Essays in Empirical Public Finance

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Introduction

Taxes are among the oldest instruments of governments to generate income. There is documented evidence dated to the first dynasty of the Old Kingdom in the 3rd millennium B.C. that the pharaoh collected taxes which ancient Egyptians had to pay (e.g. Malik, 2000). With respect to taxation modern Europeans do not seem to be very different from ancient Egyptians: some kind of tax has to be paid everywhere. An important difference to ancient times is that nowadays not the pharaoh, but elected governments collect these taxes. What is taxed and how differs a lot across European countries. One of the most striking features of modern countries is that in many cases taxation is not exclusive to one government, since local, regional, and central governments exist in parallel and their territories overlap. All those levels of government need revenues to fulfill their responsibilities. In the European Union, the degree of importance of the local and regional level varies across countries, as does the autonomy over tax instruments, which sub-national entities can use on the revenue side of their budget.

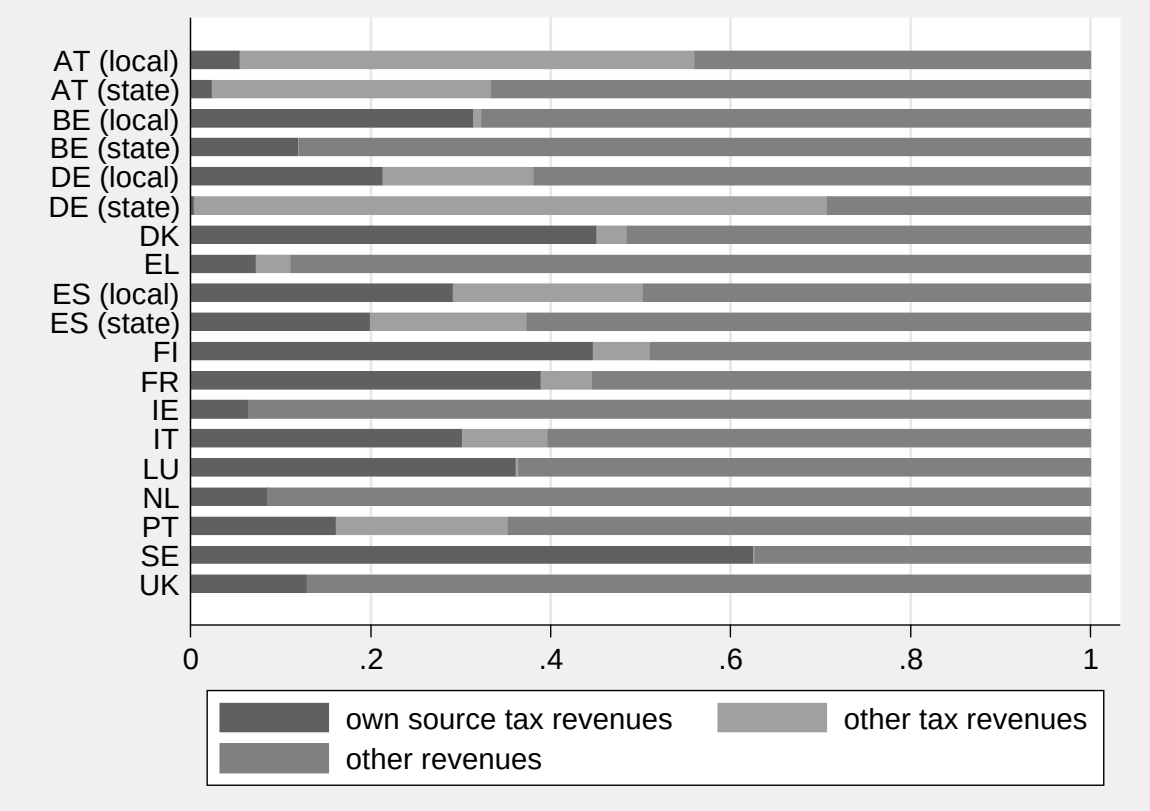
Starting with the Union level itself, a part of its budget is financed by a share of each member state's harmonized revenues from the value added tax. The relevance of taxation at the supranational level is rather low, though. Traditional own source revenues at this level of government, raised on behalf of the entire Union, are mainly import duties on services and goods. In addition the EU level is financed with transfers from the member states. Although there is a still ongoing debate over European taxes, until now the European Union does not have the power to decide upon an own tax-base, reliefs, or a tax-rate. However, the European debt crisis revived the debate over more fiscal centralization at the European level, including the harmonization of some tax bases, the set-up of a stronger European fiscal authority, or even the creation of European tax instruments.

So far, most tax related issues are still dealt with exclusively by the member states, and in many cases additionally by their sub-national entities. Central government tax bases, tax rates, and other elements of the tax code vary substantially between countries in Europe. Below the central level, the federal set-up of European countries, the fiscal policy instruments at their disposal, and their fiscal position in terms of debts and deficits vary remarkably. While the debate at the European level is mostly about centralizing taxation at the supranational level, in most of the member states a trend towards decentralization to the sub-national sector has been observable over the past two decades. This is related to an increasing importance of sub-national governments' decision making. The central aim of this work is a better positive understanding of issues arising in public finances at the sub-national level.

The literature on *fiscal federalism* deals with questions of public finance in multi-tiered governmental systems. Ever since the 1950's, academic scholars were concerned about taxation and the provision of public goods in a world where countries divide some of those responsibilities between the central and sub-national levels. The provision of public goods and taxation at those lower levels of government can, under certain circumstances, be more efficient than at the higher level (e.g. Tiebout, 1956; Musgrave, 1959; Oates, 1972). One assumption of the earlier literature, sometimes classified as *first generation fiscal federalism*, was that benevolent governments maximize public social welfare and do not distort public policies because of rent-seeking or vote-maximizing behavior (Oates, 2005).

Most European countries have established a principle of local autonomy and self-government.[1] When discussing the revenue side of local or state budgets, two important features have to be taken into account. First, the distinction between revenues from taxation and other revenues, such as user fees, grants, and other allocation of funds. Second, tax revenues have to be split up into own and shared revenues. Own revenues are those where the respective government has an impact on tax rates or reliefs, and other tax revenues arise through redistribution mechanisms. Figure I.1 shows the composition for the EU15 countries. Three stylized facts can be derived from this graph, which serve as one of the motivations for the three empirical contributions in this dissertation:

[1] See Dexia (2008) for a comprehensive descriptive analysis.



Notes: Average taken over the years 1995-2008. Own-source taxes are classified as those where the sub-national entity has discretion over the tax base or the tax rate. Other revenues contain grants, fees, and other contributions. Source: own calculation, data from Eurostat, IMF, and the OECD revenue statistic. Further details of the construction see Chapter 1.

Figure I.1: Breakdown of sub-national government revenue

1. The degree of tax-autonomy varies widely across sub-national sectors in the EU15.

2. German local governments have substantial autonomy over taxation.

3. The local sector in the neighboring country France shares this characteristic of relatively high ratios of own-source taxes.

Each of the three contributions in this dissertation is concerned with one of the stylized facts presented above and relates to the recent conclusions of the *second generation fiscal federalism* literature as surveyed by Weingast (2009). Main conclusions of this new strand of literature are challenged with the data in one of the following chapters respectively.

The first chapter deals with the question of whether fiscal rules and the heterogeneity in the structure of revenues, as shown in Figure I.1, have an impact on sub-national fiscal outcomes. This topic has been a particular focus of the younger literature on fiscal federalism. While the traditional literature emphasized the potential pros of higher efficiency of decentralization, recently also potential cons were more intensively discussed in the literature (see e.g. Prud'homme, 1995). Weingast (1995) defines five conditions, and for an ideal, *market-preserving* type of federalism, all of which should be fulfilled simultaneously. One of them says that *"all governments, especially subnational ones,* [should] *face hard budget constraints"* (Weingast, 1995, p. 4). This condition implies that local and regional governments are fully responsible for their own financial decisions. One main channel behind soft-budget constraints instead is the expected likelihood to receive bailouts and additional grants from higher level governments. If those sub-national governments have incentives to overspend, their budget constraints become soft, resulting in higher sub-national deficits and debts. To meet the criteria of hard budget constraints, "[...] *each level of government in the federal system must be fiscally independent. That is, each must have its own tax base that more or less matches its expenditure obligations without significant intergovernmental transfers"* (McKinnon, 1997, p. 73). An excellent survey and a collection of case studies for different countries around the globe is provided by Rodden, Eskeland, and Litvack (2003). According to this, the abovementioned structure of revenues across European sub-national sectors is a particularly strong driving force of a bias towards higher deficits. The revenue structure is important for the functioning of a federal organized country and is at the core of the analysis in this chapter.

This part of my research investigates the differences of deficits across EU15 sub-national governments. Specifically, I establish a link between the fiscal profligacy and the autonomy that these governments have in raising their revenues. This autonomy might constraint sub-national sectors as a form of an implicit rule, since more autonomy over taxation goes along with greater responsibility for the results of their own fiscal policies. In line with the soft-budget hypothesis, higher autonomy should reduce the bias towards deficits. On the other hand, a well established framework of fiscal rules can help prevent a deficit bias and centralize the budget process (see

Hallerberg, Strauch, and von Hagen, 2009, for an extensive treatment of this relationship). My research pays special attention to the increasing implementation of fiscal rules across sub-national government sectors of the European Union by investigating their impact on deficits together with their tax autonomy. Results from my original dataset, which covers full information for 14 years for the EU15, show that the effectiveness of means depends critically on the federal background. Explicit fiscal rules, as formulated in law or constitutions, work for unitary countries. Implicit rules in the form of higher tax autonomy improve the market-preserving aspect of the federal structure in countries which are organized as federations according to their constitution.

The second chapter deals with the perception that economic policies are not always carried out by benevolent governments acting as social planners, but rather by *"government officials, usually with at least one eye to their reelection prospects"* (Hatfield, 2006, p. 1). This prediction is a result of the work in political economy and public choice, which assumes that politicians and bureaucrats act in their own interest instead of focusing on the welfare of their constituents. This chapter is motivated by the second stylized fact presented above. In Germany, local councils can manipulate local tax rates on business and revenues from these taxes are a substantial part of local level budgets. According to the theory of political budget cycles, policy makers are supposed to use the tools at their disposal to signal their competence to the electorate in order to increase their reelection prospects at the ballot boxes (Rogoff, 1990). Voters, even those who are rational and forward-looking, might reward lower taxes or higher spending if information asymmetry does not allow them to fully evaluate the long-term consequences of such policies. Politicians, in turn, can make use of this and try to signal their "competence" by keeping taxes low, even though financial pressure might heavily call for a tax increase.

The autonomy that German local governments enjoy in setting their taxes, together with the fact that these tax rates are often quite persistent over time, calls for an investigation of political budget cycles in tax rate choices. The purpose of that chapter is to assess whether politicians manipulate the timing of tax rate changes in a strategic way to maximize reelection prospects. To do so, we exploit the German local

business tax as a testing ground which is set autonomously by German municipalities. As election dates vary across local councils, the data allow us to disentangle the effects related to the timing of elections from common trends. The results strongly suggest the notion of a political budget cycle. The decision to alter business tax rates as well as the annual percentage change of the tax rates are determined by electoral events. Specifically, we find that in election years the probability of a tax hike declines while this is exactly the opposite once the election took place. In post-election years the probability of a tax increases or positive changes of the tax rates is significantly larger than zero. This pattern is in line with considerations of the political budget cycles literature, as politicians do not implement unpopular policies at times when voters are likely to remember that at the ballot boxes.

The third chapter[2] of my dissertation contributes to the empirical research in the area of fiscal interactions and tax competition. European businesses in cross-border situations encounter important tax issues. This chapter draws on the second and third stylized fact that both German and French local jurisdictions can autonomously charge taxes on business activities. According to Figure I.1 more than 20% of German and 40% of French sub-national revenues are generated by taxes where the respective authorities can decide upon the tax rate. Both countries' taxation tools have an impact on the after tax profits of firms. The research presented in this chapter focuses on the question of whether officials in local jurisdictions use this tax instrument in a strategic way in order to be attractive for capital investment or to maximize reelection prospects. These hypotheses are predictions from the tax competition (see Wilson (1999) for a survey) and the yardstick competition (Besley and Case, 1995) literatures. We are in particular interested if local communities interact only with respect to other domestic communities or also with respect to those on the other side of the Franco-German border.

A newly constructed panel data set of the municipalities in France and in Germany along the Rhine Valley allows us to estimate an empirical model of strategic interactions between French and German local jurisdictions over the period 2000-2007. We compute effective average tax rates to obtain comparable measures of the

[2]The research presented in this chapter is based on Cassette, Di Porto, and Foremny (2012).

tax burden for each municipality in each country. With this data we estimate panel models in which we distinguish between the influence of competing municipalities that belong to the same country and the effect of competing municipalities that belong to different countries, sharing a border. A specific feature of our sample is that the Franco-German border coincides with the River Rhine. Crossing the Rhine is only possible where infrastructure in the form of bridges or ferries is available. This allows us to distinguish between the pure effect of neighborhood and the role of infrastructure. Our results show that a strong border effect exists in local tax rate setting, even though capital is free to cross the border. Spatial correlation between the taxes set by local governments is driven exclusively by domestic effects, even after controlling for bridges and ferries.

This thesis investigates how different tax systems, tax tools, and institutional settings affect economic agents and outcomes. The research presented in this dissertation provides empirical evidence for an interplay between politics and fiscal policy in an European sub-national context. Over the last decades decentralization in European countries and at the Union level itself has always been in motion. The strategic element in fiscal policy observed in the data, be it the timing of tax rate changes, the structure of competition for capital among local governments, or how to restrain deficits, suggests that it is important to take the role of the politicians themselves into account when competencies are transferred and restructured across governmental levels.

Chapter 1

Vertical aspects of sub-national deficits

The impact of implicit and explicit constraints in Europe

1.1 Introduction

This chapter tackles the questions of why the aggregated fiscal performance of sub-national governments in European countries differs, and how this can be explained by different institutional settings, such as fiscal rules and autonomy over tax instruments.

Much research has been done since the early 1990's which dealt with the question of why certain countries have experienced long periods of budget deficits that accumulated in high levels of public debt while others did not. Attention has focused on political and institutional factors, since even countries with similar underlying economic conditions showed a widespread variation in debt levels. It has been argued that to a large extent the design of the institutions which govern the budgetary process is the underlying reason for the cross-country heterogeneity in fiscal positions (among others, see von Hagen and Harden, 1994, 1995; von Hagen, 2002, 2005; Alesina and Perotti, 1996, for this line of argument).

While much attention, both theoretical and empirical, has been spent on the central or general budget and national fiscal policy, the links between sub-national debts and deficits, their institutions, and in particular the restrictions imposed on them by

fiscal rules, have not yet been explored in depth. The institutional background in this context is different from that of the central level because vertical relationships between the levels of government play a crucial role. This chapter aims at a closer empirical investigation of the underlying forces.

The differences in fiscal positions below the national level can be caused by a deficit bias due to a common pool externality. Budgetary inflows in almost all countries come to a certain extent from a common source in the form of transfers or grants, while budgetary outflows are targeted to specific regions or municipalities. To be precise, a substantial share of revenues is generated with instruments that sub-national entities have no direct discretion over. The concept that the tax base is responsible for bailouts and connected through this channel to the deficit bias was introduced by von Hagen and Eichengreen (1996). They argue that, in a dynamic context, the budget constraints of governments which are highly dependent on revenues that are not generated by their own instruments might become soft. The respective decision makers at the sub-national level might expect ex-ante that, if they cause a large and unsustainable deficit, the resulting outstanding debt would have to be bailed out ex-post by a higher-level government. In other words, the central government cannot credibly commit itself to a no-bailout policy, if the respective lower level government has no power to solve fiscal problems on its own because the instruments to do so are not available once fiscal trouble has emerged. If instead a large proportion of sub-national revenues comes from own tax resources, this might work as an implicit way of the central government to communicate that sub-national entities should act on their own behalf. In this case, they can be asked to implement adjustments by increasing tax rates under their control. Low fiscal autonomy instead is connected with higher deficits, since budget constraints are soft (von Hagen and Eichengreen, 1996).

A recent attempt to mitigate this time inconsistency problem of soft budget constraints was to impose fiscal rules on sub-national governments. The idea of fiscal rules is to force local or regional governments to act in the way the central level desires. The number of fiscal frameworks which impose balanced budget or debt rules on lower governmental sectors has increased over the last two decades. The introduction of the Maastricht Treaty and the Stability and Growth Pact could be seen as

the cornerstone in the interest of such rules. In recent years a strong increase in the number of fiscal rules at the national level can be observed. The goal of these rules, often called "national stability pact", could easily be jeopardized if the budgetary policies of sub-national governments do not act in concert. Therefore, almost all of these national pacts impose restrictions on lower level governments as well.

The driving forces behind sub-national deficits I explore in this paper are twofold. On the one hand, I focus on the autonomy that these governments have in raising revenues. This autonomy might constrain sub-national sectors as a form of an implicit rule, since greater autonomy goes along with greater responsibility for results of their fiscal policy. On the other hand, I also focus on explicit fiscal rules, as formulated in laws or constitutions, covering restrictions imposed on the sub-national sector to harden the budget constraint.

I also analyze what drives countries to adopt, keep, or to strengthen their framework of rules. This is an important task that helps overcome a potential problem of endogeneity, which is well known in this strand of literature. Stricter rules may be adopted by governments with stronger preferences for fiscal discipline or a severe need for consolidation. I show that good instrumental variables for sub-national rules exist which can help to solve this potential endogeneity problem. The main reasoning of the paper in this dimension is that political characteristics of the rule imposing level might be good instruments for the rules themselves at the lower governmental level. They fulfill the exclusion restriction since these political variables might have an impact on the fiscal outcome of the central level, but not on the deficits of sub-national governments.

I derive my results from a panel-data set of the sub-national sectors of the EU15 countries, covering data for fiscal rules, tax autonomy, and political and fiscal variables over the period 1995-2008. Regressions of the deficits of sub-national sectors on measurements of the strictness of rules and the discretion to tax show that the effectiveness of fiscal rules and the impact of tax autonomy depend critically on the federal structure of the respective country. As a main result, fiscal rules work in unitary countries and not in federations, but implicit restrictions in the form of higher tax autonomy are an effective way to constrain excessive spending for the federal countries in my sample.

This chapter is organized as follows: Section 1.2 presents stylized facts for sub-national public finances of the EU15 countries. Section 1.3 summarizes the underlying theory and the related literature. The empirical analysis starts in Section 1.4 with an explanation of my identification strategy. Section 1.5 presents my dataset, and my results are shown and discussed in Section 1.6. This chapter comes to a close in the Section 1.7.

1.2 Stylized facts

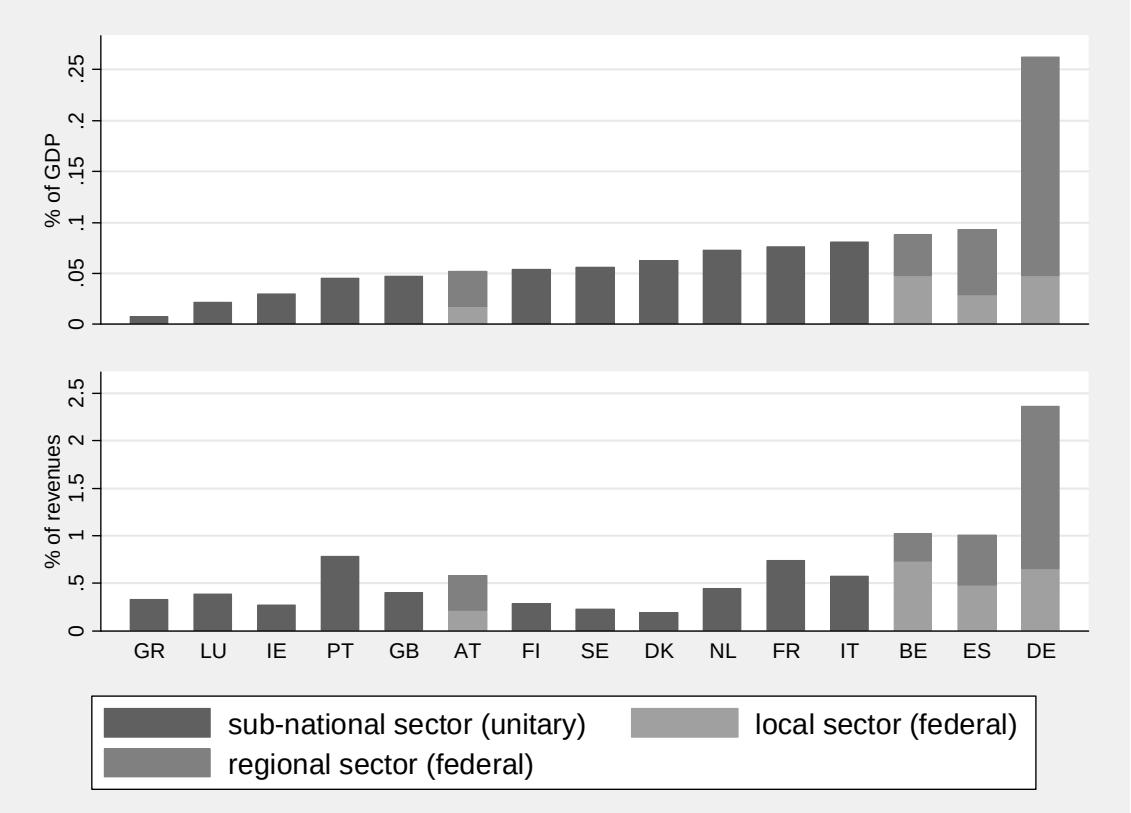
The structure of European countries differs in many respects. One of the most important distinctions is the role and status of the sub-national sector due to the constitutional structure.

federal countries	Austria, Belgium, Germany, Spain (local and regional levels included seperately)
unitary countries	Denmark, Finland, France, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Sweden, United Kingdom (consolidated sub-national values included)

Table 1.1: Unitary and federal classification

Three countries out of the EU15 are original federations as written down in the respective constitution (Austria, Belgium, Germany), and another country (Spain) has a very regionalized structure. All these countries have had handed over important responsibilities to the regional and local level, and these sub-national governments have significant own legislative powers. I treat this group of countries as federations in my analysis. The other group of states consists of unitary countries, but those may have a different number of sub-national levels. While Finland has only a local level sector, the remaining unitary countries (Denmark, France, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Sweden, and the United Kingdom) have at least one regional level, but with limited legal autonomy, compared to their federal counterparts. As indicated in Table 1.1, I group all these countries as unitary ones.

European countries differ substantially in the level of sub-national debt which they have accumulated in the past. Figure 1.1 shows the level of debt outstanding in 2008



Notes: Consolidated outstanding debt in 2008. Top panel: as a share of GDP. Bottom panel: as share of revenues collected at the respective level of government.

Figure 1.1: Sub-national outstanding debt

as a share of GDP in the top panel. This indicates that a substantial part of the total debt in European countries is due to sub-national borrowing. Most federal countries, and in particular Germany, show relatively large ratios of debt to GDP. However, this measure can be misleading, since it does not take into account the actual size of the sub-national sector. Therefore, the bottom panel depicts the outstanding debt as a share of revenues for the same year at the sub-national sector. Measures in terms of revenues capture two important dimensions. First, they indicate the relevance of debt in terms of the capacity to generate budgetary inflows. Second, this measures the size of the sub-national sector as mentioned before.[1] While the ranking for federal countries remains largely the same, this further illustrates the differences in unitary countries. Even though the Nordic countries have much larger sub-national sectors relative to the general government sector, their debt is lower compared to countries

[1]The actual size might be also depicted in terms of expenditures, but note that the ordering of countries does not change if I do so.

such as Portugal or France, which are less decentralized.

Since debts are (at least formally)[2] the accumulation of deficits over time, the paper aims at answering the following questions. First, why did some federal countries, such as Germany, have on average larger deficits than other federal countries? And second, what drives the pattern of deficits over time in the unitary countries, even though the differences in decentralization have been taken into account? To sum it up, I will explore why sub-national sectors in some countries are exposed to a larger bias toward deficits than others.

1.3 Theoretical motivation and related empirical literature

A well-established reasoning for differences in debts and deficits at any level of government is that the respective decision makers do not fully internalize the costs of the public goods they acquire. This is known as the common pool problem of public budgeting. Since costs are shared by the whole population, theoretical models, as those of von Hagen and Harden (1995), Velasco (2000), Hallerberg, Strauch, and von Hagen (2009), and Krogstrup and Wyplosz (2010), emphasize that these costs are not fully internalized by the spending claims of individual spending ministers, in the sub-national context by members of local or regional councils. This results in overspending, since only a small part of the additional social costs of raising the tax burden are taken into account, eventually creating a problem of $1/n$. The more interest groups are involved in deciding the budget, the more fragmented the budget process becomes, and the larger the deficit bias due to individual spending claims. This is a result of a horizontal externality since it occurs within one government.

This point, which applies to every level of government, is supplemented by one that especially lets sub-national governments be inclined to overspend and borrow extensively. This might occur because several sub-national entities are grabbing for resources out of a national common pool (von Hagen, 2005). In this case the existence of soft budget constraints creates a vertical externality. Bordignon (2006) provides

[2]See von Hagen and Wolff (2006) for a treatment of creative accounting and stock-flow adjustments.

a survey of this literature. When a budget constraint is considered to be soft, a sub-national government can increase expenditures without facing the full additional social costs. A hard budget constraint instead makes the entity internalize the full additional social costs, since it expects to be responsible for the consequences of its spending plans (Rodden, Eskeland, and Litvack, 2003).

The underlying problem is of a dynamic nature: sub-national governments can accumulate unsustainable debt levels if they expect ex-ante that the central government might wish to bail them out once fiscal obligations can no longer be fulfilled ex-post. In other words, sub-national governments might expect that under certain circumstances the central government will assume responsibility for the liabilities they accumulate. Thus, there is a link between expectations of the future behavior of a higher-level government and the fiscal policy chosen at present. One main channel of these expectations is intergovernmental fiscal transfers. The probability that a sub-national entity is not responsible for its fiscal decisions taken today is higher, the lower the share of own-source revenues is. In other words, the higher the dependency on central governmental grants and transfers, the higher the expectation of a bailout. This is because the central level has less room to ask for adjustments in sub-national taxes in the case of fiscal trouble, resulting in a dynamic game between the two actors (von Hagen and Eichengreen, 1996).

This "default-bailout game" between the central and sub-national level is formalized by Inman (2001) and Kornai, Maskin, and Roland (2003). The center commits itself at the first stage to a no-bailout policy. The sub-national level instead chooses to spend at a level where the local marginal benefit is higher than the marginal social costs if it has a strong belief that the commitment of the center at the first stage is not credible. Finally, the central government has to decide whether or not to provide additional transfers to the lower level in order to reduce the deficit there. If the center has strong incentives to do so, its actions will be anticipated by the lower level government. The budget constraint is the softer, the lower the costs of the center to provide additional funds compared to leaving the sub-national government alone with its deficits.

Starting with Wildasin (1997), several papers formalized the problem in partial equilibrium models in order to analyze the effects of different issues on the preva-

lence of soft budget constraints (see Vigneault (2006) for an extensive overview over theoretical considerations). Wildasin (1997) focuses on the size and structure of jurisdictions. In his model the incentives of the central government to intervene in lower-level public finances is due to positive externalities of local public expenditures. Since these interventions can be anticipated at the first stage, local budget constraints are soft. The model of Goodspeed (2002) shows that a bailout forced by incentives of a lower level government to accumulate high debt has to be paid partially by other regions through increased taxation. Köthenbürger (2007) investigates the impact of fiscal equalization schemes, and Breuillé, Madiès, and Taugourdeau (2006) focus on the impact of horizontal and vertical tax competition. For federal systems, Breuillé and Vigneault (2010) have recently shown that the soft budget problem can be worse in a multi-tier system if regional level governments have discretion over transfer policies. In that case a soft budget constraint on the regional level yields even softer budget constraints on the local level.

The theoretical interest in soft budget constraints in the context of fiscal federalism has also triggered empirical contributions in this area. These studies focus either on cross-country evidence over aggregated fiscal policy on the sub-national level, or country specific case studies. Rodden, Eskeland, and Litvack (2003) provide a collection of mostly descriptive case studies. Additional country specific evidence for sub-national bailouts is provided by von Hagen et al. (2000) for German states, Italian regions, Australian and Swedish local jurisdictions.[3] Evidence for Sweden is found by Dahlberg and von Hagen (2004). They show that the ability of the central Swedish government to commit to a no-bailout policy is rather weak, while the high degree of tax autonomy at the local level helps to harden budget constraints. A recent study by Pettersson-Lidbom (2010) identifies the expectations of local Swedish governments over a future discretionary grant by an instrumental variable approach. He uses the grants received by neighboring municipalities as an instrument for the anticipation of own additional future discretionary grants. A significant soft budget effect is found, and on average debt is increased by 20 percent when the budget constraint

[3]Among others, further contributions deal with bailouts across the German states (Seitz, 2000; Fink and Stratmann, 2011; Baskaran, 2012), Spanish regions (Sorribas-Navarro, 2011), and various Latin American countries (e.g. Echavarria, Renteria, and Steiner, 2002; Bevilaqua, 2002; Nicolini et al., 2002).

becomes soft. Apart from these studies, there is not much more empirical evidence at the country level. The lack of empirical work can be explained by the fact that expectations over the additional allocation of funds are not easy to measure, and as shown in the various case studies, numerous aspects of intergovernmental relations can create this effect.

In order to solve the soft budget problem of time inconsistent behavior, countries characterized by little revenue raising power at sub-national levels might impose more restrictions through fiscal rules on lower level governments in order to commit the local or regional level to fiscal discipline. Indeed, von Hagen and Eichengreen (1996) show that borrowing limits are more prevalent in countries where the share of sub-central government's own-source resources is small. This is because if own taxes could be adjusted, the central government could deny a bailout. It has been also pointed out that these incentives might be different according to the federal organization of countries.

Recent empirical work on fiscal rules at the general level of government across European countries[4] has established that their effectiveness depends on the institutional and political background of the respective country. Evidence in von Hagen (2006) underpins the importance of the design of the budget process that enables the government to commit to the rule. Hallerberg, Strauch, and von Hagen (2007) show that the stringency of fiscal targets has an impact in European countries which are characterized by ideological dispersion in the government. An intensive discussion of these results is provided in Hallerberg, Strauch, and von Hagen (2009). Similar results are obtained by the study of Debrun et al. (2008), who apply another indicator to capture the strictness of rules across European Union countries.

Empirical contributions that are closely related to this paper perform cross-country comparisons at the sub-national level, rather than investigating individual local or regional governments. At the sub-national level fiscal rules and tax autonomy may have simultaneously an influence on fiscal positions. This literature focuses on

[4]For studies exploiting variation across US states see, among others, von Hagen (1991); Poterba (1994); Bayoumi and Eichengreen (1995); Poterba (1996); Fatás and Mihov (2006). Bohn and Inman (1996) find that only constitutional rules prevent deficits in US states, while statutory ones do not. Feld and Kirchgassner (2006) find that across Swiss cantons those with fiscal constraints have significantly lower deficits. In addition, Alesina et al. (1999) show for a sample of Latin American countries that well designed budget institutions reduce deficits.

the differences across countries in order to investigate which institutional elements have an impact on sub-national fiscal policy. Rodden (2002, 2006) uses a panel-data set of forty-three OECD, developing, and developed countries over ten years (1986 to 1996). A first set of results is based on ten-year average regressions, capturing long-run effects. He finds that vertical fiscal imbalance (i.e. the share of grants and shared taxes in revenues) is positively related to deficits. For a second set of results all countries are grouped in two categories, countries with high and low borrowing autonomy. For the former he finds that vertical fiscal imbalance is still a driving force of deficits, while there is no effect for the latter. As already mentioned in the conclusion of that paper, more work should be done to investigate the effects of tax autonomy, and in particular the changes over time and the different degrees of borrowing autonomy. Plekhanov and Singh (2006) analyze with a panel-data set over 1982-2000 which specific institutional design of borrowing constraints prevents large sub-national deficits. Their classification of fiscal rules is based on dummies according to the way the rules are imposed. This paper finds, while averaging over all years for each country, that rules imposed by the central government and cooperative agreements might reduce deficits when the vertical imbalance is large.

These days, however, almost all European sub-national governments are constrained by some restrictions, and the pure classification into categories as in Plekhanov and Singh (2006) is not without ambiguity. Another probable shortcoming of the existing empirical literature is that none of the papers provide a panel analysis which takes the changes in fiscal rules and tax autonomy over time into account. On the one hand, this is because time invariant indicators are used, and hence institutional changes are neglected. On the other hand, some results are based on between estimations, which were carried out on the average of the variables per country over time. Fiscal rules differ over time and how stringent and transparent they are applied. In particular European countries introduced numerous rules for sub-national sectors over the last two decades. I use a continuous index, rather than a categorical approach, to investigate whether the strictness of rules has an impact.

Similar arguments apply to the characterization of own-source revenues. The concept of vertical fiscal imbalance should be carefully reconsidered, since it has not accounted for shared taxes. But shared taxes, collected by the central and then

redistributed to the lower level sectors, might not be any different from grants in terms of incentives as tax rates cannot be decided at the sub-national level. I rather focus on the development of own-source taxes, which takes into account the distortionary nature of taxes, when central governments ask for adjustments by increasing tax rates rather than providing additional funds through bailouts or by increasing grants. This is even more important since the underlying problem of soft budget constraints is a dynamic one.

Solving these issues is one of the main contributions of this paper. I estimate panel models where I carefully construct measures of the tax autonomy of sub-national sectors, the different strength of borrowing restrictions in the form of fiscal rules, and explicitly take into account the variation over time. This can be interpreted as comparing the outcome for times before major reforms of rules and tax autonomy were implemented with the time after implementation.

A further well known problem in the literature on fiscal rules is that their correlation with deficits does not necessarily have to be causal. Studies on the national level have highlighted the lack of good quality instruments in order to address a problem of endogeneity. This explicit sub-national context, however, allows finding variables that are correlated with the fiscal rules index, but are orthogonal to the error term. I exploit the fact that fiscal rules are in almost all cases imposed by a higher level of government. Earlier contributions have shown that political economy variables are able to explain the stringency of fiscal rules (see Debrun et al. (2008), for instance). However, on the national level these variables might not be simultaneously uncorrelated with budgetary outcomes. Although this is true on the national level, in the case of sub-national sectors the decision makers over rules (the central government) and the decision makers over budgetary policy (the sub-national entities) are not the same. I will make use of the fact that the characteristics of central governments, which impose rules on the sub-national one, are unlikely to be correlated with their budgetary outcomes, but describe well the prevalence of rules. The attempt to solve this endogeneity problem is another contribution of this paper compared to the existing literature.

1.4 Identification

The main objective of this paper is to analyze whether a measure of the budgetary position can be explained by autonomy over taxation and fiscal rules, as tools which might restrict governments from profligacy. I estimate a reduced form model of a fiscal reaction function according to equation (1.1):

$$D_{i,t} = \gamma tax_{i,t-1} + \delta rules_{i,t} + \boldsymbol{\beta}\mathbf{X_{i,t}} + \mu_i + \eta_t + \varepsilon_{i,t} \tag{1.1}$$

The dependent variable is a measure of the budget deficit, $D_{i,t}$, at the sub-national level. The impact of the tax-structure in terms of sub-national autonomy is captured by the parameter γ. I estimate the reaction to a lagged variable of the share of taxes which are under discretion of the respective government. I argue that using the one period lag is important since policy makers will use their knowledge from the past to build their expectations about the future. A high dependency on own-source taxes in the past indicates that it is likely that current deficits must be paid back by own resources instead of expecting to receive transfers from the central government.

The parameter δ captures the impact of fiscal rules, as an explicit way to restrict public finances. The data section spends special attention to the question how the variables tax and $rules$ are constructed.

The impact of other explanatory control variables is measured by the parameters in the vector $\boldsymbol{\beta}$. μ_i and η_t are individual and time fixed effects, respectively. The inclusion of individual fixed effects is, besides capturing unobserved heterogeneity, important to focus on the dynamic nature of the underlying problem. I aim at an estimate of the impact of changes in the institutional framework on budgetary outcomes in the form of annual deficits. Hence, the question is how rules and autonomy affect deficits in the short run, and the inclusion of fixed effects captures all time invariant factors.

It is important to take the connection of the sub-national level to the higher level of government into account. The mechanism to tie the hands of lower-level governments by giving them autonomy might work well in federations, where lower-level governments have substantial degrees of freedom over their policies and legal acts. On the contrary, in unitary countries the sub-national level is more or less the

extension of central government policies. When the sub-national level is not much more than a branch of the central one, a credible commitment of the center to a no-bailout strategy might be impossible in any case (even in line with a positive impact of autonomy on deficits).

$$D_{i,t} = \boldsymbol{\gamma}\boldsymbol{\Phi}' tax_{i,t-1} + \boldsymbol{\delta}\boldsymbol{\Phi}' rules_{i,t} + \boldsymbol{\beta}\mathbf{X_{i,t}} + \mu_i + \eta_t + \varepsilon_{i,t} \tag{1.2}$$

To capture these effects, I estimate models according to equation (1.2) and interact a set of dummies $\boldsymbol{\Phi}$ with the main variables of interest.

$$\boldsymbol{\Phi}' = \begin{bmatrix} \Phi_1 \\ \Phi_2 \end{bmatrix} \text{ and } \begin{array}{l} = 1 \text{ if unitary country, 0 otherwise} \\ = 1 \text{ if local or regional level in a federal country, else 0} \end{array}$$

These dummies classify the respective form of government, as given in Table 1.1. Eventually I end up with separate coefficients on tax autonomy and fiscal rules for federal and unitary countries.

To address problems of autocorrelation and heteroskedasticity, I estimate cluster-robust forms of the variance-covariance matrix. In some cases the small number of groups relative to coefficients does not allow to cluster over countries. In that case I estimate the variance-covariance matrix according to Newey and West (1987) with standard errors that are robust to both, heteroskedasticity and autocorrelation (HAC).

As a robustness check, I also estimate dynamic models with a lagged dependent variable. Unfortunately, this implies an additional problem, since fixed effects estimates are likely to be biased as long as the time span is short (Nickell, 1981). To control for the bias introduced by the lagged dependent variable together with fixed effects, I use the bias-corrected version constructed by Bruno (2005) and bootstrap the standard errors. Judson and Owen (1999) show that this is the appropriate choice for a panel with my characteristics, i.e. when neither N nor T is large.

The possibility that fiscal rules are the result of, rather than the reason for fiscal performance, requires a careful analysis of causality. I use an instrumental variable approach to overcome this hurdle. First, I estimate the factors determining the fiscal rules index. I include political determinants of the level of government which

introduces the rules, indicators of the general fiscal stance of the respective country, as well as dummies for different time periods (the time of the Stability and Growth Pact, for instance) and further controls, included in $\mathbf{Z}$, into the model.

According to equation (1.3), I estimate a model for each value of the fiscal rules index j across countries, using the average of covariates during the time span when the rule was applied:

$$rules_j = \boldsymbol{\gamma}\overline{\mathbf{pol_j}} + \boldsymbol{\delta}\overline{\mathbf{budget_j}} + \boldsymbol{\theta}\overline{\mathbf{time_j}} + \boldsymbol{\beta}\overline{\mathbf{Z_j}} + \varepsilon_j \tag{1.3}$$

Furthermore I estimate a fixed effects model to capture the variance in rules over time according to the model in equation (1.4):

$$rules_{i,t} = \boldsymbol{\gamma}\mathbf{pol_{i,t}} + \boldsymbol{\delta}\mathbf{budget_{i,t}} + \boldsymbol{\theta}\mathbf{time_{i,t}} + \boldsymbol{\beta}\mathbf{Z_{i,t}} + \mu_i + \varepsilon_{i,t} \tag{1.4}$$

Ideally, this step offers candidates for instruments. Finally, I re-estimate equation (1.1) and use instruments for the fiscal rules index. I spend additional attention to the validity of instruments in Section 1.6.3.

This identification procedure corrects some drawbacks of former empirical approaches. First, the focus on the within variance with time-varying indicators allows identification of the effects in the short run. Second, including the lagged value of tax autonomy creates a better reflection that decision makers form their expectations by observed values from the previous period. Last, the proper choice of instruments can eliminate a potential source of endogeneity.

1.5 Data

I use aggregate data for sub-national sectors to investigate the deficit bias which might occur due to the relationships between different governmental layers in European countries. All EU15 members are included over a period ranging from 1995 to 2008. I include regional and local governments as separate entities in the four federal organized member states. This provides 19 observations per year and 266 in total

over the fourteen years covered by my data set.[5]

The dependent variable is a measure of the budgetary position in each year. While several possible definitions are at hand, I chose to use annual deficits as a share of revenues. Other possibilities are defining the dependent variable as the deficit per capita or as a share of GDP. I took the decision in favor of my choice, since this measure incorporates differences in capabilities to raise revenues, as the deficit is expressed as a share of the revenue capacity in a given year.[6]

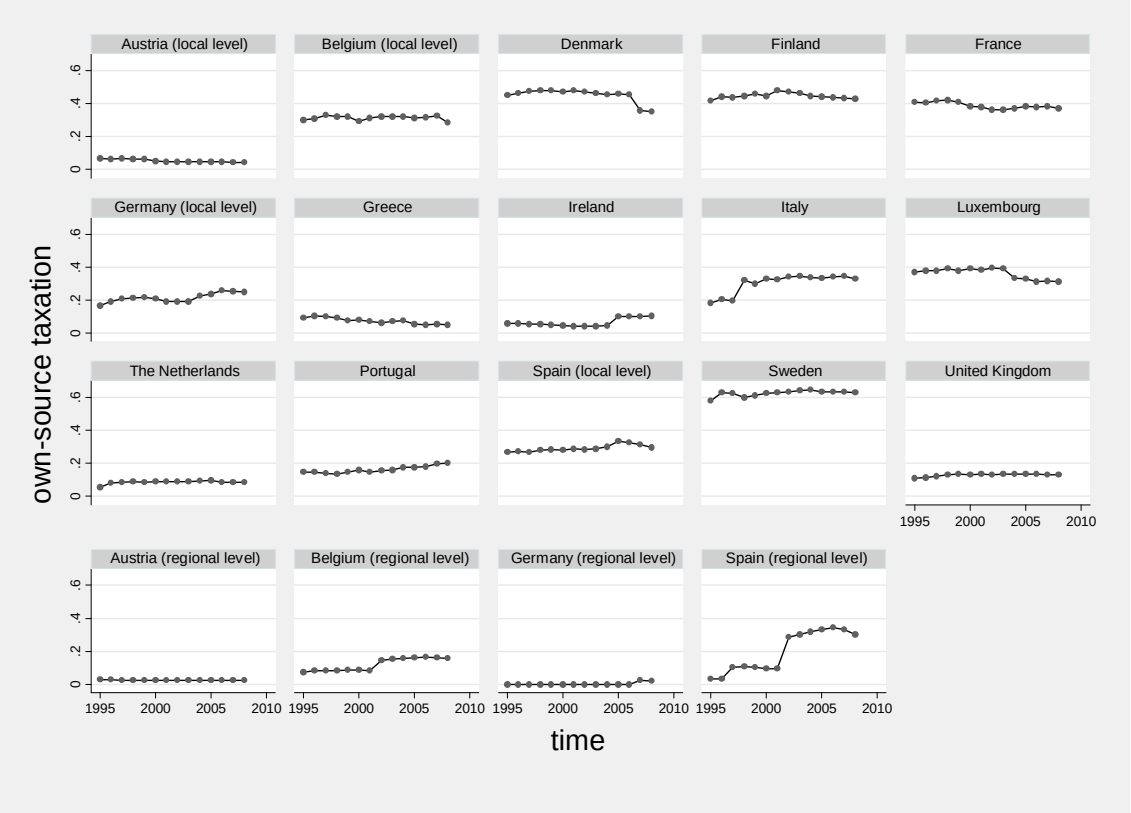
Two important indicators have to be computed in order to investigate the effects of fiscal rules and tax autonomy. I construct both indicators as a time-varying index that captures the development for each country over the entire time period.

First, an indicator of tax autonomy is needed to test whether the dependency on own tax resources creates incentives to balance the books. The smaller the share of revenues from own-source taxation is, the higher the expectation over a bailout in times of fiscal stress. I compute an indicator of the share of own-source tax revenues in total revenues on each governmental level, respectively. The classification of own-source revenues is, unfortunately, not straightforward. Other studies rely on the degree of vertical imbalance or the share of taxes in total revenues, which can be misleading.[7] It is important to distinguish real own-source revenues from revenues which arise due to tax-sharing arrangements, i.e. taxes collected by a higher level and automatically transferred to the lower one. The OECD (1999) provides a classification of the taxing power of sub-national levels. Unfortunately, their *Fiscal Decentralization Database* provides only information for two or at most three years, 1995, 2002, and 2005. I use the *Revenue Statistics* of the OECD, the *Taxes in Europe* database of the European Commission, numerous national sources over changes in tax-systems, and the information provided by Stegarescu (2005) to construct an indicator over the entire 14 years of the sample. I treat all taxes over which either discretion on

[5]Please refer to Appendix A1.4 for robustness checks on alternative sample designs. Main results remain unchanged.

[6]Taking deficits as a share of revenues or expenditures as the dependent variable follows the previous studies in this literature. However, the correlation with other possible measures, as expressing deficits as a share of GDP or in per capita terms, is high. See Table 1.9 in the Appendix A1.2 for details.

[7]A good example are German federal states. Their share of tax revenues in total revenues is substantial, but the share of real own-source taxes is close to zero since they cannot decide on an individual tax rate.

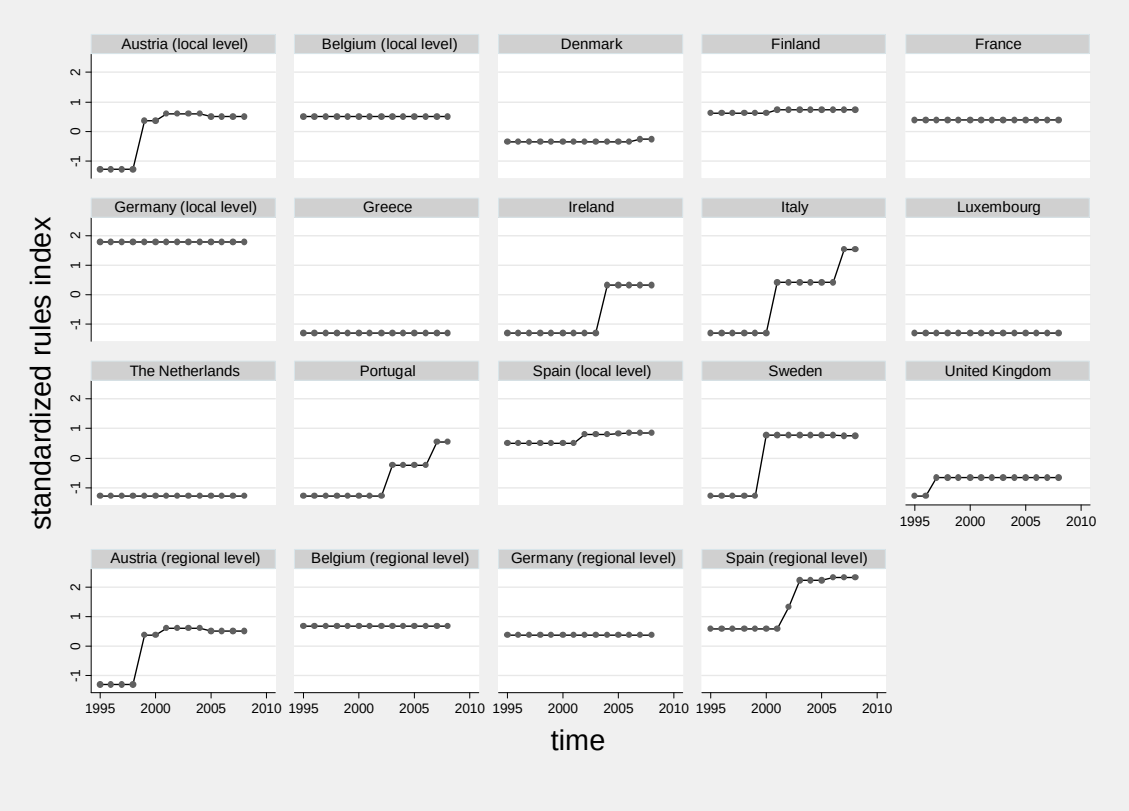


Notes: Share of tax revenues under discretion of the respective governmental level. Classification of autonomy according to the OECD fiscal decentralization database and national tax legislation. Own calculations.

Figure 1.2: Revenues from own-source taxation

rates, reliefs, or both are under the power of the sub-national entity as own-source tax revenues. This measure does not overestimate the revenue autonomy in the presence of shared taxes.

Figure 1.2 provides a graphical representation of this indicator. The Nordic countries are characterized by the largest share of autonomous revenues while German states, both Austrian sectors, Ireland, and the Netherlands have on average very little discretion over their revenues. Variation in the indicator is generated due to two different effects. On the one hand, the tax-system can be changed, equipping lower level governments with a richer set of instruments or more autonomy over existing taxes. Some governmental sectors, such as the Spanish regions and the sub-national Italian sector have implemented considerable changes within this period. On the other hand, the share of other revenues could also shift when the center re-allocates resources to lower levels of government. An increasing value of this indicator repre-



Notes: Standardized fiscal rules index. Survey information is taken from European Commission (2009). Own calculations according to Appendix A1.1.

Figure 1.3: Fiscal rules index

sents a higher responsibility at the sub-national level and might help to avoid soft budget constraints.

Second, I construct another indicator to depict the strength of fiscal rules, i.e. how stringent borrowing is regulated. Fiscal rules are nowadays frequently used at the sub-national level in European countries (European Commission, 2009, 2008, 2006; Sutherland, Price, and Joumard, 2005) to mitigate a deficit bias and to harden the budget constraint by imposing numerical targets on budgetary variables or limiting the access to credits. I use the data provided by the European Commission (2009) to create an index of the strictness of these rules. All fiscal rules which can have an impact on the deficit are included in the calculation of the index. These are balanced-budget-rules, debt brakes, and other restrictions on borrowing.[8] The original EU index is adjusted to the situation of sub-national levels. In the non-federal

[8]Expenditure ceilings are very rare at the sub-national level and, as in the original EU variable, excluded for the main analysis of the impact of rules on deficits.

countries, an average of the rules applying to different levels, weighted by their share of expenditures in the total sub-national budget, is used.[9]

Figure 1.3 shows the development of this indicator. The restrictions are relatively stable over time in one group of countries (Belgium, Germany, Denmark, France, and Finland) while another group (Austria, Spain, Ireland, Italy, Portugal, and Sweden) has increased the strictness of rules in recent years. Most of these countries introduced national stability pacts as an answer to the limitations arising from European supranational rules. A third group (Greece, Luxemburg, the Netherlands, and the United Kingdom) goes without strict rules. When these fiscal arrangements worked as an effective tool to dampen a deficit bias, a negative coefficient is expected.

The other controls are summarized in Table 1.2. The fiscal position of the central government *def_cg_rev* is included to capture a copycat effect. Sub-national governments that observe a loose fiscal policy at the national level can follow the example given by the central government, expecting that they are not sanctioned if the higher level is profligate as well.

The degree of decentralization is taken into account by the share of sub-national expenditures in general government expenditures *edec*. Unfortunately, this indicator is not able to distinguish between expenditures that could be categorized as compulsory or those that are optional. Nevertheless, the share of expenditures captures the weight of the sub-national sector in the general budget and how spending proportions are shared between the governmental levels. These shares differ across European countries, with varying responsibilities and discretion over their exercises.

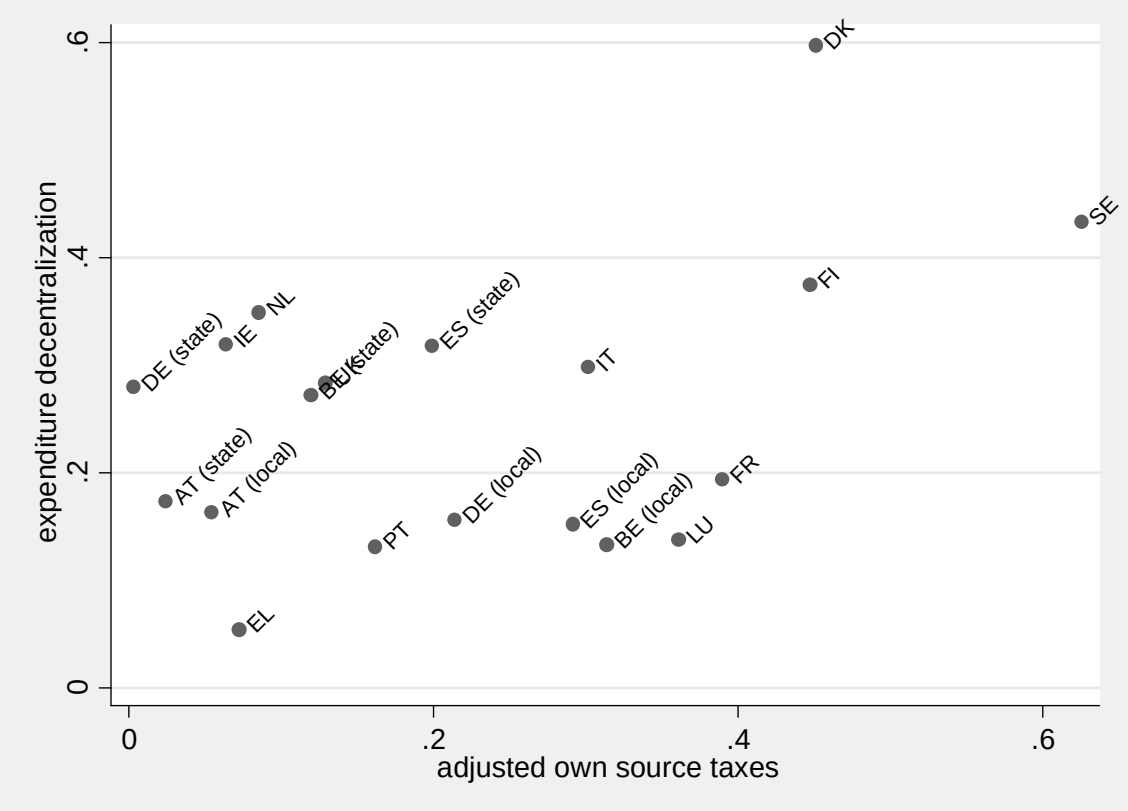
Figure 1.4 shows the country means over my period of study. The Nordic countries, for instance, are characterized by a high level of services and responsibilities on the local level. Danish sub-national governments spend on average more than every second *Danske kroner*, followed by their Swedish and Finnish neighbors. The regional levels of Belgium, Spain, and Germany are responsible for approximately one quarter of total expenditures, accompanied by their local governments with additional, but lower expenditure shares. The less decentralized countries are France, Portugal, Luxembourg, and Greece. The plot against the average of own-source tax revenues indicates that in many cases higher expenditure decentralization is accompanied by a

[9]The construction of this index is described in detail in Appendix A1.1.

Variable	Source		Mean	Std. Dev.	Min	Max
Dependent variable						
$deficit/revenues$	Eurostat	overall	0.006	0.034	-0.100	0.112
		between		0.022	-0.042	0.062
		within		0.026	-0.087	0.101
Tax autonomy						
tax^1	OECD,	overall	0.227	0.172	0.000	0.646
	own calculations	between		0.173	0.003	0.625
		within		0.037	0.061	0.370
$tax * federal$		overall	0.152	0.122	0.000	0.343
$tax * unitary$		overall	0.281	0.184	0.041	0.646
Fiscal rules						
$rules^2$	EC,	overall	0.459	0.357	0.000	1.284
	own calculations	between		0.311	0.000	1.100
		within		0.188	-0.014	1.061
$rules * federal$		overall	0.699	0.277	0.000	1.284
$rules * unitary$		overall	0.284	0.303	0.000	1.008
Controls						
$def\_cg\_rev^3$	Eurostat	overall	0.081	0.113	-0.189	0.621
		between		0.074	-0.031	0.276
		within		0.087	-0.169	0.556
$edec^4$	Eurostat	overall	0.254	0.131	0.043	0.659
		between		0.131	0.054	0.598
		within		0.029	0.116	0.360
$intexp\_rev^5$	Eurostat	overall	0.942	1.307	0.004	5.875
		between		1.303	0.007	5.382
		within		0.306	0.042	2.256
$outgap$	Eurostat	overall	0.374	1.648	-4.707	5.209
		between		0.372	-0.111	1.429
		within		1.608	-4.540	5.376
ln_totpop	Eurostat	overall	16.496	1.290	12.913	18.229
		between		1.323	12.999	18.225
		within		0.028	16.410	16.614
$depratio^6$	Eurostat	overall	0.670	0.012	0.636	0.690
		between		0.011	0.646	0.685
		within		0.006	0.640	0.687
$unempl^7$	Eurostat	overall	0.075	0.031	0.019	0.184
		between		0.027	0.034	0.123
		within		0.017	0.036	0.137
N=19, T=14 (1995-2008), n=266						

Definitions: [1]revenues from own-source taxes as share of total revenues; [2]fiscal rules index; [3]central government deficit as share of revenues; [4] share of sub-national expenditures in general government expenditures; [5] interest expenditures as share of revenues; [6] share of working population in total population; [7]unemployment rate

Table 1.2: Summary statistics: Deficit estimation



Notes: Mean by country over 1995-2008. Vertical axis: share of expenditures in general government expenditures, horizontal axis: revenues from own-source taxation as share of total sub-national revenues.

Figure 1.4: Decentralization over 1995-2008

higher degree of autonomy over tax revenues. As noted before, this is not the case for some countries, in particular for the German federal states, but also not for Austria, Ireland, and the Netherlands.

Additional covariates are included to capture cyclical and institutional effects and to consider the spending needs of lower-level governments. I include the output gap *outgap*, the unemployment rate *unempl*, the ratio of the working age to total population *depratio*, the log of total population *ln_totpop*, and interest expenses *intexp_rev*. All fiscal variables are computed as share of revenues.

Table 1.3 summarizes the additional political variables, which I take into account for the estimation of fiscal rules themselves. The motivation for the central government to impose restrictions on lower level governments could be determined by the perception that a soft budget problem is at hand. Thus, the federal structure itself plays a role and several determinants of the deficit might also be crucial for

Variable	Source		Mean	Std. Dev.	Min	Max
ideology[1]	World Bank,	overall	0.376	0.327	0.000	1.000
	own calculations	between		0.131	0.089	0.589
	Beck et al. (2001)	within		0.301	-0.213	1.171
herfgov[2]	World Bank	overall	0.666	0.270	0.181	1.000
	Beck et al. (2001)	between		0.257	0.221	1.000
		within		0.101	0.350	1.004
disctrict[3]	World Bank	overall	9.402	6.050	1.000	22.500
	Beck et al. (2001)	between		5.712	1.000	20.300
		within		2.364	5.052	25.352
contract[4]	Hallerberg et al. (2009)	overall	0.425	0.495	0.000	1.000
		between		0.465	0.000	1.000
		within		0.199	0.068	1.282
debt_gg_gdp[5]	Eurostat	overall	0.634	0.265	0.061	1.304
		between		0.255	0.071	1.102
		within		0.091	0.406	1.019
N=19, T=14 (1995-2008), n=266						

Definitions: [1]index from zero (single party left-wing) to one (single party right-wing); [2]Herfindahl measure of fractionalization (probability that two randomly chosen individuals belong to different political groups); [3]district magnitude; [4] form of fiscal governance; [5]debt at the general government level as share of gdp

Table 1.3: Summary statistics: Central government characteristics

the strictness of rules. These issues are taken into account by using some of the variables already discussed. However, the center must also believe that fiscal rules are a mean to cure the problem and must be able to implement the rules through the legislature. Hence, political variables which characterize the central government and its preferences are related to fiscal rules, since they describe general preferences for a rules based framework. Most of the data is obtained from the World Bank Database of Political Institutions 2009 (Beck et al., 2001).

First, to control if the ideological orientation of the government plays a role, an index over the two main government parties, reaching from zero (left-wing, single party government) to one (right-wing, single party government), is calculated. There is no general conjecture over the direction of the impact of this variable, and the sign could point in either direction.[10]

Second, the Herfindahl index measures the fractionalization of the ruling coalition.

[10]Debrun et al. (2008) report evidence that more conservative orientated governments make less use of fiscal rules.

A single party government yields a value of one, while values close to zero indicate a more dispersed government. This index can be interpreted as the probability that two randomly picked members of the ruling coalition belong to the same party. The expected sign of this variable is not clear. On the one hand, a more fragmented government could be willing to restrict lower levels, because they are able to blame other coalition members when local or regional politicians complain about new rules. On the other hand, a less fragmented government might find it easier to pass new rules through the legislature.

Third, the district magnitude measures the average number of seats in the parliament per electoral district. Beside the impact on the effective number of parties,[11] the district magnitude might have an additional impact in the sub-national context. A higher value indicates that more seats are allocated within one electoral district. Hence, the connection between local politics and the politicians elected into the central parliament might be loose. On the contrary, a small district magnitude means that the representative in the central legislature could be seen as directly responsible for the respective district. A strong connection to the sub-national level might cause representatives to be cautious with imposing strict rules, because they do not want to cross with local politicians and voters.

Last, I include the predicted form of fiscal governance, according to von Hagen and Harden (1995), Hallerberg, Strauch, and von Hagen (2007), and Hallerberg, Strauch, and von Hagen (2009). This literature characterizes whether a delegation or contract approach of fiscal governance is appropriate for different countries. Centralizing the budget process could be done by the former approach under which governments give authority to one special member that is vested with special strategic power. On the national level the finance minister is typically in charge of this special function. The latter approach instead relies on contracts between all members of the cabinet with spending rights. I include the indicator developed in this literature to investigate whether central governments that are assumed to be contract countries follow this approach when designing rules for sub-national levels.

[11] The idea was developed by Duverger (1954), tested empirically by Taagepera and Shugart (1993) and put in the context of budgetary politics by Hallerberg and von Hagen (1999).

1.6 Results

This section presents the results of my analysis. After estimating the baseline model in the first subsection, I investigate the factors which determine the strictness of fiscal frameworks in the second subsection. The goal is to identify the driving forces behind fiscal rules in order to use them as instruments for instrumental variable estimations when fiscal rules are treated as endogenous. The results from these estimations are presented in the last subsection, where I also discuss my findings in more detail.

1.6.1 The impact of sub-national fiscal rules on budgetary outcomes

Table 1.4 presents the results of the regressions for budgetary outcomes. The dependent variable in any model is the share of the annual deficit in revenues at the respective sub-national sector. Positive values arise if expenditures exceed revenues and all coefficients with a negative sign improve the budgetary position by reducing deficits.

The first two columns show results from regressions according to equation (1.1), while the first column (a) does not include neither individual nor time fixed effects, but panel-corrected standard errors (PCSE). I find neither significant effects of the lagged tax autonomy nor the strength of fiscal rules when I pool all observations and include a dummy variable for federal countries. As mentioned earlier, including fixed effects is superior to cross section models since the variation within groups over time is important. Fixed effects also capture time-invariant preferences for fiscal sustainability. In addition, an F-test ($F_{(18,216)}$=6.21, p-value 0.00) indicates that significant individual effects are at present and simple cross section estimations are not efficient. Therefore, I turn to fixed effect models in columns (b) to (e), since a Hausman test rejects the appropriateness of random effects ($\chi^2_{(12)}$=42.49, p-value=0.00).

Results of model (b) are similar to those from the cross section without any significant effect of tax autonomy or fiscal rules on deficits. As abovementioned, the means to cure the deficit bias might be different conditional on whether the respective country is a unitary one or a federation. To control for the likely different effects I turn to the estimation of specification (1.2) from column (c) onwards.

Dependent Variable	Cross Section	Panel Model			
Deficit/Revenues	(a)	(b)	(c)	(d)	(e)
Tax autonomy					
$tax_{(t-1)}$	-0.006	-0.101			
	(0.023)	(0.061)			
$tax_{(t-1)} * unitary$			0.195**	0.195	0.153
			(0.098)	(0.120)	(0.096)
$tax_{(t-1)} * federal$			-0.272***	-0.272***	-0.159*
			(0.069)	(0.056)	(0.087)
Fiscal rules					
$rules$	-0.012	-0.016			
	(0.011)	(0.010)			
$rules * unitary$			-0.043***	-0.043***	-0.033**
			(0.014)	(0.014)	(0.015)
$rules * federal$			0.002	0.002	0.006
			(0.014)	(0.015)	(0.020)
Controls					
def_cg_rev	0.066**	0.087**	0.076**	0.076*	0.060*
	(0.028)	(0.037)	(0.036)	(0.040)	(0.035)
$edec$	0.100***	0.147*	0.214**	0.214***	0.127
	(0.026)	(0.088)	(0.087)	(0.074)	(0.078)
$intexp\_rev$	0.002	-0.002	-0.001	-0.001	-0.003
	(0.004)	(0.007)	(0.007)	(0.007)	(0.009)
$outgap$	-0.001	-0.001	-0.000	-0.000	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$unempl$	0.173	-0.036	-0.047	-0.047	0.001
	(0.123)	(0.216)	(0.209)	(0.187)	(0.193)
ln_totpop	0.007*	0.365**	0.520***	0.520***	0.324**
	(0.004)	(0.180)	(0.167)	(0.136)	(0.133)
$depratio$	0.326	-0.565*	-0.603*	-0.603*	-0.356
	(0.258)	(0.322)	(0.331)	(0.356)	(0.396)
$trend$	0.002***	0.004	0.005	0.005	-0.000
	(0.001)	(0.008)	(0.007)	(0.005)	(0.001)
$federal$	0.005				
	(0.009)				
LDV					0.368***
					(0.069)
country/year FE	No/No	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes
R^2	0.181	0.223	0.270	0.270	
Standard errors in parentheses, see notes for details *** p<0.01, ** p<0.05, * p<0.1, n=247 N=19 T=14					

Notes: Model (a): pooled regression with panel corrected standard errors, constant term not reported; Model (b) and (c): fixed effect estimation with standard errors robust to heteroskedasticity and autocorrelation (Newey-West); Model (d): clustered standard errors at the individual level; Model (e) dynamic panel data estimation, bias correction initialized by Arellano and Bond estimator, bootstrapped standard errors with 1000 repetitions, LDV is the lagged dependent variable.

Table 1.4: Regressions of deficits

These estimations show encouraging results. The lagged tax autonomy is significant for both types of government. Interestingly, coefficients are different across the two groups. According to the hypothesis of soft budget constraints, sub-national governments in federations run lower deficits when their share of own-source tax revenues in the previous year has been a relatively large share in total revenues. Given an increase in the share of revenues directly at their hands, it might be perceived that these own generated revenues also have to be used for potential future liabilities, causing lower present deficits. Sub-national sectors in unitary countries instead show up with an opposing behavior. These governments might anticipate that they are more or less the extension of the central government and giving them more autonomy does not constrain them sufficiently from profligate spending. Nevertheless, when I estimate the model with cluster robust standard errors in column (d), or a dynamic specification in column (e), tax autonomy in unitary countries is not significant anymore. These findings are in line with those of Rodden (2002): more autonomy over revenues generated by own-source taxation is an implicit tool to constraint sub-national governments in federal organized countries. Although effective in federations, this does not work for unitary countries.

Fortunately, fiscal rules do, but only for the group of unitary countries. Sub-national governments in non-federal states overspend less when fiscal rules are stricter and the access to borrowing is limited. In this case, fiscal rules are an effective tool to mitigate a deficit bias, although tax autonomy is not. However, this does not hold true for entities in federally organized states, where in no specification a significant coefficient is detected. The result of the dynamic model in column (e) corroborates this result. Fiscal rules prevent only sub-national sectors in non-federal countries from running high deficits. For the rest of the paper, I consider model (d) as the preferred benchmark estimation.

Summing up, different types of institutional designs call for different means to control sub-national public finances. A careful consideration of the intergovernmental relations is required when fiscal rules should be implemented. Given the overall legal autonomy, which is characteristical for federal countries, higher autonomy over taxes yields on average lower deficits. On the other hand, a framework based on fiscal rules works well in unitary organized countries. This is likely to be the case because

these governments have no instruments or enough legal autonomy to circumvent the limitations.

The other covariates are in line with expectations. Lower level governments follow the example of the center, since larger deficits on that level are positively correlated with those on the sub-national level. Countries that are more decentralized in terms of expenditure shares also run on average higher deficits. Demographic changes reveal two interesting insights. First, when the total population grows, so do deficits. Local services are often connected to the number of people that call for them; hence more people represent larger spending needs. Second, when the share of the working population grows, budgetary positions improve. All other variables do not have an impact on deficits which is significantly different from zero in any model.[12]

1.6.2 The determinants of sub-national fiscal rules

Whereas national fiscal rules are often self imposed, sub-national rules are not. They are almost always imposed by the central level, and institutional and political variables of that level have an impact on the strictness of the rules themselves. Even though one can argue that in federal countries the regional level could impose rules on the local one, this has not been observed over the last decades. The new fiscal frameworks in Spain and Austria for instance were both imposed on all sub-national levels by the central government.[13] This section explores which factors induce a higher reliance on rules, and which circumstances might trigger the adoption of rules.

The first column of Table 1.5 presents the results from an OLS regression according to equation (1.3) of each single outcome of the fiscal rules index on the average values over the period in which one set of rules was in force in a given country.[14] In other words, each value of the fiscal rules index appearing in a country is regressed on the average values of all other covariates during that time. This simple approach reveals

[12]The dynamic model shows only a significant effect of total population, while for all other variables estimates are not significantly different from zero.

[13]Self imposed rules of particular regional governments and their local counterparts are a somewhat new phenomenon. My sample covers data up to 2008, and none of the rules was self imposed by a regional level or imposed by that level on the local government sector.

[14]The interpretation of dummies that vary over time such as elections or the stability and growth pact are in this estimation an indicator over the relative number of events in the respective time span. For example, *sgp* takes the value 0.6 if the rules was valid during 6 years of the Stability and Growth Pact.

Dependent Variable	Cross Section			Panel Model	
Rules Index	(a)	(b)	(c)	(d)	(e)
Political variables					
herfgov	-0.641**	-0.226**	-0.066	-0.394***	-0.138
	(0.231)	(0.091)	(0.074)	(0.131)	(0.087)
election	-0.139	0.014	0.016	0.019	0.015
	(0.233)	(0.011)	(0.012)	(0.016)	(0.015)
ideology	-0.112	-0.014	-0.014	0.036	0.011
	(0.103)	(0.034)	(0.027)	(0.028)	(0.024)
district	0.014	0.003	0.004	0.018***	0.007*
	(0.008)	(0.006)	(0.003)	(0.006)	(0.003)
contract	-0.501**	-0.150**	-0.064	-0.281***	-0.006
	(0.182)	(0.070)	(0.057)	(0.069)	(0.051)
Budgetary variables					
def_rev	-0.710	-0.160	-0.156	-0.119	-0.094
	(1.754)	(0.256)	(0.244)	(0.269)	(0.320)
$def\_rev_{(t-1)}$		-0.195	-0.111	-0.356	-0.045
		(0.262)	(0.247)	(0.313)	(0.291)
$debt\_gg\_gdp_{(t-1)}$	-0.036	-0.004	-0.011	0.384**	0.083
	(0.169)	(0.094)	(0.048)	(0.153)	(0.132)
Timing					
sgp	0.374**	0.050*	0.061**	0.063*	0.072**
	(0.156)	(0.028)	(0.025)	(0.038)	(0.028)
trend		0.018***	0.002	0.020***	-0.003
		(0.005)	(0.003)	(0.006)	(0.006)

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Rules Index	(a)	(b)	(c)	(d)	(e)
Controls					
depratio	2.210	3.487*	0.565	7.055**	0.805
	(3.315)	(2.077)	(1.164)	(2.816)	(1.978)
outgap	0.050	-0.005	0.001	-0.012	-0.005
	(0.036)	(0.007)	(0.006)	(0.008)	(0.007)
unempl	3.337*	0.490	0.242	0.848	-0.597
	(1.833)	(1.155)	(1.120)	(1.757)	(1.412)
$unempl_{(t-1)}$		0.688	0.301	-1.464	0.520
		(1.080)	(0.993)	(1.528)	(1.300)
tax	0.879**	0.538*	0.422	0.717*	0.717*
	(0.363)	(0.318)	(0.339)	(0.398)	(0.390)
$tax_{(t-1)}$		0.561*	-0.135	1.350***	-0.097
		(0.313)	(0.339)	(0.407)	(0.383)
ln_totpop	0.066	0.083***	0.030*	-0.022	0.580
	(0.051)	(0.029)	(0.016)	(0.821)	(0.681)
edec	0.597	0.200	0.147	-0.594	-0.070
	(0.359)	(0.197)	(0.109)	(0.362)	(0.324)
local dummy	0.203*	0.353***	0.101**		
	(0.100)	(0.068)	(0.040)		
regional dummy	0.291***	0.436***	0.117***		
	(0.102)	(0.067)	(0.043)		
LDV			0.698***		0.803***
			(0.067)		(0.065)
Constant	-2.484	-3.780**	-0.920		
	(2.350)	(1.591)	(0.874)		
Fixed Effects	No	No	No	Yes	Yes
R^2	0.888	0.501	0.853	0.637	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
(1) n=41, (2)-(5) n=247 N=19 T=14

Notes: Model (a): aggregated estimation according to equation 1.3; Models (b) and (c): pooled regression with panel corrected standard errors; Model (d): fixed effect estimation with standard errors robust to heteroskedasticity and autocorrelation (Newey-West); Model (e): bias correction initialized by Arellano and Bond estimator, bootstrapped standard errors with 1000 repetitions, LDV is the lagged dependent variable.

Table 1.5: Determinants of fiscal rules

interesting insights, at which I look with more sophisticated methods according to equation (1.4) in columns (b) to (e). The first two remaining models (b and c) provide cross-sectional evidence, and the last two (d and e) show results from fixed effect estimations. Models (c) and (e) include also the lagged value of the rules index in order to account for the persistency of this variable.

The top panel of the table shows the impact of political variables on the rules index. The first variable $herfgov$ is significant and negative in almost all specifications, except the dynamic ones in models (c) and (e). A government which consists of a single party or of one big and one small coalition member, represented by a higher value of the Herfindahl fractionalization index (i.e. a less fractionalized one), tends to impose less strict rules. One-party governments might receive more leeway from their sub-national counterparts and might try to avoid this conflict. Countries that are supposed to follow a contract approach of fiscal governance at the central level (Hallerberg, Strauch, and von Hagen, 2009) impose less strict rules on their sub-national governments. The district magnitude also becomes significant and positive in the panel specifications.[15] This supports the view that rather loose connections to lower level politics increase the use of fiscal rules at the sub-national level.

None of the other political variables, and neither budgetary ones, have an impact on the rules themselves. It is important to note that this implies that sub-national deficits do not have a feedback effect on rules. The only budgetary variable which is significant in at least one specification is the lagged debt level of the general government in the panel specification (d). Central governments impose restrictions when general fiscal stress is at hand, but do not react to deficits at the sub-national level.

In terms of timing, the introduction of the Stability and Growth Pact has (from 1999 onwards) increased the strength of rules. This effect is not surprising since most national stability pacts were introduced as an answer to the supranational European fiscal framework in order to force the lower level governments not to counteract central level fiscal policies. Also not surprising is that rules increase over time, as indicated by the included linear trend. Out of the other control variables only the demographic structure, the population size, the sub-national tax autonomy, and unemployment

[15]Due to the little within variance, I check whether this result is robust when I include time dummies. The parameter is still significant at the same level.

have an increasing impact on the implementation of fiscal rules.

To sum up, the fractionalization of the government in power, the district magnitude, and the predicted form of fiscal governance determine the strictness of sub-national fiscal rules. Ideology of the central government and national elections instead do not. Neither do the budgetary variables, beside the lagged overall level of debt, as long as a static model is estimated. However, constituencies in federal countries, as indicated by the two dummies against the base group of unitary countries, rely more on rules than their non federal counterparts. Given the results over the effectiveness of fiscal rules from the previous section, those countries seem to back the wrong horse. This also could indicate that the political actions of the center to implement rules in unitary and federal countries might be different. In particular, the timing when the center implements rules, and whether the present or lagged political variables matter, may differ as the ultimate results have suggested.

The estimations presented in Table 1.6 show that this is indeed the case. Model (a) to (e) include separate coefficients for federations and unitary states as well as their one period lag for one of the political variables per estimated equation, respectively. For example, column (a) shows a regression with four different coefficients for the impact of the Herfindahl index on rules: the current value of federal countries, the lagged value of federal countries, the current value of unitary countries, and finally the lagged value for this group. Models (b) to (e) continue with this procedure for the other covariates. Column (f) shows the estimates of the full model, including lagged and current values of all variables simultaneously.

Model (a) shows that it is rather the one period lag than the current value of the Herfindahl index which matters. Furthermore, it can be seen that federal countries do not follow the direction described above. In this case there is a positive relationship, indicating that less fractionalization is associated with stricter rules. In federal countries the central government might impose those stricter rules in order to tie the hands of sub-national politicians, which might belong to a different party. A ideological position of central governments which is contrary to the majority of sub-national ones is a frequently observed feature in federal countries. Surprisingly ideology is now marginal significant at the 90% level for unitary countries when the lags of all variables are included in the model as shown in (f). Election year effects (b) instead are

Dependent Variable	Fixed Effect Panel Model					
Rules Index	(a)	(b)	(c)	(d)	(e)	(f)
Herfindahl index (fractionalization)						
$herfgov$		-0.381***	-0.387***	-0.443***	-0.358***	
		(0.129)	(0.124)	(0.132)	(0.132)	
$herfgov * federal$	-0.006					-0.078
	(0.114)					(0.116)
$herfgov_{(t-1)} * federal$	0.313***					0.359***
	(0.106)					(0.102)
$herfgov * unitary$	-0.335					-0.233
	(0.229)					(0.189)
$herfgov_{(t-1)} * unitary$	-0.482*					-0.641***
	(0.274)					(0.244)
Election year						
$election$	0.016		0.017	0.021	0.014	
	(0.014)		(0.015)	(0.016)	(0.016)	
$election * federal$		0.038				0.038
		(0.028)				(0.025)
$election_{(t-1)} * federal$		0.011				-0.008
		(0.021)				(0.016)
$election * unitary$		0.003				-0.004
		(0.024)				(0.021)
$election_{(t-1)} * unitary$		-0.010				-0.012
		(0.027)				(0.023)
Ideology (1=right-wing single party)						
$ideology$	0.056**	0.041		0.082***	0.029	
	(0.027)	(0.028)		(0.027)	(0.028)	
$ideology * federal$			-0.063			0.027
			(0.040)			(0.030)
$ideology_{(t-1)} * federal$			0.021			-0.011
			(0.032)			(0.030)
$ideology * unitary$			0.055			0.075*
			(0.052)			(0.041)
$ideology_{(t-1)} * unitary$			0.069			0.057
			(0.048)			(0.042)
District magnitude						
$district$	0.019***	0.018***	0.020***		0.017***	
	(0.006)	(0.006)	(0.007)		(0.006)	
$district * federal$				-0.005		0.009
				(0.007)		(0.007)
$district_{(t-1)} * federal$				0.006		0.009**
				(0.005)		(0.005)
$district * unitary$				0.011*		0.007
				(0.006)		(0.005)
$district_{(t-1)} * unitary$				0.019***		0.021***
				(0.004)		(0.003)

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Rules Index	(a)	(b)	(c)	(d)	(e)	(f)
Contract						
contract	-0.290***	-0.281***	-0.302***	-0.282***		
	(0.068)	(0.068)	(0.065)	(0.068)		
$contract * federal$					-0.346***	-0.351***
					(0.089)	(0.080)
$contract_{(t-1)} * federal$					-0.003	0.057
					(0.033)	(0.037)
$contract * unitary$					-0.090	-0.095
					(0.056)	(0.070)
$contract_{(t-1)} * unitary$					-0.073	-0.233**
					(0.086)	(0.098)
Controls						
def_rev	-0.217	-0.153	-0.283	0.054	-0.170	-0.121
	(0.241)	(0.278)	(0.264)	(0.252)	(0.273)	(0.223)
$def\_rev_{(t-1)}$	-0.293	-0.352	-0.321	-0.264	-0.254	-0.340
	(0.275)	(0.318)	(0.320)	(0.307)	(0.313)	(0.275)
unempl	-1.005	0.561	1.345	0.542	0.459	-1.387
	(1.466)	(1.782)	(1.803)	(1.828)	(1.770)	(1.441)
$unempl_{(t-1)}$	-0.291	-1.205	-1.895	-0.856	-1.134	-0.168
	(1.256)	(1.541)	(1.603)	(1.530)	(1.526)	(1.268)
tax	0.613*	0.779*	0.877**	0.875**	0.794*	0.642*
	(0.329)	(0.403)	(0.389)	(0.386)	(0.412)	(0.363)
$tax_{(t-1)}$	1.190***	1.336***	1.351***	1.309***	1.322***	1.139***
	(0.371)	(0.407)	(0.389)	(0.392)	(0.409)	(0.383)
depratio	5.510**	6.750**	8.374***	8.798***	6.536**	7.166***
	(2.422)	(2.795)	(2.837)	(2.913)	(2.862)	(2.476)
outgap	-0.007	-0.009	-0.007	-0.008	-0.008	-0.007
	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)
debt_gg_gdp	0.428***	0.354**	0.410***	0.300**	0.299*	0.482***
	(0.128)	(0.153)	(0.148)	(0.152)	(0.155)	(0.141)
ln_pop_tot	0.273	-0.134	-0.706	0.067	-0.034	-0.055
	(0.658)	(0.800)	(0.850)	(0.784)	(0.809)	(0.702)
edec	-0.630*	-0.552	-0.678*	-0.423	-0.544	-0.642*
	(0.360)	(0.363)	(0.384)	(0.386)	(0.375)	(0.372)
sgp	0.054	0.061*	0.081**	0.053	0.057	0.050
	(0.036)	(0.036)	(0.037)	(0.038)	(0.038)	(0.036)
trend	0.016***	0.019***	0.019***	0.015**	0.017***	0.017***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
R^2	0.702	0.636	0.647	0.654	0.642	0.735
Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, n=247 N=19 T=14						

Notes: Specification according to model (d) in Table 1.5. Fixed effect estimation with standard errors robust to heteroskedasticity and autocorrelation (Newey-West).

Table 1.6: Determinants of fiscal rules II

still not observable. As for fractionalization, also the district magnitude seems to be more important one period lagged for unitary countries, but according to estimation (d) and (f) signs do not change. A higher value of this variable is still increasing the rules index. The contract approach in central governments' fiscal policy instead is different for both types of countries with respect to the timing. For the federal ones the actual one is significant and negative, while for the unitary states the one period lagged value matters.

These results, while interesting on their own, are important to answer a last open question, namely the causality between rules and fiscal outcomes. My instrumental variable approach, presented in the next sub-section, builds on the results derived above. It is important to keep in mind that the proper choice of instruments can be different for the two distinct types of countries.

1.6.3 Endogeneity, IV results, and discussion

The relationship between budgetary outcomes and fiscal rules might be confounded by potential endogeneity of the latter. The enacted fiscal policy could be the cause for - rather than the result of the adoption of fiscal rules. In this case countries with fiscal difficulties at the sub-national level might impose stricter rules. The different stringency of fiscal rules across countries could be also driven by an omitted variable, in particular preferences for fiscal discipline, as noted by Poterba (1996). If balanced budgets attain an outstanding status in some states, those countries might impose stricter rules according to their preferences. However, as those preferences are assumed to not change a lot over time, this effect is captured by including individual fixed effects. Nevertheless, it has to be secured that the impact of rules on deficits, as estimated in section 1.6.1, is indeed going from tighter rules to better budgetary positions (at least in unitary countries).

I use an instrumental variables approach to solve this question. Variables that satisfy the two properties of valid instruments, namely being uncorrelated with the error of the regression of equation (1.2), but highly correlated with the rules index, must be found. This is usually regarded as a complicated task: explanations for the prevalence of fiscal institutions, for instance political variables which reflect prefer-

ences, might be simultaneously connected to the result of fiscal policy. This would imply that they are correlated with the variable that captures fiscal rules, but also with the error term.

The context of sub-national budgetary outcomes instead offers a convenient feature to tackle this hurdle. Rules and institutions for lower level governments are introduced by a higher level of government. The characteristics that drive the introduction of the rules, as worked out in Section 1.6.2, are correlated with the rules itself (and might be correlated with the budgetary outcomes of that higher governmental level), but not with the budgetary position of the governments where the rules are imposed on. The previous section has shown that political characteristics of the central government are indeed related to the strictness of rules. In addition, there was no feedback effect of deficits, which excludes that central governments introduce rules when sub-national deficits are regarded as unsustainable. Hence, there are possible candidates for a set of excluded instruments which are correlated with the endogenous fiscal rules variables, but are not correlated with the error term in the explanatory equation. In other words, those variables are likely to be in line with the exclusion restriction in instrumental variable regressions.

I use the variables which are, according to the previous section, found to be correlated with the fiscal rules index as instruments. These are the interacted district magnitude, the form of fiscal governance, and the Herfindahl index of government fractionalization. The results of these regressions are shown in Table 1.7.[16] Column (a) repeats the estimation without instruments for comparison. Models (b) and (c) differ only in the way how standard errors are computed. The set of instruments for these two estimations contains the actual political variables for federations, but the one-period lag for unitary countries. The absolute value of the coefficient on fiscal rules in unitary countries is now more or less twice as large as before. This indicates that the earlier estimate was biased towards zero. In terms of significance both models make the same predictions, and surprisingly also tax autonomy in unitary countries is gaining significance. The positive coefficient, however, indicates that higher autonomy in this group of countries does not work as a limitation but rather as an augmentation for deficits. In contrast to federations, sub-national governments

[16] I report the first stage estimations for all regressions using instruments in Appendix A1.3.

Dependent Variable	IV 2SLS Panel Model			
Deficit/Revenues	(a)	(b)	(c)	(d)
Tax autonomy				
$tax_{(t-1)} * unitary$	0.195	0.365*	0.365**	0.334**
	(0.120)	(0.190)	(0.148)	(0.141)
$tax_{(t-1)} * federal$	-0.272***	-0.284***	-0.284***	-0.289***
	(0.056)	(0.073)	(0.075)	(0.075)
Fiscal rules				
$rules * unitary$	-0.043***	-0.088**	-0.088***	-0.079***
	(0.014)	(0.041)	(0.026)	(0.024)
$rules * federal$	0.002	-0.007	-0.007	-0.001
	(0.015)	(0.027)	(0.021)	(0.021)
full set of controls	Yes	Yes	Yes	Yes
country/year FE	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes
Excluded Instruments	none	$herfgov_t * federal$		$herfgov_t$
		$district_t * federal$		$district_t$
		$contract_t * federal$		$contract_t$
		$herfgov_{(t-1)} * unitary$		$herfgov_{(t-1)}$
		$district_{(t-1)} * unitary$		$district_{(t-1)}$
		$contract_{(t-1)} * unitary$		$contract_{(t-1)}$
R^2	0.173	0.134	0.134	0.147
Hansen J	.	3.799	6.083	12.64
Hansen J p-value	.	0.434	0.193	0.245
K-P Weak Id. F	.	29.97	10.70	10.01
Robust standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1, n=247 N=19 T=14				

Notes: Two stage least square estimations. First stage regressions are presented in Table 1.12 of Appendix A1.3. Set of control variables as before, results not reported here but in Table 1.11 of Appendix A1.3. Model (a): repetition of the estimation without instrumenting the rules index; Model (b): cluster-robust standard errors, using the Herfindahl index, the form of fiscal governance and the district magnitude as instruments for federal countries. For unitary countries the one time lag of these variables is included; Model (c): same as (b) but with with standard errors robust to heteroskedasticity and autocorrelation (Newey-West); Model (d): present and lagged values are used as intsruments in both first stage equations, standard errors robust to heteroskedasticity and autocorrelation (Newey-West).

Table 1.7: IV regressions

in unitary countries are more or less a branch of the center and they may assume the center to take over liabilities anyway.

The model in column (d) uses the full set of instruments (i.e. lagged and current values) for both the federal and unitary fiscal rules index. The results are similar to the previous ones, but the validity of instruments changes slightly. While none of the models is affected by overidentification (note that the Hansen J-test does always accept the null of joint validity[17]), the Kleibergen-Paap F-Statistic for weak identification in models (b) and (c) is superior to (d). Since the models with different instruments for the unitary and federal index works better, all instruments might not be suited equally well for the two groups.

To shows this in detail, I present separate regressions for each type of country in Table 1.8. The estimations labeled 'I' include only the unitary countries, while those labeled 'II' include local and regional sectors of federations. Models (a) use the full set of instruments, while (b) involves only current values and (c) only lagged values, respectively. Signs and significances of the two main variables of interest do not change compared to the estimations before. A higher degree of tax autonomy still mitigates the deficit bias in federations and exaggerates deficits in unitary countries. Rules continue to prevent deficits in unitary countries in all specifications, but with the additional insight that the proper choice of instruments depends on the type of the country. The Kleibergen-Paap statistic reveals that actual values are better suited as instruments for federal organized countries, while this is true for the one period lags for estimating the effect in unitary countries. Also control variables behave differently, and federal countries respond stronger to cyclical elements such as the output gap, unemployment, and deficits at the central level. At the end of the day these regressions confirm and robustify the earlier conclusions.

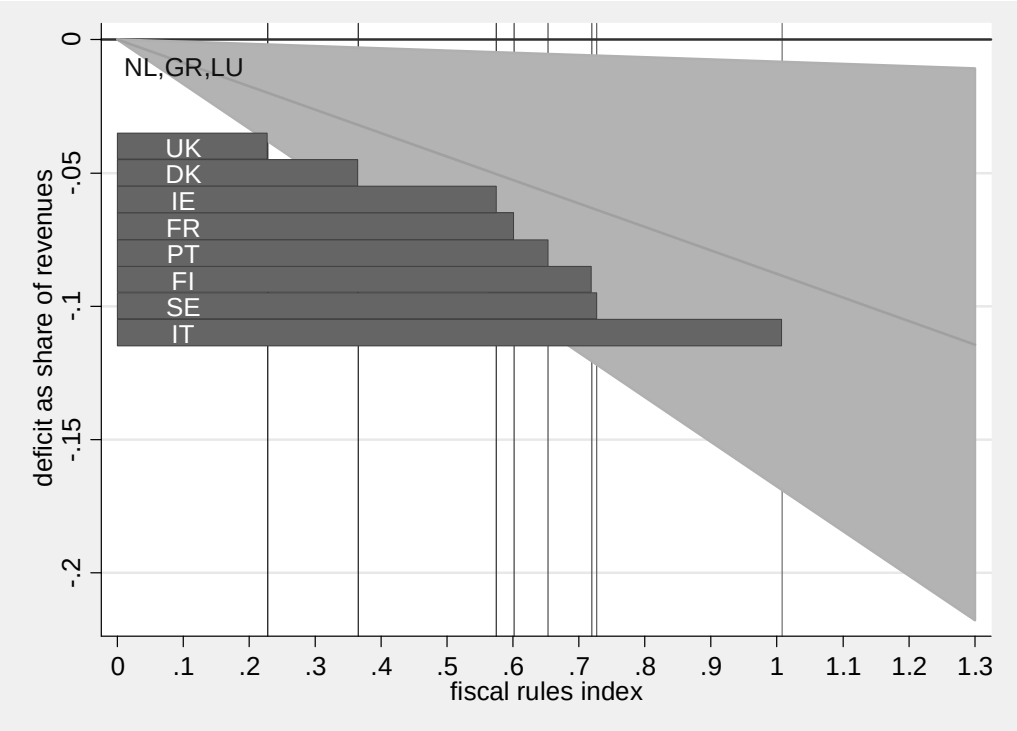
These results are encouraging for policy makers. Figure 1.5 depicts the marginal effect of stricter rules in unitary countries in the top panel (a) and the effect of tax autonomy in federations in the bottom panel (b). The bars on the left show the actual value of the fiscal rules index and tax autonomy in the year 2008. Significant improvements of budgetary positions are potentially feasible through reforms

[17]The joint null is that the instruments are valid instruments, i.e. both requirements are fulfilled: they are uncorrelated with the error term, and the excluded instruments do not have to be included into the estimated equation.

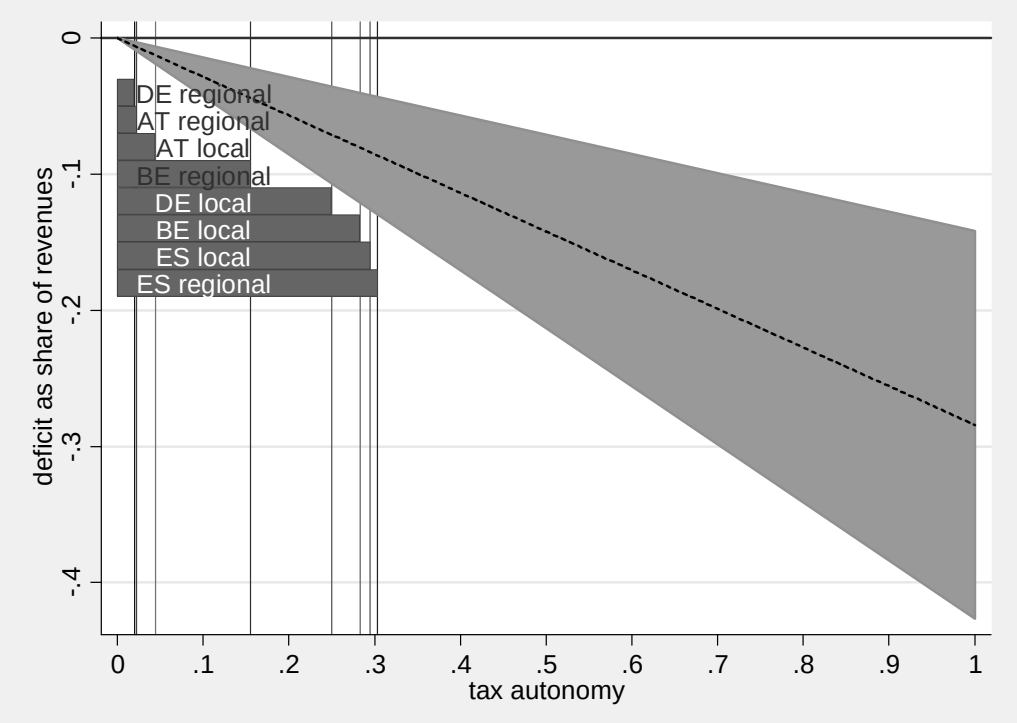
Dependent Variable	IV 2SLS Panel Model					
Deficit/Revenues	(a.I) federal	(a.II) unitary	(b.I) federal	(b.II) unitary	(c.I) federal	(c.II) unitary
Tax autonomy						
$tax_{(t-1)}$	-0.267**	0.316**	-0.259**	0.291**	-0.238**	0.321**
	(0.110)	(0.136)	(0.108)	(0.131)	(0.119)	(0.142)
Fiscal rules						
rules	-0.027	-0.091***	-0.031	-0.085***	-0.043	-0.093***
	(0.023)	(0.027)	(0.023)	(0.027)	(0.036)	(0.028)
full set of controls	Yes	Yes	Yes	Yes	Yes	Yes
country/year FE	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes
Excluded Instruments	$herfgov_t$ $district_t$ $contract_t$ $herfgov_{(t-1)}$ $district_{(t-1)}$ $contract_{(t-1)}$		$herfgov_t$ $district_t$ $contract_t$		$herfgov_{(t-1)}$ $district_{(t-1)}$ $contract_{(t-1)}$	
R^2	0.623	0.235	0.624	0.246	0.623	0.232
Hansen J	6.180	2.149	0.822	0.118	0.919	1.452
Hansen J p-value	0.289	0.828	0.663	0.943	0.632	0.484
K-P Weak Id. F	7.491	8.637	14.08	7.975	4.680	16.38
Robust standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1, n=104/143 N=8/11 (federal/unitary) T=14						

Notes: Two stage least square estimations. First stage regressions are presented in Table 1.14 of Appendix A1.3. Set of control variables as before, results not reported here but in Table 1.14 of Appendix A1.3. Separate regressions for federal (a)/(c)/(e) and unitary (b)/(d)/(f) countries. Model (a)/(b): Actual and lagged instruments; Model (c)/(d): only actual instruments; Model (e)/(f): only lagged instruments. Standard errors robust to heteroskedasticity and autocorrelation (Newey-West).

Table 1.8: IV regressions



(a) Effect of fiscal rules in unitary countries



(b) Effect of tax autonomy in federations

Bars: (a) value of the rules index in 2008, (b) value of tax autonomy in 2008. Marginal effect accroding to model (b) in Table 1.7

Figure 1.5: Policy implications

of rule frameworks and the structure of tax systems. This is particularly true for countries which currently make little use of those mechanisms. A one standard deviation in unitary countries (0.303, cf. Table 1.2) increase in the rules index decreases the annual share of deficits in revenues on average by 2.7 percent. A one standard deviation increase in the tax autonomy of federations (0.122, cf. Table 1.2) causes a reduction of deficits of about 3.5 percent, *ceteris paribus*. Hence changes in the institutional framework, in particular the adoption of another set of fiscal rules or changing autonomy over taxes, can help to reduce deficits in the short run.

A last issue is whether these two instruments work in isolation or whether there is an interplay between the two. To check for this, I re-estimate the model and allow for interaction between the fiscal rules index and tax autonomy.[18]

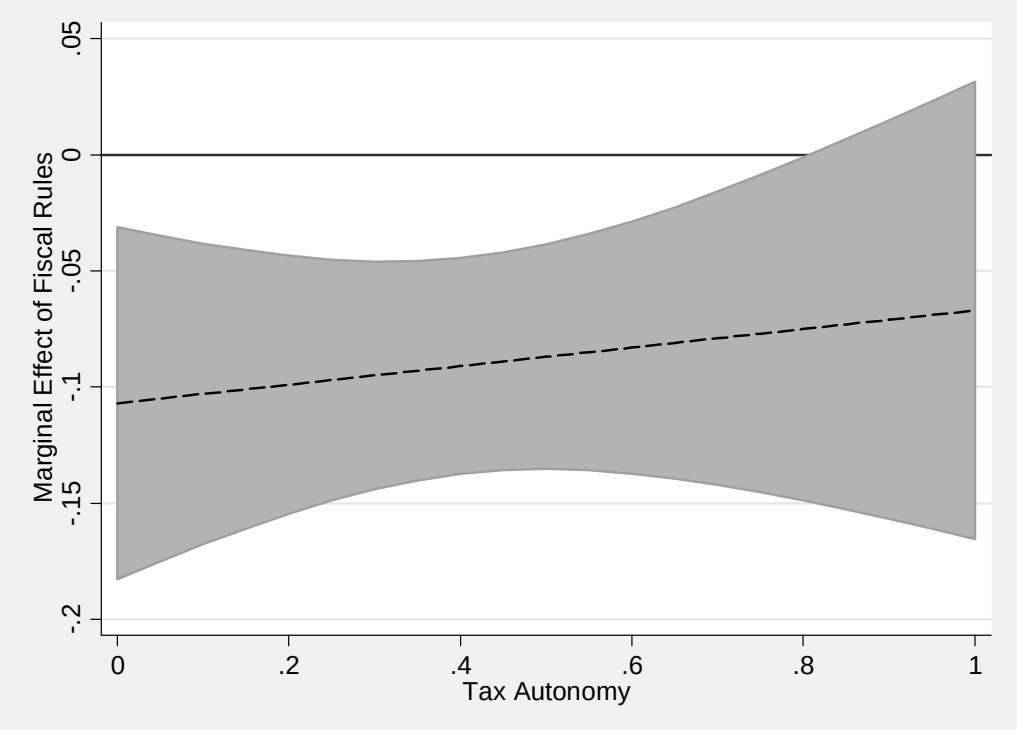
The top panel (a) in Figure 1.6 shows a plot of the marginal effect of fiscal rules in unitary countries. The interaction term is not significant in this case (p-value=0.6, cf. Table 1.10 in the appendix). The negative impact on deficits remains similar in terms of magnitude when tax autonomy varies.

Tax autonomy itself was identified as the proper tool for federal countries. The marginal effect in this case is depicted in the bottom panel of Figure 1.6. Here the interaction term is significant (p-value=0.03, cf. Table 1.10 in the appendix) and the figure shows that this tool becomes more effective when fiscal rules are tighter. That is, even though rules themselves do not help, an increase in tax autonomy should be considered together with the rules framework. In the policy arena, these results and in particular the fact that the effectiveness of tools to restrict deficits depends on the countries' type should be carefully taken into consideration.

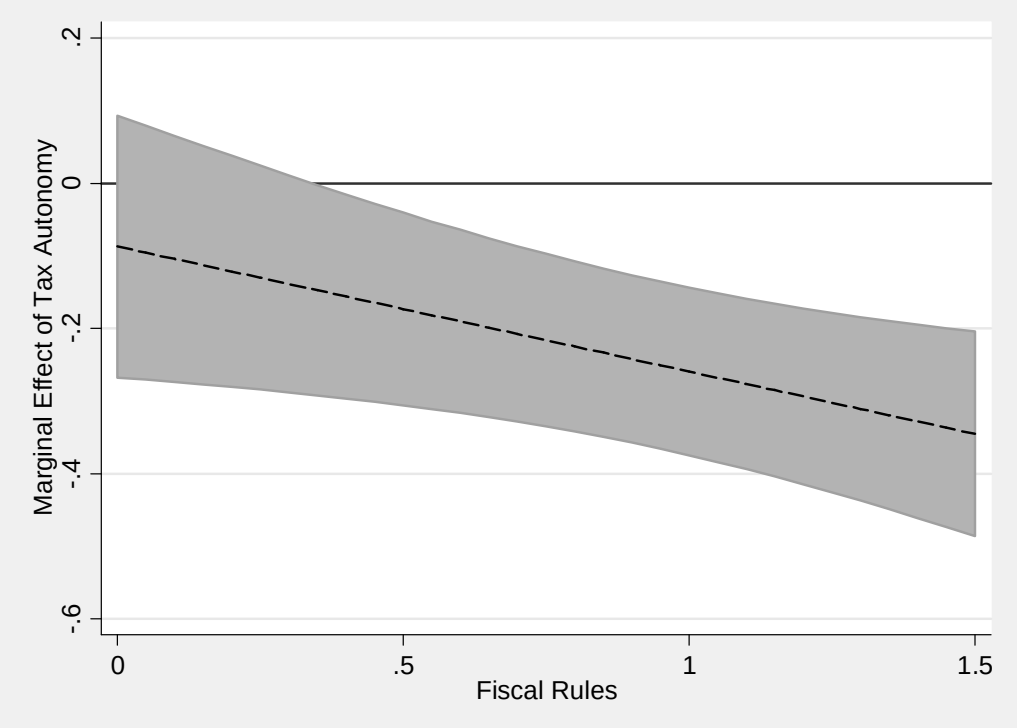
1.7 Conclusion

The main goal of this chapter is to explore which institutional arrangements help to keep the books of sub-national governments in balance. I focused on two different mechanisms which are potentially able to constrain the sub-national sector from fiscal profligacy. On the one hand I investigated the role of own tax resources, since less autonomy creates incentives to run deficits because of bailout expectations. On the

[18]Estimates are shown in Table 1.10 of Appendix A1.3.



(a) Marginal interaction effect of fiscal rules in unitary countries



(b) Marginal interaction effect of tax autonomy in federations

Notes: (a) plot of the marginal effect of fiscal rules while allowing for interaction with tax autonomy, (b) plot of the marginal effect of tax autonomy while allowing for interaction with fiscal rules. 95% CI in gray.

Figure 1.6: Marginal effects interaction terms

other hand, I studied the impact of fiscal rules, which a central government might impose to restrict the sub-national sector.

My main findings are that a well designed framework of fiscal rules works in unitary countries, but not per se in federations. Because of the higher autonomy which local and regional governments in federal countries enjoy, a rules based framework does not help in this case. Here, it is rather higher legal autonomy over tax instruments that might prevent large deficits at the sub-national sector as a form of market-preserving federalism (Weingast, 1995). These findings suggest that the choice of tools depends critically on the type of government and the constitutional structure. This complements the literature of fiscal rules on the general government level, where the political environment and the electoral system, for instance, are important determinants for the effectiveness of fiscal rules (Hallerberg, Strauch, and von Hagen, 2007). As a result, a suitable framework needs to be tailored to the characteristics of a specific country. More stringent rules do not always result in more desirable outcomes and neither does a general restriction of tax autonomy.

This chapter is a further step in sub-national public finance in order to explore how deficits could be avoided and large debts prevented. My findings suggest several issues for future research. The next step should be to make use of decentralized data for several European countries. This allows investigating additional effects which occur horizontally within the sub-national governments in combination with the vertical dimension between governmental levels, as explored in this paper. Another interesting point is the recent introduction of self-imposed fiscal rules in some regions of federal countries. Federations often grant autonomy to sub-national governments which allows them to adopt rules by themselves. The German state of Hesse for example, has held a referendum and 70% of voters opted for the introduction of a fiscal rule into the regional constitution. Since self-imposed rules might be an important signal to the markets and reflect the preferences of voters, effects might differ from those of centrally imposed rules in federations. The evaluation of the effectiveness is an interesting task for future research, once enough data is available.

A1 Appendix

A1.1 Construction of the rules index

The construction of the rules index follows the European Commission (2009). I adopt their dataset and calculate the rules index for the sub-national sectors. All balanced budget rules and debt rules applying to the sub-national sector are taken into account. All information about the included rules are available on the webpage of the European Commission. Rules applying to the general government sector are weighted by the respective sub-national expenditure share in it. The indicator is the sum of each criterion, devided by the total number of criteria. Each criteria itself is devided by the maximum score, i.e. all variables are forced to be between zero and one.

- *Criterion 1: statutory base of the rule*
  The score of this criterion index is constructed as a simple average of the two elements below:

- *Criterion 1a: Statutory or legal base of the rule*

  4 is assigned for a constitutional base

  3 if the rule is based on a legal act (e.g. Public finance Act, Fiscal Responsibility Law)

  2 if the rule is based on a coalition agreement or an agreement reached by different general government tiers (and not enshrined in a legal act)

  1 for political commitment by a given authority (central or local government, Minister of Finance)

- *Criterion 1b: Room for setting or revising objectives*

  3 if there is no margin for adjusting objectives (they are encapsulated in the document underpinning the rule)

  2 there is some but constrained margin in setting or adjusting objectives

  1 there is complete freedom in setting objectives (the statutory base of the rule merely contains broad principles or the obligation for the government or the relevant authority to set targets)

- *Criterion 2: Nature of the body in charge of monitoring respect of the rule*
  The score of this variable is augmented by one point in case there is a real time monitoring of compliance with the rule (e.g. existence of alert mechanisms in case there is a risk of non-respect of the rule).

3 if there is a monitoring by an independent authority (Fiscal Council, Court of Auditors or any other Court) or the national Parliament

2 monitoring by the Ministry of Finance or any other government body

1 no regular public monitoring of the rule (there is no report systematically assessing compliance)

- *Criterion 3: Nature of the body in charge of enforcement of the rule*

  3 enforcement by an independent authority (Fiscal Council or any Court) or the National Parliament

  2 enforcement by the Ministry of Finance or any other government body

  1 no specific body in charge of enforcement

- *Criterion 4: Enforcement mechanisms of the rule*
  The score of this variable is augmented by 1 point in case escape clauses are foreseen and clearly specified.

  4 there are automatic correction and sanction mechanisms in case of non-compliance

  3 there is an automatic correction mechanism in case of non-compliance and the possibility of imposing sanctions

  2 the authority responsible is obliged to take corrective measures in case of non-compliance or is obliged to present corrective proposals to Parliament or the relevant authority

  1 there is no ex-ante defined actions in case of non-compliance

- *Criterion 5: Media visibility of the rule*

  3 is assigned if the rule observance is closely monitored by the media, and if non-compliance is likely to trigger a public debate

  2 for high media interest in rule-compliance, but non-compliance is unlikely to invoke a public debate

  1 for no or modest interest of the media

A1.2 Additional tables

Deficit		(1)	(2)	(3)
as share of revenues	(1)	1.000		
in Euro per capita	(2)	0.887	1.000	
as share of GDP	(3)	0.900	0.955	1.000

Notes: Correlation between different indicators of sub-national deficits.

Table 1.9: Correlation of deficit measures

A1.3 Additional regression results

Results interaction model

Dependent Variable Deficit/Revenues	Interaction Terms
Unitary countries	
$tax_{(t-1)} * unitary$	0.380**
	(0.156)
$rules * unitary$	-0.107**
	(0.039)
$rules * tax_{(t-1)} * unitary$	0.040
	(0.075)
Federal countries	
$tax_{(t-1)} * federal$	-0.087
	(0.092)
$rules * federal$	0.006
	(0.021)
$rules * tax_{(t-1)} * federal$	-0.172**
	(0.075)
Controls	
def_cg_rev	0.074*
	(0.042)
edec	0.181*
	(0.087)
intexp_rev	0.002
	(0.008)
outgap	-0.000
	(0.002)
unempl	-0.148
	(0.146)
ln_pop_tot	0.607***
	(0.172)
depratio	-0.511*
	(0.294)
trend	-0.001
	(0.001)
country/year FE	Yes/Yes
R^2	0.289
Robust standard errors in parentheses	
*** p¡0.01, ** p¡0.05, * p¡0.1, n=247 N=19 T=14	

Notes: Results for a regression allwong for interactions between $rules$ and $tax_{(t-1)}$. Marginal effects presented in pictures 1.6 (a) and (b).

Table 1.10: Results interaction model

Details to Table 1.7

Dependent Variable	IV 2SLS Panel Model			
Deficit/Revenues	(a)	(b)	(c)	(d)
Controls				
def_cg_rev	0.076*	0.076*	0.076**	0.077**
	(0.040)	(0.042)	(0.037)	(0.036)
edec	0.214***	0.197**	0.197**	0.201**
	(0.074)	(0.085)	(0.088)	(0.088)
intexp_rev	-0.001	0.003	0.003	0.002
	(0.007)	(0.008)	(0.007)	(0.007)
outgap	-0.000	0.000	0.000	0.000
	(0.002)	(0.002)	(0.002)	(0.002)
unempl	-0.047	-0.097	-0.097	-0.092
	(0.187)	(0.215)	(0.215)	(0.214)
trend	0.005	0.006	0.006	0.006
	(0.005)	(0.005)	(0.007)	(0.007)
ln_pop_tot	0.520***	0.544***	0.544***	0.542***
	(0.136)	(0.160)	(0.168)	(0.167)
depratio	-0.603*	-0.429	-0.429	-0.481
	(0.356)	(0.404)	(0.377)	(0.359)
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1, n=247 N=19 T=14				

Notes: Two stage least square estimations. Table shows the results for control variables included in the estimations but not presented in the text in table 1.7. First stage regressions are presented below. Model (a): repetition of the estimation without instrumenting the rules index; Model (b): cluster-robust standard errors, using the Herfindahl index, the form of fiscal governance and the district magnitude as instruments for federal countries. For unitary countries the one time lag of these varibales is included; Model (c): same as (b) but with with standard errors robust to heteroskedasticity and autocorrelation (Newey-West); Model (d): present and lagged values are used as intruments in both first stage equations, standard errors robust to heteroskedasticity and autocorrelation (Newey-West).

Table 1.11: Results of controls according to Table 1.7

	Model (b)		Model (c)		Model (d)	
Equation: $rules*$	$unitary$	$federal$	$unitary$	$federal$	$unitary$	$federal$
Excluded instruments						
$herfgov * federal$	-0.187*	0.221***	-0.187*	0.221***	-0.168	0.067
	(0.098)	(0.058)	(0.108)	(0.073)	(0.116)	(0.063)
$herfgov_{(t-1)} * federal$					-0.022	0.255***
					(0.098)	(0.082)
$contract * federal$	0.119**	-0.502***	0.119***	-0.502***	0.033	-0.447***
	(0.061)	(0.025)	(0.046)	(0.093)	(0.037)	(0.085)
$contract_{(t-1)} * federal$					0.114***	-0.053***
					(0.038)	(0.018)
$district * federal$	-0.000	0.007*	-0.000	0.007**	-0.008	0.011**
	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
$district_{(t-1)} * federal$					0.010*	-0.002
					(0.005)	(0.004)
$contract * unitary$					-0.061	0.019
					(0.071)	(0.022)
$contract_{(t-1)} * unitary$	-0.265**	0.032	-0.265***	0.032	-0.216**	0.026
	(0.126)	(0.025)	(0.103)	(0.020)	(0.107)	(0.018)
$district * unitary$					0.008*	0.001
					(0.005)	(0.001)
$district_{(t-1)} * unitary$	0.022***	0.001	0.022***	0.001	0.016***	-0.000
	(0.002)	(0.001)	(0.004)	(0.001)	(0.002)	(0.001)
$herfgov * unitary$					-0.256	0.044
					(0.175)	(0.046)
$herfgov_{(t-1)} * unitary$	-0.771***	0.005	-0.771***	0.005	-0.557**	-0.026
	(0.258)	(0.025)	(0.177)	(0.024)	(0.224)	(0.039)
Other						
$tax_{(t-1)} * unitary$	2.083**	0.017	2.083***	0.017	2.117***	-0.026
	(0.822)	(0.078)	(0.668)	(0.096)	(0.610)	(0.108)
$tax_{(t-1)} * federal$	-0.604*	1.839***	-0.604**	1.839***	-0.538**	1.840***
	(0.338)	(0.326)	(0.246)	(0.189)	(0.243)	(0.174)
def_cg_rev	-0.047	-0.001	-0.047	-0.001	-0.093	0.016
	(0.222)	(0.033)	(0.162)	(0.044)	(0.160)	(0.046)
$edec$	-0.594**	0.158	-0.594*	0.158	-0.686*	0.121
	(0.260)	(0.177)	(0.345)	(0.129)	(0.354)	(0.121)
$intexp\_rev$	0.004	0.013	0.004	0.013	0.004	0.011
	(0.055)	(0.016)	(0.038)	(0.014)	(0.040)	(0.014)
$outgap$	0.004	0.000	0.004	0.000	0.004	0.000
	(0.010)	(0.002)	(0.008)	(0.002)	(0.008)	(0.002)
$unempl$	-0.860	0.087	-0.860	0.087	-0.538	-0.147
	(1.644)	(0.399)	(1.171)	(0.274)	(1.140)	(0.252)
ln_pop_tot	0.421	0.313	0.421	0.313	0.277	0.196
	(0.909)	(0.459)	(0.625)	(0.324)	(0.630)	(0.312)
$depratio$	4.733*	0.180	4.733**	0.180	4.897**	0.388
	(2.664)	(0.747)	(2.285)	(0.546)	(2.380)	(0.653)
$trend$	-0.003	-0.003	-0.003	-0.003	-0.001	0.002
	(0.016)	(0.005)	(0.028)	(0.007)	(0.028)	(0.009)
R-squared	0.588	0.748	0.588	0.748	0.608	0.763

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: First stage regressions for the results presented in table 1.7. Endogenous variables in the second stage is the fiscal rules index for both types of government.

Table 1.12: First stage regressions to Table 1.7

Details to Table 1.8

Dep. Var.	IV 2SLS Panel Model					
Def./Rev.	(a.I) federal	(a.II) unitary	(b.I) federal	(b.II) unitary	(c.I) federal	(c.II) unitary
Controls						
def_cg_rev	0.162***	0.028	0.159***	0.029	0.155***	0.028
	(0.044)	(0.051)	(0.044)	(0.052)	(0.049)	(0.051)
edec	0.376*	0.021	0.378*	0.028	0.381*	0.020
	(0.227)	(0.101)	(0.226)	(0.102)	(0.223)	(0.102)
intexp_rev	-0.011	0.012	-0.010	0.012	-0.009	0.013
	(0.011)	(0.009)	(0.011)	(0.009)	(0.011)	(0.009)
outgap	0.017***	-0.001	0.017***	-0.001	0.017***	-0.001
	(0.004)	(0.002)	(0.004)	(0.002)	(0.004)	(0.002)
unempl	1.262***	-0.318	1.287***	-0.309	1.347***	-0.319
	(0.290)	(0.238)	(0.294)	(0.238)	(0.322)	(0.238)
ln_pop_tot	1.113***	0.238	1.115***	0.240	1.119***	0.237
	(0.172)	(0.239)	(0.172)	(0.237)	(0.172)	(0.239)
depratio	0.884	-0.638*	0.992	-0.658*	1.258	-0.634*
	(0.823)	(0.351)	(0.811)	(0.341)	(1.053)	(0.355)
trend	0.005	0.004	0.005	0.004	0.005	0.004
	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)
Robust standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1, n=104/143 N=8/11 (federal/unitary) T=14						

Notes: Two stage least square estimations. Table shows the results for control variables included in the estimations but not presented in the text in table 1.8. First stage regressions are presented below. Separate regressions for federal (a)/(c)/(e) and unitary (b)/(d)/(f) countries. Model (a)/(b): Actual and lagged instruments; Model (c)/(d): only actual instruments; model (e)/(f): only lagged instruments. Standard errors robust to heteroskedasticity and autocorrelation (Newey-West).

Table 1.13: Results of controls according to Table 1.8

Equation: *rules*	Model (a.I)	Model (a.II)	Model (b.I)	Model (b.II)	Model (c.I)	Model (c.II)
Excluded instruments						
$herfgov$	0.079	-0.260	0.168	-0.649***		
	(0.096)	(0.170)	(0.105)	(0.148)		
$herfgov_{(t-1)}$	0.279**	-0.619***			0.242*	-0.828***
	(0.118)	(0.229)			(0.132)	(0.184)
$contract$	-0.450***	-0.067	-0.488***	-0.189**		
	(0.088)	(0.082)	(0.109)	(0.091)		
$contract_{(t-1)}$	-0.077*	-0.196**			-0.372***	-0.251***
	(0.039)	(0.097)			(0.107)	(0.094)
$district$	0.020*	0.004	0.010	0.015***		
	(0.012)	(0.004)	(0.008)	(0.006)		
$district_{(t-1)}$	-0.009	0.015***			0.011	0.018***
	(0.010)	(0.003)			(0.008)	(0.003)
Other						
$tax_{(t-1)} * unitary$		2.101***		2.749***		2.048***
		(0.540)		(0.450)		(0.584)
$tax_{(t-1)} * federal$	1.448***		1.445***		1.553***	
	(0.302)		(0.326)		(0.415)	
def_cg_rev	0.006	-0.242	-0.135	-0.190	0.043	-0.255
	(0.139)	(0.236)	(0.154)	(0.227)	(0.224)	(0.242)
$edec$	1.434*	-0.812**	1.278	-0.911**	1.267	-0.787*
	(0.831)	(0.408)	(0.852)	(0.433)	(1.058)	(0.408)
$intexp\_rev$	0.057*	-0.018	0.062*	0.022	0.086*	-0.014
	(0.030)	(0.056)	(0.034)	(0.055)	(0.049)	(0.053)
$outgap$	0.016	0.000	0.026	0.003	0.047**	0.000
	(0.015)	(0.008)	(0.017)	(0.009)	(0.023)	(0.008)
$unempl$	0.585	-1.686	2.276	-1.104	2.775	-1.864
	(1.380)	(1.723)	(1.545)	(1.457)	(1.898)	(1.704)
ln_pop_tot	1.023	0.835	1.968***	0.257	1.490*	0.898
	(0.664)	(1.201)	(0.706)	(1.137)	(0.887)	(1.173)
$depratio$	-1.038	3.185	-0.024	3.492	4.702	3.073
	(4.082)	(2.697)	(3.286)	(2.705)	(5.066)	(2.528)
$trend$	0.010	-0.004	-0.002	0.006	0.006	-0.002
	(0.020)	(0.047)	(0.017)	(0.044)	(0.028)	(0.048)
R-squared	0.846	0.729	0.831	0.686	0.772	0.722
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1						

Notes: First stage regressions for the results presented in table 1.8. Endogenous variables in the second stage is the fiscal rules index for both types of government.

Table 1.14: First stage regressions to Table 1.8

A1.4 Robustness check: federal specification

Throughout the text I used two different data points for each federal country, i.e. I included the local and regional level as separate observations. Table 1.15 shows the results of two robustness checks in order to proof whether results remain unchanged when the data is treated differently.

Model (a) repeats the previous results of model (d) in table 1.4 for comparison. The next column shows a regression where I merged the local and regional government in the four federal countries. Instead of 19 observations per year the dataset now consists out of 15, one for each included country. However, results remain unchanged and the main conclusions are as before.

As a last check, I estimate different coefficients for the local and regional level in federations. That means that $\mathbf{\Phi}$ now becomes the following:

$$\mathbf{\Phi}' = \begin{bmatrix} \Phi_1 \\ \Phi_2 \\ \Phi_3 \end{bmatrix} \text{ and } \begin{array}{l} = 1 \text{ if unitary country, 0 otherwise} \\ = 1 \text{ if local level in a federal country, else 0} \\ = 1 \text{ if regional level in a federal country, else 0} \end{array}$$

However, results are in line with the previous findings. The signs and magnitude of coefficients for $tax_{(t-1)}$ are similar for the local and regional level. Rules remain insignificant in both cases.

Dependent Variable	Fixed Effects Panel Model		
Deficit/Revenues	(1)	(2)	(3)
Tax autonomy			
$tax_{(t-1)} * unitary$	0.195**	0.186*	0.194**
	(0.098)	(0.099)	(0.097)
$tax_{(t-1)} * federal$	-0.272***	-0.309*	
	(0.069)	(0.180)	
$tax_{(t-1)} * regional$			-0.300***
			(0.076)
$tax_{(t-1)} * local$			-0.332*
			(0.174)
Fiscal rules			
$rules * unitary$	-0.043***	-0.048***	-0.044***
	(0.014)	(0.016)	(0.014)
$rules * federal$	0.002	0.029	
	(0.014)	(0.023)	
$rules * regional$			0.016
			(0.017)
$rules * local$			-0.019
			(0.017)
Controls			
def_cg_rev	0.076**	0.120***	0.074**
	(0.036)	(0.039)	(0.037)
$edec$	0.214**	0.232**	0.200**
	(0.087)	(0.114)	(0.090)
$intexp\_rev$	-0.001	0.001	-0.001
	(0.007)	(0.010)	(0.007)
$outgap$	-0.000	-0.002	-0.000
	(0.002)	(0.002)	(0.002)
$unempl$	-0.047	-0.215	-0.059
	(0.209)	(0.242)	(0.210)
$trend$	0.005	0.002	0.006
	(0.007)	(0.009)	(0.007)
ln_pop_tot	0.520***	0.526**	0.514***
	(0.167)	(0.223)	(0.168)
$depratio$	-0.603*	-0.668*	-0.615*
	(0.331)	(0.392)	(0.340)
R^2	0.270	0.289	0.177
Number of Groups	19	15	19
Number of Observations	247	195	247
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Notes: Model (a): repetition of the estimation of model (d) in table 1.4 for comparison; Model (b): the local and regional level in federal countries are merged; Model (c): individual coefficients for the regional and local level in federal countries. All standard errors are robust to heteroskedasticity and autocorrelation (Newey-West).

Table 1.15: Separate coefficients for local and regional governments

Chapter 2

Business taxes and the electoral cycle[1]

2.1 Introduction

The last decades have seen a strong and rising interest in identifying the determinants of corporate tax setting behavior. Recent theoretical and empirical papers stress that corporate tax rate choices are influenced by the size and structure of the economy, the government's budgetary situation and tax competition (see e.g. Bucovetscy, 1991; Wilson, 1999; Buettner, 2003; Devereux, Lockwood, and Redoano, 2007). One aspect that has been rather neglected though is the impact of political economy determinants on corporate tax rates. One key question in this area is whether politicians engage in opportunistic behavior and deliberately manipulate government policies over the course of the electoral cycle in order to increase their reelection prospects.

Traditional papers in this area suggest that, in a world with asymmetric information, incumbent politicians have an incentive to signal their competency by increasing public spending prior to elections in order to boost the economy (see e.g. Nordhaus, 1975). Empirical evidence for this type of spending cycles has been rather mixed though (see e.g. Alesina, Roubini, and Cohen (1997) and Drazen (2000) for an overview). A more recent strand of the theoretical literature has suggested that politicians may use adjustments of short-run policy instruments, like tax policy choices,

[1]This chapter is based on joint work with Nadine Riedel. Special thanks go to her.

to demonstrate their competency to the electorate rather than through spending-induced changes of the economic conditions (see e.g. Persson and Tabellini, 2001). This predicts a political budget cycle in tax rates in the sense that tax increases tend to be delayed until after the election, while the probability of tax decreases is increased in the election year and the year prior to the election. While political budget cycles in key budgetary elements such as spending and deficits are frequently found in European data, empirical evidence for this type of systematic tax rate manipulation is, however, scarce at best.

The present chapter contributes to this literature and tests for political cycles in tax rate adjustments. Our empirical analysis uses the German local business tax which is set autonomously by German municipalities as a testing ground. The analysis is based on a unique and rich panel data base of around 8000 German municipalities and their political, social, and budgetary situation for the time period between 2000 and 2008. As election dates vary across local councils, the data allow us to disentangle effects related to the timing of elections from common trends.

Descriptively, our data suggest a strong trend to increase the local business tax rate during the covered time period. While more than half of the communities in our sample raised their local business tax rate once or more during our sample period, only a small fraction of around 5% of the communities enacted a tax decrease. This pattern largely reflects a number of expenditure shocks at the local level driven by rising costs for the provision of social services and a number of reforms that shifted public responsibilities to the local level. As a result, communities were forced to adjust their local business tax rates as the major revenue instrument at their own discretion.

The purpose of this chapter is to assess the timing of these local business tax rate changes and to test whether it follows a systematic pattern induced by the electoral cycle. To do so, we estimate panel models which determine the effect of elections on the annual growth rate of local business taxes. In robustness checks, we also use logistic models to determine the impact on the probability that a municipality increases or decreases its local business tax rate. Our results provide strong evidence in favor of an electoral cycle. Specifically, we find that tax rate growth and the probability to observe an increase in the local business tax rate are significantly lower

in election and pre-election years, while they jump up in the post-election years. The effects are quantitatively important. Our preferred estimates suggest that, relative to other years, the growth rate of local business tax rates is reduced by around 40% in election years and increased by around the same amount in post-election years. This result is robust to controlling for a large number of economic, social, and budgetary characteristics as well as municipality fixed effects.

As indicated above, our paper relates to the empirical literature on political budget cycles. The majority of this literature focuses on spending cycles and reports mixed evidence (see Alesina, Roubini, and Cohen, 1997). However, for European countries spending cycles are frequently observed in the data after the set-up of the European Monetary Union (see Mink and de Haan, 2005, among others). We are aware of only three earlier papers that assess political cycles in tax rates. Mikesell (1978) and Nelson (2000) analyze the effect of elections on the adjustment of US state taxes in the post-war period. While they do find patterns which are in line with the notion of political tax cycles, their identification approach is purely descriptive and does not account for any type of heterogeneity between US states. Thus, their qualitative and quantitative results may suffer from problems related to omitted variables. A recent paper by Dahlberg and Mörk (2011) provides evidence for electoral effects on tax rate changes by combining Swedish and Finish data on local governments. In their study, variation in election dates arises only between the two groups of Swedish and Finish municipalities which differ in their institutional characteristics and may be subject to heterogeneous shocks. Our estimation approach tackles these problems by exploiting variation in election timing across federal states within the same country and by controlling for both time-constant and time-varying heterogeneity in the social, political, and budget situation of municipalities.

The remainder of the chapter is structured as follows: Section 2.2 provides a brief theoretical motivation for our analysis, Section 2.3 presents our data set and gives an overview over the institutional background for the German local business tax. Our estimation strategy is described in Section 2.4. Section 2.5 presents the results and Section 2.6 concludes.

2.2 Theory and related literature

One of the main elements of fiscal policy is politics. As Tufte (1978) summarizes, *"as goes politics, so goes economic policy and performance. This is the case because, as goes economic performance, so goes the election."* This relationship has been studied extensively by the theoretical and empirical literature on political business cycles and political budget cycles. The central idea of a political business cycle is that politicians have an incentive to implement demand-increasing policy measures prior to elections in order to boost the economy which then affects key macroeconomic variables, such as unemployment, output, and inflation (Nordhaus, 1975; Lindbeck, 1976). The empirical evidence for such a political cycle in macroeconomic performance is, however, rather mixed (see Alesina, Roubini, and Cohen (1997) and Drazen (2000) for an overview). On theoretical grounds these models were criticized for their assumption of non-rational and myopic voters, which are easy to fool by such means.

Subsequent papers drop the irrationality assumption and focus on information asymmetries between voters and politicians. Rogoff and Sibert (1988) and Rogoff (1990) investigate fiscal choices in a game where politicians signal their level of competence. As a result, fiscal policies are distorted in election years. An important difference to the earlier papers is that these models predict distortions in main budgetary concepts, such as spending, revenues, deficits, and taxes rather than in macroeconomic indicators. It has been argued that politicians may want to implement expansionary politics in election and pre-election periods to signal their competency to the electorate by a higher level of public good supply at constant levels of taxation or by implementing low-tax policies for a given public good provision. Beyond these signaling considerations, incumbents may want to implement political actions in pre-election years in a very general sense, which are likely to be appreciated by the electorate and which might thus increase their reelection probability. Analogously, as voters face high costs of ousting unpopular politicians from office in non-election years and *"unpopular actions in nonelection years may be heavily discounted by election time"* (Nelson, 2000, p. 544), politicians have an incentive to implement unpopular decisions at the beginning of the election period when the time span to the next election is as large as possible.

Following most of the empirical literature, we do not aim at providing an explicit test of political budget cycle models. As noted by Kneebone and McKenzie (2001), doing so is difficult since a measure for government competency is needed. Instead, we test a reduced form of political budget cycle models by investigating whether tax rate changes are determined by election dates. There is a large and still growing literature testing for election effects in public policy. Most of this literature finds evidence in favor of political budget cycles across European and OECD countries. Alesina, Roubini, and Cohen (1997) provide an exhaustive overview. Recent work of Schuknecht (2000), Persson and Tabellini (2003) and Shi and Svensson (2006) report results which are in line with political spending cycles at the national level. Hallerberg, Strauch, and von Hagen (2007) show that public debt of European Union countries tends to increase more in election years. In particular after the set-up of the European Monetary Union members of the Eurozone have systematically run fiscal expansions during elections years (Buti and van den Noord, 2003; von Hagen, 2006; Mink and de Haan, 2005; Efthyvoulou, 2012). Similar evidence for an effect of elections on debt in OECD countries is found by Alt and Dreyer Lassen (2006).[2]

Using data collected at the country level obviously has a number of limitations, first and foremost that it commonly does not allow to perfectly control for all other institutional and monetary differences across countries. Following Rogoff's advice to *"look at data for state and local elections, instead of concentrating solely on the small number of observations available for national elections"* (Rogoff, 1990, pp. 34), using a panel at the sub-national level with data for several regions or local governments which operate under similar regulations in one country can solve this problem. Empirical contributions using sub-national data commonly find election effects in budgetary components. As the first empirical contributions using sub-national data, Blais and Nadeau (1992) find that government spending of Canadian provinces does increase in election years and this extra spending translates into a higher deficit, while Rosenberg (1992) finds a significant increase of spending in pre-election years for Israeli

[2]This paper confirms a political budget cycle conditional on the degree of transparency of the budget process and qualifies the results of Brender and Drazen (2005). They claim that budget cycles are only a phenomenon of countries which recently have become a democracy. However, according to the vast majority of studies the occurrence of political budget cycles across European countries is a well established result.

municipalities.[3] However, the advantage of institutional homogeneity and more data points when using sub-national data comes at a cost: in most of the applications, local election dates do not vary across observations.

The focus of our paper is on business tax rates as one of the most directly visible elements of local public finance. Some of the earlier studies do investigate electoral effects in revenues, in particular the share of revenues generated by taxation. However, it is not obvious why these revenue shares should be a signal of competence to voters. Lower revenues at a given tax rate for instance could be seen as exactly the opposite, the government's inability to administer the tax collection. A notable exception is the paper of Dahlberg and Mörk (2011) which also accounts for changes in statutory tax rates.

Apart from that, the effect of electoral cycles on tax setting behavior is rather unexplored. We are aware of only two studies which, in a descriptive way, assess the effect of elections on the tax policy choice of US states. Mikesell (1978) and Nelson (2000) investigate how electoral cycles impact on the changes in tax rates and the adoption of new taxes for US states. Both papers report evidence for a strong political cycle as tax increases occur with a higher frequency the larger the time until the next election. However, results are based on a purely descriptive approach and do not account for cross-sectional or longitudinal heterogeneity which may be correlated with the states' tax policy and confound the results.

We account for these shortcomings and use a more rigorous empirical identification strategy to test for political cycles in the context of the German local business tax. If the above theoretical incentives are relevant for political decision making, local politicians in Germany may want to signal their competency to the electorate by keeping local business taxes low, for a given amount of public good provision. Following this line of argument, we expect a reduced probability for tax increases prior to elections

[3]Other studies with a focus on sub-national governments provide evidence for electoral cycles in spending and deficits for the German state level (Galli and Rossi, 2002), for Sweden (Pettersson-Lidbom, 2001), for regional governments in Russia (Akhmedov and Zhuravskaya, 2004), and for Colombian municipalities (Drazen and Eslava, 2010). Veiga and Veiga (2007) and Baleiras and da Silva Costa (2004) provide evidence for political expenditure cycles for Portuguese municipalities, as does Kneebone and McKenzie (2001) for Canadian provinces. Dahlberg and Mörk (2011) show that elections impact on public employment using data for Sweden and Finland. The fact that these studies do find political budget cycles for well established democracies casts further doubt on the new-democracy hypothesis of Brender and Drazen (2005).

and a higher one once the election took place. Note in this context that, beyond the competence signal, increases in the local business tax might be unpopular with voters in a very direct sense as tax increases likely exert an effect on the inhabitants' after-tax income. The German local business tax is levied on non-incorporated as well as incorporated businesses and reduces their after-tax income. Business owners are often residents and hence voters in the community. They also act as an influential multiplier, since they can easily express their opinion over public policies to their costumers which are part of the electorate. In addition, several studies suggest that a significant fraction of corporate and business taxes are borne by workers (see e.g. Arulampalam, Devereux, and Maffini, 2007; Desai, Foley, and Hines, 2007), which may also make business tax increases unpopular with the electorate given that they anticipate the negative income effect.

Following these considerations, we will assess the existence of electoral cycles in the tax rate setting behavior of German municipalities. Precisely, we will investigate whether business tax rates are significantly reduced in pre-election and election years, and significantly increased in post-election years. In doing so, we use panel estimators and exploit that local election dates in Germany vary across federal states. This allows us to separate common shocks to all municipalities from potential effects related to the electoral cycle.

2.3 Data

2.3.1 Institutional background

The testing ground for our empirical analysis is the local government sector in Germany. The German federal system consists of three tiers: the federal, state, and local governments. There are sixteen states and around 12,000 municipalities in Germany. The power to levy an individual tax rate on business income is restricted to the federal and the local government level.

The responsibilities of local governments vary only slightly across German states. Their main mandatory tasks include the construction and maintenance of roads, sewerage, kindergartens and primary schools. Other responsibilities, such as the main-

tenance of cultural or sport facilities, tourism, and public transport are optional. In addition, local governments are responsible to provide certain social benefits to the unemployed and the poor. Our sample period is characterized by rising expenditures at the local level due to increasing social costs and a number of federal reforms which shifted additional spending burdens on to the local government level. Examples are the law for the provision of additional kindergarten capacities by the local level ('Gesetz zum Ausbau der Kindergartenbetreuung') and additional social security payments for the elderly and the unemployed (see e.g. Deutsche Bundesbank, 2000, 2007).

While a major fraction of the funds for the provision of these services comes from state grants and redistributed tax revenues collected by higher levels of government, local communities have discretion over two tax instruments at their disposal: the local business tax (*Gewerbesteuer*) and a local property tax (*Grundsteuer*). In revenue terms, the local business tax is by far the more important revenue source for local jurisdictions and significantly contributes to local government revenues. The average tax rate set by German municipalities is 16.25% and makes up a considerable fraction of the tax burden on firms in Germany.[4] The tax base is defined as firm profit earned within the boundaries of a municipality, town, or city. The tax applies to both the incorporated and non-incorporated sector. The tax base definition follows the corporate and income tax law. While the tax base law is set at the national level and thus applies to all municipalities in Germany, the local council of each municipality can decide autonomously upon a so-called tax collection rate. The rate chosen is valid for at least the next entire budget year. At the local level, a budget year corresponds to the calendar year. Municipalities can change their tax rates from year to year, but not during the year. There is no upper bound for the tax rate, but a lower bound was introduced in 2004.[5] The majority of the local business tax revenues remains directly with the municipalities. A small share has to be transferred to the central and regional level though, as an element of the German federal equalization scheme.

On the policy side, the election and legislative processes of local councils must be in line with the municipal codes of their states. Our empirical analysis exploits

[4]The current corporate tax rate at the national level is 15%.

[5]The idea was to prohibit very low tax rates chosen by a small number of "tax haven" communities before 2004.

the fact that the election dates of local councils differ across federal states. The election years for the eight states included in our analysis are listed in Table 2.1. Apart from this difference, municipal codes are similar across states with respect to business taxation. In particular, in all federal states a simple majority of votes in the local council is required to enact a change in the local business tax rate. Moreover, in all states, a large number of parties tend to take part in local elections, including the major parties which also operate at the regional or national level as well as numerous local parties and candidates.[6]

federal state	years		
Schleswig-Holstein	1998	2003	2008
Lower Saxony (Niedersachsen)	1996	2001	2006
North Rhine-Westphalia (Nordrhein-Westfalen)	1999	2004	2009
Hesse (Hessen)	1996	2001	2006
Rhineland-Palatinate (Rheinland-Pfalz)	1999	2004	2009
Baden-Wuerttemberg	1999	2004	2009
Bavaria (Bayern)	1996	2002	2008
Saarland	1999	2004	2009

Notes: Election years for local councils according to the federal state wherein the local governments are located.

Table 2.1: Elections at the local level

The homogeneity of the political and administrative legislation is an advantage of our data set. This offers convenient features to test our hypothesis, in particular the fact that all communities have exactly the same fiscal policy tools at hand.

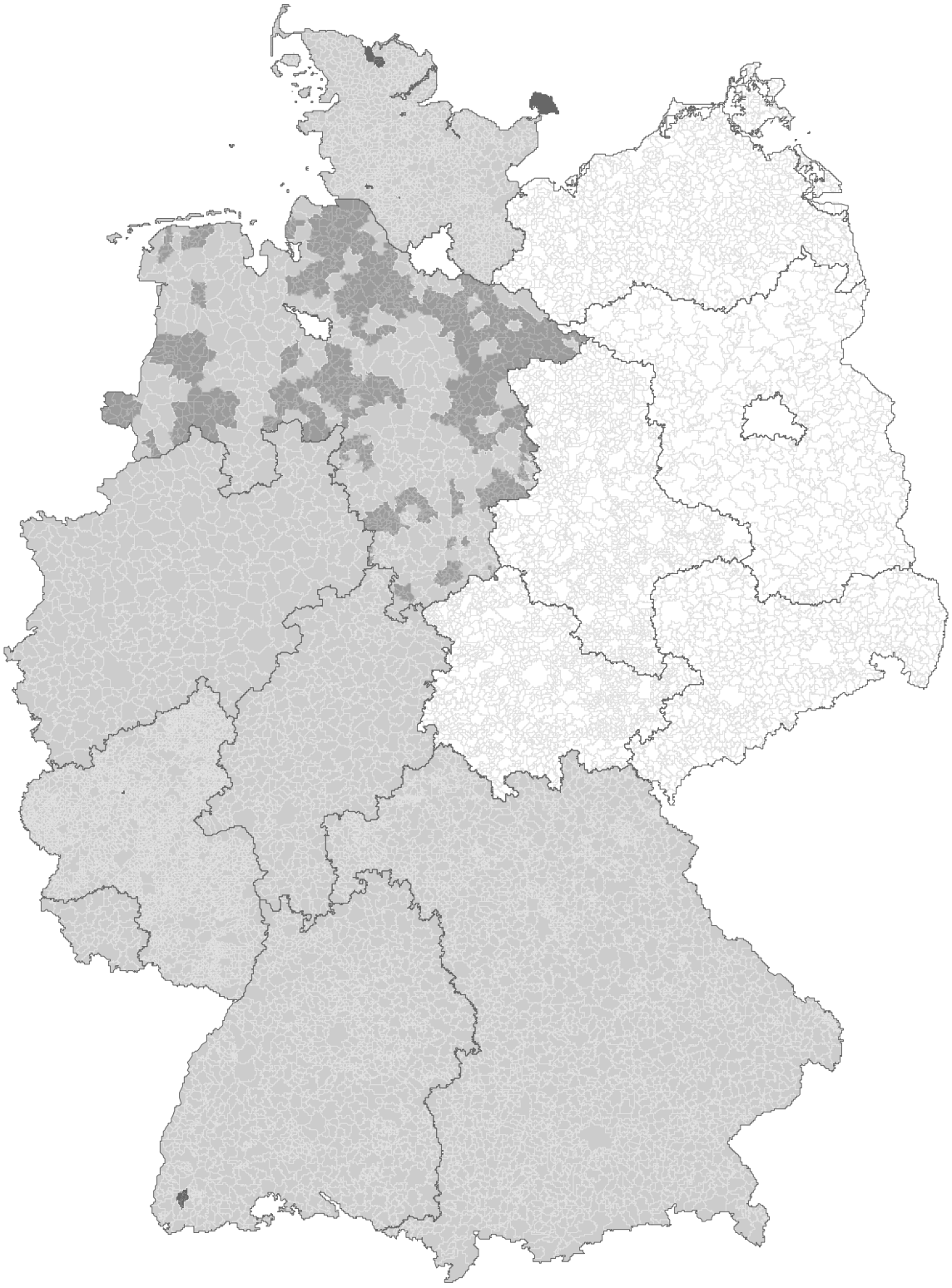
2.3.2 Data set

Our data set covers German communities in the period between 2000 and 2008.[7] The data accounts for all municipalities in West German states (except the city states of Bremen and Hamburg[8]). We disregard communities in Eastern Germany which joined

[6]Note in this context that one important difference between elections at the local level compared to state or federal elections is that commonly a larger number of small parties is represented in the local council as with the former no minimum threshold of votes has to be passed in order to be considered for the allocation of seats.

[7]Some data, like electoral results, are also collected for years prior to our sample period in order to determine whether our first sample year (the year 2000) is a post-election year and to determine the composition of the local council in the first sample years.

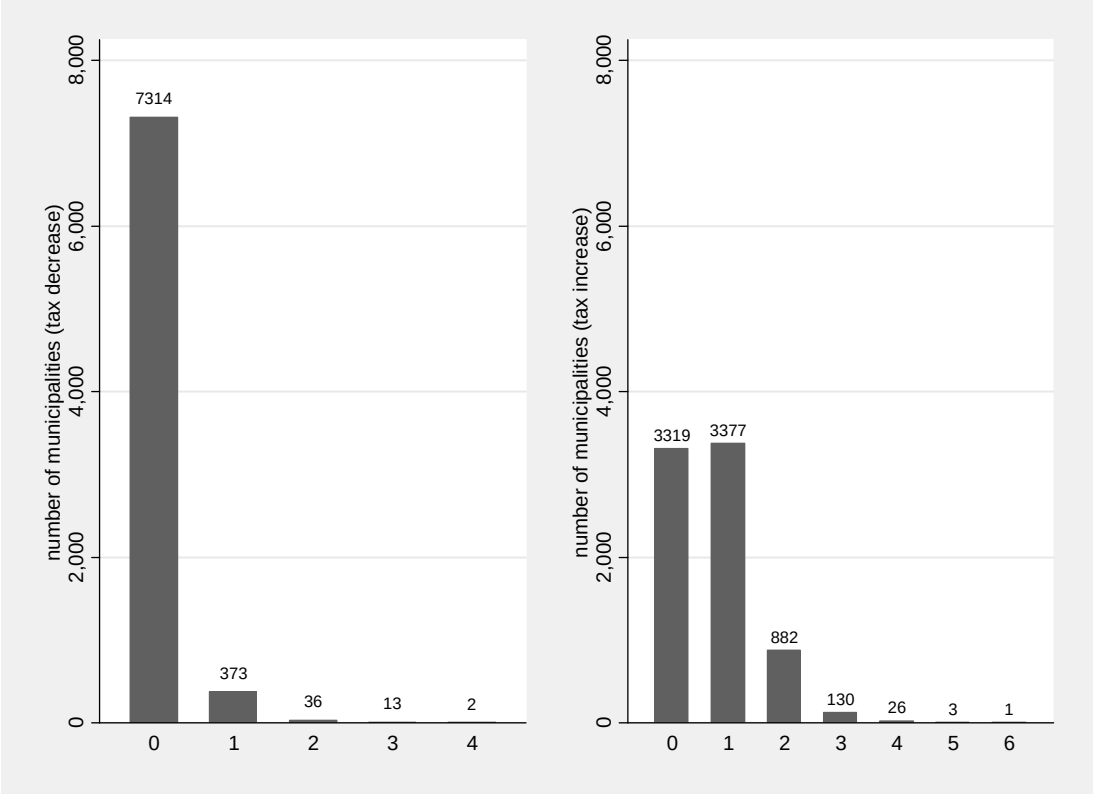
[8]We exclude the city states, because local and regional budgets are not easy to separate in this context.



Notes: All light gray shaded municipalities are included. Dark gray shaded areas in Lower Saxony belong to a municipal union and are dropped from the sample. Black shaded municipalities were subject to mergers during our period and are also dropped.

Figure 2.1: Sample

the Federal Republic of Germany in the reunification of 1990 as a major fraction of those communities was subject to mergers and local government reforms after the German reunification. Furthermore, we exclude West German municipalities which were subject to a merger and those belonging to a municipal union in Lower Saxony. Eventually, we end up with a sample of 7738 municipalities.[9] Figure 2.1 presents a graphical representation of our sample.



Notes: Left (right) panel shows the sum of municipalities over absolute number of negative (positive) changes. No municipality increased the tax rate more than six times or decreased more than four times within our panel.

Figure 2.2: Tax changes

As mentioned above, we observe a rising trend in local business tax rates during our sample period. A majority of communities raised their local business tax rate at least once. Only a small number of municipalities observes two or more changes, see Figure 2.2 for details. In contrast to the large number of tax hikes, declines of local business tax rates are rare. Only around 5% of the municipalities in our data lowered their tax rates at least once within our sample period.

[9]Public finance data is not available for one year in the federal state of Schleswig-Holstein. Results remain unchanged when we exclude them from the sample.

This pattern may on the one hand reflect increased funding needs of local municipalities as rising social costs and reforms which shifted additional obligations to the local level put pressure on community finances. On the other hand, our sample period is also characterized by two major declines in the federal corporate tax rate (in 2001 and 2008) which might - in a vertical tax competition framework - increase the communities' incentive to raise their local business tax rate.[10]

Figure 2.3 depicts the geographical distribution of tax rate changes, showing that tax hikes and cuts are not exclusive to particular federal states.

We augment our data set by detailed information on socio-economic and political characteristics of the communities in our data. Descriptive statistics are presented in Table 2.2. First, we include the total number of inhabitants to capture differences in community size. The variable points to a strong heterogeneity between the municipalities in our data which includes small jurisdictions with less than 10 inhabitants as well as the city of Munich with 1.3 million people. Second, we include a number of socio-economic variables, precisely the share of young inhabitants below the age of 15 and the share of old inhabitants above the age of 65 as the demographic structure may affect local business tax choices. Third, to capture employment effects, we include the local unemployment rate, defined as the number of unemployed as a share of total population.[11]

Furthermore, we add four indicators for the municipalities' fiscal performance and economic capacity to our data set. First, we include public borrowing in each year, defined as the share of revenues that is generated by new credits, less amortization of debts. Second, we include the total outstanding debt in per capita terms. This value is obtained at the county level, but it also includes municipality-specific information on debt of hospitals and other city owned companies like transportation or sewage. Third, to control for the prosperity of a community in terms of per capita income and wealth, we also include a variable for the average private per capita income level. Last, we control for mandatory provision of services by including expenditures. All described variables show a considerable cross-sectional and longitudinal variation as

[10] This is in line with the finding of the vertical tax element presented in chapter three of this thesis.

[11] Due to confidentiality reasons, this variable is censored if less than three people are unemployed. In this case the variable is set equal to zero.

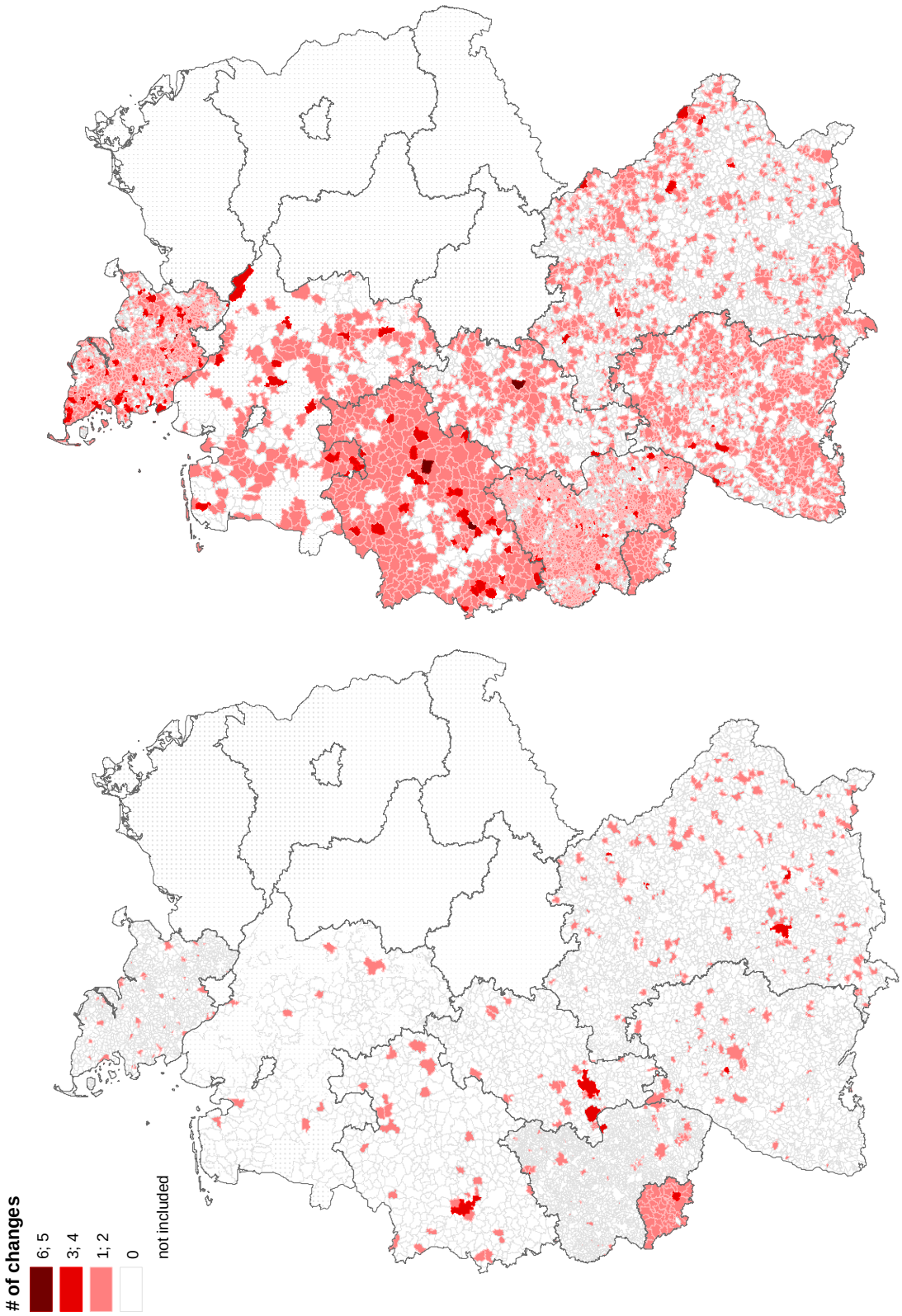


Figure 2.3: Number of changes (decreases/increases)

Notes: left (right) panel shows municipalities colored according to the number of tax cuts (hikes). Dotted areas are not included.

Variable	Mean	Std.Dev.	Min	Max
Controls				
credits	-.002	.073	-2.828	.685
unemployment	.029	.013	0.000	.190
young	.163	.033	0.000	.600
old	.180	.042	0.000	.500
city	.183	.387	0.000	1.000
debt	2.368	1.034	.481	6.831
population	7947.075	31778.29	3.000	1326807
income	17462.470	1831.300	13222.000	29938.000
expenditures	1.008	6.323	0.000	1053.085
Party controls - seat shares				
cdu	.246	.234	0.000	1.000
spd	.163	.180	0.000	1.000
gruene	.014	.035	0.000	.375
fdp	.011	.033	0.000	.583
farright	.000	.005	0.000	.226
farleft	.000	.003	0.000	.154
other	.565	.382	0.000	1.000
Raw tax data				
collection rate	336.386	31.860	0	900
diff. collection rate	1.296	6.571	-150	200
Dependent variables				
$\underline{\tau}^{binary}$	.007	.084	0.000	1.000
$\overline{\tau}^{binary}$	.081	.273	0.000	1.000
τ^{growth}	.369	1.974	-61.224	100
Changes (Dep.var excluding zeros)				
$\underline{\tau}^{binary}$ if $\neq 0$	.080	.271	0.000	1.000
$\overline{\tau}^{binary}$ if $\neq 0$	.920	.271	0.000	1.000
τ^{growth} if $\neq 0$	4.177	5.312	-61.225	100
N=69642, T=9 (2000-2008), n=7738				

Notes: credits: new credits minus repayments as share of annual revenues (public finance data is not available for the federal state of Schleswig-Holstein for the years 2000 to 2002.), unemployment: unemployed people as share of total population (data is censored if less than three people are unemployed. The share is set to zero in that case.), population: number of inhabitants, young: share of inhabitants under 15 years of age, old: share of inhabitants over 65 years of age (Population data for the year 2000 is missing and imputed through the group mean.) city: dummy varibale, debt: total municipal debt per capita (county level), income: income in Euro per capita (county level), expenditures: per capita expenditures on voluntary services. Party controls are the respective seat shares in the local council. Collection rate: statutory business tax collection rate.

Table 2.2: Summary statistics

indicated by large standard deviations.

Finally, we include detailed information on the seat shares of the political parties in the municipal council. We directly observe the share of the four main parties, which also run for national or regional elections. These are the center-right conservative party (CDU), the center-left social democrats (SPD), the liberal party (FDP), and the Green party (Gruene). We create aggregated values for parties at the far-left of the political spectrum (comprising Die Linke, the former PDS, and the former WASG), for parties at the far-right of the political spectrum (comprising the nationally organized extreme right parties NPD, DVU, Die Republikaner, and some right wing parties) and an aggregated value for all remaining political parties which mainly are locally operating civil parties.

2.4 Identification

Our baseline analysis focuses on tax rate changes in the form of the annual percentage change of the tax rate:

$$\tau_{i,t}^{growth} = \frac{tax_{i,t} - tax_{i,t-1}}{tax_{i,t-1}} \tag{2.1}$$

Alternative specifications use binary dependent variables $\overline{\tau}^{binary}$ and $\underline{\tau}^{binary}$ to assess the determinants of the general probability that a community increases and decreases its tax rate. The variable $\overline{\tau}$ is coded one if the statutory tax rate increased from the previous to the current year, and zero otherwise. Formally,

$$\overline{\tau}_{i,t}^{binary} = \begin{cases} 1 & \text{if} \quad tax_{i,t} - tax_{i,t-1} > 0 \\ 0 & \text{otherwise} \end{cases} \tag{2.2}$$

$\underline{\tau}^{binary}$ is defined analogously for tax decreases. The generic model estimated for the various definitions of τ is specified as

$$\tau_{i,t,s} = \mathbf{t}'_{\mathbf{t,s}}\boldsymbol{\delta} + \mathbf{x}'_{\mathbf{i,t}}\boldsymbol{\beta} + \varepsilon_t + \mu_{i,s} + \epsilon_{i,t} \tag{2.3}$$

where $\mathbf{t}$ is a set of time period specific dummies, which we relate to election dates to test for an electoral cycle. In our main analysis, we include dummy variables for the year before an election is held, the election year, and the year after the election.

$$\mathbf{t}' = \begin{bmatrix} t_{t-1} \\ t_t \\ t_{t+1} \end{bmatrix} \text{ and } \begin{cases} =1 \text{ in the pre-election year, 0 otherwise} \\ =1 \text{ in the election year, 0 otherwise} \\ =1 \text{ in the post-election year, 0 otherwise} \end{cases} \tag{2.4}$$

These variables vary across federal states s. Individual municipalities i within the borders of one state share common election dates, but variation arisis across the German states.

In addition, the estimations include a full set of year fixed effects ε to capture common shocks over time affecting all our sample communities. As election dates vary across communities in different states, election effects captured by the vector $\mathbf{t}$ and the time fixed effects are both identified. Thus, the approach resembles a difference-in-difference framework in which communities with no election in a particular year act as a control group to identify the effect of elections on the tax setting behavior in the treatment group of communities with an election (and on those communities in a pre- and post-election year respectively).

We include community fixed effects μ_i in the baseline model which absorb time-constant heterogeneity between jurisdictions or a full set of state fixed effects μ_s which absorb potential effects related to institutional differences between states.

In terms of control variables, $\mathbf{x}$ gathers other determinants as described in the previous section that are related to the decision whether or not to change the tax rate and vary across municipalities i and over time t. In some specifications $\mathbf{x}$ also includes political variables.

The baseline model is estimated with usual panel data estimators. To estimate the models where our dependent variable comes in a binary form, we use a logit transformation and report the average marginal effects. Due to the nature of our data, serial correlation of errors is not a major problem. However, we cluster standard errors at the municipal level. We also present standard errors clustered at the state-year level

to capture potential correlation of residuals at these units. Note that clustering at the state level is infeasible since the number of groups is small. Nevertheless, Bertrand, Duflo, and Mullainathan (2004) show that standard errors might be underestimated in the presence of serial correlation when clustering is conducted at the state-year rather than state level. Therefore, we also make use of two-way clustering at the state-year and individual level (Cameron, Gelbach, and Miller, 2011). We spent particular attention to this when it comes to the presentation of our result.

2.5 Results

Table 2.3 presents the result of the estimation model outlined in equation (2.1). In specifications (a) to (d) we regress the annual growth rate of the local business tax on the set of dummy variables for the pre-election, election and post-election year as well as a full set of community fixed effects and time-varying community characteristics.[12] Model (a) assumes independence of the errors across observations. In models (b) and (c) standard errors are clustered at the community level (model (b)) and state-year level (model (c)) respectively. Model (d) accounts for two-way clustering of the standard errors at the state-year level and community level as described above. Additional to coefficient estimates and standard errors, the table reports the p-values and 95% confidence intervals for the coefficient estimates.

The specifications confirm the hypothesis of an electoral cycle in tax setting behavior. Specifically, the coefficient estimates for the dummy variables t_{t-1} and t_t have a negative sign, while the coefficient estimate for the post-election year is positive. In specifications (a) and (b) all three coefficient estimates turn out statistically significant, indicating that the growth rate in the business tax is reduced by 0.09 in the year prior to the election and by 0.16 in the election year. Evaluated at the sample mean (=0.37, cf. Table 2), this corresponds to a drop in the growth rate by 24% and 43% respectively. In the post election year, the estimation suggests that the growth rate is significantly increased by 0.17, or evaluated at the sample mean, by 47%. Models (c) and (d) equally derive a significant election year and post-election year effect,

[12]The table depicts the coefficient estimates for the electoral dummies only. The coefficient estimates for the control variables are reported in Table 2.10 in the appendix.

Dependent Variable	Individual Fixed Effect Model				State Fixed Effect Model	
τ^{growth}	(a)	(b)	(c)	(d)	(e)	(f)
t_{t-1}			-0.091			-0.088
s.e.	0.023	0.023	0.107	0.106	0.109	0.109
p-value	**0.000**	**0.000**	0.396	0.391	0.423	0.418
95% CI	(-0.137 - -0.046)	(-0.137 - -0.046)	(-0.304 - 0.122)	(-0.300 - 0.117)	(-0.307 - 0.130)	(-0.301 - 0.125)
t_t			-0.159			-0.163
s.e.	0.024	0.027	0.080	0.080	0.079	0.079
p-value	**0.000**	**0.000**	**0.049**	**0.046**	**0.044**	**0.039**
95% CI	(-0.207 - -0.111)	(-0.212 - -0.107)	(-0.318 - -0.000)	(-0.315 - -0.003)	(-0.321 - -0.005)	(-0.318 - -0.008)
t_{t+1}			0.173			0.168
s.e.	0.024	0.026	0.089	0.089	0.091	0.090
p-value	**0.000**	**0.000**	**0.057**	**0.053**	**0.069**	**0.063**
95% CI	(0.125 - 0.220)	(0.121 - 0.224)	(-0.006 - 0.351)	(-0.002 - 0.347)	(-0.014 - 0.350)	(-0.009 - 0.345)
Time FE	yes	yes	yes	yes	yes	yes
Clustering	no	community	state-year	two-way	state-year	two-way

Notes: Dependent variable: annual percentage change in the statutory business tax rate. Coefficients for the pre-election, election, and post-election are reported. Coefficients on other controls are shown in Table 2.10 in the Appendix A2. Model (a) to (d) include individual fixed effects, models (e) and (f) state fixed effects. Standard errors are clustered at the reported level. p-values in bold indicate that coefficients are significant at the 10% level.

Table 2.3: Regression results

while the coefficient estimate for the pre-election year loses its statistical significance. Taken together, this pattern is consistent with the theoretical considerations in Section 2 and suggests that politicians indeed tend to keep local business taxes low by avoiding changes prior to elections and implement tax increases in post-election years when the time gap to the next election is maximized.

Models (e) and (f) of Table 2.3 reestimate these baseline regressions replacing the community fixed effects by a full set of state fixed effects. Again, the models account for clustering of the standard errors at the state-year level and for two-way clustering at the state-year and community level respectively. This modification leaves both, the qualitative and quantitative results unchanged.

We note that the control variables exhibit the expected signs (see Table 2.10 in the appendix for results). Interestingly, the coefficient estimate for the community's newly issued debt relative to revenues ('credits') is positive and statistically significant in all specifications, indicating that those communities with high financing needs, as proxied by new debt issues, tend to observe higher tax rate growth than other jurisdictions. The coefficient estimates for all other control variables turn out insignificant in the specifications that control for community fixed effects when we cluster at the state-year level. The specifications which include state-fixed effects further suggest that large and high-income communities tend to observe lower growth rates of the local business tax within our sample period. This may be related to the fact that communities receive a fixed share of the lagged personal income tax paid by their residents.[13] Rich communities with high average incomes thus receive higher tax revenues and may be less affected by reforms within our sample period that shifted additional tasks and spending obligations to the community level.

As described in Section 2.3.1, our sample period was characterized by a strong upward trend in local business taxes. While every second community increased its local business tax rate at least once during our sample period, only a minor fraction of communities opted for a tax rate reduction. To assess whether the impact of election dates on tax rate increases differs from its impact on tax rate decreases, we transform our dependent variable to capture positive growth rates ($\overline{\tau}^{\text{growth}}$) and negative growth rates ($\underline{\tau}^{\text{growth}}$) separately. Thus, in the construction of $\overline{\tau}^{\text{growth}}$ ($\underline{\tau}^{\text{growth}}$),

[13]Note, however, that the personal tax instruments are set at the national level.

Dependent Variable	$\overline{\tau}^{growth}$		$\underline{\tau}^{growth}$	
	(a)	(b)	(c)	(d)
t_{t-1}	-0.099	-0.095	0.007	0.006
	(0.103)	(0.107)	(0.021)	(0.021)
t_t	-0.147*	-0.150*	-0.012	-0.013
	(0.077)	(0.078)	(0.012)	(0.012)
t_{t+1}	0.190**	0.185**	-0.017	-0.017
	(0.088)	(0.091)	(0.012)	(0.013)
Fixed Effects	individual	state level	individual	state level

Notes: Time FE included in all models. Standard errors are clustered at the state-year level. Models (a) and (c) include individual fixed effects, models (b) and (d) state dummies. For results of control variables refer to Table 2.11 in the Appendix A2.

Table 2.4: Tax cuts vs. tax hikes

community-year observations with negative (positive) tax rate growth are treated as zero. Specifications (a) to (d) of Table 2.4 reestimate our baseline model accounting for the modified dependent variables. Standard errors are clustered at the state-year level and specifications (a) and (c) ((b) and (d)) include a full set of community fixed effects (state fixed effects). We find the baseline results confirmed in specifications (a) and (b) that investigate the impact of the electoral cycle on positive growth rates in the local business tax measure. Thus, increases in local business tax rates tend to be significantly reduced in the election years and significantly increased in the post-election years. Repeating the same exercise for the negative business tax growth $\underline{\tau}^{\text{growth}}$ derives statistically insignificant coefficient estimates for all three election dummies. As the number of business tax reductions observed in our data is tiny (less than 1% of the community-year observations), this likely reflects imprecisions in the estimated effects due to limited variation in the data.

The fact that many communities do not observe a tax rate change within our sample period further suggests that a binary regression model may fit the data better. Thus, we additionally run estimation models that test for a potential impact of the election cycle on the community's probability to increase or lower the local business tax rate. Table 2.5 presents the results for the marginal effects of a logit model including state level and year fixed effects.[14] Model (a) assesses the effect of

[14]The coefficient estimates are presented in Table 2.12 in the appendix. We also estimated conditional logit models which account for unobserved heterogeneity across jurisdictions but suffer from the shortcoming that there are no convenient possibilities to compute marginal effects. The

Dependent Variable	$\overline{\tau}^{binary}$	$\underline{\tau}^{binary}$
	(a)	(b)
t_{t-1}	-0.013	-0.004*
	(0.017)	(0.002)
t_t	-0.031**	-0.002
	(0.012)	(0.002)
t_{t+1}	0.035**	0.001
	(0.017)	(0.002)

Notes: Marginal effects for the different points of time in the electoral cycle. Underlying regressions are presented in Table 2.12 in the Appendix A2

Table 2.5: Marginal effects

the election cycle on a community's probability to increase its tax rate while model (b) assesses the effect on the probability for a tax decrease. In line with the previous results, our findings are confirmed in the specification for tax hikes while the coefficient estimate for election dummies turn out insignificant in most instances for the tax cuts. The findings of model (a) also quantitatively correspond to our baseline estimates. Calculating marginal effects suggests that the probability to observe a tax increase is reduced by 3.1 percentage points in the election year and jumps up by 3.5 percentage points in the post-election year. Relative to the unconditional probability for a tax increase/decrease, this corresponds to a change by 38% and 43%.

In a robustness check, we assess whether the election cycle is related to changes in the composition of the city council. In general, German local politics are characterized by a large number of parties as membership in the local city council is not tied to obtaining at least 5% of the votes like it is the case in national elections. Thus, besides the nationally operating parties, a number of civil parties are active at the local level which are mainly concerned with local policy issues and are thus difficult to classify in the left-right-spectrum. In addition, the ideology of nation-wide operating parties is sometimes difficult to capture at local level politics. To nevertheless assess whether changes in the distribution of seats across parties impacts on the political business cycle determined in this paper, we classify parties in right wing parties and left wing parties which are likely to form coalitions. From this information, we define a dummy variable indicating major changes in the composition of the local council.

qualitative results of the conditional logit model are in line with those of the logit model including only state dummies though.

Dep. Variable	τ^{growth}		$\overline{\tau}^{growth}$		$\underline{\tau}^{growth}$	
	(a)	(b)	(c)	(d)	(e)	(f)
t_{t-1}	-0.097	-0.096	-0.103	-0.102	0.005	0.006
	(0.117)	(0.118)	(0.113)	(0.115)	(0.022)	(0.023)
t_t	-0.146	-0.151	-0.141	-0.147*	-0.004	-0.005
	(0.093)	(0.092)	(0.088)	(0.088)	(0.012)	(0.013)
t_{t+1}	0.194*	0.189*	0.210**	0.203**	-0.016	-0.014
	(0.100)	(0.100)	(0.099)	(0.101)	(0.013)	(0.014)
$t_{t-1} \cdot change$	0.045	0.054	0.031	0.047	0.014	0.007
	(0.107)	(0.096)	(0.096)	(0.088)	(0.019)	(0.019)
$t_t \cdot change$	-0.021	-0.017	0.014	0.020	-0.035	-0.037
	(0.099)	(0.093)	(0.084)	(0.076)	(0.027)	(0.032)
$t_{t+1} \cdot change$	0.017	0.022	0.018	0.031	-0.002	-0.010
	(0.127)	(0.118)	(0.114)	(0.104)	(0.026)	(0.023)
Fixed Effects	individual	state level	individual	state level	individual	state level

Notes: All regressions include a constant and time fixed effects. Models (a), (c), (e) include individual fixed effects, remaining models include state dummies. Standard errors are clustered at the state-year level, *** p<0.01, ** p<0.05, * p<0.1. For results of control variables refer to Table 2.13 in the appendix.

Table 2.6: Interaction with council changes

The variable takes on the value 1 if an election destroys or brings about a majority for one of the blocs. Since civil parties receive a significant fraction of vote shares at the local level, direct changes from a left-wing to a right-wing majority or vice versa are rather rare though. The idea of this measure is to capture perturbations in the council majorities rather than ideological differences. Table 2.6 reports the results of specifications which reestimate our baseline model augmenting the set of regressors by interaction terms between the election dummies and the dummy variable indicating major changes in the composition of the local council as defined above. As indicated in the table, the coefficient estimates for the interaction terms turn out insignificant and simultaneously do not change the pattern of our baseline estimates. This suggests that on average the election cycle in tax setting behavior is not related to elections which do or do not change city council majorities.

Furthermore, we assess the robustness of our results to including a control variable for the lagged level of the local business tax rate. The results are presented in Table 2.7. Specification (a) reestimates our baseline model using the growth rate in the business tax as dependent variable. The coefficient estimate for the lagged level

Dependent Variable	$\overline{\tau}^{growth}$	$\overline{\tau}^{binary}$	$\underline{\tau}^{binary}$
	(a)	(b)	(c)
tax_{t-1}	-0.106***	-0.010**	0.011***
	(0.011)	(0.005)	(0.003)
t_{t-1}	-0.063	-0.153	-0.401
	(0.083)	(0.427)	(0.355)
t_t	-0.177**	-0.512**	0.042
	(0.067)	(0.243)	(0.354)
t_{t+1}	0.054	0.539*	0.001
	(0.071)	(0.310)	(0.344)

Notes: Model (a) includes municipal fixed effects, (b) and (c) state level fixed effects. Time fixed effects always included. Standard errors are clustered at the state-year level, *** p<0.01, ** p<0.05, * p<0.1. For results of control variables refer to Table 2.14 in the appendix.

Table 2.7: Inclusion of the lagged tax level

of the business tax rate turns out negative and statistically significant indicating mean reversal in the communties' business tax setting behavior. Moreover, again, the coefficient estimates for the election year and post election year dummy turn out negative and positive respectively, whereas only the former is statistically significant at conventional significance levels though. Specifications (b) and (c) augment the binary models by the lagged level of the tax rate. Specification (b) presents the results for the election cycle on a community's probability to increase its tax rate. In line with intuition, the coefficient estimate for the lagged dependent variable turns out negative suggesting that communities with a high local business tax are less likely to observe a tax increase. The specification also confirms our baseline findings qualitatively and quantitatively whereas both, the coefficient estimates for the election and post-election dummies now turn out statistically significant. The average marginal effect in the election year is -3.0 percentage points and the marginal effect of the post-election year is also comparable to the previous findings indicating an increase in probability of 4.6 percentage points. Specification (c) reports analogous results for the binary model indicating tax rate decreases. Here, in line with intuition, the lagged dependent variable turns out positive and statistically significant, indicating that communities with a high local business tax have a higher probability to observe tax decreases. Apart from that the results resemble our baseline findings in the sense that the coefficient estimates for electoral dummies turn out statistically insignificant.

Dependent Variable	$\tau^{effective}$	$\tau^{difference}$
	(a)	(b)
t_{t-1}	-0.090	-0.271
	(0.096)	(0.391)
t_t	-0.144**	-0.505*
	(0.072)	(0.280)
t_{t+1}	0.164**	0.607*
	(0.081)	(0.326)

Notes: Time and individual FE included in all models. Standard errors are clustered at the state-year level. Dependent variable in (a) is the effective tax rate, in (b) the first difference. For results of control variables refer to Table 2.15 in the appendix.

Table 2.8: Other definitions of the dependent variable

In our baseline model, the growth rate of the dependent variable is calculated based on the community's *statutory* local business tax rate. A particular feature of the German local business tax is that a firm's local business tax payment is itself deductible from its tax base ('self-deductibility'), implying that the firm's effective tax burden falls short from the statutory one.[15] As a robustness check, we thus reestimate our baseline model defining the growth rate in the effective local business tax accounting for the deductibility of the tax. The results are presented in specification (a) of Table 2.8 and qualitatively and quantitatively resemble our baseline findings. As an additional modification, specification (b) reruns the baseline specification using the change in the local business tax rate as the dependent variable instead of the growth rate. Again, the findings are comparable to our baseline estimates.

Our baseline model includes three dummy variables to capture the electoral cycle: a dummy variable for the pre-election year, a dummy variable for the election year and a dummy variable for the post-election year. As elections for local councils take place every five years (every 6 years in Bavaria), the two remaining years act as baseline category. In Table 2.9 we reestimate our baseline model using the local business tax growth rate as the dependent variable and including indicator variables for the election year, for the first year after the election, for the second year after the election, for the first year prior to the election, and for the second year prior to the

[15]Self-deductibility of the local business tax implies that the corporate tax payment T is calculated as $T = t(\pi - T)$, with t denoting the local business tax rate (in percentage values) and π denoting the company profits. Rearranging derives $T = t/(1 + t)\pi$. Hence, the statutory local business tax rate which is, for example, implied by a local business tax of 16.25% is 0.1625/1.1625=14%.

Dependent Variable	τ^{growth}				
	(a)	(b)	(c)	(d)	(e)
t_{t-2}	-0.022				
	(0.076)				
t_{t-1}		-0.081			
		(0.099)			
t_t			-0.167**		
			(0.079)		
t_{t+1}				0.229***	
				(0.086)	
t_{t+2}					0.108
					(0.117)

Notes: Time and individual FE included in all models. Standard errors are clustered at the state-year level. Dependent variable in (a) is the effective tax rate, in (b) the first difference.

Table 2.9: Different time points of the electoral course

election separately. The pattern is very consistent with our theoretical considerations in the sense that we find a negative, but small and insignificant coefficient estimate in the specification (a) which includes a dummy variable for years two years prior to the election. In specification (b) we include a dummy variable for the pre-election year and find a negative effect which is larger in absolute terms than in the previous specification, although still not significant. In specification (c) which includes a dummy variable for the election year, the effect is negative and again larger in absolute terms than in the previous two specifications, which now also gains statistical significance. Including only a dummy variable for the first year after the election yields a positive and statistically significant coefficient estimate, confirming our baseline estimations (see specification (d)). Rerunning the specification with a dummy variable indicating the second post-election year again yields a positive coefficient estimate which, in line with expectation, is smaller though and does not fully gain statistical significance.

To conclude, the results in this section are in line with an election cycle in tax rate setting. In particular, we find that tax rate growth is significantly reduced in the election year and significantly increased in the first post-election year.

2.6 Conclusion

The aim of this chapter was to assess whether there is an electoral cycle in the tax setting behavior of local communities. For that purpose, we exploited rich panel information on a large set of communities in Germany. As the election dates for local councils in Germany vary across states, our data allows us to disentangle effects related to electoral cycles from common trends. Using conventional fixed effects panel methods and logit estimations, and controlling for time-constant and time-varying heterogeneity between the communities, our results provide strong evidence that tax setting is affected by election dates. Specifically, our findings suggest that the tax rate growth is significantly reduced in election years, while it jumps up in the post-election years. The effects turn out quantitatively important and suggest that, evaluated at the sample mean, tax rate growth is decreased and increased by around 40% in the pre- and post-election year respectively. Thus, our findings suggest that political economy determinants, in particular the timing of elections, affect the tax policies of local communities.

A2 Appendix

A2.1 Detailed tables

Dependent Variable	Individual Fixed Effect Model				State Fixed Effect Model	
τ^{growth}	(a)	(b)	(c)	(d)	(e)	(f)
credits	0.313***	0.313***	0.313***	0.313***	0.404***	0.404***
	(0.110)	(0.111)	(0.105)	(0.111)	(0.092)	(0.090)
income	0.019	0.019	0.019	0.019	-0.433**	-0.433**
	(0.581)	(0.545)	(1.481)	(1.472)	(0.206)	(0.197)
debt	-0.019	-0.019	-0.019	-0.019	0.022	0.022
	(0.042)	(0.035)	(0.093)	(0.093)	(0.023)	(0.022)
expenditures	-0.043	-0.043	-0.043	-0.043	-0.054	-0.054**
	(0.028)	(0.081)	(0.042)	(0.071)	(0.033)	(0.023)
unemplyment	-3.060**	-3.060**	-3.060	-3.060	-0.422	-0.422
	(1.425)	(1.364)	(2.127)	(2.132)	(1.890)	(1.850)
population	0.000	0.000	0.000	0.000	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
young	0.409	0.409	0.409	0.409	0.423	0.423
	(0.694)	(1.422)	(1.313)	(1.394)	(0.393)	(0.368)
old	-0.307	-0.307	-0.307	-0.307	0.232	0.232
	(0.683)	(1.262)	(1.131)	(1.207)	(0.297)	(0.275)
city					-0.003	-0.003
					(0.025)	(0.022)
spd	0.322	0.322*	0.322	0.322	0.049	0.049
	(0.197)	(0.180)	(0.269)	(0.268)	(0.077)	(0.071)
cdu	0.392**	0.392***	0.392	0.392	0.033	0.033
	(0.156)	(0.150)	(0.333)	(0.335)	(0.053)	(0.048)
fdp	-2.039**	-2.039***	-2.039	-2.039	-0.440	-0.440**
	(0.829)	(0.707)	(1.715)	(1.698)	(0.307)	(0.220)
gruene	0.127	0.127	0.127	0.127	-0.273	-0.273
	(0.715)	(0.992)	(1.174)	(1.224)	(0.285)	(0.270)
farleft	1.228	1.228	1.228	1.228	1.647	1.647
	(4.124)	(2.482)	(2.834)	(2.825)	(2.625)	(2.971)
farright	1.404	1.404	1.404	1.404	-1.570	-1.570
	(2.698)	(1.976)	(1.704)	(1.951)	(1.139)	(1.142)
R^2	0.011	0.011	0.011	0.011	0.017	0.004
Time FE	yes	yes	yes	yes	yes	yes
Clustering	no	community	state-year	two-way	state-year	two-way

Notes: Results of control variables for the estimations presented in Table 2.3 in the text. All models include time fixed effects, constant term not reported. n=66403, N=7738, standard errors are clustered at the reported level, *** p<0.01, ** p<0.05, * p<0.1

Table 2.10: Regression results

Dependent Variable	$\overline{\tau}^{growth}$		$\underline{\tau}^{growth}$	
	(a)	(b)	(c)	(d)
credits	0.287***	0.375***	0.026	0.029
	(0.086)	(0.078)	(0.040)	(0.044)
income	0.789	-0.305*	-0.770**	-0.128*
	(1.427)	(0.181)	(0.368)	(0.071)
debt	-0.021	0.023	0.002	-0.001
	(0.084)	(0.023)	(0.021)	(0.005)
expenditures	-0.013	0.009	-0.030	-0.063*
	(0.039)	(0.022)	(0.054)	(0.037)
unemployment	-3.100	-1.513	0.040	1.091**
	(2.042)	(1.789)	(0.520)	(0.458)
population	0.000**	-0.000***	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
young	-0.173	0.416	0.582	0.008
	(0.839)	(0.359)	(1.179)	(0.172)
old	0.859	0.391	-1.166	-0.160*
	(0.732)	(0.266)	(0.996)	(0.091)
city		-0.011		0.009
		(0.021)		(0.014)
spd	0.301	0.058	0.021	-0.010
	(0.242)	(0.072)	(0.077)	(0.024)
cdu	0.366	0.020	0.026	0.012
	(0.325)	(0.048)	(0.074)	(0.018)
fdp	-2.755	-0.294	0.716	-0.147
	(1.675)	(0.286)	(0.434)	(0.145)
gruene	0.308	-0.135	-0.181	-0.138
	(1.030)	(0.255)	(0.391)	(0.128)
farleft	0.543	-0.559	0.685	2.206***
	(2.812)	(2.633)	(0.507)	(0.638)
farright	0.962	-1.747*	0.442	0.177
	(1.684)	(1.031)	(0.673)	(0.408)
Fixed Effects	individual	state level	individual	state level

Notes: Results of control variables for the estimations presented in Table 2.4 in the text. All models include time fixed effects. n=66403, N=7738, standard errors clustered at the state-year in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 2.11: Regression results

Dependent Variable	$\overline{\tau}^{binary}$	$\underline{\tau}^{binary}$
	(a)	(b)
t_{t-1}	-0.198	-0.622*
	(0.279)	(0.343)
t_t	-0.547**	-0.288
	(0.219)	(0.258)
t_{t+1}	0.416**	0.142
	(0.198)	(0.248)
credits	0.852***	-0.932**
	(0.212)	(0.451)
income	-0.707	1.744***
	(0.523)	(0.478)
debt	0.037	-0.018
	(0.089)	(0.088)
expenditures	0.046	0.138***
	(0.033)	(0.033)
unemployment	-0.729	-1.972
	(3.934)	(5.868)
population	-0.000***	0.000***
	(0.000)	(0.000)
young	0.876	-1.380
	(0.586)	(2.157)
old	1.341***	-0.673
	(0.474)	(1.469)
city	0.061	0.026
	(0.062)	(0.138)
spd	0.154	0.361
	(0.171)	(0.345)
cdu	0.202*	0.120
	(0.104)	(0.274)
fdp	-0.732	3.078***
	(0.564)	(0.943)
gruene	-0.946	3.391***
	(0.684)	(1.015)
farleft	9.631*	-14.588
	(5.577)	(11.078)
farright	-5.522	11.117***
	(5.469)	(3.450)
Constant	4.155	-21.715***
	(4.966)	(4.664)

Notes: Results for the logit estimations of the marginal effects presented in Table 2.5 in the text. All models include time and state fixed effects. n=66403, N=7738, standard errors clustered at the state-year in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 2.12: Logit coefficient estimates

Dependent Variable	τ^{growth}		$\overline{\tau}^{growth}$		$\underline{\tau}^{growth}$	
	(a)	(b)	(c)	(d)	(e)	(f)
credits	0.309***	0.403***	0.286***	0.375***	0.024	0.028
	(0.106)	(0.093)	(0.087)	(0.079)	(0.040)	(0.045)
income	0.081	-0.430**	0.882	-0.304	-0.801**	-0.127*
	(1.545)	(0.208)	(1.497)	(0.184)	(0.379)	(0.072)
debt	0.013	0.024	0.008	0.025	0.005	-0.001
	(0.106)	(0.023)	(0.097)	(0.022)	(0.021)	(0.005)
expenditures	-0.045	-0.056*	-0.016	0.007	-0.029	-0.063*
	(0.043)	(0.033)	(0.039)	(0.022)	(0.055)	(0.037)
unemployment	-3.038	-0.398	-3.081	-1.484	0.043	1.086**
	(2.130)	(1.901)	(2.042)	(1.797)	(0.532)	(0.464)
population	0.000	-0.000***	0.000**	-0.000***	-0.000*	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
young	0.405	0.416	-0.178	0.413	0.583	0.003
	(1.312)	(0.394)	(0.839)	(0.359)	(1.179)	(0.173)
old	-0.313	0.225	0.860	0.389	-1.173	-0.164*
	(1.132)	(0.299)	(0.741)	(0.268)	(0.995)	(0.092)
city		-0.003		-0.013		0.010
		(0.026)		(0.022)		(0.014)
spd	0.360	0.044	0.348	0.050	0.012	-0.007
	(0.274)	(0.079)	(0.244)	(0.075)	(0.080)	(0.023)
cdu	0.425	0.034	0.395	0.022	0.030	0.012
	(0.339)	(0.055)	(0.330)	(0.050)	(0.075)	(0.019)
fdp	-1.942	-0.457	-2.675	-0.309	0.733	-0.148
	(1.761)	(0.317)	(1.719)	(0.295)	(0.444)	(0.148)
gruene	-0.009	-0.322	0.193	-0.171	-0.202	-0.151
	(1.197)	(0.294)	(1.051)	(0.263)	(0.406)	(0.130)
farleft	1.488	1.747	0.721	-0.418	0.767	2.165***
	(2.802)	(2.618)	(2.791)	(2.635)	(0.514)	(0.633)
farright	1.691	-1.548	1.109	-1.771*	0.582	0.223
	(1.663)	(1.131)	(1.624)	(1.018)	(0.719)	(0.416)
constant	-0.549	4.650**	-8.459	3.422*	7.911**	1.228*
	(14.952)	(1.994)	(14.456)	(1.765)	(3.698)	(0.695)
Fixed Effects	individual	state level	individual	state level	individual	state level

Notes: Results of control variables for the estimations presented in Table 2.6 in the text. All models include time fixed effects. n=66403, N=7738, standard errors clustered at the state-year in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 2.13: Regression results

Dependent Variable	$\overline{\tau}^{growth}$	$\overline{\tau}^{binary}$	$\underline{\tau}^{binary}$
	(a)	(b)	(c)
credits	0.048	0.708***	-1.273***
	(0.099)	(0.239)	(0.465)
income	-4.463***	-0.690	2.144***
	(1.547)	(0.596)	(0.634)
debt	0.205**	0.171**	-0.218*
	(0.093)	(0.069)	(0.112)
expenditures	-0.076*	0.022	0.158***
	(0.044)	(0.074)	(0.037)
unemployment	-2.790	3.564	-0.767
	(1.749)	(4.716)	(7.133)
population	-0.000***	-0.000	0.000***
	(0.000)	(0.000)	(0.000)
young	0.479	1.187	-3.153
	(1.290)	(1.139)	(3.045)
old	0.469	1.861***	1.510
	(1.056)	(0.675)	(1.695)
city		0.072	-0.274
		(0.070)	(0.176)
spd	-0.296	0.279	0.889
	(0.246)	(0.215)	(0.684)
cdu	-0.424	0.274	0.564
	(0.279)	(0.246)	(0.372)
fdp	1.469	2.665***	-1.706
	(1.641)	(0.890)	(2.585)
gruene	0.571	0.979	0.508
	(1.128)	(0.899)	(1.960)
farleft	-3.335	5.923	-33.096**
	(2.679)	(5.912)	(14.604)
farright	2.478	-10.363	11.282***
	(1.794)	(6.727)	(4.201)
Constant	78.364***	6.150	-29.092***
	(16.594)	(6.514)	(5.847)

Notes: Results for controls of the estimations presented in Table 2.7 in the text. Model (a) includes municipal fixed effects, (b) and (c) state level fixed effects. Time fixed effects always included. Standard errors are clustered at the state-year level, *** p<0.01, ** p<0.05, * p<0.1.

Table 2.14: Regression results

Dependent Variable	$\tau^{effective}$	$\tau^{difference}$
	(a)	(b)
credits	0.294***	1.123***
	(0.096)	(0.374)
income	0.082	0.606
	(1.338)	(5.226)
debt	-0.014	-0.057
	(0.083)	(0.323)
expenditures	-0.031	-0.125
	(0.032)	(0.127)
unemployment	-2.810	-10.676
	(1.912)	(7.408)
population	0.000	0.000
	(0.000)	(0.000)
young	0.086	2.000
	(0.985)	(4.498)
old	0.021	-0.410
	(0.852)	(3.878)
spd	0.283	1.185
	(0.242)	(0.973)
cdu	0.345	1.543
	(0.301)	(1.309)
fdp	-2.016	-8.063
	(1.522)	(6.680)
gruene	0.421	-0.236
	(1.119)	(4.183)
farleft	0.830	3.876
	(2.607)	(10.847)
farright	1.348	4.595
	(1.549)	(6.090)

Notes: Results for controls of the estimations presented in Table 2.8 in the text. Time and individual FE included in all models. Standard errors are clustered at the state-year level. Dependent variable in (a) is the effective tax rate, in (b) the first difference.

Table 2.15: Other definitions of the dependent variable

Chapter 3

Strategic fiscal interaction across borders

Evidence from French and German local governments along the Rhine-Valley[1]

3.1 Introduction

Over the last decades the mechanisms driving strategic fiscal policy interactions between governments have been a focus of academic study and public debate. While public discussion tends to focus on tax competition, tax evasion, and international tax havens, the academic literature focused first on the fiscal arrangements of local governments within the same country. The literature on fiscal federalism emphasizes that there can be two kinds of externalities from multi-tiered government systems. On the one hand, *horizontal externalities* can arise when the fiscal choices of one jurisdiction affect the fiscal decisions made by other competing jurisdictions at the same level of government. This can happen because governments try to attract a mobile tax base (see Wilson (1999) for a survey) or politicians attempt to maximize their re-election prospects (Besley and Case, 1995). On the other hand, *vertical externalities* can arise as a result of fiscal interactions between different layers of government,

[1]This chapter is based on joint work with Aurélie Cassette and Edoardo Di Porto. Special thanks go to both of them.

and particularly if these different layers share a common tax base.

The existing empirical literature on horizontal fiscal policy interactions can be differentiated by the level of government studied. Strategic interactions have either been investigated at the local domestic level or at the central international level. This chapter contributes to the literature by taking into account that local level government tax interactions can involve national borders. The key question to be answered in this chapter is whether local governments of one country interact only with their domestic neighbors or also with their foreign counterparts which are part of another country. Our data set is made up of the municipalities in the French-German border area, located along the Rhine River. Our main results confirm internal interactions within each of the two countries, but we do not find interactions between German and French jurisdictions in either direction.

The relevance of our question has increased by two trends which shaped tax systems in Europe - the process of European integration, and fiscal decentralization. When national governments decide to transfer responsibilities to sub-national governments, they need to find ways to finance them. This is usually done by either increasing tax autonomy by devolving local taxation powers through new tax instruments or increasing the transfers from central government. Endowing local jurisdictions with specific local taxes has consequences on the fiscal interactions of the respective governments, especially if these taxes affect a mobile tax base. In addition, the process of economic integration among the countries of the European Union has raised numerous questions related to fiscal coordination among member states. It is important to note that, in a highly integrated economic area, such as the European Union, products and factors are free to move across borders. While indirect taxation is harmonized by several agreements, factor income taxation is not. In the absence of taxation and other infrastructural or institutional barriers, investment will focus on areas where production costs are lower. The introduction of taxes distorts the investment decision because firms are lured to locations where after-tax profits are higher. For this reason, business and corporate taxation is attracting a great deal of attention as an element important for the operation of the internal market. Against this background, an investigation of the interactions among local governments with substantial discretion over taxes in different countries is an important question which

has not been answered yet.

So far the literature may have neglected this issue because this question is an empirically demanding one. It is important to account for the other than local elements of the tax system that affect a firm's net-of-tax profits. These elements vary across countries, but not across jurisdictions in the same country. If foreign jurisdictions and their different taxation systems are taken into account, elements of the tax code adopted by higher governmental levels come into play. Local particularities eventually generate a multifaceted bandwidth of potential after-tax profits in different regions beyond national borders.

However, the scope for lower level governments to attract mobile factors is limited. For example, it is very unlikely that communities in Lapland observe and react to the fiscal choices made in Andalusia, and the literature on local interactions shows that proximity of jurisdictions matters. Also, tax interactions will only occur if sub-national governments have sufficient discretion over fiscal instruments and are able to influence the after-tax profits of firms. These conditions explain our choice of the regional sample. The German-French context is an interesting example of proximate countries where business is taxed at the local level. In both countries local governments have a major impact on the overall tax burdens of firms. French and German municipalities can set taxes on business activities and on property which increase firms' tax liabilities. Proximity is also taken into account, since Germany and France share a common border along the Rhine Valley. The empirical analysis in this chapter tackles the question of whether those local governments on any side of the border interact with their foreign neighbors when they decide upon fiscal policy. To do so, we estimate tax reaction functions which differentiate between the spatial interactions with respect to the origin of the neighbors.

Our main results show that spatial correlation between the taxes set by local governments is driven exclusively by domestic effects. We also distinguish between an effect due to proximity along the border and one potentially arising out of infrastructural disadvantages. The Franco-German border coincides with the Rhine River which can be crossed only where infrastructure, such as ferries or bridges, allows. We find that this effect does not change the main finding that local interactions are a domestic issue.

This chapter is organized as follows: Section 3.2 describes sub-national tax systems and the institutional background in France and Germany. Section 3.3 reviews the empirical literature. Section 3.4 presents the empirical specification and the peculiarities of our context. Section 3.5 introduces the data set and section 3.6 presents the results. This chapter comes to a close in section 3.7 with providing concluding remarks.

3.2 Business taxation in France and Germany

In general, sub-national governments have two main sources of revenue: the taxes they impose with their own discretion over tax rates, and grants and redistributed tax revenues from other government levels. In 2007, German local governments received about one quarter of their revenue from own taxes and French ones received about a third of their income from this source. An important point is that even though local authorities in Germany and France can influence the overall tax burdens of firms, the tax instruments available are different. French local jurisdictions can impose a professional tax (*taxe professionelle*, subsequently abbreviated tp) and German municipalities have at their disposal a local trade tax (*Gewerbesteuer*, gs). Local governments in both countries can choose the rate of tax on real estate. Both tax systems show important differences at sub-national (different tax base) and national (especially in capital allowances) levels. We translate the formal tax code into a measure of the tax burden in order to make it comparable across the two countries. The tax systems of both countries have been subject to several reforms and changes. In the remaining of this section we describe the major characteristics of the French and German fiscal system which are important to our context and were valid during the sample period.

3.2.1 Local characteristics: The French case

French sub-national government is four tiered. The lowest level consists of around 36,000 municipalities, divided into more than 13,000 groups or *Etablissements Publics de Coopération Intercommunale*. The middle tier consists of 96 departments and the top tier of the 22 French regions. Our paper focuses on the lowest tier of government,

i.e. municipalities. Business is taxed at all levels and is subject to a national corporate income tax (*impôt sur les sociétés*, cit) and two sub-national taxes: a local business tax (*taxe professionnelle*, tp) and a real estate tax (*taxe foncière*, tf). The statutory rates t_{tp} and t_{tf} are set annually by the local authorities and vary across regions, departments, and municipalities. The consolidated tax rate is the sum of the sub-national level rates. The groups of municipalities can choose to set a single business tax rate (*taxe professionnelle unique*), which applies to all municipalities belonging to the inter-municipal group or to apply an additional tax rate on each of the local taxes. In the first case, the municipalities do not set individual business tax rates and the municipal cooperation acts to merge jurisdictions. In the second case, this new level of local government sets an additional tax rate, which strengthens tax base sharing.

The professional tax is a local business tax levied on tangible fixed assets, such as machinery, and on buildings. The tax base is the rental value σ of the tangible fixed assets used for the business purposes.[2] For buildings, tax law defines the rental value as 8% of the value of the buildings; for machinery, the rental value is 16% of the value. In both cases a general deduction of 16% applies and the local tax is deductible from the corporate income tax (t_{cit}). The effective rate is given by

$$T_{tp} = (1 - t_{cit})\sigma(1 - 0.16)t_{tp}$$

The *taxe foncière*, or real estate tax, is levied on the owners of residential properties in France. The tax base is obtained after applying a 50% allowance to the rental value compared to the one of business facilities. The effective rate accounts for deductions from the corporate income tax

$$T_{tf} = (1 - t_{cit})\sigma t_{tf}$$

3.2.2 Local characteristics: The German case

Germany has two sub-national government levels: the 16 federal states (*Bundesländer)* and the approximately 12,000 municipalities or cities. The German framework of pub-

[2]See Table 3.7 in the Appendix A3.1 of this chapter for details on the rental value.

lic finance is a complex system based on revenue-sharing and equalization schemes between government layers. Corporate profits in Germany are taxed by a central government tax (*Körperschaftsteuer*, cit). The revenues are shared with the federal states. The trade tax (*Gewerbesteuer*, gs) is the local business tax which is a tax on the profits earned by corporations, non-incorporated firms, and self-employed persons. A share of this tax goes to the states and central government. The tax base consists of the profits of business enterprises determined under income tax law or corporation tax law. Each local authority has discretion over the so called collection rate c_{gs}. These collection rates can be transformed into an ordinary statutory tax rate expressed as a percentage by dividing the collection rate by 100 and applying a specific multiplier (5% under our assumptions)[3] set by law, which implements a degree of progression into the tax code. The tax liability is also deductible from its own tax base and the tax base of the corporate income tax (see Scheffler (2005) for details of the German tax code). The adjusted effective tax rate can be calculated as

$$\begin{aligned} T_{gs} &= \frac{5}{100} \cdot \frac{c_{gs}}{100} \cdot (1 - T_{gs}) \cdot (1 - t_{cit}) \\ \Leftrightarrow \; T_{gs} &= \frac{c_{gs}}{2000 + c_{gs}} (1 - t_{cit}) \end{aligned}$$

A second local tax is the municipal real estate tax (*Grundsteuer*, pt). Each municipality has the right to choose a collection rate for this tax c_{pt} and can distinguish between agricultural and other areas. We focus on other areas, which are likely to be used for business purposes. The effective rate accounts for the deductibility of real estate taxes from corporate income taxation (t_{cit}). It is determined by

$$T_{pt} = (1 - t_{cit}) \sigma c_{pt}$$

Other studies on international tax-comparisons, for example ZEW (2008), assume that the tax base of the real estate tax amounts to 25% of the acquisition costs.[4]

In order to obtain comparable measures of the tax burdens in the two countries,

[3] The applied multiplier depends on the amount of the tax base and the legal form of the firm. In our setting we focus on the highest multiplier, which applies to all incorporated firms. Their share of the total tax base in 2004 was about 55%. However, the results do not change for any other value.

[4] For details, see Table 3.7 in the Appendix A3.1.

which is based on different tax bases, we compute municipal specific effective average tax rates. This measure takes into account the elements that vary between sub-national governments, i.e. the variation of tax rates across municipalities. At the same time this measure captures the differences across the two countries. The computation of these tax rates is specified in the Appendix A3.1 and the resulting tax rates are described in detail in the data section 3.5.

3.3 Literature review

The existence of strategic interactions between fiscal authorities is a common prediction of the tax competition (surveyed by Wilson, 1999) and the yardstick competition (Besley and Case, 1995) literatures. The reason for a strategic component in tax rates is an outflow of mobile capital in the case of tax competition. In yardstick competition, the different incentives and objectives of politicians promote interactions. The empirical literature tests for the existence of strategic interactions among governments. These models usually are implemented empirically by estimating a fiscal reaction function where the optimal tax rate in the equilibrium in a jurisdiction depends on the tax rates in nearby jurisdictions (see Revelli (2006) for a survey of the empirical models).

Up to now, empirical studies concentrate either on international tax competition between countries (Redoano, 2007; Devereux, Lockwood, and Redoano, 2008; Cassette and Paty, 2008) or tax interactions among local jurisdictions or regions within a country (see Brueckner (2003) for a survey). The former group of studies shows that industrialized countries compete over statutory and effective average corporate tax rates. Most country studies of the second group find empirical evidence of positive interactions among sub-national governments using various data sets of local property, income, or business tax rates. For example, interaction effects have been found by Brett and Pinkse (2000) for Canada, Heyndels and Vuchelen (1998) for Belgium, Brueckner and Saavedra (2001) for the United States, Revelli (2001) for the United Kingdom, Feld and Reulier (2009) for Switzerland, Solé-Ollé (2003) for Spain, Bordignon, Cerniglia, and Revelli (2003) for Italy, Edmark and Ågren (2008) for Sweden, and Allers and Elhorst (2005) for the Netherlands.

Tests for strategic interactions have also been performed in the two countries of our study. The local business tax is the major source of tax revenue for local governments in France, which explains why most empirical work on France focuses on this tax instrument at the lowest level of government. All studies on spatial interactions at the municipal level find evidence of tax interactions. Jayet, Paty, and Pentel (2002) focus only on horizontal interactions when investigating tax interactions in France. They check for the existence of tax mimicking between municipalities in Nord-Pas de Calais (Northern France). Tax interactions between neighbor municipalities occur in urban but not in rural areas. Charlot and Paty (2007, 2010) study spatial fiscal interactions among municipalities controlling for vertical fiscal interactions and accounting for agglomeration forces. They observe significant mimicking behavior among jurisdictions when choosing local business tax rates and vertical interactions between municipalities and regions. Empirical studies using French data have also been performed at the department level (Leprince, Madiès, and Paty, 2007; Dubois, Leprince, and Paty, 2007) and the regional level (Feld, Josselin, and Rocaboy, 2003), finding significant results in favor of tax competition.

In contrast to the fairly large literature on the French setting, studies of strategic interactions in Germany are scarce. Using panel data for a German state (Baden-Wuerttemberg), Buettner (2001) finds that tax rates are strategic complements, i.e. that the best response of a municipality to an increase in adjacent municipalities' tax rates is to raise its own tax rate. In a further paper (Buettner, 2003), he confirms that the tax base is affected not only by the municipality's own tax rate, but also by the tax rates in neighboring jurisdictions, although the effect is rather small. The regional sample for these two studies is located close to the border-region and a set of dummies is used to capture effects in regions particularly exposed to international competition. The results suggest that within a bandwidth of 30 kilometers distance from the border, significant effects are at work. However, this is not worked out in detail since the data set ends at the German frontier. Hence, internal country competition may be different in the border region, but whether this is due to interactions with the foreign municipalities is not answered yet. A recent study by Geys and Osterloh (2011) evaluates the responses of German mayors to questionnaires about whom they consider to be their main competitors. This paper shows that it is mostly

other jurisdictions within Germany that are seen as competitors. Only mayors from municipalities located very close to the border with France responded differently. Again, whether fiscal policy in border regions depends on - and reacts strategically to the fiscal policy enacted abroad, or whether domestic effects dominate, remains an open question.

To our knowledge, no empirical studies test the existence of local tax interactions across national borders. From a theoretical perspective, as long as capital is perfectly mobile and in the absence of other frictions, there are no reasons why politicians and voters should consider only the behavior of adjacent municipalities within the same country. The aim of this chapter is to fill this gap in the literature with combining local fiscal data from two countries.

3.4 From theory to empirics

This section shows how we reach from theory to empirical models able to test our main hypotheses. While theoretical arguments are in line with the standard models of tax competition, our empirical strategy is context specific and differs from other studies that examine only domestic local interactions.

3.4.1 Theoretical background

Following Brueckner (2003), the utility of residents in municipality i (u_i) depends on their private consumption (c_i) and on the quantity of public goods provided by the local government (g_i), thus

$$u_i = u(c_i(k_i), g_i(k_i); X_i) \tag{3.1}$$

where X_i is a vector of characteristics of the jurisdiction, such as demographic attributes reflecting the preferences and needs of the local population. k_i is the resource used as the tax base in that jurisdiction (capital used by firms for production). The demand for capital depends on the fiscal environment in the jurisdiction because firms maximize after-tax profits. As in Zodrow and Mieskowski's (1986) basic model, a perfectly competitive firm produces output by a twice differentiable, constant returns to

scale production function under the assumption that labor is locally fixed:

$$f_i(k_i, l_i), \text{ with } l = 1, \text{ and } f_k > 0 > f_{kk}$$

As discussed above, sub-national governments in France and Germany have dissimilar local tax bases. The French local tax can be seen as a unit capital tax while the German local business tax is a tax on profits. Thus, the after local-tax profits of firms are different in both countries. Maximizing the respective profit function yields the profit maximizing first order conditions for the demand for capital in either country:[5]

$$\begin{aligned} f'(k_i)(1 - T_{gs}) &= r \quad \text{for germany} \\ f'(k_i) - T_{tp} &= r \quad \text{for france} \end{aligned}$$

Under the assumption that capital is perfectly mobile, capital market equilibrium implies that the after-tax rate of return equalizes across jurisdictions, independent of the tax instrument applied. Furthermore, Lockwood (2004) shows that, although a jurisdiction may care about which tax instrument its rivals use, the jurisdiction is indifferent towards these instruments since for any tax rate on profits there is a revenue equivalent unit rate. Hence we define τ as the effective average tax rate, that is the tax burden for a one-unit hypothetical investment project. We can transform the German profit tax into per unit tax by writing $T_{gs} = \frac{\tau}{f'(k_i)}$. Since taxes in France are already expressed per unit, equilibrium in the capital market for both countries implies that

$$f'(k_i) = r + \tau_i \tag{3.2}$$

is the profit-maximizing condition for jurisdictions in both countries. The tax rate τ is the measure of the tax burden which we use in our empirical estimations. In addition to transforming the different tax bases, this measure is able to depict further elements of the tax code. For example, it accounts for the coexistence of real estate taxes on the municipal level. We now define φ as the inverse of $f'(k_i)$ and the demand

[5]These equations are simplified since we take account only of the local business taxes. However, the underlying problem is similar for other taxes.

for capital is given by

$$k_i = \varphi(r + \tau_i) \tag{3.3}$$

Market clearing requires that

$$\sum_{i=1}^{m} \varphi(r + \tau_i) + \sum_{i=m+1}^{n} \varphi(r + \tau_i) = \sum_{i=1}^{n} k_i \tag{3.4}$$

where m is the share of municipalities in one of the two respective countries. Equations 3.3 and 3.4 show that capital demand depends on all tax rates and differentiation of them yields $\frac{\partial \varphi}{\partial \tau_i} < 0$, i.e. capital flees by an increase in the effective average tax rate.

Maximization of (3.1) subject to the capital demand equilibrium (3.4) shows that the optimal tax policy depends on tax rates elsewhere and the municipality's own local characteristics. The resulting reaction function is given by

$$\tau_i = \tau(\tau_{-i}, X_i) \tag{3.5}$$

where the notation $-i$ indicates all other municipalities than i.

However, this result holds if and only if capital is perfectly mobile between the two countries. On the other hand, it could be argued that capital first adjusts at country level, i.e. the two countries compete for shares, say α and $(1 - \alpha)$. Once proportions are fixed, each municipality can only try to increase its attractiveness for firms to locate in its area rather than in a nearby municipality in the same country. In that case, interactions reduce to the standard within-country case and domestic tax rates are a function of nearby domestic policy choices.

$$\tau_{i \in [1,m]} = \tau(\tau_{-i \in [1,m]}, X_i)$$
$$\tau_{i \in [m+1,n]} = \tau(\tau_{-i \in [m+1,n]}, X_i)$$

Proposition 1. *In the absence of restrictions on the mobility of capital, tax rates are a function of all other domestic and foreign tax rates, irrespective of the tax base. As soon as capital is fixed in either country, only domestic interactions occur.*

Hence, a local jurisdiction of any of the two countries could interact with the fiscal policy enacted in the local jurisdictions of the other country. To test the existence of tax interactions among local governments, we estimate reduced-form tax reaction functions which allow us to distinguish the between country effects from the domestic effects within one country. These estimations can be seen also as an indirect test of the mobility of capital between the two regions on their respective sides of the frontier. We present our estimation strategy in the next sub-section.

3.4.2 Identification

Our main question refers to whether there is a correlation between local tax rates across national borders. Existing empirical work that disentangles the effects between different sub-groups, in our application between domestic and foreign interactions, utilize spatial autoregressive fixed effect methods (e.g. Cassette and Paty (2008) using Generalized Method of Moments - GMM methods, Gérard, Jayet, and Paty (2010) using Maximum Likelihood estimators). To test the existence of tax interactions among local governments, we need to estimate the reduced-form reaction function, which can be expressed in a matrix form such as

$$\tau = \rho \mathbf{W}\tau + \mathbf{X}\beta + \eta + \upsilon + \varepsilon$$

where ρ is the parameter associated with the weighted average of competing governments' tax rates. The coefficients in β include the parameters associated with the socio-economic characteristics of municipality i. We allow for different reactions to the control variables in $\mathbf{X}$ in the two countries by interacting them with a country dummy. Finally, η is a vector of municipal fixed effects, υ is a vector of year fixed effects and ε is an idiosyncratic error term. Including a community (or municipal) fixed effect η_i is important in our case. Under this specification, all identifying variations come from changes over time. This allows us to eliminate possible omitted variables which do not vary over time.

The weighting scheme $\mathbf{W}$ defines which other local governments should be regarded as neighbors. Usually a weight matrix is used where $\mathbf{W}$ is row normalized, each row summing to unity.

In order to distinguish the influence of competing domestic municipalities from the effect of competing foreign municipalities, we use a decomposition of the weight matrix, which is a linear combination of partial weights. Starting from any standard weight matrix $\mathbf{W}$, we define three partial interaction matrices[6] such that $\mathbf{W} = \mathbf{W}^{FF} + \mathbf{W}^{GG} + \mathbf{W}^{FG}$:

- $\mathbf{W}^{FF}$ for interactions within France; $\mathbf{W}^{GG}$ for interactions within Germany. All elements in the weighting matrix $\mathbf{W}^{FF}$ and $\mathbf{W}^{GG}$ are equal to zero if the municipalities i and j are from different countries;

- $\mathbf{W}^{FG}$ for interactions between France and Germany. The elements of the weighting matrix $\mathbf{W}^{FG}$ are equal to zero if municipality i and j belong to the same country and different from zero otherwise.

As a consequence, $\mathbf{W}$ is row-normalized while the sub-matrices are not. The reduced-form reaction function can be written in matrix form as

$$\tau = \rho_1 \mathbf{W}^{GG}\tau + \rho_2 \mathbf{W}^{FF}\tau + \rho_3 \mathbf{W}^{FG}\tau + \mathbf{X}\beta + \eta + \upsilon + \varepsilon \tag{3.6}$$

where ρ_1 is the parameter associated with the weighted average of the tax rates of other jurisdictions in Germany if municipality i is also German. Analogically, ρ_2 is the parameter associated with the weighted average of other French municipalities' tax rates if municipality i is French. The coefficient ρ_3 measures the effect associated with the weighted average of the tax rates of other jurisdictions that do not belong to the same country as municipality i. Parameters ρ_1, ρ_2, and ρ_3 thus measure the degree of tax interactions among German municipalities, among French municipalities, and between French and German municipalities.

Since interactions are supposed to be strategic, tax rates are determined jointly and are endogenous. Ordinary least squares estimates of the parameters of equation (3.6) are inconsistent (Anselin, 1988). In order to deal with the endogeneity of competing municipalities' tax variables on the right hand side, we use an instrumental variables (IV) approach as proposed by Kelejian and Robinson (1993) and Kelejian

[6] See Gérard, Jayet, and Paty (2010) for a similar exercise that goes beyond standard specification of the weight matrix for Belgian municipalities.

and Prucha (1998). Details on the set of instruments used are provided in the following sub-section. We develop two estimations for this static approach, one showing standard errors robust to heteroskedasticity and autocorrelation (HAC) according to Newey and West (1987) and one with robust standard errors clustered at municipal level as suggested by Bertrand, Duflo, and Mullainathan (2004).

It is worth noting that tax rates in such a framework could be persistent over time, for example because changes in tax rates might be costly for governments to implement. To capture possible dynamic effects we include a time-lagged dependent variable to control for persistence in tax rates

$$\tau = \gamma\tau_{t-1} + \rho_1\mathbf{W}^{GG}\tau + \rho_2\mathbf{W}^{FF}\tau + \rho_3\mathbf{W}^{FG}\tau + \mathbf{X}\beta + \eta + \upsilon + \varepsilon \tag{3.7}$$

The presence of the lagged dependent variable in equation (3.7) together with fixed effects requires the use of a GMM estimator as suggested by Kukenova and Monteiro (2009), namely difference GMM (Arellano and Bond, 1991). The difference GMM estimator corrects also for the endogeneity of the spatial lags.

Our main specification allows so far for different spatial interactions in Germany and France, namely ρ_1 and ρ_2. However, it assumes that the degree of cross border interaction is the same from France to Germany and vice versa. As a robustness check, we estimate a model that allows for asymmetric border effects.

$$\tau = \rho_1\mathbf{W}^{GG}\tau^G + \rho_2\mathbf{W}^{FF}\tau^F + \rho_3^G\mathbf{W}^{FG}\tau^F + \rho_3^F\mathbf{W}^{FG}\tau^G + \mathbf{X}\beta + \eta + \upsilon + \varepsilon \tag{3.8}$$

In this specification τ^G and τ^F are respective vectors of the tax rates of all the German and all the French municipalities. In this regression the coefficient ρ_3^G captures the degree of interaction of German municipalities with respect to their French neighbors. The coefficient ρ_3^F instead shows how French municipalities interact with their German counterparts on the other side of the border. These two coefficients provide evidence of asymmetric cross border competition for both countries.

With similar arguments as for the introduction of two different country specific spatial lags for the border effect, we also estimate a version of equation (3.7) in which

we allow for different coefficients for the one period lagged dependent variable.[7]

The robustness of our regressions and validity of instruments is evaluated with the usual tests after IV estimations. We show Hansen-J tests for all our estimations. This test ensures that the instruments are not correlated with the residuals, and that the excluded instruments do not have to be part of the main estimated equation. To control for weak identification, we include the Kleibergen-Paap rank F test for our instrumental variables estimations (Kleibergen and Paap, 2006). For the dynamic estimations, we need to conduct the Arellano and Bond (1991) test, denoted AR(2), to confirm that the residuals of the first-differenced estimating equation are not second-order correlated. All statistics are necessary to confirm the validity of the instruments used.

3.4.3 Instruments and covariates

In our first static specification according to equation (3.6), we use spatial IV as proposed by by Kelejian and Robinson (1993) and Kelejian and Prucha (1998). We are aware that, although the standard models in spatial econometrics are useful for specification testing, they assume a parametric structure which can be sensitive to model misspecification. Spatial autoregressive (SAR) models are useful when a well-specified theory predicts that the dependent variable is directly affected by neighboring values (McMillen, 2012). This is exactly our case, since our estimation is based on a well understood structural model which is in line with the traditional local tax competition literature. Therefore, there are no concerns over the direction of the causal relationships in the model. SAR models, if developed within a well specified theory, are useful for a variety of reasons (McMillen, 2012, p. 2): "*First, they provide convenient model specification tests that indicate when a base model does not adequately account for spatial relationships. Second, they provide convenient robustness checks that can provide some confidence in crucial statistical results. Finally, they are currently the only feasible way to approach estimation of an important class of models in which the primary objective is to estimate the causal relationship of neighboring values of the dependent variable on itself.*" An estimation method such as the one proposed

[7] We estimate the equation $\tau = \gamma^G \tau^G_{t-1} + \gamma^F \tau^F_{t-1} + \rho_1 \mathbf{W}^{GG}\tau + \rho_2 \mathbf{W}^{FF}\tau + \rho_3 \mathbf{W}^{FG}\tau + \mathbf{X}\beta + \eta + \upsilon + \varepsilon$.

by Kelejian and Robinson (1993) adds other benefits to these advantages. IV is very well understood, it allows discussion of the identifying assumptions, and useful tests for exogeneity are available.

As instruments, we include the set of instruments $Z_{i,t}$ which fulfill the assumption of exogeneity:

$$E(\varepsilon_{i,t}|Z_{i,t}) = 0$$

As Kelejian and Robinson (1993) advise, all the spatially lagged covariates $\mathbf{WX}$ fulfill this property and can be considered in the set of instruments.[8] Note that the structure of our theoretical model imposes causal relationships excluding $E(\varepsilon_{i,t}|WX_{i,t}) \neq 0$. The same applies to any lagged value of $\tau_{i,t}$, at least if we are considering the static model where we implicitly impose the assumption $E(\varepsilon_{i,t}|\varepsilon_{i,t-1}) = 0$. On this basis, we can insert $\mathbf{W}\tau_{i,t-1}$ in the set of instruments. Due to the theoretical structure of our model, this can also be considered a valid instrument and was used before in similar applications (Buettner (2001), amongst others). We investigate the appropriateness of time lags of the spatially lagged tax rates as instruments by conducting a difference-in-Hansen test, which checks the validity of a subset of instruments. It does this by computing the increase in Hansen-J when the particular subset is added to the estimation set-up.

For the dynamic GMM specification we are implicitly assuming that $E(\varepsilon_{i,t}|\varepsilon_{i,t-1}) \neq 0$.[9] In this case, in line with GMM applications, the set of instruments $Z_{i,t}$ is composed of the time lagged values of the dependent variable $\tau_{i,t-2}$ and $\tau_{i,t-3}$ together with $\mathbf{WX}$, $\mathbf{W}^{GG}\tau_{i,t-1}$, $\mathbf{W}^{FF}\tau_{i,t-1}$ and $\mathbf{W}^{FG}\tau_{i,t-1}$. Because of the structure of the relations imposed by our theoretical model and the fact that $E(\varepsilon_{i,t}|\varepsilon_{i,t-(1+k)}) = 0$, by assumption, all of our instruments can be considered statistically exogenous.

The spatial interaction parameters are only properly identified by this approach if there is no omitted variable. We control for this issue in two ways. First, as already mentioned, we use a fixed effect specification with time and individual fixed effects. All possible control variables that are persistent over time, or observations,

[8] We do not use the spatial lags of demographic and unemployment variables as instruments. As noted in Buettner (2001), they are found to be correlated with the error terms.

[9] In this case, the reaction function derived by our theory is not equation (5) anymore but $\tau_{i;t} = \tau(\tau_{-i,t}, \tau_{i,t-1}, X_{i,t})$

such as political cycles,[10] can be excluded from our specification. We control for socio economic factors that could be considered exogenous and that let $\tau_{i,t}$ vary over time. In line with the local tax competition literature the most important sources of variation for local taxes are unemployment rates, shares of young and old inhabitants, and density. This is because local variations of these factors induce different levels of public services at the local level. To capture possible variations given by vertical tax competition, we include the vertical tax element of the Effective Average Tax Rate (EATR) among the covariates. In addition, to take account of different local level endowments, we include regional per capita GDP.

We perform a number of preliminary specification tests using this set of covariates. We compute Lagrange Multiplier tests surveyed by Anselin, Le Gallo and Jayet (2008) for spatial error correlation and a spatially lagged dependent variable, which are robust to the respective alternative form. This ensures that a spatial autoregressive model (SAR) is the correct specification as opposed to a spatial error model (SEM) with spatial correlation of the error terms. The null of these tests is that there is no spatial process. The p-values of these tests indicate that the spatial error model is not appropriate (LM error test p-value=0.99), whereas, according to our specification, the spatial lag model is the correct specification (LM lag test p-value=0.00). If there are any omitted variables which are spatially correlated and also vary over time (note that the fixed effects solve the case if those omitted variables are invariant over time), this omission would create a spatial autocorrelation in the error term. Since the performed robust LM test is not in favor of spatial autocorrelation in the error term, we take this as a 'bare bone' test of the validity of the covariates used, and the model specification.

3.5 Data and geographical issues

The subjects of our study are local governments in the Franco-German border area. In order to focus on the effects arising from possible interactions across this border, we included in our sample all municipalities located within 30 km of distance to

[10] In our setting local elections occur in the same year in each municipality: this means that the year fixed effects specification does already control for local elections.

the Rhine. We focus on those local governments belonging to the German federal state of Baden-Wuerttemberg and those in the French departments of Bas-Rhin and Haut-Rhin. Figure 3.1 depicts the regions from which our sample is drawn. On the French side, local governments belonging to a city union that chose the single tax rate regime are aggregated since fiscal policy decisions are taken jointly. This provides us a sample of 602 municipalities.

It can be argued that our sample is a spatial selection from two nations - France and Germany - and that this selection could cause some kind of bias. We argue that geographically and historically the Rhine Valley can be treated as a common region. This valley is surrounded by mountains on both sides, and mountains lower spillover effects from and to other municipalities. Therefore, our geographical choice provides a reliable quasi-experimental setting for the identification of cross border competition effects.

Our dataset provides annual information for the period 2000-2007 for two broad categories: taxation and socio-economic variables. Before describing the dataset, we demonstrate how geographical features such as neighborhood and proximity are introduced in our setup via spatial weights.

3.5.1 Spatial weights

In the literature on tax competition governments are assumed to take account of flights of capital to neighboring jurisdictions resulting from an increase in the original jurisdiction's tax rate. Thus, a scheme that assigns weights based on geographic distance or contiguity is frequently applied in the empirical literature. First, based on the Euclidian distance, we treat different numbers of nearby jurisdictions as neighbors. The weighting scheme $\mathbf{W}^{NN6}$ for instance establishes a connection to the six closest municipalities and assigns a weight of $w_{ij}^{NN6} = 1/6$ to each. In the context of international interactions only jurisdictions from the foreign country are regarded as potential candidates for neighbors. In other words, each domestic municipality is connected only to those on the other side of the border.[11]

Another possibility is to express 'neighborship' in terms of distance. This scheme

[11] $w_{ij} = 0$ if i and j are from the same country, but if not different from zero.

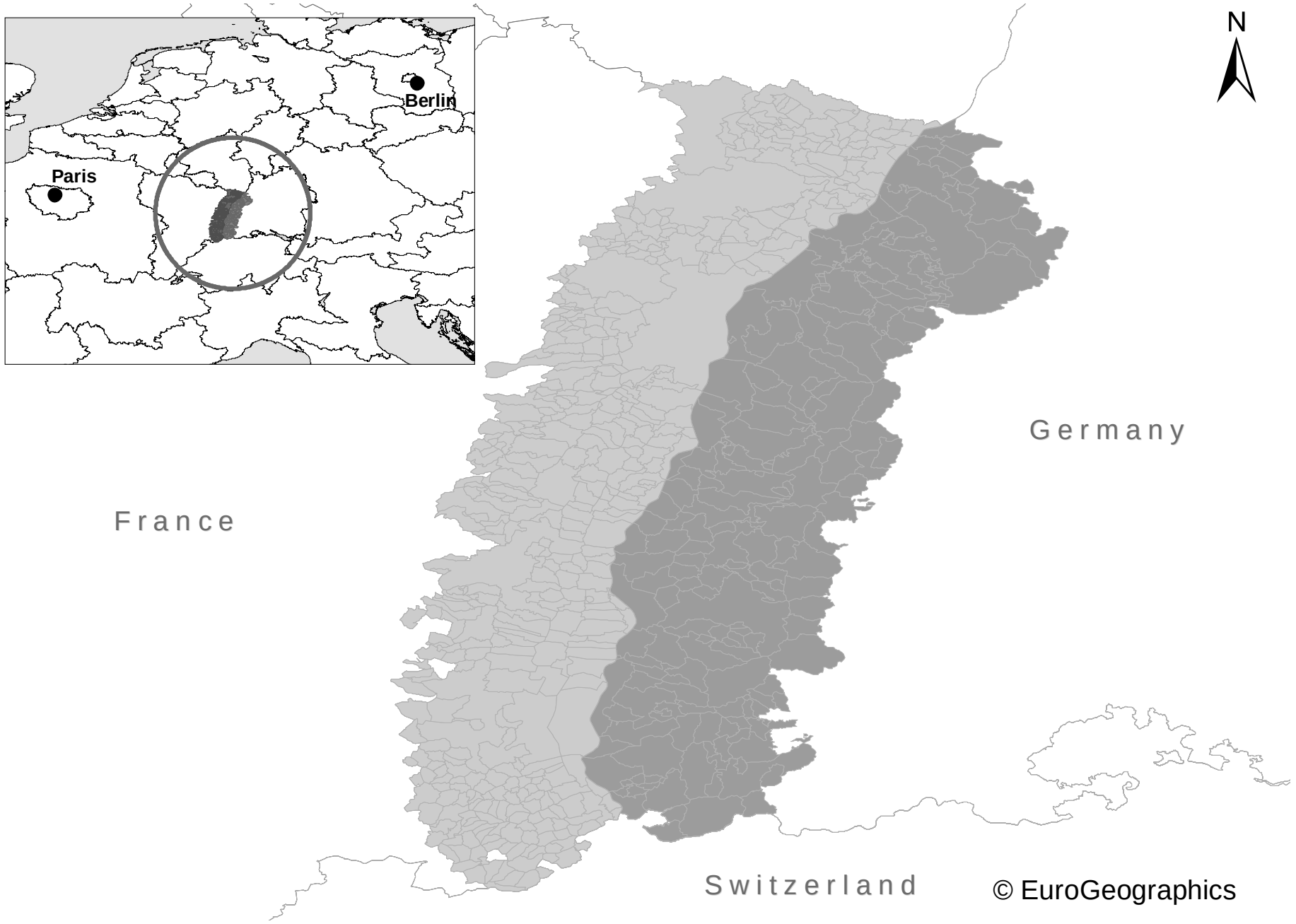


Figure 3.1: Sample: The Franco-German border area

is given by the weight matrix $\mathbf{W}^{DIST}$ and imposes a smooth distance decay, with weights given by w_{ij}^{DIST} where d_{ij} is the Euclidian distance between the centroids of municipality i and municipality j. After standardization, we get

$$w_{ij}^{DIST} = \frac{1/d_{ij}}{\sum_j 1/d_{ij}}$$

for the elements in $\mathbf{W}^{DIST}$. We use cut-off criteria to exclude municipalities from being neighbors if they are more than 15 km or 30 km distant.

A feature of our dataset is that the border between Germany and France coincides with the Rhine River. This allows us to reformulate the weighting scheme based on distance in order to take account of the local infrastructure. Crossing the border is only possible at points where bridges or ferries establish a connection between the two countries. Our weights $w_{ij}^{DIST\_INFRA}$ are calculated as the nearest river crossing point from municipality i to reach municipality j in the other country. A comparison of the ρ_3 parameter with distance and this measure reveals whether it is the border or the infrastructure enabling mobility that is important for tax rate interactions.

3.5.2 Taxation data

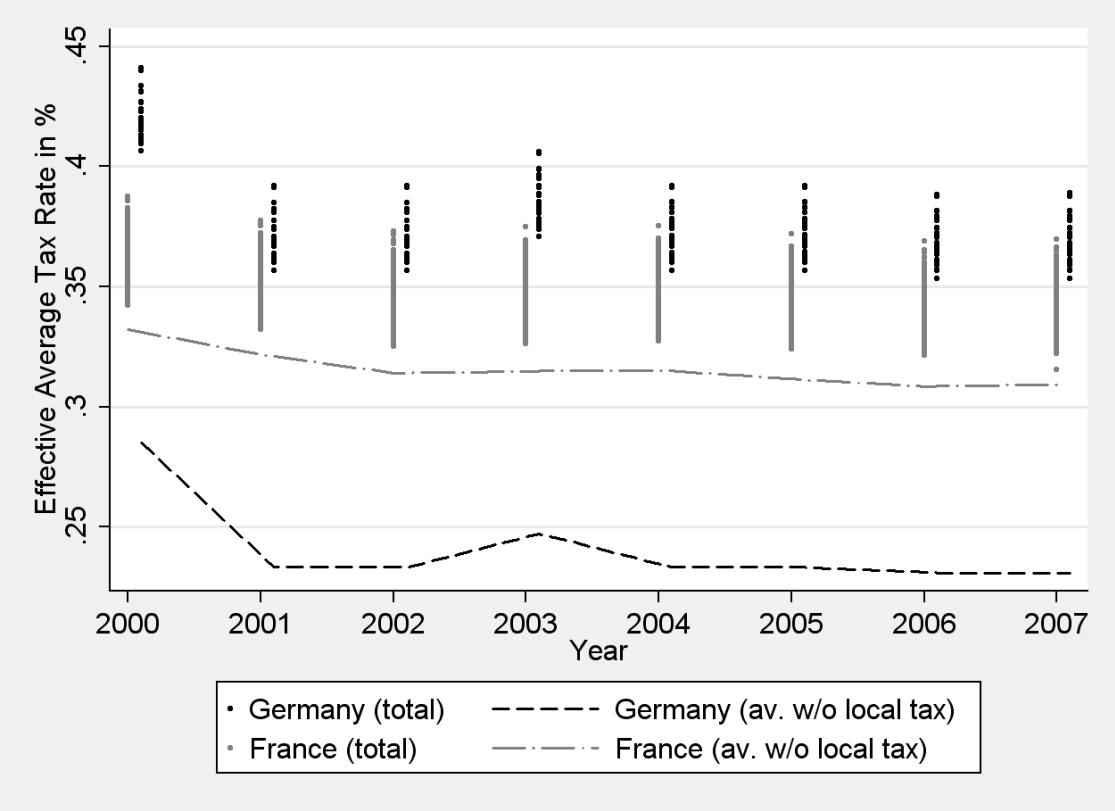
Taxation data are the core elements of our dataset. In order to depict the overall burden borne by firms and to provide a comparable measure of the tax burden, we compute the Effective Average Tax Rate (EATR) using the framework developed by Devereux and Griffith (2003). These measures are often applied in studies of international tax comparisons and the tax competition literature at the national level. The EATR is a measure of the effect of tax on a non marginal investment, which covers its economic costs and provides an economic profit. This is a measure of the proportion of pre-tax economic profit that the investor gets to keep after paying taxes. The rates calculated by this method are based on a specific form of investment, using specific sources of financing. The methodology used to compute the EATR is provided in the Appendix A3.1. Since we are interested in the part that local governments can have an impact on, we calculate the local EATR by setting all elements of the tax code not under local discretion equal to zero. This means

that our measure will be highly correlated with local statutory tax rates. We expect a positive impact of neighbors' tax rates on the domestic tax rate, as shown in the literature. However, we are mainly interested in the impact of foreign fiscal policy choices on the decisions taken in the home country which can only be compared by using effective tax rates.

In addition, we introduce a measure of the tax burden imposed by higher levels of government including national corporate income taxes. In contrast to the calculation of the local tax rate, we set everything at the discretion of the bottom level equal to zero. This procedure allows a comparable measure of the tax burden for the local and the higher levels to be derived. This is of particular importance for France, because the tax base differs between a central tax on firms (corporate income tax based on profits) and sub-national taxes. Moreover, effective tax rates allow us to account for differences between the two countries in the composition of the corporate income tax base (especially in capital allowances).

The literature shows that the sign of the slope of the vertical tax reaction function is theoretically ambiguous (Besley and Rosen, 1999; Keen and Kotsogiannis, 2002; Goodspeed and Leprince, 2005). On the one hand, the lower level government may reduce tax rates in response to a tax hike at the upper levels in order to avoid too strong pressure on the tax base. On the other hand, tax rates at one level will rise following a tax hike at another level in order to keep revenues stable given the resulting loss to the tax base. Whether strategic substitutability or strategic complementarity between tax rates imposed by different levels of government is the more likely outcome needs to be settled empirically. Some empirical studies find a positive effect (Besley and Rosen, 1999; Esteller-More and Solé-Ollé, 2001; Rizzo, 2010), and some find an inverse relationship between upper and lower level tax rates (Hayashi and Boadway, 2001; Brett and Pinkse, 2000). For French municipalities, Charlot and Paty (2010) establish that regional tax rates and municipal tax rates are strategic complements, but they find no vertical business tax interaction between municipalities and departments. According to this we would expect a positive coefficient for French municipalities. However, existing work on the French case does not test the reaction of municipal tax rates to the central corporate income tax rate and the analysis is restricted to the business tax. Since our measure of the tax burden combines

all the taxes borne by firms, we do not have a prior expectation over the sign of this variable.



Notes: Decomposition of the Effective Average Tax Rate (EATR). Dots represent the overall tax burden, lines represent the tax burden due to higher than local level governments.

Figure 3.2: Decomposition of Effective Average Tax Rates (EATR)

Figure 3.2 favors the argument that local governments in the two countries have the possibility to interact over their fiscal policy instruments. Each dot represents the overall effective average tax rate, either in France (gray) or in Germany (black). The distance from zero to the respective line is an average measure of the vertical tax burden in our estimations. The difference between the line and each dot is the additional local tax burden, which we use in logs as our dependent variable. Since they are spread at the same intervals after 2000, municipalities potentially have the power to interact with their foreign neighbors. Nevertheless, French municipalities have a lower share of the overall tax burden (difference between the line and each dot) than their German counterparts.

Table 3.1 shows summary statistics for the effective tax rates and the additional vertical tax burden in both countries. We take the logs of all tax variables in our

Variable		Mean	Std. Dev.	Min.	Max.	Observations
Germany						
local eatr τ	overall	0.136	0.006	0.121	0.159	N = 1320
	between		0.005	0.123	0.158	n = 165
	within		0.002	0.119	0.150	T = 8
vertical eatr	overall	0.241	0.017	0.231	0.285	
	between		0.000	0.241	0.241	
	within		0.017	0.231	0.285	
France						
local eatr τ	overall	0.030	0.009	0.007	0.060	N = 3496
	between		0.009	0.011	0.058	n = 437
	within		0.002	0.013	0.051	T = 8
vertical eatr	overall	0.316	0.007	0.308	0.333	
	between		0.001	0.315	0.317	
	within		0.007	0.309	0.332	

Table 3.1: Summary statistics: Tax variables

empirical estimation.

3.5.3 Socio-economic control variables

Socio-economic variables are introduced to control for different spending needs or preferences for public goods in the local jurisdictions and their size. The municipalities in our sample are different in terms of inhabitants. In both countries the share of small jurisdictions is quite substantial, while only a handful of large cities (Strasbourg, Freiburg, Baden-Baden) is included. Table 3.2 presents summary statistics for control variables we include in our estimations.

The set of control variables includes economic variables, such as the unemployment rate and regional GDP per capita. We include the unemployment rate since local authorities have certain obligations to unemployed people, such as housing costs in Germany. In addition, the number of unemployed people could be a proxy for the cyclical stance and other economic conditions. Furthermore, the log of regional GDP, one period lagged, is included. This controls further for economic conditions and the fact that tax rates usually react one period later to changes in the GDP.

We also include socio-demographic variables, such as population density, proportion of the population aged less than 15 years, and proportion of population aged

Variable		Mean	Std. Dev.	Min	Max	Observations
Germany						
young	overall	16.894	2.004	6.154	23.958	N = 1320
	between		1.751	9.617	20.839	n = 165
	within		0.984	10.650	20.046	T = 8
old	overall	16.996	3.088	7.612	28.429	
	between		2.833	8.547	26.987	
	within		1.244	13.057	20.843	
unemployment	overall	3.381	1.148	0.000	9.187	
	between		1.003	0.000	7.443	
	within		0.563	1.439	5.810	
density	overall	294.219	254.017	16.931	1698.551	
	between		254.611	18.034	1671.332	
	within		6.490	243.381	336.992	
log regional gdp (t-1)	overall	10.063	0.178	9.732	10.632	
	between		0.162	9.856	10.505	
	within		0.075	9.914	10.224	
France						
young	overall	19.450	2.231	10.369	29.167	N = 3496
	between		2.045	14.192	25.799	n = 437
	within		0.896	14.617	24.356	T = 8
old	overall	13.819	2.963	4.974	26.007	
	between		2.849	5.661	23.503	
	within		0.826	9.726	17.962	
unemployment	overall	5.854	2.161	0.000	15.791	
	between		1.962	0.985	13.955	
	within		0.909	0.566	10.083	
density	overall	177.042	219.673	19.415	2238.687	
	between		219.775	21.750	2184.338	
	within		7.212	122.774	231.391	
log regional gdp (t-1)	overall	10.055	0.102	9.862	10.241	
	between		0.048	10.003	10.100	
	within		0.090	9.906	10.205	

Notes: young: share of inhabitants under the age of 15, old: share of inhabitants over the age of 65, unemployment: number of unemployed as a share of total population, density: population density, log regional gdp (t-1): log-transformed lagged value of gdp, measured at the regional level.

Table 3.2: Summary statistics: Control variables

over 65 years. These variables can be interpreted as expenditure needs indicators and may have a positive sign. Since the age structure of the population might reflect preferences for public expenditure, these two characteristics of the population are likely to have an impact on the level of taxation. For example, the working population is more likely to favor a tax policy oriented to creating a good business environment compared to the older population, whose demand for public goods might be higher. A priority for the younger generation is the provision of kindergartens for their children. These kinds of expenditures are imposed at the local level in both countries. In the case of economies of scale in the supply of public goods, population density may have a negative sign.

3.6 Results

This section discusses the results of our empirical analysis. First, we provide the results for our basic specifications. For this first set of results, we always focus on weights constructed using a criterion that regards the six nearest municipalities as neighbors. Following this, we provide different robustness checks, also with other numbers of neighbors. Later in this chapter, we compare the results of our basic specification with an air-line distance weighting scheme and with a distance weighting scheme reformulated to take into account the presence of infrastructure. Our main result is that in none of our specifications is the cross border competition coefficient ρ_3 statistically different from zero. Our conclusion is that no cross border interactions are at work and only the fiscal policy of other domestic jurisdictions is taken into account when local governments decide over own tax rates.

3.6.1 Baseline estimates

The first two columns in Table 3.3 show the results of the main IV estimations, which are either estimations showing robust (a) or municipal clustered (b) standard errors, respectively. Internal spatial lags are significant in both the regressions, independent of how standard errors are computed. Tax rates within the two countries are correlated with the tax rates chosen by their neighboring jurisdictions. The significant coefficients ρ_1 and ρ_2 confirm that local jurisdictions within a given country

	Spatial IV			Difference GMM	
Dependent Variable	Model Eq. 3.6		Model Eq. 3.8	Model Eq. 3.7	
$ln(\tau)$	(a)	(b)	(c)	(d)	(e)
equilibrium interaction coefficients					
$W^{FF}\ln(\tau)$	0.893***	0.893***	0.902***	1.154***	1.190***
	(0.103)	(0.124)	(0.126)	(0.133)	(0.141)
$W^{GG}\ln(\tau)$	0.502***	0.502***	0.491***	0.636*	0.521**
	(0.110)	(0.180)	(0.180)	(0.349)	(0.260)
$W^{FG}\ln(\tau)$	0.062	0.062		-0.113	-0.032
	(0.114)	(0.128)		(0.154)	(0.083)
$W^{FG}\ln(\tau^G)$ if F			1.572		
			(2.872)		
$W^{FG}\ln(\tau^F)$ if G			0.024		
			(0.121)		
lagged dependent variable					
$\ln(\tau_{(t-1)})$				-0.045	
				(0.033)	
$\ln(\tau^F_{(t-1)})$ if F					-0.037
					(0.034)
$\ln(\tau^G_{(t-1)})$ if G					0.004
					(0.045)
controls Germany					
young	-0.002	-0.002	-0.002	-0.018	-0.010
	(0.001)	(0.002)	(0.002)	(0.024)	(0.011)
old	0.000	0.000	0.000	-0.007	-0.007
	(0.001)	(0.001)	(0.001)	(0.012)	(0.010)
unemployment	-0.002*	-0.002*	-0.002	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
density	-0.000**	-0.000*	-0.000*	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
log reg. GDP	-0.018	-0.018	-0.016	0.014	-0.018
	(0.036)	(0.039)	(0.039)	(0.054)	(0.061)
vertical EATR	-0.025	-0.025	-0.030	-0.101**	-0.107**
	(0.049)	(0.043)	(0.044)	(0.045)	(0.049)

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	(a)	(b)	(c)	(d)	(e)
controls France					
young	-0.003**	-0.003*	-0.003*	0.024	0.035
	(0.001)	(0.002)	(0.002)	(0.035)	(0.033)
old	-0.003	-0.003	-0.003	0.042	0.033
	(0.002)	(0.002)	(0.002)	(0.036)	(0.033)
unemployment	-0.000	-0.000	-0.000	0.002	0.002
	(0.001)	(0.002)	(0.002)	(0.008)	(0.008)
density	0.000	0.000	0.000	0.001	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
log reg. GDP	0.003	0.003	-0.000	-0.066	-0.063
	(0.059)	(0.057)	(0.058)	(0.062)	(0.064)
vertical EATR	-0.041	-0.041	-0.017	0.469*	0.483**
	(0.273)	(0.292)	(0.297)	(0.243)	(0.204)
individual/year FE	yes/yes	yes/yes	yes/yes	yes/yes	yes/yes
Std.Err.	robust	clustered	clustered	clustered	clustered
Observations (n)	4214	4214	4214	3612	3612
Number of municipalities (N)	602	602	602	602	602
Hansen J	1.633	0.909	0.739	79.63	92.20
Hansen J (p-value)	0.652	0.823	0.864	0.278	0.504
K-P Underid.	119.8	73.06	45.74	.	.
K-P Underid. (p-value)	0.000	0.000	0.000	.	.
K-P Weak Id. F	13.99	10.97	8.276	.	.
Diff. Hansen Lags	1.633	0.909	0.140	.	.
Diff. Hansen Lags (p-value)	0.652	0.823	0.932	.	.
AR(1) test	.	.	.	-3.277	-3.202
AR(1) (p-value)	.	.	.	0.001	0.001
AR(2) test	.	.	.	1.441	1.540
AR(2) (p-value)	.	.	.	0.150	0.124
#of instruments (excluded)	24 (6)	24 (6)	25 (7)	95 (6)	116 (6)

Standard errors in parentheses, clustered at the municipal level,
model (a) with robust standard errors. *** p<0.01, ** p<0.05, * p<0.1

Notes: Spatial weights are calculated regarding the six nearest municipalities as neighbors (W^{NN6}). Standard errors are computed as indicated in the table and shown in parenthesis. Model (c) includes a linear and quadratic time trend and model (g) includes a constant (not reported here).

Table 3.3: Regression results

interact over their tax instruments. This result is in line with the empirical literature that establishes a positive relationship between local municipalities' tax rates in France (Jayet, Paty, and Pentel, 2002; Charlot and Paty, 2007, 2010) and Germany (Buettner, 2001). Our results provide empirical support for the study of Geys and Osterloh (2011) which uses questionnaires and shows that German mayors do not consider foreign municipalities to be their main competitors. Note that the matrix decomposition does not allow for normalization; hence we cannot directly discuss the magnitude of this coefficient. Since we obtain positive coefficients, we can conclude that there is a competition effect within the country, but not across the border. In column (c) we allow for asymmetric cross border effects and include separate coefficients for French and German cross-border interactions according to equation (3.8). However, this does not change the results as foreign effects are still insignificant and domestic effects remain largely as before.

Unemployment, density, and young population explain the rest of the variance showing negative coefficients. A greater share of young people significantly decreases the tax rate in France. This might be due to the fact that, although communities have to provide services to this group, their parents favor business friendly policies since they are most likely still to be of working age. Both countries try to counteract unemployment by lowering tax rates in order to establish an attractive environment for business activities, but this effect is only significant for German municipalities.

The instrumentation strategy for these models was explained in Section 3.4.3. Its relevance is verified by a set of tests: the Hansen-J test indicates that the orthogonality of the set of instruments with respect to the residuals cannot be rejected. Furthermore, the Difference-in-Hansen test on the time lags as additional instruments does not reject their validity. We can conclude that our instruments are exogenous, and cannot be considered as weak according to the Kleibergen-Paap rank F statistic.

In the dynamic GMM specification (equation 3.7, column (d) in Table 3.3), all the variance from the covariates is attracted by the time lag, which fails to be significant but has a negative sign. The result for cross border interactions remain unchanged, and tax competition is confined to within the countries. In this estimation the vertical element of the tax system also has an impact on the own tax rate. These coefficients are now significant in both of the countries, but most interestingly, signs differ across

them. German municipalities show up with a negative sign, which implies that they react to a decrease on the higher level with an increase of own tax rates. On the French side things go hand in hand: the lower level follows an increase of taxes at the higher levels of government with the same action.

The Hansen-J test again confirms the validity of instruments. The Arellano-Bond tests for AR(1) and AR(2) reveal that autocorrelation is treated in the right way. We use 95 instruments, a number that is acceptable in light of the number of cross-sections in this estimation (602). This ensures that the Hansen test is not weakened by the proliferation of instruments (Roodman, 2009).

The time lag captures the tax rate trend over time, but trends might be different in the two countries. Model (e) takes this into account by allowing for different responses of municipalities in the two countries. Now signs go in different directions, indicating a rising trend in Germany and a falling trend in France. However, the coefficients are still not significant. An explanation behind this result is that we use effective tax rates instead of statutory ones. Since these tax rates gather information from different underlying taxes, as property and business taxes, we do not find a significant effect even though individual taxes might be serially correlated.

3.6.2 Robustness to spatial truncation and the sample size

So far we restricted our sample to municipalities inside a 30-kilometer-wide Rhine border area. It could be argued that local governments in each country are presumably interacting with governments outside this area. Since the tax rates of those governments are not considered, the model could appear to be not well specified. A first answer to this concern has been given in the data section: the Rhine Valley can be treated as a valley surrounded by mountains, and mountains lower spillover effects from and to other municipalities. As a consequence, the spatial truncation should not bias the results as interactions with municipalities outside this area are unlikely.

Another way to think about this problem is to consider samples of different geographical size. Should any selection bias to be induced via geographical truncation, this would lead to overestimation of the cross border coefficient and underestimation of the domestic lags if we restrict our sample to municipalities which are close to the

Dependent Variable	20km	30km	all
$ln(\tau)$	(a)	(b)	(c)
equilibrium interaction coefficients			
$W^{FF}\ln(\tau)$	0.880***	0.893***	0.879***
s.e.	(0.175)	(0.124)	(0.286)
p-value	0.000	0.000	0.002
95% CI	[0.538 - 1.222]	[0.649 - 1.136]	[0.319 - 1.438]
$W^{GG}\ln(\tau)$	0.523**	0.502***	0.361
s.e.	(0.254)	(0.180)	(0.362)
p-value	0.040	0.005	0.318
95% CI	[0.025 - 1.020]	[0.149 - 0.856]	[-0.347 - 1.070]
$W^{FG}\ln(\tau)$	0.053	0.062	0.046
s.e.	(0.131)	(0.128)	(0.193)
p-value	0.687	0.630	0.812
95% CI	[-0.204 - 0.310]	[-0.189 - 0.312]	[-0.332 - 0.424]
Observations (n)	2429	4214	5530
Number of municipalities (N)	347	602	790
individual/year FE	yes/yes	yes/yes	yes/yes
Hansen J (p-value)	0.822	0.823	0.849
K-P Weak Id. F	3.054	10.97	15.54
Diff. Hansen Lags (p-value)	0.822	0.823	0.849
Standard errors in parentheses, clustered at the municipal level. 95% CI in square brackets, *** p<0.01, ** p<0.05, * p<0.1			

Notes: Only main coefficients reported. List of covariates as before. See Table 3.9 in Appendix A3.2 for details. Model (a) includes only municipalities not more distant than 20km from the respective border. Model (b) repeats the main estimations shown in Table 3.3 for comparison. Model (c) includes all municipalities in adjacent counties and regions.

Table 3.4: Regressions for different distances to the border

border. Table 3.4 shows the results for the full sample in column (b) and for a restricted sample, excluding 255 municipalities which are located between 20 and 30 km distance to the border in column (a). Column (c) instead includes all municipalities in the two French regions which are adjacent to the border and in all German counties which either touch the border or are located inside a border touching county. This sample could be considered as a full sample drawn from a closed region according to political criteria. Results from this excercise mitigate concerns of a selction bias. Model (a) does not show different results compared to (b), but should be interpreted with caution, since instruments are rather weak in this sample. However, the sample including all municipalities (c) shows similar results for the French domestic effect and no significant effects anymore in Germany. The results of no competition with respect to foreign municipalities remains unchanged in all models. Note that the 95% confidence interval around the point estimate is larger in the full sample. This strengthens the result of no international interaction effects, because any bias introduced through a too small sample selection would work against our main conclusion of no international interactions. Therefore, the small sample used so far provides reliable evidence for this result, and this finding is stable when increasing the sample size. However, domestic competition in Germany might be specific to the sample and more prevalent very close to the border.

3.6.3 Robustness to the construction of weights and infrastructural means

So far all estimations were computed by using a weighting matrix that regards the six municipalities close by as neighbors to calculate the spatial weights. Since the applied weighting scheme is exogenously chosen, we want to confirm that results are indeed unchanged if we apply another set of weights.

Several robustness checks, shown in Table 3.5, confirm our previous findings. The four estimations (a) to (d) regard the four, six, eight, and ten nearest municipalities as neighbors. Results are, however, similar to those obtained in the baseline estimations. The domestic spatial lags indicate significant interactions, while the coefficient on the foreign spatial lag remains insignificant.

Dependent Variable	$\mathbf{W}^{NN4}$	$\mathbf{W}^{NN6}$	$\mathbf{W}^{NN8}$	$\mathbf{W}^{NN10}$
$ln(\tau)$	(a)	(b)	(c)	(d)
equilibrium interaction coefficients				
$W^{FF}\ln(\tau)$	0.815***	0.893***	0.928***	0.912***
s.e.	(0.113)	(0.124)	(0.126)	(0.129)
p-value	0.000	0.000	0.000	0.000
95% CI	[0.594 - 1.036]	[0.649 - 1.136]	[0.682 - 1.174]	[0.660 - 1.164]
$W^{GG}\ln(\tau)$	0.393***	0.502***	0.572***	0.641***
s.e.	(0.115)	(0.180)	(0.189)	(0.218)
p-value	0.001	0.005	0.002	0.003
95% CI	[0.168 - 0.618]	[0.149 - 0.856]	[0.202 - 0.941]	[0.213 - 1.068]
$W^{FG}\ln(\tau)$	-0.035	0.062	0.048	0.065
s.e.	(0.058)	(0.128)	(0.095)	(0.101)
p-value	0.541	0.630	0.615	0.524
95% CI	[-0.148 - 0.078]	[-0.189 - 0.312]	[-0.138 - 0.234]	[-0.134 - 0.263]
individual/year FE	yes/yes	yes/yes	yes/yes	yes/yes
Hansen J (p-value)	0.619	0.823	0.733	0.872
K-P Weak Id. F	10.77	10.97	19.06	30.16
Diff. Hansen Lags (p-value)	0.619	0.823	0.733	0.872
Standard errors in parentheses, clustered at the municipal level. N=602, n=4214 95% CI in square brackets, *** p<0.01, ** p<0.05, * p<0.1				

Notes: Only main coefficients reported. List of covariates as before. See Table 3.10 in Appendix A3.2 for details. Spatial weights are calculated by using (a) 4, (b) 6 as before, (c) 8, (d) 10, nearest municipalities as neighbors.

Table 3.5: Results for different spatial weights

We are also interested to know whether the border or a gap in infrastructure is responsible for this absence of cross border competition. The use of adjacent municipalities as neighbors, independent of the means of reaching them, suggests that direct information spill-overs could be excluded as the underlying reason, as long as the results are non-significant. When taxes are set to attract, or at least not to lose capital, the municipalities that are easier to reach will be the most likely competitors. We compute weights based on distance to analyze this question. We distinguish between weights based on air-line distance (W^{DIST}) and another set of weights where the Rhine, and hence the border, can only be crossed where infrastructure allows it (W^{DIST_INFRA}). In other words, the measure of the distance takes account of the presence of a bridge or a ferry to cross the Rhine and to commute between France and Germany.

Columns (a) and (c) in Table 3.6 show the results for air-line distance according to equation 3.6; infrastructure is accounted for in columns (b) and (d). The first two estimations are for a cut-off distance of 15 kilometers, the last two for 30 kilometers. Since the results do not indicate differences between alternatives in terms of significance, we can exclude any explanation for possible interactions. The results for the cross-border term are also insignificant in the infrastructure specification, and domestic tax rates do not respond to those of potential neighboring competitors for capital abroad. Nevertheless, the internal coefficients of the two countries are significant if neighborship is defined in terms of distance. Finally, although we allow for different means of interaction, cross-border spillovers are absent from all the specifications.

3.7 Conclusion

A gap in the empirical literature on fiscal interactions is the question of whether local governments interact with other local jurisdictions across national borders. It has been well documented that taxation decisions at the national level depend on the decisions in other countries. This applies also to sub-national governments within a specific country, which interact with other domestic governments. Whether local governments tend to mimic their foreign counterparts, however, is an open question. We conducted an empirical investigation of this question. The European Union and

Dependent Variable	$\mathbf{W}^{DIST}$ with $d_{ij} < 15km$		$\mathbf{W}^{DIST}$ with $d_{ij} < 30km$	
$ln(\tau)$	(a) dist	(b) infra	(c) dist	(d) infra
equilibrium interaction coefficients				
$W^{FF} \ln(\tau)$	1.206***	1.223***	1.384***	1.406***
s.e.	(0.170)	(0.172)	(0.237)	(0.240)
p-value	0.000	0.000	0.000	0.000
95% CI	[0.872 - 1.539]	[0.886 - 1.560]	[0.920 - 1.848]	[0.936 - 1.875]
$W^{GG} \ln(\tau)$	0.679***	0.591***	0.840**	0.741*
s.e.	(0.221)	(0.196)	(0.429)	(0.378)
p-value	0.002	0.003	0.050	0.050
95% CI	[0.247 - 1.111]	[0.206 - 0.976]	[0.000 - 1.681]	[-0.001 - 1.482]
$W^{FG} \ln(\tau)$	0.045	0.003	0.008	-0.015
s.e.	(0.096)	(0.078)	(0.166)	(0.147)
p-value	0.642	0.965	0.959	0.917
95% CI	[-0.143 - 0.233]	[-0.149 - 0.156]	[-0.316 - 0.333]	[-0.303 - 0.272]
individual/year FE	yes/yes	yes/yes	yes/yes	yes/yes
Hansen J (p-value)	0.741	0.600	0.337	0.281
K-P Weak Id. F	50.03	44.37	50.91	90.88
Diff. Hansen Lags (p-value)	0.741	0.600	0.337	0.281
Standard errors in parentheses, clustered at the municipal level. N=602, n=4214 95% CI in square brackets, *** p<0.01, ** p<0.05, * p<0.1				

Notes: Only main coefficients reported. List of covariates as before. See Table A3.2 in Appendix A3.2 for details. Spatial weights are calculated according to the distance between the jurisdictions centroids. Models (a) and (b) cut-off after 15km, (c) to (d) after 30km. Models indicated by 'dist' show the air-line distance, while those indicated by 'infra' take into account infrastructure between the two countries.

Table 3.6: Results for distance weights

its common internal market is a convenient environment for this examination because there are no legal barriers to the free movement of capital. The Franco-German context is of particular interest since revenues from business taxation are an important element of local governments' budgets and have an intense impact on firms' after-tax profits. Local jurisdictions in the border area, from which we construct our sample, might try to increase their tax bases. We investigate if they do so relative to other domestic tax regimes, relative to other foreign regimes, or relative to both types of jurisdictions.

Our results do not confirm that domestic municipalities interact with foreign ones. Although we apply a variety of definitions for neighborship, the interaction terms are not significant. We find no evidence of local-international interactions. This finding is consistent with the view that local jurisdictions pay attention only to their domestic counterparts, taking an earlier choice over the country as given. An intuitive explanation for our result is that the costs connected to cross-border competition are comparatively high. Other national characteristics, besides pure tax elements, might be more important for the decision about where to settle a business. In particular, the institutional and cultural framework, and the use of a different language, might create strong frictions on mobility. These points might be more important than small differentials in tax rates. Once the decision in which country to do business is taken, only the question of in which specific region the investment should take place remains open. Thus, local governments strive to remain attractive only relative to their domestic neighbors. Our results can also be interpreted as a indirect test for regional mobility of capital, which in our case seems not to be very mobile across the River Rhine. Most important, taxes are set by politicians. The costs to them of comparing domestic and foreign tax codes are higher than making simple within-country comparisons. The different tax bases can create a particular problem for local politicians trying to evaluate their position relative to foreign municipalities.

Although our empirical results exclude local interactions across national borders, further theoretical work could determine under which conditions interactions would be likely to occur. In addition, the variety of sub-national taxation systems, languages, and other characteristics in Europe would suggest the need for more empirical research in different directions. Future work could concentrate on regions where some

barriers are absent (e.g. language in the case of Germany and Austria) or the mobility of capital is affected (accession to the European Union). A better understanding of the border effect in a borderless Europe seems to be interesting and important.

A3 Appendix

A3.1 Local Effective Average Tax Rates

We compute Effective Average Tax Rates (EATR) according to the method proposed by Devereux and Griffith (2003). Using this method, the impact of tax is measured by the extent to which the pre-tax economic rent R^* is reduced by taxation. The EATR is a measure of the proportion of pre-tax economic profit that the investor gets to keep after paying taxes. It is based on the difference between the Net Present Value of the perturbation in the capital stock in the absence and presence of tax, $R^* - R$, which is a measure of the total impact of taxation on the investor. This difference is scaled using the Net Present Value of the pre-tax total income stream, net of depreciation,

$$EATR = \frac{R^* - R}{\frac{p}{(1+r)}}$$

where p is the pre-tax financial return of the investment and r the real interest rate. Assumptions are made about the values of these two parameters (see Table 3.7). We define R^* as the economic rent of the project in the absence of tax:

$$R^* = \frac{p - r}{1 + r}$$

We also define R as the economic rent of the project in the presence of tax (where tax is the sum of all taxes which have an impact on the investment project):

$$R = \frac{(p - r)(1 - tax)}{1 + r}$$

Table 3.7 sums the value of the economic parameters we use in all the calculations. We use the same economic parameters for the calculation in all periods and both

countries to figure out the evolution of taxation parameters and the differences in the tax systems rather than the development of economic conditions. Five different types of investment are considered - buildings, financial assets, machinery, intangibles and inventories. These hypothetical investments can be financed through three different sources - retained earnings, debt, and new equity.

Variable	Symbol	Value in %
True economic depreciation rates		
intangibles	δ_{INT}	15.35
industrial buildings	δ_{BUI}	3.1
machinery	δ_{MAC}	17.5
finacial assets	δ_{FIN}	0
inventories	δ_{INV}	0
Economic parameters		
Real interest rate	r	5
Inflation rate	π	2
Pre-tax rate of return for EATR	p	20
Nominal interest rate (%)	$i = (1+r)(1+\pi) - 1$	7.1

Table 3.7: Parametrization

Investments in industrial buildings trigger liability for real estate tax in both countries. The tax base is determined by the notional annual rent were the property to be lent in the open market. However this notional rent is often substantially lower than the market rental value, even if every year the notional rent is multiplied by a factor to reflect the national variation in prices.[12] In Germany these values relate to the location's market values in the past and are not linked to recent market values. In these cases, ZEW (2008) makes assumptions concerning the country-specific relation between the acquisition cost used in the model and the tax value determined by the tax offices. In Table 3.8, we give the rental value rate σ for each type of capital.

σ	machinery	buildings	
France	16% (tp)	8% (tp)	4% (tf)
Germany		25% (pt)	

Table 3.8: Rental value rate

[12]In France, individual property values have not been reviewed by the tax authorities since 1974.

Applying this parameterization, the tax laws related to the local taxes and the above described equations, we are able to compute country-specific effective average tax rates for a set of five investment goods (buildings, machinery, inventory, finacial and intangible assets) and three financing opportunities (retained earnings, new equity and debt). Instead of calculating effective tax rates for each of these 15 combinations and then weighting them by a country-specific EATR, we compute financed-weighted effective tax rates for each asset. According to OECD (1991) we can use the following weights: 55% retained earnings, 10% new equity, and 35% debt. Next, we follow the European Commission (2001) and use equal weights for each asset to calculate municipal-specific averages of the EATR for both countries. We obtain the tax rates of the different government levels by setting the taxes on other levels equal to zero.

A3.2 Detailed regression results

This appendix provides the complete regression tables for all control variables which were ommited from the tables in the text.

Dependent Variable	20km	30km	all
$ln(\tau)$	(a)	(b)	(c)
equilibrium interaction coefficients			
$W^{FF} \ln(\tau)$	0.880***	0.893***	0.879***
	(0.175)	(0.124)	(0.286)
$W^{GG} \ln(\tau)$	0.523**	0.502***	0.361
	(0.254)	(0.180)	(0.362)
$W^{FG} \ln(\tau)$	0.053	0.062	0.046
	(0.131)	(0.128)	(0.193)
controls Germany			
young	-0.003	-0.002	-0.001
	(0.002)	(0.002)	(0.002)
old	-0.001	0.000	-0.000
	(0.002)	(0.001)	(0.003)
unemployment	-0.003	-0.002*	-0.001
	(0.002)	(0.001)	(0.009)
density	-0.000	-0.000*	-0.000
	(0.000)	(0.000)	(0.000)
log reg. GDP	-0.014	-0.018	-0.094
	(0.037)	(0.039)	(0.170)
vertical EATR	-0.003	-0.025	-0.018
	(0.050)	(0.043)	(0.099)
controls France			
young	-0.004	-0.003*	0.010
	(0.003)	(0.002)	(0.015)
old	-0.006**	-0.003	-0.021
	(0.003)	(0.002)	(0.015)
unemployment	-0.001	-0.000	0.005
	(0.003)	(0.002)	(0.011)
density	0.000	0.000	-0.001
	(0.000)	(0.000)	(0.001)
log reg. GDP	0.050	0.003	0.138
	(0.069)	(0.057)	(0.283)
vertical EATR	-0.060	-0.041	0.185
	(0.328)	(0.292)	(1.398)
individual/year FE	yes/yes	yes/yes	yes/yes
Std.Err.	clustered	clustered	clustered
Observations (n)	2429	4214	5530
Number of municipalities (N)	347	602	790
Hansen J	0.915	0.909	0.801
Hansen J (p-value)	0.822	0.823	0.849
K-P Underid.	9.676	73.060	42.090
K-P (p-value)	0.046	0.000	0.000
K-P Weak Id. F	3.054	10.97	15.54
Diff. Hansen Lags	0.915	0.909	0.801
Diff. Hansen Lags (p-value)	0.822	0.823	0.849
#of instruments (excluded)	24 (6)	24 (6)	24 (6)

Standard errors in parentheses, clustered at the municipal level.
*** p<0.01, ** p<0.05, * p<0.1

Notes: Complete table for the results presented in Table 3.4. Model (a) includes only municipalities not more distant than 20km from the respective border. Model (b) repeats the main estimations shown in Table 3.3 for comparison. Model (c) includes all municipalities in adjacent counties and regions.

Table 3.9: Regressions for different distances to the border

Dependent Variable	$\mathbf{W}^{NN4}$	$\mathbf{W}^{NN6}$	$\mathbf{W}^{NN8}$	$\mathbf{W}^{NN10}$
$ln(\tau)$	(a)	(b)	(c)	(d)
equilibrium interaction coefficients				
$W^{FF}\ln(\tau)$	0.815***	0.893***	0.928***	0.912***
	(0.113)	(0.124)	(0.126)	(0.129)
$W^{GG}\ln(\tau)$	0.393***	0.502***	0.572***	0.641***
	(0.115)	(0.180)	(0.189)	(0.218)
$W^{FG}\ln(\tau)$	-0.035	0.062	0.048	0.065
	(0.058)	(0.128)	(0.095)	(0.101)
controls Germany				
young	-0.002	-0.002	-0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
old	0.000	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
unemployment	-0.003**	-0.002*	-0.002	-0.002
	(0.001)	(0.001)	(0.002)	(0.002)
density	-0.000*	-0.000*	-0.000*	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
log reg. GDP	-0.013	-0.018	-0.020	-0.028
	(0.040)	(0.039)	(0.040)	(0.040)
vertical EATR	-0.029	-0.025	-0.017	-0.004
	(0.042)	(0.043)	(0.043)	(0.043)
controls France				
young	-0.004*	-0.003*	-0.004**	-0.004**
	(0.002)	(0.002)	(0.002)	(0.002)
old	-0.004*	-0.003	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)
unemployment	-0.001	-0.000	-0.000	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)
density	-0.000	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
log reg. GDP	0.034	0.003	-0.007	-0.016
	(0.058)	(0.057)	(0.058)	(0.059)
vertical EATR	-0.039	-0.041	-0.017	-0.098
	(0.282)	(0.292)	(0.289)	(0.285)
Hansen J	1.782	0.909	1.285	0.704
Hansen J (p-value)	0.619	0.823	0.733	0.872
K-P Underid.	76.75	73.06	90.71	102.9
K-P (p-value)	0.000	0.000	0.000	0.000
K-P Weak Id. F	10.77	10.97	19.06	30.16
Diff. Hansen Lags	1.782	0.909	1.285	0.704
Diff. Hansen Lags (p-value)	0.619	0.823	0.733	0.872
#of instruments (excluded)	24 (6)	24 (6)	24 (6)	24 (6)

Standard errors in parentheses, clustered at the municipal level.
*** p<0.01, ** p<0.05, * p<0.1

Notes: Complete table for the results presented in Table 3.5. Spatial weights are calculated by using (a) 4, (b) 6 as before, (c) 8, (d) 10, nearest municipalities as neighbors.

Table 3.10: Results for different spatial weights

Dependent Variable	$\mathbf{W}^{DIST}$ with $d_{ij} < 15km$		$\mathbf{W}^{DIST}$ with $d_{ij} < 30km$	
$ln(\tau)$	(a) dist	(b) infra	(c) dist	(d) infra
equilibrium interaction coefficients				
$W^{FF} \ln(\tau)$	1.206***	1.223***	1.384***	1.406***
	(0.170)	(0.172)	(0.237)	(0.240)
$W^{GG} \ln(\tau)$	0.679***	0.591***	0.840**	0.741*
	(0.221)	(0.196)	(0.429)	(0.378)
$W^{FG} \ln(\tau)$	0.045	0.003	0.008	-0.015
	(0.096)	(0.078)	(0.166)	(0.147)
controls Germany				
young	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
old	0.000	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
unemployment	0.000	0.000	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)
density	-0.000*	-0.000*	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
log reg. GDP	-0.040	-0.046	-0.048	-0.057
	(0.041)	(0.040)	(0.040)	(0.040)
vertical EATR	-0.043	-0.056	-0.057	-0.071
	(0.047)	(0.046)	(0.062)	(0.059)
controls France				
young	-0.003	-0.003	-0.004*	-0.003*
	(0.002)	(0.002)	(0.002)	(0.002)
old	-0.002	-0.002	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
unemployment	0.001	0.001	0.000	0.000
	(0.002)	(0.002)	(0.002)	(0.002)
density	-0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
log reg. GDP	-0.080	-0.090	-0.109	-0.121*
	(0.060)	(0.060)	(0.067)	(0.064)
vertical EATR	0.240	0.292	0.414	0.481
	(0.323)	(0.323)	(0.422)	(0.417)
Hansen J	1.250	1.870	3.379	3.827
Hansen J (p-value)	0.741	0.600	0.337	0.281
K-P Underid.	148.3	150.9	68.91	162.5
K-P (p-value)	0.000	0.000	0.000	0.000
K-P Weak Id. F	50.03	44.37	50.91	90.88
Diff. Hansen Lags	1.250	1.870	3.379	3.827
Diff. Hansen Lags (p-value)	0.741	0.600	0.337	0.281
#of instruments (excluded)	24 (6)	24 (6)	24 (6)	24 (6)

Standard errors in parentheses, clustered at the municipal level.
*** p<0.01, ** p<0.05, * p<0.1

Notes: Complete table for the results presented in Table 3.6. Spatial weights are calculated according to the distance between the jurisdictions centroids. Models (a) and (b) cut-off after 15km, (c) to (d) after 30km. Models indicated by 'dist' show the air-line distance, while those indicated by 'infra' take into account infrastructure between the two countries.

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