). According to the point estimates own revenues will decline in the future by 57 cents,

[11] *Cf.* §6 of the Finanzausgleichgesetz (Fiscal Equalization Act) of the state of Baden-Wuerttemberg.

[12] Standard errors are obtained by sampling from the normal joint distribution of the VECM estimates and computing the corresponding distribution in the impulse-response functions as suggested by Sims (1987) and Hamilton (1994:337).

Table 5: Implied Present Value Responses

Response	Innovation to Own Reven.		Gen. Expen.		Grants		Eq. Transf.		Debt Serv.	
Own Revenues	-0.569⋆	(.021)	0.063⋆	(.012)	-0.040⋆	(.011)	-0.020	(.015)	0.185⋆	(.055)
Gen. Expend.	0.274⋆	(.019)	-0.851⋆	(.013)	0.355⋆	(.018)	-0.531⋆	(.020)	-0.991⋆	(.082)
Grants	-0.004	(.008)	0.028⋆	(.008)	-0.546⋆	(.015)	-0.057⋆	(.014)	-0.447⋆	(.053)
Eq. Transfers	0.146⋆	(.006)	-0.047⋆	(.004)	0.045⋆	(.004)	-0.530⋆	(.008)	0.042	(.026)
Debt Service	-0.029⋆	(.002)	0.033⋆	(.002)	-0.023⋆	(.002)	0.030⋆	(.003)	-0.323⋆	(.019)
	response to permanent change									
Own Revenues			0.425⋆	(.059)	-0.088⋆	(.024)	-0.043	(.032)	0.273⋆	(.081)
Gen. Expend.	0.634⋆	(.023)			0.782⋆	(.022)	-1.129⋆	(.046)	-1.464⋆	(.109)
Grants	-0.009	(.017)	0.190⋆	(.044)			-0.121⋆	(.031)	-0.661⋆	(.074)
Eq. Transfers	0.338⋆	(.012)	-0.314⋆	(.046)	0.098⋆	(.010)			0.062	(.038)
Debt Service	-0.067⋆	(.004)	0.224⋆	(.028)	-0.052⋆	(.005)	0.064⋆	(.006)		

Standard errors in parentheses obtained by sampling from the normal joint distribution of the VECM estimates based on a heteroscedasticity consistent estimate of the variance-covariance matrix. ⋆ denotes significance at 5 % level.

general expenditures will increase by 27 cents and also equalization transfers will increase by 15 cents – all in present value terms.

Given the intertemporal budget constraint, the innovations in each of the budgetary components should be fully balanced in the present value of future changes in the primary surplus. Adding fiscal responses of the first four rows of Table 5 we see that, in fact, the absolute value of the present values of the changes is close to unity in most cases:[13]

Unit innovation to	Own Rev.	Gen. Exp.	Grants	Equal.Tr.	Debt Serv.
PV of change in prim. surplus	-0.993	0.989	-0.986	0.984	0.687

Only for innovations in debt service the sum of the present value of changes in the primary surplus seems not sufficient to restore fiscal balance. However, this result reflects temporal fluctuations in

[13]In order to compute the fiscal responses of the primary surplus add expenditure changes with a negative sign and revenue changes with a positive sign. For a revenue innovation, for instance, using the figures in Table 5 the total response in the components of the primary surplus is $0.993 = (-0.569) - (0.274) + (-0.004) - (0.146)$.

the debt service. Since the point estimate for the present value of future changes in debt service in response to a unit increase in debt service is -0.323, out of a unit innovation in debt service only about 0.677 ($= 1 - 0.323$) euros are permanent. Contrasting the latter figure with the present value of estimated changes in the primary surplus, the close conformity with the predictions from the intertemporal budget constraint reappears.

Generally, the results show that innovations to the components of the budget tend to be partly offset by future changes in the same component. This is particularly true for general expenditures, where about 85 cents of the necessary adjustment in response to higher expenditures by one euro comes from an offsetting change in the present value of future expenditures. Since all budget components display those fluctuations, albeit at different scales, it is instructive to re-scale responses such that the figures report the response to a permanent unit innovation. In the lower panel Table 5 reports corresponding figures. Again, the results point to a key role of general expenditures in restoring fiscal balance. Almost two thirds (63 cents) of the balancing adjustment to a permanent unit change in own revenues comes from general expenditures. However, also equalization transfers are important, making up a third (34 cents) of the necessary adjustment. Grants not related to the fiscal-equalization system show less response; in fact, the estimated response to a change in own revenues is not significantly different from zero. The responses to innovations in expenditures give a mixed picture: additional general expenditures tend to trigger an increase in grants, but changes in other spending obligations such as equalization transfers and debt service are followed by reductions in grants. The latter effects are possibly related to the role played by matching grants: if transfer obligations and debt service are financed with cuts in general expenditures, the amount of (matching) grants acquired possibly declines.

While the present values of the impulse-response functions depict the adjustment to fiscal imbalances that are associated with unpredicted changes in the various budget components, it has been left open so far what the sources of the unpredicted changes are. This limits our ability to interpret the empirical response as an adjustment to fiscal shocks. We do not know whether the innovations in the budget components can be traced back to an exogenous change in the constraints faced by fiscal policy. Moreover, a fiscal shock might not just show up in one but in several budget components, simultaneously.

Table 6: Significance of Conditioning Variables

	Equations				
Conditioning Variables	Own Reven.	Gen.Expend.	Grants	Eq.Transfers	Debt Serv.
Period-specific effects	309 (21)*	865 (21)*	766 (21)*	2987(21)*	584 (21)*
Change in local employment^a	69.0 (1) *	14.5 (1) *	5.32 (1) *	12.6 (1) *	2.95 (1)
Change in local unemployment^a	1.14 (1)	2.03 (1)	0.69 (1)	1.20 (1)	5.31 (1) *
Negative business tax rev.^{a}	105.4 (1) *	0.26 (1)	0.45 (1)	1.89 (1)	2.05 (1)

Likelihood-ratio statistics for restricting the respective set of conditioning variables to zero. ^{a} Period-specific effects included as further conditioning variables. * denotes significance at 5 % level, degrees of freedom in parentheses.

To provide some insights into the possible sources of the unpredicted changes and possible immediate budget responses, further information about the time-period, the conditions in the local economy, and about tax-revenue shocks are included by means of additional conditioning variables in our basic model. Their significance for each of the budget components under consideration is reported by means of likelihood-ratio statistics in Table 6, that summarize the gain in the predictive power from the inclusion of observed shocks.[14] The first row of Table 6 reports statistics for the inclusion of period-specific effects. These effects capture all changes in the conditions faced by all municipalities, simultaneously, such as growth, unemployment, or financial market conditions. The following rows report results for the additional inclusion of indicators of possible local fiscal shocks. While changes in local employment show a much weaker predictive power than the time effects they exert strong effects on own revenues. However, significant effects are also found for other budget components. Therefore, employment shocks do not affect a single budget component but exert more complex effects throughout the budget. Changes in local unemployment, however, are mostly insignificant and only show a weak impact on debt service.[15] But, as is evident from the last row,

[14]More precisely, the likelihood-ratio statistics indicate whether implicit restrictions in the basic, unconditional model can be rejected on statistical grounds.

[15]The different results for unemployment may be related to measurement issues. While employment is reported at the level of municipalities, unemployment is measured at the level of employment service districts. Moreover, whereas employment is reported at the level of the firm/employer, unemployment is based on the place of residence.

unusually large tax refunds that turn the business tax revenue negative do qualify as a source of own-revenue innovations. As discussed above, those cases take place, rarely, but occasionally, due to the specifics of the business tax. While the negative business tax revenue dummy has a rather strong predictive power for own-revenue innovations it does not exert any significant contemporaneous effects on innovations in the other budget components. This supports the interpretation of the impulse response to an innovation in own revenues in terms of the dynamic fiscal adjustment to a tax revenue shock.

One possibly important dimension by which cities differ in the current analysis is their population size. These size differences might play a role for the fiscal adjustment pattern, since larger jurisdictions might have more opportunities to raise own revenues in response to fiscal imbalances. One might also think of size effects on the access to debt. To test for differences in the fiscal adjustment pattern, the sample was decomposed into groups according to the long-run averages of population size and the analysis was carried out separately for each sub-sample. According to the results (see Table A.3 in the Appendix), the empirical adjustment pattern is similar across cities of different size. Revenue innovations, are mainly balanced with expenditures but also equalization grants contribute substantially whereas grants do not. Quantitatively, we see that the adjustment by means of expenditures is more important for small municipalities, and fiscal equalization grants play a more important role for large municipalities. The degree of fluctuations in budget components such as expenditures and revenues is, however, larger for small municipalities.

6 US - German Comparison

Let us finally compare the results with the existing evidence for US municipalities. Table 7 provides descriptive statistics for the US municipalities as reported in Table 2 of Buettner and Wildasin (2006) and, for convenience, also reports the corresponding German figures. We note first that the fraction of general expenditures financed with intergovernmental revenue is 28 % in the US, but more than 50 % in the German case. This suggests that intergovernmental revenue is much less important in the US case. One might object against this comparison that the US sample used by Buettner and Wildasin displays a much larger population size with a mean of 75 thousand

inhabitants compared to about 9 thousands in the German data. But also when comparing small US municipalities with the German municipalities we still observe a significantly lower share of grants in the US case in financing general expenditures (26 %).[16]

The descriptive statistics also reveal that annual changes in own revenues and general expenditures display a larger variation in the German case. Consider the annual changes in own revenues per capita. In the German case, the standard deviation is 165 € or 28 % of the mean level of own revenues. For the US case, the standard deviation of annual changes of own revenues amounts only to US$ 102 per capita or 18% of the mean. With regard to general expenditures, in the German case the standard deviation of the annual changes amounts to 28 % of the mean whereas the corresponding figure for US municipalities is 25 %.

Table 8 reports the present value responses for the U.S. case. They also support a smaller fluctuation of primary budget components, such as own revenues and general expenditures, in the US case: 35 cents of a one dollar innovation in own revenues are balanced with offsetting future changes in own revenue, and 72 cents of a one dollar innovation in general expenditures are offset by future changes in expenditures (for small municipalities: 42 and 70 cents, respectively). As noted above, the corresponding figures for the German municipalities are 57 and 85 cents, respectively.

Buettner and Wildasin (2006) also tested whether the budget innovations can be assigned to specific shocks and found that innovations in own revenues can be related to national revenue trends in the various municipal taxes weighted with the local tax structure. This suggests that in the US case as well as in Germany the systems' responses to own-revenue innovations can be interpreted as depicting the fiscal adjustment to tax-revenue shocks. Therefore, it is most interesting to compare the fiscal response to own-revenue innovations, *i.e.* to compare the first column in Table 5 with the results in the first column of Table 8.

This comparison offers some interesting differences: In the German case, equalization transfers play an important role in the adjustment towards fiscal balance: if own revenues temporarily decline by

[16]The group of US municipalities categorized as small cities in Buettner and Wildasin (2006) consists of cities between 1 and 15 thousand inhabitants.

Table 7: Statistics for U.S. in Comparison to German Municipalities

Fiscal variables	Mean	Std.Dev.	Min.	Max.
U.S. sample (in U.S. $ per capita), 1972-1997				
Levels of Budget Components				
Own Revenue	0.520	0.377	0.004	7.018
General Expenditure	0.712	0.504	0.004	7.357
Vertical Grants	0.200	0.219	0.000	2.891
Debt Service (net)	0.001	0.048	-0.496	1.033
Deficit	-0.007	0.154	-1.656	2.305
Annual Changes of Budget Components				
Own Revenue	0.014	0.102	-1.441	1.486
General Expenditure	0.017	0.191	-2.348	2.485
Grants	0.004	0.104	-1.412	1.610
Debt Service (net)	-0.001	0.032	-0.527	0.463
German sample (in € per capita), 1974-2000				
Levels of Budget Components				
Own Revenue	0.649	0.303	0.003	7.888
General Expenditure	0.984	0.327	0.208	5.668
Grants	0.529	0.206	0.000	4.361
Equal.Transfers	0.113	0.185	-0.945	3.225
Debt Service (net)	0.030	0.042	-0.365	0.434
Deficit	-0.051	0.216	-3.732	2.095
Annual Changes of Budget Components				
Own Revenues	0.004	0.165	-4.117	2.638
General Expenditures	0.003	0.274	-4.362	3.084
Grants	0.012	0.172	-2.474	3.563
Equal.Transfers	0.007	0.074	-1.176	1.039
Debt Service (net)	-0.001	0.019	-0.390	0.373

U.S. figures taken from Table 2 of Buettner and Wildasin (2006) report statistics for 1270 U.S.cities, in $ 1,000 per-capita and in prices of 2000. German figures refer to 1102 municipalities in the state of Baden-Wuerttemberg in € 1,000 per-capita and in prices of 2000, see Table 1 above.

Table 8: Implied Present Value Responses for U.S. Municipalities

Response	Innovation to			
	Own Revenue	Gen. Expend.	Vert. Grants	Debt Service
Own Revenue	-0.348 (.026)	0.162 (.019)	-0.144 (.023)	0.145 (.037)
Gen. Expend.	0.508 (.027)	-0.716 (.020)	0.338 (.027)	-0.370 (.037)
Vert. Grants	-0.086 (.012)	0.082 (.010)	-0.473 (.017)	0.049 (.016)
Debt Service	-0.005 (.005)	0.019 (.004)	-0.015 (.004)	-0.387 (.014)
	response to permanent increase			
Own Revenue		0.571 (.040)	-0.273 (.044)	0.236 (.059)
Gen. Expend.	0.780 (.021)		0.641 (.043)	-0.604 (.063)
Vert. Grants	-0.131 (.019)	0.287 (.033)		0.079 (.026)
Debt Service	-0.008 (.008)	0.068 (.014)	-0.028 (.008)	
	responses for small U.S. cities			
Own Revenue	-0.420 (.047)	0.204 (.040)	-0.188 (.049)	0.306 (.082)
Gen. Expend.	0.443 (.049)	-0.696 (.039)	0.262 (.051)	-0.319 (.084)
Vert. Grants	-0.075 (.023)	0.056 (.018)	-0.502 (.029)	-0.018 (.034)
Debt Service	-0.002 (.008)	0.015 (.006)	-0.012 (.007)	-0.337 (.027)
	response to permanent increase			
Own Revenue		0.673 (.070)	-0.378 (.097)	0.462 (.117)
Gen. Expend.	0.765 (.044)		0.525 (.094)	-0.482 (.129)
Vert. Grants	-0.130 (.040)	0.184 (.059)		-0.027 (.051)
Debt Service	-0.004 (.014)	0.050 (.020)	-0.025 (.014)	

Source: Buettner and Wildasin, 2006.

one euro, equalization transfers change by 15 cents in present value terms. In the US case, a one dollar revenue shortfall would only trigger an increase in grants by about 9 cents in present value terms. Also when focusing on permanent changes in own revenues, we see that in the German case a much larger fraction of a revenue change is compensated by offsetting equalization transfers. Whereas in the US case grants rise only by about 13 cents in present value terms if own revenue permanently declines by one dollar, in the German case the contribution of fiscal equalization to restoring fiscal balance given a decline in own revenue by one euro amounts to no less than 34 cents. This shows that intergovernmental transfers do, in fact, play a more important role in the German case in maintaining fiscal balance in the presence of temporary as well as permanent own-revenue

shocks. The downside of the larger role of intergovernmental transfers is the smaller contribution of expenditure to maintaining fiscal balance. While in the US case, expenditures contribute about 78 cents of the necessary adjustment to a permanent unit dollar change in revenues, in the German case adjustment of expenditures make up only about 63 cents.

The findings of larger fluctuations in primary budget components and of a larger fraction of own-revenue changes compensated by offsetting intergovernmental transfers might well be related. Given larger fluctuations in own revenues one might argue that there is a higher demand for insurance provided by interregional redistribution (*e.g.*, Graham and Rodden, 2003, and Stegarescu, 2008).

However, there is a second possible relationship pointing at a reversed causality. To see this, note that the large fluctuations in own revenues are likely reflecting the much lower importance of property taxes for the finances of German municipalities which, in contrast, rely much more on the rather unstable business tax, which, essentially, is a tax on profits. In fact, while the German municipalities do have a land tax at their disposal where they have the autonomy to set the tax rate, they tend to rely heavily on the rather volatile business tax. In 2000 the revenue share of the business tax in own revenues is about 44.1 %. While there is no general property tax, the share of the land tax is about 16.2 %. US municipalities which enjoy much less fiscal assistance by intergovernmental revenue rely much more on property taxes. For comparison, according to the 1997 Census of Government US municipalities report a share of corporation taxes in own source revenue of about 1.9% whereas the share of property tax revenue is reported with 28.9%.

While a thorough analysis of the choice of the revenue structure is beyond the scope of this paper, we may note that the empirical differences observed are consistent with theoretical concerns that the large degree of insurance provided by the system of equalization transfers results in a moral-hazard problem: the riskier local tax base may be adopted by the German municipalities partly because localities are much more insured against the revenue risks. We should note, however, that grants, and, in particular, redistributive grant schemes such as fiscal equalization may exert further effects on the choice of revenue instruments.[17]

[17]Besides income effects, the literature on tax competition, for instance, has noted that various competition effects can be mitigated by equalization grants (*e.g.*, Dahlby and Wilson, 1994, Koethenbuerger, 2002, Bucovetsky and

While incentive effects of fiscal equalization on the choice of the revenue structure might explain why revenue fluctuations are stronger in the German case, it is interesting to note that also expenditures show stronger fluctuations in the German case. Of course, this could be driven by the revenue side. But, also other explanations come to mind. While the political process is always a candidate for disturbances, matching grants for specific types of spending might tend to amplify the budgetary effects of spending decisions. Another possible explanation could be that budget rules and restrictions of debt finance reduce the scope for tax smoothing by German municipalities.

7 Conclusions

This paper has developed an empirical model of the adjustment path towards fiscal balance for a sample of German municipalities. While the model is restrictive in the sense that it assumes a uniform adjustment path for all municipalities, it does not add much restrictions on the properties of the adjustment path, except for some implications of the intertemporal budget constraint. Due to the specifics of the fiscal institutions under which German municipalities operate, the analysis distinguishes not only general expenditures, own revenues, and debt service, but also two separate components capturing intergovernmental transfers: grants and fiscal-equalization transfers. The latter aim explicitly at equalizing fiscal capacities across the local governments and, therefore, might be quite effective in providing fiscal assistance.

The results obtained are consistent with the intertemporal budget constraint since the present value of all future changes in the primary surplus calculated using a fixed discount rate is matching quite closely with the initial disturbance of fiscal balance regardless of which budget component is actually considered.

For all budget components temporary fluctuations are observed in the sense that current changes in a component are offset with future changes in the same variable. Thus, an increase in own revenues is followed by a reduction, a decline in general expenditures is offset by a future increase *etc.* Focusing on permanent innovations, most of the adjustment is actually carried out by changing

Smart, 2006).

general expenditures. But, also equalization transfers play an important role in fiscal adjustment.

In order to explore whether and to what extent the unpredicted changes in the budget components are associated with exogenous shocks various indicators of local shocks have been added to the system, capturing labor market conditions as well as large tax refunds associated with the business tax. The results suggest that the empirical response to an innovation in own revenues can be interpreted as revealing the dynamic fiscal adjustment in response to a revenue shock to the business tax.

A comparison with the case of US municipalities investigated by Buettner and Wildasin (2006) shows that intergovernmental transfers do, in fact, play a more important role in maintaining fiscal balance in the German case in the presence of temporary as well as permanent revenue shocks. Whereas in the US case intergovernmental transfers rise only by about 13 cents in present value terms if tax revenue permanently declines by one dollar, in the German case the contribution of fiscal equalization to restoring fiscal balance amounts to no less than 34 cents. Despite the large degree of insurance, however, general expenditures show larger fluctuations in the German case and also own revenues are more volatile.

Given that the German municipalities rely heavily on the rather unstable business tax but show much less tax effort with regard to land taxation, these results may reflect a moral-hazard effect of fiscal equalization: The large amount of insurance provided by the system of equalization grants in Germany might induce the municipalities to rely on the highly volatile business tax rather than to use property taxes as the US municipalities. However, to provide clear-cut empirical evidence on this moral hazard effect of fiscal equalization that takes account of possibly competing explanations is left for future research.

References

Asdrubali, P., Sorensen, B. E., and Yosha, O. (1996). Channels of Interstate Risk Sharing: United States 1963-1990. *Quarterly Journal of Economics* 111 (4), 1081–1110.

Avery, R. B. (1977). Error Components and Seemingly Unrelated Regressions. *Econometrica* 45,

199–209.

Baltagi, B. H. (1995). *Econometric analysis of panel data.* New York et al.: Wiley.

Baltagi, B. H., G. Bresson and A. Pirotte (2007). Panel unit root tests and spatial dependence. *Journal of Applied Econometrics* 22, (2007), 339–360.

Bohn, H. (1991). Budget Balance Through Revenue or Spending Adjustment. *Journal of Monetary Economics* 27, 333–359.

Bordignon, M., Manasse, P., and Tabellini, G. (2001). Optimal regional redistribution under asymmetric information. *American Economic Review* 91 (3), 709–724.

Bronner, O., Faiss, K., and Fuerth, F. (1998). Der kommunale Finanzausgleich in Baden-Wuerttemberg, *Praxis der Gemeindeverwaltung*, Stuttgart: Kommunal- und Schulbuchverlag.

Brachat-Schwarz, W. (2005), Zur regionalen Verteilung der Schlsselzuweisungen auf die Kommunen Baden-Wrttembergs seit 1995, *Statistisches Monatsheft Baden-Wuerttemberg* 7(2005), 47–50.

Bucovetsky, S. (1997). Insurance and incentive effects of transfers among regions: equity and efficiency. *International Tax and Public Finance* 4, 463–483.

Bucovetsky, S. and Smart, M. (2006). The efficiency consequences of local revenue equalization: Tax competition and tax distortions. Journal of Public Economic Theory 8, 119–144.

Buettner, T. and Holm-Hadulla, F. 2008. Fiscal equalization: The case of German municipalities. *CESifo DICE Report* 6, 16–21.

Buettner, T., and Wildasin, D. E. (2006). The dynamics of municipal fiscal adjustment. *Journal of Public Economics*, 90, 1115–1132.

Dahlby, B. and L. S. Wilson. (1994). Fiscal capacity, tax effort, and optimal equalization grants. *Canadian Journal of Economics*, 27, 657–672.

Garrett, G. and Rodden. J. (2003). Globalization and fiscal decentralization. In: Kahler, M. and Lake, D. A. (eds.) *Governance in a global economy: political authority in transition.* Princeton and Oxford: Princeton University Press, 87–109.

Gordon, R. G. (1983). An optimal taxation approach to fiscal federalism. *Quarterly Journal of Economics* 97, 567–586.

Hamilton, J. D. (1994). *Time Series Analysis.* Princeton: Princeton University Press.

Holtz Eakin, D., Newey, W., and Rosen, H. (1991). The Revenue-Expenditure Nexus: Evidence from Local Government Data. *International Economic Review* 30, 415–429.

Im, K. S., Pesaran, M. H., and Shin, Y. (2003). Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics* 115, 53–74.

Kasper, A. (2008), Entwicklung der Kommunalfinanzen 19472007, in *Kommunale Steuer-Zeitschrift* 57 (2008), 1–20.

Koethenbuerger, M. (2002). Tax competition and fiscal equalization. *International Tax and Public Finance* 9, 391-408.

Melitz, J., and Zumer, F. (2002). Regional redistribution and stabilization by the center in Canada, France, the UK and the US: A reassessment and new tests, *Journal of Public Economics*, 86 (2), 263–286.

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica* 49, 1417–1426.

Oates, W. E. (1972). *Fiscal federalism.* New York: Harcout Brace Jovanovich.

Oates, W. E. (2005). Toward a second-generation theory of fiscal federalism. *International Tax and Public Finance* 12, 349–373.

Persson, T., and Tabellini, G. (1996). Federal fiscal constitutions: risk-sharing and moral hazard. *Econometrica* 64, 623–646.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics* 22, 265–312.

Qian, Y., and Roland, G. (1998). Federalism and the soft budget constraint. *American Economic Review* 88 (5), 1143–1162.

Sala-i-Martin, X., and Sachs, J. (1992). Fiscal federalism and optimum currency areas: evidence for Europe from the United States. In M. B. Canzoneri (Ed.), *Establishing a central bank* (pp. 195–219). Cambridge MA: Cambridge University Press.

Sims, C. A. (1987). Comment on D. E. Runkle, Vector Autoregression and Reality. *Journal of Business and Economic Statistics* 5, 443–449.

Stegarescu, D. (2008). The Effects of Economic and Political Integration on Fiscal Decentralization: Evidence from OECD Countries. *Canadian Journal of Economics* forthcoming.

Trehan, B., and Walsh, C. E. (1988). Common Trends, the Government's Budget Constraint, and Revenue Smoothing. *Journal of Economic Dynamics and Control* 12, 425–444.

von Hagen, J., and Eichengreen, B. (1996). Federalism, fiscal restraints, and European monetary union. *American Economic Review* 86, 134–138.

von Hagen, J., and Hepp, R. (2000). Regional risksharing and redistribution in the German federation. *ZEI Working Paper* B-15. Bonn

Wildasin, D. E. (1997). Externalities and bailouts: hard and soft budget constraints in intergovernmental fiscal relations. *Policy Research Working Paper* No. 1843. Washington, D.C.: World Bank.

Appendix

A.1 Details of Municipal Fiscal Equalization in Germany

In all German states the most important element of fiscal equalization is the provision of formula based equalization grants (*Schluesselzuweisungen*) which are determined by a basic equalization rate applied to the difference between fiscal need and tax capacity. The former is basically the conceded level of spending per capita times the number of residents, the latter is a measure of own tax revenues at standardized tax rates. A second important element of the states' equalization laws is the country contribution (*Kreisumlage*) which is usually levied on the sum of the tax capacity and the equalization grants.

Table A.1 provides an overview of some relevant details of the currently implemented systems. They represent the current laws (2009), but, since changes in the law are not frequent, similar rules have been in place in the years before. The rules for Baden-Wuerttemberg, for instance, are almost identical to our investigation period (for a discussion of the development of municipal fiscal equalization in this state see Bronner *et al.*, 1998). The basic equalization rate varies between 50 and 90 percent (see column 2). The average figure is 0.68, implying that grants will close more than two thirds of the gap between fiscal need and tax capacity. However, in states, where the basic equalization rate is only 50 % additional guarantee clauses apply if tax capacity is below a certain share of fiscal need or of average tax capacity (see column 2). In the state of Baden-Wuerttemberg, for instance, municipalities where the tax capacity falls short of 60 % of fiscal need, receive additional transfers. These transfers ensure that that the gap between fiscal need and the sum of tax capacity and equalization grants (*i.e.*, fiscal capacity) is not larger than 12%. In effect, fiscal capacity is not smaller than 88 % of fiscal need. Hesse, Lower Saxony, and Schleswig Holstein provide even higher guarantee levels.

In each state, there is a small and varying fraction of municipalities where tax capacity is exceeding fiscal need. In most states such *abundant* municipalities receive zero equalization grants. In some states, *abundant* municipalities would actually have to transfer a fraction of excess capacity to the

Table A.1: Determinants of Equalization Transfers in the German States

State	Basic Rate	Guarantees	Abundancy Rules	Contrib. to Equal.Fund	Contrib. to County[d])
	(1)	(2)	(3)	(4)	(5)
Baden-Wuerttemberg	70%	88%	14.8-25.7%[c]	6.3%[c]	10.5%
Bavaria	55%	75%[a])			14.2%
Brandenburg	75%				17.3%
Hesse	50%	90%			19.7%
Mecklenburg-Westpomm.	65%				16.1%
Lower Saxony	75%	95%	20%		15.2%
Northrhine-Westphalia	90%				21.9%
Rhineland-Palatinate	50%	73%[b])		0-10%	13.3%
Saar	90%	70%[b])			22.4%
Saxony	75%				9.06%
Saxony-Anhalt	70%		0-15%		15.3%
Schleswig-Holstein	50%	91%	20%		13.0%
Thuringia	70%				15.1%

Figures refer to the 2009 legislation. Only contributions to the county are own calculations based on 2007 effective rates. [a]) : Under the guarantee clause additional grants are paid in the amount of 15% of the difference between tax capacity and 75% of the state average tax capacity.

[b]) : Under the guarantee clause additional grants make up the difference between tax capacity and 73% (70%) of the state average tax capacity.

[c]) : All municipalities are obliged to contribute to the equalization fund at a rate of 22.1 out of the sum of tax capacity and equalization grants. With a basic rate of 0.70 the effective rate contribution rate out of tax capacity is 6.3 %.

[d]) Average burden from county contributions is depicted by the average share of business tax revenues that municipalities have to transfer to the county government.

equalization fund. As depicted in the third column, this fraction is smaller than the basic equalization rate rate. Two states demand contributions from all municipalities (see column 4). However, in all states, regional, and, in particular, county governments request further contributions, so called *Umlagen* that are usually levied on the fiscal capacity, *i.e.* the sum of tax capacity and equalization grants. The most important element is the contribution to the county. Column (5) reports effective contribution rates capturing the average share of business tax revenues transferred to the county government.

Further contributions to state and federal governments related to business tax revenue sharing, are, however, not considered as a part of the fiscal equalization system, and, therefore, are directly

netted out from business tax revenues in this study.

A.2 Data Sources and Definitions

The basic dataset consists of all 1111 municipalities (Gemeinden) of the state of Baden–Wuerttemberg in the period from 1974 to 2000. 9 municipalities were removed because of data problems. With the exception of the price index for public consumption that is obtained from the Federal Statistical Office the data is obtained from the state's statistical office (Statistisches Landesamt).

Own revenues includes revenue from business, land and other taxes, exclusive of revenue from income taxes and sales taxes, since the latter are subject to a revenue sharing system. Business tax revenue is included net of revenue sharing contributions to the state and federal governments (*Gewerbesteuerumlage*). In addition own revenues include charges and user fees, fines as well as rents and royalties.

General expenditures include the compensation of employees including social security contributions as well as pensions, furthermore, all current expenses, excluding interest expenses and contributions to the revenue sharing and fiscal-equalization systems.

Grants comprise all sorts of unconditional and conditional or targeted grants including revenue sharing grants related to income and sales taxes but excluding grants related to the fiscal-equalization system.

Equalization transfers consist of contributions to the state-wide fiscal-equalization system, including county contributions, net of state equalization grants received.

Debt service is defined by the interest payments net of interest revenue.

A.3 Derivation of Present Value Responses

In order to derive present value responses note that System (3) can be rearranged as a first-order VAR

$$X_t \;=\; \mathbf{B}\, X_{t-1} \;+\; v_t. \tag{A.4}$$

To formulate the system in this way, we write the deficit as a sum of changes in the budget components and the preceding period's deficit

$$D_{t-1} = b'\Delta Y_{t-1} + D_{t-2}.$$

Following Bohn (1991) repeated substitution for the deficit in (3) yields the following parameter matrix $\mathbf{B}$ and corresponding vectors of variables X_t and disturbances v_t of the first-order VAR system (A.4)

$$\mathbf{B} \;\equiv\; \begin{bmatrix} \mathbf{A}_1+\gamma b' & \mathbf{A}_2+\gamma b' & \mathbf{A}_3+\gamma b' & \mathbf{A}_4+\gamma b' & \gamma \\ \mathbf{I} & \mathbf{0} & \mathbf{0} & \mathbf{0} & 0 \\ \mathbf{0} & \mathbf{I} & \mathbf{0} & \mathbf{0} & \vdots \\ \mathbf{0} & \mathbf{0} & \mathbf{I} & \mathbf{0} & 0 \\ 0 & \dots & 0 & b' & 1 \end{bmatrix}, \quad X_t \equiv \begin{bmatrix} \Delta Y_t \\ \Delta Y_{t-1} \\ \Delta Y_{t-2} \\ \Delta Y_{t-3} \\ D_{t-4} \end{bmatrix}, \quad \text{and} \quad v_t \equiv \begin{bmatrix} u_t \\ 0 \\ \vdots \\ 0 \end{bmatrix},$$

where $\mathbf{I}$ is a (5×5) identity matrix and $\mathbf{0}$ is a (5×5) zero matrix.

Assuming a specific initial innovation in period t we can employ the first-order VAR system (A.4) to predict the k-period-ahead value of the variable vector as

$$\widehat{X}_{t+k} \;=\; \mathbf{B}^k v_i,$$

where v_i is a 0-1 vector with zeros everywhere except for the i-th row, which is capturing a unit innovation in the i-th budget component. Hence, defining a 0-1 row-vector h_j which selects the j-th row of $\widehat{X}_{t+k}$ we can determine the k-period-ahead impulse response in the j-th budget component as $h_j \mathbf{B}^k v_i$. Summing over an infinite number of periods and assuming a discount factor of $\rho \equiv (1+r)^{-1}$, where r denotes the given interest rate, we can compute the present value of the

impulse response in the j-th budget component triggered by the unit innovation in the i-th budget component:

$$\widehat{\pi}\left(Y[j], Y[i]\right) \;=\; \sum_{k\geq 1} h_j \rho^k \mathbf{B}^k v_i \;=\; h_j \rho \mathbf{B}\left[1-\rho\mathbf{B}\right]^{-1} v_i$$

The corresponding figures are displayed in the upper part of Table 5 of the paper.

Table A.2: Detailed Estimation Results for Basic Model

Expl. Variable	Notation in (3)	Dependent Variable: Own Revenue		Gen. Expend.		Grants	Eq. Transf.		Debt Service	
Deficit_{t-1}	γ'	.061	(.019)	-.453	(.021)	.053	(.012)	-.080	(.005)	.032 (.002)
Own Revenue_{t-1}		-.512	(.022)	-.282	(.024)	.025	(.014)	-.048	(.006)	-.005 (.002)
$\text{Gen. Expend.}_{t-1}$	$\mathbf{A}_1'$	.018	(.015)	-.168	(.021)	.052	(.014)	.072	(.005)	.005 (.002)
Grants_{t-1}		.015	(.016)	-.122	(.031)	-.527	(.027)	-.068	(.006)	.003 (.002)
$\text{Equal. Transfers}_{t-1}$		-.036	(.032)	.090	(.036)	-.085	(.023)	-.290	(.010)	.003 (.002)
$\text{Debt Service}_{t-1}$		.233	(.082)	-.640	(.138)	-.429	(.075)	.224	(.032)	-.226 (.029)
Own Revenue_{t-2}		-.291	(.021)	-.163	(.023)	.038	(.013)	.226	(.007)	-.009 (.002)
$\text{Gen. Expend.}_{t-2}$	$\mathbf{A}_2'$	.002	(.012)	-.161	(.018)	.008	(.014)	.015	(.005)	.010 (.001)
Grants_{t-2}		.014	(.015)	-.075	(.033)	-.318	(.027)	-.020	(.006)	-.006 (.002)
$\text{Equal. Transfers}_{t-2}$		-.067	(.030)	-.045	(.032)	-.122	(.021)	-.329	(.010)	.006 (.002)
$\text{Debt Service}_{t-2}$		.257	(.086)	-.712	(.121)	-.418	(.081)	.023	(.030)	-.105 (.015)
Own Revenue_{t-3}		-.164	(.018)	-.058	(.022)	.032	(.013)	.092	(.006)	-.009 (.002)
$\text{Gen. Expend.}_{t-3}$	$\mathbf{A}_3'$	-.014	(.010)	-.128	(.015)	-.005	(.010)	.016	(.004)	.009 (.001)
Grants_{t-3}		.023	(.012)	-.029	(.026)	-.208	(.023)	-.011	(.005)	-.007 (.001)
$\text{Equal. Transfers}_{t-3}$		-.161	(.029)	-.108	(.029)	-.076	(.018)	-.099	(.010)	.004 (.002)
$\text{Debt Service}_{t-3}$		.067	(.079)	-.697	(.120)	-.307	(.074)	-.078	(.028)	-.071 (.012)
Own Revenue_{t-4}		-.063	(.014)	-.002	(.018)	.033	(.011)	.050	(.004)	-.007 (.001)
$\text{Gen. Expend.}_{t-4}$	$\mathbf{A}_4'$	-.024	(.007)	-.076	(.012)	-.016	(.009)	.014	(.003)	.005 (.008)
Grants_{t-4}		.027	(.009)	-.023	(.021)	-.129	(.019)	-.011	(.004)	-.003 (.001)
$\text{Equal. Transfers}_{t-4}$		-.102	(.028)	-.049	(.028)	-.031	(.017)	-.072	(.009)	.004 (.002)
$\text{Debt Service}_{t-4}$		.095	(.071)	-.566	(.111)	-.269	(.064)	-.096	(.024)	-.046 (.010)
Constant	a'	.014	(.002)	-.022	(.002)	.026	(.001)	.007	(.005)	.000 (.001)
Mean of Dependent Variable		.003		.003		.011	.007		-.001	

Estimated coefficients for the basic estimation equations using four lags. Heteroscedasticity robust standard errors in parentheses.

Table A.3: Results for Municipalities in Different Population Size Groups

Response	Innovation to									
	Own Reven.		Gen. Expen.		Grants		Eq. Transf.		Debt Serv.	
					small size (bottom 25%)					
Own Revenue	-0.597⋆	(.018)	0.051	(.014)	-0.032	(.012)	0.002	(.028)	0.141	(.093)
Gen. Expend.	0.295⋆	(.028)	-0.893⋆	(.022)	0.373⋆	(.027)	-0.499⋆	(.046)	-1.062⋆	(.175)
Grants	0.012	(.018)	0.005	(.016)	-0.545⋆	(.023)	-0.047	(.038)	-0.557⋆	(.128)
Eq. Transfers	0.113⋆	(.008)	-0.042⋆	(.006)	0.040⋆	(.006)	-0.529⋆	(.014)	0.054	(.043)
Debt Service	-0.022⋆	(.003)	0.024⋆	(.002)	-0.016⋆	(.002)	0.021⋆	(.005)	-0.413⋆	(.034)
					response to a permanent change					
Own Revenue			0.481⋆	(.111)	-0.071	(.028)	0.005	(.059)	0.241	(.158)
Gen. Expend.	0.732⋆	(.054)			0.819⋆	(.028)	-1.060⋆	(.102)	-1.810⋆	(.267)
Grants	0.030	(.045)	0.050	(.166)			-0.099	(.080)	-0.949⋆	(.205)
Eq. Transfers	0.281⋆	(.020)	-0.391	(.112)	0.086⋆	(.013)			0.092	(.073)
Debt Service	-0.056⋆	(.007)	0.221	(.066)	-0.035⋆	(.005)	0.044⋆	(.010)		
					medium size (25th–75th percentiles)					
Own Revenue	-0.562⋆	(.019)	0.068⋆	(.014)	-0.043⋆	(.014)	-0.039	(.020)	0.101	(.072)
Gen. Expend.	0.272⋆	(.018)	-0.847⋆	(.016)	0.370⋆	(.019)	-0.569⋆	(.025)	-1.077⋆	(.096)
Grants	-0.006	(.009)	0.030⋆	(.009)	-0.528⋆	(.013)	-0.080⋆	(.014)	-0.439	(.056)
Eq. Transfers	0.151⋆	(.008)	-0.045⋆	(.006)	0.044⋆	(.006)	-0.535⋆	(.011)	0.012	(.037)
Debt Service	-0.030⋆	(.003)	0.039⋆	(.003)	-0.028⋆	(.003)	0.034⋆	(.004)	-0.272⋆	(.024)
					response to a permanent change					
Own Revenue			0.440⋆	(.069)	-0.092⋆	(.031)	-0.083⋆	(.043)	0.139	(.098)
Gen. Expend.	0.622⋆	(.026)			0.783⋆	(.028)	-1.224⋆	(.056)	-1.479⋆	(.126)
Grants	-0.013	(.020)	0.195⋆	(.051)			-0.172⋆	(.030)	-0.603⋆	(.077)
Eq. Transfers	0.344⋆	(.013)	-0.295⋆	(.053)	0.092⋆	(.014)			0.016	(.050)
Debt Service	-0.068⋆	(.006)	0.253⋆	(.037)	-0.059⋆	(.007)	0.072⋆	(.009)		
					large size (top 75%)					
Own Revenue	-0.534⋆	(.113)	0.105⋆	(.055)	-0.056	(.048)	-0.005	(.040)	0.529⋆	(.162)
Gen. Expend.	0.245⋆	(.081)	-0.763⋆	(.042)	0.364⋆	(.043)	-0.501⋆	(.037)	-0.623⋆	(.135)
Grants	-0.024	(.013)	0.062⋆	(.015)	-0.492⋆	(.027)	-0.018	(.019)	-0.262⋆	(.068)
Eq. Transfers	0.189⋆	(.034)	-0.055⋆	(.018)	0.062⋆	(.017)	-0.504⋆	(.020)	0.141⋆	(.068)
Debt Service	-0.038⋆	(.012)	0.048⋆	(.007)	-0.033⋆	(.006)	0.039⋆	(.006)	-0.290⋆	(.036)
					response to a permanent change					
Own Revenue			0.445	(.386)	-0.109	(.095)	-0.010	(.010)	0.745⋆	(.245)
Gen. Expend.	0.526⋆	(.053)			0.717⋆	(.071)	-1.010⋆	(.107)	-0.878⋆	(.175)
Grants	-0.050	(.026)	0.263	(.148)			-0.037	(.030)	-0.369⋆	(.096)
Eq. Transfers	0.405⋆	(.034)	-0.233	(.265)	0.122⋆	(.035)			0.199⋆	(.098)
Debt Service	-0.082⋆	(.009)	0.202	(.145)	-0.064⋆	(.013)	0.079⋆	(.015)		

Standard errors in parentheses obtained by sampling from the normal joint distribution of the estimates based on a heteroscedasticity robust estimate of the variance-covariance matrix. A star denotes significance at 5 % level.

Table A.4: Fiscal Variables according to the Official Budget Classification

Variable		Position (German designation)	HGr
General Expenditure	+	Personalausgaben insgesamt	4
	+	Ausg. saechl.Verw.-u.Betr.Aufw.insg.	5/6
	–	Ausg.Erst.Verw.-Btr.Ausg.inn.Ver.	679
	–	A.Vw.Hh/Kalkulator.Kosten insg.	68
	+	Ausg.Zuweis.u.Zuschuesse insg.	7
	+	Ausgaben/Allgemeine Zuweisungen	82
	+	Weitere Finanzausgaben	84
	+	Ausgaben/Baumassnahmen	94/95/96
	+	Ausg.Zuweis.u.Zusch.f.Invest.insg.	98
Grants	+	Gemeindeanteil an der Einkommenst.	010
	+	Gemeindeanteil an der Umsatzsteuer	012
	+	Einnahmen/Zuweisungen u.Umlag.insg.	04/05/06/07
	–	Einnahmen/Schluesselzuweisungen	04
	+	Einn./Erst.f.Ausg.d.Verw.Hh.insg.	16
	+	Einn./Zuw.U.Zusch.F.Lauf.Zw.insg.	17
	+	Einnahmen/Schuldendiensthilf.insg.	23
	+	Einn./Ersatz v.sozialen Leist.insg.	24/25
	+	Einn.Zuweis.u.Zusch.f.Invest.insg.	36
Equalization Transfers	+	Ausgaben/Allgemeine Umlagen insg.	83
	–	Einnahmen/Schluesselzuweisungen	04
Debt Service	+	A.Vw.Hh/Zinsausgaben insgesamt	80
	–	Zinseinnahmen insg.	20
	+	Sonstige Ausg.Kreditbesch.kosten	990
Own Revenues	+	Realsteuern insg.	00
	-	Steuerbeteil.Gewerbesteuerumlage	810
	+	Andere Steuern insg.	02
	+	Steueraehnliche Einnahmen insg.	03
	+	Einn./Gebuehr.Entgelte,Zwg.Abgab.	10/11/12
	+	Einnahmen aus Verkauf	13
	+	Einnahmen/Mieten und Pachten	14
	+	Sonst.Verwalt.-u.Betriebseinnahm.	15
	+	Gewinnant.v.Wirtsch.untern.Konz.abg.	21
	+	Weitere Finanzeinnahmen insg.	26
	+	Einn./Beitraege u.aehnliche Entgelte	35

The second column indicates whether the respective item is added or subtracted, the third column reports the individual items in German designation; the last column reports the corresponding official classification code (Gemeindehaushaltsverordnung fuer Baden-Wuerttemberg, Gruppierungsplan).