Soft budget constraints and strategic interactions in subnational borrowing: Evidence from the German States, 1975-2005

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Abstract

Cooperative federations are usually characterized by the existence of bailout guarantees and intergovernmental transfer schemes. This paper explores whether such features of cooperative federations lead to subnational soft budget constraints using panel data from the German States covering the 1975-2005 period. The methodology is based on the premise that subnational governments' borrowing will exhibit vertical and horizontal strategic interactions if they operate under soft budget constraints. Therefore, a test for strategic interactions in subnational borrowing can be used to infer whether a cooperative federation like Germany is susceptible to soft budget constraints. The results suggest that state borrowing in Germany exhibited horizontal but not vertical interactions during the time-frame of the analysis. This indicates (i) that German States faced soft budget constraints and (ii) that they were more concerned about the likelihood of a bailout than about its volume.

Keywords: Fiscal federalism, Soft budget constraints, Strategic fiscal interactions

JEL codes: H30, H74, H77

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1 Introduction

The fiscal federalism literature distinguishes two types of federations. Countries where subnational governments possess substantial tax autonomy, where revenues are not shared, and little fiscal equalization takes place are called competitive federations. In cooperative federations, on the other hand, subnational tax autonomy tends to be low, revenues are usually shared, considerable fiscal equalization takes place, and im- or explicit bailout guarantees are often given (Schaltegger and Feld, 2009).

These two types of federations lead to different incentives for policy makers. Consequently, they will have different implications for macroeconomic and fiscal outcomes (Weingast, 2009). One criticism leveled against cooperative systems of federalism in recent years is that they are much more susceptible to subnational over-borrowing. This assertion is primarily founded on case studies which show that cooperative federations such as Argentina (Dillinger and Webb, 1999), Brazil (Samuels, 2003), and Germany (Seitz, 1999) have experienced considerably more problems with subnational debt than competitive federations like Switzerland (Feld and Kirchgässner, 2007) and the United States (Inman, 2003).

These case studies suggest that lower-level jurisdictions in cooperative federations have an incentive to over-borrow because of soft budget constraints. In federal fiscal relations, soft budget constraints can emerge if subnational governments expect that some of the costs of their borrowing will eventually be paid for by the federal government. It has been argued in the literature that federal governments in cooperative federations are more likely to bail out an indebted jurisdiction than those in competitive federations (Blankart and Klaiber, 2006). Indeed, it is a reasonable conjecture that once schools and police departments have to be closed due to subnational over-borrowing, calls for a federal intervention will be more pronounced in cooperative than in competitive federations because of differing

expectations regarding the responsibilities of the federation. In particular, the existence of an extensive fiscal equalization scheme signals to all states that the federation has the institutional means and the political will to bail out an indebted jurisdiction.[1]

One methodological approach put forward in the literature to test whether the soft budget constraints problem and thus subnational over-borrowing is more prevalent in cooperative federations than in competitive ones is to simply regress a measure for the indebtedness of the public sector on a measure for the importance of contemporaneous intergovernmental transfers. The underlying idea behind this approach is that the importance of intergovernmental transfers is a reasonable proxy for the competitiveness of a federation. In general, studies using this approach, e. g. De Mello (2000), Rodden (2002), and Baskaran (2010), find that cooperative federations do not systematically borrow more than competitive ones.

However, one problem with the methodological approach advanced in these studies is that they do not test the soft budget constraints argument properly. According to the theoretical literature on soft budget constraints, the reason for their emergence are *expected* future transfers that are paid to alleviate the costs associated with a large debt burden, not contemporaneous transfers. Therefore, contemporaneous transfers are at best only an imperfect proxy for bailout expectations, and at worst an incorrect one.

Due to this methodological problem, a second strand of the empirical literature focuses on individual countries and explores whether specific institutional features within a country lead to soft budget constraints.[2] In this paper, I follow this strand of the literature and

[1] By now, there are also several theoretical contributions suggesting that bailout guarantees and the possibility of discretionary transfers lead to fiscal distortions. See for example Wildasin (1997), Qian and Roland (1998), Goodspeed (2002), Doi and Ihori (2006), Akai and Sato (2008), Crivelli and Staal (2008), and Breuillé and Vigneault (2010).

[2] For example, Pettersson-Lidbom and Dahlberg (2005) argue that for local communities in Sweden, past bailouts provide information regarding the likelihood of future bailouts. Using an instrumental variable approach, they find that bailout expectations have a strong causal effect on local debt. Rodden (2000) studies state borrowing in Germany. He argues that the structure of fiscal equalization in Germany induces bailout expectations in the states that are net-recipients during horizontal equalization, but not in the states that are net-payers. He then shows that net-recipient states are slower in adjusting their fiscal policies to adverse fiscal shocks than net-paying states. Based on this finding, he concludes that bailout

explore whether specific features of the fiscal constitution prevailing in the Federal Republic of Germany have led to subnational soft budget constraints during the 1975-2005 period.

The methodology used in this paper is based on the premise that subnational borrowing in cooperative federations should be characterized by vertical and horizontal strategic interactions if subnational governments face soft budget constraints. In other words, if a state expects that it will receive a bailout once it faces a severe fiscal crisis, then its contemporaneous borrowing should react systematically to the borrowing of the federal government (vertical interactions) and/or to the borrowing of other member states of the federation (horizontal interactions).

Why should bailout guarantees lead to vertical strategic interactions in subnational borrowing? If the federal government cannot commit to a no-bailout policy, every subnational government has an incentive to increase borrowing. The magnitude of this incentive, however, will depend on the expected amount of resources the federal government will have at its disposal when a bailout becomes necessary. If there is reason to suspect that the federal government will have fewer resources in the future because of its own borrowing, subnational incentives to over-borrow will be, ceteris paribus, less pronounced, and vice versa.

Horizontal strategic interactions may emerge for two reasons. First, higher transfers to other subnational jurisdictions imply lower transfers for one's own jurisdiction as long as federal resources are finite. This means that if other jurisdictions over-borrow, the available resources for a bailout for one's own jurisdiction will be reduced. Second, the decision of whether or not to grant a bailout to a given subnational jurisdiction will be made not only based on its own debt burden but also based on that in other subnational jurisdictions. Usually, a jurisdiction has to prove that it faces extraordinary fiscal difficulties before it will receive a bailout. If all jurisdictions exhibit a high debt burden, it is difficult for any

expectations lead to less sound fiscal policies. However, one problematic feature of his study is that the methodology relies on the assumption that only net-recipient states operate under soft budget constraints.

individual jurisdiction to argue that it is extraordinarily needy. Hence, each subnational government has to take the borrowing in other jurisdictions into account when optimally determining its own borrowing policy.[3]

For these reasons, it can be expected that subnational borrowing in cooperative federations will be characterized by vertical and horizontal interactions if subnational governments operate under soft budget constraints. Anecdotal evidence suggests that this line of reasoning applies to Germany, an archetypical cooperative federation. Decisions regarding whether or not a state should receive a federal bailout have been made in Germany by the federal constitutional court. Relying on a number of constitutional stipulations (in particular, Art. 72 , Art. 106, and Art. 107) which demand that equal living conditions have to be guaranteed throughout the federation, the court granted two states, Saarland and Bremen, a bailout in 1992.[4] In determining whether the debt levels in Bremen and Saarland necessitate a federal bailout, the constitutional court compared the debt to GDP ratio and the fiscal burden caused by the interest payments in these two states with that in all other German states.

This ruling by the constitutional court hence made explicit what subnational policy makers in Germany have in all likelihood already known implicitly: that the probability of a state receiving a bailout depends not only on its own borrowing, but also on the borrowing of all other states. The ruling also underscored that the likelihood of another state receiving a bailout depends on any given state's borrowing insofar as it affects the average debt burden of the subnational tier. Moreover, it implicitly affirmed that the fiscal situation of the federal government will affect decisions regarding subnational bailouts. It is consequently a reasonable conjecture that the borrowing polices of the constituent

[3]Note that the theoretical models developed by Wildasin (1997), Goodspeed (2002), Breuillé and Vigneault (2010), and Akai and Sato (2008) also suggest that bailout expectations will lead to vertical and horizontal strategic interactions in fiscal policy.

[4]Even though the constitutional court declined to provide a bailout to the state of Berlin in 2006, it did so on the grounds that Berlin was not "indebted enough" to require a bailout. In fact, it reaffirmed in this ruling that a subnational debt burden that is "too high" should lead to a bailout (Häde, 2007).

members of the German federation, i. e. the states and the federal government, are interdependent and will exhibit strategic interactions if some or all states operate under soft budget constraints.

In this paper, therefore, I empirically study whether the borrowing in a given German State reacts to the borrowing of other member states of the federation and/or to the borrowing of the federal government in order to establish whether subnational governments in Germany operate under soft budget constraints. More specifically, I estimate linear models where the dependent variable is the deficit to GDP ratio of state i in year t and the main independent variables are (i) the weighted average[5] deficit to GDP ratio of the "other" states in the federation and (ii) the deficit to GDP ratio of the federal government.

Since OLS does not produce consistent estimates in models with such fiscal policy interactions, I rely on the instrumental variable approach to identify the effect of the other states' weighted average deficit to GDP ratio and the federal government's deficit to GDP ratio on the deficit to GDP ratio of a given state i. Unfortunately, I am not aware of any natural-experiment type mechanism that induces truly exogenous variation in the endogenous variables. Therefore, I use a set of instruments for which I argue below that they are likely to be robust to certain sources of endogeneity. However, since I cannot rule out all possible sources of endogeneity ex-ante, I also present a set of robustness checks in order to explore to what extent the results are driven by each of the instruments.

I use the other states' lagged weighted average deficit to GDP ratio and their weighted average contemporaneous population growth as instruments for their weighted average deficit to GDP ratio. As instruments for the deficit to GDP ratio of the federal government, I use a dummy variable indicating federal election years and a dummy variable indicating the ideology of the federal government.

[5] I consider four different weighting schemes. See section 3.2 for more details.

The lagged and contemporaneous deficits of other states will be related if there is some persistence in deficits. The reason to expect a strong relationship between the other states' population growth and their deficits is that population size is the most important determinant of the amount of equalization transfers a state receives during horizontal and vertical equalization in Germany. An increase in population size will therefore lead to higher revenues and consequently to smaller deficits in any given state. A relationship between federal deficits and federal election years can emerge if the federal government adjusts deficits in view of federal elections. Similarly, it is also a reasonable conjecture that there are ideological differences in the borrowing policies of the federal government.[6]

In addition to being strongly related to the endogenous variables, the instruments should also be uncorrelated with the error term in the second stage regressions in order to produce reliable estimates. One reason to suspect such a correlation in the current context is reverse causality between the deficit of a state i and the population growth in other states. Such reverse causality may emerge if inhabitants migrate in view of state deficits. However, the execution of a decision to migrate, even if it is based on deficits, will take time. Therefore, even though this instrument may not be strictly exogenous, it appears to be feasible to treat it as pre-determined. Nonetheless, I present in section 4.3 a robustness check where the baseline models are re-estimated after omitting the other states' weighted average

[6]I estimate least squares dummy variable (LSDV) and Anderson-Hsiao models in the empirical section. In the first stage regressions for the LSDV models, the other states' lagged weighted average deficit to GDP ratio generally displays, as expected, a significantly positive correlation with their contemporaneous weighted average deficit to GDP ratio. The weighted average of the other states' population growth is generally significantly and negatively correlated with their weighted average deficit to GDP ratio, which is expected as well. I also find in the first stage regressions for the LSDV models that right-wing federal governments have borrowed significantly more than left-wing federal governments and that federal deficits have been significantly lower in election years. In the Anderson-Hsiao models, I use both first differences and further lags of the other states' lagged weighted average deficit to GDP ratio and weighted average population growth to instrument the first differences of their contemporaneous weighted average deficit to GDP ratio. These instruments are significantly related to the endogenous variable, but because both first differences and lags of the instruments are simultaneously included, the signs of the coefficients cannot be as easily interpreted as for the LSDV models. For the first difference of the federal deficit to GDP ratio, I use first differences of the federal ideology and election dummies as instruments in the Anderson-Hsiao models. For these instruments, the first stage regressions in the Anderson-Hsiao models are similar to those in the LSDV models.

population growth from the instrument set to explore to what extent the baseline results rely on the validity of this particular instrument.

This kind of reverse-causality is implausible for the lagged weighted average deficit to GDP ratio of other states since there cannot be an effect of the deficit of state i in period t on the deficits of other states in t-1. However, it is possible that this variable has a direct effect on the deficit of a state i if states react with some lag to each others' borrowing. Since I cannot exclude this possibility ex-ante, I explore in section 4.3 to what extent the baseline results change when this variable is explicitly included in the second stage regressions.

Reversed causality between state deficits and the federal election and ideology dummies is implausible as well because the deficit of any particular state i is unlikely to have an effect on the timing or on the outcome of federal elections. However, these variables may have a direct effect on state i's deficits if some states receive fiscal benefits from a politically aligned federal government or if they adjust their fiscal policy in view of federal elections. Consequently, in line with the procedure for the other states' lagged weighted average deficit to GDP ratio, I explore the robustness of the results to including these instruments in the second stage regressions in section 4.3.

The remainder of this paper is structured as follows. In section 2, I briefly discuss the federal system and the evolution of subnational debt in Germany. In section 3, I derive the empirical specification for testing whether strategic interactions in subnational borrowing exist and describe the data. In section 4, I report the results. They suggest the presence of positive horizontal strategic interactions. However, while this finding is consistent with the existence of soft budget constraints, subnational borrowing in Germany might exhibit horizontal strategic interactions for other reasons than soft budget constraints. In particular, if voters use the borrowing in other states as yardstick to evaluate the performance of their own state governments, every state government might have an incentive to react strategically to other states' borrowing, a mechanism that is referred to as yardstick competition

(Salmon, 1987). Thus, section 5 explores whether the horizontal strategic interactions can be explained by yardstick competition or whether soft budget constraints are indeed the most likely explanation. Section 6 concludes with a discussion of the findings.

2 Fiscal federalism in Germany

The Federal Republic of Germany is founded on strong federalist principles. It consists of three tiers of government: federal (Bund), state (Länder), and local (Gemeinden). The localities, however, are with respect to fiscal matters subordinate to the states. The important protagonists for the purposes of this paper are therefore the federal and state governments.

Until the unification of West-Germany with the former GDR in October 1990, the German federation consisted of eleven states.[7] Unification took the form of an admittance of five recreated states on the territory of the former GDR into the federation. Simultaneously, West- and East-Berlin were merged into a single city-state. The number of states hence increased to sixteen. Three of these are city-states, comprising only one city: Berlin, Bremen, and Hamburg.

The federal tier has more legislative power in Germany than in the US or Canada (Watts and Hobson, 2000). However, the states have significant influence on federal legislation. All federal laws that have financial consequences for the states need majority support in the Bundesrat, i. e. the second chamber of parliament where state governments are organized. For all other legislation, the Bundesrat has a suspensive veto.[8]

[7]The city-state of West-Berlin had a special position since the western allies were formally responsible for its administration. However, it was de facto the eleventh state of West-Germany.

[8]The Bundesrat consists of representatives of the state governments, usually the first minister and other senior state ministers. The number of votes allocated to each state depends positively on the size of the population. Votes are, however, not proportional to population size. Less populous states have a disproportionately large share of votes. The number of votes can vary over time, depending on the development of the population.

Subnational expenditures are largely financed through tax revenues, transfers, and debt. In general, state governments are free to borrow. There is a nominal rule-based borrowing restriction for the federal and state tier, but it has been widely criticized as ineffective.[9] That it has indeed not prevented the persistent growth of subnational debt, can be inferred from figure 1 where the debt to GDP ratio of the subnational tier is plotted over time. This figure reveals that the debt to GDP ratio of the subnational tier has increased from just over 10% to around 25% between 1975 and 2005.

Figures 2 and 3 show that, first, all states have displayed on average positive deficits over the 1975-2005 period. Thus, all states have contributed to the accumulation of subnational debt in Germany. Second, these figures also reveal that the aggregated deficits of the subnational sector have been positive in every year, even though there is some over-time variation. While deficits have on average declined until the nineties, they sharply rose after 1990, then steadily declined until 2000, only to increase again thereafter.

While state governments possess significant expenditure and borrowing autonomy, they have almost no tax autonomy.[10] There are four types of taxes in Germany: federal, state, local, and shared taxes. Taxes designated as federal, state, or local accrue exclusively to the respective tier of government. The most important shared taxes are the income, value added, and the corporate tax. The revenue from these taxes constitutes around three-quarters of total tax revenue. Their rates and bases are determined at the federal level in negotiations between the federal and subnational governments and are harmonized between all states, i. e. rates and bases are the same throughout the federation.

[9]The current borrowing restriction is the so called "golden rule" which stipulates that deficits may not be larger than investments. However, it is fairly easy to bypass this rule. For example, it is difficult to distinguish capital and current expenditures. Moreover, the rule can be legally broken if the finance minister declares that there is a serious disruption of the macroeconomic equilibrium. It is therefore not surprising that this rule has not prevented the continuous growth of subnational debt in the last few decades. However, Germany is currently involved in a major reform of its fiscal constitution. One important aspect of this reform is the introduction of a new borrowing restriction in 2011 that is supposedly stricter than the current golden rule.

[10]See Watts and Hobson (2000) and Federal Ministry of Finance (2009) for detailed surveys of Germany's system of fiscal federalism.

The shared taxes are first distributed according to a pre-specified formula between the federal and subnational tiers.[11] The share of the income tax revenues accruing to the states is allocated among the individual states according to the residence principle (revenues accrue to the state in which the taxed person lives). The states' share of the corporate tax revenues is allocated according to the principle of permanent establishment (tax revenues from taxing a company's commercial unit accrue to the state in which that commercial unit is located). 75% of the states' share of the revenues from the value added tax are allocated on a per-capita basis. The remaining 25% are used to increase the fiscal capacities of those states that have below average per-capita revenues after the allocation of the revenues from the state and shared taxes. Hence, the sharing rule for the value added tax already equalizes revenues between states and is therefore referred to as the first leg of the federal equalization system.

After the fiscal flows during the primary allocation of shared taxes, intergovernmental transfers are paid to explicitly equalize fiscal capacities among the states. First, revenues flow from fiscally strong to fiscally weak states. This stage is referred to as horizontal equalization (Länderfinanzausgleich) because the federal government is not involved. The exact definition of what constitutes a fiscally strong or a fiscally weak state is complicated, but, in general, states that have above-average per-capita revenues after the primary allocation of tax revenues are considered to be fiscally strong and vice versa.

The second stage of equalization consists of various vertical transfers from the federal government to the states. First, all fiscally weak states receive general-purpose transfers in order to increase their fiscal capacities further. In addition, vertical transfers are also paid to certain fiscally weak states to reimburse them for specific expenditure needs.

[11] Because the localities are considered to be part of the states for fiscal purposes, I only focus on the federal and state governments in the following even though the localities receive a small fraction of the revenues from the shared taxes.

Finally, there are explicit bailout transfers (Sanierungs-Bundesergänzungszuweisungen) that can be paid by the federal government to highly indebted states in order to help them reduce their debt burden. In practice, the federal constitutional court has to determine that a state is in a budgetary crisis before these transfers are paid. Hitherto, two states, Saarland and Bremen, have received these bailout transfers from 1994 until 2004, following a ruling by the constitutional court in 1992.

3 Empirical Analysis

As argued in the introduction, a test for strategic interactions in borrowing can be used to infer whether a cooperative federation is characterized by soft budget constraints. In general, studies exploring fiscal interactions tend to focus on taxes (Devereux et al., 2008; Edmark and Agren, 2008) and expenditures (Case et al., 1993; Baicker, 2005); studies exploring fiscal interactions in borrowing policies are rarer. One exception is Landon and Smith (2000) who study for Canada how debt accumulation by the central and provincial governments affects the creditworthiness of other federation members.

3.1 Empirical model

The following model is estimated to explore the existence of vertical and horizontal strategic interactions in subnational borrowing:

$$\text{Deficit}_{i,t} = \alpha \text{W}_t \times \text{Deficit}_{i,t} + \beta \text{Deficit}_t^{fed} + \zeta \text{Deficit}_{i,t-1} + \delta \mathbf{x_{i,t}} + \gamma_i + \rho \text{Trend} + \epsilon_{i,t}. \quad (1)$$

In this model, $\text{Deficit}_{i,t}$ is the deficit to GDP ratio of state i in year t, $\text{W}_t \times \text{Deficit}_{i,t} = \sum_{j \neq i} w_{j,t} \text{Deficit}_{j,t}$ is the weighted average of the other states' deficit to GDP ratio in year

t, Deficit_t^{fed} is the federal deficit to GDP ratio, $\text{Deficit}_{i,t-1}$ is the lagged deficit to GDP ratio of state i, $\mathbf{x_{i,t}}$ is a vector of control variables as described further below and listed in table 1, γ_i are cross-section fixed effects, and Trend is a time-trend.

The existence of horizontal and vertical interactions is tested with the coefficient estimates for α and β. If the estimate for α is significantly different from 0, it can be concluded that horizontal strategic interactions in state borrowing exist. Similarly, finding that the estimate for β is significantly different from 0 indicates the presence of vertical strategic interactions.

What are the expected signs of the estimates for α and β? If soft budget constraints exist, the direction of the vertical interactions should be negative. The reason is that if the federal government borrows more in a given year, the amount of federal resources that will be available in the future for a bailout of a state will be lower. Everything else equal, this reduction in expected resources that are available for a bailout should incentivize a state i to reduce its own borrowing.

The direction of the horizontal interactions is more difficult to predict. On the one hand, an increase in the borrowing of other states should incentivize any given state i to increase its own borrowing because by doing so it can retain or increase its chances for a bailout and/or reduce the likelihood that other states will get one. On the other hand, a rise in the debt level of other states means that these states increase, ceteris paribus, their claim on limited bailout resources. Hence, the expected amount of bailout resources available to state i will be lower, thereby incentivizing it to reduce its own borrowing. Because of these two countervailing effects, the sign of the estimate for α is difficult to predict ex-ante.

Estimating model 1 involves solving two problems (Brueckner, 2003). First, the weight $w_{j,t}$ that state j has in the reaction function of state i in year t has to be determined. As these weights cannot be estimated, they have to be imposed ex-ante. The usual procedure is therefore to experiment with different weighting schemes (see the next section).

The second problem is that estimating model 1 with OLS or an analogous estimator produces inconsistent estimates because the deficits in different states and at the federal level are, by definition, determined simultaneously if fiscal interactions exist. As indicated in the introduction, I rely on the instrumental variables approach to solve this problem. I use the weighted average of the other states' lagged deficit to GDP ratio and the weighted average of the other states' population growth as instruments for the weighted average of the other states' contemporaneous deficit to GDP ratio, $\mathrm{W}_t \times \mathrm{Deficit}_{i,t}$. For the federal deficit to GDP ratio, $\mathrm{Deficit}_t^{fed}$, I use a federal election year dummy and a dummy indicating the ideology of the federal government. The federal election year dummy assumes the value 1 in years with a federal election, and else 0. The federal ideology dummy assumes the value 1 in years with a conservative federal government (a federal government that is led by the CDU-party), and else 0.

3.2 Weights

The weights of the other states in model 1 have to be chosen ex-ante. By convention, these weights have the property that, first, state i itself receives a weight of 0 and, second, that the weights of all other states $w_{j,t}$ sum to 1 (i. e. they are row-normalized).

I use four different weighting schemes. First, I give all other states the same weight. This weighting scheme will be referred to as AVG. The weights are recalculated every year, hence the weight of state j in i's reaction function is given by:

$$w_{j,t}^{\mathrm{AVG}} = \frac{1}{\sum_{k \neq i} I_{k,t}}, \tag{2}$$

where $I_{k,t}$ is an indicator variable that takes the value of 1 when state k exists in year t and else 0. This implies that the weights of the eleven West-German States remain constant at 1/10 until 1991, the year after unification, and then fall to 1/15 as five new states were

created after unification. The newly formed East-German States also receive a weight of 1/15 from 1991 onward in this weighting scheme.

Second, I assign weights to each of the other states according to their population sizes. States with a larger population receive a relatively larger weight:

$$w_{j,t}^{\text{POP}} = \frac{POP_{j,t}}{\sum_{k \neq i} POP_{k,t}}. \tag{3}$$

This weighting scheme is referred to as POP. The idea behind this weighting scheme is that the borrowing policy of a big state will impact the borrowing policy of a state i more than that of a small state. Because the weights are recalculated every year, they reflect any changes in population sizes from year to year. The population in East-Germany is incorporated in this weighting scheme from 1991 onwards.

Third, I assign weights to the other states according to their position during horizontal equalization. If state i is a net-recipient state in year t, all other net-recipient states in year t are considered to affect state i's borrowing and receive the same positive weight, whereas the net-paying states will be considered as irrelevant for its borrowing and receive a weight of 0. Conversely, if state i is a net-paying state in t, all other net-paying states in this year receive a positive weight, whereas all net-recipient states receive a weight of 0. More formally:

$$w_{j,t}^{\text{LFA I}} = \begin{cases} \frac{1}{\sum_{k \neq i} I_{k,t}} & \text{if i and j have the same position during horizontal equalization} \\ 0 \text{ else.} \end{cases} \tag{4}$$

Here, I_k is an indicator variable that is 1 when i and k have the same position during horizontal equalization and 0 else. This weighting scheme is referred to as LFA I (the acronym LFA stands for "Länderfinanzausgleich"). It is based on the premise that states

are particularly concerned with the borrowing policy of fiscally similar states. For example, a net-recipient state might feel compelled to increase its deficits if another net-recipient state incurs a large deficit in order to retain its chances for a federal bailout, but it may be indifferent to the fiscal policy of a net-paying state because it does not perceive it as a competitor in the bailout game.

Fourth, I again assign weights to the other states according to their position during horizontal equalization, but in the opposite fashion to the LFA I weights. If state i is a net-recipient state in year t, the borrowing of all other net-recipient states in year t is considered to be unrelated to state i's borrowing in this weighting scheme. These states therefore receive a weight of 0. The borrowing policy in all net-paying states, on the other hand, is assumed to affect the borrowing of state i. These states consequently receive the same positive weight. Conversely, if state i is a net-paying state in t, all other net-paying states in this year receive a weight of 0, whereas all net-recipient states receive the same positive weight. More formally:

$$w_{j,t}^{\text{LFA II}} = \begin{cases} \frac{1}{\sum_{k \neq i} I_{k,t}} & \text{if i and j have different positions during horizontal equalization} \\ 0 \text{ else.} \end{cases} \tag{5}$$

Here, I_k is an indicator variable that is 1 when i and k have different positions during horizontal equalization and 0 else. This weighting scheme is referred to as LFA II. It is based on the premise that net-paying states are particularly concerned with the borrowing policy of net-recipient states and vice versa. For example, by incurring higher deficits themselves (or by saving less), net-paying states can lower the likelihood that net-recipient states receive bailouts.

Because the LFA I and LFA II weights are recalculated every year, they reflect any changes in the position of a state during horizontal equalization from one year to another. This is particularly relevant for Bavaria and North Rhine-Westphalia. Bavaria was always a net-recipient until 1986, then held either a neutral position or was a net-payer until 1992. In 1992, it was for the last time in the sample period a net-recipient, thereafter it was always a net-payer. North Rhine-Westphalia has usually assumed a net-paying or neutral position, but received some minor amounts from horizontal equalization in the eighties and early nineties. I therefore choose the LFA I and LFA II weights accordingly. This means for the LFA I weights that in years where Bavaria and North Rhine-Westphalia were net-recipients, I assign to them a positive weight if state i is a net-recipient and else 0. In years where they were net-payers, I assign to them a positive weight when state i is a net-payer and else 0. I apply the opposite procedure for the LFA II weights.

In years where a state assumed a neutral position (i. e. neither payed nor received anything during horizontal equalization), I drop it from the sample in the regressions with the LFA weights. This effectively means that such a state receives a weight of 0 in the reaction function of the other states, i. e. its deficits are assumed to be unrelated to the deficits of other states in these years. For this reason, the number of observations in the regressions with the LFA weights is slightly smaller than in those with the AVG and POP weights.[12]

3.3 Data

The dependent variable in all regressions is the deficit to GDP ratio of state i. It is constructed by dividing the absolute nominal change (i. e. the first difference) in the

[12]Only few states have held a neutral position during the 1975-2005 period: Bavaria in 1987 and 1988, Hamburg in 1988 and 1992; North Rhine-Westphalia in 1979, 1981, 1982, 1983, 1984, and 1986; and Schleswig-Holstein in 1998. Finally, Berlin and the East-German States were not part of the horizontal equalization scheme before 1995, instead they received either grants from the federal government or from special funds. These observations, too, are dropped in the LFA regressions.

capital market debt (i. e. the long-term obligations) of a state and its localities with the nominal state GDP.

The control variables of interest are: i) the weighted average of the other states' deficit to GDP ratio and ii) the federal deficit to GDP ratio. As with the states' deficit to GDP ratio, the one for the federal government is constructed by dividing the absolute change in the capital market debt of the federal government by the nominal GDP of the whole federation.

The debt to GDP ratio of a state i at the beginning of period t is included as a control variable to capture the effect of the debt burden on a state's borrowing policy.

The revenue to GDP ratio is included to control for the resources a state has available. Controlling for this ratio is important in the current context because otherwise it would be difficult to distinguish between fiscal interactions due to deliberate choices by state governments and a mere correlation of fiscal balances because of the nature of fiscal equalization in Germany. For example, the equalization system ensures that a negative revenue shock in one single state leads to a reduction in revenues in all other states as well, which might then result in a non-deliberate increase in borrowing in all states. However, by including a state's revenue to GDP ratio in the model, it is possible to control for this alternative explanation for a uniform evolution of subnational fiscal balances.[13]

Population growth is included to capture congestion and/or scale effects on the budget. The unemployment rate is included to control for business cycle effects. The share of the "young" ($\leq$ 15 years) and the "old" ($\geq$ 65 years) in the total population is included to capture the effect of the demographic structure of a state. Productivity growth is included to capture how the productivity of the economy affects deficits.

[13]Note that revenues are largely predetermined from the perspective of a state because the fiscal constitution in Germany gives the states only minuscule tax autonomy and the tax sharing rules are fixed by federal law well before the determination of the deficit. Reverse causality is therefore unlikely. Nonetheless, the models reported below were re-estimated after including the states' revenue to GDP ratio in the set of endogenous variables and instrumenting it with its first lag. The results (available from the author) regarding the existence of horizontal and vertical interactions were essentially the same.

A dummy variable that is 1 after 1991 and 0 before is included to capture the effect of unification. A dummy indicating whether year t is an election year in state i is included to control for political business cycles.

State i's number of votes in the second chamber of parliament, the Bundesrat, is included because states tend to trade their acceptance of certain legislation introduced by the federal government for larger federal transfers. Thus, these votes constitute an asset that can translate into higher revenues in the future. An increase in the number of votes might therefore induce a state to incur higher deficits.

A number of dummy variables indicating the ideology of the government are included. During the time-frame of the analysis, German States have witnessed six different types of (coalition) governments. They are described in more detail in table 1. One of the ideology dummies has to be dropped in the regressions because of perfect collinearity. I drop the dummy indicating a sole CDU government. All estimates for the ideology variables should therefore be interpreted relative to the CDU dummy. Around 27% of the observations are characterized by sole CDU governments.

The interest rate on long-term government bonds is included to capture the costs of borrowing. This variable varies over time but not over the states. It is a reasonably good approximation of the states' borrowing costs given that their bonds tend to be rated as well as federal bonds. If a rating agency attaches different ratings to state bonds, the variance of these ratings is very small and only due to the speed with which the agency expects a federal bailout to be administered if a state should come to face unresolvable budgetary problems (Seitz, 1999; Rodden, 2005).

The federal debt to GDP ratio at the beginning of period t is included to capture the effect of the absolute fiscal position of the federal government: if the federal government has a large debt burden, subnational governments might think it prudent to incur lower deficits.

I also include in all regressions cross-section fixed effects and a time-trend. The fixed effects are included to control for unobserved heterogeneity across states. The time trend is included instead of time dummies because the effect of time dummies cannot be separately identified from that of the weighted average deficit to GDP ratio of the other states' when uniform weights are used (Devereux et al., 2008). Moreover, federal level variables cannot be included as well when time dummies are present because of perfect multicollinearity. That is, it would be impossible to study vertical strategic interactions.

4 Estimation and results

It is well known that estimating a model that includes a lagged dependent variable and fixed effects with the least squares dummy variable (LSDV) estimator leads to the Nickell-Bias because the within-transformed lagged dependent variable is correlated with the transformed error term (Nickell, 1981).[14] However, the bias approaches 0 when the time-dimension becomes large, i. e. the LSDV estimator is consistent for large T. The question is then whether the time-dimension of the data at hand, which ranges from 1975 to 2005, can be considered as large enough to apply the LSDV estimator. Using simulations, Judson and Owen (1999) report that with a time-dimension of 30 or higher, the LSDV estimator performs well compared to the alternatives. Given that my dataset is at this margin, I estimate model 1 first with the LSDV estimator, but also use thereafter in section 4.2 the Anderson-Hsiao estimator.

[14]There are several estimators available to estimate a fixed effects model. One common alternative is the LSDV estimator. When there are no endogenous variables, the LSDV estimator functions as follows. First, the fixed effects are explicitly included in the regression. Then the model is estimated with OLS. Other popular alternatives are the within- and first-difference estimators. (It can be shown that the LSDV and within-estimator are equivalent, but a degrees of freedom correction has to be applied to the standard errors when the within-estimator is used). However, all three estimators lead to biased estimates when a lagged dependent variable is included in the model. To deal with this problem, a number of dynamic panel data estimators, including the Anderson-Hsiao estimator, have been developed.

Several diagnostic tests are reported in the regression tables. Instrument validity is tested with the Hansen-J overidentification test. Instrument strength is tested with the Kleibergen-Paap rk Wald F statistic, which is the appropriate test statistic for weak identification in the case of multiple endogenous variables and non- i. i. d. errors (most regressions reported below exhibit heteroscedasticity and autocorrelation). In addition, I also report underidentification tests based on the Kleibergen-Paap rk LM statistic.

Finally, the presence of autocorrelation is tested with a procedure suggested by Devereux et al. (2008). After estimating a model, the residuals are predicted. Then, the model is re-estimated after including the first lag of the residuals as an additional control variable. If this variable turns out to be significant, it is concluded that there is evidence for autocorrelation. In the regression tables further below, the row entitled autocorrelation test reports the p-value of the lagged residuals in the appended regressions.

4.1 LSDV estimations

The results of estimating model 1 with the LSDV estimator while using the two stage least squares (2SLS) approach to instrument the endogenous variables are reported in table 2. Four different regression results are reported. They are entitled according to the weighting scheme that is used, i. e. AVG, POP, LFA I, and LFA II.

The autocorrelation tests reported at the bottom of the table 2 provide evidence for autocorrelation in at least three regressions. In addition, there is also evidence for heteroscedasticity (test results not reported). All hypothesis tests are therefore based on heteroscedasticity and autocorrelation robust standard errors.[15]

The weak identification test statistic is over 10 in all regressions. The Hansen-J test performs well in the LFA I and LFA II regressions, in contrast to its performance in the

[15]Inspection of the full results (available from the author) for the appended regressions shows that negative and not positive autocorrelation is found in these models. Not adjusting the standard errors for autocorrelation leads to essentially the same results.

AVG and POP regressions. Overall, the Hansen-J tests suggests that the LFA I and LFA II results are more reliable than the AVG and POP results for this set of regressions.

The estimate for α, the effect of the other states' weighted average deficit to GDP ratio on state i's deficit to GDP ratio, is positive in all but the AVG regression. It is also significant at least at the ten percent level in the LFA I and LFA II regressions. Since the results from the LFA I and LFA II regressions are more reliable than those from the AVG and POP regressions according to the Hansen-J test, I conclude based on this set of results that there is evidence for horizontal strategic interactions in subnational borrowing.

The estimates for β, the effect of the federal deficit to GDP ratio, is significantly negative for the POP regression, but insignificant for all other weighting schemes. Since the POP regression is unreliable according to the Hansen-J test, I conclude that there is no consistent evidence for the presence of vertical strategic interactions.

Overall, these results suggest that the borrowing behavior of German States exhibited horizontal strategic interactions during the sample period. The numerical value of the estimated coefficients in the LFA I and LFA II regressions is around 0.47. These estimates are large, but not implausible. In particular, they do not suggest explosive behavior. Taking $\alpha = 0.47$, it can be shown for uniform weights that an exogenous increase in the deficit to GDP ratio of 1 percentage point in state i leads, after all feedback effects, to a final increase of 1.027 percentage points in state i's deficit to GDP ratio and to an increase of 0.057 percentage points in each of the other 15 states. Thus, the aggregated subnational deficit to GDP ratio rises by 1.882 percentage points due to an exogenous increase in the deficit to GDP ratio of 1 percentage point in a state i.

4.2 Anderson-Hsiao estimations

As stated further above, one problem when estimating a dynamic model with fixed effects is that the LSDV estimator is inconsistent for small T. Therefore, alternative estimation

methods have been developed to estimate such models consistently if T is small. According to the simulations in Judson and Owen (1999), the best alternative in the current context is the Anderson-Hsiao estimator.

This estimator can be illustrated in a nutshell as follows (Roodman, 2008). Consider the following dynamic model with a lagged dependent variable:

$$y_i = \alpha y_{i,t-1} + \delta \mathbf{x_i} + \nu_i + \epsilon_{it}, \tag{6}$$

where $y_{i,t-1}$ is the lagged dependent variable, the $\mathbf{x_i}$ is a vector of the remaining control variables that can be endogenous or exogenous, and the ν_i are cross-section fixed effects.

The Anderson-Hsiao estimator starts out by applying the first difference transformation to model 6:

$$\Delta y_{i,t} = \alpha \Delta y_{i,t-1} + \delta \Delta \mathbf{x_i} + \Delta \epsilon_{it}. \tag{7}$$

If model 6 were a simple static fixed effects specification, model 7 could be consistently estimated with OLS (or with 2SLS if some of the variables in the $\mathbf{x}$-vector are endogenous). However, since the first-difference of the lagged dependent variable $\Delta y_{i,t-1}$ and the first-difference of the idiosyncratic error $\Delta \epsilon_{it}$ are correlated, OLS would be inconsistent. Thus, the first difference of the lagged dependent variable has to be instrumented. The variant of the Anderson-Hsiao estimator that I use in the following instruments the first difference of the lagged dependent variable $\Delta y_{i,t-1}$ with the second lag of the dependent variable $y_{i,t-2}$.

The results from estimating model 1 with this Anderson-Hsiao estimator are reported in table 3. In all regressions, I continue to use 2SLS. I instrument the first difference of the other states' weighted average deficit to GDP ratio and the first difference of the federal government's deficit to GDP ratio with the first differences and lags of the instruments already used in the LSDV regressions: (i) the first difference and the first lag of the other states' lagged weighted average deficit to GDP ratio (i. e. the second lag of the other states'

weighted average deficit to GDP ratio), (ii) the first difference and the first lag of the other states' weighted average population growth, and (iii) the first differences of the federal election and ideology dummies.

The significance tests are based on heteroscedasticity and autocorrelation robust standard errors. I use autocorrelation robust standard errors since there is evidence for first-order autocorrelation. As indicated by the second-order autocorrelation test at the bottom of table 3, there is no evidence for second-order autocorrelation, hence the second lag of the dependent variable is a valid instrument for the first difference.

The Hansen-J tests are insignificant for all except the LFA I regression. The weak identification test statistics are larger than 10 in all but the LFA II regression. Thus, while not perfect, the diagnostic tests do not suggest that the regressions suffer from common problems and, consequently, that they are reliable, at least to the extent to which they suggest similar conclusions.

Indeed, the results with respect to the variables of interest are reasonably similar in all regressions and confirm the conclusions from the previous section. The estimate for α is consistently positive. It is also significant in the AVG, POP, and LFA I regressions. The estimate for β, on the other hand, is insignificant except in the POP regression. Thus, there is strong evidence for the presence of horizontal strategic interactions, but little evidence for the presence of vertical strategic interactions.

4.3 Robustness checks

The goal of this section is to explore the robustness of the results in the last sections to the possible invalidity of the instruments through further empirical tests. As argued in the introduction, each of the instruments might suffer from a specific source of endogeneity. There might be reverse causality between the deficit of a state i and other states' population

growth. In contrast, other states' lagged deficit, federal elections, and the ideology of the federal government might have a direct effect on state i's deficit.

In order to address the possible reverse causality between state i's deficit and other states' population growth, I report replications of the LSDV and Anderson-Hsiao estimations in the last sections after dropping the other states' weighted average population growth from the instrument set. To address the concern of a direct effect of either the lagged deficit of the other states, or federal elections, or the ideology of the federal government on state i's deficit, I report replications where each of these variables is explicitly included in the second stage regressions. The replications of the LSDV models are reported in table 4 while those of the Anderson-Hsiao models are reported in table 5.

According to these tables, omitting the other states' weighted average population growth reduces the significance of the estimate for α, especially in the LSDV estimations. While none of the coefficients are significant in the LSDV estimations, they continue to be significantly positive for the POP and LFA II weighting scheme in the Anderson-Hsiao estimations. It appears that with respect to the estimate for α, the Anderson-Hsiao estimations are more robust to the exclusion of this instrument than the LSDV estimations. The estimate for β is generally insignificant (there is one exception) and thus in line with the baseline regressions.

Including the other states' lagged weighted average deficit to GDP ratio in the second stage regression causes the estimate for α to become significantly positive in the AVG and POP regressions and insignificant in the LFA II regression when the LSDV estimator is used. However, the numerical values of the estimates for α in the AVG and POP regressions are very large, which suggests that these models are not reliable. But the fact that the LFA I and LFA II regressions continue to display reasonable numerical values and remain positive is reassuring, even if the coefficient turns insignificant in the LFA II regression. With respect to the Anderson-Hsiao models, including the first difference and

the second lag of the weighted average deficit to GDP ratio of the other states in the second stage regressions reduces the significance of the estimates for α. However, the estimates remain consistently positive. The estimates for β are in general insignificant (there are two exceptions) in the LSDV and Anderson-Hsiao estimations.

Including the federal election dummy in the second stage regression does not change the results with respect to α or β in a meaningful way, neither in the LSDV nor in the Anderson-Hsiao models. Including the federal government's ideology in the second stage regressions does not change the results with respect to α significantly either. In the Anderson-Hsiao estimations, however, it leads to significantly negative estimates for β in the POP and the LFA I regressions. In the LSDV estimations, the estimate for β displays a significantly negative coefficient in the AVG and POP regressions. There is thus some, albeit weak, evidence for the presence of vertical strategic interactions when the federal ideology dummy is included in the second stage regression.

Overall, the main conclusion from the baseline regressions, i. e. that there were positive horizontal interactions in the borrowing policy of German States during the sample period, remains reasonably robust in the Anderson-Hsiao regressions. The LSDV regressions are less robust. In particular, omitting the other states' weighted average population growth as instrument causes the estimates for α in the LFA I and LFA II regressions to become insignificant.

5 Soft budget constraints vs. yardstick competition

The estimates reported in the previous section indicate that the borrowing policy of German States displayed horizontal strategic interactions during the 1975-2005 period. Until now, it has been implicitly assumed that soft budget constraints are the cause for these interactions. This is indeed a likely explanation given the provisions in the German fiscal

constitution. However, there is also an alternative explanation for the horizontal strategic interactions: that state governments engaged in yardstick competition (Salmon, 1987; Besley and Case, 1995). Both explanations result in the same reduced form for the econometric model (Brueckner, 2003). Therefore, it is not possible to conclusively determine on the basis of the estimates reported in the previous sections which of the two mechanisms is responsible for the horizontal strategic interactions.

In this section, therefore, I investigate this issue further. Since expectations cannot be measured, it is difficult to directly test to what extent bailout expectations and hence soft budget constraints drive strategic interactions. However, the yardstick competition explanation for strategic interactions can be tested based on the following argument: If strategic interactions are primarily driven by yardstick competition, the estimates for α should be i) significantly larger in election than in non-election years and ii) when the government is formed by conservative instead of left-wing parties. The reason to expect a larger effect in election years is that if a state government believes that its electorate uses the borrowing in other states as a yardstick for evaluating its own borrowing, the borrowing in other states will be particularly important when an election is imminent. The reason to expect a larger effect for conservative parties is that their constituency tends to be more critical of public borrowing. Hence, a conservative government can win favor with its voters by running a sounder fiscal policy than the other states in the federation. Likewise, it will disenchant its voters more than a left-wing government if it incurs higher deficits than other states.

To explore the election-based explanation for yardstick competition, I construct two new variables. One is constructed by interacting the weighted average of the other states' deficit to GDP ratio with a dummy variable that is 1 in election years and 0 else; the other is constructed by interacting the weighted average of the other states deficit to GDP ratio with a dummy that is 1 in non-election years and 0 else. These new variables thus separately

incorporate the other states' deficits in election and non-election years. I also create a new set of instruments according to this procedure based on the old set. I then re-estimate model 1 with these variables such that a separate effect in election and non-election years is estimated.

To explore the validity of the ideology-based explanation for yardstick competition, I again construct two new variables. One is constructed by interacting the weighted average of the other states' deficit to GDP ratio with a dummy variable that is 1 when the government is formed by the CDU alone or a CDU-FDP coalition (these two types of governments are usually considered to be conservative in Germany), and 0 else; the other is constructed by interacting the weighted average of the other states' deficit to GDP ratio with a dummy that is 1 when the government is formed by a left or centrist coalition, and 0 else. As for the election-based explanation, I also create a new set of instruments according to the same procedure, and then use these variables to re-estimate model 1.

For brevity, I only report the coefficient estimates for the weighted averages of the other states in table 6 (the full results are available from the author). Whether or not the estimates are larger for election years or, respectively, under a conservative government than in non-election years or, respectively, under a non-conservative government, can be tested with a t-test. Hence, I also report the p-value of a t-test on the equality of each of the two coefficients in these tables.

The t-tests show that the estimated coefficients for election and non-election years and those for conservative and non-conservative governments are not significantly different. This indicates that yardstick competition is not the reason for the horizontal strategic interactions, thereby suggesting that soft budget constraints are the underlying cause for the horizontal interactions in subnational borrowing.

6 Conclusion

The goal of this paper was to explore whether the German States face soft budget constraints by testing for strategic interactions in state borrowing with panel data covering the 1975-2005 period. In the empirical analysis, I found evidence pointing toward the existence of horizontal strategic interactions, but no evidence for vertical strategic interactions. With regard to the horizontal interactions, tests indicated that they were not due to yardstick competition. Soft budget constraints were hence identified as the most likely explanation for the horizontal interactions.

The fact that subnational borrowing in Germany was characterized by horizontal strategic interactions indicates that state governments believed that there was the distinct possibility of a bailout during the 1975-2005 period. The finding that there were no vertical strategic interactions indicates that subnational governments have disregarded the borrowing of the federal government during the time-frame of the analysis. In conjunction with the fact that the direction of the horizontal interactions is positive, this suggests that subnational governments were mostly concerned with the likelihood of receiving a bailout and less concerned about its amount– apparently, state governments did not believe that the federal fiscal commons would be exhausted in a significant way by federal borrowing or by bailout transfers paid to other states.

This paper hence supports the notion that the fiscal constitution that prevailed in Germany during the 1975-2005 period led to a systematic upward-ratcheting of subnational debt. The necessity of a reform of the federal fiscal constitution and its cooperative elements, in particular the intergovernmental transfer scheme, has indeed been recognized by policy makers, and this issue was part of the negotiations that were begun in 2005 on the wider "Föderalismusreform" (the reform of federalism in Germany). However, no agreement could be reached in these negotiations with respect to the intergovernmental

transfer scheme and it was decided to continue with the current system at least until 2019. Instead of a reform of the transfer scheme, a new borrowing rule was introduced for both the federal and state governments in the hope that it will be more effective in limiting the growth of debt at all tiers of government than the existing one. It will be interesting to observe how this so called "debt brake" will affect subnational soft budget constraints in the coming years.

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Figure 1: Debt to GDP ratio of the state tier in Germany, 1975-2005

Figure 2: Mean deficit to GDP ratio in German States 1975-2005. The State codes are defined as follows: BAY (Bavaria), BB (Brandenburg), BER (Berlin), BW (Baden-Wuerttemberg) HB (Bremen), HE (Hesse), HH (Hamburg), MV (Mecklenburg-Western Pomerania), NDS (Lower-Saxony), NRW (North Rhine-Westphalia), RP (Rhineland-Palatinate), SAAR (Saarland) SH (Schleswig-Holstein), SN (Saxony), ST (Saxony-Anhalt), TH (Thuringia)

Figure 3: Deficit to GDP ratio in German States 1975-2005

Table 1: Definition and source of variables

Label	Description	Source
Deficit to GDP ratio	State deficit/GDP ratio	German Federal Statistical Office
Deficit to GDP ratio of other states	Weighted average of other states' deficit/GDP ratios	German Federal Statistical Office
Federal deficit to GDP ratio	Deficit/GDP ratio of the federal government	German Federal Statistical Office
Debt to GDP ratio	State debt/GDP ratio at beginning of period t	German Federal Statistical Office
Revenue to GDP ratio	State revenue/GDP ratio	German Federal Statistical Office
Population growth	State population growth	German Federal Statistical Office
Unemployment	State unemployment rate	German Federal Agency of Employment
Population share of young	Share of "young" ($\leq$15 years) in state population	German Federal Statistical Office
Population share of old	Share of "old" ($\geq$65 years) in state population	German Federal Statistical Office
Productivity growth	State productivity growth (growth of real GDP per Worker)	Federal and State Statistical Offices (Arbeitskreis VGR der Länder)
Votes in Bundesrat	State votes in second chamber of parliament	Pitlik et al. (2005) and own calculations
Unification	Dummy=1 if year $\geq$ 1991	Own calculations
Election year	Dummy = 1 if state election year	Own calculations based on www.bundeswahlleiter.de
SPD	Dummy = 1 if state government formed by SPD only	Own calculations based on www.election.de
SPD-Green	Dummy = 1 if state government is formed by SPD-Green party coalition	Own calculations based on www.election.de
SPD-FDP	Dummy = 1 if state government is formed by SPD-FDP coalition	Own calculations based on www.election.de
CDU-SPD	Dummy = 1 if state government is formed by CDU-SPD coalition	Own calculations based on www.election.de
CDU-FDP	Dummy = 1 if state government is formed by CDU-FDP coalition	Own calculations based on www.election.de
SPD-Green-FDP	Dummy = 1 if state government is formed by SPD-Green party-FDP coalition	Own calculations based on www.election.de
SPD-PDS	Dummy = 1 if state government is formed by SPD-PDS coalition	Own calculations based on www.election.de
CDU	Dummy = 1 if state government is formed by CDU only	Own calculations based on www.election.de
Interest rate	Interest on long-term government bonds	OECD
Federal debt	Federal debt/GDP ratio at beginning of period t	German Federal Statistical Office

Table 2: Horizontal and vertical interactions in subnational borrowing, German states, 1975-2005, Least squares dummy variable estimations

	AVG	POP	LFA I	LFA II
	b/t	b/t	b/t	b/t
Deficit to GDP ratio of other states	-0.034	0.286	0.467**	0.483*
	(-0.096)	(0.827)	(2.185)	(1.734)
Federal deficit to GDP ratio	-0.108	-0.128*	0.041	0.095
	(-1.102)	(-1.685)	(0.387)	(0.971)
N	369	369	345	345
F	110.230	110.399	57.059	54.050
Hansen-test (p-val.)	0.019	0.010	0.511	0.526
Underid.-test (p-val.)	0.004	0.002	0.001	0.008
Kleibergen-Paap F statistic	13.923	26.294	20.668	27.468
Autocorr.-test (p-val.)	0.004	0.002	0.112	0.087

[a] The dependent variable is the deficit to GDP ratio of state i, the independent variables of interest are the weighted average of the other states' deficit to GDP ratio and the federal government's deficit to GDP ratio.

[b] The instruments are: other states' weighted average population growth, lagged weighted average of other states' deficit to GDP ratio, federal election year dummy, federal ideology dummy.

[c] Column headings indicate the weighting scheme used in the respective estimation, i. e. AVG refers to uniform weights, POP to population weights, LFA I to the weighting scheme where states that are fiscally similar to state i receive a positive weight, and LFA II to the weighting scheme where fiscally dissimilar states receive a positive weight.

[d] Control variables whose results are omitted (full results can be found in table A.1 in the appendix): Deficit to GDP ratio$_{t-1}$, Debt to GDP ratio, Revenue to GDP ratio, Population growth, Unemployment rate, Population share of young, Population share of old, Productivity growth, Votes in Bundesrat, Unification, Election year, SPD-Green-FDP dummy, SPD dummy, SPD-PDS dummy, SPD-Green dummy, SPD-FDP dummy, CDU-SPD dummy, CDU-FDP dummy, Interest rate, Federal debt, Trend.

[e] Stars indicate significance levels at 10% (*), 5% (**) and 1%(***).

[f] t-statistics in parentheses.

[g] t-statistics and hypothesis tests based on heteroscedasticity and autocorrelation robust standard errors.

[h] State fixed effects and time trend included in all models.

[i] The Kleibergen-Paap rk Wald F statistic is used to test for weak identification.

Table 3: Horizontal and vertical interactions in sub-national borrowing, German states, 1975-2005, Anderson-Hsiao estimations

	AVG b/t	POP b/t	LFA I b/t	LFA II b/t
Deficit of other states	0.393*	0.379**	0.256*	0.295
	(1.843)	(2.283)	(1.708)	(1.322)
Federal deficit	-0.001	-0.118***	-0.126	0.027
	(-0.014)	(-2.721)	(-1.539)	(0.411)
N	353	353	342	342
F	5.573	14.005	6.626	8.292
Hansen-test (p-val.)	0.314	0.459	0.037	0.133
Underid.-test (p-val.)	0.000	0.001	0.000	0.014
Kleibergen-Paap F statistic	13.595	117.803	15.966	2.867
First-order autocorr. (p-val.)	0.005	0.045	0.001	0.012
Second-order autocorr. (p-val.)	0.569	0.604	0.417	0.530

[a] The dependent variable is the first difference of the deficit to GDP ratio of state i, the independent variables of interest are the first difference of the weighted average of the other states' deficit to GDP ratio and the first difference of the federal government's deficit to GDP ratio.

[b] The instruments are: first difference of other states' weighted average population growth, first lag of other states' weighted average population growth, first difference of lagged weighted average of other states' deficit to GDP ratio, second lag of other states' weighted average deficit to GDP ratio, first difference of federal election year dummy, first difference of federal ideology dummy.

[c] Column headings indicate the weighting scheme used in the respective estimation, i. e. AVG refers to uniform weights, POP to population weights, LFA I to the weighting scheme where fiscally similar states receive a positive weight, and LFA II to the weighting scheme where fiscally dissimilar states receive a positive weight.

[d] Control variables whose results are omitted (full results can be found in table A.2 in the appendix): Deficit to GDP ratio$_{t-1}$, Debt to GDP ratio, Revenue to GDP ratio, Population growth, Unemployment, Population share of young, Population share of old, Productivity growth, Votes in Bundesrat, Unification, Election year, SPD-Green-FDP dummy, SPD dummy, SPD-PDS dummy, SPD-Green dummy, SPD-FDP dummy, CDU-SPD dummy, CDU-FDP dummy, Interest rate, Federal debt, Trend. All control variables are included in first differences.

[e] Stars indicate significance levels at 10% (*), 5% (**) and 1%(***).

[f] t-statistics in parentheses.

[g] t-statistics and hypothesis tests based on heteroscedasticity and autocorrelation robust standard errors.

[h] State fixed effects and time trend included in all models.

[i] The Kleibergen-Paap rk Wald F statistic is used to test for weak identification.

Table 4: Strategic interactions in subnational borrowing, German states, 1975-2005, Least squares dummy variable estimations, Robustness checks for instrument validity

	AVG	POP	LFA I	LFA II
	b/t	b/t	b/t	b/t
Omitting other states' population growth				
Deficit of other states	-0.744	-0.452	0.394	0.475
	(-1.429)	(-0.991)	(0.860)	(1.368)
Federal deficit	0.176	0.052	0.048	0.095
	(1.115)	(0.516)	(0.384)	(0.954)
Other states' lagged deficit to GDP ratio in second stage regressions				
Deficit of other states	3.235*	2.970***	0.543*	0.439
	(1.836)	(2.918)	(1.785)	(1.131)
Federal deficit	-0.393**	-0.102	0.008	0.105
	(-2.235)	(-1.052)	(0.070)	(0.835)
Lag of other states' deficit	-0.903**	-1.127***	-0.040	0.019
	(-1.998)	(-2.837)	(-0.261)	(0.153)
Federal election dummy in second stage regressions				
Deficit of other states	0.032	0.296	0.464**	0.499*
	(0.093)	(0.858)	(2.185)	(1.766)
Federal deficit	-0.134	-0.140*	0.047	0.100
	(-1.439)	(-1.849)	(0.453)	(1.010)
Federal election	-0.101	-0.098	0.046	0.071
	(-1.307)	(-1.187)	(0.801)	(1.013)
Federal government's ideology in second stage regressions				
Deficit of other states	-0.075	0.378	0.466**	0.505*
	(-0.229)	(1.108)	(2.268)	(1.780)
Federal deficit	-0.278**	-0.334***	0.036	0.044
	(-2.272)	(-2.841)	(0.174)	(0.370)
Ideology federal government	0.495**	0.501***	0.012	0.130
	(2.550)	(2.722)	(0.031)	(0.537)

Note: This table presents LSDV estimation results for models where (i) other states' weighted average population growth is dropped from the instrument set, (ii) other states' lagged weighted average deficit to GDP ratio is included in the second stage regression, (iii) the federal election dummy is included in the second stage regression, and (iv) the dummy indicating the ideology of the federal government is included in the second stage regression. For further notes, see table 2.

Table 5: Strategic interactions in subnational borrowing, German states, 1975-2005, Anderson-Hsiao estimations, Robustness checks for instrument validity

	AVG	POP	LFA I	LFA II
	b/t	b/t	b/t	b/t
Omitting other states' population growth				
Deficit of other states	0.454	0.423**	0.210	0.557*
	(1.556)	(2.068)	(1.521)	(1.783)
Federal deficit	0.026	-0.120***	-0.096	-0.065
	(0.351)	(-2.774)	(-0.917)	(-0.592)
Other states' lagged deficit to GDP ratio in second stage regressions				
Deficit of other states	1.060	0.492	1.232*	0.094
	(1.395)	(0.875)	(1.755)	(0.340)
Federal deficit	-0.097	-0.064	-0.259*	0.060
	(-0.678)	(-0.508)	(-1.852)	(0.820)
Lagged first difference of other states' deficit	0.403	-0.201	0.582**	0.091
	(1.350)	(-0.497)	(2.446)	(1.142)
Second lag of other states' deficit	0.550	-0.258	0.500	-0.029
	(0.917)	(-0.991)	(1.439)	(-0.388)
Federal election dummy in second stage regressions				
Deficit of other states	0.357*	0.375**	0.271	0.333
	(1.712)	(2.154)	(1.575)	(1.491)
Federal deficit	-0.013	-0.133***	-0.175	0.055
	(-0.230)	(-2.617)	(-1.588)	(0.642)
Federal election	-0.026	-0.080	-0.064	0.041
	(-0.479)	(-1.314)	(-0.915)	(0.798)
Federal government's ideology in second stage regressions				
Deficit of other states	0.368	0.357**	0.239	0.240
	(1.615)	(2.113)	(1.521)	(0.958)
Federal deficit	-0.008	-0.118***	-0.134*	0.021
	(-0.125)	(-2.762)	(-1.705)	(0.344)
Ideology federal government	0.094	0.125	0.159	0.098
	(0.529)	(0.794)	(1.027)	(0.642)

Note: This table presents Anderson-Hsiao estimation results for models where (i) other states' weighted average population growth is dropped from the instrument set, (ii) other states' lagged weighted average deficit to GDP ratio is included in the second stage regression (both the lagged first difference and the second lag of the level), (iii) the federal election dummy is included in the second stage regression, and (iv) the dummy indicating the ideology of the federal government is included in the second stage regression. For further notes, see table 3.

Table 6: Soft budget constraints vs. yardstick competition

			AVG b/t	POP b/t	LFA I b/t	LFA II b/t
Election	yes	Deficit of other states	-0.403	-0.075	0.341*	0.336
			(-0.907)	(-0.181)	(1.734)	(1.164)
	no	Deficit of other states	0.130	0.499	0.538**	0.460*
			(0.369)	(1.219)	(2.215)	(1.749)
t-test (p-value)			0.141	0.193	0.286	0.611
Conservative	yes	Deficit of other states	0.194	0.364	0.413*	0.427
			(0.434)	(0.741)	(1.676)	(1.481)
	no	Deficit of other states	-0.058	0.245	0.427	0.380
			(-0.163)	(0.643)	(1.493)	(1.229)
t-test (p-value)			0.551	0.822	0.966	0.881

Notes: See table 2.

Appendix

Table A.1: Horizontal and vertical interactions in subnational borrowing, German states, 1975-2005, Least squares dummy variable estimations

	AVG b/t	POP b/t	LFA I b/t	LFA II b/t
Deficit to GDP ratio of other states	-0.034	0.286	0.467**	0.483*
	(-0.096)	(0.827)	(2.185)	(1.734)
Federal deficit to GDP ratio	-0.108	-0.128*	0.041	0.095
	(-1.102)	(-1.685)	(0.387)	(0.971)
Deficit to GDP ratio$_{t-1}$	0.403***	0.392***	0.308***	0.325***
	(8.223)	(8.681)	(4.868)	(6.124)
Debt to GDP ratio	-6.504**	-5.681**	-1.744	-1.328
	(-2.196)	(-1.994)	(-0.648)	(-0.587)
Revenue to GDP ratio	-13.017*	-12.218	-27.200***	-25.616***
	(-1.729)	(-1.523)	(-3.337)	(-3.432)
Population growth	-0.195*	-0.124	0.005	0.007
	(-1.840)	(-1.078)	(0.040)	(0.047)
Unemployment	0.176**	0.140**	0.003	-0.006
	(2.293)	(2.146)	(0.063)	(-0.114)
Population share of young	33.796***	30.680***	13.473*	11.304
	(3.997)	(3.437)	(1.912)	(1.625)
Population share of old	-12.599*	-15.400**	-25.030***	-21.720**
	(-1.890)	(-2.105)	(-2.648)	(-2.566)
Productivity growth	0.004	0.028	-0.080**	-0.096***
	(0.127)	(0.890)	(-2.484)	(-2.609)
Votes in Bundesrat	-0.079	-0.033	0.318	0.091
	(-0.423)	(-0.195)	(1.389)	(0.488)
Unification	-0.926*	-1.227***	-1.231***	-1.151***
	(-1.758)	(-2.731)	(-3.584)	(-3.090)
Election year	0.112	0.131	0.051	0.053
	(0.782)	(0.984)	(0.546)	(0.530)
SPD-Green-FDP	0.499	0.443	-0.506	-0.624*
	(0.627)	(0.525)	(-1.379)	(-1.823)
SPD	0.324*	0.340**	0.083	0.110
	(1.917)	(2.055)	(0.434)	(0.544)
SPD-PDS	0.885	0.878	0.060	0.025
	(1.108)	(1.129)	(0.074)	(0.028)

SPD-Green	0.574***	0.579***	0.359*	0.393**
	(3.173)	(3.248)	(1.925)	(2.034)
SPD-FDP	0.358	0.398**	0.389*	0.343
	(1.634)	(2.063)	(1.772)	(1.541)
CDU-SPD	-0.202	-0.179	-0.187	-0.074
	(-1.062)	(-0.935)	(-0.943)	(-0.318)
CDU-FDP	0.141	0.152	-0.030	0.039
	(0.938)	(1.032)	(-0.295)	(0.307)
Interest rate	0.210***	0.164**	0.021	-0.013
	(3.481)	(2.021)	(0.343)	(-0.168)
Federal debt	-19.787***	-15.997***	-5.551	-4.943
	(-2.872)	(-3.037)	(-1.228)	(-1.263)
Trend	0.286***	0.258***	0.095**	0.078*
	(4.648)	(4.822)	(1.975)	(1.831)
N	369	369	345	345
F	110.230	110.399	57.059	54.050
Hansen-test (p-val.)	0.019	0.010	0.511	0.526
Underid.-test (p-val.)	0.004	0.002	0.001	0.008
Kleibergen-Paap F statistic	13.923	26.294	20.668	27.468
Autocorr.-test (p-val.)	0.004	0.002	0.112	0.087

[a] The dependent variable is the deficit to GDP ratio of state i; the independent variables of interest are the weighted average of the other states' deficit to GDP ratio and the federal government's deficit to GDP ratio; the various combinations of the party dummy variables (CDU, SPD, FDP, Green, PDS) indicate the ruling coalition in state i.

[b] The instruments are: other states' weighted average population growth, lagged weighted average of other states' deficit to GDP ratio, federal election year dummy, federal ideology dummy.

[c] Column headings indicate the weighting scheme used in the respective estimation, i. e. AVG refers to uniform weights, POP to population weights, LFA I to the weighting scheme where fiscally similar states receive a positive weight, and LFA II to the weighting scheme where fiscally dissimilar states receive a positive weight.

[d] Stars indicate significance levels at 10% (*), 5% (**) and 1%(***).

[e] t-statistics in parentheses.

[f] t-statistics and hypothesis tests based on heteroscedasticity and autocorrelation robust standard errors.

[g] State fixed effects and time trend included in all models.

[h] The Kleibergen-Paap rk Wald F statistic is used to test for weak identification.

Table A.2: Strategic interactions in subnational borrowing, German states, 1975-2005, Anderson-Hsiao estimations

	AVG b/t	POP b/t	LFA I b/t	LFA II b/t
Deficit to GDP ratio of other states	0.393*	0.379**	0.256*	0.295
	(1.843)	(2.283)	(1.708)	(1.322)
Federal deficit to GDP ratio	-0.001	-0.118***	-0.126	0.027
	(-0.014)	(-2.721)	(-1.539)	(0.411)
Deficit to GDP ratio$_{t-1}$	-0.059	-0.112**	-0.112**	-0.070
	(-0.970)	(-2.065)	(-2.035)	(-1.392)
Debt to GDP ratio	-35.151***	-34.370***	-31.113***	-34.597***
	(-5.634)	(-3.933)	(-3.914)	(-3.544)
Revenue to GDP ratio	-21.936**	-22.964**	-32.733***	-31.768***
	(-2.119)	(-2.082)	(-3.260)	(-2.968)
Population growth	0.044	0.081	-0.013	0.049
	(0.412)	(0.657)	(-0.121)	(0.393)
Unemployment	0.104	0.060	0.166**	0.149**
	(1.288)	(0.657)	(2.480)	(2.335)
Population share of young	-30.054*	-21.633	-13.510	-24.401
	(-1.949)	(-1.152)	(-0.844)	(-1.502)
Population share of old	15.930	8.336	-2.529	8.067
	(0.868)	(0.565)	(-0.162)	(0.544)
Productivity growth	0.049	0.034	0.004	0.020
	(1.438)	(1.143)	(0.131)	(0.510)
Votes in Bundesrat	0.072	0.134	0.013	0.006
	(0.251)	(0.534)	(0.048)	(0.020)
Unification	-0.127	-0.106	-0.141	-0.076
	(-0.455)	(-0.475)	(-0.574)	(-0.328)
Election	0.099	0.088	0.091	0.085
	(1.392)	(1.177)	(1.278)	(1.204)
SPD-Green-FDP	0.697	0.620	1.151	1.656*
	(0.980)	(1.004)	(1.505)	(1.670)
SPD	0.339	0.255	0.382	0.374
	(1.229)	(0.978)	(1.315)	(1.577)
SPD-PDS	1.160	1.378	1.123	0.974
	(0.800)	(1.083)	(0.958)	(0.920)
SPD-Green	0.202	0.235	0.181	0.142
	(0.777)	(1.071)	(0.853)	(0.616)
SPD-FDP	0.563	0.484	0.704**	0.744**
	(1.564)	(1.564)	(2.228)	(2.361)

CDU-SPD	-0.417	-0.298	-0.358	-0.553*
	(-0.948)	(-0.818)	(-0.991)	(-1.878)
CDU-FDP	-0.009	-0.054	0.054	0.159
	(-0.043)	(-0.265)	(0.269)	(0.735)
Interest rate	-0.014	-0.005	0.029	-0.039
	(-0.196)	(-0.063)	(0.405)	(-0.533)
Federal debt	2.726	-15.706**	-11.797	0.932
	(0.335)	(-2.569)	(-1.601)	(0.143)
Trend	-0.036	-0.300	0.114	-0.030
	(-0.319)	(-1.440)	(1.163)	(-0.400)
N	353	353	342	342
F	5.573	14.005	6.626	8.292
Hansen-test (p-val.)	0.314	0.459	0.037	0.133
Underid.-test (p-val.)	0.000	0.001	0.000	0.014
Kleibergen-Paap F statistic	13.595	117.803	15.966	2.867
First-order autocorr. (p-val.)	0.005	0.045	0.001	0.012
Second-order autocorr. (p-val.)	0.569	0.604	0.417	0.530

[a] The dependent variable is the first difference of the deficit to GDP ratio of state i, the independent variables of interest are the first difference of the weighted average of the other states' deficit to GDP ratio and the first difference of the federal government's deficit to GDP ratio; the various combinations of the party dummy variables (CDU, SPD, FDP, Green, PDS) indicate the ruling coalition in state i.

[b] The instruments are: first difference of other states' weighted average population growth, first lag of other states' weighted average population growth, first difference of lagged weighted average of other states' deficit to GDP ratio, second lag of other states' weighted average deficit to GDP ratio, first difference of federal election year dummy, first difference of federal ideology dummy.

[c] Column headings indicate the weighting scheme used in the respective estimation, i. e. AVG refers to uniform weights, POP to population weights, LFA I to the weighting scheme where fiscally similar states receive a positive weight, and LFA II to the weighting scheme where fiscally dissimilar states receive a positive weight.

[d] Stars indicate significance levels at 10% (*), 5% (**) and 1%(***).

[e] t-statistics in parentheses.

[f] t-statistics and hypothesis tests based on heteroscedasticity and autocorrelation robust standard errors.

[g] State fixed effects and time trend included in all models.

[h] The Kleibergen-Paap rk Wald F statistic is used to test for weak identification.

Table A.3: Summary Statistics

Variable	Variance	Mean	SD	Min	Max	Obs.
Deficit of other states	overall	1.63	1.71	-3.48	10.97	369
	between		1.21	0.42	4.53	16
	within		1.37	-4.09	9.51	23.06
Federal deficit	overall	1.96	1.58	-0.83	7.79	369
	between		0.03	1.93	2.05	16
	within		1.58	-0.92	7.81	23.06
Debt	overall	0.24	0.10	0.09	0.69	369
	between		0.08	0.10	0.38	16
	within		0.06	0.02	0.56	23.06
Revenues	overall	0.19	0.04	0.11	0.32	369
	between		0.05	0.14	0.27	16
	within		0.02	0.13	0.24	23.06
Population growth	overall	0.08	0.68	-2.23	2.09	369
	between		0.47	-0.96	0.56	16
	within		0.54	-2.47	2.06	23.06
Unemployment	overall	10.83	4.91	2.10	22.10	369
	between		5.09	5.49	20.28	16
	within		2.30	2.98	16.38	23.06
Population share of young	overall	0.17	0.02	0.11	0.23	369
	between		0.01	0.14	0.18	16
	within		0.02	0.12	0.22	23.06
Population share of old	overall	0.16	0.02	0.12	0.22	369
	between		0.01	0.15	0.19	16
	within		0.01	0.13	0.21	23.06
Productivity growth	overall	1.64	2.41	-3.14	16.17	369
	between		1.39	0.53	4.12	16
	within		2.14	-2.95	13.68	23.06
Votes in Bundesrat	overall	4.23	1.02	3.00	6.00	369
	between		0.93	3.00	5.52	16
	within		0.31	3.72	4.89	23.06
Unification	overall	0.62	0.49	0.00	1.00	369
	between		0.24	0.52	1.00	16
	within		0.44	0.10	1.10	23.06
Election year	overall	0.24	0.43	0.00	1.00	369
	between		0.03	0.21	0.31	16
	within		0.43	-0.07	1.03	23.06

SPD-Green-FDP	overall	0.01	0.12	0.00	1.00	369
	between		0.04	0.00	0.15	16
	within		0.11	-0.14	0.91	23.06
SPD	overall	0.25	0.43	0.00	1.00	369
	between		0.23	0.00	0.59	16
	within		0.37	-0.34	1.15	23.06
SPD-PDS	overall	0.03	0.17	0.00	1.00	369
	between		0.15	0.00	0.54	16
	within		0.13	-0.51	0.74	23.06
SPD-Green	overall	0.10	0.30	0.00	1.00	369
	between		0.13	0.00	0.31	16
	within		0.27	-0.21	0.97	23.06
SPD-FDP	overall	0.08	0.27	0.00	1.00	369
	between		0.14	0.00	0.52	16
	within		0.22	-0.44	0.97	23.06
CDU-SPD	overall	0.12	0.32	0.00	1.00	369
	between		0.22	0.00	0.71	16
	within		0.26	-0.60	1.08	23.06
CDU-FDP	overall	0.14	0.35	0.00	1.00	369
	between		0.15	0.00	0.46	16
	within		0.32	-0.32	1.10	23.06
Interest rate	overall	6.29	1.67	3.35	10.24	369
	between		0.68	5.19	6.58	16
	within		1.57	3.06	9.95	23.06
Federal debt	overall	0.28	0.09	0.11	0.39	369
	between		0.04	0.26	0.35	16
	within		0.08	0.13	0.41	23.06

a) Summary statistics are based on the observations used in the regressions
b) The deficit of other states and federal deficit variables are percentage points (percentages multiplied by 100), the other fiscal ratios (debt, revenues, federal debt) are percentages.