Determinants and Effects of Local Public Education Expenditures - an Empirical Approach

Dissertation zur Erlangung des akademischen Grades Doktorin der Wirtschafts- und Sozialwissenschaften (Dr. rer. pol.)

Vorgelegt im Fachbereich Wirtschaftswissenschaften

der Universität Kassel

Von Julia Hauschildt

Kassel, 18.09.2019

Disputation: 20.11.2019

Erstgutachter: Prof. Dr. Ivo Bischoff

Zweitgutachter: Prof. Dr. Rainer Voßkamp

Drittgutachter: Prof. Dr. Guido Bünstorf

Dedicated to my family and friends.

Contents

List of figures

List of tables

Chapter 1

1 General introduction

1.1 Introduction

Public schools are a frequent topic of many political and economic discussions. It is of political and scientific importance in an international context as well as in German-wide considerations as a consequence of the PISA studies since 2000 with its partly unsatisfactory results.

More precisely, the German school system was even reformed and in some ways adjusted to international standards as a result of this study. In the context of PISA, there were debates about the share of young people getting a university or college entrance diploma (German equivalent to A-levels) and the duration of grammar schools, the German school type where it is possible to get A-levels. On the one hand, the school system is characterized by federalism but Germany is no exception in this respect. On the other hand, it is (to a large extent) run publicly and financed by the states, counties and municipalities. Besides, public financing also yields for other parts of education such as public colleges (which are the majority of German colleges) but these are run by the federal state and not by local agents so they are excluded from my analysis.

This cumulative dissertation consists of three empirical papers and focuses on German specific types of schools. The first paper takes the political economy – determinant side- perspective. In particular, it analyses the question whether vocational schools serve as an instrument of interregional competition with evidence from German counties. Closely related, the second paper looks at the political economy of public school spending taking again a closer look at vocational schools. My third paper is on the short- run effects of school outcomes and fiscal

decentralization and concentrates on grammar schools. All three papers take counties as units of analysis so it is a regional economic perspective. Some research studies on determinants and effects of public school spending already exist on state- level or with microdata (e. g. Potrafke, 2011; Kauder and Potrafke, 2013; in a wider sense Pischke, 2007) but there is, to the best of my knowledge, only one on county- level so far (Schwarz and Weishaupt, 2013). The county-level is often called the "forgotten" level in terms of research – another reason to address these research topics in the way I do it in this dissertation.

In a first step, I give an introduction into the economics of local school financing. Section 1.1 gives an introduction and motivation whereas section 1.2 summarizes the state of research in terms of literature placing my papers into the research context. In 1.2.1 the literature review focuses on the determinants of public school spending, in 1.2.2 it summarizes literature on the effects of public school spending. Section 1.3.1 clarifies the role of German counties, section 1.3.2 describes the German school system. Section 1.4.1 provides (internationally comparative) descriptive statistics on the German school system and in section 1.4.2 I describe the dataset used in all three papers. Last but not least, I explain the structure of my thesis in Section 1.5.

1.2 State of research

There is much literature on education expenditures. One can distinguish between a stream of literature looking at the input side – namely at the determinants of school expenditures as inputs- and another one dealing with the output side addressing the effects of school expenditures on school outcomes as the output. Sub-Chapter 1.2.1 summarizes the relevant theoretical and empirical literature on the determinants and Sub-Chapter 1.2.2 is a summary of theoretical and empirical studies on the effects of (local) public school spending.

1.2.1 Determinants of public school spending

There is much literature on the determinant-based part of economic research on (public) school spending taking the political economy determinant side perspective. More precisely, my research questions deal with public expenditures by local agents so it is on the determinants of public school expenditures as a regional economic question.

There is a theoretical paper on this question by Falch and Rattso (1997) which is worth to mention. A multi-level model of the demand for education provision is derived including bargaining between teacher unions and the central government in combination with a demand model for local education provision. The strength in bargaining of the central government depends on political factors. This model is tested with the help of a long panel dataset from Norway. The authors find that a stable government with less party fragmentation seems to decrease teacher employment whereas a high power of the socialist party appears to lead to higher teacher employment and wages. Moreover, local governments tend to react in a rather inelastic way to central cost increases when making their own expenditures decision.

A very recent model on education spending is derived by Dotti (2019). More precisely, the author addresses the relationship between income inequality and public education expenditures by a voting model. Depending on voters' preferences, education quality, parameters of the tax system as well as public expenditures in other areas are determined. Private education exists as an exit option in this model. Dotti finds that income disparities lead to higher public education spending if and only if the expected marginal returns to education are higher for children whose parents earn comparably low wages. On the other hand, higher education quality often results in lower inequality in the future. These findings are in line with prior empirical findings on related topics.

Furthermore, there is a large body of empirical studies focusing on political and socioeconomic determinants of (local) public school spending for other countries and therefore usually with a focus on secondary and elementary schools. Denzau and Grier (1984), Denzau (1975) and more recent studies such as Freitag and Bühlmann (2003) with their research on Switzerland should be mentioned. One more recent study deals with German counties (Schwarz and Weishaupt, 2013). One could conclude that determinants tend to differ in some significances and particularly in the size of effects found- sometimes even in the direction (see more current international studies in the literature reviews of Chapter 3 and 4). Miller (1996) already tested an interest group model with elderly and parents as different and in this case rival interest groups. The author assumes that parents favor high spending levels for public education whereas elderly should prefer rather low levels. State- and county-level results using the population share of elderly people versus parents as explanatory variables of the expenditure level confirm this assumption.

1.2.1.1 Interregional competition

Interregional competition is a topic of many research contributions, too. It might be an interesting determining factor in regional economic analyses (see Chapter 2).

A highly influential theory applicable here is the theory of interregional tax competition by Wilson (1986). According to the model, there is competition for capital between local governments leading to low tax rates and low public expenditures. It is possible to derive from the theory that this form of competition exists as well as that it does not exist. Nevertheless, it must exist under realistic conditions from an empirical point of view. The majority of empirical investigations support this theory in the field of taxes (e.g. Winner, 2005). In contrast to prior

findings, Lyytikäinen (2012) does not find any spatial interdependences concerning property taxes using spatial econometric methods.

The first paper of this thesis (Chapter 2) also addresses the topic with a spatial econometric approach which goes back to Anselin (1988). Spatial econometric analyses on school spending already exist and mainly find positive spatial interdependencies (e.g. Ajilore, 2013; Gosh, 2010; Solé-Ollé, 2006).

1.2.1.2 Political economy perspective

To address the theory on political determinants more directly (as it is done in Chapter 3), one should mention some political scientific theories at this point. The Partisan Theory is on the role of political (party) ideology in certain economic policies (including expenditures). On the one hand, the traditional approach by Hibbs (1977) says that parties' policies and therefore economic policy and outcomes always depend on the party ideology and on the cliental of a party. On the other hand, the rational partisan theory by Alesina (1987) assumes opportunistic behavior of a party or policymaker.

For Germany, there are already some studies on the political determinants of public school spending. Potrafke (2011), for example, finds hints in an analysis of the state's governments for West-Germany that leftwing parties tend to spend more for schools whereas rightwing governments seem to spend more on universities and cultural issues.

1.2.2 Effects of public school spending

1.2.2.1 Education production

There is also some input as well as outcome-based research from other countries which is worth to mention and more relevant for my Solo-Paper. From a theoretical point of view, this research topic goes more into the classical field of education economics which is founded on the education production function and in a broader sense on the human capital theory by Becker (2009).

One of the first studies on the effects of school spending was the Coleman Report (Coleman et al., 1966). Its results showed that the input in terms of expenditures did not affect students' achievements in standardized tests.

Many studies on the effects of education spending on output yield different but somewhat comparable results. Hanushek (1986) summarizes prior empirical studies on education production and finds that education expenditures do not affect education outcomes in most cases. This is in line with his later findings (Hanushek, 2003).

Levacic and Vignoles (2002) review four studies on the relationship between school resources and student outcomes in the UK with pupil-level data. They find rather small impacts of resources and highlight the importance of specifications and better quality datasets to estimate education production functions.

More specifically, the relationship between class size and pupil achievements are a subject of many empirical studies. Krueger (2003) presents a reanalysis of existing literature on this question and concludes that there are positive effects of smaller classes even though the effect is rather small and sensitive to misspecifications or too small samples. One study which should be highlighted is the one by Angrist and Lavy (1999). Their analysis builds on the so-called

Maimonides' rule in Israel restricting the maximum number of pupils per class to 40. Using a regression-discontinuity design (and being one of the most influential study on this method), they find positive effects of a smaller class size on test scores of fourth and fifth graders.

The research on education production functions is closely related to the theoretical efficiency literature. Pritchett and Filmer (1999) discuss different models on the optimal allocation of expenditures. The classical optimization model predicts that each input factor should be allocated so that its marginal product is equal to that of the other inputs. Nevertheless, the existing literature says that the marginal product of the teacher input is 10 to 100 times lower than the marginal product of the other input factors such as books and other instructional material.[1] This indicates a relative overuse of teachers compared to other input factors (unlike predicted by the classical theory) - maybe because teachers are a stronger lobbying group than parents. This implies that one should not try to find the technical optimal input allocations but rather change the decision making structure towards a more efficient one.

Moreover, experimental methods are used in some studies. Dynarski et al. (2013) addresses the long-term impact of early education inputs, namely college enrollment and graduation. A project assigned pupils randomly to classes of different sizes (from kindergarten until third grade). They use linear probability models and find positively significant effects of smaller classes on the outcome variables (especially for black pupils).

BenDavid-Hadar and Ziderman (2011) empirically derive a new budget allocation formula for schools in Israel which should be need-based and more equitable. They use a nationwide database on pupils, schools and teachers in Israel. The derived formula is compared to the currently used one.

[1] This distinction between different kinds of input factors is highly relevant and applied in my Solo-Paper (see Chapter 4).

1.2.2.2 Education decentralization

Furthermore, analyses on education outcomes, education production functions and efficiency often include a decentralization reform as a source of variation.

From a theoretical point of view, education decentralization might improve outcomes through better knowledge of the local environment and needs (Fiske, 1996), higher accountability resulting in higher incentives for good performance (Hanushek et al., 2013), competition because of more agents (Oates and Schwab, 1988) as well as Tiebout Sorting (Tiebout, 1956). Tiebout Sorting means that inhabitants are mobile and tend to move to the region where the public goods (including education) are provided according to their preferences. So decentralization and therefore interregional differences in the provision of public goods might result in a segregation of citizens according to their education preferences and characteristics. In combination with the competition mentioned by Oates and Schwab (1988) and possibly because of Tiebout Sorting, this might result in a higher local provision of education resources by the public sector in order to avoid this development (see section 1.2.1).

On the other hand, education decentralization could lead to lower efficiency in the provision of resources because of less economies of scale which standard Microeconomic Theory suggests. Moreover, it could bring higher disparities in education provision and expenditures (Elmore and Fuller, 1996).

Many empirical studies analyze decentralization reforms in the USA and Latin America during the 1970s, 1980s and 1990s. Jackson et al. (2015), for example, deal with finance reforms in the USA and Faguet and Sanchez (2008) analyze Bolivia and Columbia. Many of these research contributions find positive effects on the level of expenditures and often also an indirect and positive impact on education outcomes (and inequalities). (Roy, 2011; Papke, 2005)

So far, there are no comparable regional economic studies on German school finance.

1.3 Institutional background

In the upcoming section, I will clarify the institutional background. In the first sub-section (1.3.1), I will give a short description of counties in Germany and its tasks. Thereafter, I will describe the German school system (1.3.2). Thirdly, I will explain how schools are financed (1.3.3).

1.3.1 The role of counties in Germany

Germany consists of 16 states and states are the second highest decision-making level after the Federal Republic of Germany itself. The competencies of the German states are quite large. When it comes to schooling, there is (in practice) no higher decision-making authority (see 1.3.3).

The counties are the third-highest federal level. The forth and lowest federal level is the municipal level. Their right of self-government is guaranteed by the *Grundgesetz* as the German constitution (GG, art. 28(2)).

There are 294 rural counties (*Landkreise*) in Germany, an area consisting of different municipalities and (often also) villages with a district town which is often the biggest city in a county and where the county is administered. Moreover, there are 107 municipalities with county rights (*kreisfreie Städte*). These are bigger municipalities which are counties for itself including the same tasks and competences. The biggest county in Germany had a population of 616,824 inhabitants (the county of *Recklinghausen* after the Region Hannover with 1,152,675

inhabitants), whereas the smallest county had a population of 3,4270 (*Zweibrücken* as a municipality with county rights) in 2017.

German counties have compulsory tasks, assigned federal tasks and voluntary tasks. They execute laws of the states and supply supra-municipal goods, services and equalization tasks.

There is the county council (*Kreistag)* which is elected by the inhabitants of the county to represent them in county-specific affairs. Statutes are enabled by the *Kreistag* so its functions are associated with the legislative (Bogumil and Jann, 2009; Henneke, 2012). Furthermore, there is a committee called *Kreisausschuss*, a supervisory authority created by the *Kreistag*. The *Landrat* is in a way the executive (Bogumil and Jann, 2009) being a local government authority as the head of the county's administration (Fuchs, 2012). Moreover, he is an administrative authority. However, the exact competences of these decision makers differ considerably between the different states in many cases.

Instead of levying own taxes, the county determines a specific "rate" of income the municipalities of the county are obliged to contribute to the county budget. It is named *Kreisumlage*. Last but not least, vertical grants generate additional revenues for the county. (Henneke, 2012)

1.3.2 The German school system

An internationally rather unique characteristic of the German school system is its early and still rather strict segregation. School starts once children reach an age of six years with the elementary school. They spend – depending on the state- six (Berlin and Brandenburg) or more often four years there. Following the elementary school, pupils with good grades usually continue with the grammar school (*Gymnasium*) which allows them to attend any German

college or university once it is finished successfully, a diploma named *Allgemeine Hochschulreife* or more generally *Abitur*. Traditionally, pupils spend 7 or 9 years there depending on the duration of elementary school. Secondly, average-performing pupils traditionally attend a secondary school (*Realschule*) with ends after the 10th grade. It qualifies for an apprenticeship upon successful graduation. The same is true for lower secondary schools (*Hauptschulen*) finishing after nine (or ten) years of schooling (elementary school included). The latter school track is only for low-achieving pupils. (Cortina et al., 2003; Avenarius and Füssel, 2010)

Apart from that, another rather unique property of the Germany school system are the vocational schools. They provide the theoretical training as part of the German-specific dual apprenticeship whereas the practical part is trained in companies or other institution (hospital etc.). Graduates of an apprenticeship get a qualified diploma acknowledged at the labor market. Many different professions like bank clerk, nurse, electricians or hairdresser fall under this category. Furthermore, vocational schools offer other school tracks allowing people to continue school after secondary school to acquire some form of college entrance permission. This is where segregation of the school system ends. The majority of those vocational school pupils finish it with a diploma qualifying them to enter universities of applied sciences. Some minor tracks (mostly vocational grammar schools) make it possible to yield a general university entrance qualification. (Cortina et al., 2003)

There are two current reforms worth to mention. First, the time at grammar schools was reduced by one year to 8 or 6 years (depending on prior education). In West-Germany, the first double-graduation cohort was in 2010 (I do not deal with East-Germany in my studies, see section 1.4.2). A reestablishment of the former duration of 9 or 7 years of grammar schools is planned in most states.

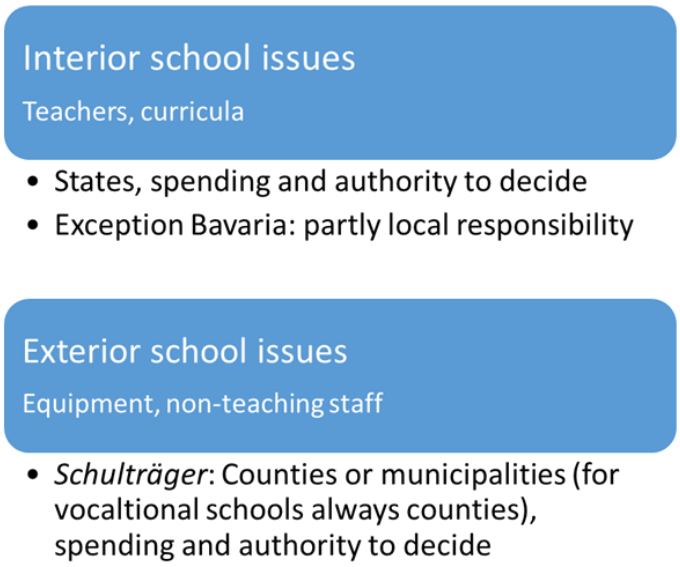
Secondly, the two secondary school forms (*Realschulen* and *Hauptschulen*) were abolished and comprehensive schools where it is possible to get any form of school diploma were founded instead. (Hurrelmann, 2013)

(Hurrelmann, 2013; Cortina et al., 2003)

1.3.3 German school financing

In Germany, the federal state is only responsible for universities or colleges in practice. The decision-making authority and the spending authority is distributed between two federal agents. The states have the authority to decide as well as the spending and allocation authority concerning teachers and curricula. These issues are the so-called interior school issues. One exception is Bavaria because local agents are partly also responsible for these issues. All other school issues are called exterior school issues (e.g. investments like buildings and facilities, running expenditures like equipment, books etc.). They are decided on and payed for by local agents. The agents responsible for the exterior school issues is called *Schulträger* (responsible for schools). It is the county or the municipality. For vocational schools, it is always the county, for grammar schools it is the municipality or the county but more often the county. The other school forms are under the responsibility of municipalities in most states. Decision making authority and spending authority are always congruent. The social workers (including school psychologists etc.) are in some states financed by the local agent *(Schulträger)*, sometimes by the state and sometimes by both of them. (see Figure 1.1)

Figure 1.1: Responsibilities in local public school financing in Germany



Source: Own figure based on Avenarius and Füssel, 2010; Avenarius and Heckel, 2000; Schwarz and Weißhaupt, 2013.

1.4 Dataset

In this Sub-Chapter of my introduction, I will present some descriptive statistical indicators characterizing the German school system and school finance (1.4.1). Afterwards, I will briefly describe the data used in all three papers (1.4.2).

1.4.1 Descriptive statistics on the German education system

The overall German public education expenditures added up to 117.0 billion Euros in 2013 which was a share of 19.9% of the overall public direct expenditures. The shares were even higher (slightly over 20% in the upcoming three years). These shares were higher in West-Germany than in East-Germany in 2013. In 2005, the federal state payed 0.6 billion Euros for

schools whereas the state payed 40,5 billion Euros and the municipalities 0.1 billion Euros. In 2013, on the contrary, the federal state did not pay anything for schools, the state payed 49.5 billion Euros and the municipalities 10.7 billion Euros. So the state had to bear a share of 82.2% in 2013. From 2005 to 2013, the public expenditures per pupil at public schools including vocational schools rose whereas the number of overall pupils decreased with high interregional variations.

Furthermore, the number of college entrants increased as well. While in 2005 only 356,076 people started to study, this number went up to 508,621. (Brugger et al., 2016)

In the school year 2004/05 36% of all 4^{th} (or 6^{th}) grade elementary school children changed to a grammar school while this rate already reached a value of 41% in the school year 2014/15.

In an international comparison of OECD states concerning the annual expenditures per pupil for educational institutions from the primary up to the tertiary education sector, Germany was above the OECD average in 2004, whereas Poland, South Korea and Spain were below that average. The USA spent the most, closely followed by Switzerland (OECD, 2007).

During the same time period, the rate of school graduates attaining a university entrance diploma increased by 10 percentage points. A general university entrance diploma was attained by 41% and a university of applied sciences entrance permission by 12% of all graduates in 2014. (Brugger et al., 2016; Brugger et al., 2018).

The first time upper secondary graduation rate of Germans younger than 25 was below the OECD average in 2016. The highest rate was reached in Korea and the lowest rate was reported for Costa Rica (OECD, 2018).

1.4.2 Description of the dataset

In all three papers, county-level data are used. Because of considerable county reorganizations and fusions East-German counties are excluded. The three city states Hamburg, Berlin and Bremen are also excluded because of the institutional differences and especially because of the fact that the local level (counties) do not exist there. Parts of one composite dataset are used in each paper – with differences in the sizes as it is an unbalanced panel dataset and questions with specific data needs are analyzed (e. g. balanced panel for the spatial econometric analysis in paper 1, Chapter 2).

The overall dataset consists of unbalanced panel data from 2000 to 2014. The school expenditures data are from the annual financial accounts of the municipalities including those of the counties – the so-called *Jahresrechnungsstatistik der Gemeinden*. They are provided by the Statistical Offices of the states.

Most of the political, socioeconomic and education panel data are from the Regional Database Germany and from the local education database provided by the Federal Statistical Office and by the Statistical Offices of the states. Some data on sectoral employment are from the statistical department of the German Federal Employment agency.

In addition, geo data (shape files) from the Federal Office for Cartography and Geodesy are included.

1.5 Structure of the thesis

The main part of my thesis consists of three Chapters – one for each paper. All three papers are related as mentioned before. In the first part of this thesis (paper 1 and 2) I analyze the determinants of local public school spending whereas the second part (paper 3) deals with the

public finance aspect – namely the effects of local public school spending and decentralization of local public school spending on short-run school outcomes. So the Chapters only partly build on each other and it is also possible to read all Chapters independently. Each Chapter includes an abstract, again an introduction and a review of paper-specific literature.

In this thesis, I empirically analyze the following main research questions:

- What are the determinants of public spending by counties for vocational schools?
- Are there any spatial interdependencies as hits of interregional competition in these expenditures?
- How does the political composition of the county council and its alignment with the governing parties on state level influence the latter expenditures?
- What are the effects of county expenditures for grammar schools on the local rate of pupils who get their *Abitur* successfully?
- What are the effects of state inputs (in terms of teacher density) for grammar schools on the local rate of pupils who get their *Abitur* successfully?

Chapters 2 to 4 can be summarized as follows.

Chapter 2 consists of a paper I wrote together with my supervisor Ivo Bischoff. It was presented at the EPCS Conference 2017 in Budapest and was published in the Review of Regional Research.[2] In this paper, determinants of expenditures for vocational schools by counties are analyzed using a panel dataset on 193 West-German counties from 2001 to 2006. Several

[2] Bischoff, I. and Hauschildt, J. (2019). Vocational schools as an instrument of interregional competition—Empirical evidence from German counties. Review of Regional Research, 39(1), 65-89.

different types of spatial econometric specifications are applied to find out whether there is any spatial correlation in the latter expenditures indicating interregional competition via vocational schools. No significant effects are found. Moreover, an extension comparing the teacher-to-pupil ratio of counties at state borders to that of interior counties shows no significant differences which supports the finding that there are no hints of any spatial correlation of local expenditures for vocational schools.

Chapter 3 is another joint research paper with Ivo Bischoff. It has been handed in for publication in the Journal CESifo Economic Studies and is now in the review process.

Once again, the determinants of expenditures for vocational school by counties are analyzed – this time from a political economy perspective. We use data on this expenditure variable of 301 German counties from 2002 to 2013 and the voting power of different parties in the county council and the alignment with the governing party on state level as main explanatory variables. Our model specifications are fixed effects and mixed models. Our findings indicate that counties' expenditures on vocational schools go down in the share of Social Democrats and go up in the share of Christian Conservatives in the county council. They seem to be higher in election years. Moreover, no positive impact of deindustrialization is found which is not in line with the findings by Jensen (2011).

Chapter 4 includes my single-authored paper. It was accepted for presentation at the EPCS Conference 2019 in Jerusalem and it was also accepted and presented at the IIPF Conference 2019 in Glasgow. It is on the short-run impacts of grammar school expenditures from county and state level on the rate of successful grammar school finishers using a dataset on Western German counties from 2001 to 2011. Moreover, I address the effects of decentralization of grammar school expenditures on the rate of grammar school graduates. To deal with the common endogeneity issues in this area, I use an instrumental variable (IV) approach with the

lagged expenditures variable, an election year dummy and a variable on the voting power of Christian Conservative in the county council as instruments. A standard Two- Stage Least Squares (2 SLS) as well as a Lewbel instrumental variable approach are applied. My findings can be summed up as follows: Teacher density as the state input is found to have positive effects. The same is true for grammar school expenditures by counties as the local input. The measure of decentralization applied here does not appear to have any significant impact.

In Chapter 5, a conclusion is drawn summing up my contribution (5.1) and deriving ideas for further research in this field (5.2).

Chapter 2

2 Vocational schools as an instrument of interregional competition – empirical evidence from German counties

Ivo Bischoff

Julia Hauschildt

Abstract

We analyze expenditures on vocational schools on county level using data from 193 West-German counties between 2001 and 2006. These expenditures represent the main public input to the widely acknowledged German apprenticeship system by local governments. We use spatial econometrics to test for spatial correlation in counties' expenditure on vocational schools but find no evidence that vocational schools serve as instrument in inter-regional competition. This conclusion receives further support by an alternative test, in which we compare the teacher-to-pupil ratio of counties on the state border and interior counties. The test does not give any indication that the teacher-to-pupil-ratio is higher in counties located at the state border.

2.1 Introduction

The German system of apprenticeship and vocational training is widely known throughout the world. It offers an attractive alternative to university-education for young people. In the classical apprenticeship system, young people enter a contract with a firm that employs them and trains their firm-specific skills. During the time as apprentice, they visit a vocational school that provides them with more general training. After having passed the necessary examinations, apprentices are awarded an official diploma by the chamber of commerce. Apprentices and firms can choose between more than 300 standardized professions (BIBB, 2014) or

"occupational profiles". The curricula for these professions are developed in a cooperation between government, labor unions and the chambers of commerce. This ensures that apprentices develop a mix of general and firm-specific skills and thus are attractive for future employers. Compared to untrained workers, employees who successfully acquire apprenticeship training receive higher wages and are less likely to be unemployed (e.g. Schmidt, 2005).

The German apprenticeship system is widely recognized to promote productivity especially in the industrial sector – thereby making Germany attractive for industry settlements despite its high wages and comparatively high degree of regulation (e.g. Finegold and Soskice, 1988; Steedman, 1993; Thelen, 2007). Thus, the German apprenticeship system plays a prominent role in the international competition for capital and especially industry settlements. At the same time, jurisdictions compete with each other through tax and expenditure policies (e.g. Wilson, 1986; Brueckner, 2003). Putting these facts together, we raise the question whether regional governments use expenditures on vocational schools as an instrument in interregional competition for capital?

In Germany, funding for vocational schools comes from two sources: The state government provides teachers and pays for their salaries while the county governments cover the costs for the so-called "external school affairs". These comprise – among other things – the costs of building and maintaining school buildings as well as maintenance and administrative staff. In addition, counties provide the funding for the training facilities in vocational schools. Especially for technical professions, these facilities are quite expensive. In 2001, the average expenditures per pupil amounted to 1323 Euros and the average total expenditures per county added up to almost 5.1 million Euros. At the same time, well-equipped schools can provide higher quality training. In public statements, local politicians and firms often argue that vocational schools are

an important location factor for firms. Thus, it seems reasonable to hypothesize that county governments use expenditures on vocational schools as an instrument in inter-regional competition for firms. In recent years, scholars have applied models from spatial econometrics to test for spatial correlation in local expenditures on primary and secondary schools (e.g. Ghosh, 2010; Gu, 2012). So far, however, these methods have not been applied to vocational schools. This is where our paper comes in. We use panel data from West-German counties between 2001 and 2006 and apply spatial econometrics to test for spatial correlation in the counties' expenditures on vocational schools. We find no evidence that vocational schools are used as an instrument in inter-county competition.

In an additional empirical test, we analyze the way in which state governments allocate teachers to the vocational schools in different counties. If this allocation is used as a strategic tool in inter-regional competition, we expect the teacher-to-pupil ratio to be higher in counties at the border to other states. Our analysis does not support this notion. Thus, we conclude that expenditures on vocational schools are not used as an instrument in inter-regional competition.

The paper proceeds as follows: Section 2.2 reviews the literature before section 2.3 sketches the institutional background. Section 2.4 presents our data and method. Results are presented in section 2.5. Section 2.6 discusses the results and concludes.

2.2 Review of literature

New Economic Geography tells us that the location decision of firms is strongly driven by agglomeration rents and network externalities. This makes it very difficult for governments especially in rural regions to promote regional development and prevent the outflow of mobile capital and high-skilled labor (e.g. Pflüger and Südekum, 2008). Nevertheless, providing good

infrastructure to firms is still one of the key instruments in regional development strategies. Good vocational schools may be one element of this firm-related public infrastructure. While the importance of the apprenticeship system for regional economic performance is mentioned parenthetically, few authors place an emphasis on this relationship. One exception is a study by Bradley and Taylor (1996). They analyze interactions between the vocational training system and the local economy in a theoretical model: The model suggests that the output of vocational training and the stock of high-skilled workers form a positive feedback loop. In addition, the number of high-skilled workers has a positive influence on local competitiveness and economic performance. Bradley and Taylor (1996) find support for the existence of these positive feedback effects in their empirical analysis for local England. Di Gioacchino and Profeta (2014) develop a two-sector model on lobbying for education, arguing rather the other way round: They stress that the production structure and firms' political pressure activities influence education policy and therefore also the composition of human capital.

The existing studies on the German apprenticeship system mainly focus on its economic effects on productivity, industry structure and income inequality. Starting in the 1990s, a number of authors address the question why this system exists in some countries like Germany or Austria while similar systems are missing in the UK or US (e.g. Harhoff and Kane, 1993; Soskice, 1994). They analyze the institutional and contractual arrangements of the system to learn more about the incentives of firms to train their employees. The essential question is: Why do firms pay for the vocational training of employees (while they usually do not pay for university education of their employees)? Essentially, they reach the conclusion that labor market imperfections and other institutional settings in Germany led to high-skill high-education equilibrium characterized by a high degree of training paid by the employer and a low frequency of quits. Countries with less regulated labor markets are more likely to end up in the low-skill-

low-education equilibrium where quits are high and firms do not pay for training (see also Acemoglu and Pischke, 1998).

There is a large body of literature on local/regional expenditures for primary and secondary education. It covers different countries and identifies a number of factors that drive local primary and secondary education. These include the age structure in the population (e.g. Denzau, 1975; Poterba, 1997), per capita income (e.g. Miller, 1996; Fernandez and Rogerson, 1996), political, economic and racial fragmentation (e.g. Colburn and Horowitz, 2003) and government ideology (e.g. Colburn and Horowitz, 2003; Potrafke, 2011).

Recently, a number of authors have addressed the question whether there is spatial interdependence in the expenditures on education. The theoretical literature suggests that these expenditures should be spatially correlated because public education creates spillovers. One strand of literature concentrates on higher education. Büttner and Schwager (2004) analyze the higher education spending decision of German states. They develop a theoretical model showing that students' mobility results in underinvestment. Using data on higher education expenditures by German states, they find a negative correlation between the expenditures of one state and those of its neighboring states (see also König et al., 2017). Poutvaara (2004) argues that the national incentives to invest in public education decrease as a result of labor mobility. He shows that graduate taxes or income-contingent loans improve welfare compared to a situation where employment-based taxes are used to fund education. All in all, the existing studies agree that decentralization in higher education financing leads to underinvestment and therefore underprovision if there is no private financial contribution at all (see also Justmann and Thisse, 1997). While vocational schools in Germany do not take any user fees either, vocationally trained employees and especially apprentices are far less mobile than the

academically trained. Moreover, firms have an immediate benefit from employing apprentices even in the time of training.

A number of studies apply spatial econometrics to test for the existence of spatial correlation in local expenditures on primary and secondary education. Spillovers are expected to be especially strong if parents are free in the choice of school for their children and they can choose to send them to another school district (Rincke, 2006; Ghosh, 2010). Ghosh (2010) uses a dataset for Massachusetts school districts and applies a Spatial Autoregressive Model and a Spatial Error Model. He takes expenditures per pupil, pupil-teacher ratio as well as a measure for the teachers' qualification as dependent variables. For expenditures per pupil, he finds positive spillover effects. Negative spillovers from direct neighbors are found concerning the pupil-teacher ratio whereas no significant spillovers are found for the third dependent variable. Both results indicate that there is inter-regional competition. Gu (2012) reaches the same conclusion when analyzing disparities and spatial interactions in local public education expenditure per capita in 1520 Chinese counties. He uses a Spatial Error Model as well as a standard Spatial Lag Model and finds significantly positive spillovers of school expenditures by neighboring counties. In this paper, we apply similar techniques to test whether the counties expenditures on vocational schools are spatially related.

2.3 Institutional background

2.3.1 The German apprenticeship system

The apprenticeship system in Germany is internationally (almost) unique. It offers the possibility for young people who finished secondary school to acquire a formal qualification certified in a Diploma without going to college or university. They can choose between more than 300 different professions like bank clerk, construction worker, mechanic, electrician, IT-

technician etc. (BIBB, 2014). For each profession, a nationwide curriculum settles the essential content of the apprenticeship education. The curricula of existing professions and the introduction of new professions are settled in a formalized process involving the chambers of commerce, labor unions and the German national and federal government as well as the Federal Ministry of Education and Research and the Federal Institute for Vocational Education and Training (Kuppe et al., 2015).

The standard way for a young person to acquire an apprenticeship qualification is to fill a position as apprentice in a firm that is qualified to train him in the desired profession. Apprentices sign a special contract with their employer. In this contract, the firm agrees to provide the apprentice with the necessary training in the practical parts of the profession and to give him the time off to visit the vocational school. The largest part of vocational schools are state-run schools. They offer courses in general skills and in the theoretical skills underlying a profession (e.g. material sciences, programming skills). The apprentice agrees to go through the training and to work for the firm during the rest of the time. Apprentices receive some pay but the amount is generally lower than the pay of untrained workers.

Visiting the vocational schools is obligatory and costless. Apprentices usually attend a vocational school (*Berufsschule*) for 1-2 days per week. In most cases, they visit vocational schools that are located in the county where their firm is located or in neighboring counties. For some rather rare vocational programs, however, students may have to travel considerable distances for theoretical training. In this case, they usually receive block training. Depending on prior school education and profession, the time of apprenticeship is usually two to three and a half years (Kuppe et al., 2015). The chambers of commerce are in charge of supervising the practical training within the firm and make sure that it complies with the agreed standards. They are also in charge of the final examination of apprentices in the practical elements of their

education (Hippach-Schneider et al., 2007). The apprenticeship contract usually ends after successfully completing the apprenticeship. Some apprentices are offered the prospect of a regular labor contract after successfully completing their training. The retention rate varies across firms and industries. In general, the retention rate is low in small firms and high in large firms (e. g. Pfeifer et al., 2009).

2.3.2 The role of German counties

The German constitution assigns the task of education to the states (*Länder*) which in turn delegate some of the tasks to the county level. Therefore, it is necessary to take a closer look at the counties in Germany. As of 2001, 118 German cities served as municipality and county at the same time (so-called cities with county rights). Next to them, there are 367 rural counties (*Landkreise)* with an average population of 178.448 and an average number of 42 municipalities on their territory (in 2001). Hereafter, we will use the term county as generic term for both cities with county rights and rural counties. The German Constitution grants municipalities and counties the right to self-government (Grundgesetz, Art. 28(2)). Municipalities are granted substantial autonomy in their decision about how to fulfill their tasks and they have the right to raise local taxes (including the right to set a local tax multiplier). The German counties have much less autonomy. They are assigned a "twin role" placing them in charge of a) executing numerous *Länder* laws (such as the exterior school issues for vocational schools or local social security benefits) and b) providing supra-municipal goods and services (e.g. county hospitals, county roads, waste management). Furthermore, they give support to financially weak local municipalities to guarantee an equal provision of local public goods and services within the county. Sometimes, administrative tasks are assigned to them by the state (e.g. building and

trade control). Besides, there are some voluntary tasks, especially concerning cultural issues like museums etc. (e.g. Seele, 1990; Scherf and Hofmann, 2003).

The county parliament (*Kreistag*) is elected by the citizens of the county to represent them in all affairs settled on county level. It is authorized to enact statutes and can be seen as the legislative body of the county (Jann and Bogumil, 2009). The so-called *Landrat* is the head of the county's government and administration at the same time (e.g. Jann and Bogumil, 2009; Fuchs, 2012). He is accountable to the *Kreistag* when it comes to fulfilling tasks assigned to the county level and accountable to the state government when it comes to delegated tasks. Finally, there is the *Kreisausschuss* which is basically a committee created by the *Kreistag* as supervisory authority.

On the revenue side, the *Landkreise* rely to some extend on vertical grants while they do not have any tax autonomy. However, they have one source of revenues for which they can influence the size by setting a rate. This is the so-called *Kreisumlage*. The *Kreisumlage* defines a share of "regular municipal revenues" that the county can extract from the budgets of its municipalities. The taxrate (so-called *Umlagesatz*) is set by the county council in a simple majority vote. The municipalities' approval is not needed. The higher the *Kreisumlage*-rate, the more municipal fiscal capacity the county is taxing away (e.g. Seele, 1990; Henneke, 2012).

The formal responsibility for vocational schools rests with the German *Länder*. They are in charge of the so-called interior school issues. In other words, they employ the teaching staff and pay for their salaries. In addition, they develop the curricula (in accordance with the nationwide regulations negotiated with the chambers of commerce). The counties are in charge of the exterior school issues and have to provide funding for non-teaching staff, after school care, buildings, school equipment, administrative costs etc.

In most counties, vocational training is concentrated in a few, large school centers. These school centers often encompass different types of vocational schools that share facilities and staff. For this reason, the statistical offices cannot provide expenditure data by school type but publish joint expenditure data on a number of different schools grouped as schools of the vocational education branch (*Berufliche Schulen*). Hereafter, we will use the term vocational pupils as umbrella term for all pupils in the schools of this vocational education branch. The term apprentice is used for those pupils with a labor and training contract with a private firm who visit a *Berufsschule* – the school we are primarily interested in. It is by far the largest type of vocational school, accounting for 67 percent of all pupils in *Landkreise* and 71 percent in cities with county rights (in the sample of West-German counties without Bavaria underlying the main analysis below). For some professions, e.g. in the field of health care, the need for theoretical training is substantially larger. In these professions, apprentices usually do not have individual contracts with a training firm or other institution. Instead, they undergo three years of schooling in so-called *Berufsfachschulen* and receive practical training during internships outside schools. Students graduate from this school type with a vocational qualification in their chosen field. These schools account for 21 percent of all pupils in *Landkreisen* and 16 percent in cities with county rights. Next to these two types of schools that provide vocational training and account for almost 90 percent of all pupils, a few other types of schools belong to the vocational education branch. The so-called *Fachschule* offers advanced training for adults who have already completed an apprenticeship and who have already acquired some work experience. It provides general as well as (theoretical) vocational training and can be finished with a general university entrance qualification or a university of applied science entrance qualification. The *Berufsoberschulen* provide the same qualification upon successful graduation but require some form of completed apprenticeship. Vocational grammar schools are full-time grammar schools where some (minor) subjects include vocational aspects. The

successful graduation from this type of school gives the students a general university entrance qualification (KMK, 2015). The share of the remaining types of vocational students is negligibly small.[3] In our analysis, we will control for the shares of pupils in different school types.

Given the large number of more than 300 professions for which apprenticeship contracts can be signed, it is obvious that not all counties can offer the relevant vocational school classes in all these professions (so-called *Fachklassen*). Instead, most counties only offer a limited amount of *Fachklassen*. Firms and apprentices in a certain county i can still sign an apprenticeship contract for a profession not offered by the vocational schools of their county. In this case, the apprentice has to visit a vocational school in a different county. For frequent professions, it is often possible to find the adequate *Fachklasse* in the neighboring county. Apprentices of rare professions may have travel substantial distances for vocational school training. The regional distribution of *Fachklassen* is settled by the state – after consulting the regional chambers of commerce and the counties'. It seems reasonable to assume that some types of vocational training are more expensive per apprentice than others. For instance, technical apprenticeships which require training in apprenticeship workshops cause higher (material) costs than those without apprenticeship workshops (Pfeifer et al., 2009). As data on the distribution of *Fachklassen* across counties is not available, we control for these differences through county fixed effects.

The cities with county rights play an important role in providing vocational training to apprentices working in a neighboring "*Landkreis*". Frequently, the counties also open their training classes to apprentices from nearby cities. Generally speaking, however, the exchange

[3] Additionally, there are some (minor) types of vocational schools which only exists in some German states, e. g. *Fachakademien* in Bavaria. They are comparable to *Fachschulen*. Vocational students without apprenticeship are included in the *Berufsschüler* but we control for their share (see data section).

is unbalanced with the cities receiving more outside students than they send to the surrounding counties. In most states, vocational schools receive a fixed grant per student from outside covering some of the variable costs (Avenarius and Heckel, 2000).

Table 2.1: Vocational schools and student structure in West Germany without Bavaria (2002)

Table 2.1.1: *Landkreise*

Variable	Obs	Mean	Std. Dev.	Min	Max
No. Voc. Schools	149	6.42	4.70	1	25
Share Berufsschüler	149	0.63	0.09	0.29	0.80
Share Berufsfachschüler	149	0.22	0.07	0.07	0.40
Share Fachgymnasiasten	149	0.06	0.06	0	0.18
Share Fachschüler	149	0.06	0.04	0	0.38
Share Fachoberschüler	149	0.04	0.04	0	0.27
Share foreign students	149	0.07	0.05	0	0.25
Share without apprenticeship	149	0.09	0.04	0.02	0.19

Table 2.1.2: Cities with county rights

Variable	Obs	Mean	Std. Dev.	Min	Max
No. Voc. Schools	44	8.57	7.24	1	36
Share Berufsschüler	44	0.70	0.05	0.58	0.80
Share Berufsfachschüler	44	0.16	0.06	0.06	0.34
Share Fachgymnasiasten	44	0.03	0.04	0	0.14
Share Fachschüler	44	0.07	0.04	0	0.19
Share Fachoberschüler	44	0.03	0.02	0	0.07
Share foreign students	44	0.09	0.05	0	0.19
Share without apprenticeship	44	0.08	0.04	0.03	0.20

Table 2.1 provides information on the number of schools and the structure students for the West-German *Landkreise* and cities with county rights included in our dataset. The average number of *Berufsschulen* is 6.4 in the *Landkreise* and 8.5 in the cities with county rights. On the other hand, the share of *Berufsfachschüler* and *Fachgymnasiatsen* is substantially larger in

the *Landkreise*. The share of non-German pupils in vocational schools is higher in cities with county rights.

2.4 Data and hypotheses

We use data on 193 counties in the West-German *Länder* for 2001 -2006.[4] The restriction to the years 2001 – 2006 is due to restrictions in budgetary data after 2006. In the main analysis reported here, we exclude Bavaria and restrict the sample to the other West-German *Länder*. The rationale behind this is that the degree of decentralization is substantially larger in Bavaria. In some Bavarian counties, even teachers' salaries are (partially) paid for by the county and official statistics do not provide reliable data about the exact cost-sharing rule or about the reasons for this special treatment. Without Bavaria, we are left with 193 observations per year comprising 149 West-German *Landkreise* and 44 cities with county rights. The descriptive statistics in table 2.2 show that there is substantial heterogeneity in population size, population growth, industry structure, county council composition as well as in economic and fiscal indicators. The average population size is similar in *Landkreise* and cities with county rights (220.000 inhabitants on average). At the same time, we find substantial differences between *Landkreise* and cities with county rights in other categories. Cities with county rights have higher unemployment rates and more debt per capita. In addition, the share of non-German population is larger. Regarding industry structure, cities with county rights have a higher share of employees in the service and production sector while the construction sector is larger in the *Landkreise*. In addition, the share of employees working in large firms (>250 employees) is

[4] Our dataset is a combination of three data sources: Budgetary data from the Federal Statistical Office, the so-called Genesis data on counties' characteristics, also provided by the Federal Statistical Office, as well as data on the share of employees and apprentices by firm size – provided by the statistics department of the Federal Employment Office.

substantially larger in cities with county rights while *Landkreise* have a higher share of employees working in small firms (< 10 employees). A similar pattern is observed for the distribution of apprentices across firms of different size: The share of apprentices working in large firms (>250 employees) is substantially larger in cities with county rights while *Landkreise* have a higher share of apprentices working in small firms (< 10 employees). It is important to note that these shares refer to the location of the apprentices' firms rather than the location of the vocational schools they visit.

Table 2.2: Descriptive statistics of West-German counties (without Bavaria) 2002

Table 2.2.1: *Landkreise*

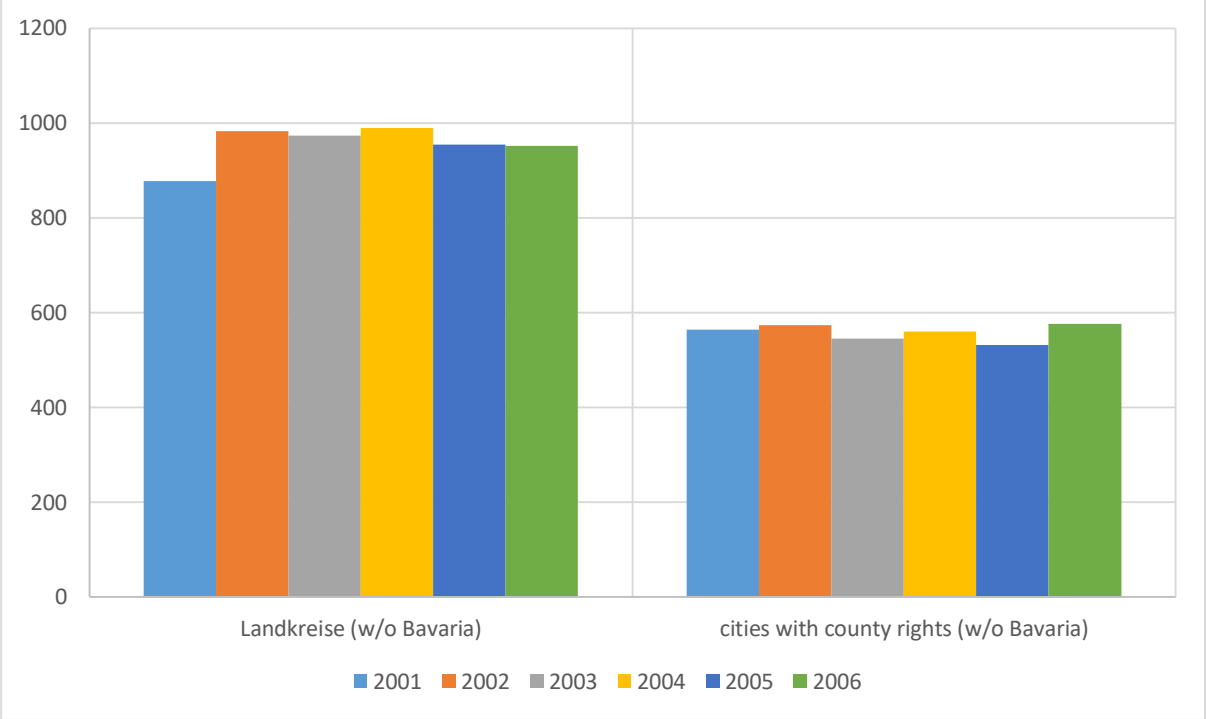
Variable	Obs	Mean	Std. Dev.	Min	Max
Population size	149	221 218	115 712	57 587	654 276
Unemployment rate (percent)	149	7.2	1.9	4.1	12.8
Public debt/capita (€)	149	920	320	319	1 738
Share employment big firms	149	0.40	0.08	0.22	0.63
Share employment small firms	149	0.33	0.06	0.19	0.49
Share apprentices big firms	149	0.19	0.07	0.03	0.38
Share apprentices small firms	149	0.29	0.05	0.17	0.42
Share agricultural sector	149	0.03	0.02	0.004	0.09
Share construction sector	149	0.07	0.01	0.04	0.11
Share production sector	149	0.25	0.08	0.09	0.49
Share manufacturing sector	149	0.30	0.06	0.16	0.43
Share financial sector	149	0.11	0.03	0.06	0.27
CDU seats share	149	0.46	0.10	0	0.74
Share Non-German citizens	149	0.07	0.03	0.03	0.18
Population growth (percent)	149	-0.2	1.41	- 4.49	2.97

Table 2.2.2: Cities with county rights

Variable	Obs	Mean	Std. Dev.	Min	Max
Population size	44	219 826	185 726	35 846	968 639
Unemployment rate (percent)	44	10.4	2.1	6.9	16
Public debt/capita (1000 €)	44	1 401	650	455	2 849
Share employment big firms	44	0.53	0.09	0.27	0.80
Share employment small firms	44	0.23	0.05	0.09	0.39
Share apprentices big firms	44	0.33	0.10	0.15	0.58
Share apprentices small firms	44	0.21	0.04	0.09	0.31
Share agricultural sector	44	0.004	0.004	0.0005	0.02
Share construction sector	44	0.05	0.02	0.02	0.08
Share production sectro	44	0.20	0.10	0.08	0.56
Share manufacturing sector	44	0.33	0.07	0.17	0.48
Share financial sector	44	0.15	0.04	0.09	0.27
Share Non-German citizens	44	0.12	0.04	0.05	0.22
CDU seats share	44	0.44	0.06	0.3	0.57
Population size (percent)	44	0.5	2.00	-4.57	5.25

Looking at the counties' annual expenditures on vocational schools per pupil, we find substantial differences between *Landkreise* and cities with county rights. The *Landkreise* spend substantially more (on average 889 € per pupil and year), while the figure for cities with county rights is substantially lower (505 €). In both categories, investments account for roughly 50 percent of total expenditures. We find substantial variation in per pupil expenditures within both groups –across time as well as across counties. The standard deviation across counties amounts to 590 € while the within variation yields a standard deviation of 257 €. Figure 2.1 shows that there is no trend in the average expenditures.

Figure 2.1: Counties' expenditures on vocational schools per pupil (2001-2006)



County governments have limited influence on the number of schools on their territory and the educational program these schools offer. These facts are negotiated with the state government. On the other hand, county governments can influence the quality of vocational schooling by spending more on equipment and activities. We argue that spending more funds on vocational schools is not a sign of inefficiency or waste but rather an indication that a county is investing more in the general skills of their vocational pupils. The literature on interjurisdictional competition suggests that local and regional governments compete for mobile capital (e.g. Wilson, 1986). Offering well-equipped vocational schools may be one instrument in this competition. The empirical literature has compiled evidence for the existence of both tax competition and expenditure competition (e.g. Brueckner, 2003). In addition, the big stake-holders in vocational training in Germany – governments, labor unions and the chambers of commerce – argue that the existence of a well-equipped vocational school nearby is an essential argument in firm's location choice. Thus, hypothesis H1 reads:

Hypothesis H1:

The spatial correlation in countries' expenditures on vocational schools is positive.

There is, however, the theoretical literature on inter-state correlation in expenditures in higher education (see section 2.2) that provides a counter-argument against this hypothesis. Accordingly, counties may free ride on the vocational schools provided by the neighboring counties. In the context of vocational schools, free riding may be empirically relevant in counties that are close to a city with county rights. For the counties in rural areas, however, this explanation does not seem plausible. First, we have to account for the mere size of German counties especially in rural areas. On average, a German *Landkreis* covers 978 km². The travel costs that apprentices have to incur are substantial – even if the relevant vocational school is within the same county. Second, a substantial number of pupils visiting the vocational school branch are younger than 18 years and thus do not have a driver's license. For them, travel is extremely time consuming. Third, counties in most states have to pay for pupils sent to other counties.

Given that vertical schools are funded by the state as well as by the county, we may expect vertical externalities (e.g. Keen and Kotsogiannis, 2002). For instance, the county government may free ride on the expenditures of the state: The more teachers per pupil the state government provides, the less need for additional funding from the county to make the local vocational school attractive. Unfortunately, official sources do not provide data on the state expenditures for vocational schools at county level. We do, however, have data on the teacher to pupil ratio for some years and counties. This data provides a very good approximation of the state expenditures per pupil because teachers' salaries are by far the largest part of state expenditures in vocational schools (e.g. Brugger et al., 2017) and the average pay is the same across all counties within one state. Given that the data on teachers has many missing values, we cannot

include it in the spatial regressions and control directly for vertical fiscal externalities. Instead, we have to rely on auxiliary arguments. To this end, we run an ordinary panel regression with the expenditures per pupil as endogenous variable. In this regression, we use all covariates used in the later regressions (see section 2.5) and add the teacher-to-pupil ratio. The latter is far from significant while the performance of the other variables is similar to the one reported in the main paper. This result indicates that vertical externalities do not play a prominent role in the context of funding vocational schools. In the regressions below, county fixed effects control for inter-state differences in teachers per pupil.

2.5 Empirical analysis

2.5.1 Empirical models

Our main aim is to test for the existence of spatial correlation in the counties' expenditures for vocational schools. Following the literature, we use the expenditures per pupil as dependent variable. This is the most direct way to capture possible differences in the quality of vocational schools – as influenced by the county government.

Table 2.3: Moran's I from a SAR-Model (West-Germany without Bavaria)

Year	Moran's I
2003	0.276*** / 0.236***
2004	0.322*** / 0.302***
2005	0.379*** / 0.359***
2006	0.372*** / 0.353***

(*** p<0.01, ** p<0.05, * p<0.1); contiguity W /population-weighted W

Moran's I-tests provide a first indication for the existence of spatial correlation (e.g. Anselin et al., 1996). The tests are performed year-wise for the years 2003 to 2006 using a row-standardized contiguity matrix as well as a contiguity matrix with relative weights proportional to the inverse geographical distances (see table 2.3). The independent variables used in the regressions are the ones described in detail below. The significantly positive coefficients suggest that there is positive spatial correlation between counties' expenditures on vocational schools as hypothesized in H1. However, the coefficient may also reflect the presence of common factors such as state regulation driving the counties' expenditures. Therefore, a more thorough empirical analysis is needed.

When applying spatial econometrics, researchers implicitly assume that a number of identifying assumptions hold. Next to the general identifying assumptions underlying econometric models – e.g. regarding the omitted variable bias – spatial econometrics involve additional assumptions. Most importantly, they assume that the econometric model captures the true pattern of spatial interaction in the underlying sample (e.g. Gibbons and Overman, 2012). In reality, we do not know the true structure of spatial interactions and thus we cannot claim that a particular specification of the latter is appropriate. Our strategy to cope with this problem is to apply an array of different models with different identifying assumptions and compare the results. If the different models lead to similar results, the bottom line conclusion can be considered robust even when the question which one of the models used is most adequate remains unsettled.

We start by using the SAR model specification assuming that spatial dependencies are totally captured by a spatial lag in the dependent variable (e.g. Le Sage, 2014). The SAR-model assumes that local decision makers focus directly on neighboring counties' expenditures for vocational schools when choosing their own expenditures program. The empirical model looks as follows:

$$\ln\left(\frac{exp\,voc.\,schools}{pupils}_{it}\right) = \alpha_i + pW_{ij}\ln\left(\frac{exp\,voc.\,schools}{pupils}_{jt}\right) + \delta\left(X_{it}\right) + \theta_i + \lambda_t + \varepsilon_{it} \quad (2.1)$$

Second, we apply a Spatial Error Model (SEM). Unlike the SAR-model, the SEM-model contains a spatially auto-correlated error term instead of a spatially- lagged dependent variable. Third, we use a generalized spatial two-stage least square model (GS2SLS) that unifies both spatial error and spatial lags in one model (e.g. Arraiz et al., 2010).[5] Finally, we use a Spatial Durbin Model (SDM). It is less restrictive in its assumptions and allows for spatially lagged explanatory variables in addition to spatially lagged dependent variable (e.g. Le Sage, 2014; Ajilore, 2013). The SDM-model allows for the possibility that counties also take into account other characteristics of neighboring counties aside from their expenditures on vocational schools when making their own expenditure decisions.

In a next step, we have to specify the spatial weighting matrix (W). It identifies those counties that a certain county i interacts with and defines the relative intensity of interaction. We apply a conventional row-standardized contiguity matrix that restricts interaction to direct neighbors and assigns each one of them the same relative weight. In addition, we use the contiguity matrix with relative weights proportional to the inverse geographical distances. Applying the four models named above with these two weighting matrices leaves us with eight models to be reported in table 2.4. In table 2.5, we replicate these 2x4 models but use weighting matrices that restrict spatial relations to counties within the same state.

Before we report the results, we have to describe the factors potentially driving the counties' per capita expenditures on vocational schools contained in the matrix X of covariates. First, the demand for vocational training outside the firm may be different for firms of different size: Small firms have less capacity to provide their apprentices with a wide range of necessary skills

[5] We use the user-written stata command gs2sls (see Shehata, 2012; Shehata and Mickaiel, 2013)

in-house. Given their lower retention rate (e.g. Pfeiffer et al., 2009), small firms have lower incentives to train their apprentices. Therefore, high-quality training – especially regarding general skills – cannot and/or will not be provided by the training firms. As a consequence, the county government has to exert more effort into training in public vocational schools when apprentices come from smalls firms. To capture this effect, we include the share of apprentices in the county working in firms with less than 20 employees. We also control for the share of apprentices in firms with more than 100 employees. Again, note that these variables refer to the apprentices working in firms located within the county borders.

We account for the impact of political ideology, by introducing the share of seats in the local assembly held by Christian Democratic Parties. In addition, we introduce a dummy for election years on county level to control for the possibility of opportunistic spending cycles. Differences in the counties' general economic and fiscal situation are captured by the disposable income per capita and the unemployment rate (based on the whole civilian labor force) and overall annual public debt per capita of local municipalities. We control for share of non-German population and for the county's age composition. The larger the share of old persons, the higher the demand for consumption expenditures as opposed to investment (including human capital formation).

We account for the fact that the counties differ in relative importance of school types by introducing the shares of pupils by school types (see table 2.1) leaving out only the share of pupils in the *Berufsschule*. Thereby, we place our focus on expenditures per apprentice in the classical apprenticeship system, namely the students with a formal labor contract who train for a profession and receive part of the training in the *Berufsschule* while the largest part of training takes place outside the school. We also control for the share of non-German pupils in the vocational school branch. The need for training among these apprentices may be higher because

of deficiencies e.g. in the knowledge of the German language and to help these pupils overcome possible discrimination of non-Germans in the job market. On the other hand, one might argue that non-German pupils have less political influence than German pupils because they themselves and their parents are often not allowed to vote in local elections. We also control for possible economies of scale or scope by introducing the number of pupils in the vocational school branch per 1000 inhabitants directly. This variable also captures the net balance of pupils going to or coming from other counties.

We introduce county fixed effects to control for the remaining time-invariant heterogeneity in vocational education and counties in general. Most importantly, this controls for the likely difference in expenditures that result from differences in the necessary training facilities needed for training particular professions. These differences may be substantial because there is a significant degree of division of labor between counties (see section 2.3.2). Fixed effects are an adequate way of coping with the unobservable differences in training facilities needed across counties because the structure of schools and classes is quite stable in our period of observation. Year fixed effects control for common shocks across time. Finally, we control for the sectoral structure of the local economy by including the employment shares in agriculture, in manufacturing and in financial services (see table 2.2). While county fixed effects account for principle differences in sector weights across counties and year fixed effects capture the common trend in sectoral change, the county-specific employment shares capture differences in the sectoral dynamics across counties. All independent variables are lagged by one year. We take the natural logarithm of all continuous variables (except for variables representing percentage shares).

2.5.2 Results

Tables 2.4 and 2.5 report the regression results using the 2x4 specifications with full weighting matrices and with state-restricted weighting matrices respectively. All reported models use the full set of variables described above.

Table 2.4: Results of different spatial regression models with full weighting matrices

	(1)	(2)	(3)	(4)	(4)	(1')	(2')	(3')	(4')	(4')
Model type	SAR	SEM	GS2SLS	SDM	Wx	SAR	SEM	GS2SLS	SDM	Wx
W-Matrix	CONT	CONT	CONT	CONT	CONT	DIST	DIST	DIST	DIST	DIST
Share apprent. big firms (t-1)	-0.161	-0.159	-0.0751	0.0356	-0.581	-0.162	-0.162	-0.125	0.0779	-0.534
	(0.420)	(0.420)	(0.480)	(0.435)	(0.988)	(0.420)	(0.420)	(0.481)	(0.433)	(0.749)
Share apprent. small firms (t-1)	-2.677***	-2.668***	-2.073*	-2.596***	-2.903	-2.688***	-2.687***	-2.353**	-2.768***	-1.219
	(0.913)	(0.917)	(1.088)	(0.913)	(1.791)	(0.912)	(0.914)	(1.097)	(0.912)	(1.655)
Share foreign pupils (t-1)	-1.681	-1.671	-1.638	-0.596	-0.779	-1.681	-1.680	-1.637	-0.564	0.0946
	(1.253)	(1.253)	(1.813)	(1.270)	(2.502)	(1.253)	(1.253)	(1.829)	(1.270)	(2.316)
Share apprentices/pop (t-1)	-4.860	-4.863	-3.987	-5.233	4.167	-4.868	-4.860	-3.705	-3.486	-9.502
	(10.77)	(10.78)	(13.82)	(11.22)	(22.78)	(10.78)	(10.78)	(13.76)	(11.17)	(18.65)
Log disp. Income/capita (t-1)	0.228	0.234	0.267	0.779	-1.168	0.227	0.228	0.206	0.470	-0.374
	(0.708)	(0.710)	(1.225)	(0.778)	(1.407)	(0.708)	(0.708)	(1.195)	(0.772)	(1.281)
Log public debt/capita (t-1)	-0.0337	-0.0335	-0.0425	-0.0361	-0.166	-0.0335	-0.0335	-0.0363	-0.0510	-0.0301
	(0.0598)	(0.0598)	(0.0794)	(0.0603)	(0.150)	(0.0598)	(0.0598)	(0.0767)	(0.0601)	(0.108)
Unemployment rate (t-1)	0.0215	0.0215	0.0125	0.0124	0.0394	0.0217	0.0217	0.0161	0.0123	0.0395
	(0.0159)	(0.0159)	(0.0185)	(0.0181)	(0.0300)	(0.0159)	(0.0159)	(0.0186)	(0.0181)	(0.0273)
CDU seatshare (t-1)	0.872***	0.877***	0.882*	1.334***	-0.632	0.871***	0.872***	0.804	1.440***	-0.940*
	(0.282)	(0.285)	(0.509)	(0.367)	(0.569)	(0.282)	(0.283)	(0.505)	(0.360)	(0.529)
Election year	0.0395*	0.0401*	0.0325	0.176***	-0.171**	0.0397*	0.0398*	0.0373	0.177**	-0.171**
	(0.0237)	(0.0240)	(0.0334)	(0.0671)	(0.0741)	(0.0237)	(0.0238)	(0.0322)	(0.0726)	(0.0790)
Share elderly pop. (t-1)	-7.705	-7.645	-8.484	-8.151	0.910	-7.695	-7.681	-8.617	-7.456	5.766
	(5.393)	(5.395)	(8.131)	(5.691)	(11.38)	(5.394)	(5.392)	(7.991)	(5.821)	(9.869)
Share foreign pop. (t-1)	-3.486	-3.422	0.487	1.023	-32.21***	-3.557	-3.534	-0.670	0.392	-28.83***
	(4.951)	(4.996)	(5.981)	(5.346)	(11.00)	(4.952)	(5.011)	(6.093)	(5.322)	(8.710)
Share agricultural s. (t-1)	11.04	11.22	15.60	20.28**	-47.81***	10.97	11.03	15.02	17.89**	-47.02***
	(8.213)	(8.324)	(12.45)	(8.831)	(14.54)	(8.221)	(8.356)	(12.63)	(8.708)	(13.54)
Share manufacturing s. (t-1)	2.205	2.212	2.162	2.191	0.909	2.205	2.207	2.138	2.382	-1.172
	(1.766)	(1.768)	(2.258)	(1.841)	(3.431)	(1.766)	(1.767)	(2.231)	(1.847)	(3.197)
Share financial s. (t-1)	0.164	0.160	-0.832	-0.466	2.647	0.184	0.182	-0.192	-0.804	4.143

	(2.085)	(2.086)	(3.020)	(2.128)	(4.853)	(2.084)	(2.085)	(3.092)	(2.149)	(4.268)
spatial corr. (coeff. ρ, λ , *w*)	0.0111	0.0109	0.474**	-0.0286		0.00271	0.00266	0.299	-0.0154	
	(0.0467)	(0.0499)	(0.199)	(0.0483)		(0.0430)	(0.0459)	(0.205)	(0.0438)	
Observations	965	965	965	965	965	965	965	965	965	965
R^2	0.002	0.002		0.008	0.008	0.002	0.002		0.015	0.015
Cross sectional units	193	193	193	193	193	193	193	193	193	193

*** p<0.01, ** p<0.05, * p<0.1 Standard errors in parentheses; All models use county fixed effects, year fixed effects and controls for the composition of pupil population

Table 2.5: Results of different spatial regression models with state-restricted weighting matrices

	(1)	(2)	(3)	(4)	(4)	(1')	(2')	(3')	(4')	(4')
Model type	SAR	SEM	GS2SLS	SDM	Wx	SAR	SEM	GS2SLS	SDM	Wx
W-Matrix	CONT	CONT	CONT	CONT	CONT	DIST	DIST	DIST	DIST	DIST
Share apprent. big firms (t-1)	-0.150	-0.131	-0.0925	-0.0926	-1.291	-0.154	-0.136	-0.142	-0.0259	-1.068
	(0.419)	(0.420)	(0.471)	(0.428)	(0.953)	(0.419)	(0.420)	(0.480)	(0.429)	(0.810)
Share apprent. small firms (t-1)	-2.639***	-2.577***	-2.436**	-2.744***	-3.513**	-2.661***	-2.632***	-2.624**	-2.845***	-1.604
	(0.911)	(0.913)	(1.079)	(0.910)	(1.682)	(0.911)	(0.911)	(1.090)	(0.914)	(1.590)
Share foreign pupils (t-1)	-1.698	-1.689	-1.771	-1.226	1.199	-1.686	-1.688	-1.695	-1.081	1.324
	(1.252)	(1.251)	(1.827)	(1.258)	(2.272)	(1.252)	(1.252)	(1.836)	(1.263)	(2.086)
Share apprentices/pop (t-1)	-4.743	-4.688	-4.268	-9.653	1.727	-4.679	-4.555	-4.456	-6.451	-7.452
	(10.76)	(10.79)	(13.77)	(11.05)	(20.99)	(10.77)	(10.79)	(13.95)	(11.00)	(17.51)
Log disp. Income/capita (t-1)	0.249	0.273	0.328	0.577	0.259	0.240	0.252	0.254	0.383	0.211
	(0.707)	(0.717)	(1.186)	(0.777)	(1.257)	(0.707)	(0.715)	(1.169)	(0.779)	(1.171)
Log public debt/capita (t-1)	-0.0348	-0.0338	-0.0398	-0.0460	-0.144	-0.0341	-0.0339	-0.0350	-0.0539	-0.0265
	(0.0597)	(0.0599)	(0.0767)	(0.0601)	(0.133)	(0.0597)	(0.0599)	(0.0750)	(0.0601)	(0.101)
Unemployment rate (t-1)	0.0206	0.0200	0.0164	0.0106	0.0508*	0.0209	0.0203	0.0198	0.0122	0.0452*
	(0.0158)	(0.0161)	(0.0187)	(0.0179)	(0.0285)	(0.0158)	(0.0160)	(0.0189)	(0.0180)	(0.0261)
CDU seatshare (t-1)	0.867***	0.901***	0.854*	1.295***	-0.685	0.859***	0.885***	0.844*	1.330***	-0.774
	(0.282)	(0.290)	(0.486)	(0.383)	(0.538)	(0.282)	(0.287)	(0.479)	(0.373)	(0.501)
Election year	0.0380	0.0401	0.0317	0.120	-0.0936	0.0387	0.0404	0.0375	-0.0667	0.0901
	(0.0237)	(0.0250)	(0.0343)	(0.169)	(0.169)	(0.0237)	(0.0247)	(0.0323)	(0.252)	(0.251)
Share elderly pop. (t-1)	-7.849	-7.713	-8.453	-8.884	8.617	-7.890	-7.771	-8.129	-8.518	8.270
	(5.389)	(5.384)	(7.755)	(5.712)	(10.53)	(5.392)	(5.377)	(7.769)	(5.824)	(9.282)
Share foreign pop. (t-1)	-3.233	-2.880	-1.989	0.155	-23.23**	-3.242	-2.848	-2.864	0.0673	-22.81***
	(4.938)	(5.005)	(5.875)	(5.429)	(10.12)	(4.942)	(5.010)	(5.876)	(5.370)	(8.256)
Share agricultural s. (t-1)	11.62	12.81	14.13	22.32**	-41.49***	11.59	12.77	12.35	19.05**	-43.92***
	(8.213)	(8.401)	(12.39)	(8.857)	(13.55)	(8.221)	(8.429)	(12.49)	(8.765)	(12.48)
Share manufacturing s. (t-1)	2.168	2.221	2.010	2.687	0.649	2.171	2.216	2.124	2.768	-0.291
	(1.765)	(1.770)	(2.202)	(1.794)	(3.303)	(1.765)	(1.771)	(2.194)	(1.807)	(3.138)
Share financial s. (t-1)	0.0871	0.0685	-0.316	-0.325	1.751	0.145	0.123	0.0856	-0.635	2.244

	(2.083)	(2.081)	(3.041)	(2.122)	(4.665)	(2.082)	(2.079)	(3.068)	(2.142)	(4.119)
spatial corr. (coeff. ρ, λ , *w*)	0.0499	0.0565	0.237	0.0344		0.0387	0.0441	0.0844	0.0364	
	(0.0425)	(0.0451)	(0.196)	(0.0438)		(0.0391)	(0.0415)	(0.176)	(0.0399)	
Observations	965	965	965	965	965	965	965	965	965	965
R^2	0.002	0.003		0.002	0.002	0.002	0.003		0.010	0.010
Cross sectional units	193	193	193	193	193	193	193	193	193	193

*** p<0.01, ** p<0.05, * p<0.1 Standard errors in parentheses; All models use county fixed effects, year fixed effects and controls for the composition of pupil population

The results in tables 2.4 and 2.5 show that, contrary to our prediction, the share of apprentices in small firms is significantly negative in all but specification (3) in table 2.4. Per capita expenditures on vocational schools increase in the share of Christian Democratic council members in all specifications using SAR, SER and SDM models. Turning to our main research question, only specification (3) in table 2.4 yields a significant coefficient for spatial interaction in counties expenditures for vocational schools. In all other models, we find no evidence that there is any spatial correlation with coefficients being far from significant. Looking at the coefficients in the Wx column of the SDM models, we find the population share of foreigners and the agricultural employment share in neighboring counties to have a significant impact on per pupil expenditures. All other factors are insignificant. This result provides additional support to the notion that the expenditures on vocational schools in German counties are not strongly linked to the policies and the general situation in neighboring counties.

To test the robustness of our results, we run a large number of additional specifications. These includes specifications that use different variables to capture the sectoral composition, the composition of the county council, or the demographic composition of the population. We also rerun for Bavaria. Furthermore, we split total expenditures for vocational schools into running expenditures and investment expenditures and rerun the main specifications reported above for both sub-categories. Finally, we apply a dynamic panel estimator that allows for spatial interaction (Shehata and Mickaiel, 2013).[6] All these sensitivity analyses support the main result of this paper: We do not find any evidence expenditures for vocational schools serve as a strategic tool in the competition for mobile capital between counties.

[6] This test is used to account for institutional inertia in public spendings. It is important to note that the time period of only 5 years is very short and thus dynamic panel estimators do not yield reliable estimates.

2.5.3 An alternative test: Teachers per capita in border counties

In this section, we briefly present an additional test to see whether expenditures on vocational schools are used as an instrument in interregional competition for mobile capital and firm settlements. It focuses on the role of the state government in allocating teachers across counties. The test compares the teachers-to-pupil ratio in counties situated at the state border to the ratio in interior counties. The essential logic behind this test is the following: If states use vocational schools to attract mobile capital, they will operate with higher teacher-to-pupil ratios in border counties than in interior counties – other things equal.

To test this notion, we use the teacher-to-pupil ratio as dependent variable in a standard panel model. The empirical model reads:

$$\ln\left(\frac{teachers}{pupils}_{it}\right) = \alpha_i + \beta_i state\_border_i + \gamma_i country\_border_i + \delta\left(X_{it}\right) + \lambda_t + \varepsilon_{it} \qquad (2.2)$$

County fixed effects are replaced by two dummies identifying each state as being located at the state border and/or at the country border. If vocational schools are used to attract mobile capital, we expect positively significant coefficients for β_i andr γ_i. The matrix X_{it} of controls contains all major controls used in the previous sections –except for the share of CDU-members in the county council. Instead, we account for the alignment between state government and the strongest party in the county council and for the absolute difference in county council seat shares between SPD (Social Democratic Party) and CDU. This difference captures the degree to which counties are regarded as swing counties that may receive more teachers for opportunistic reasons (e.g. Banaszewska and Bischoff, 2017). We introduce the county's population and variables capturing the sectoral composition of the local economy to compensate further for dropping county fixed effects. Finally, we use state $\times$ year fixed effects to capture any unobserved state-specific impact on teacher allocation. Robust standard errors are used.

As the data on teachers is not available for all states, our sample is reduced to 167 counties (including 46 municipalities with county rights). This time, we include data from Bavarian counties because they are responsible for a large part of the sample. The available data informs us about the total number of teachers and the number of full-time teachers in the vocational school branch per county.[7] The average overall teacher-to-pupil ratio is similar for rural counties and for municipalities with county rights – taking on the value of 1:25 in 2001. It is slightly lower in Bavaria than in the other West-German states. We use both the overall teacher-to-pupil ratio and the ratio of fulltime teachers to pupils as dependent variables introducing the share of full-time employed teachers as an additional control variable.

[7] The data is provided by the State Bureaus of Statistics. Data is not available for Baden-Württemberg and Saarland. Data on the share of full-time employed teachers is only provided for some states and time periods.

Table 2.6: Regression results on teacher-to-pupil ratios

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	teachers per 100 students	fulltime teachers per 100 students	teachers per 100 students	fulltime teachers per 100 students	teachers per 100 students	fulltime teachers per 100 students
Sample	West Germany		West Germany w/o Bavaria		Bavaria only	
ratio of fulltime teachers	-10.20**	2.887***	-3.006***	2.660***	-8.720	2.763***
	(4.361)	(0.478)	(0.524)	(0.348)	(6.749)	(0.634)
alignment county - state	0.0622	0.0464	-0.0309	-0.0134	1.569	0.257
	(0.263)	(0.0522)	(0.0532)	(0.0389)	(1.866)	(0.332)
voteshare differential SPD CDU	2.806	0.164	-0.290	-0.130	5.345	-0.188
	(1.741)	(0.478)	(0.261)	(0.196)	(4.608)	(1.676)
Border to other German state	0.0898	-0.0375	0.0847	0.0690*	-0.0222	-0.179
	(0.359)	(0.0773)	(0.0560)	(0.0391)	(1.149)	(0.317)
Border to foreign country	-0.569	-0.0692	0.0536	0.0336	-0.727	-0.0742
	(0.574)	(0.220)	(0.100)	(0.0725)	(1.247)	(0.495)
SPD leads state government	-1.808**	-0.779**	0.104	0.149		
	(0.919)	(0.351)	(0.180)	(0.129)		
city with county rights	1.363	0.0977	0.448***	0.316***	4.774	-0.224
	(0.866)	(0.260)	(0.171)	(0.118)	(3.247)	(0.649)
State x year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
χ^2-Statistic	1094***	935***	81748***	1344***	1989***	4010***
R^2 (overall)	0.6	0.16	0.8	0.83	0.58	0.04
Observations	615	615	253	253	362	362
Number of AGS_Kreis	239	239	148	148	91	91

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Using this set-up, we run two specifications for all West- German states (columns 1 and 2 in table 2.6), two excluding Bavaria (column 3 and 4) and two using Bavaria only (column 5 and 6). Regardless of the specification, we do not find any evidence that states operate with higher teacher-to-pupil ratios in border states.

2.6 Conclusion

The German system of apprenticeship is regarded an important factors explaining Germanys success in attracting industry settlements – despite its high wages and level of regulation. As competition also takes place among jurisdictions within a country, it seems straightforward to hypothesize that public expenditures on vocational schools are used as an instrument in this competition. Surprisingly, this question has not been addressed empirically so far. Thus, our analysis breaks new grounds. Our first empirical test focuses on expenditures for vocational schools at county level. Moran's I tests support our hypothesis for the West-German sample (excluding Bavaria). However, once we apply more sophisticated spatial econometric regression techniques, we find no evidence that supports our hypothesis. This result holds for a large number of different specifications and regression models with different identifying assumptions. Thus, we conclude that there is no inter-county competition for mobile capital in the field of vocational schooling. Second, we run an alternative test that compares the teacher-to-pupil ratio in counties at the state border to the ratio of interior counties. The test provides no evidence that state governments use the placement of teachers in vocational schools as an instrument of inter-state competition for mobile capital. In sum, we do not find any indication that subnational governments in Germany use funds for vocational schools as a strategic tool in the intra-national competition for mobile capital. One side result of our analysis is noteworthy:

The counties' firm structure drives the counties' expenditures for vocational schools: Small firms seem to have less political influence than large firms.

Our study suffers from a number of limitations – mostly due to deficiencies in the data we can use. First, a reform in the public accounting system prevented that we use a longer panel. If a larger panel was available, a dynamic panel estimator could account for the stickiness in public expenditures. While the theory underlying the current analysis does not contain dynamic elements, the empirical pattern in public expenditures often displays a substantial degree of stickiness. Second, we do not have information about the division of labor between counties in the training of different professions (i.e. the structure of the *Fachklassen*, see section 2.3.2). County fixed effects capture most of the heterogeneity because the division of labor only changes very slowly. Third, we cannot fully control for the role of vertical externalities (e.g. Keen and Kotsogiannis, 2002) – though our auxiliary test suggests that they are not relevant here (see section 2.4). Finally, official statistics do not allow the clear-cut isolation of those expenditures spent on the training of apprentices in *Berufsschulen*. Instead, we are left with data on the overall expenditures on schools of the vocational branch. We cope with this shortcoming by controlling for pupils' shares in different types of schools. As apprentices represent by far the largest group among these pupils, we are confident that this shortcoming does not cause systematic distortions.

Why do we not find any support for the notion that that sub-national governments use expenditures on vocational schools as an instrument in the inter-regional competition for firm settlements and jobs? The first argument was already discussed in section 2.2 (literature review) and in section 2.4 (data and hypothesis). Accordingly, counties may free ride on the vocational schools provided by the neighboring counties. Although there are a number of arguments suggesting that free riding is likely to be limited (see section 2.4), we cannot exclude the

possibility that it neutralizes the incentives of counties to compete for firms through higher expenditures on vocational schools.

The literature on fiscal equalization in Germany (e.g. Scherf and Hofmann, 2003) implies that there may be a second reason why we do not find empirical support for our hypothesis. On the one hand, counties benefit from attracting capital and jobs through the *Kreisumlage* that extracts part of the additional business tax revenues generated. In addition, additional firms and jobs reduce the social transfer payments the counties have to cover. On the other hand, however, the German fiscal equalization system takes the bite out of many fiscal incentives. As a result, counties may lack incentives to entertain well-equipped vocational schools.

Finally, the lack of positive spatial correlation may result from the fact that the division of labor between counties in training the regional apprentices (i.e. the allocation of *Fachklassen*) is deliberately designed as a form of collusion that prevents inter-county competition. Di Liddo and Giuranno (2016) recently present a theoretical model of inter-local cooperation among opportunistic governments that – if interpreted in the context of vocational education – supports this notion.

In any case, further research is needed. Any further research in the field of vocational schooling faces one essential challenge: the division of labor between counties in training the regional apprentices. This division of labor means that different counties may have different per capita costs of providing vocational training just because some specialize on professions that require more expensive training than others. We control for this by introducing county fixed effects. While this largely solves the main challenge, it bears a high price because several interesting questions regarding the funding of vocational training cannot be answered. For instance, it is impossible to test whether the internal composition of counties – i.e. their municipal structure

– drives their funding decisions. These analyses have to be left for the future when a suitable proxy for the heterogeneity in profession-specific training costs is found.

Chapter 3

3 The political economy of vocational education spending - empirical evidence from Germany

Ivo Bischoff

Julia Hauschildt

Abstract

We provide – to the best of our knowledge – the first empirical study on the political economy of public spending on vocational education. Vocational schools raise human capital among non-academics and gives the latter a stronger bargaining position in wage negotiation – thereby supporting the clientele of leftwing parties. At the same time, they provide publicly funded inputs that raise firm productivity – an aim particularly important for conservative parties. We analyze expenditures on vocational schools of 301 West-German counties between 2002 and 2013 using two-way fixed effects and mixed models. We find the counties' expenditures on vocational schools to decrease in the voting power of Social Democrats and increase in the voting power of Christian conservatives in the county council. Expenditures are higher in election years. We find no support for the conjecture building on Jensen (2011) according to which expenditures on vocational education are higher in regions suffering from de-industrialization.

3.1 Introduction

Vocational schools play an important role in preparing young people who do not go through higher education for their future work. The existing economic literature on vocational education has addressed its role in promoting productivity and its impact on the income distribution and on unemployment (e.g. Mason et al., 1992; Bradley and Taylor, 1996; Thelen, 2007). Empirical studies clearly show that public investment in the latter education branch generally yields high returns and countries with well-developed vocational training programs traditionally face

higher youth employment (Petnuchova et al., 2012; Deissinger, 2015). However, Hampf and Woessmann (2017) show that general education outperforms vocational education when it comes to long-term adaptability to a changing economic environment. Considerable attention has been paid to the question why the German system of vocational education is so different from the system of vocational education in the UK or US (e. g. Harhoff and Kane, 1993; Soskice, 1994). In a recent paper, Bischoff and Hauschildt (2019) address the question whether regional governments use expenditures for vocational schools as an instrument in the inter-regional competition for mobile capital.

So far, however, little attention has been paid to the political economy of vocational education. This lack of research is surprising because vocational education is very interesting from a Public Choice perspective. First, well-equipped vocational schools are visible to many voters and firms – thus potentially serving as an instrument in political expenditure cycles (e.g. Bräuninger, 2005; Tepe and Vanhuysse, 2009). Moreover, the question of how political ideology shapes expenditures on vocational schools is an interesting one. The general training apprentices receive in vocational schools increases their wages and employment perspectives (e.g. Finegold and Soskice, 1988; Steedman, 1993; Schmidt, 2005). Acemoglu and Pischke (1998) point out that vocational education also increases trained workers' potential mobility and strengthens their bargaining position in labor contract negotiations. These benefits especially working class households and their children – the traditional clientele of leftwing parties. On the other hand, vocational schools may be seen as a public input into local firms' production function. Well-equipped vocational schools increase the productivity of local firms (e.g. Deissinger, 2015), strengthen their position on (international) markets and thus ultimately raise their profits – thereby benefiting the typical clientele of conservative parties.

In this paper, we take these contradicting notions to an empirical test using panel data on West-Germany between 2002 and 2013. We focus on the role of counties and their expenditures. While state governments provide teachers and pays for their salaries, counties cover the costs for the so-called "external school affairs". These comprise – among other things – the costs of building and maintaining school buildings as well as maintenance and administrative staff. In addition, counties provide the funding for the training facilities in vocational schools. Especially for technical professions, these facilities are quite expensive. In 2001, the average expenditures per pupil amounted to 802 Euros and the average total expenditures per county added up to almost 4.5 million Euros – one quarter of the counties' overall expenditures on schooling. We apply two-way fixed effects as well as mixed models to identify the impact of political factors on counties' expenditures per pupil.

Our results can be summarized as follows: Expenditures per pupil decrease in the voting power of Social Democrats in the county council but increase in the power of Christian Democrats. This regularity holds for the full sample as well as for rural counties. We find evidence for political spending cycles in the rural counties as well as in the full sample – with expenditures per pupil being higher in election years. While Jensen (2011) argues that regions threatened by de-industrialization spend more on education, we do not find this regularity in the case of vocational education.

Section 3.2 reviews the related literature and section 3.3 introduces the reader to the German system of vocational education and the role of counties. Section 3.4 presents the data and hypotheses. The empirical analysis is found in section 3.5. Section 3.6 concludes.

3.2 Review of literature

3.2.1 Public expenditures on education

The empirical analysis of government expenditures on education started more than 40 years ago with a number of studies on primary and secondary education in the US (e.g. Denzau, 1975; Denzau and Grier, 1984). Since then, a substantial body of studies has emerged – covering numerous countries in the developed world as well as in developing countries. A number of regularities emerged. Studies found expenditures per capita to depend on the per capita income (e.g. Fernandez and Rogerson, 1996), political and racial fragmentation or local crime rates (e.g. Colburn and Horowitz, 2003), the degree of urbanization (e.g. Freitag and Bühlmann, 2003) and the age structure of the population (e.g. Miller, 1996; Fernandez and Rogerson, 1996; Busemeyer, 2009; Cattaneo and Wolter, 2009). Cross-country studies also point at the importance of institutional factors and the cultural heritage (e.g. Boix, 1997; Busemeyer, 2009). Jensen (2011) argues that the process of deindustrialization devaluates the specific skills of workers and thus creates a high demand for educational expenditures. Building on the literature of varieties on capitalism, he argues that the risk of skill redundancy and thus additional demand for education is particularly high in the so-called coordinated market economies – among them Germany.

Some studies specifically focus on the role of party ideology in shaping public expenditures on education. The basic notion put forth in these studies is the following: Primary and secondary education in public schools is an essential instrument to promote the interest of the working class. Thus, leftwing parties spend more on these tasks to promote their clientele (e.g. Boix, 1997; Kauder and Potrafke, 2013). Many though not all studies support this notion (e.g. Boix, 1997; Colburn and Horowitz, 2003; Potrafke, 2011). When it comes to higher education, the beneficiaries are more likely to be found among (the children of) well-educated households

with above-average income (e.g. Busemeyer, 2007; Jensen, 2011). Among them, conservative parties are more popular than leftwing parties and thus conservative parties are expected to spend more on higher education than leftwing governments. The empirical analysis of Potrafke (2011) supports this notion: Empirically analyzing Western German states from 1974-2006, he provides evidence that conservative governments spend more on universities while leftwing governments provide more funds for schools. On the other hand, Kauder and Potrafke (2013) show that it was especially leftwing government that opposed the introduction of tuition fees for German public universities.

A recent survey run in eight European countries (including Germany) shows that education ranks high among citizens' priorities for more public investments (Busemeyer et al., 2017). It reveals a strong across-the-board support for more public investments in education. In line with the general notion above, support is somewhat higher among leftwing citizens. The value of an apprenticeship is highly recognized in most countries – including Germany. At the same time, the support for additional investments in vocational schools among German citizens is lower than for investments in other school branches (Busemeyer et al., 2017).

While some of the above studies mention the specific role of vocational education (e.g. Jensen, 2011), it has rarely been analyzed. Two exceptions are noteworthy here: First, Busemeyer et al. (2011) provide an analysis of Swiss citizens and their preferences for public spending on education. They show that leftwing citizens demand higher spending. Moreover, they find that citizens want to see priorities set on those educational branches they emanated from. Specifically, citizens who went through vocational school want to see these prioritized while citizens with higher education prefer to see spending concentrated in higher education. The former are the classical clientele of leftwing parties while the latter are more likely to lean towards conservative parties. Thus, the results by Busemeyer et al. (2011) indirectly support

the notion that leftwing parties spend more on vocational schools than conservative ones. At the same time, they only analyze policy preferences rather than actual spending behavior of governments.

The second noteworthy paper is Bischoff and Hauschildt (2019). Like this paper, they use data for West-German counties in the early 2000s. Their focus rests on the spatial interaction in expenditures on vocational schools. They do not find any evidence supporting the notion that these expenditures are used as an instrument in the inter-regional competition for mobile capital. They control for the vote share of Christian Conservatives and find it to be associated with higher per capita expenditures. Beyond that, Public choice aspects are of minor importance for them.

3.2.2 Vocational training and the labor market

A number of authors address the question why the German system of vocational training exists in some countries like Germany or Austria while similar systems are missing in the UK or US (e. g. Harhoff and Kane, 1993, Soskice, 1994). While it is not puzzling to have firms pay for firm-specific training, the question is: Why do they invest in the general skills of their apprentices and thereby reduce their monopsony power in negotiations with them? Acemoglu and Pischke (1998) argue that firms have monopsony power (because of superior information) and thus pay more for training if quits are rare. If quits are high, a low amount of training is provided in equilibrium. The level of labor market imperfections and other institutional settings in Germany makes quits difficult and thus rare and thereby leads to high-skill high-education equilibrium characterized by a high degree of training, high skill-levels and a low frequency of quits (see also Harhoff and Kane, 1993; Soskice, 1994). As workers benefit more from the high-skill high-education equilibrium, the above arguments suggest that especially leftwing parties

face incentives to spend public resources on vocational training – thereby helping to keep this equilibrium stable.

Bradley and Taylor (1996) develop a theoretical model to analyze interactions between the vocational training system and the local economy: It suggests that the output of vocational training and the stock of high-skilled workers form a positive feedback loop. In addition, the number of high-skilled workers has a positive influence on local competitiveness and economic performance. Bradley and Taylor (1996) find support for the existence of these positive feedback effects in their empirical analysis for local England.

Di Gioacchino and Profeta (2014) develop a two-sector model on lobbying for education, arguing rather the other way round: They stress that the production structure and firms' political pressure influence education policy and therefore also the composition of human capital. Interpreted through the lens of Public Choice theory, this suggests that conservative parties spend more funds on vocational schools because they entertain closer links to local firms and are thus more likely to be influenced by business groups.

3.3 Institutional background

3.3.1 Vocational education in Germany

The German system of vocational education rests on two main pillars (see also Bischoff and Hauschildt, 2019). The first and largest pillar is the widely acknowledged apprenticeship system. It offers the possibility for young people who finished secondary school[8] to acquire a formal qualification certified in a diploma without going to college or university. In the classical apprenticeship system, young people enter a contract with a firm that employs them and trains

[8] This is not a formal requirement (Kuppe et al. 2015, p. 9).

their firm-specific skills. During the time as apprentice, they visit a vocational school that provides them with theoretical profession-related training. They can choose between more than 300 different professions like bank clerk, construction worker, mechanic, electrician, IT-technician etc. (BIBB, 2014). For each profession, the essential content of the apprenticeship education is settled in a nationwide curriculum negotiated among chambers of commerce and firms, labor unions and the German national and federal government as well as the Federal Ministry of Education and Research (Kuppe et al., 2015).

The standard way for a young person to acquire an apprenticeship qualification is to fill a position as apprentice in a firm that is qualified to train him in the desired profession. Apprentices sign a special contract with their employer. In this contract, the firm agrees to provide the apprentice with the necessary training in the practical parts of the profession and to give him the time off to visit the vocational school. The largest part of vocational schools are state-run schools. They offer courses in general skills and in the theoretical skills underlying his profession (e.g., material sciences, programming skills). The apprentice agrees to go through the training and to work for the firm in the rest of the time. Apprentices receive some pay but the amount is much lower than the pay of untrained workers (e.g. Bischoff and Hauschildt, 2019).

Visiting the vocational schools is obligatory and costless. Apprentices usually attend a vocational school (*Berufsschule*) for 1-2 days per week. In most cases, they visit vocational schools located in the county where their firm is located or in a neighboring county. Depending on prior school education and profession (and partly on the apprentice's personal decision to shorten the apprenticeship program), the time of apprenticeship is two to three and a half years. The chambers of commerce supervise the practical training within the firm (in the case of a classical apprenticeship), give the final examination of apprentices in the practical elements of

their education and issue the apprenticeship diploma (Hippach-Schneider et al., 2007). The apprenticeship contract ends after successfully completing the apprenticeship. Some apprentices are offered the prospect of a regular labor contract after successfully completing their training. The retention rate varies across firms and industries (e.g. Pfeifer et al., 2009).

The second pillar of the German system of vocational education covers all those professions, e.g. some professions in the field of health care, where the share of theoretical training is substantially larger. In these professions, apprentices do not have individual contracts with a training firm or other institution. Instead, they undergo three years of schooling in so-called *Berufsfachschule* and receive practical training during internships outside schools. The *Berufsfachschule* also offers shorter full-time programs (with a duration of one year) as partial qualifications shortening future related apprenticeship programs (KMK, 2014).

3.3.2 The role of German counties

The German constitution assigns the task of education to the states (*Länder*) that in turn delegate some of the tasks to the county-level. As of 2001, there are 367 rural counties (*Landkreise)* with an average population of 178.448 and an average number of 42 municipalities on their territory. Next to them, there are 118 German cities that serve as municipality and county at the same time (so-called cities with county rights/*kreisfreie Städte*). Hereafter, we will use the term county as generic term for both cities with county rights and rural counties.

The German Constitution grants municipalities and counties the right to self-government (GG, art. 28(2)). Municipalities provide important public services like local roads, business parks, cultural infrastructure and pre-school childcare – accounting for 16.5 percent of total public expenditures (*Statistisches Bundesamt*, 2016). While municipalities are granted substantial

autonomy, German counties have less autonomy. They are assigned a "twin role" placing them in charge of a) executing numerous laws from upper-tier governments (such as local social security benefits) and b) providing supra-municipal goods and services (e.g. county hospitals, county roads, waste management etc.).[9] Furthermore, they support financially weak local municipalities to limit inequality in the provision of local public goods and services within the county. Finally, there are some voluntary tasks, especially concerning cultural issues like museums etc. (e.g. Seele, 1990; Scherf and Hofmann, 2003).

On the revenue side, counties rely heavily on vertical grants – most of them distributed through a formula-based fiscal equalization system at state level. It gives more grants per capita to fiscally weak counties or municipalities without fully levelling out differences in fiscal capacity. While cities with county rights – like all German municipalities – have the right to levy local business and land taxes, rural counties do not have any tax autonomy. However, they can generate revenues by setting a rate of the so-called *Kreisumlage*. The *Kreisumlage* defines a share of "regular municipal revenues" that the county can extract from the budgets of its municipalities. The taxrate (so-called *Umlagesatz*) is set by the county council in a simple majority vote. The municipalities' approval is not needed (e.g. Seele, 1990; Scherf and Hofmann, 2003; Henneke, 2012).

The formal responsibility for vocational schools rests with the German states (*Länder)*. They employ the teaching staff, pay for their salaries and develop the curricula (in accordance with the nationwide regulations negotiated with the chambers of commerce). The counties are in charge of the external school issues and have to provide funding for non-teaching staff, after school care, buildings, school equipment, administrative costs etc.

[9] Sometimes, administrative tasks are also assigned to them by the state (e.g. building and trade control).

Given the large number of more than 300 professions, it is obvious that not all counties can offer the relevant vocational school classes in all these professions. Instead, most counties only offer a limited amount of so-called *Fachklassen* while accepting pupils from other counties. The cities with county rights play an important role in providing vocational training for the less densely populated rural counties in the region. While the latter also open their training classes to apprentices from the cities, the exchange is unbalanced with the cities receiving more outside pupils than they send to the surrounding rural counties. In most states, vocational schools receive a fixed grant per student from outside covering some of the variable costs (see Avenarius and Heckel, 2000). The regional distribution of *Fachklassen* is settled by the state – after consulting the regional chambers of commerce and the counties.

It seems reasonable to assume that some types of vocational training are more expensive per student than others. For instance, technical apprenticeships which include apprenticeship workshops cause higher (material) costs than those without apprenticeship workshops (Pfeifer et al., 2009). As data on the distribution of *Fachklassen* across counties is not available, we will control for the division of labor among counties through county fixed effects.

In most counties, vocational training is concentrated in a few, large school centers. These school centers often encompass different types of vocational schools that share facilities and staff. For this reason, the statistical offices cannot provide expenditure data by school type but publish joint expenditure data on a number of different schools grouped as schools of the vocational education branch (*Berufliche Schulen*). Hereafter, we will use the term vocational pupils as umbrella term for all pupils in the schools of this vocational education branch. The two main pillars described in section 3.1 account for the largest part of all pupils by far. The *Berufsschule* (first pillar) account for roughly 70 percent and the *Berufsfachschule* (second pillar) for approximately 15 percent of all pupils in the vocational school branch.

The remaining 15 percent of pupils visit schools that still place a focus on vocational training yet the focus is weaker. The so-called *Fachschule* offers advanced training for adults who have already completed an apprenticeship and acquired some work experience. It consists of general as well as (theoretical) vocational training providing an additional formalized vocational qualification. It can be finished with a university of applied science entrance qualification in addition (*Fach-Abitur*). The *Berufsoberschulen* provide the latter qualification (or a general university entrance qualification) upon successful graduation but require some form of completed apprenticeship. Vocational grammar schools are basically full-time grammar schools where some (minor) subjects include vocational aspects. The successful graduation from this type of school gives the students a general university entrance qualification (KMK, 2014).[10] In our analysis, we will control for the shares of pupils in different school types. Table 3.1 provides information on the number of schools and the structure of pupils for the West-German counties included in our dataset.

[10] The share of the remaining types of vocational pupils is negligibly small.

Table 3.1: Structure of vocational students (2002)

	rural counties					Municipalities with county rights				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Share voc. students unemployed	225	0.09	0.04	0.00	0.27	71	0.08	0.04	0.00	0.20
share students Berufsaufbauschule	225	0.00	0.00	0.00	0.01	71	0.00	0.00	0.00	0.00
share students Berufsfachschule	225	0.17	0.10	0.00	0.44	71	0.12	0.07	0.00	0.34
share students Fachgymnasium	225	0.04	0.06	0.00	0.19	71	0.02	0.03	0.00	0.14
share students Fachoberschule	225	0.04	0.05	0.00	0.27	71	0.05	0.03	0.00	0.16
share students Berufsoberschulen Obersch.	225	0.01	0.02	0.00	0.15	71	0.01	0.02	0.00	0.07
share students Fachschulen	225	0.06	0.08	0.00	0.97	71	0.07	0.03	0.00	0.19
share students Fachakademien	225	0.01	0.03	0.00	0.49	71	0.01	0.01	0.00	0.07
share foreign voc. students	225	0.06	0.04	0.00	0.25	71	0.08	0.04	0.00	0.19
share voc. students/pop	225	0.02	0.01	0.00	0.05	71	0.06	0.03	0.02	0.13
share Berufsschüler	225	0.67	0.13	0.00	1.00	71	0.73	0.06	0.58	0.92
number voc. schools	225	5.12	5.00	0.00	38.00	71.00	7.17	7.51	1.00	40.00

3.3.3 Political decision making at county-level

The rural counties have a local parliament elected by their citizens. The county parliament (*Kreistag*) represent the citizens of a county in all affairs settled at county-level. It is enabled to enact statutes and can be seen as the legislative body of the county (Jann and Bogumil, 2009). The local administration is headed by the *Landrat* in rural counties (e.g. Jann and Bogumil, 2009; Fuchs, 2012). In most states, the *Landrat* is elected directly by the resident population (e.g. Fuchs, 2012; Heinelt and Egner, 2012). The *Landrat* is accountable to the county parliament when it comes to fulfilling tasks assigned to the county-level. All major decisions at county-level are made by the county parliament. Above all, this includes the right to pass a budget and thus authorize public expenditures. The county parliament also sets the administrative guidelines for the county administration. It usually elects specialized committees that supervise the county administration in specific fields of activity. However, the institution of a county government similar to state or federal governments does not exist on county-level. Therefore, we will focus on the seat shares of different parties in the county council to identify the impact of party ideology on expenditures for vocational schools.

In cities with county rights, the city council is the legislative body equivalent to the county parliament – elected by the resident population. It represents its citizens in all affairs settled at municipal or county-level. Its competences are very similar to those of the county parliament. Most importantly, they pass the budget and authorize public expenditures. Again, there are committees controlling the administration but there is nothing comparable to a state or federal government at this level.

3.4 Data and hypotheses

We use data on all counties in the West-German states for 2002 - 2013. This leaves us with 301 observations per year comprising 217 rural counties and 84 cities with county rights in West Germany. The descriptive statistics in table 3.2 show that there is substantial heterogeneity in population size, industry structure, county council composition as well as in economic and fiscal indicators. Bavarian counties are substantially smaller than the counties in other states. At the same time, the average population size in rural counties is similar to that of cities with county rights (approximately 182.000 for West-Germany excluding Bavaria and 125.000 inhabitants in Bavaria). In the counties of our sample, the population decreased by 2 percent on average between 2002 and 2012. The highest growth rate is 12.4 percent and the lowest is -11.6 percent over this time period. The average annual population growth rate varies from -7 percent to 5 percent in our panel (with lower values in rural counties compared to cities with county rights). At the same time, we find substantial differences between rural counties and cities with county rights in other categories. Cities with county rights have higher unemployment rates and more debt per capita. In addition, the share of non-German population is larger. Regarding industry structure, cities with county rights have a higher share of employees in the service and production sector while the construction sector is larger in rural counties. In addition, the share of employees working in large firms (>250 employees) is substantially larger in cities with county rights while rural counties have a higher share of employees working in small firms (< 10 employees). A similar pattern is observed for the distribution of apprentices across firms of different size: The share of apprentices working in large firms (>250 employees) is substantially larger in cities with county rights while rural counties have a higher share of apprentices working in small firms (< 10 employees). It is important to note that these shares refer to the location of the apprentices' firms rather than the location of the vocational schools they visit.

Table 3.2: Characteristics of counties 2002

	rural counties					Municipalities with county rights				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
expeniture/pupil	225	1943.07	8135.01	52.05	108837.06	71	877.06	857.00	154.05	5078.04
Share apprentices Small	225	0.30	0.05	0.17	0.46	71	0.20	0.04	0.09	0.31
Share apprentices big	225	0.19	0.07	0.03	0.38	71	0.32	0.09	0.15	0.58
income/capita (in 1000)	225	16.80	1.73	1.33	2.65	71	16.91	1.59	1.42	2.24
debt/capita	225	0.93	0.33	0.32	20.26	71	10.37	0.64	0.05	20.85
unemployment rate	225	60.79	20.02	30.30	140.80	71	90.69	20.34	50.60	16.00
CDU seat share	225	0.46	0.09	0.00	0.74	71	0.44	0.07	0.26	0.60
CDU strongest	225	0.77	0.42	0.00	1.00	71	0.69	0.47	0.00	1.00
CDU abs majority	225	0.34	0.48	0.00	1.00	71	0.15	0.36	0.00	1.00
SPD seat share	225	0.31	0.11	0.10	0.55	71	0.36	0.09	0.15	0.56
SPD strongest	225	0.19	0.39	0.00	1.00	71	0.25	0.44	0.00	1.00
SPD abs majority	225	0.02	0.15	0.00	1.00	71	0.03	0.17	0.00	1.00
left seat share	225	0.35	0.11	0.11	0.62	71	0.39	0.09	0.20	0.61
FDP seat share	225	0.03	0.03	0.00	0.13	71	0.03	0.03	0.00	0.24
absolute majority	225	0.36	0.48	0.00	1.00	71	0.18	0.39	0.00	1.00
OTHER seat share	225	0.15	0.11	0.00	0.67	71	0.13	0.08	0.00	0.36
share children	225	0.17	0.01	0.14	0.22	71	0.15	0.01	0.11	0.17
share elderly	225	0.17	0.02	0.12	0.23	71	0.19	0.01	0.16	0.23
foreign share	225	0.07	0.03	0.03	0.18	71	0.12	0.04	0.05	0.24
GRUENE seat share	225	0.04	0.03	0.00	0.13	71	0.03	0.04	0.00	0.14
FDP seat share	225	0.03	0.03	0.00	0.13	71	0.03	0.03	0.00	0.24
RIGHT seat share	225	0.01	0.01	0.00	0.05	71	0.01	0.01	0.00	0.05
population (in 1000)	225	196.39	1250.72	51.77	1125.88	71	1869.73	2101.50	35.85	1234.69
deindustrialization	225	71.08	7.07	43.07	88.01	71	78.03	9.05	43.07	91.03
Umlagesatz	212	39.09	9.06	0.00	56.01	0	.	.	.	.
d. Gew.Hebesatz	224	342.10	28.06	297.07	445.08	0	.	.	.	.

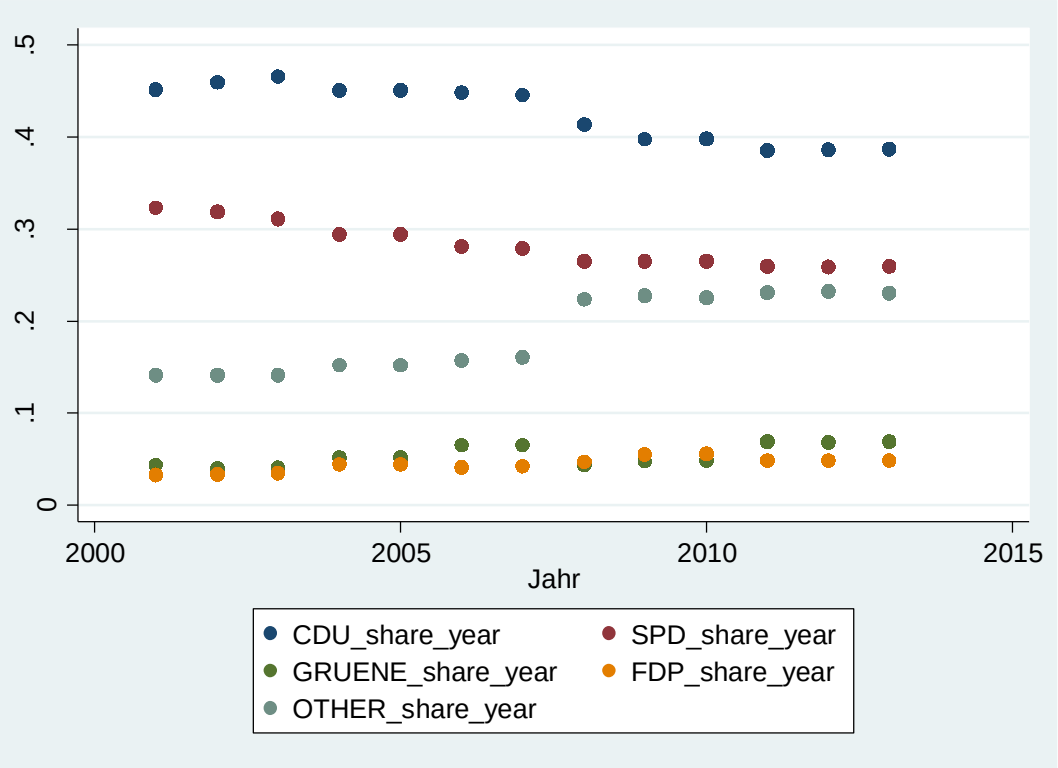
Looking at the counties' annual expenditures on vocational schools per pupil, we find substantial differences between rural counties and cities with county rights. Due to the higher degree of decentralization, the figures are three to four times larger in Bavaria than in the other West-German counties. At the same time, rural counties spend substantially more (1943 € per pupil and year (2002)), the figure for cities with county rights is substantially lower (877 €). In addition, we find substantial variation in per pupil expenditures within both groups.

The county councils are dominated by the same parties that dominate state and federal governments in Germany. The Social Democratic Party (SPD) is the largest leftwing party and the Christian Democratic Union (CDU) is its opponent on the conservative side of the political spectrum. In Bavaria, the conservative side of the spectrum is dominated by the Christian Social Union - the CDU's so-called "sister party". Both parties are strongly linked – forming a common fraction on the federal level and agreeing not to run against each other at state or local level. Therefore, we will refer to both of them as Christian Conservatives. Figure 3.1 shows that they have substantially higher seat shares than the Social Democrats. Social democrats are somewhat stronger in cities with county rights than in rural counties while the opposite is true for Christian Conservatives. Christian Conservatives are the strongest party in 75 percent of cases while Social Democrats are strongest in only 20 percent of the cases (in 2002). Absolute majorities of Social Democrats are very rare while Christian Conservatives have the absolute majority of seats in 30 percent of the cases (2002).

We observe substantial variation in seat shares across counties and across time. The share of seats held by the Social Democrats and Christian Conservatives varies from less than 8 to 64 percent and 10 to 80 percent respectively. From one term to the next, the median absolute change in seat share was 6.3 percent for Christian Conservatives and more than 11 percent for Social Democrats.

In our period of observation, both large parties have lost seats – largely at the expense of Liberal Democrats (FDP) and the Green Party – accounting for around 4.5 and 5.3 percent of the seats on average. In some county parliaments – especially in the states *Schleswig-Holstein* and Bavaria – local voter's associations hold seats in county parliaments. They are not associated with a particular political ideology, nor formally connected to any political party mentioned above (e.g. Baskaran and Lopes da Fonseca, 2016). On average, they account for 18 percent of the seats. This share is similar for cities with county rights and for rural counties. The same applies to the seat shares of Liberal Democrats and the Green Party. The Socialist Party (PDS/DIE LINKE) is of minor importance at county-level and so are rightwing parties – with average seat shares of less than one percent.

Figure 3.1: Seat shares of parties in county council (2002-2013)



The counties themselves have very limited influence on the number of schools on their territory or the educational program these schools offer. These facts are negotiated with the state government (see section 3.3). On the other hand, counties can influence the quality of vocational schooling by spending more on equipment and activities. We argue that spending more funds on vocational schools is not a sign of inefficiency or waste but rather an indication that a county is investing more in the general skills of their vocational pupils.

Elections for the county parliaments are held every five or six years, depending on the state. As these elections are not synchronized across states, we observe elections and thus changes in seat shares in every year between 2001 and 2013. The survey results described by Busemeyer et al. (2017) suggest that high expenditures for vocational schools are quite popular among the electorate. Thus, opportunistic politicians are likely to spend more on vocational schools in election years. This leads to our first hypothesis:

H1: Expenditures on vocational schools are higher in election years.

Our second set of hypotheses focusses on the role of party ideology on vocational expenditures. As laid out in section 3.2, there are reasons suggesting that leftwing parties use expenditures on vocational schools to support their clientele – skilled workers without university diploma and their children. This notion is supported by the standard arguments put forth in the literature – arguing that well-equipped public schools benefit low-income households more than high-income households that have private schools as substitutes. The specific literature on vocational education provides further support in this respect: High general skills trained in vocational schools strengthen the workers' bargaining power on the labor market and help preserve what is called the high-skill high-education equilibrium (see section 3.2.2). Social Democrats traditionally entertain strong links to the German labor unions and claim to be the party that – more than all others – promote the workers' interests. Thus, hypothesis H2 reads:

H2: The larger the voting power of Social Democrats in the county council, the more a county spends on vocational schools.

On the other hand, especially the paper by Di Gioacchino and Profeta (2014) implies that firm-friendly conservative parties are lobbied by the local industry to provide them with a high-quality public input to their production function. Christian Conservatives claim to focus on business interests with a special focus on small and medium-sized enterprises. Especially among Christian conservatives, these enterprises are considered the backbone of the German economy and they rely heavily on the apprenticeship system. Thus, hypothesis H2A states:

H2A: The larger the voting power of Christian Conservatives in the county council, the more a county spends on vocational schools.

3.5 Empirical analysis

3.5.1 Empirical models

The data set we analyze is a panel data set covering 301 counties for the period of 2002 - 2013. First, we apply a standard two-way fixed effects panel model:

$$\ln\left(\frac{exp\,voc.\,schools}{pupils}_{it}\right) = \alpha_i + \beta \cdot voting\ power_{it} + \delta\left(X_{it}\right) + \lambda_t + \varepsilon_{it} \tag{3.1}$$

The index i denotes the county and t represents the index for time. Parameter α_i stands for county fixed effects. The latter control for the likely difference in expenditures that result from differences in the necessary training facilities needed for training particular professions. These differences may be substantial because there is a significant degree of division of labor between counties (see section 3.3.2). Fixed effects are an adequate way of coping with the unobservable differences in training facilities needed across counties because the structure of schools and

classes is quite stable in our period of observation. They also control for any differences in state regulation and for the difference between rural counties and cities with county rights. Year fixed effects (λ_t) control for common shocks across time.

Second, we will apply mixed panel models (e.g. Rabe-Hesketh and Skondral, 2008). Mixed panel models are used less frequently in economics yet they have one main advantage compared to the standard panel model that is highly relevant in our case. Mixed models account for the fact that our data is nested: It combines many counties with repeated observations generated in nine different states – each of which is containing both rural counties and cities with county rights. Given the institutional differences across states and between rural counties and city with county rights within each state, we have reasons to believe that the effect size of our main political variables may differ across these 9x2 clusters. Mixed models allow for random slopes across clusters (e.g. Rabe-Hesketh and Skrondal, 2008: Chapter 4). The regression equation reads:

$$\ln\left(\frac{exp\,voc.\,schools}{pupils}_{ijt}\right) = (\alpha + \zeta_{1i}) + (\beta + \zeta_{2j}) \cdot voting\ power_{ijt} + \delta(X_{ijt}) + \lambda_t + \varepsilon_{ijt} \qquad (3.2)$$

The newly introduced index j captures the clusters. The mixed model introduces two parameters ζ_{1i} and ζ_{2j}. It assumes that the covariates $voting\ power_{ijt}$ and X_{ijt} are exogenous with $E(\zeta_{1i} | X_{ijt}, voting\ power_{ijt}) = 0$, $E(\zeta_{2j} | X_{ijt}, voting\ power_{ijt}) = 0$ and $E(\varepsilon_{ijt} | X_{ijt}, voting\ power_{ijt}, \zeta_{1i}, \zeta_{2j}) = 0$. Parameter ζ_{1i} captures the county i's deviation from the mean intercept coefficient α. The parameter ζ_{2j} represents the cluster j's deviation from the mean slope parameter β for our central variable of interest: $voting\ power_{ijt}$. It accounts for the fact that the impact of political constellations on expenditures for vocational schools may differ in size depending on the institutional framework in which the county councils operate.

We use dummy variables for the election year and pre-election years to test Hypothesis H1. To measure parties' voting power, we calculate the normalized Banzhaf-index for each party present in the county council. When calculating the Banzhaf-index, the first step is to calculate the number of constellations of parties excluding a certain party P that have no majority without party P but that turn into a winning coalition if party P joins. These are then summed up across all parties. Dividing this sum by the number of cases where party P makes the swing yields the normalized Banzhaf-index for party P. Consequently, the normalized Banzhaf index ranges between 0 and 1. The larger the index, the more powerful a party is. In case party P has an absolute majority, its Banzhaf-index is 1 and it is 0 for all other parties (e.g. Huber et al., 2003). Hypothesis H2 implies that the expenditures for vocational schools increase in the normalized Banzhaf-index of Social Democrats while H2A implies the analogous relationship for the normalized Banzhaf-index of Christian Conservatives. We test these hypotheses in different specifications to avoid multi-collinearity.

Matrix X_{it} and X_{ijt} contain a number of control variables. First, we control for the normalized Banzhaf-index of the other parties, namely for the Liberal Democrats (FDP), the Green Party and the local voters' associations.[11] We also include two variables that account for possible patterns in earmarked vertical grants to counties that may in turn influence counties' expenditures. The main logic behind these variables is the following: State governments may use vertical grants to increase their own popularity among the local population and/or to influence local elections at county-level. The literature on the political economy of vertical grants shows that upper-tier governments give more grants to lower-tier districts dominated by their own party and to swing districts (e.g. Solé-Ollé and Sorribas-Navarro, 2008; Banaszewska

[11] In most cases, there is only one local association per county in the county council. We do not differentiate between different associations across counties but bundle all associations in one Banzhaf index. Whenever there are two associations or independent candidates, these are bundled.

and Bischoff, 2017). Applied to our specific context, this implies that counties where Social Democrats (Christian Conservatives) hold the highest vote share receive more earmarked grants if Social Democrats (Christian Conservatives) are part of the state government. In addition, counties receive more earmarked grants if the vote-margin between Social Democrats and Christian Conservatives is small. Unfortunately, we cannot observe the amount of vertical grants specifically earmarked for vocational schools. Instead, we accommodate the above conjectures by including a dummy variable alignment that takes on the value 1 if the strongest party at the county-level is aligned with one of the parties in the state government. The variable CDU-SPD-differential represents the absolute value of the difference in seat shares between Christian Conservatives and Social Democrats. Low values for this variable indicate a close race between the two parties.

We use two different variables to account for the argument by Jensen (2011) according to which educational expenditures may be driven by the degree of de-industrialization. The first variable is the one proposed by Jensen (2011) himself, namely the share of employees working outside of manufacturing and agricultural sector. In addition, we use the change in this employment share compared to the previous year. This variable captures a dynamic interpretation of Jensen's main argument: Accordingly, it may be the *loss* of industrial employment rather than its absence that needs to be dealt with.

We capture differences in the counties' general economic and fiscal situation by including the unemployment rate (based on the whole civilian labor force) and the available income per capita (deflated with consumer price index). Following the literature on primary and secondary education (see section 3.2), we also control for the county's age composition by including the share of older citizens (≥ 65 years) and the share of children in the total population.

Furthermore, we have to account for the fact that the counties differ in relative importance of different school types within the vocational education branch (see section 3.3.2). To this end, we account for the share of pupils in all types of schools with the pillar 1 (*Berufsschule*) as baseline category.[12] We also control for the share of non-German vocational pupils as well as for the ratio of total number of pupils in the vocational school branch to the counties resident population. The latter variable is included to capture possible economies of scale and the net balance of guest pupils coming from or going to other counties. We account for the fact that the demand for vocational training outside the firm may be different for firms of different size (see Bischoff and Hauschildt, 2019). To this end, we include the share of apprentices in the county working in firms with less than 20 employees as well as the share of apprentices working on firms with more than 200 employees.[13] Finally, the dummy variable named *Doppik* takes the value of 1 whenever a county applies double-entry bookkeeping instead of the traditional system of cameralistics. Almost all counties switch from the latter to the former during our period of observation.

All independent variables are lagged by one year to account for the fact that the budget of a certain year t is passed in t-1. We take the natural logarithm of all continuous variables but not for dummy variables and variable representing percentage shares. Standard errors are clustered at county-level.

[12] We also account for the share of pupils without any apprenticeship training position visiting a vocational school to prepare them for an apprenticeship later.
[13] Note that these variables refer to the apprentices working in firms located within the county borders.

3.5.2 Results

The main regression results are presented in table 3.3. The sample analyzed here contains all 301 rural counties and cities with county rights in West-Germany between 2002 and 2013. Due to occasional missing values especially in the early years, the panel is not fully balanced. Column (1) presents the results of a standard panel fixed effects model using the normalized Banzhaf-index for the Social Democrats (see Hypothesis H2).[14] Column 2 and 3 report the analogous results of a mixed model including random slopes and random slopes plus random intercepts respectively[15]. All three models use the share of employees working outside of manufacturing and agricultural sector as deindustrialization measure. Model 4 reruns model 1 but uses the second deindustrialization measure, namely the change in the share of employees working outside of manufacturing and agricultural sector.[16]

[14] The Hausman test clearly indicates that the fixed effects model is preferred.
[15] We also ran a random intercept model. Likelihood- ratio tests indicate that the random slope model is strictly preferred.
[16] Qualitatively identical results emerge if we use mixed models instead of the fixed-effects model reported here (Regression outputs are presented in the supplementary material.)

Table 3.3: Regression results on the counties' expenditures for vocational schools per capita using panel FE and mixed models (full sample)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil
Model	FE	Mixed	Mixed	FE	FE	Mixed	Mixed	Mixed
Share apprentices small firms (t-1)	0.102	-0.699	-0.859	0.102	0.102	-0.699	-1.030	0.102
	(0.754)	(0.689)	(0.662)	(0.760)	(0.754)	(0.689)	(0.673)	(0.760)
Share apprentices big firms (t-1)	0.325	-0.159	-0.144	0.334	0.325	-0.159	-0.223	0.334
	(0.416)	(0.385)	(0.383)	(0.414)	(0.416)	(0.385)	(0.372)	(0.414)
Share foreign vocational stud (t-1)	-0.363	-1.757**	-1.624*	-0.359	-0.363	-1.757**	-2.387***	-0.359
	(1.143)	(0.881)	(0.890)	(1.147)	(1.143)	(0.881)	(0.876)	(1.147)
Vocational pupils/pop (t-1)	-18.44***	-13.78***	-15.58***	-18.42***	-18.44***	-13.78***	-13.61***	-18.42***
	(5.514)	(2.426)	(2.565)	(5.523)	(5.514)	(2.426)	(2.263)	(5.523)
Disposable income/capita (t-1)	2.056***	1.831***	1.889***	2.034***	2.056***	1.831***	1.877***	2.034***
	(0.652)	(0.519)	(0.530)	(0.621)	(0.652)	(0.519)	(0.521)	(0.621)
Unemployment rate (t-1)	-0.00198	-0.0103	-0.0105	-0.00133	-0.00198	-0.0103	-0.0113	-0.00133
	(0.0151)	(0.0134)	(0.0130)	(0.0152)	(0.0151)	(0.0134)	(0.0129)	(0.0152)
Share children (t-1)	-2.907	-2.297	-4.090	-2.833	-2.907	-2.297	-2.848	-2.833
	(4.726)	(3.761)	(3.790)	(4.783)	(4.726)	(3.761)	(3.805)	(4.783)
Share older citizens (t-1)	3.474	1.070	1.608	3.412	3.474	1.070	1.902	3.412
	(3.019)	(2.256)	(2.212)	(2.992)	(3.019)	(2.256)	(2.260)	(2.992)
Deindustrialization (t-1)	0.000887	-0.00852	-0.0115*		0.000887	-0.00852	-0.00662	
	(0.0159)	(0.00551)	(0.00589)		(0.0159)	(0.00551)	(0.00548)	
Δ Deindustrialization (t-1)				0.0115				0.0115
				(0.0133)				(0.0133)
Doppik	-0.270***	-0.276***	-0.258***	-0.271***	-0.270***	-0.276***	-0.274***	-0.271***
	(0.0472)	(0.0474)	(0.0467)	(0.0472)	(0.0472)	(0.0474)	(0.0471)	(0.0472)
Election year	0.0546***	0.0601***	0.0624***	0.0546***	0.0546***	0.0601***	0.0602***	0.0546***
	(0.0161)	(0.0158)	(0.0156)	(0.0161)	(0.0161)	(0.0158)	(0.0158)	(0.0161)
Pre-election year	-0.0133	-0.0144	-0.0115	-0.0118	-0.0133	-0.0144	-0.0150	-0.0118
	(0.0148)	(0.0145)	(0.0144)	(0.0147)	(0.0148)	(0.0145)	(0.0145)	(0.0147)

GRUENE: BANZHAF index (t-1)	0.379	0.457*	0.368	0.378	0.879***	0.890***	0.964***	0.879***
	(0.261)	(0.255)	(0.262)	(0.261)	(0.309)	(0.302)	(0.314)	(0.309)
FDP: BANZHAF index (t-1)	-0.412	-0.404	-0.267	-0.418	0.0893	0.0295	0.164	0.0837
	(0.302)	(0.287)	(0.290)	(0.306)	(0.353)	(0.328)	(0.331)	(0.357)
Local voter ass.: BANZHAF index (t-1)	0.0872	0.136	0.140	0.0880	0.588***	0.570***	0.765***	0.590***
	(0.145)	(0.148)	(0.172)	(0.145)	(0.219)	(0.213)	(0.235)	(0.219)
SPD: BANZHAF index(t-1)	-0.501***	-0.433***	-0.498***	-0.502***				
	(0.140)	(0.128)	(0.158)	(0.140)				
CDU: BANZHAF index (t-1)					0.501***	0.433***	0.540***	0.502***
					(0.140)	(0.128)	(0.142)	(0.140)
Aligned (t-1)	0.121***	0.0954**	0.110***	0.121***	0.121***	0.0954**	0.0884**	0.121***
	(0.0388)	(0.0383)	(0.0367)	(0.0389)	(0.0388)	(0.0383)	(0.0378)	(0.0389)
CDU-SPD differential (t-1)	0.309	0.594*	0.552	0.308	0.309	0.594*	0.742**	0.308
	(0.358)	(0.322)	(0.348)	(0.362)	(0.358)	(0.322)	(0.330)	(0.362)
Constant	yes	yes	yes	yes	yes	yes	yes	yes
Controls pupils' structure (t-1)	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
random slope		-0.427***	-0.407***			-0.427***	-0.556***	
		(0.110)	(0.118)			(0.110)	(0.126)	
random intercept			0.105				-0.447**	
			(0.242)				(0.210)	
Observations	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100
R-squared	0.165			0.165	0.165			0.165
Number of groups	301	301	301	301	301	301	301	301

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

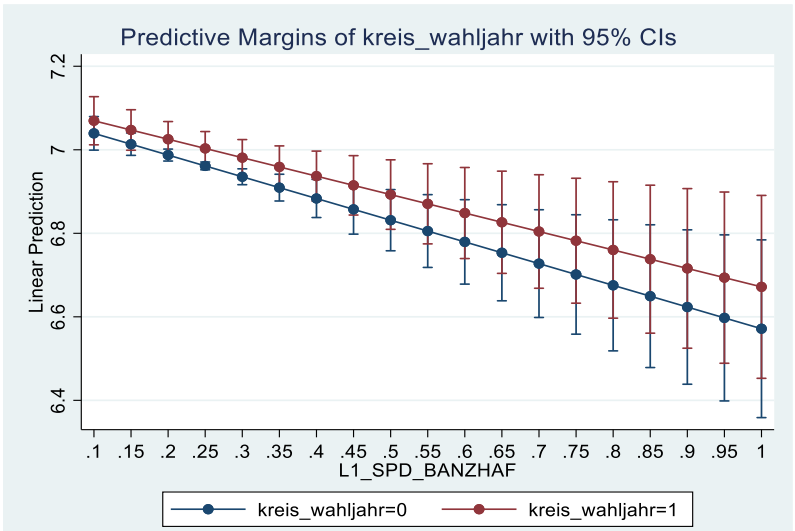
In these four models, the ratio of vocational pupils to total population and the variable *Doppik* are negatively significant in all three specifications. The opposite is true for the disposable income per capita and the variable alignment. The share of non-Germans among the apprentices is significantly negative in the mixed model with random slope only. The significantly positive coefficient estimator for the election year dummy supports Hypothesis H1. The negatively significant coefficient for the voting power of Social Democrats clearly rejects Hypothesis H2. The random slope is highly significant and negative in models 2 and 3 whereas the random intercept is insignificant. In order to highlight the robustness of these effects in our mixed models, we calculate the 95 percent bandwidth (Rabe-Hesketh and Skondral, 2008) for these two political variables in addition (see table 3.3). The table shows that the coefficient of the Banzhaf-index for the Social Democrats lies in an interval which is smaller than zero with a probability of 95 percent.[17]

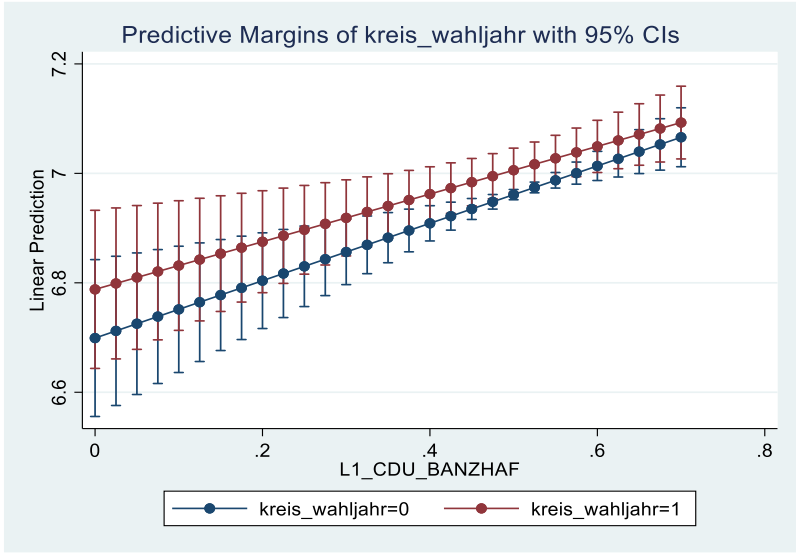
In the columns 5 to 8, we rerun specifications 1 to 4 using the normalized Banzhaf-index for Christian conservatives (see Hypothesis H2A) instead of the one for Social Democrats. The control variables that were significant in specification 1 to 4 perform accordingly. In addition, the share of non-German apprentices is significant in both mixed models and the Banzhaf-index for the Green Party is significantly positive in all four specifications. The results clearly support Hypothesis H1. The newly introduced Banzhaf-index for Christian Conservatives is significantly positive – yielding support for Hypothesis H2A. Analogous to table the first four models, the coefficient of the Banzhaf-index for the Christian Conservatives lies in an interval which is larger than zero with a probability of 95 percent.

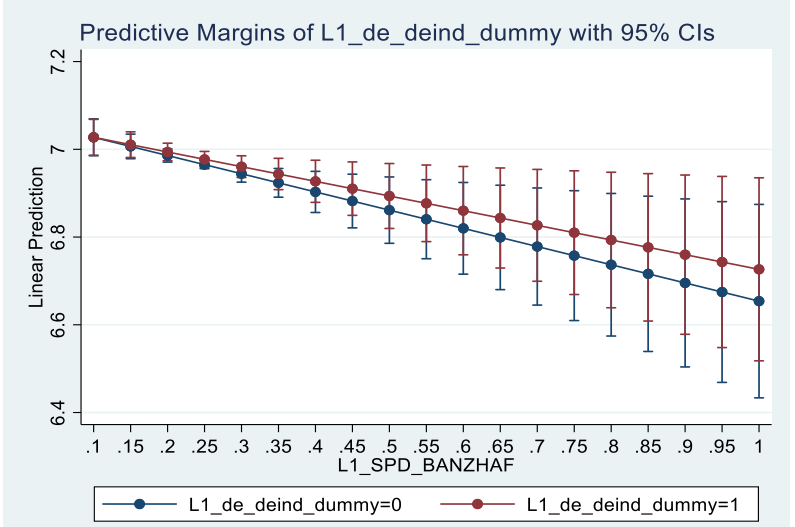
[17] Qualitatively identical results emerge if we use mixed models instead of the fixed-effects model reported here (Regression outputs are presented in the supplementary material.)

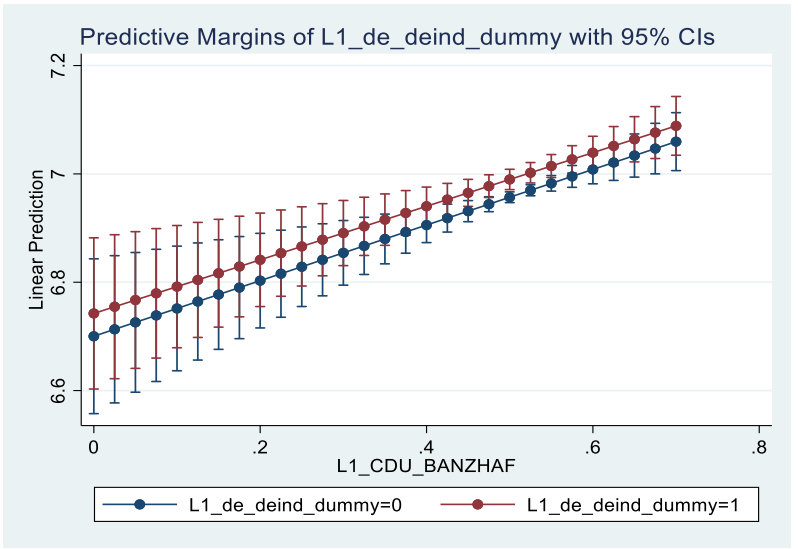
Next, we run a model 1 and 5 but include a multiplicative interaction term between election year and the (lagged) Banzhaf-index of the Christian Conservatives. This specification is motivated by the notion that the impact of party ideology may be larger in election years. The upper two margin plots in figure 3.2 do not provide any evidence that parties differ in the degree to which they spend more on vocational education in election years. In the main body of the paper, we only report the margin plots while the regression tables can be found in the supplementary material. Again, mixed models yield qualitatively identical results.

Figure 3.2: Margin plots for the interaction of Banzhaf-index of major parties and election year and a deindustrialization dummy (full sample)









Finally, we rerun 4 and 8 but include a multiplicative interaction term between the Banzhaf-index of Social Democrats and Christian Conservatives respectively and a variable capturing the change of deindustrialization. To receive a straight-forward margin plot, we replace the deindustrialization variable by a dummy variable which takes the value 1 if the share of employees outside industry and agriculture is decreasing (0 else). This specification combines the argument of Jensen (2011) with the political-economy aspects in focus in our paper. Jensen (2011) argues that districts hit hard by deindustrialization require higher expenditures for vocational education to accommodate the structural change. Our specifications test whether the challenges of deindustrialization moderates the impact of party ideology on vocational expenditures. The lower two margin plots in figure 3.2 do not support the notion that deindustrialization moderates the impact of the voting power of both Social Democrats and Christian Conservatives on educational expenditures. Again, qualitatively identical results emerge if we use mixed models instead of the fixed-effects models.

With respect to our main hypotheses, we find expenditures to be higher in election years in all specification. Thus, hypothesis H1 is supported. The effect is sizeable: Based on the coefficient in model 1, we arrive at an increase in expenditures by 5.6 percent for election years. With respect to the role of party ideology, we find the expenditures on vocational schools to decrease in the voting power of Social Democrats in the county council, while it increases in the power of Christian Conservatives. Thus, our results reject hypothesis H2 but support H2A. Again, the effect size is notable: An increase of the Banzhaf-index of Christian Conservatives by 0.2 increases expenditures 10.5 percent.

3.5.3 Robustness checks

So far, we did not differentiate between Bavaria and the other West-German states. However, Bavaria differs substantially from the other West-German states with respect to the division of labor between state level and subsidiary jurisdictions. The degree of decentralization is substantially larger in Bavaria. In some Bavarian counties, teachers' salaries are also (partially) paid by the county. We test the robustness of our results by dropping Bavaria (see table 3.4).

Table 3.4: Regression results on the counties' expenditures for vocational schools per capita using panel FE and mixed models (excluding Bavaria)

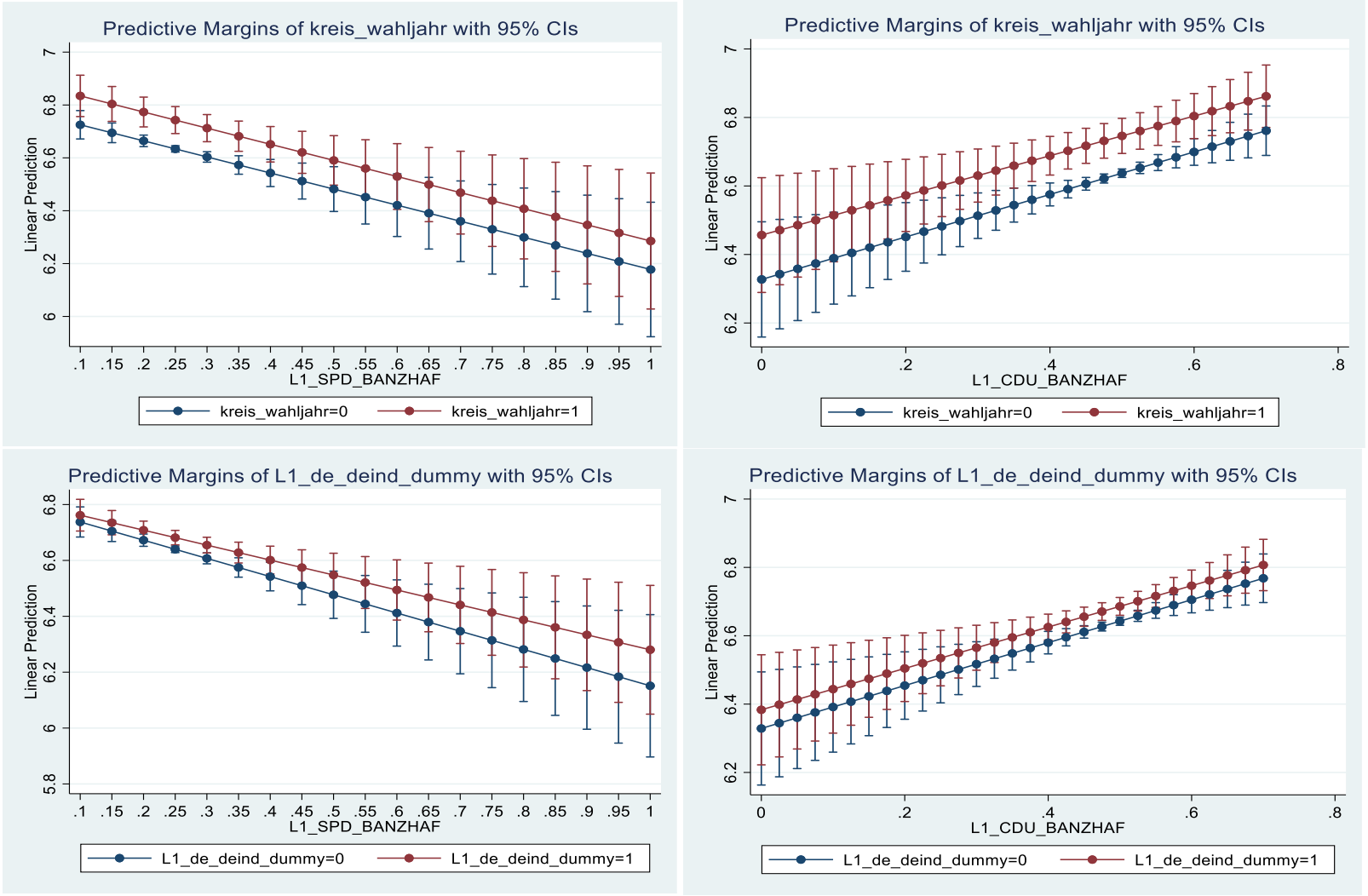
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil
Model	FE	Mixed	Mixed	FE	FE	Mixed	Mixed	Mixed
Share apprentices small firms (t-1)	-0.368	-1.419**	-1.700**	-0.446	-0.368	-1.419**	-1.460**	-0.446
	(0.926)	(0.672)	(0.661)	(0.923)	(0.926)	(0.672)	(0.685)	(0.923)
Share apprentices big firms (t-1)	0.0519	-0.284	-0.324	0.123	0.0519	-0.284	-0.327	0.123
	(0.524)	(0.384)	(0.396)	(0.527)	(0.524)	(0.384)	(0.384)	(0.527)
Share foreign vocational stud (t-1)	-1.491	-1.395*	-1.119	-1.560	-1.491	-1.395*	-1.945**	-1.560
	(1.630)	(0.800)	(0.838)	(1.641)	(1.630)	(0.800)	(0.819)	(1.641)
Vocational pupils/pop (t-1)	-25.88*	-13.18***	-14.44***	-26.00*	-25.88*	-13.18***	-13.27***	-26.00*
	(13.34)	(3.299)	(3.288)	(13.36)	(13.34)	(3.299)	(3.533)	(13.36)
Disposable income/capita (t-1)	2.052**	0.948**	0.935*	2.150**	2.052**	0.948**	0.905*	2.150**
	(0.857)	(0.468)	(0.480)	(0.874)	(0.857)	(0.468)	(0.464)	(0.874)
Unemployment rate (t-1)	-0.0342*	-0.00851	-0.0135	-0.0329*	-0.0342*	-0.00851	-0.0127	-0.0329*
	(0.0183)	(0.0147)	(0.0145)	(0.0182)	(0.0183)	(0.0147)	(0.0140)	(0.0182)
Share children (t-1)	2.894	-1.330	-1.874	2.122	2.894	-1.330	-1.029	2.122
	(7.432)	(3.905)	(4.044)	(7.450)	(7.432)	(3.905)	(4.017)	(7.450)
Share older citizens (t-1)	-0.553	1.033	1.210	-0.345	-0.553	1.033	1.536	-0.345
	(4.421)	(2.068)	(2.062)	(4.474)	(4.421)	(2.068)	(2.128)	(4.474)
Deindustrialization (t-1)	-0.0138	-0.0104**	-0.0112**		-0.0138	-0.0104**	-0.0104**	
	(0.0186)	(0.00483)	(0.00515)		(0.0186)	(0.00483)	(0.00512)	
Δ Deindustrialization (t-1)				0.0223				0.0223
				(0.0202)				(0.0202)
Doppik	-0.258***	-0.234***	-0.237***	-0.261***	-0.258***	-0.234***	-0.238***	-0.261***
	(0.0533)	(0.0492)	(0.0490)	(0.0533)	(0.0533)	(0.0492)	(0.0490)	(0.0533)
Election year	0.105***	0.106***	0.109***	0.106***	0.105***	0.106***	0.105***	0.106***
	(0.0219)	(0.0222)	(0.0222)	(0.0219)	(0.0219)	(0.0222)	(0.0218)	(0.0219)
Pre-election year	0.00406	-0.00163	-0.00268	0.00403	0.00406	-0.00163	-0.00156	0.00403
	(0.0237)	(0.0233)	(0.0234)	(0.0238)	(0.0237)	(0.0233)	(0.0230)	(0.0238)

GRUENE: BANZHAF index (t-1)	0.630*	0.725**	0.824**	0.632*	1.239***	1.076***	1.125***	1.244***
	(0.349)	(0.328)	(0.347)	(0.348)	(0.416)	(0.385)	(0.393)	(0.412)
FDP: BANZHAF index (t-1)	-0.402	-0.204	-0.0404	-0.386	0.207	0.146	0.180	0.226
	(0.354)	(0.313)	(0.309)	(0.356)	(0.426)	(0.369)	(0.361)	(0.424)
Local voter ass.: BANZHAF index (t-1)	-0.0516	0.0141	0.0991	-0.0483	0.557**	0.364*	0.471**	0.564**
	(0.198)	(0.172)	(0.187)	(0.195)	(0.261)	(0.220)	(0.236)	(0.255)
SPD: BANZHAF index(t-1)	-0.609***	-0.350**	-0.516***	-0.612***				
	(0.171)	(0.138)	(0.154)	(0.168)				
CDU: BANZHAF index (t-1)					0.609***	0.350**	0.378***	0.612***
					(0.171)	(0.138)	(0.140)	(0.168)
Aligned (t-1)	0.112***	0.108***	0.119***	0.112***	0.112***	0.108***	0.102***	0.112***
	(0.0367)	(0.0368)	(0.0357)	(0.0368)	(0.0367)	(0.0368)	(0.0363)	(0.0368)
CDU-SPD differential (t-1)	0.435	0.503	0.373	0.455	0.435	0.503	0.621*	0.455
	(0.475)	(0.345)	(0.357)	(0.471)	(0.475)	(0.345)	(0.374)	(0.471)
Constant	yes	yes	yes	yes	yes	yes	yes	yes
Controls pupils' structure (t-1)	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
random slope		-1.006***	-1.026***			-1.006***	-1.098***	
		(0.0749)	(0.0889)			(0.0749)	(0.0941)	
random intercept			-0.386				-0.894***	
			(0.262)				(0.163)	
Observations	2,007	2,007	2,007	2,007	2,007	2,007	2,007	2,007
R-squared	0.157			0.157	0.157			0.157
Number of groups	208	208	208	208	208	208	208	208

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

Comparing the results in table 3.4 with our findings in table 3.3, there are some minor differences in the performance of control variables. First, the share of apprentices working in small firms is negative and significant in all mixed models. Second, the deindustrialization variable is negatively significant in all mixed models. Third, the Banzhaf-index for local initiatives is significantly positive in some models. At the same time, the main conclusions from table 3.3 are clearly supported: The election year dummy is significantly positive in all specifications and the Banzhaf-indices of both Social Democrats and Christian Democrats perform like they do in table 3.2. Compared to the full sample, we arrive at higher effect sizes. Expenditures in election years are higher by more than 10 percent and an increase in the Banzhaf-index of Christian Conservatives by 0.2 is equivalent to an increase in expenditures by 13 percent. The margin plots do not show any moderating effect – neither for the election year nor for the degree of deindustrialization (see Figure 3.3).

Figure 3.3: Margin plots for the interaction of Banzhaf-index of major parties and election year and a deindustrialization dummy (excluding Bavaria)



In a second round of sensitivity analysis, we drop the cities with country rights. These fulfill both municipal and county tasks, have other sources of revenues and benefit more directly from the potential increase in local business tax that emerges if higher expenditures on vocational schools help to attract capital. The results are reported in Table 3.5. The estimations are a replication of those in table 3.3 except from the fact that they contain two additional control variables. First, we introduce the average business tax rate multiplier set by the municipalities within a county. It captures the average nominal tax burden of local firms within the county. The benefit-received principle as well as the theory of inter-jurisdictional competition implies a positive relationship between tax burden and the quality of local infrastructure. Vocational schools are part of the firm-related infrastructure. Second, the *Umlagesatz* of the *Kreisumlage* is included as an additional proxy for the counties' fiscal capacity (see section 3.3.2).

Table 3.5: Regression results on the counties' expenditures for vocational schools per capita using panel FE and mixed models (rural counties only)

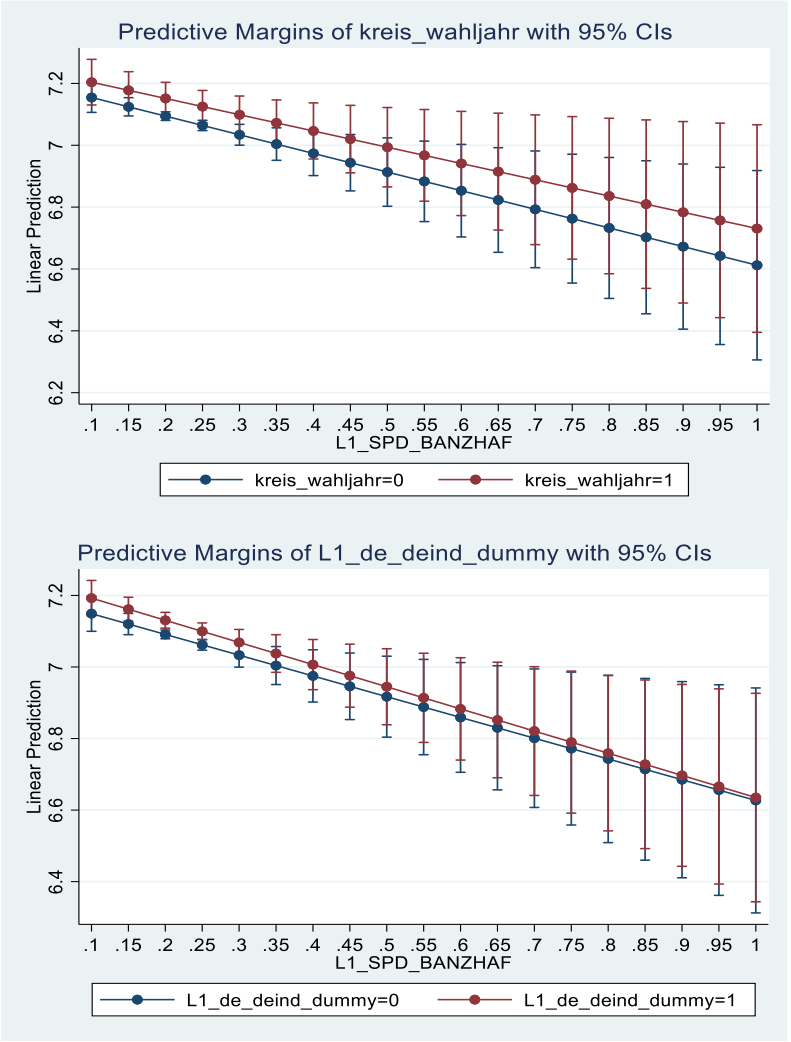
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil	ln exp/pupil
Model	FE	Mixed	Mixed	FE	FE	Mixed	Mixed	Mixed
Share apprentices small firms (t-1)	-0.458	-1.728**	-1.760**	-0.464	-0.458	-1.728**	-2.166***	-0.464
	(0.900)	(0.804)	(0.789)	(0.912)	(0.900)	(0.804)	(0.782)	(0.912)
Share apprentices big firms (t-1)	-0.593	-0.777	-0.782	-0.565	-0.593	-0.777	-0.697	-0.565
	(0.572)	(0.493)	(0.483)	(0.569)	(0.572)	(0.493)	(0.470)	(0.569)
Share foreign vocational stud (t-1)	-1.198	-1.387	-1.401*	-1.206	-1.198	-1.387	-1.684**	-1.206
	(1.060)	(0.853)	(0.821)	(1.058)	(1.060)	(0.853)	(0.850)	(1.058)
Vocational pupils/pop (t-1)	-51.13***	-43.90***	-44.13***	-50.95***	-51.13***	-43.90***	-42.44***	-50.95***
	(9.417)	(5.951)	(6.121)	(9.438)	(9.417)	(5.951)	(5.303)	(9.438)
Disposable income/capita (t-1)	1.684**	1.121**	1.120**	1.667**	1.684**	1.121**	1.151**	1.667**
	(0.726)	(0.555)	(0.556)	(0.704)	(0.726)	(0.555)	(0.561)	(0.704)
Unemployment rate (t-1)	0.00370	-0.00466	-0.00284	0.00586	0.00370	-0.00466	-0.000225	0.00586
	(0.0175)	(0.0170)	(0.0170)	(0.0174)	(0.0175)	(0.0170)	(0.0172)	(0.0174)
Share children (t-1)	8.369	5.602	3.234	8.249	8.369	5.602	4.872	8.249
	(5.671)	(4.111)	(4.124)	(5.644)	(5.671)	(4.111)	(4.269)	(5.644)
Share older citizens (t-1)	-5.321	-1.277	-1.949	-5.248	-5.321	-1.277	-0.538	-5.248
	(4.274)	(2.613)	(2.626)	(4.274)	(4.274)	(2.613)	(2.641)	(4.274)
Deindustrialization (t-1)	-0.000563	-0.0139**	-0.0157**		-0.000563	-0.0139**	-0.00981*	
	(0.0164)	(0.00605)	(0.00630)		(0.0164)	(0.00605)	(0.00592)	
Δ Deindustrialization (t-1)				0.0216				0.0216
				(0.0147)				(0.0147)
Doppik	-0.168***	-0.155***	-0.140***	-0.171***	-0.168***	-0.155***	-0.149***	-0.171***
	(0.0495)	(0.0480)	(0.0474)	(0.0493)	(0.0495)	(0.0480)	(0.0476)	(0.0493)
average business tax multiplier (t-1)	0.00278	-0.00275*	-0.00274*	0.00277	0.00278	-0.00275*	-0.00283**	0.00277
	(0.00233)	(0.00143)	(0.00147)	(0.00231)	(0.00233)	(0.00143)	(0.00141)	(0.00231)
Umlagesatz	-0.00320	0.00259	0.00253	-0.00313	-0.00320	0.00259	0.00220	-0.00313

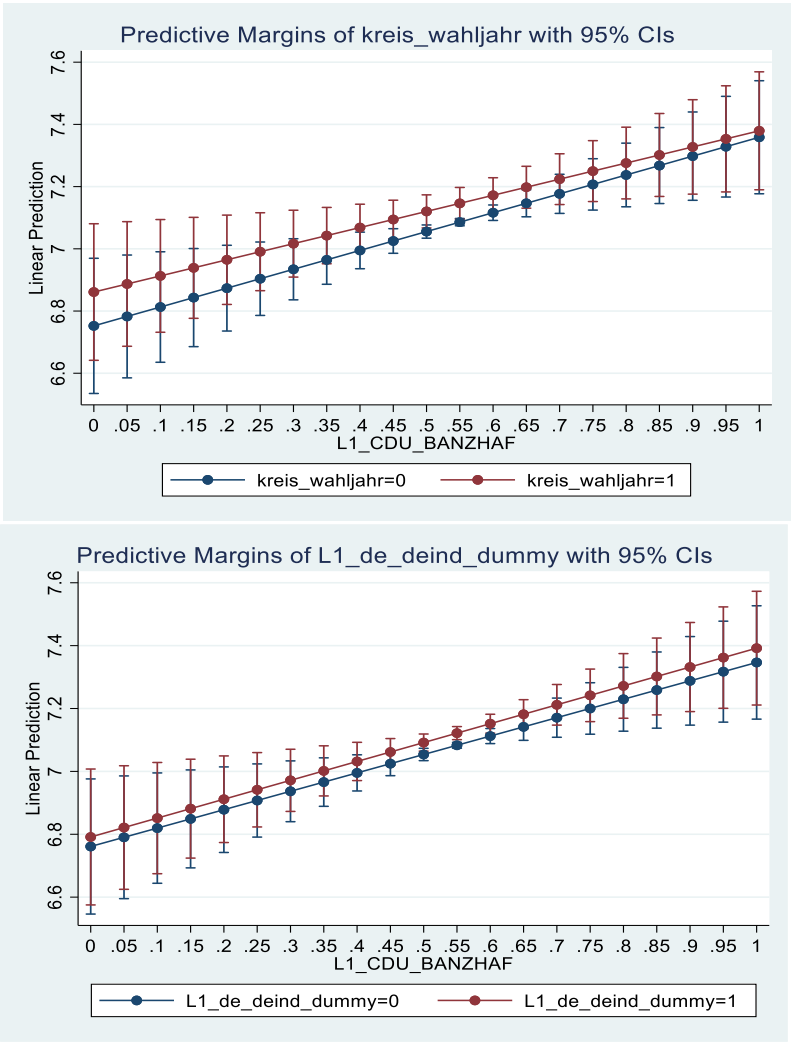
	(0.00588)	(0.00452)	(0.00464)	(0.00587)	(0.00588)	(0.00452)	(0.00459)	(0.00587)
Election year	0.0730***	0.0839***	0.0878***	0.0740***	0.0730***	0.0839***	0.0854***	0.0740***
	(0.0210)	(0.0212)	(0.0202)	(0.0212)	(0.0210)	(0.0212)	(0.0206)	(0.0212)
Pre-election year	-0.0145	-0.00933	-0.00736	-0.0112	-0.0145	-0.00933	-0.0104	-0.0112
	(0.0182)	(0.0173)	(0.0170)	(0.0179)	(0.0182)	(0.0173)	(0.0172)	(0.0179)
GRUENE: BANZHAF index (t-1)	0.252	0.252	0.265	0.259	0.837**	0.776**	0.920**	0.843**
	(0.316)	(0.305)	(0.297)	(0.314)	(0.395)	(0.382)	(0.385)	(0.392)
FDP: BANZHAF index (t-1)	0.193	0.124	0.150	0.183	0.778*	0.647	0.652	0.766*
	(0.374)	(0.361)	(0.378)	(0.374)	(0.419)	(0.407)	(0.406)	(0.416)
Local voter ass.: BANZHAF index (t-1)	0.0316	0.125	0.229	0.0309	0.616	0.648*	0.955**	0.615
	(0.259)	(0.259)	(0.267)	(0.254)	(0.389)	(0.376)	(0.393)	(0.383)
SPD: BANZHAF index(t-1)	-0.584***	-0.524***	-0.528**	-0.584***				
	(0.200)	(0.181)	(0.208)	(0.199)				
CDU: BANZHAF index (t-1)					0.584***	0.524***	0.664***	0.584***
					(0.200)	(0.181)	(0.190)	(0.199)
Aligned (t-1)	0.00173	-0.00238	0.0102	0.000275	0.00173	-0.00238	-0.00106	0.000275
	(0.0448)	(0.0426)	(0.0426)	(0.0447)	(0.0448)	(0.0426)	(0.0423)	(0.0447)
CDU-SPD differential (t-1)	0.162	0.523	0.722*	0.158	0.162	0.523	0.674	0.158
	(0.571)	(0.453)	(0.439)	(0.566)	(0.571)	(0.453)	(0.434)	(0.566)
Constant	yes	yes	yes	yes	yes	yes	yes	yes
Controls pupils' structure (t-1)	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
random slope		-0.589***	-0.574***			-0.589***	-0.756***	
		(0.122)	(0.130)			(0.122)	(0.159)	
random intercept			-0.101				-0.632***	
			(0.242)				(0.223)	
Observations	1,982	1,982	1,982	1,982	1,982	1,982	1,982	1,982
R-squared	0.230			0.231	0.230			0.231
Number of groups	217	217	217	217	217	217	217	217

The results are in line with the results reported in the previous tables 3.3 and 3.4: The Banzhaf-index for Social Democrats (again) shows a negative and highly significant coefficient in the fixed effects model as well as in the random slope and random intercept models whereas Banzhaf-index for Christian Conservatives seatshare is highly significant and positive in all specifications. Similarly, the election year dummy yields positively significant coefficient estimators in all specifications. The effect sizes are somewhat larger than in the full sample (12.3 percent for an increase in the Banzhaf-index of Christian conservatives by 0.2 and 7.6 percent for election years). And again, there is no evidence that the impact of party ideology is moderated by the presence of elections or by the degree of deindustrialization (see figure 3.4). The performance of our control variables is also qualitatively identical to the performance in tables 3.3 and 3.4. Alignment with the state government, disposable income per capita and the ratio of vocational pupils to total population are significant in all models while the Banzhaf-index of the Green Party is only significant in some models. The newly introduced variables - business tax multiplier and *Umlagesatz* – are insignificant with one exception (see model 6).[18]

[18] One might argue that the counties' decision on the *Umlagesatz* and their decision on educational expenditures are interrelated. We tested this in IV-regressions using the lagged *Umlagesatz* as instrument. These regressions provide absolutely no evidence that the *Umlagesatz* is endogenous. At the same time, they support hypotheses H1 and H2A while rejecting H2.

Figure 3.4: Margin plots for the interaction of Banzhaf-index of major parties and election year and a deindustrialization dummy (rural counties only)





3.6 Concluding remarks

The German system of apprenticeship has been analyzed in numerous theoretical and empirical studies. So far, the focus rests on the impact of the system on labor market outcomes, industry performance and income distribution. The political economy of this system has been largely ignored. In this paper, we provide – to the best of our knowledge – the first large-scale empirical analysis of the factors driving local public expenditures on vocational education. Our results indicate that political factors matter. We find expenditures to be higher in counties with a large voting power of Christian Democrats (or Christian Social Party members) in the county council. In addition, we find evidence for an opportunistic budget cycle in vocational school expenditures – with expenditures being higher in election years. Both effects are economically significant. At the same time, our results do not support the notion put forth by Jensen (2011) according to which regions suffering from de-industrialization spend more on vocational education to accommodate structural change. This holds regardless of whether Social Democrats or Christian Conservatives have more political power.

Our study is not without shortcomings. Most importantly, we miss the necessary data to observe the division of labor between counties in training the regional apprentices. We control for the resulting unobserved heterogeneity through county fixed effects. In future, the division of labor itself is an interesting object of investigation: What factors are driving the allocation of *Fachklassen* across space? Is it purely reactive or is it used as a means of regional policy? And if so, is it successful? Especially in rural counties threatened by the emigration of firms and young people, these questions are essential.

Chapter 4

4 The short-run production of school outcomes and fiscal decentralization: empirical evidence from Germany

Julia Hauschildt

Abstract

The effects of local public school spending and decentralization on school outcomes are a subject of many international studies. We analyze the short-run effects of grammar school expenditures from different federal levels on the rate of young people who successfully get a college entrance qualification using a regional database on Germany from 2001 to 2011. We find positively significant effects of the teacher density as a state input as well as of grammar school expenditures per pupil by counties as the local input on the outcome variable. Furthermore, no significant effects of the decentralization measure we include are found. These results hold for two methods: Fixed-effects instrumental variable estimations and the new method proposed by Lewbel (2012) - both with the lagged expenditure variable, an election year dummy as well as a measure of the power of Christian Conservatives in the county council as instruments.

4.1 Introduction

There is a vivid discussion about the German school system, the number of young people who get a college entrance permission (*Abitur*) and the number of university students – especially since the German students' results of the first PISA study shocked many politicians in 2001. The comparably low rate of young people getting the *Abitur* and therefore being able to enter college is often criticized when looking at the German education system as the *Abitur* is almost

a prerequisite for a successful career and as it is an important measure of human capital (OECD, 2018; OECD, 2008).

Another special property of the German school system is decentralization. The impact of education decentralization on education outcomes have been analyzed in many (international) studies (e.g. Burki et al., 1999; Roy, 2011). The same is true for the impact of public school spending in general (e.g. Hanushek ,2003; Krueger, 2003; Pritchett and Filmer, 1999; Jackson et al., 2015; Hyman, 2017). This paper provides the first empirical analysis on public school expenditures and decentralization on county- level dealing with Germany. More precisely, the focus rests on the effects of local public school expenditures and decentralization on school outcomes.

In the last two decades, there has been no school decentralization reform in Germany. Thus, our empirical strategy builds on an interesting institutional feature instead: Schools are financed and decided on mainly by the state governments. The so-called interior school issues including teachers and curricula are decided on and financed by the states whereas the exterior school issues which is basically everything else – teaching material, buildings etc. - are financed and decided on by local authorities. The latter are the counties (and municipalities with county rights) or the municipalities – depending on the state, school type and sometimes on the individual schools. So the degree of decentralization differs considerably between and within states. This dual type of school financing is a rather unique characteristic of the German public school finance system (Avenarius and Heckel, 2000; Avenarius and Füssel, 2010; Schwarz and Weishaupt, 2013). The overall German education budget raised to 192.1 Billion Euro in 2014 and is expected to continue to raise. The same trend is observed for the share of education expenditures compared to the overall public direct expenditures (Brugger et al., 2017).

So far, there is no analysis on the effects of local education spending and decentralization – including the county and municipality level- on education outcomes dealing with Germany. Even though the dual way of financing is a special property (as is the segregated school system). Moreover, school federalism and therefore school financing have never been attached by any reform so far which is rather rare (the reform on federalism in 2006 had no effects on schools, only on colleges). This is the first research contribution.

The underlying research questions can be summed up as follows: Does the level of local public school expenditures influence school outcomes, namely the rate of young people who get the *Abitur*? What role does the degree of (finance) decentralization play? There are also some theoretical research contributions related to these questions; e. g. Pritchett and Filmer (1999) discuss a theoretical model on the optimal choice of different education input factors and empirically find a relative overspending for teachers compared to expenditures on other educational inputs (see more detailed in Chapter 1).

Form a methodological point of view, we will perform a panel data analysis with a dataset on Western German counties from 2001 to 2011. Because of the G8/9 reform which allowed grammar school pupils to graduate after 12 years of schooling instead of 13 (see section 4.3), we do not consider more recent years. As the traditional G9 system with 13 years of schooling at grammar schools is about to be reestablished, an analysis of our time period is politically more relevant. To deal with possible endogeneity issues (e.g. Angrist and Krueger, 2001) we use an Instrumental Variable (IV) approach.

Several different variables, namely the share of Christian Democratic seats in the county council, an election year dummy as well as the lagged expenditures per pupil by counties are used as instrumental variables. We add a Lewbel Instrumental Variable approach which is another research contribution.

Our findings are in line with the existing related research contributions. The impact of the teacher density is positively significant and the impact of public grammar school spending by counties on the rate of successful grammar school finishers is small but positive as well. Moreover, the effects of our decentralization measure appear to be insignificant.

The paper is structured as follows. Section 4.2 is a summary of related literature whereas section 4.3 clarifies the institutional background. In section 4.4, the empirical model is derived. The results are described in section 4.5 and the conclusion is drawn in the last section.

4.2 Background literature

With respect to the impact of expenditures on school outcomes, the Coleman Report (Coleman et al., 1966) can be seen as the first influential empirical research contribution addressing our question. It showed no effects of a variation in per pupil spending on student achievement in standardized tests.

Many studies using different (more sophisticated) methods and dealing with different countries followed and often arrive at similar results (see Hanushek, 2003 for a review): Overall resource policies do not lead to improvements in pupil performance. Nevertheless, there are situations where additional resources or smaller classes improve performance but one cannot derive any conditions under which the outcome effects are clearly positive.

A more recent study is done by Haegeland et al. (2012) dealing with Norway. IV estimations with the hydropower tax revenue per capita as an instrument for school expenditures show a significantly positive relationship between school spending and pupil performance at the age of 16. At the same time, the latter instrument is highly significant. Some OLS estimations are included as well but do not show any significant effect.

Chetty et al. (2014) focus on teachers as input factor trying to find out the long- term effects of high value-added teachers (those who raise students' test scores) in primary schools. The authors use a huge sample of district and tax records on primary school teachers and students finding out that pupils taught by high value-added teachers are more likely to attend college, achieve higher wages and are less likely to have children early. In terms of methodology, they use OLS as well as dynamic panel estimations. [19] [20]

Moreover, many recent studies analyze this question using data on school finance reforms. The majority of these studies analyzes the education centralization reform in Michigan in 1994. It changed the finance system from a system which was financed locally through local property taxes to a more state financed system. More precisely, the so-called foundation allowance was granted. This is an amount provided by the state which each district has to pay (at least) per pupil.

Hyman (2017) analyzes this school finance reform and the long-run effects of increased primary school spending on students' college enrollment and completion. He uses student-level data and the foundation allowance as an instrument for spending. A positive impact is found. These positive effects are mostly found for urban and suburban as well as initially wealthier and higher achieving districts.

Chaudhary (2009) estimated the short- run impact of the school finance reform in Michigan (Proposal A) on education inputs and test scores, too. According to the latter reform, state revenues for education were raised and it brought a centralization of school finance from the

[19] Furthermore, there are studies which focus on the efficiency of schools (e. g. Hanushek, 1986, Hanushek and Luque, 2003). Jimenez and Paqueo (1996), for example, focus on cost efficiency (for a given achievement level) depending on the share of local expenditures. They find that a higher share of decentral expenditures lowers costs, ceteris paribus.

[20] Some studies explicitly estimate education production or cost functions. One fundamental study on the education production function was published by Hanushek (1986).

local level to state level. He uses a difference- in- differences approach as well as an IV approach with the foundation allowance and its interaction with year dummies as instruments. The author finds that the reform leads to increased teacher salaries. Furthermore, he finds a positive impact on 4th grade test scores in some of his models using the foundation allowance generated by Proposal A as an instrument.

Roy (2011) and Papke (2005) also analyze the latter finance reform getting the following results: They find positive effects on outcomes – (especially) for districts with initially low spending (poor performance). These are contradictory findings compared to Hyman (2017). Jackson et al. (2015) empirically analyze school finance reforms in the US during the 1970s and 1980s and find positive long- run effects of education spending increases on education and economic outcomes - especially for people from low income families. The outcome measures are completed years of education, wage and incidence of adult poverty. They use the type of funding formula change as well as its timing as instruments for spending and compare the outcomes of different cohorts which are exposed to that reform. Event study and instrumental variable models are used.

Other authors explicitly analyze the effects of different decentralization reforms in the US during the 1970s and 1980s. Candelaria and Shores (2015) perform such an analysis using differences- in- differences models and find that the reforms led to higher high-school graduation rates for high-poverty districts in the long- run and to an increase in per pupil spending.

Another set of studies analyze the decentralization reforms in Latin America yielding varying results. Faguet and Sánchez (2008), for example, compare the effects of decentralization on public education outcomes for the cases of Bolivia and Colombia. In Colombia, it increases enrollment rates in public schools whereas it made governments redirect resources to areas of

greater need. They use OLS as well as IV estimations with lagged per capita tax measures as instruments. Many of those investigations, e.g. Burki et al. (1999), only find positive effects if authority is directed to very decentral levels, such as school boards.

Using panel data on Swiss cantons, Barankay and Lockwood (2007) analyze the relationship between decentralization and the productive efficiency of the government. They find evidence that more decentralization leads to higher education attainment – especially for male students. Moreover, their study provides no evidence of any adverse effects across education types.

A distinctly related strand of literature deals with the competitive effects of private schools – the most extreme case of school decentralization- on school outcomes. Dee (1998) uses 2SLS on a dataset on US school districts and finds that competition from private schools has a significantly positive impact on the high school graduation rates of public schools in the area. Patrinos (2010) analyzes the Dutch education system where the majority of schools are administered privately but funded by the government. Using an instrumental variable approach, he finds a positive impact of this system on test scores in math, reading as well as science. These results are in line with other investigations such as Hoxby (1994).

For Germany, empirical investigations on education federalism and inequality only exist on state level (e.g. Freitag and Schlicht, 2009), not on county-level. Pischke (2007) performs a study on the effects of the school year length on outcomes. Therein, he uses the short school year in Germany as a variation. His results show that the latter variation implied higher grade-repetition rates in primary schools and fewer pupils entering higher secondary schools. Nevertheless, it did not affect later (long- run) earnings or employment.

To sum up one can say that authors who address related research questions regularly face problems to deal with endogeneity, often using weak or single instruments. We also use (fiscal) instrumental variables and a decentralization measure (which varies massively between

German counties) instead of a school finance reform as there is no comparable reform in Germany during the time period considered. Our decentralization measure (see sections 4.3 and 4.4) is an interesting institutional variation and provides an alternative to the latter reforms. The same is true for the fiscal instrumental variables which are used. For Germany, it can be seen as an interesting case study for other categories of expenditures.

4.3 Institutional background

Now we provide some background information on the German school system with a focus on the different types of upper secondary schools in Germany which provide a college entrance permission once they are finished successfully. Furthermore, we explain (local) public school financing in Germany and the role of counties.

4.3.1 The German school system

Traditionally, Germany has a three-branch school system. Children start to go to school at the age of six and spend four (or in some states six) years at elementary school. Afterwards, good students attend a grammar school (*Gymnasium*). After 9 years (or 7 years if elementary schools cover grades 1 through 6) at grammar school, they receive the degree *Allgemeine Hochschulreife* allowing them to apply to university or college upon successful graduation. Starting in 2010 in some West-German states (in parts of Eastern Germany it was implemented earlier but we do not analyze Eastern Germany here), the duration of grammar schools was shortened such that the number of overall school years for grammar school pupils is 12 instead of 13 years (G9/8 reform)- 4 or 6 years of elementary school included. This duration is more in line with international standards. The latter reform was implemented between 2010 and 2016

in a rather flexible way varying between schools or counties of the same state in West-Germany. Recently, a return to the traditional system G9 system is planned in most states.[21]

The fourth school type is the vocational school which is almost unique in Germany. More precisely, the traditional dual German apprenticeship system consists of a theoretical part taught at vocational schools and a practical part in the company (Bischoff and Hauschildt 2019). Moreover, vocational schools offer tracks where adults or elder youngsters can reach a university of college entrance permission after they have finished secondary school instead of visiting a traditional grammar school.

There are two different kinds of college entrance permissions. *Allgemeine Hochschulreife* (AH) theoretically allows students to study at any higher education institution. It is possible to study a variety of different subjects at universities. The *Fachhochschulreife* (FH) only qualifies for studies at universities of applied sciences which offer only a limited number of (rather applied) fields of studies. The FH can be achieved at several different types of vocational schools whereas the AH is obtained at grammar schools or at vocational grammar schools (special sub-type of vocational schools). (Hurrelmann, 2013; Cortina et al., 2003)

[21] Average students usually attend a secondary school (*Realschule*) which leads to a duration of 10 years of schooling (elementary school included). Once it is finished successfully, they are qualified to do an apprenticeship. The same is true for students with poor grades who usually attend a lower secondary school (*Hauptschule*) which allows a graduation after 9 (or 10) years of schooling (altogether). Pupils from that school type can apply for an apprenticeship afterwards. However, the latter two school types where gradually abolished starting in the first decade of the 21st century (the time periods analyzed here) and comprehensive schools (*Gesamtschulen*) where created instead. These schools have six (or four) grades. (Hurrelmann, 2013; Cortina et al., 2003; Avenarius and Füssel, 2010)

4.3.2 (Local) public school financing in Germany

The public expenditures for grammar schools (and vocational schools) are two-dimensional in Germany: expenditures on the interior school issues and expenditures on the exterior school issues. The former consists of spending for teachers' salaries and are generally paid by the states (only in Bavaria the responsibility is partly local). The latter consist of everything except from teachers and curricula – namely equipment like books, administrative staff, buildings and in some states non-teaching staff[22]- and are paid for by the so-called *Schulträger* which are the counties or the municipalities (for vocational schools always counties). In Germany, the decision-making authority is always the same as the spending authority. (see Avenarius and Heckel, 2000; Avenarius and Füssel, 2010; Schwarz and Weishaupt, 2013)

4.3.3 German counties

There are 367 rural counties (*Landkreise)* with 178.448 inhabitants on average in Germany (2001). Moreover, 118 cities are municipality and county at the same time- these are the so-called cities with county rights which are also-called counties in the following text.

So what is exactly the role of counties? One can distinguish between their compulsory tasks, their voluntary tasks as well as their assigned federal tasks. It is kind of a twin role, namely executing *Länder* laws on the one hand and providing supra-municipal goods and services and equalization tasks on the other hand. (Henneke, 2012)

There is on the one hand the so-called *Kreistag*, elected by the citizens of the respective county to represent them in certain affairs. It could be seen as the legislative (Bogumil and Jann, 2009).

[22] The non-teaching staff mainly consists of social workers and related staff. Depending on the state, this staff is either paid by the state or by the *Schulträger* and sometimes also jointly by both of these federal levels.

On the other hand, there is the *Kreisausschuss* which is basically a committee created by the *Kreistag* as supervisory authority. Last but not least, the *Landrat* has very special dual tasks (Fuchs, 2012): He is the head of the county's administration and therefore a local government authority as well as an administrative authority. One can say that he is executive (Bogumil and Jann, 2009). There are quite a lot of differences between the different states concerning the detailed competences of the latter three local agents.

The counties cannot levy taxes but they can determine a certain "rate" of revenues (tax and others) of the municipalities within the respective counties that these municipalities have to pay to them. This is called *Kreisumlage*. Furthermore, there are revenues from vertical grants. (e. g. Henneke, 2012)

All in all, counties are much less politically autonomous compared to the state level. That is one reason why it is sometimes seen as the "forgotten level" concerning public economic research. Nevertheless, its effects on public and in our case school outcomes should be worth to analyze. (see Seele, 1990; Bogumil and Jann, 2009; Fuchs, 2012)

4.4 Empirical analysis

4.4.1 Data and hypotheses

We use an unbalanced panel dataset on Western German counties for the time period from 2001 to 2011 (leaving out all Eastern German counties because there were several regional reforms at county-level during this period and leaving out more current years because of the G8/9 reform). The dataset includes 232 *Landkreise* and 87 municipalities with county rights but excludes the three German city states (see table 4.1). Moreover, the state *Baden-Württemberg* is excluded because data on teachers are not available for the whole time period for this state.

In 2002, on average 86,5% of those pupils who were in a grammar or vocational school successfully got some form of university entrance permission two years later. There are high variances in these quotas within Germany. The standard deviation of the former measure was around 6% in 2002. The latter quote was considerably higher in 2010, namely almost 95% with a standard deviation of 23% (partly) because of the flexible implementation of the reform. Altogether, the share of pupils who successfully reach a college entrance qualification shows a positive time trend, especially since 2010 because of the latter reform.

The expenditures per pupil of counties for grammar schools were on average 843 Euros in 2002 (and 1255 in 2010), with a standard deviation of 592 and a maximum of 3631 Euros (and with a standard deviation of 1133 and a maximum of 7594 in 2010). They are on average 780 Euros for vocational schools but show a much higher variance for this school type.) The average share of municipal expenditures among all local expenditures (municipal plus county expenditures) for grammar schools is 55% with a variance between counties of almost 47%. The latter share decreases slightly to 47% until 2010 whereas its interregional variance stays constant over time.

The teacher density - namely the number of teachers per student- is on average 0.0654 for grammar schools and 0.058 for vocational schools (2002). In 2013, the staff expenditures for active officers at public schools (mainly for teachers) were about 4250 Euros per pupil (see Brugger et al., 2016). (see Table 4.1 and Figure 4.1)

Table 4.1: Descriptives

2002

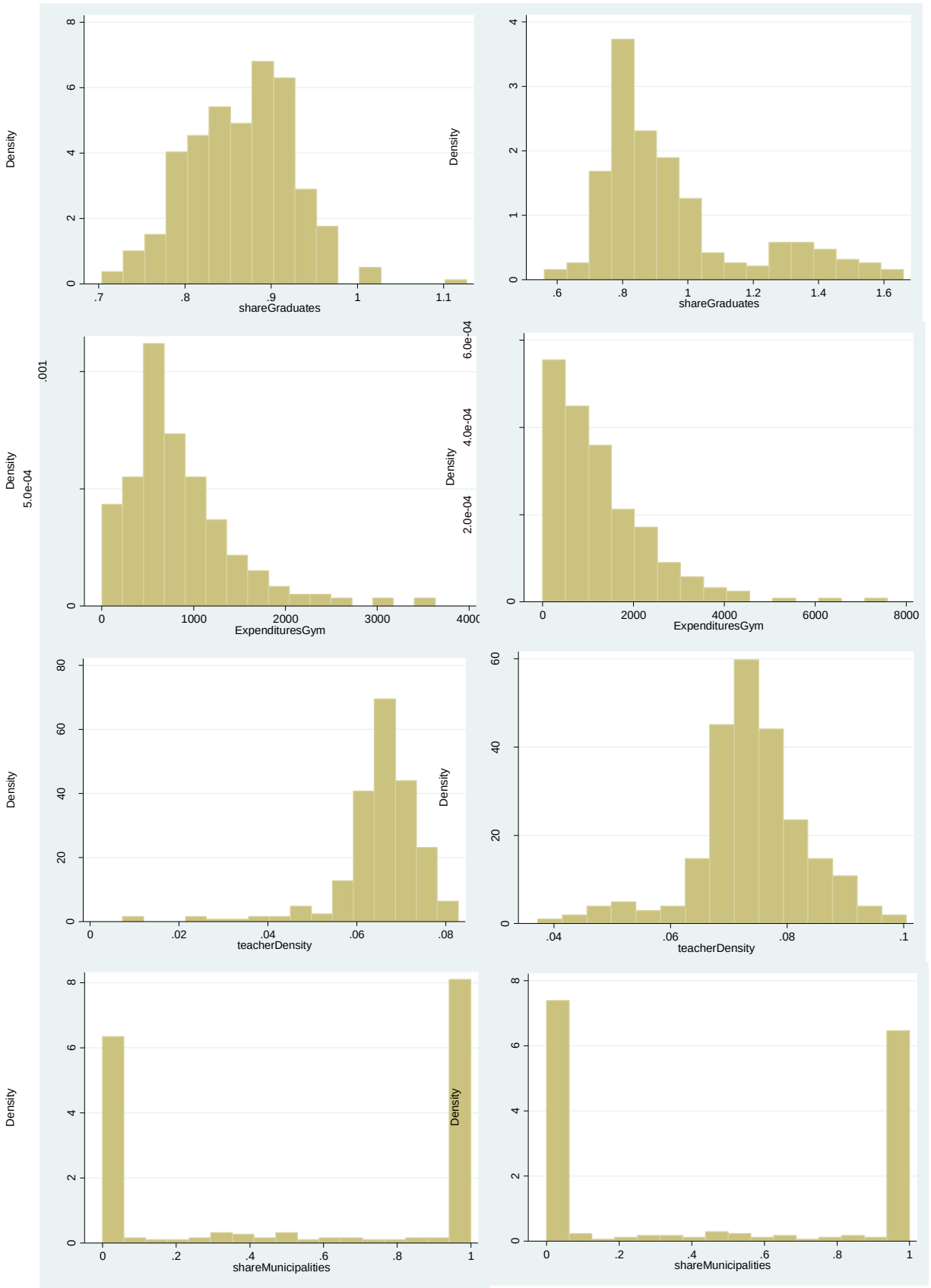
Variable	Obs	Mean	Std. Dev.	Min	Max
share Graduates	319	.8651	.0605	.7037	1.1267
share municipalities	319	.5506	.4651	0	1
teacher density	265	.0655	.0099	.0073	.08287
disposable income/capita	318	16883.54	1717.337	13265	26516
Share teachers full time	224	.6489	.1002	.4369	.8977
share *Oberstufe*	319	.0986	.0188	.0638	.1984
Gym expenditures/capita	264	843.1003	592.1749	.1752	3631.126
municipalities expenditures/capita	162	566.8738	491.2181	.0086	2200.094
population density	319	566.9671	685.744	42.4374	3976.976
unemployment rate	319	7.5671	2.4688	3.3	16.9
foreign share	319	.0861	.0433	.0250	.2603
local expneditures Gym altogehter	307	3019.285	11965.19	250.8712	157331.4
CDU seatshare	301	.4583	.0830	0	.74
CDU seatshare BANZHAF	301	.5622	.3097	0	1
share bank	318	.1174	.0397	.0610	.3494
share production	318	.2373	.0847	.0850	.5612

Table 4.1: Descriptives

2010

Variable	Obs	Mean	Std. Dev.	Min	Max
share Graduates	277	.9547	.2303	.5611	1.6601
share municipalities	277	.4704	.4713	0	1.0
teacher density	242	.0739	.0095	.0372	.1005
disposable income/capita	277	19733.35	2022.59	15497	31239
Share teachers full time	53	.5834	.0427	.4932	.6940
share *Oberstufe*	277	.1138	.02	.0702	.2008
Gym expenditures/capita	242	1254.966	1132.923	-.1246	7593.832
municipalities expenditures/capita	188	786.8649	927.3488	.0305	5937.859
population density	277	568.9457	704.365	40.3204	4355.282
unemployment rate	277	6.4906	2.5756	1.9	16.3
foreign share	277	.0799	.0396	.0269255	.2577
local expneditures Gym altogehter	194	5461.595	17760.73	310.5132	185798.5
CDU seatshare	269	.3973	.0828	0	.7045
CDU seatshare BANZHAF	269	.4082	.2045	0	1
share bank	277	.1370	.0444	.0674	.3614
share production	277	.2070	.0802	.0480	.4928

Figure 4.1: Development of key variables 2002 vs. 2010



As we see in the institutional section, there are inputs for equipment from the county-level which are the main focus of our analysis. On the one hand, this is a research gap for Germany and on the other hand, it is internationally relevant as it is comparable to analyses on school districts in the USA. Furthermore, the dual character of inputs as described in the institutional section is internationally rather unique but at the same time provides an interesting variation as there is no comparable decentralization reform. Therefore, counties can be seen as an interesting different yet comparable case. Generally, there is no consensus concerning the empirical findings on the effects of (local) inputs on school outcomes (typically measured by graduation rates or test scores). Positive effects of county or municipality spending on output as well as a relative overuse of teachers are found by Pritchett and Filmer (1999). This is the other reason why we differentiate between the input on exterior school issues and the teacher input. Apart from this, the level of the latter input is set according to predetermined rates which makes our focus on the further input even more reasonable.

According to Hanushek (2003), one could not predict any effect or direction of school inputs. Other studies hint at rather positive effects (e g. Hyman, 2017; Roy, 2011) with contradictory findings only concerning the question which sub-groups profit most. That is the reason why we address the question whether there is any effect of spending on outcomes without any expected sign here (see also literature review). One could expect a comparable higher efficiency of school inputs because of the German specific dual way of school financing and because of the fact that the latter institutional characteristic has never been reformed. Nevertheless, it is not possible do deviate any specific hypothesis regarding our first question so we can only repeat it here:

Does the level of local public spending on grammar schools have any significant short-run impact on the share of young adults who get the *Abitur*?

From a theoretical point of view, there are two possible directions of the effects of decentralization on education outcomes, namely competition (Oates and Schwab, 1988) resulting in a positive impact of decentralization or a negative impact as it might lower efficiency as standard microeconomic theory suggests. Empirical findings on decentralization and centralization reforms are summarized in the previous section and hint at positive but small effects. There is no relevant decentralization reform in Germany. Nevertheless, the varying input share by municipalities for German grammar schools offer an interesting alternative source of variation.

So the second research question is the following one:

Does the common result that decentralization has a rather positive impact on school outcomes also hold for Germany?

4.4.2 Methodology

4.4.2.1 Model specification

We explain the rate of successful grammar school graduates as a function of local (county-level) inputs. More precisely, these inputs are local expenditures on exterior school issues as well as the teacher input by the state. Apart from that, our dependent variable is explained as a function of local sociodemographic and institutional factors. These factors have proven relevant in the current related research on education finance and other research contributions in the field of public finance.

As we focus on the effects of school spending by counties on county-level school outcomes endogeneity might be a problem. Following Papke (2005), Hyman (2017) etc. we use a 2SLS

specification to address this concern. [23] In our alternative specifications, we use the Lewbel (2012) approach to find efficient instruments using a heteroscedastic covariance restriction. It has the advantage to perform better even in the case of weak instruments.

Consequently, our empirical model reads as follows.

(4.2)

$$\left(\frac{Gram\,graduates_{t+3}}{pupils_{it}}\right)=\alpha_i+p\ln\left(\frac{avCountyGramExp}{pupils}_{it}\right)+c(decentralization_{it})+\delta\left(X_{it}\right)+\theta_i+\lambda_t+\varepsilon_{it}$$

(4.1) $$\ln\left(\frac{avCountyGramExp}{pupils}_{it}\right)=\alpha_i+b\left(Z_{it-1}\right)+d(X_{it})+l_t+\varepsilon_{it}$$

The analysis is on county-level (i). Moreover, we take the logarithm of each variable keeping the original scale if and only if a variable is a percentage or dummy.

4.4.2.2 Variables

The dependent variable in estimation (1) is the short-run school outcome variable, namely the rate of pupils who get the *Abitur* successfully. It is calculated by dividing the number of local pupils who successfully get their general university entrance permission (AH) (numerator) by the number of 11th graders from grammar schools, comprehensive schools or *Waldorfschulen* (an alternative school type in Germany) three years before (denominator).[24] Both measures are

[23] This is in line with the fact that the null hypothesis of exogeneity can be rejected once we perform an endogeneity test on our local expenditure variable.

[24] These are the three types of general-education schools allowing pupils to get a university entrance diploma.

given per school year so the time periods are congruent. The existing literature identifies a number of different factors that determine or measures of school outcomes, among them class size, teacher quality, test scores or graduation rates (e.g. Chetty et al., 2014; Angrist and Lavy, 1999; Krueger, 2003; Hanushek, 2003; Dynarski et al.,2013). Our school outcome variable can therefore be seen as a conservative measure of school outcome.

The main explanatory variable is the input of the county. It is calculated by dividing the overall annual public grammar school expenditures of counties by the number of local grammar school pupils for the full calendar years included in the three school years considered per definition on our outcome variable (see above). We take an average of these two calendar years. If a pupil graduates for example in summer 2012, we use the average expenditure per pupil in 2011 and 2010. We do not take annual expenditures divided by two to approximate the first half of the 11^{th} grade or the last half of the 13^{th} grade as those inputs would be simple averages/approximations. We only want to include inputs which are allocated *de facto*. So it is a short term input.

Unfortunately, we cannot identify how these expenditures are distributed among pupils of different grades so we have to make the simplifying assumption that the money counties spend is rather equally distribute among grades.

To capture state inputs, we include the teacher/pupil ratio for each county at grammar schools, a common measure which is used for the state input here. This is a good measure for the state school inputs as the wage of teachers is nationally almost equal and the allocation of teachers is based on fixed predetermined formula. Once again, we take an average of the last three school years before graduation.

To test for the impact of decentralization, we use the share of expenditures for grammar schools by municipalities divided by the overall local (municipalities plus counties) expenditures for

grammar schools as a decentralization measure (called share municipalities). It varies for institutional reasons.

Apart from that, we use socioeconomic variables as control variables: Population density, the population share of foreigners, disposable income per capita in a county as well as the unemployment rate. Moreover, we control for time variant characteristics of the sectoral structure using the local share of people working in the bank sector and the local share of people who work in the field of manufacturing as additional controls. So we can exclude that other factors influence our outcome variable, e.g. a good labor market situation might raise the probability that pupils leave grammar school earlier without an *Abitur* which might not necessarily indicate a failure.

In order to control for the distribution of expenditures among grammar school pupils, we control for the share of pupils in 11th grade. So we control for the share of pupils we are addressing (when they start the 11th grade) among all local grammar school pupils assuming that local monetary inputs are allocated to the pupils of different grades and age proportionally to their share. The latter control variable is called “share 11” here.

It is important to note that all the controls and the decentralization variable are taken from the period where the analyzed graduation cohorts are in 11th grade, the baseline year.

Finally, county fixed effects are included in each specification in order to control for the remaining unobserved heterogeneity. Most importantly, these could be differences in the local school structure such as a higher share of private schools, specific types of vocational schools where a lower share of expenditures are attributed to vocational grammar schools etc. Year fixed effects control for common changes across time. Standard errors are clustered at county-level and robust to heteroscedasticity which is found by a White test (p-values are 0.000 for both the first and the second stage regressions).

4.4.2.3 Instrumental variables

As the expenditures per pupil at county-level may be endogenous (see section 4.2 and endogeneity tests in tables 4.2 and 4.3), we have to use a standard 2 SLS and a Lewbel IV approach.

An election year dummy is an instrument in our estimations 1-3 (Stage 1) in both types of IV estimations. One can intuitively argue that this variable should not influence the share of successful grammar school graduates in any direct way. At the same time, it is expected to have an effect on (grammar) school expenditures by counties because of election cycles. The study in the previous Chapter strongly supports this notion.

Our second instrument is the CDU-Banzhaf index, a common measure for the voting power of a party (see definition in Chapter 3). Looking at previous research findings (e.g. Bischoff and Hauschildt, 2019) it appears to have a highly significant impact on school expenditures by a county. However, it should not affect the rate of successful grammar school graduates directly as tests show (available upon request).

Our third instrument – used in all IV estimations- are the expenditures per grammar school pupil included lagged by one year – a common procedure whenever any other strong instrument is missing- as it is highly correlated (Fisher, 1965; Reed, 2015).

These instruments are captured by Z in equation (1).

In the upcoming section, three types of specifications are implemented. In table 4.2 is a standard 2 SLS estimation using the instruments mentioned above, table 4.3 presents results from Lewbel (2012) Instrumental Variable estimations using excluded instruments and synthetically generated instruments. This procedure assumes heteroscedasticity in the first stage regression

and is very helpful when a proper or strong instrument is missing which is true for our case as it is in many education economic studies.[25]

4.5 Results and discussion

4.5.1 2 SLS estimations

Our second stage results are shown in table 4.2.1. In all four specifications shown here, we find significantly positive effects of the teacher/student ratio at the 10% level.

The effects of the local expenditures are positively significant at the 1% level but small in specification (1), (2) and (4) whereas they seem insignificant in estimation (3).

Moreover, our decentralization measure is insignificant in all specifications.

Looking at our controls, we find a significantly positive impact of population density but significantly negative effects of the share of employment in the banking sector and of the local unemployment rate. A negative and significant coefficient is also found for the control for the share of pupils in 11^{th} grade. We do not find any significant impact of our controls on local disposable income per capita, the share of foreigners or the share of employment in the production sector.

[25] The White test as well as the Breusch Pagan test indicate heteroscedasticity also in the first stage regression in our analysis.

Table 4.2.1: 2 SLS second stage regression results on West-Germany

VARIABLES	(1) shareGraduates (t+3)	(2) shareGraduates (t+3)	(3) shareGraduates (t+3)	(4) shareGraduates (t+3)
log_av_*Gym*				
expenditures/pupil	0.0979***	0.0979***	0.0792	0.0977***
	(0.0185)	(0.0187)	(0.0864)	(0.0186)
av teacher tensity	2.323*	2.380*	2.383*	2.322*
	(1.282)	(1.307)	(1.329)	(1.282)
log_disposable income/capita	0.215	0.222	0.237	0.215
	(0.287)	(0.301)	(0.303)	(0.287)
share 11	-4.793***	-4.822***	-4.770***	-4.793***
	(0.368)	(0.366)	(0.457)	(0.368)
population density	0.000843***	0.000833***	0.000845***	0.000843***
	(0.000235)	(0.000236)	(0.000239)	(0.000235)
unemplpyment rate	-0.0301***	-0.0305***	-0.0317***	-0.0301***
	(0.00738)	(0.00747)	(0.0104)	(0.00737)
share bank	-2.471**	-2.275**	-2.377**	-2.472**
	(0.976)	(0.989)	(1.054)	(0.976)
share production	0.501	0.676	0.738	0.501
	(0.656)	(0.675)	(0.744)	(0.656)
foreign share	-1.785	-1.996	-1.834	-1.784
	(2.687)	(2.723)	(2.782)	(2.687)
share municipalities	-0.164	-0.162	-0.175	-0.164
	(0.106)	(0.106)	(0.121)	(0.106)
Year fixed effects	yes	yes	yes	yes
Constant	yes	yes	yes	yes
Number of observations	1,483	1,440	1,442	1,483
R-squared	0.589	0.587	0.591	0.589
Number of groups	233	222	222	233

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4.2.2: 2 SLS first stage regression results on West-Germany

VARIABLES	(1) Gym exp	(2) Gym exp	(3) Gym exp	(4) Gym exp
log_av_*Gym* expenditures/pupil (t-1)	0.7736392***	0.7776483***		.7745383***
	(0.0432667)	(0.0456895)		(.0429739)
election year (t-1)	-0.0144831	-.0137323	-.1101095**	
	(0.030336)	(.0310606)	(.0375518)	
CDU BANZHAF (t-1)		-.0860483	.0862023	
		(.1511908)	(.2571599)	
av teacher tensity	-0.3012114	-.2031263	1.141826	-.4758917
	(1.901026)	(-1.885891)	(3.575133)	(1.818644)
log_disposable income/capita	0.5359815	.5147944	.4689184	.5321017
	(0.529487)	(.5594015)	(1.1953319	(.5292279)
share 11	1.291909**	1.313194**	2.012419**	1.3387**
	(0.5853419)	(.5797702)	(.8967802)	(.5564529)
population density	-0.0001974	-.0001999	-.0000738	-.0001965
	(0.0005896)	(.0005888)	(.0013657)	(.0005898)
unemplpyment rate	-0.0395147*	-.0412179*	-.074505**	-.0398198*
	(0.0230008)	(.0223589)	(.0342975)	(.0230121)
share bank	-1.928398	-2.344799	-3.723824	-1.945413
	(2.130476)	(2.169319)	(4.509598)	(2.134005)
share production	-0.5305612	-.8835537	3.171928	-.5147692
	(1.49485)	(1.525824)	(2.930023)	(1.496264)
foreign share	4.138377	4.446558	8.527004	4.036988
	(4.538804)	(4.740177)	(11.676)	(4.499618)
share municipalities	0.3676938*	.3789969*	-.6847869**	.3663731*
	(0.1961461)	(.1972615)	(.3375312)	(.1959953)
Year fixed effects	yes	yes	yes	yes
Constant	yes	yes	yes	yes
Kleibergen-Paap rk LM statistic	55.600	55.446	8.382	53.756
p- value	0.0000	0.0000	0.0151	0.0000
Kleibergen-Paap rk Wald F statistic	169.905	120.770	4.368	324.845
Hansen J statistic	1.027	3.935	3.634	0.000
p- value	0.3109	0.1398	0.0566	
Endogeneity test	13.559	13.636	1.226	11.601
p- value	0.0002	0.0002	0.2682	0.0007
Number of observations	1,483	1,440	1,442	1,483
R-squared	0.589	0.587	0.591	0.589
Number of groups	233	222	222	233

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

Table 4.2.2 shows the first stage results. In estimation (1) the (one- year) lagged grammar school expenditures by counties (also averages of the two relevant calendar years) per capita are used as a strong but trivial instrument. It is positive and highly significant whereas the election year dummy as a second exogenous instrument is insignificant and therefore a weak instrument.

Underidentification can be rejected whereas the overidentification test shows an insignificant test statistic so the equation might be exactly identified here. The Kleibergen-Paap rk Wald F statistic is much higher than 10 – even higher than 100 showing that we can exclude weak identification. Moreover, the null hypothesis of exogeneity of the variable considered endogenous here can be rejected .

In estimation (2), the CDU-Banzhaf is added as a third instrument, it is also a weak one. Apart from that all the test statistics etc. stay qualitatively identical.

In estimation (3) we leave out the lagged expenditure measure as a strong instrument and use only election year and the CDU-Banzhaf as instruments. The first instrument becomes significant at the 5% level and shows a negative coefficient whereas the CDU-Banzhaf stays a weak instrument. The overall estimation does not appear to be appropriate as the Kleibergen-Paap rk Wald F statistic is smaller than 10, overidentification can be rejected here. This might be the reason why our expenditure variable is insignificant in estimation (3) stage 2.

Last but not least, only the lagged expenditure variable is an instrument in specification (4). The results and test statistics are comparable to (1) and (2). The Hansen J-statistic for the overidentification test is 0 here as our equation is exactly identified.

4.5.2 Lewbel estimations

In table 4.3, we use the Lewbel approach as we have only estimated appropriate models using the trivial lagged expenditure variable as a strong instrument so far.

Our second stage results are qualitatively identical in all four specifications. Local expenditures and teacher density as state and county inputs both show significant and positive coefficients. The decentralization measure – again- does not show any significant effect in specifications (2) to (4). It is negatively significant at the 10% level in estimation (1) where only generated instruments are used.

The local unemployment rate and the share of employment in the banking sector stay significantly negative. The same is true for our control on the share of 11^{th} -graders. Besides, the population density shows again a significantly positive but small impact. Apart from that, the insignificance of all other control variables (share production, disposable income per capita and share foreigners) cannot be rejected.

Table 4.3.1: Lewbel second stage regression results on West-Germany

VARIABLES	(1) shareGraduates (t+3)	(2) shareGraduates (t+3)	(3) shareGraduates (t+3)	(4) shareGraduates (t+3)
log_av_*Gym* expenditures/pupil	0.0583***	0.1000***	0.143***	0.100***
	(0.0146)	(0.0201)	(0.0414)	(0.0200)
av teacher tensity	2.332*	2.324*	2.360*	2.325*
	(1.314)	(1.280)	(1.270)	(1.280)
log_disposable income/capita	0.225	0.213	0.197	0.213
	(0.289)	(0.287)	(0.289)	(0.287)
share 11	-4.645***	-4.798***	-4.892***	-4.798***
	(0.370)	(0.368)	(0.383)	(0.368)
population density	0.000856***	0.000843***	0.000853***	0.000843***
	(0.000243)	(0.000236)	(0.000245)	(0.000236)
unemplpyment rate	-0.0328***	-0.0300***	-0.0269***	-0.0300***
	(0.00713)	(0.00737)	(0.00785)	(0.00737)
share bank	-2.675***	-2.462**	-2.308**	-2.462**
	(0.983)	(0.977)	(1.001)	(0.977)
share production	0.672	0.493	0.330	0.492
	(0.653)	(0.653)	(0.669)	(0.653)
foreign share	-1.463	-1.802	-2.149	-1.803
	(2.766)	(2.688)	(2.752)	(2.688)
share municipalities	-0.191*	-0.162	-0.127	-0.162
	(0.103)	(0.107)	(0.114)	(0.107)
Year fixed effects	yes	yes	yes	yes
Constant	yes	yes	yes	yes
Number of observations	1,492	1,485	1,488	1,485
R-squared	0.593	0.589	0.571	0.589
Number of groups	236	235	236	235

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In stage 1, estimation (1) only uses generated instruments whereas estimation (2) uses the lagged endogenous expenditure variable as an instrument. The third specification (3) contain election year as a single instrument and the last one (4) contains the lagged endogenous as well as the election year dummy as instruments.

The test statistics are comparable to those for our standard 2SLS estimations with respect to some aspects, namely underidentification and week identification (the Kleibergen-Paap rk Wald F statistic is big enough) can be rejected (see table 4.3.2). Nevertheless, we have a significant j-statistic for the specifications with generated and excluded instruments which means that the validity of our specifications should be questioned. However, the C-statistic is far from significant indicating that our excluded instruments are appropriately exogenous.

Table 4.3.2: Lewbel second stage regression results and test statistics on West-Germany

VARIABLES	(1) GenInst	(2) GenInst	(2) GenExtInst
av log_*Gym* expenditures/capita	0.0583***	.1342**	0.1000***
	(0.0146)	(.0428)	(0.0201)
av teacher tensity	2.332*	2.354*	2.324*
	(1.314)	(1.27)	(1.280)
log_disposable income/capita	0.225	.1906	0.213
	(0.289)	(.29)	(0.287)
share *Oberstufe*	-4.645***	-4.876***	-4.798***
	(0.370)	(.381)	(0.368)
population density	0.000856***	.0008486***	0.000843***
	(0.000243)	(.00024)	(0.000236)
unemplpyment rate	-0.0328***	-.02772***	-0.0300***
	(0.00713)	(.00776)	(0.00737)
share bank	-2.675***	-2.323**	-2.462**
	(0.983)	(.999)	(0.977)
share production	0.672	.3629	0.493
	(0.653)	(.665)	(0.653)
foreign share	-1.463	-2.076	-1.802
	(2.766)	(2.73)	(2.688)
share municipalities	-0.191*	-.1307	-0.162
	(0.103)	(.116)	(0.107)
Year fixed effects	yes	yes	yes
Constant	yes	yes	yes
Kleibergen-Paap rk LM statistic			89.428
p- value			0.0000
Kleibergen-Paap rk Wald F statistic			114.579
Hansen J statistic			39.820
p- value			0.0022
Hansen J statistic (eqn. excluding suspect orthog. conditions)			38.984
p- value			0.0018
C statistic			0.836
p- value			0.3607
Number of observations	1,492		1,485
R-squared	0.593		0.589
Number of groups	236		235

VARIABLES	(3) GenInst	(3) GenExtInst	(4) GenInst	(4) GenExtInst
av log_*Gym* expenditures/capita	.1412***	0.143***	.1342***	0.100***
	(.0425)	(0.0414)	(.0428)	(0.0200)
av teacher tensity	2.359*	2.360*	2.354*	2.325*
	(1.27)	(1.270)	(1.27)	(1.280)
log_disposable income/capita	.1974	0.197	.1906	0.213
	(.289)	(0.289)	(.29)	(0.287)
share *Oberstufe*	-4.889***	-4.892***	-4.876***	-4.798***
	(.382)	(0.383)	(.381)	(0.368)
population density	.0008533***	0.000853***	.0008486***	0.000843***
	(.00024)	(0.000245)	(.00024)	(0.000236)
unemplpyment rate	-.02697***	-0.0269***	-.02772***	-0.0300***
	(.00783)	(0.00785)	(.00776)	(0.00737)
share bank	-2.313**	-2.308**	-2.323**	-2.462**
	(1)	(1.001)	(.999)	(0.977)
share production	.3352	0.330	.3629	0.492
	(.669)	(0.669)	(.665)	(0.653)
foreign share	-2.138	-2.149	-2.076	-1.803
	(2.75)	(2.752)	(2.73)	(2.688)
share municipalities	-.1281	-0.127	-.1307	-0.162
	(.114)	(0.114)	(.116)	(0.107)
Year fixed effects	yes	yes	yes	yes
Constant	yes	yes	yes	yes
Kleibergen-Paap rk LM statistic		56.442		89.545
p- value		0.0000		0.0000
Kleibergen-Paap rk Wald F statistic		21.800		109.081
Hansen J statistic		36.753		42.116
p- value		0.0056		0.0017
Hansen J statistic		34.781		38.978
p- value		0.0066		0.0018
C statistic		1.972		3.138
p- value		0.1602		0.2082
Number of observations		1,488		1,485
R-squared		0.571		0.589
Number of groups		236		235

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Most surprisingly, insignificant effects of our decentralization measure can be shown in the majority of our estimations which is not in line with the results of many studies on decentralization reforms (e.g. Chaudhary 2009; Hyman 2017, see section 4.2). Effects of decentralization might only be measurable in the long- run. There might be countervailing effects of decentralization neutralizing each other. Moreover, decentralization exerts an indirect effect via higher expenditures in many of the studies mentioned above. So this is not necessarily a contradiction (given the fact that we only control for a rather constant decentralization index and not for a decentralization reform).

The pupils' structure is highly significant in all specifications with coefficients of the share of 11^{th} -grades being highly negative. Local public spending authorities might tend to allocate more resources if the share of younger grammar school pupils is higher which could be for social reasons.

All in all, the latter findings are not in line with the majority of studies which find no significant impact of school spending on outcomes described by Hanushek (2003) or Hanushek (1986). It appears also contradictory to the relative overuse of teachers found by Pritchett and Filmer (1999). Nevertheless, these results are qualitatively comparable with those found in more recent studies (Haegeland et al., 2012). Particularly, it is in line with the results of studies analyzing school finance reforms in this context. Particularly, Hyman (2017) is worth to mention or Jackson et al. (2015) etc. as they find positive effects of school spending on outcomes for certain sub-groups.

An alternative specification with a dependent variable including all types of college entrance permission receiving students at vocational schools and expenditures for vocational schools and vocational school teachers cannot be implemented properly for data availability reasons. Data on expenditures for vocational schools by counties are not available for each different

vocational school track but only as a sum of all expenditures for vocational schools. So it is not possible to isolate an analysis on a vocational school track where pupils get some form of college or university entrance diploma from an analysis including traditional vocational schools as part of the dual apprenticeship system (see Chapters 2 and 3). Consequently, no precise analysis on the share of pupils who get some form of college entrance permission at these school types is not possible and we have to restrict our research study to traditional grammar schools.

4.6 Conclusion

All in all, we find positively significant effects of the teacher density as a state input and of school expenditures by counties on the outcome variable. This is not in line with some research findings (e.g. Hanushek, 2003 in a review). However, more recent studies including decentralization reforms yield comparable results in many cases. It is contradictory to the relative overuse of teachers found in come research contributions.

The effects of local school expenditures might be small in the short run because these expenditures are for exterior school issues such as teaching material. Even though these expenditures show a relatively high variation within and between counties, their effects on school outcomes might not be too strong or it might show in the long- run. Furthermore, insignificant effects of the decentralization measure are found in most specifications. This somewhat contradicts the research findings on the centralization reforms in the US. There might be countervailing effects of decentralization neutralizing each other. The decentralization measure is defined as a quotient of expenditures for exterior school issued from different decentral levels which could also explain the insignificance. Besides, financial participation by municipalities is rather rare in some states. Moreover, we only consider a relatively short time

period and such a variation might only be present and therefore showing effects (e.g. as an instrument) in the long- run.

To get more robust findings, the panel dataset should contain more years which means information on the local expenditures are needed for a longer time period. In a next step, the share of students attending private schools should be included as control variable. The data on the expenditures on vocational schools are another limitation as the expenditures for vocational grammar schools cannot be separately identified from the aggregated expenditure variable. However, there is a small but existing track in vocational school where pupils can yield a general university entrance diploma. Another critical point are the data on teachers as they contain many missing variables and exclude the state of *Baden-Württemberg*.

Moreover, this German example with fiscal and other regional data again confirms the common problem in education economic research to find a strong (nontrivial) instrument. The validity of the Lewbel approach as a robustness check can be underlined.

One could say that a strong role of counties as the forgotten level can be shown here and the importance of the teacher input and therefore the role of the state in school financing is underlined by our findings. It somehow proves the efficiency of this type of decentralization with its dual type of school financing.

5 Conclusion

Now I will discuss the results and derive ideas for future research.

5.1 Contribution of the thesis

In Chapter 2 and 3, the following central questions are addressed:

- What are the determinants of public spending by counties for vocational schools?
- Are there any spatial interdependencies as hints of interregional competition in these expenditures?
- How does the political composition of the county council and its alignment with the governing parties on state level influence the latter expenditures?

Secondly, may single-authored Paper in Chapter 4 tries to answer the following question:

- What are the effects of county expenditures for grammar schools on the local rate of pupils who get their *Abitur* successfully?

Paper 1 (Chapter 2) tests for spatial correlation in the dependent variable expenditures per vocational school pupil. We use a model with a spatially lagged dependent variable, a Spatial Error Model testing for spatial correlation in the error term and a Spatial Durbin Model which contains spatially lagged explanatory variables. As an extension, we test for differences in the allocation of teachers between state border and inner counties. No matter of which specification is applied, there are no hints of any spatial effect. These results are contrary to prior research findings from other countries (dealing with other school types). Therefore, interregional competition cannot be shown in this field which is an interesting finding given the fact that vocational schools are a special property of the German education system and that they seem

to stay a fixed part of it. One reason might be that the clientele of vocational schools is less mobile than other employees making this form of competition unnecessary. Interregional competition is also not found by Lyytikäinen (2012) in the field of property taxes.

As a minor finding, the share of apprentices in small firms can be identified as a negative determining factor of our expenditure variable. This is again contrary to the existing literature. Bavaria is an exceptional case here: There are no significant impacts of the share of apprentices in small firms but significantly positive impacts of their share in big firms.

Addressing the question of the political composition, paper 2 (Chapter 3) provides some useful results. We find that a higher voting power of Christian Democrats in the county council increases public spending for vocational schools whereas a higher power of Social Democrats decreases it. This is in line with the traditional party preferences and can also be seen as being in line with the prediction by Hibbs (1977) according to which parties tend to act according to their clientele's preferences. However, opportunistic behavior, of course, cannot be rejected. On the contrary, expenditures are significantly higher in election years indicating opportunistic budget cycles. Political alignment of the county council with the state government seems to affect expenditures in a positive way (whenever cities with county rights are not excluded from the analysis). These rather extensive results on political determinants of vocational school spending are- to the best of my knowledge- the first results ever for this specific topic making the analysis particularly innovative. Unlike Jensen (2011), we do not find positive impacts of deindustrialization.

Last but not least, paper 3 (Chapter 4) provides evidence of positive impacts of both teacher density as a state input as well as positive (but small) impacts of county grammar school expenditures on the local share of grammar school pupils who get their diploma. In comparison with prior research findings (e.g. Hanushek, 2003), my results show higher (and robustly

significant) effects than other related research studies. Nevertheless, looking at 11th graders three school years later, I only estimate short-run effects whereas other findings focus on longer time periods. Moreover, some other studies deal with elementary or younger high school pupils. It is worth to stress here that my study is analyzing a poor qualitative outcome measure. However, this is the first study on Germany looking at school expenditures from different levels in this way.

All in all, I get significant results so the additional role of counties in the important field of school financing can be proved as local public vocational school expenditures clearly and robustly depend on political impact factors. Only interregional competition is not present here. Looking at the outcome side, there are also robustly significant effects of local monetary inputs on graduation rates even though the teacher input by the state appears to be more effective. So the county- level should not be left to be the "forgotten jurisdiction".

5.2 Further research

From a political economic point of view, it could be interesting to extend the analysis of Paper 2 to all school types in Germany – especially given the fact that significant results are found for vocational schools. Unfortunately, such an analysis is not possible for East-German counties because of lacking data. A comparison with other expenditure categories such as health care or cultural issues might be interesting to check if these expenditures are rival and how different parties react to that if it is the case. Potrafke (2011) performs a similar analysis on state- level (comparing – among others- expenditures for schools and universities).

Moreover, there are not many spatial econometric analyses on Germany so far which might make it innovative in other fields of local public expenditures such as ecological expenditures by counties –a research field not addressed for the county-level yet.

A longer, more current dataset could be promising for several reasons. First, one could replicate an analysis on the political economy of vocational school spending for a longer time period containing the time of German reunification as well as the arrival of refugees in 2015 as interesting variations. Which role do vocational schools play during times of changes in the structure of labor forces?

Lastly, the effects of local and state school spending should be analyzed for a longer time period in order to look at medium-term and long-term effects. The G8/G9 reform of the duration of grammar schools and its reversion make it difficult to collect a longer dataset. The same is true for other school forms because of the establishment of comprehensive schools in Germany during the first decade of the 21th century. One could therefore look at younger grammar school pupils if some other outcome measure such as PISA test score of 9^{th}- graders were available on county-level. Unfortunately, these data are not available so far.

Bibliography

Acemoglu, D. and Pischke, J.-S. (1998). Why Do Firms Train? Theory and Evidence. Quarterly Journal of Economics, 113(1), 79-119.

Ajilore, O. (2013). Estimating the Spillover Effects of School District Demographics on Per Pupil Spending. Journal of Education Finance, 39(2), 101-114.

Alesina, A. (1987). Macroeconomic policy in a two-party system as a repeated game. The Quarterly Journal of Economics, 102(3), 651-678.

Angrist, J. D. and Krueger, A. B. (2001). Instrumental variables and the search for identification: From supply and demand to natural experiments. Journal of Economic Perspectives, 15(4), 69-85.

Angrist, J. D. and Lavy, V. (1999). Using Maimonides' rule to estimate the effect of class size on scholastic achievement. The Quarterly Journal of Economics, 114(2), 533-575.

Anselin, L. (1988) Spatial Econometrics: Methods and Models. Dordrecht: Kluwer Academic Publishers.

Anselin, L., Bera, A. K., Florax, R. and Yoon, M. J. (1996). Simple diagnostic tests for spatial dependence. Regional Science and Urban Economics, 26(1), 77-104.

Arraiz, I., Drukker, D. M., Kelejian, H. H. and Prucha, I. R. (2010). A spatial cliff-ord-type model with heteroskedastic innovations: small and large sample results. Journal of Regional Science, 50(2), 592-614.

Avenarius, H. and Füssel, H. P. (2010). Schulrecht. Ein Handbuch für Praxis, Rechtsprechung und Wissenschaft, 8.

Avenarius, H., and Heckel, H. (2000). Schulrechtskunde: Ein Handbuch für Praxis, Rechtspchung und Wissenschaft. Luchterhand.

Banaszewska, M. and Bischoff, I. (2017). The Political Economy of EU-funds: Evidence from Poland. Journal of Economics and Statistics, 237 (3), p. 191-224.

Barankay, I. and Lockwood, B. (2007). Decentralization and the productive efficiency of government: Evidence from Swiss cantons. Journal of Public Economics, 91(5), 1197-1218.

Baskaran, T. and Lopes da Fonseca, M. (2016). Electoral competition and endogenous political institutions. Journal of Economic Behavior & Organization 122, pp. 43–61.

Becker, G. S. (2009). Human capital: A theoretical and empirical analysis, with special reference to education. University of Chicago press.

BenDavid-Hadar, I. and Ziderman, A. (2011). A new model for equitable and efficient resource allocation to schools: The Israeli case. Education Economics, 19(4), 341-362.

BIBB, (2014). BIBB Datenreport / A4.1.1 Anzahl und Struktur anerkannter Ausbildungsberufe nach BBiG/HwO. Bibb.de. Abgerufen am 09. 05. 2017 von https://www.bibb.de/datenreport/de/2014/19504.php.

Bischoff, I. and Hauschildt, J. (2019). Vocational schools as an instrument of interregional competition - Empirical evidence from German counties, Review of Regional Research, 38(1), p.65-89.

Boix, C. (1997). Political parties and the supply side of the economy: The provision of physical and human capital in advanced economies, 1960-90. American Journal of Political Science, 814-845.

Bradley, S. and Taylor, J. (1996). Human capital formation and local economic performance. Regional Studies, 30(1), 1-14.

Bräuninger, T. (2005). A partisan model of government expenditure. Public Choice, 125(3-4),

Brueckner, J. K. (2003). Strategic Interaction among Governments: An Overview of Empirical Studies. International Regional Science Review 26 (2): 175-188.

Brugger, P., Blaeschke, F. and Schneider, B. (2016). Bildungsfinanzbericht 2016.Wiesbaden:Statistisches Bundesamt (https://www.destatis.de/GPStatistik/receive/DESerie_serie_00000812 last access:17.09.2019).

Brugger, P., Schulz, A., Blaeschke, F. and Schneider, B. (2017). Bildungsfinanzbericht 2017.Wiesbaden:Statistisches Bundesamt (https://www.destatis.de/GPStatistik/receive/DESerie_serie_00000812 last access:17.09.2019).

Brugger, P., Schulz, A., Schneider, B. and Leiste, M. (2018). Bildungsfinanzbericht 2018.Wiesbaden:Statistisches Bundesamt (https://www.destatis.de/GPStatistik/receive/DESerie_serie_00000812 last access:17.09.2019).

Burki, S. J., Perry, G., Dillinger, W., Griffin, C., Gutman, J., Rojas, F., ... and Winkler, D. (1999). Beyond the center: Decentralizing the state. The World Bank.

Busemeyer, M. R. (2007). Determinants of public education spending in 21 OECD democracies, 1980–2001. Journal of European Public Policy, 14(4), 582-610.

Busemeyer, M. R. (2009). Social democrats and the new partisan politics of public investment in education. Journal of European Public Policy, 16(1), 107-126.

Busemeyer, M. R., Cattaneo, M. A. and Wolter, S.C. (2011). Individual policy preferences for vocational versus academic education: Microlevel evidence for the case of Switzerland. Journal of European Social Policy21: 253-273.

Busemeyer, M., Lergetporer, P. and Woessmann, L. (2017). Public Opinion and the Acceptance and Feasibility of Educational Reforms. EENEE Analytical Report 28. Publications of the European Union, Luxembourg

Büttner, T. and Schwager, R. (2004). Regionale Verteilungseffekte der Hochschulfinanzierung und ihre Konsequenzen. In Bildung, 33. Wirtschaftswissenschaftliches Seminar Ottobeuren, Tübingen , 251-278.

Candelaria, C. A. and Shores, K. A. (2015). The Sensitivity of Causal Estimates from Court-Ordered Finance Reform on Spending and Graduation Rates. Center for Education Policy Analysis Working Paper, (16-05).

Cattaneo, M.A. and S.C. Wolter (2009). Are the Elderly a Threat to Educational Expenditures? European Journal of Political Economy 25(2): 225–236.

Chaudhary, L. (2009). Education inputs, student performance and school finance reform in Michigan. Economics of Education review, 28(1), 90-98.

Chetty, R., Friedman, J. N. and Rockoff, J. E. (2014). Measuring the impacts of teachers I: Evaluating bias in teacher value-added estimates. American Economic Review, 104(9), 2593-2632.

Colburn, C. B. and Horowitz, J. B. (2003). Local politics and the demand for public education. Urban Studies, 40(4), 797-807.

Coleman, J.S., Campbell, E.Q., Hobson, C.J., McPartland, J., Mood, A.M., Weinfeld, F.D. and York, R.L. (1966). Equality of Educational Opportunity. Washington, D.C.: U.S. Government Printing Office.

Cortina, K. S., Baumert, J., Leschinsky, A., Mayer, K. U. and Trommer, L. (2003). Das Bildungswesen in der Bundesrepublik Deutschland. Strukturen und Entwicklungen im Überblick. Reinbek: Rowohlt.

Dee, T. S. (1998). Competition and the quality of public schools. Economics of Education review, 17(4), 419-427.

Dotti, V. (2019). The political economy of public education. Research in Economics, 73, 35-52.

Deissinger, T. (2015). The German dual vocational education and training system as 'good practice'? Local Economy, 30(5), 557-567.

Denzau, A. T. (1975). An empirical survey of studies on public school spending. National Tax Journal, 241-249.

Denzau, A. and Grier, K. (1984). Determinants of local school spending: Some consistent estimates. Public Choice, 44(2), 375-383.

Di Gioacchino, D. and Profeta, P. (2014). Lobbying for Education in a Two-Sector Model. Economics & Politics, 26(2), 212-236.

Di Liddo and Giuranno (2016). Asymmetric yardstick competition and municipal cooperation. Economics Letters 141, 64-66.

Dynarski, S., Hyman, J. and Schanzenbach, D. W. (2013). Experimental evidence on the effect of childhood investments on postsecondary attainment and degree completion. Journal of Policy Analysis and Management, 32(4), 692-717.

Faguet, J. P. and Sánchez, F. (2008). Decentralization's effects on educational outcomes in Bolivia and Colombia. World Development, 36(7), 1294-1316.

Falch, T. and Rattsø, J. (1997). Political economic determinants of school spending in federal states: Theory and time-series evidence. European Journal of Political Economy, 13(2), 299-314.

Fernandez, R. and Rogerson, R. (1996). Income distribution, communities, and the quality of public education. The Quarterly Journal of Economics, 135-164.

Finegold, D. and Soskice, D. (1988). The failure of training in Britain: analysis and prescription. Oxford review of economic policy, 4(3), 21-53.

Fisher, F. M. (1965). The choice of instrumental variables in the estimation of economy-wide econometric models. International Economic Review, 6(3), 245-274.

Fiske, E. B. (1996). Decentralization of education: Politics and consensus. The World Bank.

Freitag, M. and Bühlmann, M. (2003). Die Bildungsfinanzen der Schweizer Kantone. Der Einfluss sozioökonomischer Bedingungen, organisierter Interessen und politischer Institutionen auf die Bildungsausgaben im kantonalen Vergleich. Swiss Political Science Review, 9(1), 139-168.

Freitag, M and Schlicht, R. (2009). Educational federalism in Germany: Foundations of social inequality in education. Governance, 22(1), 47-72.

Fuchs, G. (2012). Der Landrat: Karrierewege, Stellung, Amtsführung und Amtsverständnis. Springer-Verlag.

Fuller, B. F. and Elmore, R. (1996). Who Chooses? Who Loses? Culture, Institutions and the Unequal Effects of School Choice. Teachers College Press, 1234 Amsterdam Ave., New York, NY 10027 (paperback: ISBN-0-8077-3537-X; clothbound: ISBN-0-8077-3538-8).

Ghosh, S. (2010). Strategic interaction among public school districts: Evidence on spatial interdependence in school inputs. Economics of Education review, 29(3), 440-450.

Gibbons, S. and Overman, H. G. (2012). Mostly pointless spatial econometrics?. Journal of Regional Science, *52*(2), 172-191.

Gu, J. (2012). Spatial dynamics and determinants of county-level education expenditure in China. Asia Pacific Education review, 13(4), 617-634.

Hægeland, T., Raaum, O. and Salvanes, K. G. (2012). Pennies from heaven? Using exogenous tax variation to identify effects of school resources on pupil achievement. Economics of Education review, 31(5), 601-614.

Hampf, F. and Woessmann, L. (2017). Vocational vs. General Education and Employment over the Life Cycle: New Evidence from PIAAC. CESifo Economic Studies 63(3): 255–269.

Hanushek, E. A. (1986). The economics of schooling: Production and efficiency in public schools. Journal of economic literature, 24(3), 1141-1177.

Hanushek, E. A. (2003). The failure of input-based schooling policies. The economic journal, 113(485), F64-F98.

Hanushek, E. A. and Luque, J. A. (2003). Efficiency and equity in schools around the world. Economics of Education review, 22(5), 481-502.

Hanushek, E. A. and Woessmann, L. (2010). The cost of low educational achievement in the European Union. European Expert Network on Economics of Education.

Hanushek, E. A., Link, S. and Woessmann, L. (2013). Does school autonomy make sense everywhere? Panel estimates from PISA. Journal of Development Economics, 104, 212-232.

Harhoff, D., and Kane, T. J. (1993). Financing apprenticeship training: Evidence from Germany (No. w4557). National Bureau of Economic Research.

Heinelt, H., and Egner, B. (2012). Germany: Hubert Heinelt and Björn Egner. In The Second

Henneke, H. G. (2012). Die Kommunen in der Finanzverfassung des Bundes und der Länder: Darstellung. 5. Aufl. Wiesbaden: Kommunal-und Schul-Verlag.

Hibbs, D. A. (1977). Political parties and macroeconomic policy. American Political Science Review, 71(4), 1467-1487.

Hippach-Schneider, U., Krause, M. and Woll, C. (2007). Berufsbildung in Deutschland. Kurzbeschreibung, Cedefop Panorama series, 136.

Hoxby, C. M. (1994). Do private schools provide competition for public schools? (No. w4978). National Bureau of Economic Research.

Huber, G., Kocher, M. and Sutter, M. (2003). Government strength, power dispersion in goverments and budget deficits in OECD-countries. A voting power approach. Public Choice, 116, 333–350.

Hurrelmann, K. (2013). Das Schulsystem in Deutschland: Das „Zwei-Wege-Modell "setzt sich durch. Zeitschrift für Pädagogik, 59(4), 455-468.

Hyman, J. (2017). Does money matter in the long run? Effects of school spending on educational attainment. American Economic Journal: Economic Policy, 9(4), 256-80.

Jackson, C. K., Johnson, R. C. and Persico, C. (2015). The effects of school spending on educational and economic outcomes: Evidence from school finance reforms. The Quarterly Journal of Economics, 131(1), 157-218.

Jann, W. and Bogumil, J. (2009). Verwaltung und Verwaltungswissenschaft in Deutschland. Wiesbaden: VS-Verlag.

Jensen, C. (2011). Capitalist systems, deindustrialization, and the politics of public education. Comparative Political Studies, 44(4), 412-435.

Jimenez, E. and Paqueo, V. (1996). Do local contributions affect the efficiency of public primary schools?. Economics of Education review, 15(4), 377-386.

Justman, M. and Thisse, J. F. (1997). Implications of the mobility of skilled labor for local public funding of higher education. Economics Letters, 55(3), 409-412.

Keen, M. J. and Kotsogiannis, C. (2002). Does federalism lead to excessively high taxes?. American Economic Review, *92*(1), 363-370.

Kauder, B. and Potrafke, N. (2013). Government ideology and tuition fee policy: Evidence from the German states. CESifo Economic Studies, 59(4), 628-649.

Koenig, J., Brenner, T. and Buenstorf, G. (2017). Regional effects of university funding: Excellence at the cost of regional disparity?. Review of Regional Research: Jahrbuch für Regionalwissenschaft, 37(2), 111-133.

Krueger, A. B. (2003). Economic considerations and class size. The Economic Journal, 113(485), F34-F63.

Kultusministerkonferenz (KMK) (2014). Definitionenkatalog zur Schulstatistik 2014. abgerufen am 12.07.2016 von http://www.kmk.org/fileadmin/Dateien/pdf/Statistik/Defkat2014_2.pdf.

Kultusministerkonferenz (KMK) (2015). Definitionenkatalog zur Schulstatistik 2015. abgerufen am 12.07.2016 von http://www.kmk.org/fileadmin/Dateien/pdf/Statistik/Defkat2015_2.pdf.

Kuppe, A. M., Lorig, B., Schwarz, H. and Stöhr, A. (Eds.). (2015). Ausbildungsordnungen und wie sie entstehen. Bundesinstitut für Berufsbildung.

LeSage, J. P. (2014). What regional scientists need to know about spatial econometrics. Available at SSRN 2420725.

Levačić, R. and Vignoles, A. (2002). Researching the links between school resources and student outcomes in the UK: A review of issues and evidence. Education Economics, 10(3), 313-331.

Lewbel, A. (2012). Using heteroscedasticity to identify and estimate mismeasured and endogenous regressor models. Journal of Business & Economic Statistics, 30(1), 67-80.

Lyytikäinen, T. (2012). Tax competition among local governments: Evidence from a property tax reform in Finland. Journal of Public Economics, 96(7-8), 584-595.

Mason, G., Prais, S. J. and Van Ark, B. (1992). Vocational education and productivity in the Netherlands and Britain. National Institute Economic Review, 140(1), 45-63.

Miller, C. (1996). Demographics and spending for public education: a test of interest group influence. Economics of Education review, 15(2), 175-18.

Oates, W. E. and Schwab, R. M. (1988). Economic competition among jurisdictions: efficiency enhancing or distortion inducing? Journal of Public Economics, 35(3), 333-354.

OECD (2007). Education at a Glance 2007. OECD Indicators. OECD Publishing. Paris. abgerufen am 10.09.2019 von https://doi.org/10.1787/eag-2007-en.

OECD (2008). Education at a Glance 2008. OECD Indicators. OECD Publishing. Paris. abgerufen am 10.09.2019 von https://doi.org/10.1787/eag-2008-en.

OECD (2018). Education at a Glance 2018. OECD Indicators. OECD Publishing. Paris. abgerufen am 10.09.2019 von https://doi.org/10.1787/eag-2018-en.

Papke, L. E. (2005). The effects of spending on test pass rates: evidence from Michigan. Journal of Public Economics, 89(5-6), 821-839.

Patrinos, H. (2010). Private education provision and public finance: the Netherlands.

Petnuchova, J., Hrmo, R., Hornakova, V., Podaril, M., Stur, M., Ridzonova, Z. and Novota, M. (2012). Vocational education and training in OECD countries. In 2012 15th International Conference on Interactive Collaborative Learning (ICL) (pp. 1-6). IEEE.

Pfeifer, H., Dionisius, R., Schönfeld, G., Walden, G. and Wenzelmann, F. (2009). Kosten und Nutzen der betrieblichen Berufsausbildung. Forschungsprojekt des Bundesinstituts für Berufsbildung, Bonn.

Pflüger, M. and Südekum, J. (2008). A synthesis of footloose-entrepreneur new economic geography models: when is agglomeration smooth and easily reversible? Journal of Economic Geography, 8(1), 39-54.

Pischke, J. S. (2007). The impact of length of the school year on student performance and earnings: Evidence from the German short school years. The Economic Journal, 117(523), 1216-1242.

Poterba, J. M. (1997). Demographic Structure and the Political Economy of Public Education. Journal of Policy Analysis and Management 16(1): 48-66.

Potrafke, N. (2011). Public expenditures on education and cultural affairs in the West German states: does government ideology influence the budget composition?. German Economic Review, 12(1), 124-145.

Poutvaara, P. (2004). Educating Europe: should public education be financed with graduate taxes or income-contingent loans? CESifo Economic Studies, 50(4), 663-684.

Pritchett, L. and Filmer, D. (1999). What education production functions really show: a positive theory of education expenditures. Economics of Education Review, 18(2), 223-239.

Rabe-Hesketh, S. and Skrondal, A. (2008). Multilevel and Longitudinal Modelling Using Stata 2nd edition. Stata Press, College Park, Texas.

Reed, W. R. (2015). On the practice of lagging variables to avoid simultaneity. Oxford Bulletin of Economics and Statistics, 77(6), 897-905.

Rincke, J. (2006). Competition in the public school sector: Evidence on strategic interaction among US school districts. Journal of Urban Economics, 59(3), 352-369.

Roy, J. (2011). Impact of school finance reform on resource equalization and academic performance: Evidence from Michigan. Education Finance and Policy, 6(2), 137-167.

Scherf, W. and Hofmann, K. (2003). Die kommunale Finanzverfassung in Deutschland. In Kommunalpolitik in den deutschen Ländern (pp. 313-334). VS Verlag für Sozialwissenschaften.

Schmidt, S. (2005). Bildung schützt vor Erwerbslosigkeit. Statistisches Monatsheft Baden-Württemberg, 7(2005), 14-17.

Schwarz, A. and Weishaupt, H. (2013). Regionale Disparitäten der Bildungsfinanzierung. In Bildungskontexte (pp. 483-510). Springer Fachmedien Wiesbaden.

Seele, G. (1990). Die Kreise in der Bundesrepublik Deutschland. Verfassung, Organisation und Aufgabenstellung einer Institution. Köln.

Shehata, E. and Mickaiel, S. (2013). Spregdpd: Stata module to estimate spatial panel arellano-bond linear dynamic regression: Lag & durbin models.

Shehata, E. A. E. (2012). GS2SLS. Stata module to estimate Generalized Spatial Two Stage Least Squares Cross Sections Regression.

Solé-Ollé, A. (2006). Expenditure spillovers and fiscal interactions: Empirical evidence from local governments in Spain. Journal of Urban Economics, 59(1), 32-53.

Solé-Ollé, A. and Sorribas-Navarro, P. (2008). The effects of partisan alignment on the allocation of intergovernmental transfers. Differences-in-differences estimates for Spain. Journal of Public Economics, 92(12), 2302-2319.

Soskice, D. (1994). Reconciling markets and institutions: The German apprenticeship system. In Training and the private sector: International comparisons (pp. 25-60). University of Chicago Press.

Statistisches Bundesamt (2016). Finanzen und Steuern – Vierteljährige Kassenergebnisse des Öffentlichen Gesamthaushalts. 1. Vierteljahr 2016. Fachserie 14, Reihe 2.Wiesbaden.

Steedman, H. (1993). The economics of youth training in Germany. The economic journal, 103(420), 1279-1291.

Tepe, M. and Vanhuysse, P. (2009). Educational business cycles. Public Choice, 139(1-2), 61-82.

Thelen, K. (2007). Contemporary challenges to the German vocational training system. Regulation & Governance 1, 247-260.

Tiebout, C. M. (1956). A pure theory of local expenditures. Journal of political economy, 64(5), 416-424.

Wilson, J. D. (1986). A theory of interregional tax competition. Journal of Urban Economics, 19(3), 296-315.

Winner, H. (2005). Has tax competition emerged in OECD countries? Evidence from panel data. International Tax and Public Finance, 12(5), 667-687.