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78
2018

Education Economics from a Historical Perspective

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Schriftleitung: Chang Woon Nam

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Bibliografische Information der Deutschen Nationalbibliothek

Die Deutsche Nationalbibliothek verzeichnet diese Publikation
in der Deutschen Nationalbibliografie; detaillierte bibliografische
Daten sind im Internet über
http://dnb.d-nb.de
abrufbar.

ISBN: 978-3-95942-044-0

Druck: ifo Institut, München

ifo Institut im Internet:
http://www.cesifo-group.de

Preface

This study was prepared by Ruth Schüler while she was working at the Ifo Center for the Economics of Education. It was completed in July 2016 and accepted as a doctoral thesis by the Department of Economics at the University of Munich in November 2016. It consists of four distinct empirical analyses on educational economics from a historical perspective, two chapters investigating the consequences of educational inputs and two chapters examining the determinants of educational provision and performance in nineteenth-century Prussia. The econometric analyses are based on census data, originally collected by the Royal Statistical Office of Prussia and partly digitized for this thesis.

The thesis analyzes how education funding emerges in a federal system and how it affects prosperity and nation building in a setting of religious and ethno-linguistic heterogeneity. Chapter 2 provides evidence that educational spending accelerated economic development in the industrializing western regions of Prussia though not in Prussia's agricultural East, suggesting that primary education instilled knowledge that permitted a shift to higher-skilled and higher-paid occupations in those regions that faced a sectoral change of the economy. Chapter 3 shows that a higher share of central state contributions in education increased pro-nationalist attitudes and to a smaller extent voter turnout. This indoctrination was especially successful in constituencies that were populated by a high share of either religious or linguistic minorities.

Chapter 4 investigates the effects of linguistically polarized societies on educational provision in decentralized systems. Evidence for a negative effect of polarization on educational spending is found. Further analysis exploiting increased centralization shows that centralization can increase educational provision in polarized regions. Chapter 5 makes use of a natural experiment introducing centralized school monitoring against the background of the *Kulturkampf*, a cultural struggle between the Prussian state authorities and the Catholic Church. While the reform overall increases school performance, resistance from the targeted Catholic population is found.

Keywords: Education, Public Spending, Prussian Economic History, Human Capital, Economic Development, Industrial Revolution, Nation Building, Indoctrination, Minorities, Polarization, Public Goods, Decentralization, Centralization, Resistance, Monitoring, Accountability

JEL-Codes: I21, I22, H41, H52, H75, N13, N33

Acknowledgements

First and foremost, I am grateful to my supervisor Ludger Wößmann for his valuable comments and advice throughout all stages of this thesis. I also thank Davide Cantoni as my second supervisor who equally provided valuable feedback on all chapters of this thesis. Furthermore, I thank Oliver Falck for accompanying the first stage of my PhD and for being my third examiner.

In particular I want to thank Francesco Cinnirella for joint work on Chapters 3 and 4 and for comments on the remaining parts of this thesis. Overall, I am grateful for his patience and encouragement.

I thank the whole team of the Ifo Center for the Economics of Education and the Ifo Institute in general. In particular, I want to thank Nadine Fabritz who supported me while sharing an office and even beyond our time as colleagues. I am grateful to Jens Ruhose who always took time to discuss my work and who shared a lot of his academic experience with me. Furthermore, Katharina Candel-Haug, Anna Ciesielski and Sybille Lehwald played an important role in exchanging experiences across departments. I furthermore thank all student assistants who supported my work. In particular, I am grateful to Laura Schilz who assisted on Chapters 3 and 4 and who showed a great interest in my research.

I want to thank Larissa Zierow who allowed me to keep close ties with the Ludwig-Maximilians-University of Munich and who was a great fellow student to discuss academic topics and life beyond academics.

I also thank Martin Uebele, Ulrich Pfister and Maria Stanfors who encouraged me to pursue this path and continued supporting me while preparing my dissertation. Furthermore, Thilo Albers and Pawel Bukowski were great PhD companions and I especially want to thank them for advice on Chapters 4 and 5.

My work was financially supported by an Economic History Association Exploratory Travel and Data Grant of 2014.

Finally, I want to thank my Mum and Sister and Shaban Masengesho and my friends and family, overall Eva Tierwald, Andrea Liebler, Maren Bernlöhr, Arne Thomas, Nadine Sylla and my roommates in Munich for reminding me of my own way.

I dedicate this work to my Father Johann-Georg Schüler and my Grandfather Günther Ullmann.

Education Economics from a Historical Perspective

Inaugural-Dissertation
zur Erlangung des Grades Doctor oeconomiae publicae (Dr. oec. publ.)
an der Ludwig-Maximilians-Universität München
Volkswirtschaftliche Fakultät

2016

vorgelegt von
Ruth Schüler

Referent: Prof. Dr. Ludger Wößmann
Korreferent: Prof. Davide Cantoni, Ph.D.
Promotionsabschlussberatung: 16. November 2016

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"He who controls the past controls the future.
He who controls the present controls the past."

George Orwell, 1984

Chapter 1
Introduction

1.1 Education Economics from a Historical Perspective

The long shadow of history affects educational systems and consequently economic growth until today.[1] Examining the mass expansion of education from a historical perspective helps understanding how characteristics of contemporary educational systems emerged. Many characteristics of the contemporary German educational system have their roots in the past: educational matters being decided at the level of the German states (*Länder*); the early tracking system; teacher training as well as large parts of the curriculum go back to the nineteenth century when the socio-economic changes evoked through the Second Industrial Revolution induced a changed demand in skills. The thesis analyzes consequences and determinants of Prussia's educational system after the foundation of a German nation state in 1871, particularly shedding light on how education funding emerges in a federal system and how it affects prosperity and nation building in a setting of religious and ethno-linguistic heterogeneity.

Rich micro-regional data from the turn of the twentieth century allow examining the role of education for socio-economic developments during the formative years of the German nation (Sperber, 1997). As the German Empire had just been founded in 1871, data from Prussia as the hegemon of the newly founded German nation state and the role model for primary education in Western Europe at the time (Lindert, 2004) permit exploring whether the educational system contributed to prosperity and nation building in a country that was socially, religiously and economically polarized.

Evidence from this thesis suggests that the local funding regime shaping the Prussian educational system until the ending 1880s manifested the economic divide within the country, lowered the provision of education in polarized regions and brought about resistance against modernizing moments from the marginalized groups of the population. Once the system shifted to a higher degree of centralization in the ending 1880s, a more

[1] Seminal papers having investigated the importance of human capital for economic growth are Mankiw et al. (1992), Benhabib and Spiegel (1994), Barro (2001) and Glaeser et al. (2004). More specifically Huillery (2009) and Valencia Caicedo (2014) investigate the persistence of educational institutions on educational characteristics and outcomes today.

balanced provision of education could be achieved and nation building was "successfully" enforced through indoctrination in schools.

By aiming at contributing both to open questions in educational economics as well as at adding to the historical narrative on Prussia's educational system at the turn of the twentieth century, the thesis follows Abramitzky's (2015) understanding of economic history stating that the economic historian does not only ask what she might learn from history to test existing theories and to derive conclusions for today, but that she is also interested in studying historical phenomena per se.

1.2 Determinants and Consequences of Education

This thesis evolves around the consequences and determinants of education in a historical context, aiming at exploring the mass expansion of an educational system and how it consequently shaped socio-economic developments.

The literature on modern educational production functions investigates how educational inputs such as individual student characteristics, family background, teacher characteristics, as well as resources and the educational system itself affect educational outcomes, measured by test scores and performance in the labor market (Hanushek, 2006) and also investigates effects of education on non-economic outcomes such as civic returns (Dee, 2004). *Chapter 2* contributes to the effects of educational inputs on economic outcomes at a time when the educational system expanded rapidly. *Chapter 3* explores how the composition of educational funding affects electoral outcomes in a nation-building process, showing that the source of government spending matters for aligning voters with the central state's ideology.[2]

How does an educational system have to be designed to achieve the desired outcomes? The literature on the determinants of education looks at characteristics of the school system such as funding, accountability and central exams, school autonomy, the presence of private schools, school entry age or school tracking. This thesis specifically analyzes characteristics of an educational system in a setting shaped by a high concentration of minorities and therefore arguably diverging interests. *Chapter 4* investigates how the provision of educational spending is affected by linguistic polarization in a locally funded system, showing that a centralization of educational funding can increase educational provision in a linguistically polarized society. [3] At the same time, *Chapter 5* shows that increasing school attendance through the introduction of centralized monitoring fails in regions that oppose the introduction of such school inspections.

[2] *Chapter 3* is joint work with Francesco Cinnirella.

[3] *Chapter 4* is joint work with Francesco Cinnirella.

1.3 The Case of Prussia

Prussia as a role model in primary education provides an interesting case to examine a state that early on expanded and reformed its educational system (Lindert, 2004). Focusing at the turn of the twentieth century allows observing the formative years of the German nation (Sperber, 1997).

1.3.1 Socio-economic Developments at the Turn of the Twentieth Century

Prussia underwent the second phase of the Industrial Revolution towards the end of the nineteenth century. In economic terms, this generated higher income, eventually increasing the gap between the high-skilled, well-paid upper tail and the low-skilled, low-paid workforce at the lower end of the wage distribution (Hahn, 2005). Consequently, this economic development initiated the emergence of different antagonisms between social milieus and classes and the urban vs. the rural population.

With the foundation of the German Empire under Prussia's hegemony in 1871, a growing nationalism was initiated. The fragmentary identity of a Prussian citizen now transformed into the ideal Prussian citizen being "Protestant and German" (Clark, 2007). This demarcation defined three distinct minorities: the Polish minority in the East, the Catholics in both the Western provinces of Rhineland and Westphalia and in the East and the Social Democrats in the urban industrializing regions of Prussia.

These groups of the population were heavily attacked by legislative campaigns and social action throughout the foundation phase of the German Empire. The anti-Polish movement comprised a *Germanization* strategy ranging from introducing German as the only language of instruction in primary schools to prohibiting Polish-speaking assemblies. The Catholics were combatted during the *Kulturkampf*, the struggle between the Catholic Church and the Prussian authorities between 1872 and 1886/1887. And the Social Democratic Party, advocating the rights of the mainly urban industrial workers experienced a ban of their party between 1878 and 1890. The school was used as an instrument to fight this upcoming movement while fighting these minorities was considered as constructive nation building.

Historians such as Clark (2007) and Alexander (2008) argue that Prussia's decline in the twentieth century evolved from the failure of Prussia's institutions to keep up with the pace of socio-economic developments and in particular with the challenge to integrate minorities into the Prussian state. The role of Prussia's educational system ranging from being characterized as a retarded as opposed to a modernizing institution is debated in the historical literature. While the historiography of the 1960s stresses the "occupation" and "politicization" of schools, reducing the function of the school to producing loyal subjects,

the later literature of the 1980s stresses the modernizing moments of the educational system such as achieving full literacy and enhancing political participation (Kuhlemann, 1991). This thesis aims at examining which of these views might prevail.

1.3.2 The Prussian Educational System

Until the foundation of the German Empire, the Prussian educational system was known as a role model to other Western countries (Lindert, 2004) and contributed to making Prussia a multinational state by incorporating minority schools within the public educational system as separate autonomous streams (Gradstein and Justman, 2005). As the educational system was denominational, providing separate schools for Protestant and Catholic children, operated under the supervision of its own clergy, the Catholic and consequently also the Polish minority had autonomy over schools. After the foundation of the German Empire and the introduction of both the School Inspection Law and a national curriculum in 1872, Catholic schools came under central school inspection. Consequently only the Protestant schools remained autonomous. With several laws explicitly prohibiting Polish as a language of instruction in primary schools, these reforms turned the Prussian educational system away from its multicultural orientation towards a more national orientation forging the ideal of a Prussian citizen (Clark, 2007). This became even more evident with the Royal Decree formulated by Emperor Wilhelm II in 1889 which stressed the role of the school in forming citizens devoted to the Prussian Kings and hostile towards social democratic tendencies.

Furthermore, the local funding of primary schools which had long guaranteed Prussia's pioneering role in education failed to keep pace with the population growth (Lamberti, 1989). Finally, the bipartite system of primary school for the lower class and *Gymnasium* for the upper class did not provide students with the skills demanded by the Second Industrial Revolution. Business magnates hence lobbied for more applied contents in primary education and for schools especially tailored to convey such contents, so-called *Realschulen*.[4] The school policy at the turn of the century thus faced three challenges in modernizing the educational system so that it would adjust to the changing requirements induced by population growth, industrialization, modernization and their consequences: Who should pay for schools? Who should have the authority over schools? What kind of education should be offered—religious or secular education (Anderson, 1970)?

With the School Inspection Law and the General Regulations, introducing a national curriculum devoted primarily to ideological subjects, first steps towards secularization, nationalization and a professionalization of the educational system were undertaken. The school policy was dominated by the different Ministers of Ecclesiastical and Education

[4] On the introduction of *Gewerbeschulen* and *Realschulen* in nineteenth-century Bavaria, see Semrad (2015).

Affairs with Adalbert Falk introducing crucial reforms in terms of curriculum and autonomy in the 1870s. In the ending 1880s a major shift towards more central spending was introduced by several laws on the organization of school funding. Finally, after decades of negotiations, the first comprehensive law on schools was passed in 1906, regulating the funding of primary schools at the national level (Lamberti, 1989).

1.4 Related Literature

Economic history has increasingly looked upon determinants and consequences of education to see what impacts education and how education affects economic development and the society. This has become possible by increasing digitization of data, especially for Prussia, France, Italy and England. Religion and its impact on education have been looked upon from several angles, especially stressing the effect of Protestantism on the demand of education (e.g., Akcomak et al., 2015; Andersen et al., *forthcoming*; Becker and Woessmann, 2009; Cantoni, 2015; Dittmar, 2011). In particular, Becker and Woessmann (2009) revise Max Weber's hypothesis on the Protestant ethic arguing that Luther's preach that everyone should be able to read in order to understand the words of the Scripture initiated a higher demand for education in Protestant regions, consequently leading to higher literacy and ultimately to higher economic prosperity. Max Weber's observation of higher economic prosperity in Protestant regions is therefore complemented by the educational demand channel. Most of the literature examining the effects of religion on education, argue that particular religious groups had a higher demand for education than others, increasing educational provision and performance. This thesis examines another aspect on how religion might affect educational performance. Contrary to the Protestants, Catholics were the perceived and declared religious minority of Prussia. The thesis, therefore examines whether resistance from the Catholic population against reforms imposed by the Protestant central authorities additionally decreased attachment to the public educational system by the Catholic minority, proposing a further explanation for the gap in school performance between Catholic and Protestant regions. Beyond this, it helps explaining why private enrollment among Catholic students persists to be relatively high (West and Woessmann, 2010).

Furthermore, the thesis shows that not only the religious dimension mattered, but that also linguistic polarization explains differences in the provision of education and educational funding in particular.

Another topic in explaining varying patterns of education is the role of ruling elites. Sokoloff and Engerman (2000) stress the role of large landowners in limiting the demand for education. For Prussia, Cinnirella and Hornung (2016) find that landownership concentration as a proxy for the institution of serfdom had a negative effect on the demand

for education. As they observe a diminishing negative effect in the second half of the century, they argue that a stepwise abolition of serfdom was an important driver of the change in enrollment and that emancipation increased the private demand for education.

The literature on capital and skill complementarities aims at disentangling the supply and the demand side of education (Goldin and Katz, 2008). A lot of attention has been devoted to the role of education for both the First and the Second Industrial Revolution. In his deskilling hypothesis Mokyr (1999) postulates that the First Industrial Revolution in England was unaffected of basic human capital. Becker et al. (2011) revisit Mokyr's deskilling hypothesis. Linking school enrollment data with a factory employment database, they find that basic education is significantly associated with non-textile industrialization in both the first and the second phase of the Industrial Revolution. They derive from this finding that formal education was important for Prussia being a technological follower of the Industrial Revolution. Beyond this evidence on the importance of basic education for followers of the Industrial Revolution, there is new evidence on the importance of "upper tail knowledge", i.e. the knowledge of highly skilled craftsmen for innovation. Research on the role of education for the Second Industrial Revolution still needs to explore the role of secondary and technical education, requiring new data collection. The channels on how education affected the industrialization process are still underexplored as well. In looking at inputs into the educational production function, this thesis contributes to examining these channels.

Another challenge remains in explaining the demographic transition. Several papers (Becker et al., 2010, 2012, 2013) look at the relationship between the quality-quantity trade-off of children in Prussia showing that the trade-off between child quality and quantity already existed in the mid of the nineteenth century before the onset of the demographic transition.

Another topic with little evidence from a historical perspective evolves around non-monetary effects of education, such as increased indoctrination. This thesis contributes to this under-investigated topic by analyzing whether higher central contributions in the educational system contributed to nation building.

1.5 Data

Micro-regional data from the Royal Statistical Office of Prussia allow examining the formative years of the German nation from a Prussian perspective using modern micro-econometric methods. The advantage of using micro-regional data for Prussia at the turn of the twentieth century is that Prussia provides one institutional framework, but at the same time faces substantial variation in the educational provision and socio-economic development. Three chapters of the thesis exploit county-level variation while one chapter exploits variation at the constituency-level.

The thesis evolves in particular around the education censuses on primary schools published by the Royal Statistical Office of Prussia between 1886 and 1911. The education censuses contain detailed and comprehensive information on the number of students, teachers, schools by school type, and school finance. Volumes of the education censuses of 1891 to 1911[5] were in parts digitized for this thesis and complemented by data from the *Zentralblatt*, a monthly publication on educational matters by the Prussian Ministry of Ecclesiastical and Education Affairs. Furthermore data stemming from the ifo Prussian Economic History Database (iPEHD)[6] and the Galloway Prussia Database 1861 to 1914 complement the data.

1.6 Methods

The thesis investigates determinants of educational provision and performance on the one hand and the consequences of educational investments both for economic development and common identity building on the other hand. The challenge for all these interplays is to identify a causal effect to be able to understand how the educational system should be organized to achieve the desired outcomes.

Two sources for biases arise when aiming at identifying causal effects. First, solely investigating correlations bears the danger of reversed causality, i.e. not being able to identify in which direction causality goes. More developed counties will be more affluent, consequently being endued with more resources to invest in primary education hindering to detect whether education contributes to economic development.

The second source of biases accrues from unobserved variables that might affect the outcome while being correlated with the variable of interest. Natural resources that allow both for higher educational spending and economic development might be a source of such concern.

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[5] Two volumes of the education census were published after World War I in 1921 and 1926. However, data from these volumes are not considered in this thesis.

[6] For a detailed description of iPEHD; see Becker et al. (2014).

Identifying causal effects requires an identification strategy tailored to both the research question under examination and the data available. The settings and data of the four chapters therefore make use of four different identification strategies.

One method of tackling concerns arising from reversed causality and omitted variables is finding a variable that isolates variation in the potentially endogenous variable of interest. The so-called instrument is only allowed to affect the outcome variable through the variable of interest, which is the so-called exclusion restriction. *Chapter 4* makes use of an instrumental variable approach.

Furthermore observing changes in levels between one group facing a change in the variable of interest—the so-called treated group—versus counties that do not face this change—the so-called control group, allows for a difference in differences approach. The introduction of the School Inspection Law in predominantly Catholic counties and pre- and post-reform data fulfill the requirement for applying a difference in differences approach.

The time dimension of the data allows for a panel approach which is applied in two chapters. Using county and constituency-fixed effects respectively eliminates possible biases from time-invariant unobserved characteristics. By observing changes in both the outcome variable and the input variable, level effects are accounted for.

Finally, a value-added approach is used because data restrictions for the outcome variable do not allow applying a fixed-effects model. Including the lagged term of the outcome variable rules out that any historical development patterns might drive the relationship to be identified, i.e. educational inputs and economic development. The approach relies on the assumption that the lagged outcome variable is a sufficient statistic for historical inputs capturing endowments such as county-specific economic and overall conditions. As both education and economic development follow a cumulative process, this assumption is likely to hold.

1.7 Outline of the Thesis

The thesis is set out as follows: *Chapter 2* investigates whether specific educational investments matter for economic development. *Chapter 3* explores the effect of central investments in education on nation building. *Chapter 4* examines whether linguistic polarization in a decentralized system leads to a lower provision of educational spending. The introduction of centralized monitoring and resistance against the reform is analyzed in *Chapter 5*.

In detail, *Chapter 2* investigates the role of educational investments for economic development by using data on schooling quantity and quality provided by the first and second Prussian census on primary schools and two measures capturing the high and the low end of the income distribution, namely income tax per capita and day laborer wages. Applying a valued added approach for West Prussia, educational investments are found to increase income tax per capita substantially while day laborer wages stay constant. Breaking up educational investments into the teacher-student ratio, teacher unit costs, and infrastructure expenditures, the positive effect of educational investments on income at the high end of the income distribution primarily works through teacher unit costs and to a lesser extent through infrastructure investments. The important role of teachers is in line with the contemporary literature on educational production functions stressing the role of teacher quality for student performance.

Chapter 3 addresses the question whether educational investments by the central government can increase pro-nationalist attitudes. Prussia at the turn of the twentieth century provides an ideal laboratory to test this hypothesis as it was in a process of nation building and perceived primary school as a factory to produce "loyal citizens". Combining census data on the sources of school funding with federal election data at the level of 199 constituencies in five-year intervals from 1886 to 1911 allows estimating a model with constituency-fixed effects. A higher share of central expenditure increases the vote share of pro-nationalist parties especially in regions that have a high share of minorities such as Catholics and Poles. Voter turnout also increases marginally.

Chapter 4 analyzes the provision of public primary education in a setting characterized by a linguistically polarized society and a decentralized educational system. Instrumental variable estimates using distance to the eastern border show that linguistic polarization has a negative impact on local spending. Exploiting a reform of education spending shows that centralization increases the provision of education relatively more in linguistically polarized counties.

Chapter 5 investigates the effects of a reform introducing centralized monitoring. The reform being passed during the *Kulturkampf*, a severe conflict between the Prussian-Protestant authorities and the Catholic Church had as a consequence that centralized school inspection was introduced in predominantly Catholic regions. To measure the effect of the reform, data on school inspectors and Prussian county-level data are combined. Applying a difference in differences approach shows positive effects of the reform on school performance in denominationally mixed regions but no effect in predominantly Catholic regions. An increase in private enrollment and a mitigated effect of an overall improvement of teacher provision in the latter regions provides further evidence for Catholic resistance.

Chapter 2
Educational Inputs and Economic Development

2.1 Introduction

Towards the end of the nineteenth century, Prussia went through the second phase of the Industrial Revolution. At the same time, the country as a pioneer in primary education expanded its school system ensuring comprehensive school attendance (Lindert, 2004). Little is known, however, about how educational inputs affected ultimate outcomes like earnings—about the educational production process, the input-outcome relationship, and the efficiency of resource use. I hypothesize that higher investments in primary education translated into a higher skilled labor force, illustrated by increasing taxable income.

A large modern literature studies the effects of educational inputs on outcomes in school and later in life finding that all inputs except for school resources matter for later outcomes (e.g., Hanushek, 1986, 2006, 2010). But while there is some historical evidence on how school attendance and literacy relate to returns in the labor market (e.g., Mitch, 1984; Long, 2006), hardly anything is known about how specific school inputs were or were not crucial for the outcomes of the educational production process in a historical perspective. End of nineteenth-century Prussia provides a historical setting with a heavily expanding school system, where class size was huge and deficiencies of school buildings were prevalent with both the quality and quantity of schools varying substantially across Prussia.

This chapter estimates educational production functions in a historical context, focusing mainly on Prussia west of the Elbe. Using rich county-level data, it is the aim to estimate how different school inputs in 1886 and 1891 relate to subsequent increases in income. Data on income taxes and day laborer wages allow investigating the effects of educational investments both for the high and the low end of the income distribution.

The approach follows such modern contributions as Card and Krueger (1992a, 1992b), Heckman et al. (1996) and Chetty et al. (2011) in using subsequent earnings as the outcome measure of regionally varying school resources. As is standard in the educational production function literature, a value-added (VA) specification is employed conditioning on initial outcome differences (e.g., Hanushek, 2006). By focusing on changes (rather than levels) in outcomes, time-invariant unobserved factors that relate to both inputs and outcomes are eliminated from the analysis.

Educational investments increase income tax per capita while day laborer wages remain constant. The effect of educational investments at the high end of the income distribution mainly works through teacher unit costs, going in line with the findings of the literature on contemporary educational production functions stressing the importance of teacher quality for student performance. Infrastructure expenditures are also positively associated with income tax per capita, though to a smaller magnitude.

Hypothesizing that higher skills acquired in primary school allowed people to shift to higher skilled and higher paid jobs, becoming subject to paying income taxes and leaving the segment of day laborers, reconciles the findings on the positive association found for income tax per capita and the null effect found for day laborer wages. This is stressed by additional evidence for Prussia east of the Elbe where the economy remained agricultural, restricting occupational mobility. Consequently, no association between investments in primary education and income tax per capita are detected for East Elbia while day laborer wages are positively correlated with educational spending.

Section 2.2 discusses the related literature. Section 2.3 describes the economic and educational situation in Prussia in the ending nineteenth century. Section 2.4 introduces the data. Section 2.5 presents the empirical approach, the estimation results and explores possible mechanisms. Section 2.6 concludes.

2.2 Related Literature

This chapter contributes to two strands of the literature. First, it expands the literature on educational production functions to a historical dimension. Secondly, it speaks to the historical literature on the returns to education. The second strand of literature so far neglects zooming into particular measures of educational quality and quantity such as class size, teacher quality or infrastructure provision.[7]

[7] The underlying idea of the chapter that human capital fosters economic development and is indispensable for the transition phase to self-sustaining growth goes back to the growth model developed by Lucas (1988). Empirically, Mitch (1999) provides counter evidence for England as the first industrializing nation where formal education was unessential for economic growth. In the context of Prussia, Becker et al. (2011) show that basic education mattered for Prussia's industrialization as the country was a technological follower of the First Industrial Revolution which made basic skills a requirement to adapt technological innovations made by the industrial pioneer England. As this chapter focuses on the particular inputs in the education process, the extensive literature following from this theory and its empirical response is not discussed here.

2.2.1 The Educational Production Function

The literature on the educational production function was triggered off by the Coleman report on Equality of Educational Opportunity investigating the relationship between educational inputs and output in the US with the aim to analyze the effect of school quality—measured first of all by class size—on student achievement (Bowles, 1970; Hanushek, 1979, 2003).

The early literature used test scores as an immediate outcome of the educational inputs. Test scores are not available in the historical context of nineteenth-century Prussia, requiring another measure of student performance. The literature examining current educational production functions started looking at long term outcomes of educational inputs by examining performance in the labor market, mostly measured by later earnings. These long term measures allow capturing whether skills acquired in school eventually translated into higher labor market success and might therefore be considered as the more encompassing measure for educational outcomes. The approach in this chapter hence follows such modern contributions as Card and Krueger (1992a, 1992b), Heckman et al. (1996), and Chetty et al. (2011) in using subsequent earnings as the outcome measure of regionally varying school resources.

The modern literature does not provide consensual evidence on which school resources have a significant impact on subsequent earnings (Todd and Wolpin, 2003). The overall consensus that can be derived from the modern empirical literature is that additional educational spending does not automatically improve the quality of schooling and school outcomes, but that it is teacher quality that matters for student's performance.[8] The effects of a high-quality teacher on student's performance are large. Being taught by a teacher near the top of the quality distribution translates into one year's worth of additional learning.

[8] Studies which causally evaluate the impact of teacher quality on student's performance measure teacher quality by student's improvement in test scores. By controlling for initial students' test scores, the improvement in subsequent test scores is attributed to the teacher's quality, the so-called teacher's value-added. Koedel et al. (2015) review the literature on the value-added approach, discussing the draw backs of the approach. In linking school district and tax records, Chetty et al. (2014a, 2014b) are able to control for detailed information on students and their families at great detail showing that student's prior test scores are indeed able to provide unbiased forecasts of teacher's impacts on student achievement and have a substantial effect on students' lifetime earnings.

2.2.2 Historical Evidence on Educational Inputs and Economic Development

But do these findings also hold for a time when compulsory schooling had just been achieved, when it was common that teachers in the countryside had to handle 140 to 170 students at a time (Tews, 1914), when the lack of school buildings and teachers was severe due to population increase and internal migration and therefore considered as one of the main challenges by the Prussian Ministry of Ecclesiastical and Education Affairs (Königliches Statistisches Bureau in Berlin, 1908)?

There are only few empirical studies examining the impact of educational resources in primary schooling on ultimate outcomes from a historical perspective and all of them focus on England. Mitch (1984) looks at the changes in the rate of return to literacy after an increase in government involvement in primary education, finding that the return to male literacy decreases once the English government started to compensate for underinvestment in literacy. Long (2006) examines the impact of school attendance on adult labor market outcomes in Victorian England by looking both at occupational mobility from one generation to the next and on associated wage gains. He finds a small positive effect in terms of occupational mobility and a relatively small effect of education on earnings.

Lundgreen (1976) relates education and economic growth for nineteenth-century Prussia, finding that education had only little impact on income growth by estimating a classical production function and using public expenditures on education and enrolment rates in order to measure the amount of schooling. However, he uses time series data not exploiting the variation across Prussian counties and does not further decompose public expenditures into single inputs of the educational production function. Becker et al. (2011) examine the effect of primary education on economic growth for the nineteenth century when Prussia underwent the first and second phase of the Industrial Revolution. Linking school enrollment data with factory employment data, they find that primary education and non-textile industrialization are positively associated. They hypothesize that basic education was important for Prussia's economic catch-up as the country was a technological follower of the Industrial Revolution. This chapter takes this further by examining which specific educational inputs mattered for economic development.

2.3 Historical Background

At the end of the nineteenth century Prussia experienced an economic boom through the second phase of the Industrial Revolution granting higher tax income for the state and the municipalities. Simultaneously, the primary educational system expanded both quantitatively and qualitatively. However, the industrial progress did not take place evenly across Prussia, but expanded from the North West of Prussia (Kuhlemann, 1991), generating mass migration from the eastern to the western parts of Prussia, assuring an ample supply of labor in the West.[9] Therefore, this analysis focuses on the industrializing Prussian regions west of the river Elbe.

The provinces in the East of Prussia which were still heavily relying on the agricultural sector[10] lacked a demand for workers who were able to read, write and do calculus, i.e. for cognitive skills delivered by primary school. Furthermore, many people in the East of Prussia remained illiterate despite having attended school (Glück, 1979). In the agricultural regions of Prussia, the primary school was even considered as an institution impeding the economic progress of those regions and suppressing the capacity of municipalities by burdening them with funding the educational system (Kuhlemann, 1991).

2.3.1 Economic Development

Undergoing the second phase of the Industrial Revolution, Prussia's economy faced a fundamental structural change with the emergence of the chemical and electrical sector (Hahn, 2005).

According to the narrative of economic history, the Second Industrial Revolution relied on the steady accumulation and diffusion of useful knowledge and therefore meant technological progress on a scientific basis—as opposed to the First Industrial Revolution where industrialization was unaffected of basic education (Mokyr, 1999).

[9] While the population west of the river Elbe grew at a rate of 15 percent between 1885 and 1900, it grew at only seven percent in the regions east of the river Elbe.

[10] The low level and variation of income tax per capita in Prussia east of the Elbe is illustrated in Figure 2.3.

Large economies of scale, the electrification of production processes and interchangeable parts' technology culminated in standardized mass production, leading to the emergence of large-scale firms. The labor force was segmented into skilled well-paid supervisory personnel and unskilled low-paid ancillary personnel that could easily be substituted (Ullmann, 1980). Besides this segmentation of the labor market, a new group, the white collar workers, emerged, carrying out clerical tasks emerging from the more interdependent work flows in large-scale firms. With an increasing demand for investments in new technologies, the banking sector became indispensable to assure access to capital (Kocka, 2002).

This structural change in the economy changed the relative demand for skills, i.e. for educated workers, and the technological progress simultaneously raised the return to human capital investments. As explicated above, Becker et al. (2011) already demonstrated the importance of human capital embodied in primary education for Prussia's economic catch up.

Urban primary schools in particular provided students with a solid knowledge base to continue with an apprenticeship and consequently work as skilled laborers (Geissler, 2011). As wages depended on the kind of education and formation, skilled craftsmen and technicians earned substantially more than unskilled workers.

2.3.2 The Educational System and Economic Development

Prussia's educational system had been bipartite until the advancement of the Second Industrial Revolution made industrial stakeholders realize the increased demand for technical and applied skills and advocate for vocational and technical education (Schütte, 2003). Before this, children from the lower social strata attended the extended primary school which encompassed students from age six to 14 (Neugebauer, 1992) releasing them to low-skilled and low-paid jobs, while children from the upper tail of the social strata attended *Gymnasium* which was the only educational institution granting the right to attend university and consequently granting access to high-paid and high-status jobs.

As Prussia had built her educational system after the Napoleonic defeat of Jena in 1806, one of the main aims of primary education was to educate a strong military which resulted in molding loyal subjects of the state (Hage et al., 1988). Even though the curriculum introduced by the General Regulations of 1872 shifted the contents to more applied subjects such as geometrics and social studies (so-called *Realien*), the bigger part of the curriculum remained being devoted to subjects such as German and religion which rather aimed at socializing the students than teaching technical and applicable skills (Lamberti,

1989).[11] It was only with the Second Industrial Revolution that industrial stakeholders started to lobby for the introduction of more applied schools such as continuation and vocational training schools finally granting alternative educational paths to graduates of extended primary education (Schütte, 2003).

The Prussian primary educational system itself experienced a public expansion of schooling from 1861 onwards which Lundgreen (1976) argues to be captured by total expenditures for education. The increasing investments in education resulted in a decline of the student-teacher ratio and an increase of teachers' salaries, both indicators of a quality change of educational services.

As there was no universal legal framework for the funding of primary schools on state-level until 1906, the levels of investments in primary education varied widely across Prussia (Wittmütz, 2007). The funding of primary schools was primarily left to the local authorities such as the municipalities and large landowners while the state came up for educational expenses when local authorities failed to cover educational costs. In 1886, about 88 percent of educational spending for primary schools came from local sources. Given the local structure of school funds, Lindert (2004) depicts the educational expansion as a result of a spontaneous political will. Expenditures on primary education made up about 20 percent of a municipality's annual budget and therefore implied the greatest shift of resources from the upper income groups to the poor (Lindert, 2004).

Due to the local funding of the primary schools, the quality of schooling differed widely across Prussia. The widest gap was observed between the urban and the rural areas – and between the East and the West (Neugebauer, 1992). While the single-class school was predominant in the countryside with one teacher teaching all levels and ages of students, multiple-class schools allowed for differentiation between levels and ages of students in the cities (Kahlert, 1978). Urban schools were in general better equipped than rural schools. However, they had to react to the influx of students through the ongoing urbanization and the general population growth. Urban schools could not expand their capacities as fast as people were moving to the cities. But also teachers rather moved from the countryside to the cities, deteriorating the existing shortage of teachers in the countryside and especially in economically underdeveloped regions (Kuhlemann, 1991).

Even though class size was legally limited to 80 students in single class schools and 70 students in multiple class schools respectively, these limits were rather desired than achieved being particularly excessed in the Rhineland - and also in the East of Prussia (Tews, 1914).

[11] The function of the primary school in conveying a national ideology in the context of Prussia at the turn of the century and the literature related to education and indoctrination is discussed in *Chapter 3*.

The historical debate on school resources in Prussia mainly focused on the importance of reducing class size which was considered a quality standard for schooling and was understood as the main condition for the mass expansion of education. The shortage of school buildings and other school facilities was also addressed in the contemporary pedagogical debate (Kahlert, 1978). However, increasing teacher's quality by e.g. standardizing teacher's education was partly opposed as primary school teachers were feared to gain too much influence in the society once obtaining a certain level of education (Kuhlemann, 1991).

2.4 Data

This chapter uses data on 217 counties in West Elbian Prussia, mainly stemming from the ifo Prussian Economic History Database (iPEHD). In section 2.5.6, I will expand the analysis to East Elbia, examining a sample of 235 counties.

2.4.1 School Inputs

The Royal Statistical Office of Prussia conducted its first education census on primary schools in 1886 containing rich information on the school environment, teacher's quality and student inputs. From 1886 to 1911 the census is conducted every five years providing a systematic and consistent longitudinal dataset on educational inputs. As data on the outcome variables—income tax per capita and day laborer wages—is only available at two points in time and I expect a time lag of about 15 (10) years until the acquired human capital in primary school fully unfolds, I will use data from the education censuses for the years 1886 and 1891.

In order to examine the efficiency of resources used for primary schools, I will examine overall expenditures per student to capture the overall investments into the educational system. In a second step, the teacher-student ratio, teacher unit costs, and infrastructure expenditures per student will be looked upon. Similar to class size, the teacher-student ratio will capture the provision of teachers. Teacher unit costs denote the log teacher wages per teacher. As teacher wages at this time already depicted quality differences with teachers of low-quality schools (e.g. so-called *Küsterschulen*) earning less than ordinary teachers, I consider teacher wages as a measure of teacher quality following the contemporary literature on educational production functions. Infrastructure expenditures per student comprise the expenditures for the construction, enlargement and maintenance of school buildings. As can be seen in Table 2.1, teacher salaries made up for the bigger part of educational expenditures. As discussed above, the teacher-student ratio was already considered as a standard for school quality by contemporaneous observers (Kahlert, 1978). As insufficient school buildings lacking a decent aeration and windows hampered the learning conditions, investments in infrastructure will be looked upon as third component capturing the school environment.

2.4.2 Measuring Economic Development

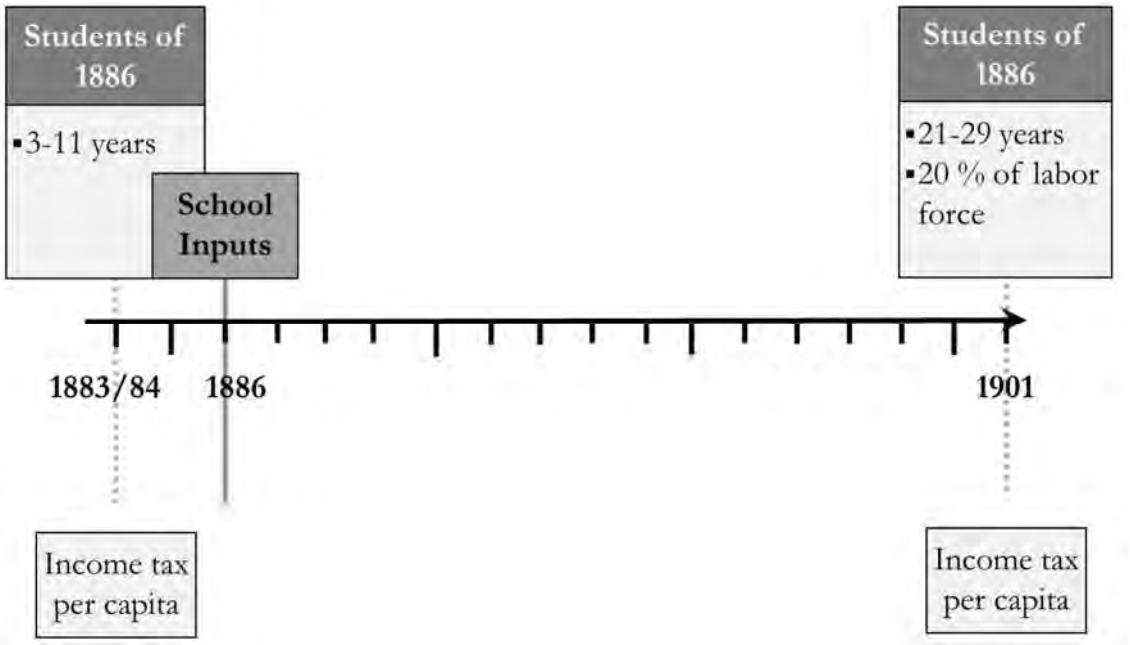
Following the modern literature as Card and Krueger (1992a, 1992b), Heckman et al. (1996) and Chetty et al. (2011), subsequent earnings are used as an outcome measure of the educational production function. Prussian county-level data provide two measures to capture subsequent earnings. Income tax per capita grasps both the skilled high end of the income distribution and includes income from rents, unaffected of human capital attainment.[12] Assuming that income from rents is rather stable over time, I expect increases in income to be ascribed to increases in high-skilled labor in the first place. At the low end of the income distribution, day laborer wages provide a measure of returns to unskilled labor. Both, income tax per capita and day laborer wages are available at two points in time, allowing for a value-added approach, introduced below.

As people were only liable to income taxes if they exceeded an annual income threshold of 900 marks, low-income households were naturally exempted from paying income taxes (Hill, 1892). The municipal tax statistics of 1883/1884 provide data on income taxes for the respective year. The *Festschrift* on the occasion of the centenary of the Royal Statistical Office of Prussia published a volume containing income tax receipts and the total number of income tax payers covering all Prussian counties (averaged over the tax years 1899 through 1903).[13] The available data on income tax per capita are therefore measured both before and after educational inputs are measured in 1886. The time lag of 15 years between the educational inputs and the output allows the student cohort of 1886 to continue education and acquire relevant experience to pay off in the labor market. The timeline of the data is illustrated in Figure 2.1.

[12] More precisely income taxes were constituted of 1. Investments from capital; 2. Income from real estates; 3. Profits or earnings from trades, industries and mines; 4. Wages, salaries, professional earnings, or pensions, annuities, or other sources of periodical income (Hill, 1892).

[13] In the following, I will refer to the year 1901 for income tax per capita as this denotes the average year between 1899 and 1903.

Figure 2.1: Timeline for Data with School Inputs of 1886 and Income Tax per Capita in 1883/84 and 1901



Note: Own illustration.

The second measure for returns to primary education is wages of low-earning households that are not subject to income taxation, so-called day laborer wages. These data are available from the Social Security Statistics in 1892 and 1901 (from Neuhaus, 1904). It was levied because an amendment of the Health Insurance Law made contributions to the Health Insurance System a constant fraction of the customary wage paid to day laborers in each county. This illustrates the representativeness of these wages for low-income households by the Prussian authorities making them a useful proxy for the local standard of living of the low-wage earnings segment (Becker and Woessmann, 2009).

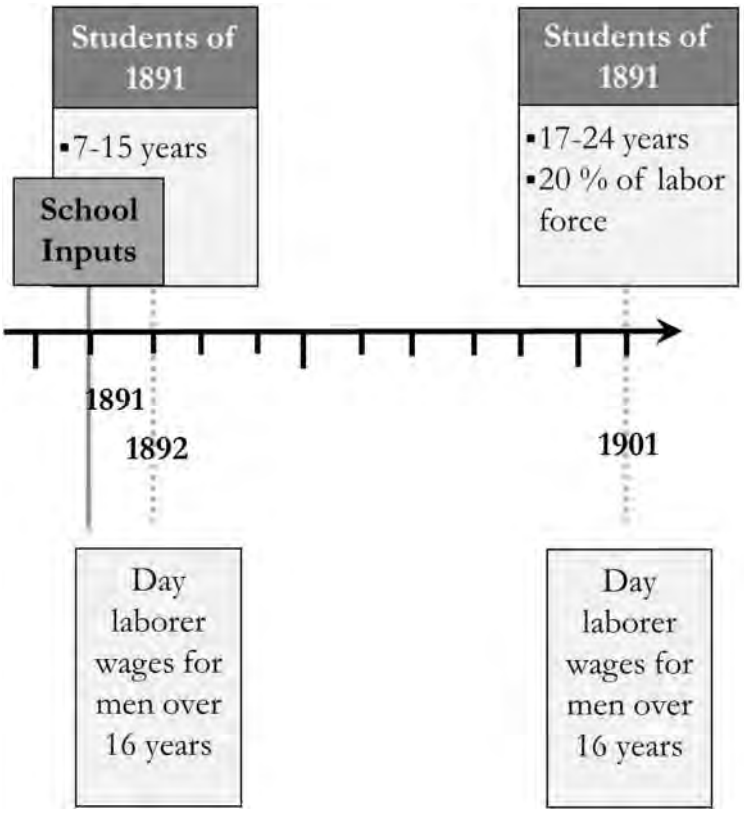
The data were collected at the municipality level which is why it is available separately for urban and rural municipalities. It is furthermore subdivided by men and women and by workers below and above the age of 16 years. As 75 percent of the labor force were male (Lundgreen, 1976), I will look at the average of the earnings of urban and rural male workers over 16 years, weighted by the urban and rural share of the population of each respective county, in the baseline specification.[14] As the education census also reports data separately for rural and urban parts of each county, I will look at the urban and the rural sample separately in a second step.

Measuring day laborer wages of men over 16 years in 1892 assures that the student population of 1891 is not contributing to the work force yet as the student population of 1891 is still under 16 years old. Ten years later, in 1901, the student cohort of 1891 fully

[14] Results are robust to using earnings of urban male workers over 16 years and rural male workers over 16 years separately. Results are not shown, but available upon request.

contributes to the labor market and constitutes roughly 20 percent[15] of it. Ideally, one would like to observe only the wages of the student cohort attending school in 1891 which would require data on day laborer wages that can be further split up by specific age cohorts. Measuring earnings in 1901 would require data for day laborer workers between 16 and 24 years. Using day laborer wages for men over 16 years meets the restriction of the minimum age, but unfortunately data do not permit restricting wages to workers below 24 years. The timeline of the data is illustrated in Figure 2.2.

Figure 2.2: Timeline for Data with School Inputs of 1891 and Day Laborer Wages of 1892 and 1901



Note: Own illustration.

In order to understand the underlying mechanisms on how the embodied human capital might have led to higher economic development, I furthermore investigate changes in the sectoral composition of the economy. Therefore, I use data from the occupation censuses of both 1882 and 1895. The occupation censuses distinguish between the agricultural sector; the manufacturing sector including mining, construction, the manufacturing of metals, machinery, equipment, chemicals, textiles, paper, leather, food products, and wood; the service sector including trade business, insurance, transport, lodging, and

[15] This is a rough measure, derived from dividing the student population of 1891 by the total population between 14 and 69 years in 1900, thereby assuming that all students survived to working age and that the share of the respective student cohort and of the overall population not entering the active work force are the same. Lundgreen (1976) defines the workforce as the population between 14 and 69 years.

restaurants; the domestic service sector constituted of servants and housemaids;[16] the public administration and military sector and the sector constituted of people without employment. As described in section 2.1, the Second Industrial Revolution implied a shift to the electrical and chemical sector (comprised in the manufacturing sector) and to clerical work (captured by the service sector). When approaching possible underlying mechanisms of investments in primary education and economic development in section 2.5.4, I will test which sector benefitted from higher investments in education.

2.4.3 Controlling for Demographic and Developmental Characteristics

For the control variables, data from the occupation census of 1882 and from the population census of 1885 and 1890 are used. Besides the educational inputs, demographic factors and other county characteristics can have an impact on income and earnings differences. As Becker and Woessmann (2009) found that Protestant counties were more prosperous than Catholic counties through a higher demand for education, the share of Protestants is controlled for. A higher share of females is expected to lower income tax per capita as women usually did not participate in the first labor market where income tax was generated. Concerning earnings in the low income sector, female workers who received lower earnings on average, might have decreased the demand for male labor and therefore decreased male day laborer earnings. As Cinnirella and Hornung, (2016) find that landownership concentration which is used as a proxy for the institution of serfdom has lowered school enrollment in nineteenth-century Prussia, landownership concentration is included as a control, even though the authors show that the effect of landownership concentration diminishes towards the end of the nineteenth century. As the presence of the landed elite was especially high in agricultural regions, a high level of landownership concentration is expected to lower both income tax per capita and day laborer wages.

In a third step of the estimation, I include possibly endogenous covariates in order to conservatively control for other confounding drivers of development. As cities are known to generate higher income and wages, the share of people living in cities is included. In order to account for the shifts in the sectoral composition, going back to the second phase of the Industrial Revolution, the share of workers employed in the manufacturing sector measured in 1882 is also considered. Income taxes were levied per household which is why the average household size is included additionally. As people migrated to the more industrialized regions of Prussia in order to find work, the share of people who ever migrated across localities or beyond is included as well. Finally, the share of primary education funds stemming from municipal sources (taxes) is considered in order to account for the fiscal capacity of the municipalities.

[16] In the occupation census of 1882, domestic servants (*Dienstboten*) were reported in a separate category. Data on the domestic service sector and domestic servants will be therefore merged into one category.

2.4.4 Descriptive Statistics

As can be seen in the descriptive statistics in Table 2.1 as well as in Figure 2.3, there is a huge variation in income tax per capita both in 1901 and 1883/1884. The overall trend shows rising income tax per capita and an increasing gap between low and high income counties over time with average income tax per capita doubling between 1883/1884 and 1901. Figure 2.3 illustrates the variation of income tax per capita across Prussia in 1901 and again motivates why this chapter focuses on the West of Prussia as variation in income tax per capita in the East of Prussia is very low.

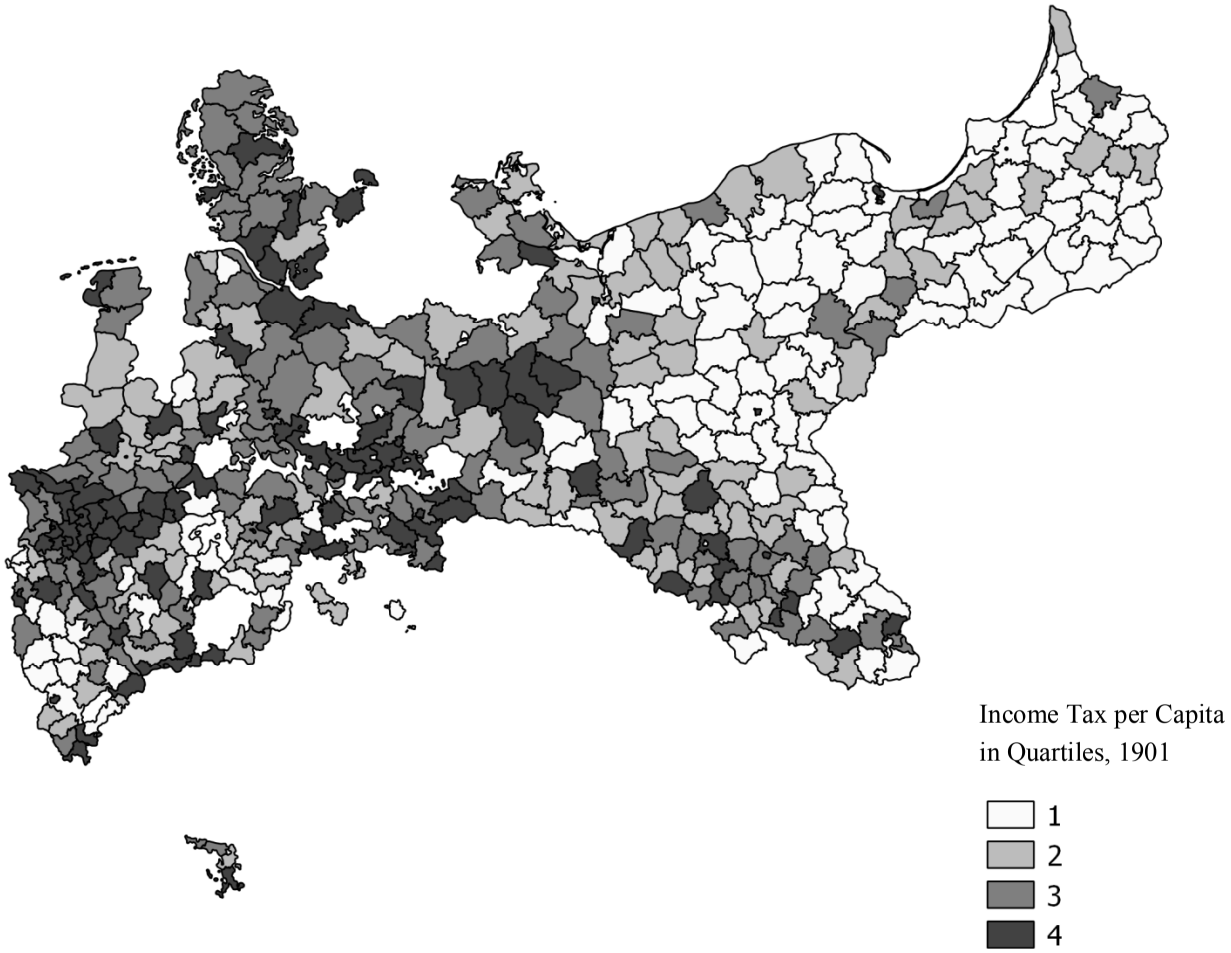
The variation of day laborer wages is lower than the one in income tax per capita and does only slightly increase over time. Concerning the sectoral composition of the economy, a shift away from the agricultural sector and domestic services to the service sector can be observed. More than two thirds of educational investments are devoted to teachers. Huge variation across counties is found in all focal variables, i.e. in expenditures per student; the teacher-student ratio, teacher unit costs and infrastructure expenditures per student.

Table 2.1: Descriptive Statistics 1885/1886 and 1890/1891

	1885/1886				1890/1891			
	Mean	Std. Dev.	Minimum	Maximum	Mean	Std. Dev.	Minimum	Maximum
Income tax per capita 1901	3.814	3.069	0.810	24.389				
Income tax per capita 1883/1884	1.756	1.214	0.328	11.219				
Day laborer wages 1901					2.026	0.319	1.500	3.100
Day laborer wages 1892					1.741	0.268	1.250	2.677
Employed in agriculture (share) 1882 and 1895	0.427	0.188	0.005	0.761	0.415	0.199	0.005	0.765
Employed in manufacturing (share) 1882 and 1895	0.331	0.136	0.114	0.718	0.357	0.148	0.113	0.741
Employed in service (share) 1882 and 1895	0.068	0.034	0.024	0.242	0.085	0.041	0.027	0.273
Employed in domestic services (share) 1882 and 1895	0.083	0.031	0.020	0.239	0.014	0.011	0.001	0.073
Employed in military (share) 1882 and 1895	0.042	0.037	0.014	0.274	0.048	0.041	0.017	0.317
Without occupation (share) 1882 and 1895	0.050	0.027	0.010	0.165	0.080	0.031	0.020	0.217
Expenditures p. stud., incl. fringe benefits (in Mark) 1886 and 1891	23.624	7.463	14.364	79.461	28.685	7.565	16.687	79.751
Teacher-student ratio (x 100) 1886 and 1891	1.446	0.205	1.018	2.063	1.367	0.196	0.950	2.080
Teacher unit costs (in Mark) 1886 and 1891	1144.572	187.692	832.764	2471.015	1279.639	164.967	983.571	1942.446
Infrastructure expenditures per student (in Mark) 1886 and 1891	7.981	4.707	3.312	48.309	10.198	4.969	4.127	49.483
Personnel expenditures (share) 1886 and 1891	0.676	0.074	0.392	0.841	0.655	0.068	0.380	0.803
Infrastructure expenditures (share) 1886 and 1891	0.324	0.074	0.159	0.608	0.345	0.068	0.197	0.620
Protestant (share) 1885 and 1890	0.563	0.397	0.003	0.995	0.562	0.394	0.005	0.996
Females (share) 1885 and 1890	0.504	0.013	0.464	0.552	0.504	0.014	0.461	0.552
Landownership concentration 1882	0.002	0.003	0.000	0.030	0.002	0.003	0.000	0.030
Urbanization (share) 1885 and 1890	0.315	0.249	0.010	1	0.315	0.251	0.010	1.000
Average household size 1885 and 1890	4.863	0.328	3.848	5.607	4.853	0.345	3.806	5.656
Movers (share) 1885 and 1890	0.345	0.111	0.148	0.635	0.348	0.113	0.142	0.634
Municipal contributions (share) 1886	0.237	0.109	0	0.583				

Note: The samples of 1886 and 1891 contain 217 observations for West Elbia. See Appendix 2A for data sources and details.

Figure 2.3: Income Tax per Capita in 1901



Note: Income tax per capita is constructed as the sum of income taxes over the total population. County borders as in 1871. Source: Own illustration; see main text for details.

2.5 Estimating an Educational Production Function

First, descriptive evidence is derived from an ordinary least squares (OLS) model. OLS models always run the risk of missing out to account for other confounding factors, not captured by the control variables, and might be biased due to reversed causality. In this specific context, economic development might also be affected by past infrastructure investments of a county which facilitates economic progress. Spill-overs of past growth might equally affect economic development at the time of observation. Reversed causality might arise from the fact that prosperous counties might invest more into their educational system than less developed counties. Even though expenditures for primary schools mainly stemmed from local sources and hence not from income taxes, local revenues and income taxes of a respective county are still very likely to be correlated. In order to account for the biases evolving from both omitted variables and reversed causality, a value-added approach (VA) is introduced in section 2.5.2, accounting for past investments in the educational system and a county's infrastructure in general as well as for historical growth paths.[17] The VA specification allows controlling for the initial situation in each county by including the lagged outcome variable in the estimating equation. The key assumption for a VA specification is that the lagged outcome variable is a sufficient statistic for historical inputs and also captures endowments such as county-specific economic and general conditions (Todd and Wolpin, 2003). As the development of basic education in Prussia had developed at the local level controlling for the lagged outcome variable and thereby looking at the change in the outcome variable instead of the level allows estimating the contribution of educational inputs on economic development more precisely.

The acquisition of human capital is generally considered as a cumulative process (Todd and Wolpin, 2003). This does not only yield for the individual, but also for the acquisition of education at the aggregate county-level. Providing the population with education is easier, once educational institutions such as schooling laws and their enforcement have been established, school buildings have been built and the provision of high-quality teachers is ensured. By including the lagged outcome variable the VA approach cannot only capture past educational investments of a county, but is also able to control for its natural advantages (Hanushek, 1997). However, the approach also bears the risks of biases which will be discussed in section 2.5.2.

[17] Data on educational investments in 1868/1869 for the estimations on income tax per capita and 1883 for estimations on day laborer wages would allow for a first difference model. The earliest data measuring educational investments are available for 1882, published by the Royal Statistical Office. The data of 1882 would allow for a first difference model for day laborer wages, though not for income tax per capita. In the sake of comparability, I resign from applying a first difference model to day laborer wages. A panel model with county fixed effects differencing out time-invariant unobservable characteristics of a county cannot be applied as the outcome variables are only available at two distinct points in time.

2.5.1 OLS Model and Results

In order to estimate the returns to educational inputs, descriptive evidence is derived from OLS estimates. The following estimation specification is estimated:

$$logY_i = \alpha + \beta e_i + X'_i\gamma + \alpha_p + \varepsilon_i \qquad (2.1)$$

where Y_i indicates income tax per capita in 1901 or day laborer wages in 1901, respectively. i denotes county. β is the coefficient of interest. e denotes the different educational inputs. First, overall expenditures per student will be looked upon. In a second step, the teacher-student ratio, teacher unit costs and infrastructure expenditures per student are used simultaneously in order to examine which association withstands while holding the other input variables constant in a kind of horse race approach. X' is a vector of control variables including the share of Protestants, the female share and landownership concentration. In a second step the growth rates of these variables between 1885 (1890) and 1900 are included. Subsequently, province-fixed effects α_p for six provinces are included in order to look at differences within a province. Finally, possibly endogenous controls such as the urban share, the average household size, the share of workers employed in manufacturing, the share of people who migrated across locality borders and the share of funds provided by the municipality are included in the estimation, again being complemented by the growth rates of these possibly endogenous covariates over the period 1885 (1890) and 1900. ε_i indicates the error term. Both, the outcome variables and the focal input variables with the exception of the teacher-student ratio are included as logarithm which allows interpreting the coefficients as elasticities.

As shown in Table 2.2, Columns 1 to 6, overall expenditures per student correlate positively and significantly with income tax per capita throughout all specifications. The coefficient decreases by more than half once the possibly endogenous controls are included in Column 5.

In the preferred specification including county-specific growth rates and province-fixed effects (Column 4), increasing expenditures per student in 1886 by 10 percent correlates with 17 percent higher income tax per capita. Given that the share of the labor force in 1901 going to primary school in 1886 and therefore benefitting from educational expenditures in 1886 made up only about 20 percent of the labor force in 1901,[18] this coefficient is substantially high. However, at the moment only correlations are looked upon and the result could also be driven by the fact that richer counties invested more in education which will be addressed in section 2.5.2.

[18] This is again based on the assumption that the labor force is constituted of all male and female individuals between 14 and 69 years old (Lundgreen, 1976).

Table 2.2: Economic Development and Spending on Education: OLS Estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dep. Var.:	Income tax per capita 1901 (log)						Day laborer wages 1901 (log)					
Expenditures p. student (log)	1.697***	1.645***	1.669***	1.712***	0.657***	0.660***	0.306***	0.343***	0.339***	0.342***	0.128***	0.096**
	(0.089)	(0.094)	(0.103)	(0.096)	(0.241)	(0.222)	(0.042)	(0.045)	(0.041)	(0.039)	(0.044)	(0.040)
Protestant		0.022	0.027	0.059	0.020	-0.017		-0.057**	-0.063**	0.005	-0.030	-0.044
		(0.078)	(0.079)	(0.104)	(0.078)	(0.079)		(0.025)	(0.031)	(0.039)	(0.030)	(0.031)
Female		-4.515**	-2.605	-1.813	-1.541	-0.434		-2.969***	-2.767***	-2.477***	-0.810	-1.106*
		(2.102)	(2.095)	(2.612)	(2.322)	(2.213)		(0.713)	(0.709)	(0.757)	(0.662)	(0.617)
Landownership concentration		11.818	4.181	-0.144	-4.958	-10.995		-10.471*	-11.128*	-7.937	-3.842	-4.252
		(8.802)	(10.567)	(11.865)	(7.989)	(7.953)		(5.470)	(6.287)	(6.143)	(5.944)	(3.845)
Urbanization					0.982***	0.924***					0.056	0.020
					(0.167)	(0.153)					(0.046)	(0.042)
Average. household size					-0.064	-0.080					0.010	-0.027
					(0.111)	(0.107)					(0.038)	(0.035)
Employed in manufacturing					0.298	0.374*					0.408***	0.327***
					(0.202)	(0.225)					(0.064)	(0.069)
Movers					1.514***	2.036***					0.472***	0.261**
					(0.404)	(0.417)					(0.125)	(0.129)
Municipal contribution					0.201	0.042						
					(0.224)	(0.212)						
Exogenous GR	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Province FE	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Endog. GR	No	No	No	No	No	Yes	No	No	No	No	No	Yes
Observations	217	217	217	217	217	217	217	217	217	217	217	217
R-squared	0.50	0.51	0.54	0.56	0.75	0.79	0.20	0.37	0.38	0.44	0.64	0.68

Note: OLS estimates. The dependent variable is the logarithm of income tax per capita in 1901 in Columns 1 to 6 (and the logarithm of the average male day laborer wages over 16 years in 1901 in Columns 7 to 12). The variable of interest, expenditures p. student (log) is the log of total expenditures per student in 1886. Protestant denotes the share of Protestants in 1885 (1890). Female denotes the share of females in 1885 (1890). Landownership concentration denotes the share of farms larger than 100 ha arable land in 1882. Urbanization is the share of people living in cities in 1885 (1890). Average household size is the average number of people living in private households in 1885 (1890). Employed in manufacturing denotes the percentage of workers employed in manufacturing in 1882. Movers denote the share of people born in another locality than their resident locality in 1885 (1890). Municipal contribution denotes the share of primary expenditures, contributed by the municipality in 1886. Exogenous GR include the growth rates of 1) the Protestant share between 1885 (1890) and 1900, 2) the female share between 1885 (1890) and 1900, 3) landownership concentration between 1882 and 1895. Province-fixed effects are for six provinces. Endog. GR include the growth rates of 4) the share of people living in cities between 1885 (1890) and 1900, 5) the population between 1885 (1890) and 1900, 6) the average household size between 1885 (1890) and 1900, 7) the share in manufacturing between 1882 and 1895 and 8) the share of movers between 1885 (1890) and 1900. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

The regressions using day laborer wages as the dependent variable in Columns 7 to 12 in Table 2.2 also show a stable positive association between expenditures per student and day laborer wages even though the coefficient on educational expenditures is substantially lower than the one for income tax per capita.[19] Just as in the estimations investigating income tax per capita, the association reduces by almost half once the possibly endogenous covariates are included in Column 11. In the preferred specification in Column 10 an increase in educational expenditures per student by 10 percent is correlated with a 3.4 percent increase in day laborer wages.

2.5.2 A Value-Added Approach

The identification of the value-added approach is based on the assumption that the lagged value of the outcome variable absorbs all sources of endogeneity (Todd and Wolpin, 2003), i.e. any potential correlation between the variable on educational investments and the error term is eliminated when controlling for the lagged value of the outcome variable. While controlling for the lagged value of the outcome variable, historical endowments and inputs affecting economic development are accounted for. However, there might be contemporary shocks that influence both income or day laborer wages and educational expenditures simultaneously. Counties that highly invest in primary education might also invest in other types of public goods, especially in other sectors of education, such as secondary or tertiary education, that equally affect economic development. At the time of observation, publicly funded universities established research and development departments contributing to innovations which eventually translated into higher income. If investments in primary education and other investments in public goods, enhancing economic development, are correlated, the estimates would overestimate the true effect of investments in primary education.

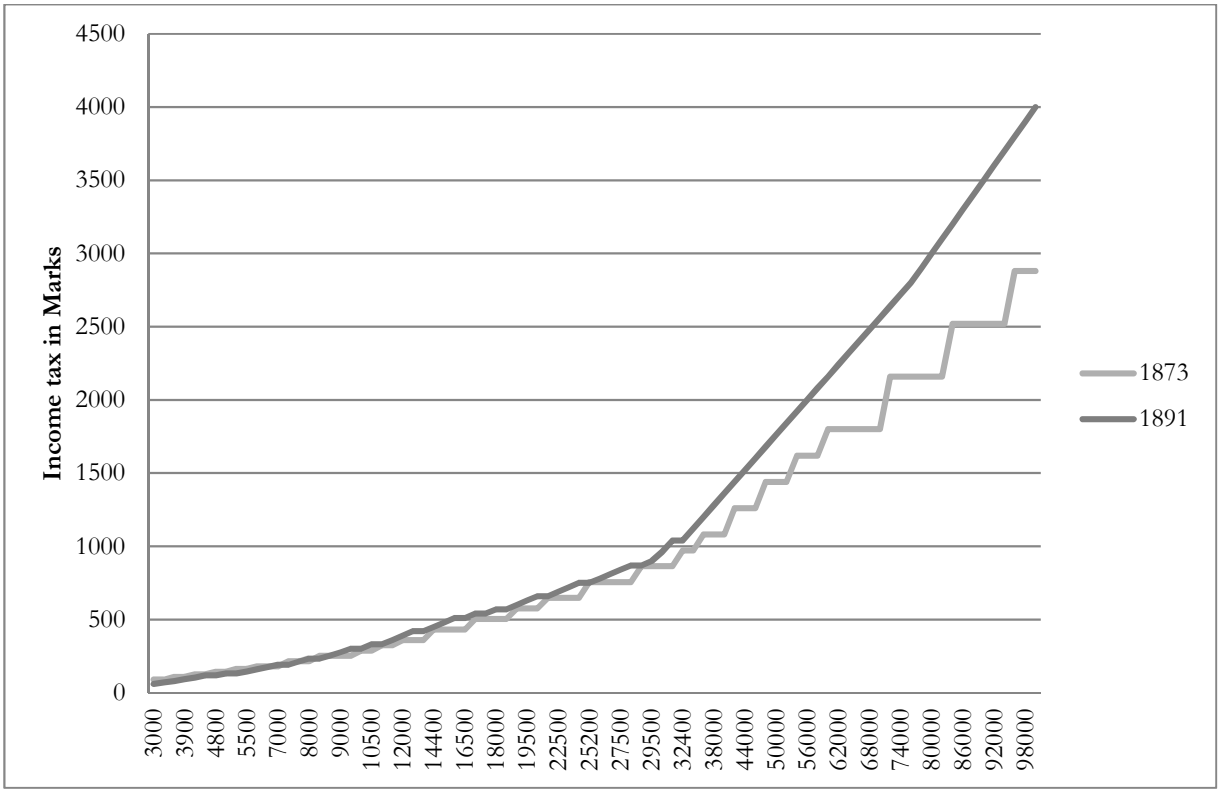
Measuring outcomes 15, respectively 10 years, after inputs are measured, bears the danger of structural changes affecting economic development in the intervening years. Assuming that these structural changes positively affect economic development and are positively correlated with educational investments, the estimates might again be overestimated. In order to evade this bias, the absence of additional input factors has to be assumed.

The student cohorts of 1886 and 1891 only constitute roughly 20 percent of the labor force once students enter the labor market. This, at the other hand, would mean that the estimate has to be interpreted as a lower bound of the true effect.

[19] As the variable of interest and the covariates in the estimations on income tax per capita stem from 1885 and 1886 and those on day laborer wages of 1890 and 1891, the coefficients are not directly comparable.

Further bias might arise when using the income tax data. As the Prussian minister of finance Johann von Miquel introduced a major tax reform in 1891, changing the income tax system from a class tax to a tax system with progressive elements, the reform would have to affect all Prussian counties in the same way to avoid any bias. Figure 2.4 illustrates the changes in tax rates following from the reform showing that people at the very high end of the income distribution had to pay proportionally more taxes after 1891. If counties with a relatively high share of the population at the top of the income distribution invest more in primary education, this might again lead to overestimating the true effect of primary educational investments as increases in the income tax generated through the reform would be attributed to higher educational investments.

Figure 2.4: Income Tax per Capita – Changes between 1873 and 1891



Note: Income classes depicted for 1873. Progressive income tax depicted for 1891. Own illustration following Hill (1892).

Another drawback of the income tax data is that income taxes are censored at a minimum of 900 Marks which prevents observing increases in income at the low end of the income distribution. If income in a county increases on average, but people remain below the threshold of 900 Marks, the estimate would have to be considered as a lower bound estimate on the effect on the upper part of the income distribution. Otherwise, I have to assume that any substantial increase in income is only made once the threshold of 900 Marks is exceeded. Using day laborer wages allows shedding some light on the effect on the lower part of the income distribution.

Another flaw of the income tax measure is possible tax evasion. Income taxes were paid according to the self-reported income of each household (Hill, 1892).[20] If tax evasion differed across counties and was high in counties with low educational investments, the estimate would again be an upper bound of the true effect.

However, given the data available, the VA approach is the best available method reducing biases arising from both omitted variables and reversed causality. Assuming the absence of any other simultaneous shifts that might impact economic development, the VA approach is able to reduce the concern of reversed causality and accounts for some bias evolving from omitted variables. If following the standard view in the literature that both educational investments and economic progress are cumulative processes, the VA approach will account for the likely correlation between locally funded educational investments and income tax per capita by controlling for the lagged outcome variable.

Figure 2.5 illustrates the predictive power of income tax per capita in 1883/1884 for income tax per capita in 1901 and equally of day laborer wages in 1892 for day laborer wages in 1901. The correlation coefficient between income tax per capita in 1883/1884 and 1901 is 0.87 and 0.93 for day laborer wages illustrating the strength of the approach. The estimation equation for the VA specification looks as follows:

$$logY_{i,t} = \alpha + \beta\, e_{i,t} + X'_{i,t}\gamma + logY_{i,t-1} + \alpha_p + \varepsilon_i \quad (2.2)$$

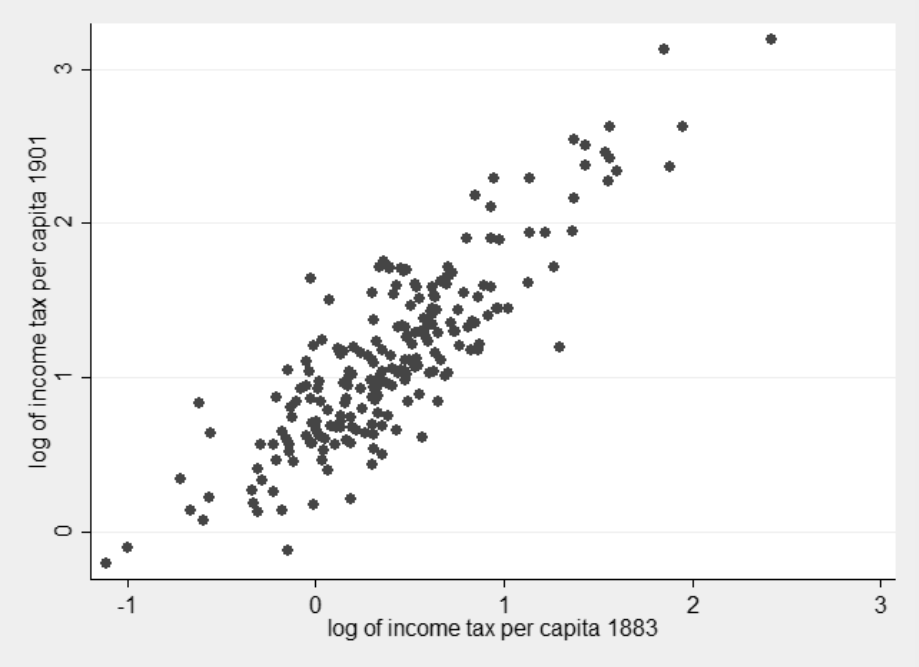
where $logY_{i,t-1}$ indicates the lagged outcome variable, i.e. income tax per capita in 1883/1884 or day laborer wages in 1892 respectively, while the other parts of the estimation specification concur with the OLS specification.

The lagged outcome variable for the estimation using income tax per capita is measured in 1883/1884, i.e. prior to the educational inputs of 1886. I thereby assume that any kind of income shock that might have occurred between 1883/1884 and 1886 is not systematically related to the amount of educational inputs invested in 1886.

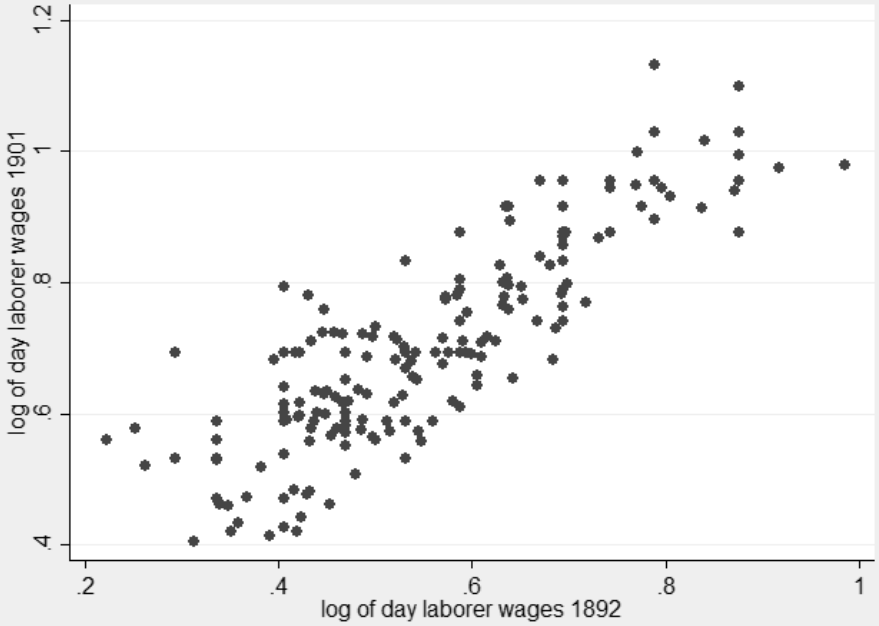
[20] Hill (1892) reports that incomes were reported at less than one half or even less than one third of their true value with huge variations in this miss-reporting.

Figure 2.5: Predictive Power of Income Tax per Capita in 1883 and 1901 and Day Laborer Wages in 1892 and 1901

Income tax per capita in 1883 and 1901



Day laborer wages for men over 16 years in 1892 and 1901



Note: The correlation coefficient between log of income tax per capita in 1883/1884 and in 1901 is 0.87. The correlation coefficient between log of day laborer wages in 1892 and 1901 is 0.93. See Appendix 2A for data sources.

2.5.3 Results of Value-Added Approach

Once I control for the initial levels of development by including the lagged outcome variable for income tax per capita (Table 2.3, Columns 1 to 6), the coefficient on overall expenditures per student decreases by at least half, but remains significant in all specifications, ranging between 0.665 and 0.304, i.e. increasing overall expenditures per student by 10 percent raises income tax per capita in 1901 by about 6 percent in the preferred specification in Column 4, i.e. the coefficient from the OLS regression is reduced by a factor of three. Bearing in mind the rather low and often statistically insignificant estimates from the literature on contemporary educational production functions (Hanushek, 1997), these findings are noteworthy.

The VA coefficient remains high and strongly significant throughout all specifications, supporting the power of the approach in capturing underlying differences.[21] Furthermore, the explained variance of the model exceeds 80 percent in the preferred specification, indicating the high explanatory power of the regression model.

When looking at day laborer wages in Columns 7 to 12 in Table 2.3, the significant positive correlation between day laborer wages and expenditures per student found for the conditional correlations in Table 2.2 disappears as soon as initial wage levels are considered. As discussed in section 2.5.2 this could be due to an underestimation of the effect as only a small share of students of 1891 constituted the labor force of 1901. However, the coefficient might also be an upper bound due to a classical omitted variable bias where investments in primary education could be correlated with unobserved other investments. The coefficient turns negative once including the endogenous controls in Columns 11 and 12, though is not significant at a statistical level. As in the regressions on income tax per capita, the VA term is high and strongly statistically significant and the explanatory power of the regression model is high.

As day laborer wages are reported both for rural and urban municipalities and the education census also distinguishes between rural and urban parts of a county, it is possible to run regressions for day laborer wages at a more disaggregate level. The covariates included are only available at the aggregate county level and will be included as such.

[21] The VA coefficient decreases remarkably once the endogenous covariates are included in column 5 as those variables could themselves be outcomes of the educational production function.

Table 2.3: Economic Development and Spending on Education: Value-Added (VA) Estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dep. Var.:	Income tax per capita 1901 (log)						Day laborer wages 1901 (log)					
Expenditures p. student (log)	0.665***	0.592***	0.610***	0.583***	0.307**	0.304**	-0.029	0.014	0.015	0.030	-0.018	-0.021
	(0.101)	(0.097)	(0.105)	(0.102)	(0.119)	(0.118)	(0.035)	(0.032)	(0.033)	(0.032)	(0.038)	(0.036)
VA term	0.779***	0.847***	0.832***	0.843***	0.722***	0.713***	0.905***	0.862***	0.865***	0.855***	0.726***	0.705***
	(0.048)	(0.053)	(0.056)	(0.053)	(0.060)	(0.053)	(0.048)	(0.051)	(0.051)	(0.051)	(0.053)	(0.053)
Protestant		-0.085*	-0.081	0.059	-0.020	-0.076		-0.054***	-0.043**	-0.011	-0.020	-0.020
		(0.050)	(0.058)	(0.080)	(0.063)	(0.055)		(0.015)	(0.017)	(0.025)	(0.023)	(0.024)
Female		-3.847**	-3.312**	-3.410**	-3.459**	-3.022**		-0.150	0.001	-0.004	0.266	0.123
		(1.609)	(1.552)	(1.697)	(1.536)	(1.449)		(0.483)	(0.452)	(0.469)	(0.481)	(0.472)
Landownership concentration		-20.925**	-20.659*	-17.954	-4.450	-6.599		-2.463	-2.859	-2.790	-2.658	-2.340
		(10.206)	(11.387)	(11.510)	(7.205)	(4.444)		(1.963)	(2.383)	(2.518)	(3.014)	(2.452)
Exogenous growth rates	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Province FE	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Add. Controls	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Endog. GR	No	No	No	No	No	Yes	No	No	No	No	No	Yes
Observations	217	217	217	217	217	217	217	217	217	217	217	217
R-squared	0.79	0.81	0.82	0.83	0.89	0.91	0.84	0.85	0.85	0.86	0.89	0.91

Note: Value-Added estimates. The dependent variable is the logarithm of income tax per capita in 1901 in Columns 1 to 6 (and the logarithm of the average male day laborer wages over 16 years in 1901 in Columns 7 to 12). The variable of interest, expenditures p. student (log) is the log of total expenditures per student in 1886. The VA term is the logarithm of income tax per capita in 1883/1884 in Columns 1 to 6 (and the logarithm of the average male day laborer wages over 16 years in 1892 in Columns 7 to 12). Protestant denotes the share of Protestants in 1885 (1890). Female denotes the share of females in 1885 (1890). Landownership concentration denotes the share of farms larger than 100 ha arable land in 1882. Exogenous growth rates include the growth rates of 1) the Protestant share between 1885 (1890) and 1900, 2) the female share between 1885 (1890) and 1900, (3) landownership concentration between 1882 and 1895. Province-fixed effects are for six provinces. Additional Controls include urbanization, average household size, employed in manufacturing, movers and municipal contributions for the estimations on log income tax per capita. Endog. GR include the growth rates of 4) the share of people living in cities between 1885 (1890) and 1900, 5) the population between 1885 (1890) and 1900, 6) the average household size between 1885 (1890) and 1900, 7) the share in manufacturing between 1882 and 1895, and 8) the share of movers between 1885 (1890) and 1900. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

Table 2.4 reports the results on the rural and urban sample of day laborer wages. The OLS estimate for the full sample, reported in Column 1 (Table 2.4), is slightly lower than the aggregate county estimate in Column 10 of Table 2.2.[22] The correlation between expenditures per student and day laborer wages is slightly higher in the disaggregated urban and rural sample, displayed in Columns (2) and (3). However, once the VA term is introduced in Columns 4 to 6, the coefficient turns negative for all samples. The coefficient is statistically significant at the 10 percent significance level in the rural sample. At the disaggregate level, day laborer wages might even decrease in counties with high educational expenditures.

However, as substantial movement from the countryside to the cities was going on at the time with people searching for better employment opportunities in the nearby cities, [23] the county-level is considered as the more appropriate aggregation level capturing students who moved to the cities, found higher-paid jobs and thereby might have increased their wages.[24]

Consolidating the evidence on income tax per capita and day laborer wages, it seems that investing in education increased earnings at the high end of the income distribution, while earnings at the low end of the income distribution remain unaffected. Higher educational expenditures were embodied in the population allowing people to leave the low income segment where they were exempted from paying income tax and consequently shifted to higher skilled jobs, surpassing the annual relief threshold of 900 Marks and consequently becoming liable to pay income taxes. As there was an ample supply of labor—with the share of people without employment amounting to 8 percent in 1895[25]—unskilled laborers could be easily substituted. With the supply of low skilled laborers exceeding the demand, day laborer wages remained flat.

As Prussia experienced the second phase of the Industrial Revolution which was characterized by the introduction of new industrial technologies leading to an increased demand for human capital (Galor and Moav, 2006), this finding goes very much in line with the historical circumstances.

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[22] Note that I lose 14 observations in the urban sample and 15 observations in the rural sample as there are 14 counties being entirely rural and 15 counties being entirely urban.

[23] Note that the share of the population that had moved within a county averaged at 15 percent in 1891.

[24] The wage premium of urban day laborers as compared to rural day laborers amounted to 10 percent of urban day laborer wages.

[25] Even though, an unemployment rate of 8 percent is not high by definition, the official rate might be underreported and the historical literature reports that especially low-skilled laborers faced high competition in the labor market, especially as people migrated from the rural areas to the cities and from the agricultural East to the industrializing West (Kochendörfer, 1997).

Table 2.4: Day Laborer Wages and Spending on Education in the Rural and Urban Sample: OLS and VA Estimates

Dep. Var.: Day-laborer wages of respective sample	(1)	(2)	(3)	(4)	(5)	(6)
		OLS			Value-Added	
	Full	Urban	Rural	Full	Urban	Rural
Expenditures per student (log)	0.313***	0.352***	0.347***	-0.010	-0.032	-0.082*
	(0.062)	(0.090)	(0.120)	(0.017)	(0.027)	(0.044)
VA term				0.953***	0.954***	0.960***
				(0.013)	(0.017)	(0.023)
Protestant	-0.100*	-0.102	-0.099	-0.011	-0.012	0.001
	(0.056)	(0.091)	(0.069)	(0.018)	(0.022)	(0.029)
Female	-9.034***	-8.984***	-8.854***	0.088	0.035	-0.032
	(1.397)	(2.116)	(1.656)	(0.335)	(0.454)	(0.515)
Landownership concentration	-19.667**	-14.933	-32.489***	-2.177	-0.864	-3.708
	(8.396)	(9.318)	(9.217)	(1.870)	(1.897)	(3.581)
Exogenous growth rates	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	405	203	202	405	203	202
R-squared	0.44	0.38	0.53	0.95	0.96	0.95

Note: OLS and Value-Added estimates. The dependent variable is the logarithm of male day laborer wages over 16 years in 1901. The variable of interest, expenditures per student (log) is the log of total expenditures per student in 1886. The VA term is the logarithm of male day laborer wages over 16 years. All covariates are measured at the aggregate county level. Protestant denotes the share of Protestants in 1890. Female denotes the share of females in 1890. Landownership concentration denotes the share of farms larger than 100 ha arable land in 1882. Urbanization is the share of people living in cities in 1890. Average household size is the average number of people living in private households in 1890. Employed in manufacturing denotes the percentage of workers employed in manufacturing in 1882. Movers denote the share of people born in another locality than their resident locality in 1890. Exogenous growth rates include the growth rates of 1) the Protestant share between 1890 and 1900, 2) the female share between 1890 and 1900, 3) landownership concentration between 1882 and 1895. Province-fixed effects are for six provinces. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

Following this interpretation possibly reduces the bias evolving from the fact that the student cohorts of 1886 and 1891 only make up roughly 20 percent of the labor force in 1901. If there are such general equilibrium effects that the students of 1886 take higher skilled jobs, but older, less qualified workers remain in their positions, being complements to the young higher skilled work force, the concern of underestimating the true effect is much less reasonable. As most of the other biases described in section 2.5.2 point at overestimating the true effect, it is very likely, that an upper bound of the true effect is estimated, especially for the models using income tax per capita as the dependent variable.

2.5.4 Decomposing Educational Expenditures

Following the literature on educational production functions, I decompose educational investments into three components in order to capture the teacher-student ratio, teacher unit costs, and investments in infrastructure.

Estimates from OLS and VA models, displayed in Columns 1 to 4 for income tax per capita and Columns 5 to 8 for day laborer wages (Table 2.5), point into the same direction. As OLS results might be biased for the reasons discussed above, the discussion focuses on the VA estimates. In the preferred model for income tax per capita in Column 4, a higher provision of teachers significantly reduces income tax per capita, whereas teacher unit costs and infrastructure expenditures per student both increase income tax per capita. The coefficient on the number of teachers per student is only significant at the 10 percent level. The negative association might be surprising at first. However, the consensus in the modern literature on educational production functions is that class size does not matter for student performance. Higher teacher wages are 1 to 1 translated into higher income tax per capita. Increasing infrastructure expenditures per student by 10 percent translates into an increase of income tax per capita of 2 percent.

The VA estimates on day-laborer wages, depicted in Columns 7 and 8, point in the same direction as the estimates for income tax per capita. However, only the coefficient on teacher unit costs is significant at the 5 percent level in the preferred specification, displayed in Column 8. Even though, no significant association is found for the overall investments in education and day laborer wages as shown in Table 2.3, teacher salary—and therefore the quality of teachers—seems to be positively correlated with day laborer wages.

The results, both for income tax per capita and day laborer wages thereby confirm the findings of the contemporary educational production functions for the historical context of Prussia in the ending nineteenth century: It is teacher quality that matters for economic development.

Table 2.5: Decomposing Spending on Education: OLS and VA Estimates

Dep. Var.:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Income tax per capita 1901 (log)				Day laborer wages 1901 (log)			
	OLS		VA		OLS		VA	
Teacher-student ratio	-0.021	-0.019	-0.151**	-0.147*	-0.082*	-0.083*	-0.072**	-0.023
	(0.133)	(0.142)	(0.073)	(0.083)	(0.047)	(0.049)	(0.032)	(0.034)
Teacher unit costs (log)	2.195***	2.482***	0.938***	0.990***	0.417***	0.464***	0.173***	0.154**
	(0.211)	(0.273)	(0.154)	(0.182)	(0.072)	(0.091)	(0.048)	(0.063)
Infrastructure	0.482***	0.428***	0.265***	0.233***	0.170***	0.158***	0.015	0.005
expenditures per	(0.074)	(0.080)	(0.052)	(0.055)	(0.026)	(0.023)	(0.020)	(0.020)
student (log)								
VA term			0.729***	0.737***			0.803***	0.820***
			(0.054)	(0.054)			(0.053)	(0.053)
Protestant	-0.015	-0.163*	-0.080	-0.037	-0.060**	-0.040	-0.044***	-0.029
	(0.069)	(0.093)	(0.051)	(0.071)	(0.029)	(0.040)	(0.017)	(0.026)
Female	-1.263	-1.882	-2.464*	-3.263**	-2.390***	-2.213***	-0.089	-0.022
	(1.894)	(2.376)	(1.362)	(1.564)	(0.675)	(0.711)	(0.446)	(0.455)
Landownership	18.130**	12.154	-9.523	-8.882	-7.972	-4.603	-2.181	-2.066
concentration	(7.650)	(9.304)	(8.737)	(9.643)	(5.506)	(5.486)	(2.437)	(2.712)
Exogenous growth	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
rates								
Province FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	217	217	217	217	217	217	217	217
R-squared	0.38	0.43	0.85	0.86	0.50	0.52	0.79	0.81

Note: OLS and VA estimates. The dependent variable is the logarithm of income tax per capita in 1901 in Columns 1 to 4 (and the logarithm of the average male day laborer wages over 16 years in 1901 in Columns 5 to 8). The variables of interest are the teacher-student ratio in 1886 (1891), i.e. the number of teachers per 100 students, teacher unit costs (log) in 1886 (1891) which denote the average spending per teacher, and infrastructure expenditures per student (log) in 1886 (1891) which comprise the expenditures for the construction, enlargement and maintenance of school buildings. Protestant denotes the share of Protestants in 1885 (1890). Female denotes the share of females in 1885 (1890). Landownership concentration denotes the share of farms larger than 100 ha arable land in 1882. Exogenous growth rates include the growth rates of 1) the Protestant share between 1885 (1890) and 1900, 2) the female share between 1885 (1890) and 1900, 3) landownership concentration between 1882 and 1895. Province-fixed effects are for six provinces. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

2.5.5 Sectoral Shifts

Having hypothesized that the increase of income tax per capita through higher educational expenditures and the simultaneous flat response of day laborer wages stem from the fact that people educated in 1886 managed to enter higher paid and higher skilled jobs might be supported by the fact that counties benefitting from higher educational expenditures managed to translate these expenditures into shifting away from agriculture to "modern" sectors of the economy.

Data from the occupation censuses in 1882 and 1895 allow applying a VA approach observing shifts of the six main occupational sectors, defined by the Royal Statistical Office of Prussia. The Statistical Office distinguishes between the sectors for agriculture, manufacturing, service, domestic services, military and workers without occupation. More than 40 percent of workers were still employed in the agricultural sector, followed by roughly one third working in manufacturing in 1882 and 1895. The remaining work force was constituted of workers in services, domestic services, the military and those without occupation. If my hypothesis was correct, workers should shift from the agricultural sector where wages were rather flat and relatively low to the manufacturing or service sector[26] where skills such as reading, writing and calculus were required. The manufacturing sector needed skilled workers who were able to apply newly introduced technology such as new production machines. The Second Industrial Revolution in Prussia meant in particular the rise of the chemical and optical industry as well as of electrical and mechanical engineering. These new industries were based on connecting research and industrial production. Beyond general skills in reading, writing and calculus, chemical and physical knowledge was therefore required (Hahn, 2005). Even though primary school might have not conveyed this specific knowledge, it might have contributed to the screening process of finding those candidates being able to acquire and apply this knowledge (Landes, 1994). With the growing importance of formal skills, skills acquired on the job lost importance (Lente and Altena, 2009).

Beyond screening able students, primary education might have mediated the direct productive use of skills such as reading, writing and calculus which were important to understand written instructions. Furthermore, behavioral traits and non-cognitive skills taught in primary school such as discipline and obedience could have been important for workers to get along in a working environment that was marked by the time device of machines (e.g. Bowles et al., 2001). As work became increasingly technical, primary school might have also contributed to the ability to adapt new technologies (Nelson and Phelps, 1966). The mechanization of work also led to a segmentation of the labor market. Ancillary jobs in different trades required supervisory personnel. This technically

[26] The service sector comprises trade business, insurance, transport, lodging, and restaurants.

qualified supervisory personnel received income at the high end of the income distribution while unqualified ancillary workers received income at the low end of the income distribution. Furthermore, skills acquired in primary school might have fed the newly emerging sector of white collar workers, especially requiring reading, writing and calculating skills, required mostly in the service sector.

I expect the manufacturing and the service sector to increase as I expect these two sectors to require skills acquired in primary school. As a by-product of a society with on average higher income thanks to higher educational expenditures, I equally expect the domestic service sector to increase as demand for domestic services will increase with more workers entering the high-wage segment of the economy. I expect the agricultural sector to decrease as a consequence of workers shifting to the "modern" sectors, namely manufacturing and services. If new employment opportunities are generated with higher educational expenditures, e.g. in the domestic service sector, the share of workers without occupation might decrease. The share of workers employed in the military is expected to remain constant.[27]

Table 2.6 (Panel A) shows how investments in primary education affected the sectoral composition of the economy. As expected, higher expenditures in primary education correlate positively with an increase in manufacturing (Column 2), service (Column 3) and domestic services (Column 4). It is the service sector that benefits most from investments in education. The higher wage receiving population (in the manufacturing and service sector) seems to react by increasing the demand for domestic service personnel which is reflected by the positive coefficient on domestic services. The coefficients on both the share of workers employed in agriculture (Column 1) and those without any occupation (Column 6) are negative, though not significant. The coefficient on the military share is positive, but very small and also insignificant (Column 5).

When decomposing educational investments into the components teacher-student ratio, teacher unit costs and infrastructure expenditures per student (Table 2.6, Panel B), the teacher-student ratio and the share of workers employed in agriculture are positively correlated (Column 1). For all other sectors, I observe a negative interplay between the teacher-student ratio and the share employed in the respective sector which turns significant for the share employed in manufacturing (Column 2).

[27] Even though the original aim of Prussian school was to education a strong military, the size of the military sector is expected to react to other factors besides educational investments.

The positive association between overall expenditures in primary education and the share of workers employed in manufacturing, services or domestic services is mainly driven by higher infrastructure expenditures as shown in Columns 2 to 4. Teacher unit costs play an important part in the increase of the service sector (Column 3). The estimates of teacher unit costs for the manufacturing and the domestic service sector are also positive but slightly below the level of conventional significance. Infrastructure expenditures are negatively correlated with the share of workers employed in the agricultural sector. More money invested in expanding schools correlates with a smaller agricultural sector. Expanding school capacity might have offered students the necessary skills to move away from the agricultural sector and find employment in another sector. The VA term is fairly high for all sectors with the exception of domestic services both in Panel A and B.[28]

[28] This is owed to the fact that the category of domestic servants is abolished after 1882 and combined with domestic services in this analysis.

Table 2.6: Sectoral Shifts and Spending on Education: VA Estimates for West Elbia

Dep. Var.: Share in	(1) Agriculture	(2) Manufacturing	(3) Service	(4) Domestic Services	(5) Military	(6) Without occupation
PANEL A: Expenditures per student (log)						
Expenditures per student	-0.021	0.031***	0.043***	0.012***	0.004	-0.004
(log)	(0.041)	(0.009)	(0.015)	(0.004)	(0.005)	(0.010)
VA term	0.974***	1.046***	0.864***	0.228***	0.977***	0.833***
	(0.068)	(0.022)	(0.130)	(0.040)	(0.053)	(0.133)
R-squared	0.89	0.93	0.84	0.57	0.82	0.67
PANEL B: Decomposition						
Teacher-student ratio	0.106***	-0.057***	-0.005	-0.002	-0.002	-0.002
	(0.032)	(0.015)	(0.007)	(0.004)	(0.011)	(0.008)
Teacher unit costs (log)	-0.044	0.029	0.069***	0.010	0.009	0.000
	(0.083)	(0.022)	(0.024)	(0.008)	(0.011)	(0.017)
Infrastructure expenditures	-0.053**	0.031***	0.016***	0.006***	0.001	-0.002
per student (log)	(0.021)	(0.008)	(0.005)	(0.002)	(0.005)	(0.004)
VA term	0.875***	0.980***	0.768***	0.218***	0.973***	0.828***
	(0.101)	(0.025)	(0.139)	(0.043)	(0.052)	(0.141)
R-squared	0.90	0.94	0.86	0.59	0.83	0.67
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Exogenous growth rates	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	217	217	217	217	217	217
Mean dep. var. 1882	0.43	0.33	0.09	0.01	0.05	0.05
Mean dep. var. 1895	0.42	0.36	0.07	0.08	0.04	0.08

Note: Value-Added estimates. The dependent variable is the share of workers employed in agriculture in 1895 in Column 1, the share of workers employed in manufacturing in 1895 in Column 2, the share of workers employed in service in 1895 in Column 3, the share of workers employed in domestic services in 1895 in Column 4, the share of workers employed in the military in 1895 in Column 5 and the share of people without any occupation in 1895 in Column 6. The variable of interest is the log of total expenditures per student in 1886 in PANEL A. The variables of interest are the teacher-student ratio in 1886, i.e. the number of teachers per 100 students, teacher unit costs (log) in 1886 which denote the average spending per teacher, and infrastructure expenditures per student (log) in 1886 which comprise the expenditures for the construction, enlargement and maintenance of school buildings in PANEL B. The Value-Added term is the share of workers employed in agriculture in 1882 in Column 1, the share of workers employed in manufacturing in 1882 in Column 2, the share of workers employed in service in 1882 in Column 3, the share of workers employed in domestic services in 1882 in Column 4, the share of workers employed in the military in 1882 in Column 5 and the share of people without any occupation in 1882 in Column 6. Protestant denotes the share of Protestants in 1885. Female denotes the share of females in 1885. Landownership concentration denotes the share of farms larger than 100 ha arable land in 1882. Exogenous growth rates include the growth rates of 1) the Protestant share between 1885 and 1900, 2) the female share between 1885 and 1900, 3) landownership concentration between 1882 and 1895. Province-fixed effects are for six provinces. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

2.5.6 East Elbia as a Counterfactual

As shown in Figure 2.3, income tax per capita east of the river Elbe remained rather low and did not show a lot of variation in 1901. As described above, the East of Prussia still heavily relied on the agricultural sector with the manufacturing sector only reaching 25 percent of workers employed in 1895 (as compared to one third in West Elbia). As hypothesized above, the increase in income tax per capita through higher educational investments worked through a sectoral shift of the economy. As this shift was not realized in the East of Prussia, no association between educational investments and income tax per capita is expected to be found for this part of Prussia. In order to stress this counterfactual argument, I will first show that higher educational expenditures did not initiate a sectoral shift to "modern" sectors east of the Elbe, applying the same data as in section 2.5.5 for the sample east of the Elbe.

Table 2.7 shows results on the sectoral shifts in East Elbia. Panel A shows increases of the agricultural sector (Column 1), the service sector (Column 3) and the domestic services (Column 4) following higher investments in primary education. However, the manufacturing sector as the best measure capturing industrial progress stays fairly constant and the positive coefficient on the agricultural sector coincides with the reproach of contemporaries that the educational system in the East of Prussia rather impeded economic progress (Kuhlemann, 1991). Even though we see an increase in the service sector this coefficient is only half of the coefficient found for the sample west of the Elbe.

The estimates from the decomposition (Panel B of Table 2.7) show that the teacher-student ratio is positively associated with the share of workers employed in agriculture and the share of the working force without any occupation while it is negatively associated with the share of workers employed in manufacturing and domestic services.[29] Higher teacher salary positively correlates with the share of workers employed in services and domestic services. Higher investments in infrastructure expenditures are associated with an increase in the share employed in manufacturing, service, domestic services and the military while they are negatively associated with the share employed in agriculture and the sector encompassing people without occupation.

[29] One possible explanation is that teacher supply is high in counties with no alternative employment opportunities where being a teacher promises relatively high wages and relatively high social status.

Table 2.7: Sectoral Shifts and Spending on Education: VA Estimates for East Elbia

Dep. Var.: Share in	(1) Agriculture	(2) Manufacturing	(3) Service	(4) Domestic Services	(5) Military	(6) Without occupation
PANEL A: Expenditures per student (log)						
Expenditures per student	0.029*	0.013	0.024***	0.011*	0.006	-0.005
(log)	(0.015)	(0.013)	(0.006)	(0.006)	(0.010)	(0.005)
VA term	0.999***	0.984***	0.981***	0.362***	0.890***	0.828***
	(0.022)	(0.034)	(0.057)	(0.085)	(0.073)	(0.057)
R-squared	0.95	0.94	0.92	0.49	0.72	0.71
PANEL B: Decomposition						
Teacher-student ratio	0.110***	-0.056***	-0.007	-0.015*	-0.025*	0.020***
	(0.018)	(0.016)	(0.007)	(0.008)	(0.013)	(0.005)
Teacher unit costs (log)	-0.018	0.061	0.051***	0.032**	-0.011	-0.004
	(0.053)	(0.039)	(0.018)	(0.015)	(0.029)	(0.014)
Infrastructure expenditures	-0.039***	0.026***	0.012***	0.008***	0.021***	-0.012***
per student (log)	(0.012)	(0.008)	(0.005)	(0.003)	(0.007)	(0.003)
VA term	0.969***	0.949***	0.934***	0.352***	0.873***	0.817***
	(0.026)	(0.037)	(0.063)	(0.082)	(0.073)	(0.056)
R-squared	0.96	0.94	0.92	0.52	0.73	0.74
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Exogenous growth rates	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	235	235	235	235	235	235
Mean dep. var. 1882	0.51	0.23	0.07	0.02	0.05	0.06
Mean dep. var. 1895	0.50	0.25	0.06	0.10	0.04	0.10

Note: Value-Added estimates. The dependent variable is the share of workers employed in agriculture in 1895 in Column 1, the share of workers employed in manufacturing in 1895 in Column 2, the share of workers employed in service in 1895 in Column 3, the share of workers employed in domestic services in 1895 in Column 4, the share of workers employed in the military in 1895 in Column 5 and the share of people without any occupation in 1895 in Column 6. The variable of interest is the log of total expenditures per student in 1886 in PANEL A. The variables of interest are the teacher-student ratio in 1886, i.e. the number of teachers per 100 students, teacher unit costs (log) in 1886 which denote the average spending per teacher, and infrastructure expenditures per student (log) in 1886 which comprise the expenditures for the construction, enlargement and maintenance of school buildings in PANEL B. The Value-Added term is the share of workers employed in agriculture in 1882 in Column 1, the share of workers employed in manufacturing in 1882 in Column 2, the share of workers employed in service in 1882 in Column 3, the share of workers employed in domestic services in 1882 in Column 4, the share of workers employed in the military in 1882 in Column 5 and the share of people without any occupation in 1882 in Column 6. Protestant denotes the share of Protestants in 1885. Female denotes the share of females in 1885. Landownership concentration denotes the share of farms larger than 100 ha arable land in 1882. Exogenous growth rates include the growth rates of 1) the Protestant share between 1885 and 1900, 2) the female share between 1885 and 1900, 3) landownership concentration between 1882 and 1895. Province-fixed effects are for six provinces. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

Having seen that higher educational investments did not translate into shifts towards sectors which encompassed the modernizing and industrializing occupations of the time, I expect no increase in income. Estimating equation 2.2 for the sample east of the Elbe allows testing this hypothesis. Table 2.8 shows results on the association between educational investments and the two outcome variables for the sample east of the Elbe. As expected no association between expenditures per student and income tax per capita is found (as shown in Panel A).[30] However, day laborer wages are positively associated with higher investments in primary education which is driven by higher teacher wages (depicted in Panel B). This allows speculating that the most highly skilled parts of the population, not being offered any employment opportunities appropriate to their skills in the East, left their homes to seek better employment opportunities in the West. This out-migration decreases the general supply of labor. Assuming constant demand of day laborer wages, this eventually increased day laborer wages.

[30] Decomposing educational investments into the three different inputs again shows a negative association between the teacher-student ratio and income tax per capita and a positive association for infrastructure expenditures in the preferred specification of Column 4.

Table 2.8: Economic Development and Spending on Education East of the Elbe: VA Estimates

Dep. Var.:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Income tax per capita 1901 (log)						Day laborer wages 1901 (log)					
PANEL A: Expenditures per student (log)												
Expenditures p. student (log)	-0.106	-0.059	-0.112	0.132	0.012	0.018	0.089**	0.102***	0.113***	0.120***	0.084**	0.078**
	(0.118)	(0.132)	(0.132)	(0.141)	(0.185)	(0.184)	(0.038)	(0.039)	(0.038)	(0.037)	(0.040)	(0.039)
VA term	0.799***	0.800***	0.821***	0.713***	0.513***	0.414***	0.743***	0.718***	0.712***	0.700***	0.567***	0.529***
	(0.048)	(0.051)	(0.049)	(0.051)	(0.057)	(0.049)	(0.039)	(0.040)	(0.039)	(0.041)	(0.052)	(0.052)
R-squared	0.73	0.74	0.75	0.80	0.83	0.86	0.83	0.84	0.85	0.86	0.87	0.88
PANEL B: Decomposition												
Teacher-student ratio	-0.407***	-0.467***	-0.542***	-0.476***	-0.408***	-0.318**	0.014	0.068*	0.061*	0.028	0.037	0.065
	(0.095)	(0.112)	(0.105)	(0.122)	(0.120)	(0.127)	(0.027)	(0.035)	(0.035)	(0.040)	(0.044)	(0.046)
Teacher unit costs (log)	1.019***	1.121***	1.028***	0.478	0.008	0.076	0.121***	0.121**	0.116**	0.146**	0.155**	0.215***
	(0.255)	(0.299)	(0.280)	(0.360)	(0.342)	(0.328)	(0.044)	(0.049)	(0.050)	(0.070)	(0.063)	(0.070)
Infrastructure exp. (log)	0.065	0.060	0.135	0.273***	0.238**	0.150	0.039	0.012	0.025	0.049	0.017	-0.015
	(0.086)	(0.097)	(0.095)	(0.097)	(0.117)	(0.128)	(0.024)	(0.026)	(0.026)	(0.033)	(0.031)	(0.031)
VA term	0.671***	0.686***	0.675***	0.678***	0.505***	0.431***	0.747***	0.728***	0.719***	0.696***	0.564***	0.525***
	(0.057)	(0.059)	(0.056)	(0.055)	(0.058)	(0.052)	(0.039)	(0.041)	(0.040)	(0.043)	(0.053)	(0.052)
R-squared	0.77	0.77	0.80	0.83	0.85	0.87	0.84	0.85	0.85	0.86	0.87	0.88
Controls	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Exogenous GR	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Province FE	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Add. Controls	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Endogenous GR	No	No	No	No	No	Yes	No	No	No	No	No	Yes
Observations	236	235	235	235	235	235	236	235	235	235	235	235

Note: Value-Added estimates. The dependent variable is the logarithm of income tax per capita in 1901 in Columns 1 to 6 (and the logarithm of the average male day laborer wages over 16 years in 1901 in Columns 7 to 12). The variable of interest is the log of total expenditures per student in 1886 in PANEL A and the teacher-student ratio, teacher unit costs (log) and infrastructure expenditures in PANEL B. The VA term is the logarithm of income tax per capita in 1883/1884 in Columns 1 to 6 (and the logarithm of the average male day laborer wages over 16 years in 1892 in Columns 7 to 12). Protestant denotes the share of Protestants in 1885 (1890). Female denotes the share of females in 1885 (1890). Landownership concentration denotes the share of farms larger than 100 ha arable land in 1882. Exogenous GR include the growth rates of 1) the Protestant share between 1885 (1890) and 1900, 2) the female share between 1885 (1890) and 1900, 3) landownership concentration between 1882 and 1895. Province-fixed effects are for six provinces. Additional Controls include urbanization, average household size, employed in manufacturing, movers and municipal contributions for the estimations on log income tax per capita. Endogenous GR include the growth rates of 4) the share of people living in cities between 1885 (1890) and 1900, 5) the population between 1885 (1890) and 1900, 6) the average household size between 1885 (1890) and 1900, 7) the share in manufacturing between 1882 and 1895, and 8) the share of movers between 1885 (1890) and 1900. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

2.6 Conclusion

This chapter investigates the relationship of different educational inputs and educational outcomes in the historical context of late nineteenth-century Prussia, the pioneer in primary education, thereby combining the literature on modern educational production functions and the economic historical literature on the interplay of education and economic growth.

Rich county-level data from the Prussian education censuses of 1886 and 1891 are combined with data on income taxes in 1883/1884 and 1901 and day laborer wages in 1892 and 1901. Income taxes and day laborer wages provide measures of long-term school performance for both the high and the low end of the income distribution.

As estimates from OLS models might be biased due to omitted variables such as the initial development level of a county, and reversed causality stemming from the fact that richer counties have more resources to invest in education, a value-added approach is applied. Hereby, the lagged outcome variable is included at the right-hand side of the estimation equation to capture past endowments of the county both in terms of school structures and economic development. Even though biases through contemporary shocks such as other public investments remain a concern, this approach is most suited to the data and reduces many biases evolving from OLS estimations.
By estimating different historical educational production functions for West Prussia in the ending nineteenth century, it is found that overall educational expenditures per student increased income tax per capita while day laborer wages remain constant. Educational investments increasing income at the high end of the income distribution primarily works through higher teacher wages proxying higher teacher quality as well as through infrastructure investments, though to a smaller extent. The findings allow hypothesizing that higher educational investments translating into higher human capital of the population shifted workers to higher income jobs and crowded out low-skilled labor. This hypothesis is backed up by evidence from East Elbia which remained largely agricultural at the time, thereby denying skilled workers occupational opportunities adequate to their skill level. No association between educational investments and income taxes is found for East Elbia stressing that increasing economic development through educational investments worked primarily through occupational shifts to the higher skilled work force.

Appendix 2A Data Sources

Table A2.1: 1883/1886 – 1901 Variables

Income tax per capita 1901	Sum of income taxes over total population in 1901. (Königliches Statistisches Bureau in Berlin, 1905).
Income tax per capita 1883/1884	Sum of income taxes over total population in 1883/1884. (Königliches Statistisches Bureau in Berlin, 1884).
Employed in agriculture (share)	Share of workers employed in agriculture and animal husbandry (sector A) over working population in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76b).
Employed in manufacturing (share)	Share of workers employed in manufacturing (sector B) over working population in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76b).
Employed in service (share)	Share of workers employed in service (sector C) over working population in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76b).
Employed in domestic services (share)	Share of workers employed in domestic services and as domestic servants (sector D and G) over working population in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76b).
Employed in military (share)	Share of workers employed in public administration and military (sector E) over working population in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76b).
Without occupation (share)	Share of people without occupation (sector F) over working population in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76b).
Expenditures per student, incl. fringe benefits	Primary school expenditures, including fringe benefits, per student of mandatory school age (6-14) in 1886.
Teacher-student ratio	Ratio of fully employed teachers over 100 students attending public or private primary school in 1886.
Teacher unit costs	Total expenditures for personnel per fully employed teacher in 1886.
Infrastructure expenditures per student	Primary school expenditures allocated to infrastructure, i.e. construction, enlargement and maintenance of schools, per student of mandatory school age (6-14) in 1886.
Protestant (share)	Share of Protestants per total population in 1885 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 96).
Female (share)	Share of females per total population in 1885 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 96).
Landownership concentration	Share of farms larger than 100 ha arable land in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76c).
Urban (share)	Share of total population living in cities that held city rights in 1885 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 89).
Average household size	Average number of people living in one private household in 1885 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 96).
Movers (share)	Share of people born in another locality than their resident locality per total population in 1885 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 96).
Municipal contr. (share)	Share of primary school expenditures, contributed by municipalities in 1886.

Note: Unless otherwise specified, the data stem from Königliches Statistisches Bureau in Berlin (1861–1934, vol. 101).

Table A2.2: 1892/1895 – 1901 Variables

Day laborer wages 1901	Average of urban and rural day laborer wages for men over 16 years in 1901 (Neuhaus, 1904).
Day laborer wages 1892	Average of urban and rural day laborer wages for men over 16 years in 1892 (Neuhaus, 1904).
Employed in agriculture (share)	Share of workers employed in agriculture and animal husbandry (sector A) over working population in 1895 (Kaiserliches Statistisches Reichsamt, 1872-1918, vol. 104 and 109).
Employed in manufacturing (share)	Share of workers employed in manufacturing (sector B) over working population in 1895 (Kaiserliches Statistisches Reichsamt, 1872-1918, vol. 104 and 109).
Employed in service (share)	Share of workers employed in service (sector C) over working population in 1895 (Kaiserliches Statistisches Reichsamt, 1872-1918, vol. 104 and 109).
Employed in domestic services (share)	Share of workers employed in domestic services (sector D) over working population in 1895 (Kaiserliches Statistisches Reichsamt, 1872-1918, vol. 104 and 109).
Employed in military (share)	Share of workers employed in public administration and military (sector E) over working population in 1895 (Kaiserliches Statistisches Reichsamt, 1872-1918, vol. 104 and 109).
Without occupation (share)	Share of people without occupation (sector F) over working population in 1895 (Kaiserliches Statistisches Reichsamt, 1872-1918, vol. 104 and 109).
Expenditures per student, incl. fringe benefits	Primary school expenditures, including fringe benefits, per student of mandatory school age (6-14) in 1891.
Teacher-student ratio	Ratio of fully employed teachers over 100 students attending public or private primary school in 1891.
Teacher unit costs	Total expenditures for personnel per fully employed teacher.
Infrastructure expenditures per student	Primary school expenditures allocated to infrastructure, i.e. construction, enlargement and maintenance of schools, per student of mandatory school age (6-14) in 1891.
Protestant (share)	Share of Protestants per total population in 1890 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 121a).
Female (share)	Share of females per total population in 1890 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 121a).
Landownership concentration	Share of farms larger than 100 ha arable land in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76c).
Urban (share)	Share of total population living in cities that held city rights in 1890 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 117).
Average household size	Average number of people living in one private household in 1890 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 121a).
Movers (share)	Share of people born in another locality than their resident locality per total population in 1890 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 121a).

Note: Unless otherwise specified, the data stem from Königliches Statistisches Bureau in Berlin (1861–1934, vol. 120).

Chapter 3*
Nation Building: The Role of Central Education Spending

3.1 Introduction

Can public spending on education buy votes, measured by voter turnout and the pro-nationalist vote share? The majority of the literature on "pork barrel spending", that is, using government funds for local projects in order to "buy votes," looks at the impact of different kinds of investments on voter turnout or support for the incumbent party. In this chapter, we focus on the composition of funding for primary schools.[31] Whereas the previous literature looks at overall government funds, we are interested in examining whether the composition of funds mattered, namely, whether money came from local or central funds. We argue that, in our specific context, central funds more precisely capture the central state's impact on educational affairs, aiming at building a nation.

Prussia provides an interesting laboratory for testing the relationship between the composition of public spending on education and political participation as it increased the share of central expenditures on education from 10 to over 40 percent between 1886 and 1911. At the same time, it started using the school as a way of shaping Prussian citizens and creating a homogeneous Prussian nation. We exploit this increase in central expenditures in order to examine whether the increased impact of Prussian state authorities on educational affairs shaped attitudes toward the state, namely, voter turnout and support for pro-nationalist parties. Participating in elections was understood as one of a Prussian citizen's duties, allowing us to capture adherence to the state. Imperial Chancellor Bismarck described the two conservative parties of the time, along with the National Liberal Party, as parties that supported the Prussian state and its constitution, which is why the share of votes for those pro-nationalist parties in elections for the federal parliament, the *Reichstag*, allows measuring whether citizens aligned with the principles of the Prussian state.

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* This chapter is based on joint work with Francesco Cinnirella, Ifo Institute for Economic Research (see Cinnirella and Schueler, 2016).

[31] As consistent data distinguishing between local and central investment, covering the whole period of observation are available only for education, we look at educational expenditures only.

We merge data on the federal elections of the German Empire with data on the composition of educational spending on primary schools stemming from six education censuses undertaken between 1886 and 1911. Data stemming from the education censuses of 1901 to 1911 were digitized explicitly for this chapter. Observing 199 constituencies at six different points in time allowed the construction of a dataset with nearly 2,000 observations.

Using a panel model with constituency-fixed effects allows accounting for unobserved time-invariant characteristics of a constituency, such as persistently higher social capital when it comes to voter turnout, or a higher intensity of pro-nationalist attitudes in the past when it comes to support for pro-nationalist parties. In a second step, we more explicitly exploit the time dimension of the data by estimating a dynamic model. We thereby look at the effect that a higher share of central spending had on students' electoral outcomes once they reached legal voting age.

Results suggest that an increase in central spending leads to a higher vote share for pro-nationalist parties and slightly higher voter turnout. When decomposing the share of central spending into the shares devoted to personnel or to buildings, we find that both categories are positively related to the pro-nationalist vote share, with spending on personnel having a stronger effect. No significant association is found for voter turnout, suggesting that it is overall central spending that matters for this outcome. Looking at heterogeneous effects, we find that increasing central state interventions won support for pro-nationalist parties most notably from those segments of the population that traditionally opposed the Prussian ideal of a citizen, namely, the non-German speaking and the Catholic, and in those regions that were highly polarized in terms of their linguistic or religious composition. Applying a dynamic model shows that the share of educational spending contributed by the central state also affected support for pro-nationalist parties once students—who were especially affected by the substantial shift toward more central spending in 1888/1889—reached legal voting age. Again, decomposing the central spending share into spending for personnel and buildings suggests that teachers played a major role in conveying pro-nationalist attitudes to their students.

The remainder of the chapter is organized as follows. Section 3.2 discusses the related literature. Section 3.3 elaborates on the historical background. Section 3.4 introduces the dataset. Section 3.5 presents the fixed-effects model, its results, pursues the allocation of central spending and subgroup effects, and carries on with a dynamic approach. Section 3.6 concludes.

3.2 Related Literature

This chapter contributes to the economic-historical literature aimed at explaining voting patterns in historical Germany. Lehmann (2010) sheds light on why Imperial Germany, between the elections of 1878 and 1879, was one of the first countries in Europe to turn from liberalism to protectionism. Using King's algorithm, she attributes changes in votes to specific groups of voters and finds that the largest shift toward protectionism came from the agricultural sector, arguing that voting decisions depend on sectoral interests. In this chapter, we similarly examine how the vote shares of different subgroups such as the noble landlords or Catholics were affected by an increasing share of central spending.
Koenig (2015) examines the effect of war participation on the rise of right-wing parties during the interwar period. By looking at electoral outcomes at the turn of the century and thereby at the formative years of the German nation, we shed light on a period in German history for which the historical literature's prior is that voting patterns followed the social milieu (Lepsius, 1993), therefore implying a static distribution of votes.

Voigtlaender and Voth (2014) look at the effect of highway construction in Nazi Germany on support for the NSDAP in the last semi-free elections after Hitler seized power. They argue that the infrastructure investment of building the highway signaled the state's interest in the region and thus bought votes for the NSDAP. As funding primary schools was widely perceived as a burden by municipalities and noble landlords, we similarly argue that investments in education that were clearly made by the central state bought votes.

The chapter also contributes to the vast literature on pork barrel spending. Evidence stemming from this research is mixed. Papers mainly focus on the two-party U.S. electoral system. The majority of papers find evidence of the pork barrel spending mechanism; relatively few find no effect of pork on electoral outcomes.[32] None of these papers explicitly investigates the sources of government spending, and very few specifically look at spending on education. Kneebone and Mckenzie (2001) look at clearly visible investments, namely, schools, roads and hockey rinks, in Canadian provincial elections. However, they are interested in investigating whether spending in those categories increases in election years and do not investigate the effect of increased spending on electoral outcomes.

[32] Calvo and Murillo (2004), Drazen and Eslava (2010), Engstrom and Vanberg (2010), Kwon (2005), Lazarus and Reilly (2010), Leigh (2008) Manacorda et al. (2011), Reynolds (2014) and Stratmann (2013) find evidence in favor of pork barrel spending influencing elections. Larcinese et al. (2015), Samuels (2002) and Treisman (1996) find no effect of government spending on electoral outcomes.

This chapter also has a place in the large literature suggesting that education increases political participation. Dee (2004) was the first to empirically show an effect of educational attainment on civic engagement and attitudes, exploiting child labor laws and the availability of higher education schools. The majority of papers investigating the relationship between education and political participation focus on democracies. The German Empire, however, was a constitutional monarchy.[33] Consequently, the federal parliament, the *Reichstag*, had only limited power and votes in the *Reichstag* elections can be understood as preference measures of the population.[34]

We argue, following the literature established by Lott (1990), that education was used as a socialization tool. The main line of argumentation in the related literature (Gradstein and Justman, 2005; James, 1993; Lott, 1999; Pritchett and Viarengo, 2013) is that education produces both human capital and socialization. Valuing socialization, the state provides schooling. In his paper, Lott (1990) provides a theoretical model explaining why education is provided publicly even though private provision is much more efficient. As public schooling instills a common set of values and all government actions create wealth transfer, government-provided schooling is used to decrease the cost of wealth transfers as it allows controlling information, consequently inducing students to support certain transfers. In brief, schooling lowers the cost of wealth transfers by instilling the "right" views. To assure indoctrination, high rents received by educators and exclusive territories are the two key elements that make indoctrination via the educational system effective. In a second paper, Lott (1999) investigates which government characteristics are associated with the greatest return to indoctrination, using data from post-communist countries and South Africa. Lott argues that direct measures of educational expenditure on indoctrination are not available, thus making it impossible to distinguish between human capital investment and indoctrination, which is why he uses total public educational expenditures. By arguing that central subsidies are a good proxy for indoctrination as they were often granted conditional on shifting decision-making from local to central authorities, we provide a more direct measure of educational expenditures on indoctrination. One example of conditioning central subsidies on decision-making power is the teacher recruitment law for the provinces of West Prussia and Posen. The law shifted teacher recruitment from local authorities to the central authorities; at the same time providing 2.6 million Mark for primary schools (Glück, 1979). This nicely illustrates how higher central spending was connected to higher control by the central state, assuring

[33] The historical literature is divided on how to categorize Imperial Germany in terms of its political system. Although it conducted some of the most democratic federal elections of the time, the impact of the Imperial Chancellor and the Emperor on legislation was clearly autocratic.

[34] In a similar context, Croke et al. (2015) test whether the relationship between education and political participation holds for a paradigmatic electoral authoritarian regime and formulate a disengagement hypothesis, expecting that education decreases political participation in a system where votes do not influence political decisions. Using a major educational reform in Zimbabwe that introduced variation in access to education, they find that education decreases political participation, giving credence to their hypothesis.

that school curriculums matched those envisioned as ideal by the state authorities. Kremer and Sarychev (2000) investigate school choice, which is manifested by providing vouchers to parents so that they can choose what school their children will attend. The authors argue that governments prefer to operate schools themselves because they fear that school choice will lead to parents choosing schools that come closest to their own ideology, resulting in ideological and cultural segregation. Along similar lines, James (1993) aims at explaining differences in private-public school attendance, as do Pritchett and Viarengo (2013).

Even though we cannot observe differences in the implementation of the national curriculum, we hypothesize that a higher share of central spending translates into a higher alignment with the standard national curriculum. Cantoni et al. (2014) study how changes in the school curriculum can shape students' political attitudes by examining a textbook reform in China that took place between 2004 and 2010. The new textbook was much more favorable toward the regime, which enhanced students' trust in government officials and changed their views on political participation and democracy.

3.3 Historical Background

The German Empire and Prussia, in particular, experienced several moments of "modernization" toward the turn of the century. Interest groups, such as large industrialists and large estate owners, achieved influence over political decisions. At the same time, the emerging power of the press led to the development of public opinion.[35] Nationalism increased and the idea of an "ideal citizen" took root. The Prussian sense of identity had been "abstract and fragmentary" (Clark, 2007) before 1871, but the foundation of the German Empire in 1871 eventually led to a more defined national identity: being Prussian meant being Protestant and German. The duties of the Prussian citizenry consisted of voting, paying taxes, military service, school attendance, and respecting authorities. The army and the school were the newly founded Empire's most powerful integrating institutions and chiefly responsible for the burgeoning nationalism.

3.3.1 The Political System of Imperial Germany

The German Empire was a constitutional monarchy under Prussia's leadership. Even though the *Reichstag* was the first publicly elected parliament in German territory, it was the Emperor and the Imperial Chancellor who shaped the Empire's policy. The *Reichstag*'s duties lay in approving the Empire's budget and enacting legislation. From the foundation of the German Empire in 1871 until his withdrawal in 1890, Imperial

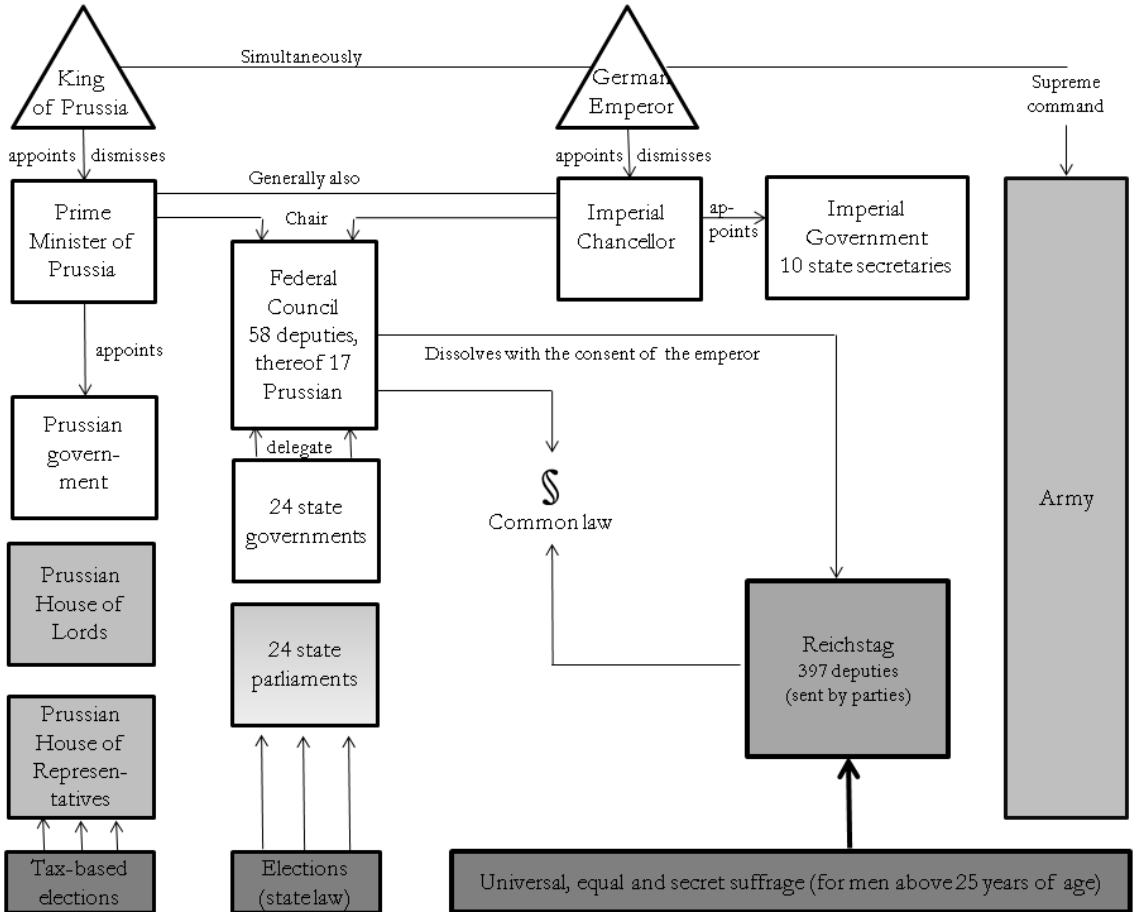
[35] Imperial Chancellor Bismarck explicitly used the press to shape people's preferences and beliefs. In 1882, he founded the semi-official organ *Neueste Mittheilungen*, which was clearly biased in favor of the government, though not an officially proclaimed organ of the government (Hoppe and Stöber, 2006).

Chancellor Bismarck, who was simultaneously the Prime Minister of Prussia, shaped the interior policies of the German Empire and of Prussia. His post was not subject to the vagaries of popular election; he had the Emperor's complete trust. When Wilhelm II ascended the throne in 1888, Bismarck's and the Emperor's views on the future course of the German Empire diverged so widely in regard to both foreign affairs and how to solve the social question evolving from Prussia's transition to an industrial society,[36] that Bismarck resigned his office in 1890. Wilhelm II involved himself much more actively in politics than his predecessors, sharply reducing the Imperial Chancellor's power, which is why his reign (1890–1914) is known as *Wilhelminism*. The waning power of the Imperial Chancellor allowed the *Reichstag* to gain more influence. And yet, as policy was chiefly set by the Imperial Chancellor or the Emperor, votes in the *Reichstag* elections can be understood as more or less preference measures. The *Reichstag* was elected by the male population above age 25 in universal, free, and secret suffrage. Every mal citizen over 25 hence had the right to vote in secret elections, each man having one vote. Elections were commonly held in schools and even though the constitution guaranteed secret voting, polling booths generally were not available until the turn of the century (Ullmann, 1980; Zippelius, 2006). The candidates were elected by an absolute majority voting system, which led to an increasing number of run-off ballots over time (Jesse, 2013). The 216 electoral constituencies were formed in 1871 and were designed to be of equal population size. However, despite huge internal migrations from the countryside to the cities and from the East to the West of the country, the constituencies were never redrawn, with the result that voters in the rural constituencies in the East were overrepresented. Figure 3.1 illustrates the political system of the German Empire as defined by its constitution.

[36] Even though Wilhelm II continued Bismarck's social reforms in improving the situation of workers, he did not use this policy to reduce the power of the worker's party, the Social Democratic Party (SPD), which was Bismarck's main concern in pursuing social reforms. He rather used the school as a combatting instrument against the SPD as explicated below.

The traditional historic narrative is that parties at the time lacked comprehensive party platforms and their electorates were constituted of the different social milieus that made up German society (Lepsius, 1993). There was the National Liberal Party (NLP) advocating the interests of the Grand Burghers and business magnates, who mainly supported Bismarck's policy. The Free Conservatives and the German Conservatives were conservative parties. The Free Conservative Party was mainly supported by conservative industrialists and had a big stronghold in the East Elbian Junkers. The Free Conservative Party supported both the policy of Imperial Chancellor Bismarck and the policy of Wilhelm II. The German Conservative Party equally represented the wealthy landowning elite Prussian Junkers and supported both Bismarck and successive chancellors. These three parties made up the pro-nationalist bloc of the party spectrum with an electorate strongly mirroring the ideal Prussian citizen, that is, Protestant and German (Clark, 2007). Bismarck himself considered these parties as *Reichsfreunde*, so-called friends of the Empire (Hagen, 2002), and Johann von Miquel, leader of the National Liberal Party, stated that the "Free Conservatives and National Liberals are 'two middle parties', representing the mainstream of Protestant opinion" (Lamberti, 1989). Voting for one of these pro-nationalist parties demonstrated loyalty to the Prussian state.

Figure 3.1: The Political System of the German Empire



Source: Kochendörfer (1997, p. 127).

Opposed to the friends of the Empire there were the so-called *Reichsfeinde*—enemies of the Empire—whose electorate was made up of those who did not conform to the ideal Prussian citizen and advocated for policies different from those endorsed by the Imperial Chancellor or the Emperor. For example, there was the Center Party most of whose members and supporters were Catholic. Especially during the *Kulturkampf*, the cultural and political struggle between the Prussian authorities and the Catholic Church, the Center Party was depicted as an enemy within the Empire. Equally the Social Democratic Party (SPD) was strongly opposed by the traditional Prussian elite as they advocated for worker rights. Bismarck was vehemently opposed to the nascent social-democratic movement and even managed to ban the SPD between 1878 and 1890, meaning that Social Democrats could be elected only as list-free candidates. After the ban was lifted, the party quickly developed into a party of the masses and garnered the majority of votes in the *Reichstag* elections (Sperber, 1997).

Several smaller parties, such as the German Free-Minded Party and others that particularly advocated for minority rights, such as for the Poles or the Danes were naturally excluded from the Prussian ideal (Sperber, 1997).

3.3.2 The Integrative Function of the Prussian Primary School

Gradstein and Justman (2005) note that the Prussian educational system before foundation of the German Empire was characterized by incorporating minority schools within the public educational system as separate autonomous streams. Prior to 1871, the educational system was clearly denominational; there were separate schools for Protestant and Catholic children, each operating under the supervision of its own clergy. With the foundation of the German Empire and enactment of the School Inspection Law in 1872, which mandated centralized school inspection in primarily Catholic counties, Catholic schools lost the authority to monitor themselves.[37] At the same time, aggressive policy against the Poles, led by Imperial Chancellor Bismarck, banned Polish as a language of instruction in primary school (Lamberti, 1989). These laws illustrate how a common identity can be shaped through demarcation (Kühne, 1997).

Accompanying its increasing financial involvement in primary education, was the central state's declaration of the school as an instrument for enhancing Prussian virtues and molding Prussians into citizens who would fulfill their proper duties of voting, paying taxes, military service, school attendance, and respecting the authorities. Early on, in his royal decree of 1889 (*Erlass Kaiser Wilhelms II. zur Reform des Schulunterrichts als Mittel zum Kampf gegen den Sozialismus, 1. Mai 1889*), Wilhelm II stressed the role of education in building a common identity. This decree was clearly aimed against social

[37] On the consequences of this reform, see *Chapter 5*.

democracy and introduced a curriculum favorable to the Prussian Kings. The decree stressed the function of the school to "generate a healthy perception of the federal and social conditions by enhancing godliness and the love of the country."

The General Regulations of 1872 introduced a national curriculum for all of Prussia. More than half the standardized curriculum was devoted to ideological subjects such as religion, German language, and history. The reader, the textbook used in Prussian elementary schools,[38] stressed life in the community and encouraged patriotism (through so-called *vaterländische Erziehung*) by allowing the various region-specific readers to use the particularities of each Prussian region to evoke a feeling of homeland (*Heimat*) (Kennedy, 1997).

3.3.3 The Political Economy of the Prussian Primary School

During the German Empire, politicians struggled for more than two decades to pass a comprehensive school law that would regulate the most important aspects of the educational system, not achieving this goal until 1906. The school law as finally enacted ensured a fair distribution of the financial obligations incurred by primary schools, granted free attendance at primary school, and guaranteed teachers a fair salary (Lamberti, 1989).

Prior to the enactment of this comprehensive, nationwide school law, local school policy was decided by the local administration, the clerical school inspectors, primary school teachers, municipal authorities, school commissions and patrons (i.e. the landlords), and parents of school children, as well as by political parties. The political parties were especially influential due to their work on petitions and participation in the parliamentary discussions in regard to the school law (Kuhlemann, 1991).

The chief issues intended to be addressed by the school law were, first, who should pay for schools, second, who should have the authority over them, and third, what kind of education should be offered—religious or secular (Anderson, 1970). This latter issue mainly revolved around the possibility of interdenominational mixed schools (*Simultanschulen*) where Protestant and Catholic students were taught simultaneously.

The parties took positions on some or all of these issues. The conservative parties were chiefly interested in relieving the noble landowners from having to pay for primary schools. The National Liberal Party supported the introduction of interdenominational mixed schools and especially wanted to ensure central control over schools. The liberal parties were interested in modernizing the educational system by increasing investment in

[38] The readers were approved by the Prussian Ministry of Ecclesiastical and Education Affairs and followed a standardized structure that included a selection of core texts common to all readers.

school maintenance and construction. They opposed the denominational orientation of the current religious education and advocated for a form of religious education in which Christianity would be given historic, but only historic, significance. Furthermore, the liberal parties were in favor of handicraft instruction for boys and instruction in domestic economy for girls. The Center Party strongly opposed the introduction of interdenominational mixed schools and fought for continuance of the denominationally divided educational system. The SPD advocated for secularization of the educational system, suggesting the introduction of comprehensive schools where all students would be taught together from kindergarten up to university. The SPD also wanted to ensure free attendance at primary school for everyone (Kuhlemann, 1991).

Until the central state slowly expanded its involvement in the educational system, Prussian primary schools were mainly financed through local means. In Table 3.1, we examine the contributors to primary school funding in 1886, which was before the substantial shift to central funding took place, to investigate which segments of the population were especially burdened by funding primary schools under the local regime and consequently benefited most from central state funding. In 1886, central state funding, comprised of central state grants and funds, made up only about 12 percent of total spending on primary schools.[39] Primary schools were mostly financed by the patronage, which meant that the landed elite paid primary school expenses. One-quarter of total expenditures were covered by the landed elite, which included nearly 40 percent of teacher wages. Municipalities were also important contributors; they covered 23 percent of total school expenditures and their contribution amounted to 60 percent of building expenditures and 68 percent of maintenance expenditures. The responsibility of municipalities for the erection, maintenance, and enlargement of public primary schools was set out in Article 25 of the Imperial Constitution. Schooling societies were the third pillar of school finance**.** Schooling societies were comprised of the heads of economically independent households in a school constituency who were required to make contributions on basis of their property, regardless of whether the household contained school-age children. Schooling societies funded 19 percent of total school expenditures, covering about one-quarter of building and maintenance expenditures and a lesser amount of teacher wages. Student fees, covering 11 percent of overall expenditures, played a non-negligible role in financing primary schools. Student fees were exclusively devoted teacher wages of which they covered 18 percent. The smallest contributors to school expenses were school foundations; they contributed 9 percent of total expenses, most of which went toward teacher wages. Contributions from foundations mainly meant contributions from church foundations, reflecting the historical tie between the Prussian educational system and the church.[40]

[39] This number is slightly higher than the one shown in Table 3.3 below because the level of observation in Table 3.1 is counties, whereas it is constituencies in Table 3.3.

[40] For a detailed description of the functioning of church foundations in Brandenburg, see Moderow (2007).

Toward the end of the nineteenth century, the central state became more heavily involved in financing Prussian primary schools. After passing a law in 1886 that granted sole authority to the central state to recruit teachers in the provinces of West Prussia and Posen, central state funding of primary school in these two provinces was supposed to increase substantially: 200,000 Mark were promised for school inspection; 400,000 Mark were to be provided for teacher wages; 2 million Mark were meant to be granted for construction of primary schools (Glück, 1979).[41] Several laws increasing central state funding of primary schools were passed at the end of the 1880s. A law of 1887 allowed for central state grants to rural municipalities and small towns through the Prussian Ministry of Ecclesiastical and Education Affairs and its associated bureaucracy (Kuhlemann, 1991). The first comprehensive law paving the way toward higher central state funding throughout the entire German Empire was passed in 1888/1889. This law fixed subventions for teacher salaries, abolished school fees, and relieved landlords of their burden to fund primary schools. Unsurprisingly, the two conservative parties had strongly supported this law, as the affected landlords made up the bulk of their electorate. In light of the fact that the landlords had also been the main contributors to teacher wages they benefited substantially from the passage of this law. In 1897, the teacher pay law (*Diensteinkommensgesetz*) fixed a minimum wage that had to be paid to all Prussian teachers and simultaneously guaranteed funding of this basic teacher pay, again increasing the share of school funds stemming from central sources. The minimum wage was set at 900 Mark,[42] with the possibility of achieving seniority pay in nine steps (Kuhlemann, 1991). Finally, the school law of 1906 created a uniform legal framework for central state funding (Lamberti, 1989).

In addition to these mandated contributions from the central state, the local bureaucracy could lobby for more funding. In 1905, the head of the province of Posen von Waldow sent a detailed description of local primary school conditions and requested 30 million Mark for the construction and improvement of school buildings and the recruitment of 1,747 new teachers. He stressed that students' cultural advancement was suffering due to overcrowded classrooms and insufficient school buildings (Unruh, 1992).

[41] As the law was fully enacted in 1887, data from the education census of 1891 allow setting these investments in perspective. With overall central state spending amounting to 27.7 million Mark, the funds associated with the teacher recruitment law amounted to 9 percent of total central spending in the two provinces.

[42] Thereby teachers exactly pass the threshold of 900 Mark to pay income taxes.

Table 3.1: Composition of Educational Spending in 1886

	Total expenditures	Teacher wages	Building expenditures	Maintenance expenditures
Fee	0.114	0.175	0	0
	(0.342)	(0.651)	(0)	(0)
Foundations	0.093	0.128	0.032	0.027
	(0.431)	(0.576)	(0.615)	(0.322)
Societies	0.186	0.143	0.249	0.275
	(0.878)	(0.747)	(1)	(1)
Patronage	0.253	0.387	0.043	0
	(0.668)	(1)	(0.561)	(0)
Municipality	0.229	0	0.596	0.675
	(0.614)	(0)	(1)	(1)
Other	0.006	0	0.028	0.006
	(0.353)	(0)	(0.862)	(0.177)
State grants	0.112	0.155	0.052	0.018
	(0.488)	(0.622)	(0.727)	(0.324)
State funds	0.007	0.011	0	0
	(0.157)	(0.215)	(0)	(0)

Note: Data are from the education census of 1886. 472 observations at the county level. All figures are shares. The minimum is always 0; the maximum is shown in parentheses.

3.4 Data

Data from the Royal Statistical Office of Prussia and the Imperial Statistical Office of the German Empire, derived from the Galloway Prussia Database 1861 to 1914, are merged for this chapter to construct a dataset on both central education spending and electoral outcomes.

3.4.1 Data on *Reichstag* Elections, Educational Spending, and Controls

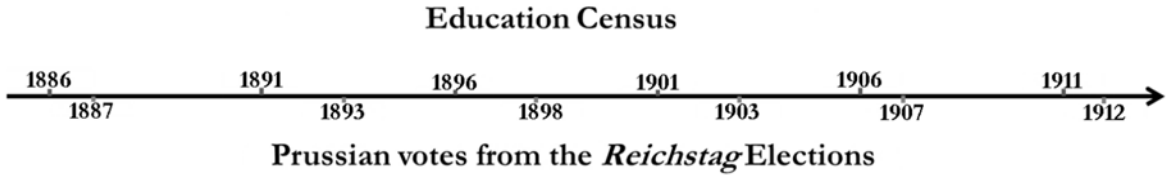
We digitized data on educational expenditures from the education censuses of 1901 to 1911 to cover the whole period of 1886 to 1911 in five-year intervals.[43] We merge these data with election data on the first ballot cast by Prussian voters in elections for the German *Reichstag* in 1887, 1893, 1898, 1903, 1907, and 1912.[44] The timing of the education census and the elections of the German *Reichstag* allow observing the political consequences of educational spending, which is illustrated in Figure 3.2.

[43] Data from the education census of 1886 are readily available through the ifo Prussian Economic History Database (iPEHD). The data from the education censuses of 1891 and 1896 were digitized for *Chapter 4* of this thesis.

[44] These variables are from the Galloway Prussia Database 1861 to 1914.

Data on the elections of the German *Reichstag* are available for 216 constituencies that remained stable over the whole period of observation. As we merge data on the *Reichstag* elections with county-level data on spending, we have to aggregate county-level data at the constituency level. Most constituencies are made up of two to four counties. However, there are instances where a municipality belongs to two adjacent constituencies. In these cases, we merge the two constituencies into one, ending with 199 constituencies in the annual sample. Consequently, we observe 199 constituencies over six points in time, resulting in 1,194 observations.

Figure 3.2: Timeline of Data on Education Census and *Reichstag* Elections



Note: Own illustration.

We construct the voter turnout by dividing the number of votes by the electorate. We construct the share of pro-nationalist votes by summing the votes for the three pro-nationalist parties—the German Conservatives, the Free Conservatives, and the National Liberals—and dividing this sum by the number of valid votes.

Data from the education censuses allow disentangling primary school funds provided by the central state from those provided locally. Furthermore, these data allow discerning the allocation of this money, that is, whether it was spent for personnel or for building purposes.

We add data from the population censuses and the agricultural and vital statistics between 1885 and 1910 to generate control variables.[45] We generate the share of people living in cities and the population density to control for the different interests and voting patterns of the urban population compared to those of the rural population. We control for the share of Protestants in the population as being Protestant conformed to the ideal Prussian citizen and we hence expect a high share of Protestants to increase participation in the elections and support for pro-nationalist parties. Along the same lines, we include the share of non-German-speaking students. The majority of non-German speakers were Poles, followed by other Slavs and Danes. Poles and other ethno-linguistic minorities longed for autonomy and therefore opposed the Prussian state. As the landed elite comprised the principal electorate of the pro-nationalist parties, we include landownership concentration in a constituency.[46] We expect landownership concentration to be positively correlated with

[45] These variables are also from the Galloway Prussia Database 1861 to 1914.

[46] On how landownership concentration affects demand for education over the nineteenth century, see Cinnirella and Hornung (2016).

both voter turnout and the vote share for pro-nationalist parties.[47] As the population working in manufacturing constituted the SPD's main electorate we consider the share of the population employed in manufacturing.[48] Lastly, in the estimations on voter turnout we include a dummy variable for whether the constituency had a run-off ballot, called "swing constituency," as a robustness check. The variable takes the value 1 if no party reached a share above 50 percent in the first round of elections and 0 otherwise. We expect that close elections, captured by the "swing constituency" dummy, increase voter turnout.

We control for voter turnout in the estimations of support for pro-nationalist parties because higher voter turnout is a possible channel for higher support of pro-nationalist parties. Finally, we include a dummy variable for whether the constituency's delegate belonged to one of the pro-nationalist parties in the previous legislative period. This variable is constructed from the results for *Reichstag* elections published by the Imperial Statistical Office (1887–1912), which include the name and the party affiliation of each candidate winning the election in the respective constituency.

[47] As data on landownership concentration are nonexistent for 1891, 1901, and 1911, we interpolate the data on landownership concentration for those years.

[48] As for landownership concentration, the occupation census provides information on the share in manufacturing only for the years 1882 (1886), 1895 (1896), and 1907 (1906), which is why we interpolate the data for the years 1891, 1901, and 1911.

3.4.2 Descriptive Statistics

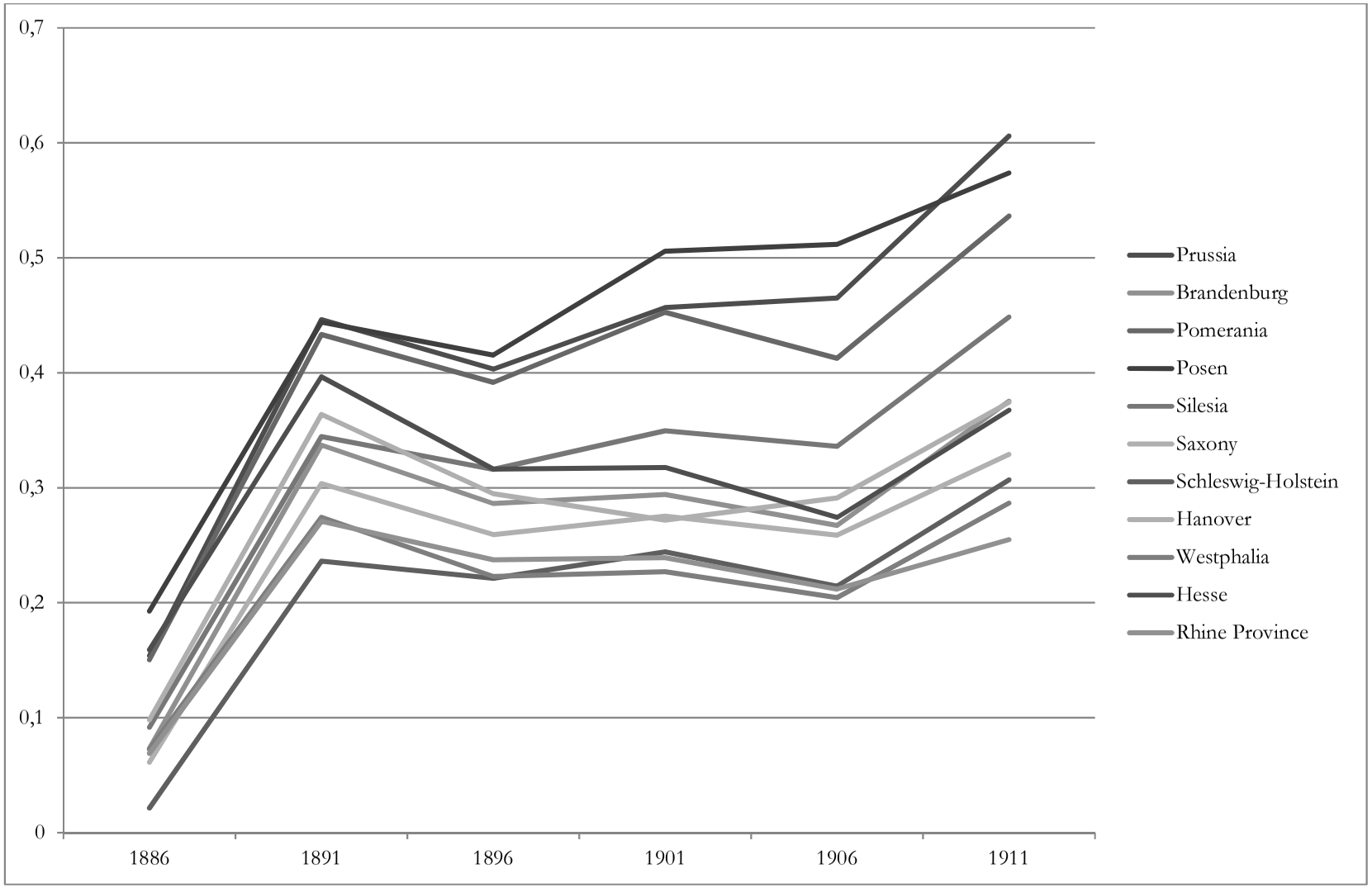
As Figure 3.3 illustrates, educational expenditures by the central state increased substantially between 1886 and 1911 with the increases being particularly high between 1886 and 1891 and between 1906 and 1911, reflecting the institutional changes described above. While primary school funding in 1886 was still chiefly local, central state expenditure increased after 1888/1889 with the so-called *Schulunterhaltungsgesetz*. The level of central state expenditure stayed stable over the period of 1891 to 1896. An increase in central state expenditure is again observed after 1897 when the first teacher pay law (*Diensteinkommensgesetz*) was introduced. Central state contributions were again stable over the period from 1901 to 1906. The last increase in central state expenditure occurred in 1911—after introduction of the first comprehensive school law for Prussia in 1906. These institutional changes can also be observed when looking at the overall increases in the share of central state spending between different years, as shown in Table 3.2. The highest shift is observed between 1886 and 1891, with an overall increase in the share of central state spending of nearly 25 percentage points. After a short overall drop between 1891 and 1896, a slight increase is observed between 1896 and 1901 when the teacher pay law was introduced. After another slight decrease between 1901 and 1906, the comprehensive school law of 1906 results in an increase in the share of central state spending of 9 percentage points. Table 3.3, setting out descriptive statistics, illustrates the secular increase in overall spending on primary schools over the period of 1886 to 1911. The average spending per student doubled over the course of those 25 years—from 23 to 57 Mark per student.

Table 3.2: Differences in the Share of Central State Spending between Years

Difference between	Mean	Std. Dev.	Minimum	Maximum
1886–1891	0.246	0.061	0.074	0.362
1891–1896	-0.041	0.033	-0.146	0.044
1896–1901	0.027	0.055	-0.116	0.196
1901–1906	-0.017	0.042	-0.142	0.168
1906–1911	0.093	0.061	-0.045	0.318
1886–1911	0.062	0.115	-0.146	0.362

Note: 199 observations.

Figure 3.3: The Share of Central State Spending by Province, 1886–1911



Note: Voter turnout is constructed as the number of votes divided by the electorate. As the province of Hohenzollern consists of only one constituency, we merge data on the provinces of Hohenzollern and Westphalia. See Appendix 3A for data sources and details.

However, there is also significant variation in the share of central state spending within each cross-section. As shown in Figure 3.3, the provinces of Posen, Prussia, and Pomerania see the highest shares of central state spending, whereas the Rhineland, Westphalia, and Schleswig-Holstein receive the lowest share of central state spending over the whole period of observation. Both Figure 3.3 and Table 3.2 show substantial variation in the increase or decrease over time. While constituencies such as Osterode-Neidenburg, Rastenburg-Friedland-Gerdauen, and Tilsit-Niederung in the province of East Prussia saw an increase in the share of central spending of more than 35 percentage points between 1886 and 1891, the increase in the share of central spending in constituencies such as the cities of Berlin, Aachen in the Rhine Province, and Magdeburg in Saxony was below 10 percentage points.[49] Between 1891 and 1896, and 1901 and 1906, constituencies such as Tecklenburg-Steinfurt-Ahaus in Westphalia, Stolp-Lauenburg in Pomerania, and Görlitz-Lauban in Silesia experienced decreases in the share of central state spending of more than 13 percentage points, while other constituencies such as Preußisch-Holland-Mehrungen and Rastenburg-Friedland-Gerdauen in East Prussia experienced increases of the same magnitude between 1901 and 1906. This substantial variation is possibly not completely explained by the institutional regime changes.

Voter turnout varies over time and space, as can be seen in Figure 3.4. A drop in voter turnout is observed in all provinces for the elections of 1898. However, voter turnout recovered and exceeded 80 percent in all provinces of Prussia in the subsequent elections. The high voter turnout, despite the rather mediocre role of the *Reichstag*, is explained by historians as a manifestation of the *duty* to participate in elections (*Partizipationspostulat*). Put differently, the right to vote was in actuality more understood as an obligation to vote (Kühne, 1997).

Pro-nationalist parties see a sharp decline in support between the elections of 1887 and 1898, decreasing from about 50 percent of the vote share to about 30 percent on average. After 1898, the vote share for pro-nationalist parties levels off at about 35 percent. As shown in Figure 3.5, the highest vote shares for the pro-nationalist parties are found in Pomerania, which was dominated by the landed elite, and thus a stronghold of pro-nationalist parties. The second highest support comes from the province of Prussia, which can be explained by understanding that this area was the heart of Prussia and also characterized by high landownership concentration. Very low support comes from the provinces of Posen, Westphalia, and the Rhineland. Predominantly Catholic Westphalia and the Rhine Province were strongholds of the Center Party. In Posen, home to a large Polish-speaking population, a majority of voters unsurprisingly supported the Polish party.

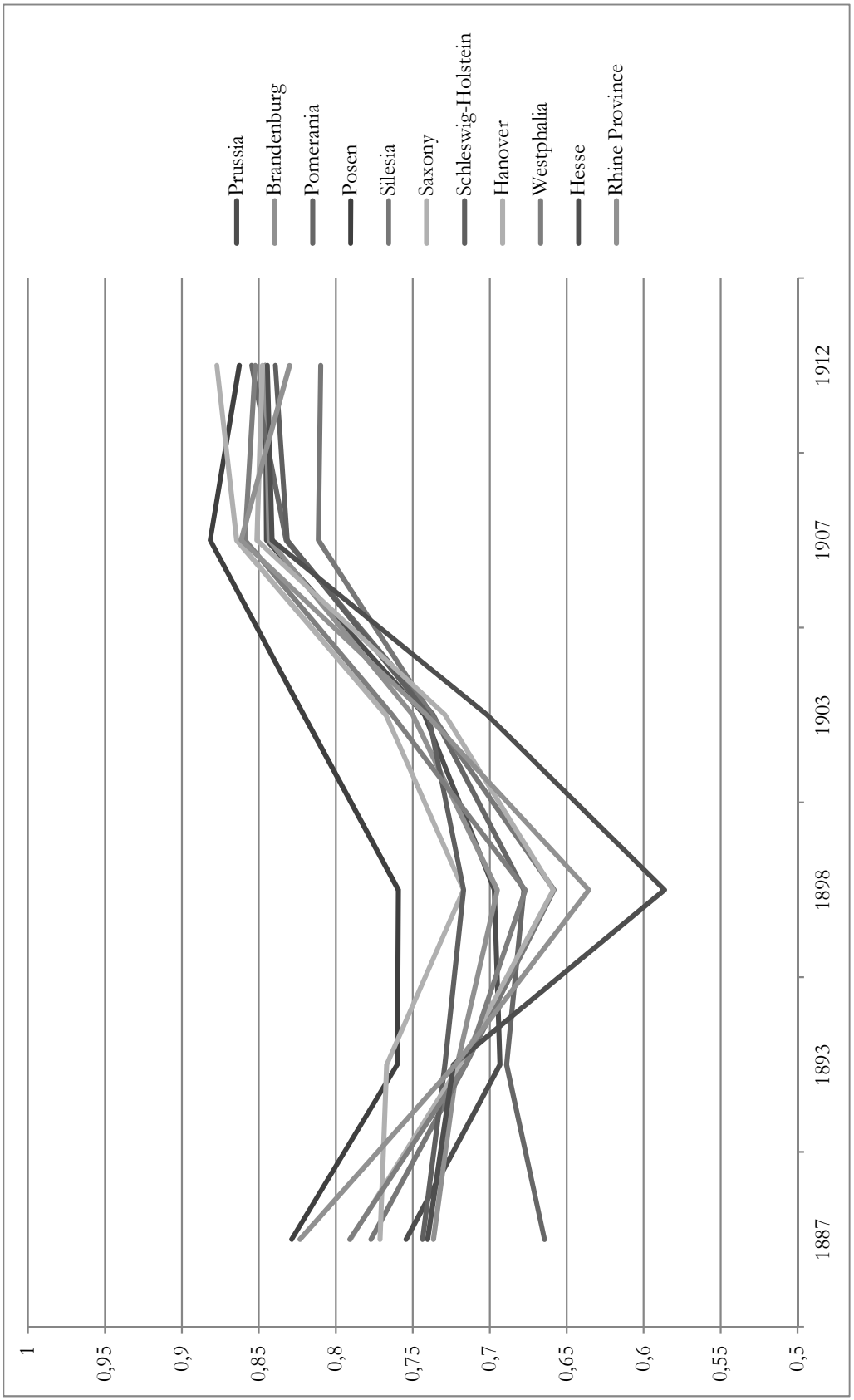
[49] This observation makes accounting for the share of the urban population even more important.

Table 3.3: Descriptive Statistics

	1886	1891	1896	1901	1906	1911
PANEL A: Outcomes						
Voter turnout	0.771	0.722	0.678	0.750	0.847	0.843
	0.081	*0.075*	*0.109*	*0.084*	*0.050*	*0.056*
Pro-nationalist vote (share)	0.492	0.359	0.319	0.326	0.355	0.330
	0.251	*0.235*	*0.229*	*0.226*	*0.246*	*0.260*
PANEL B: Variables of interest (spending on primary education)						
Expenditures per student	22.579	27.454	32.633	41.669	45.558	57.479
	7.402	*7.242*	*8.629*	*14.007*	*13.513*	*12.662*
Building expenditures per student	3.515	3.776	5.393	6.370	6.080	8.406
	3.001	*2.353*	*3.016*	*7.150*	*5.284*	*5.880*
Personnel expenditures per student	19.064	23.678	27.240	35.299	39.477	49.073
	5.115	*5.828*	*6.646*	*8.741*	*10.284*	*12.078*
Central (share)	0.104	0.351	0.310	0.337	0.320	0.413
	0.074	*0.112*	*0.105*	*0.142*	*0.146*	*0.186*
Central (share) buildings	0.056	0.070	0.052	0.191	0.206	0.180
	0.080	*0.084*	*0.077*	*0.191*	*0.202*	*0.187*
Central (share) personnel	0.111	0.391	0.356	0.358	0.336	0.457
	0.078	*0.119*	*0.114*	*0.142*	*0.146*	*0.207*
PANEL C: Controls						
Urban (share)	0.321	0.327	0.336	0.349	0.362	0.372
	0.197	*0.198*	*0.199*	*0.201*	*0.203*	*0.206*
Population density	3.134	3.524	3.792	4.254	4.499	4.591
	15.775	*18.708*	*19.894*	*22.409*	*23.871*	*24.126*
Protestant (share)	0.605	0.602	0.601	0.599	0.596	0.594
	0.366	*0.363*	*0.362*	*0.359*	*0.356*	*0.352*
Non-German students (share)	0.131	0.131	0.133	0.130	0.129	0.131
	0.255	*0.255*	*0.258*	*0.251*	*0.248*	*0.251*
Landownership concentration	0.008	0.021	0.033	0.026	0.020	0.029
	0.008	*0.025*	*0.042*	*0.033*	*0.025*	*0.044*
Employed in manufacturing (share)	0.118	0.126	0.130	0.142	0.151	0.212
	0.055	*0.058*	*0.061*	*0.065*	*0.069*	*0.122*
Swing constituencies (dummy)	0.156	0.392	0.191	0.422	0.382	0.462
	0.364	*0.489*	*0.394*	*0.495*	*0.487*	*0.500*
Pro-nationalist delegate (dummy)	0.454	0.550	0.432	0.387	0.403	0.423
	0.493	*0.493*	*0.489*	*0.480*	*0.483*	*0.490*
Linguistic polarization	0.200	0.202	0.201	0.209	0.215	0.221
	0.342	*0.341*	*0.335*	*0.335*	*0.331*	*0.327*
Religious polarization	0.422	0.435	0.441	0.449	0.460	0.469
	0.330	*0.327*	*0.325*	*0.320*	*0.314*	*0.309*

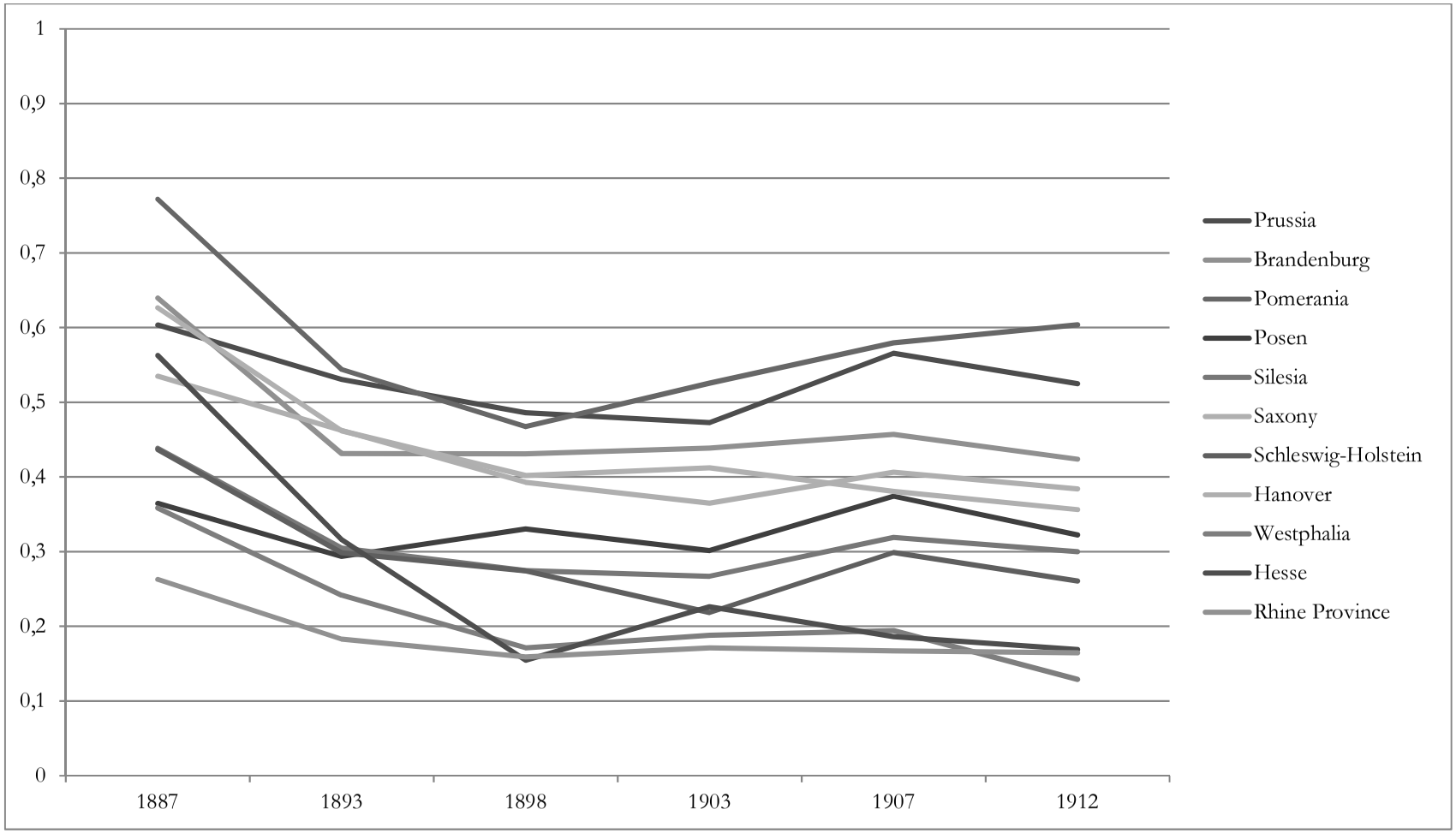
Note: Descriptive statistics of selected key variables (n=199). Standard deviation in italics. See Appendix 3A for data sources and details.

Figure 3.4: Voter Turnout by Province, 1887–1912



Note: Voter turnout is constructed as the number of votes divided by the electorate. As the province of Hohenzollern consists of only one constituency, we merge data on the provinces of Hohenzollern and Westphalia. See Appendix 3A for data sources and details.

Figure 3.5: Share of Pro-Nationalist Votes by Province, 1887–1912



Note: The share of pro-nationalist votes is constructed by summing votes for the Free Conservative Party, the German Conservative Party, and the National Liberal Party and then dividing this sum by the total number of valid votes. As the province of Hohenzollern consists of only one constituency, we merge data on the provinces of Hohenzollern and Westphalia. See Appendix 3A for data sources and details.

For the covariates, both the urban share and population density nicely illustrate the movement to the cities toward the turn of the century. Similarly, the share of the population employed in manufacturing mirrors the increasing industrialization. The share of people employed in manufacturing doubles from roughly 10 to 20 percent between 1886 and 1911.[50] The fairly persistent high share of pro-nationalist delegates in the *Reichstag* shows that pro-nationalist parties continued to win constituencies even though the overall support for their parties decreased, a phenomenon explained by the majority voting system where the pro-nationalist candidates often managed to win the run-off ballots.

3.5 Panel Estimates

The panel structure of the data allows estimating a model with constituency-fixed effects to examine the relationship between educational expenditures and voter turnout and the share of pro-nationalist votes, respectively. The fixed-effects model accounts for time-invariant unobserved characteristics of each constituency. For example, it could be the case that certain constituencies had a persistently more active civil society, leading to higher voter turnout. Or, certain constituencies may have experienced particularly dominant, charismatic pro-nationalist politicians in the past, leaving a legacy of voting pro-nationalist.[51] These time-invariant characteristics are captured by the constituency-fixed effects. Another concern has to do with reversed causality. Constituencies with a higher pro-nationalist vote share might be rewarded by a higher share of state spending. Furthermore, time-variant unobserved events might have an impact on electoral outcomes. For example, other investments by the central state, such as in roads or poor relief might equally influence electoral outcomes. If these investments are positively correlated with central state investments in primary school, we might overestimate the relationship between the share of central state spending and electoral outcomes. These potential problems—reversed causality and unobserved time-variant characteristics—cannot be captured by constituency-fixed effects.

By looking at central state educational spending and subsequent voting decisions with a one- to two-year lag, we implicitly assume that investment in the educational system had an almost immediate effect on voting decisions. As Prussia at the time was a country with low childlessness, we expect educational affairs to be a salient topic to a majority of

[50] Note that opposed to *Chapter 2*, the share employed in manufacturing is constructed by the number of workers in manufacturing over the total population of a constituency. This explains why the share employed in manufacturing is lower than in *Chapter 2*. However, both measures are highly correlated and defining the variable by the number of workers in manufacturing over the total workforce of a constituency as in *Chapter 2* does not affect the results.

[51] We partly capture this by including a dummy variable for whether the candidate elected in the previous elections belonged to a pro-nationalist party. However, this does not account for the possibility of historical figures who influenced the attitudes of the population beyond their particular "reign".

voters being family heads. Equally every citizen was subjected to some type of taxes and could therefore have an interest on how his money was spent.[52] We first look at overall spending on education and its association with the two outcome variables to see whether there is a general association between the level of spending and voting behavior. In a second step we look at our main specification, this time including the share of central state expenditures. The estimation equation for our main specification is:

$$Y_{it} = \alpha + \beta_1 c_{it} + \beta_2 s_{it} + \beta_3 X_{it} + \alpha_i + c_t + u_{it} \qquad (3.1)$$

where Y_{it} denotes voter turnout and the vote share for pro-nationalist parties in constituency *i* in year *t*, respectively. c_{it} denotes the share of central state expenditures out of total educational expenditures, while s_{it} denotes the log total expenditures per student. We expect a higher share of central state expenditures to increase loyalty to the state because it first, relieved local authorities from funding primary schools and second, allowed for a more direct control of the central state on educational affairs while local funding allowed for more autonomy. Therefore, we expect a higher share of central state expenditures to increase both voter turnout and the share of votes for pro-nationalist parties. *X* denotes the vector of controls, which include the urban share, the population density, the share of Protestants, the share of non-German-speaking students, landownership concentration and the share of the total population employed in manufacturing. We additionally include the dummy variable for whether a run-off ballot took place in the constituency in the estimations on voter turnout. As mentioned above, in the estimations on support for pro-nationalist parties, we additionally control for voter turnout and whether the delegate in the previous legislative period belonged to a pro-nationalist party. α_i denotes constituency-specific-fixed effects, c_t denotes year-fixed effects, and u_{it} denotes the error term.

[52] In Section 3.5.5 we relax this assumption by introducing a dynamic model allowing examining the effect of shifts in central education spending on voting decisions of students once they reach official voting age.

3.5.1 Voter Turnout

Columns 1 and 2 of Table 3.4 show that the overall spending level and voter turnout are not related. Consequently, we find no support for the classical pork barrel hypothesis in our context. As Section 3.3.3 showed, a majority of spending for primary schools came from local revenues, ranging from financial support by the noble landlords to parental contributions through school fees. Being raised by the local population, these funds were unlikely to be viewed as government support by voters. Naturally, central state funding also came from the Prussian population as it was raised through taxes, but this sort of funding was much more likely to be viewed as coming from the central state directly. Indeed, the *Neueste Mittheilungen* stressed that the tax reform of 1887 was especially meant to relieve local authorities from funding primary schools (Klee, 1888, vol. 8, no. 42). As money being spent on schools is one of the major channels for redistribution from the rich to the poor and should have affected the majority of the voters in a society where childlessness was rare, we investigate whether, and if so, how, central state spending shaped voter preferences.

Columns 3 and 4 of Table 3.4 show results from the cross-section, that is, without accounting for constituency-fixed effects, depicting the association between the share of central state spending and voter turnout. The association is positive and significant. Here, a positive association between overall expenditures per student and voter turnout is found in the parsimonious model in Column 3. However, this positive relationship disappears as soon as covariates are included in Column 4.

Columns 5 to 9 of Table 3.4 show results from the panel-fixed effects model. The association between the share of central state spending and voter turnout is positive, and higher than in the cross-sectional estimations. The coefficient doubles in the parsimonious specifications (Columns 3 and 5) and increases slightly in the full specification (Columns 4 and 8).

The association between central state spending and voter turnout decreases slightly once controlling for the share of people employed in manufacturing and for landownership concentration, which correlates positively and strongly with voter turnout. Upon inclusion of those two covariates, the significance level drops from 5 to 10 percent. Whether the constituency ran a second ballot or not, captured by the swing constituency dummy in Column 8, does not affect the results. In Column 9, we include constituency-specific time trends. The positive association halves and is no longer significant. This specification, however, is very demanding as constituency-specific time trends might be correlated with other covariates, resulting in multicollinearity. Moreover, constituency-specific time trends might absorb too much of the variance in voter turnout to detect any significant

results. We therefore consider Column 7 our preferred specification.[53] Increasing the share of central spending from 0 to 1,[54] is associated with an increase in voter turnout of 7 percentage points. Given the average voter turnout ranging between 68 and 85 percent over the 25 years of observation and the central state share increasing by 6 percentage points between two years on average, this is a plausible increase.

[53] As the swing constituency dummy is itself an outcome of the elections and including the control variable does not alter the results, we follow the specification in Column 7 below.

[54] We never observe such an increase.

Table 3.4: Spending on Education and Voter Turnout

Dep. Var.: Voter Turnout	(1) Pork Barrel Spending (Constituency-Fixed Effects)	(2)	(3) Central State Spending (Cross-Section)	(4)	(5)	(6)	(7) Central State Spending (Constituency-Fixed Effects)	(8)	(9)
Central spending			0.045**	0.063**	0.094***	0.087**	0.071*	0.071*	0.034
			(0.019)	(0.028)	(0.036)	(0.037)	(0.040)	(0.039)	(0.044)
Expenditures per student (log)	0.001	-0.003	0.024*	0.020	0.009	0.007	0.008	0.008	0.001
	(0.019)	(0.018)	(0.013)	(0.015)	(0.018)	(0.019)	(0.019)	(0.019)	(0.019)
Urbanization	-0.082	-0.093		0.025		-0.064	-0.071	-0.070	-0.086
	(0.060)	(0.062)		(0.024)		(0.060)	(0.061)	(0.062)	(0.063)
Population density	-0.000	-0.000		-0.000		-0.000	0.000	0.000	-0.000
	(0.000)	(0.000)		(0.000)		(0.000)	(0.000)	(0.000)	(0.000)
Protestant	0.052	0.146		0.002		-0.009	0.086	0.085	0.146
	(0.180)	(0.174)		(0.015)		(0.183)	(0.181)	(0.183)	(0.177)
Non-German students	-0.143	-0.129		0.013		-0.136	-0.143	-0.139	-0.130
	(0.103)	(0.100)		(0.021)		(0.102)	(0.101)	(0.102)	(0.100)
Landownership concentration	0.724***	0.674***		0.494***			0.718***	0.721***	0.680***
	(0.165)	(0.163)		(0.096)			(0.164)	(0.163)	(0.163)
Employed in manufacturing	-0.090	-0.044		0.083*			-0.028	-0.029	-0.022
	(0.059)	(0.058)		(0.045)			(0.067)	(0.067)	(0.065)
Swing constituency (dummy)		0.007		0.012***				0.006	0.007
		(0.005)		(0.004)				(0.005)	(0.005)
Constituency FE	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constituency-specific time trends	No	Yes	No	No	No	No	No	No	Yes
Observations	1194	1194	1194	1194	1194	1194	1194	1194	1194
R-squared	0.66	0.66			0.64	0.65	0.66	0.66	0.66

Note: OLS and FE estimates. The dependent variable is the voter turnout, i.e., the number of votes divided by the electorate. Central denotes the share of primary educational expenditures contributed by the central state. Expenditures per student (log) denote the logarithm of total spending on public primary education per student. Urbanization is the share of people living in cities. Population density is the number of people per hectare. Protestant denotes the share of Protestants. Non-German students denotes the share of students who speak a language other than German at home. Landownership concentration is constructed as the number of farms larger than 100 ha over the total number of farms. Values for 1891, 1901, and 1911 are interpolated. Employed in manufacturing denotes the share of people employed in manufacturing. Values for 1891, 1901, and 1911 are interpolated. Swing constituency is a dummy taking the value of 1 if none of the parties reached a vote share of over 50 percent in the first ballot. Constituency FE denotes constituency-fixed effects for 199 constituencies. Year FE denotes year-fixed effects for five years, namely, 1891, 1896, 1901, 1906, and 1911. 1886 is naturally excluded. Constituency-specific time trends denote the time trend for each constituency. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

3.5.2 Pro-Nationalist Vote Share

No significant association between overall expenditures on education and pro-nationalist votes is found, as can be seen in Columns 1 and 2 of Table 3.5. The cross-sectional results of Columns 3 and 4 show a positive and strong association between the share of central state spending and support for pro-nationalist parties. However, it is not clear whether a higher share of central state spending increases support for pro-nationalist parties or whether constituencies more supportive of those parties receive more governmental funding as a reward; alternatively, perhaps pro-nationalist delegates can successfully lobby for more central state funding. The positive coefficient on the share of non-German students hints at this reversed causality. The non-German-speaking segments of Prussian society, and of those, especially the Poles, did not favor the pro-nationalist parties, and it is well known that central state funds were especially targeted at formerly Polish regions with the aim of improving the school system in these specific regions and advancing *Germanization*. Indeed, three out of the five constituencies that experienced the highest increase in the share of central state spending between 1886 and 1911 were situated in the province of West Prussia, which formerly belonged to the Polish-Lithuanian Commonwealth.

When including constituency-fixed effects in Columns 5 to 9 of Table 3.5 the positive association slightly decreases, but remains strongly significant. That the constituency-fixed effects are able to capture historical tendencies to vote pro-nationalist is emphasized by the decrease by half of the coefficient of the pro-nationalist delegate (Columns 4 and 8).

Similar to the results on voter turnout, the coefficient decreases by almost half and loses its significance once constituency-specific time trends are included (Column 9 of Table 3.5). For the same reasons discussed above, Column 8 is our preferred specification. Increasing the share of central state spending from 0 to 1 implies an increase in the vote share for pro-nationalist parties of roughly 21 percentage points given an average vote share for pro-nationalist parties of 36 percent over the entire period of observation. The covariates reflect the traditional supporters of the pro-nationalist parties, that is, the Protestant population and constituencies with previous pro-nationalist attitudes, captured by the dummy on the pro-nationalist delegate. Constituencies with a high share of people employed in manufacturing exhibited lower support for pro-nationalist parties, because these workers tended to favor the SPD.[55] The coefficient on the share of non-German-speaking students turns negative, as expected; however, it is not significant.

[55] Voter turnout decreases support for pro-nationalist parties, though not significantly. Surprisingly, higher landownership concentration decreases the vote share for pro-nationalist parties, though not significantly in our preferred specification in Column 8. This might be because large landowners, even though possessing a high share of arable land, only constituted a small fraction of a constituency's electorate.

Table 3.5: Spending on Education and Pro-nationalist Vote Share

Dep. Var.: Pro-Nationalist Vote Share	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Pork Barrel Spending (Constituency-Fixed Effects)		Central State Spending (Cross-Section)		Central State Spending (Constituency-Fixed Effects)				
Central spending			0.383***	0.234***	0.272***	0.294***	0.212**	0.208***	0.126
			(0.055)	(0.059)	(0.073)	(0.073)	(0.083)	(0.078)	(0.086)
Expenditures per student (log)	0.006	0.009	0.043	0.009	0.037	0.043	0.027	0.040	0.024
	(0.038)	(0.037)	(0.029)	(0.029)	(0.037)	(0.037)	(0.038)	(0.036)	(0.038)
Urbanization	0.083	0.039		-0.075*		0.072	0.116	0.103	0.066
	(0.145)	(0.137)		(0.044)		(0.146)	(0.145)	(0.138)	(0.138)
Population density	-0.000	-0.001		-0.000*		0.000	0.000	-0.000	-0.000
	(0.001)	(0.001)		(0.000)		(0.001)	(0.001)	(0.001)	(0.001)
Protestant	0.699**	0.908***		0.354***		0.907***	0.801**	0.774**	0.912***
	(0.354)	(0.322)		(0.022)		(0.321)	(0.348)	(0.331)	(0.323)
Non-German students	-0.017	0.012		0.091***		-0.032	-0.019	-0.013	0.004
	(0.179)	(0.170)		(0.029)		(0.172)	(0.174)	(0.175)	(0.170)
Landownership concentration	-0.442*	-0.459*		-0.058			-0.458**	-0.350	-0.435*
	(0.232)	(0.250)		(0.151)			(0.220)	(0.228)	(0.240)
Employed in manufacturing	-0.474***	-0.311**		-0.198*			-0.290*	-0.243*	-0.230
	(0.135)	(0.131)		(0.102)			(0.152)	(0.146)	(0.146)
Voter turnout		-0.114		-0.080				-0.107	-0.117
		(0.085)		(0.065)				(0.085)	(0.085)
Pro-nationalist delegate		0.069***		0.137***				0.071***	0.069***
		(0.018)		(0.013)				(0.018)	(0.018)
Constituency FE	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Const.-spec. trend	No	Yes	No	No	No	No	No	No	Yes
Observations	1194	1194	1194	1194	1194	1194	1194	1194	1194
R-squared	0.29	0.33			0.29	0.29	0.30	0.33	0.33

Note: OLS and FE estimates. The dependent variable is the pro-nationalist vote share, i.e., the sum of votes for the Free Conservative Party, the German Conservative Party, and the National Liberal Party divided by the total number of valid votes. Central denotes the share of primary educational expenditures contributed by the central state. Total expenditures per student (log) denotes the logarithm of total spending on public primary education per student. Urbanization is the share of people living in cities. Population density is the number of people per hectare. Protestant denotes the share of Protestants. Non-German students denotes the share of students who speak a language other than German at home. Landownership concentration is constructed as the number of farms larger than 100 ha over the total number of farms. Employed in manufacturing denotes the share of people employed in manufacturing. Values for 1891, 1901, and 1911 are interpolated. Voter turnout is the number of votes divided by the electorate. Pro-nationalist delegate is a dummy variable taking the value 1 if the delegate of the previous election year was a member of the Free Conservative Party, the German Conservative Party, or the National Liberal Party. Constituency FE denotes constituency-fixed effects for 199 constituencies. Year FE denotes year-fixed effects for five years, namely, 1891, 1896, 1901, 1906, and 1911. 1886 is naturally excluded. Const.-spec. trend denotes the time trend for each constituency. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

3.5.3 Allocation of Central Spending

Our data allow distinguishing the allocation of central and local spending for particular spending categories. Therefore, we can observe which shares of expenditures for personnel[56] and buildings were contributed by the central state, thus allowing us to discover whether, in the interest of winning votes, the central state should have invested in teacher wages, which made up the largest share of personnel expenditures, or instead have focused on building new schools.

A new school built with central state funding would have been clearly visible to voters. On the other hand, teacher salaries accounted for two-thirds of primary school expenditures and higher central state contributions for personnel hence meant major relief for local authorities. In fact, the central state funded 33.5 percent of personnel expenditures, whereas it funded only 12.5 percent of building expenditures over the entire period of observation.

We therefore expect a higher share of central state spending for personnel as well as for buildings to be positively associated with voter turnout and pro-nationalist vote share. Results from estimating equation (3.1) using the share of central state spending for the respective allocation category and controlling for overall expenditures in this category for both voter turnout and the pro-nationalist vote share are shown in Table 3.6.

The associations between the shares of central spending for both allocation categories are positive, though not significant, when it comes to voter turnout, as can be seen in Columns 1 and 2 of Table 3.6. The coefficient on the share of central spending for buildings is slightly below the conventional significance level of 10 percent. As shown in Column 7 of Table 3.4, the coefficient on central spending is also only significant at the 10 percent level.[57] It seems that only joint central state spending convinces citizens to go to the ballot box.

Both the shares of central state spending for personnel and for buildings are positively and significantly associated with the pro-nationalist vote share, as shown in Columns 3 and 4 of Table 3.6. The share of central state spending for personnel increases the pro-nationalist vote share to a larger extent than does the share of central state spending for buildings. If a

[56] Expenditures for personnel also include maintenance expenditures. For the years 1906 and 1911, central expenditures for personnel and maintenance are reported in one category (*laufende Schulunterhaltungskosten*) which is why we group these two categories into one for the whole period of observation.

[57] That the coefficients on the share of central spending for personnel and for buildings do not sum up to the coefficient on the share of central state spending in Column 7 of Table 3.4 follows from the fact that the share of central state spending for personnel captures central state spending on personnel over total spending for personnel and does not equal the share of central state spending for personnel per total expenditures on primary schools.

higher share of central state spending for teachers meant that more pro-nationalist teachers were selected or that teachers became more pro-nationalist knowing that they owed increases of their salary to the central state and teachers were at the same time viewed as persons of respect (*Respektsperson*) in their communities, whose opinion and advice are considered by the local population when it comes to voting decisions (Deppisch and Meisinger, 1992), this might have influenced voting toward the pro-nationalist parties.

Table 3.6: Allocation of Central Spending

	(1)	(2)	(3)	(4)
Dep. Var.:	Voter Turnout		Pro-Nationalist Vote Share	
Allocation category	Share Central for *Personnel*	Share Central for *Buildings*	Share Central for *Personnel*	Share Central for *Buildings*
Share central for respective	0.039	0.019	0.163**	0.070***
allocation category	(0.037)	(0.012)	(0.077)	(0.027)
Expenditures for respective	0.008	0.002	0.011	0.007
allocation category (log)	(0.019)	(0.003)	(0.044)	(0.006)
Urbanization	-0.075	-0.082	0.115	0.076
	(0.061)	(0.059)	(0.141)	(0.131)
Population density	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)
Protestant	0.072	0.060	0.731**	0.693**
	(0.183)	(0.178)	(0.337)	(0.333)
Non-German students	-0.137	-0.152	0.002	-0.053
	(0.100)	(0.103)	(0.175)	(0.183)
Landownership concentration	0.721***	0.729***	-0.359	-0.318
	(0.164)	(0.165)	(0.232)	(0.241)
Employed in manufacturing	-0.053	-0.081	-0.276*	-0.391***
	(0.069)	(0.059)	(0.149)	(0.130)
Voter turnout			-0.101	-0.105
			(0.085)	(0.084)
Pro-nationalist delegate			0.071***	0.072***
			(0.018)	(0.018)
Constituency FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	1194	1194	1194	1194
R-squared	0.66	0.66	0.32	0.33
Mean (in %) of respective *allocation category*	33.5	12.5	33.5	12.5

Note: FE estimates. The dependent variable is voter turnout, i.e., the number of votes divided by the electorate in Columns 1 and 2 and the pro-nationalist vote share, i.e., the sum of votes for the Free Conservative Party, the German Conservative Party, and the National Liberal Party divided by the total number of valid votes in Columns 3 and 4. Share central for respective *allocation category* denotes the share of primary educational expenditures contributed by the central state for *personnel* expenditures in Columns 1 and 3 and for *building* expenditures in Columns 2 and 4. Total expenditures per student (log) denotes the logarithm of total spending on public primary education per student. Urbanization is the share of people living in cities. Population density is the number of people per hectare. Protestant denotes the share of Protestants. Non-German students denotes the share of students who speak a language other than German at home. Landownership concentration is constructed as the number of farms larger than 100 ha over the total number of farms. Employed in manufacturing denotes the share of people employed in manufacturing. Values for 1891, 1901, and 1911 are interpolated. Voter turnout is the number of votes divided by the electorate. Pro-nationalist delegate is a dummy variable taking the value 1 if the delegate of the previous election year was a member of the Free Conservative Party, the German Conservative Party, or the National Liberal Party. Constituency FE denotes constituency-fixed effects for 199 constituencies. Year FE denotes year-fixed effects for five years, namely, 1891, 1896, 1901, 1906, and 1911. 1886 is naturally excluded. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

3.5.4 Subgroup Analysis

Did the composition of school expenditures align certain segments of the society with the Prussian ideal or did it simply strengthen the support of those who had already internalized this ideal? Prussian society at the turn of the century was polarized socially, denominationally, and ethno-linguistically. While nation building worked mainly through demarcation—against the Social Democrats, the Catholics, and the Poles—landlords in rural areas, the Protestant clergy, and local politicians managed to influence the views of the local population, an endeavor supported by the growing impact of the press (Kühne, 1997). Glück (1979) states that the Prussian Junkers, the Polish aristocracy, the Catholic Church, conservative local governments and administrations and the army were the main interest groups involved in school policy.

Gradstein and Justman (2005) argue that public education promotes assimilation of minorities. As the Prussian authorities understood school as an integration tool, we want to examine whether central state expenditures proved especially effective in regions with a high share of a particular minority group, on the one hand, or particular interest groups supportive of the Prussian state, on the other.

To examine this issue, we look at constituencies with a high share of non-German-speaking students, a high share of Catholics, and a high share of people employed in manufacturing, all of which were minorities who did not match the ideal of a Prussian citizen. Furthermore, we observe two measures of how polarized a constituency was: linguistic and religious polarization. We also look at highly urbanized constituencies, constituencies with high landownership concentration, constituencies with a pro-nationalist delegate, and swing constituencies. We examine how these subgroups of society reacted to a higher share of central state funding. We therefore estimate the following estimation equation:

$$Y_{it} = \alpha + \beta_1 c_{it} + \beta_2 s_{it} + \beta_3 g_{it} + \beta_4 (g * c)_{it} + \beta_5 X_{it} + \alpha_i + c_t + u_{it} \qquad (3.2)$$

where the notation follows that of Equation (3.1). One by one, we add the interaction term $(g * c)_{it}$, interacting the share of central state expenditures with the share of the respective subgroup.

With voter turnout as the dependent variable in Panel A of Table 3.7, the interaction terms for both the share of non-German students (Column 1) and the share of Catholics (Column 2) are negative and significant. The coefficient on the share of central state spending measuring the effect of the share of central state spending in constituencies that are constituted of only German students is positive, albeit not significant. Increasing the share of central state spending from 0 to 1 in a constituency that consists of exclusively non-

German-speaking students decreases voter turnout by roughly 9 percentage points. The two coefficients measuring the interaction of the share of central state spending and polarization, set out in Columns 4 and 5, are also negative and significant. Given that the share of central state spending in constituencies with no polarization increases voter turnout by 9 and 13 percentage points, respectively, the overall decrease in fully polarized constituencies in linguistic terms is at 3 percentage points and stays positive at 5 percentage points in constituencies with full religious polarization.

A higher share of central state spending in highly urban constituencies increases voter turnout (Column 6 of Table 3.7). The same holds for constituencies with a pro-nationalist delegate. No significant associations are found for the interaction of the share of central state spending with the share employed in manufacturing (Column 3), landownership concentration (Column 7), or swing constituencies (Column 9).

Panel B of Table 3.7 sets out the results on the interaction terms for the pro-nationalist vote share. The interaction terms on the share of central state spending and non-German students (Column 1) and the share of Catholics (Column 2) are positive and highly significant. In constituencies with only non-German students (Catholics), shifting the share of central spending from 0 to 1 increases the support for pro-nationalist parties by 31 (32) percentage points. Similarly, a higher share of central state funds seems to win support for pro-nationalist parties in highly polarized constituencies (Columns 4 and 5).

The coefficient on the interaction of the share of central state spending and the share of people employed in manufacturing is negative, though only marginally significant, whereas no significant associations are found for the interaction with the urban share, landownership concentration, or pro-nationalist delegate. We do not show results on the interaction of the share of central state spending and the swing constituency dummy for the pro-nationalist vote share as the swing constituency dummy is constructed from vote shares itself.

Overall, constituencies with a high share of groups that, traditionally, were not supporters of pro-nationalist parties, namely, non-German speakers, Catholics, and constituencies with high linguistic and religious polarization, increase their support for pro-nationalist parties.

Table 3.7: Subgroup Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Subgroup	*Non-German Students*	*Catholics*	*Employed in Manufacturing*	*Linguistic Polarization*	*Religious Polarization*	*Urbanization*	*Landownership Concentration*	*Pro-Nationalist Delegate*	*Swing Constituency*
PANEL A: Dep. Var. Voter turnout									
Central x *Subgroup*	-0.175**	-0.321***	-0.098	-0.123***	-0.120**	0.286**	0.653	0.156***	0.046
	(0.069)	(0.034)	(0.184)	(0.045)	(0.047)	(0.138)	(0.681)	(0.030)	(0.028)
Central	0.082	0.133***	0.049	0.092*	0.125**	0.013	-0.020	-0.053	0.020
	(0.051)	(0.044)	(0.053)	(0.053)	(0.052)	(0.047)	(0.050)	(0.042)	(0.044)
Subgroup	-0.058	0.100***	-0.003	0.072	0.227***	-0.145**	0.407	-0.057***	-0.008
	(0.117)	(0.017)	(0.075)	(0.061)	(0.063)	(0.070)	(0.314)	(0.011)	(0.009)
R-squared	0.67	0.69	0.66	0.67	0.67	0.66	0.66	0.68	0.66
PANEL B: Dep. Var. Pro-nationalist vote share									
Central x *Subgroup*	0.256***	0.288***	-0.702*	0.145*	0.267***	-0.049	1.265	-0.091	
	(0.098)	(0.076)	(0.365)	(0.084)	(0.095)	(0.239)	(1.019)	(0.056)	
Central	0.057	0.032	0.224**	0.061	-0.013	0.135	0.083	0.176*	
	(0.095)	(0.090)	(0.093)	(0.100)	(0.106)	(0.094)	(0.099)	(0.091)	
Subgroup	-0.106	-0.096***	-0.092	0.077	0.019	0.076	-0.958*	0.096***	
	(0.176)	(0.031)	(0.146)	(0.074)	(0.189)	(0.145)	(0.519)	(0.025)	
R-squared	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	
Constituency FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constituency specific time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Ye	Yes	Yes	Yes	Yes	Yes
Observations	1194	1194	1194	1194	1194	1194	1194	1194	1194
Mean of *Subgroup* (%)	13.1	32.3	14.6	20.8	44.6	34.5	2.3	44.2	33.4

Note: FE estimates. For the definition of the variables, see notes to previous tables. Linguistic polarization is measured through the polarization index as in Equation (4.1). For the linguistic groups included, see Appendix 3A. Religious polarization is similarly measured through the polarization index as in Equation (4.1) and is based on five religious groups as reported in the population censuses: Protestants, Catholics, other Christians, Jews, and other religion. Constituency FE denotes constituency-fixed effects for 199 constituencies. Year FE denotes year-fixed effects for five years, namely, 1891, 1896, 1901, 1906, and 1911. 1886 is naturally excluded. Constituency-specific time trends denote the time trend for each constituency. Controls include urbanization, population density, Protestant, non-German students, landownership concentration, employed in manufacturing—respectively excluding the main effect from the list of covariates. Estimations in Panel B additionally include voter turnout and a dummy variable whether the delegate elected in the previous election was pro-nationalist. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

3.5.5 A Dynamic Approach

To this point, we have looked at the association between spending and voting outcomes in the upcoming elections (with a one- or two-year lag between observed spending and electoral outcomes). As described in Section 3.3.2, school was used as a way of imbedding Prussian values in students. Did this indoctrination work? Do we see higher voter turnout and a higher vote share for pro-nationalist parties in constituencies that experienced higher central state spending when the respective student cohorts were finally eligible to vote?

Men were eligible to vote at age 25. Thus, the youngest students of a cohort (being between 6 and 14 years old) entered the electorate 19 years later. We observe parts of a student cohort in the electorate after 15 years, that is, with a lag of 3 as our data are measured in five-year intervals. By applying a lag model, we assume that first-time voters had a particular impact on electoral results. Students of 1886 vote in the elections of 1903 for the first time and students of 1891 and 1896 are first-time voters in the elections of 1907 and 1912, respectively. The lag of 3 is especially interesting because it allows observing the great shift in the share of central state spending between 1886 and 1891 and its consequences on students who were taught under the old regime of 1886 and those taught under the new regime of 1891 (and 1896).[58] Note that not only did the share of central state spending increase tremendously, but also that by the Royal Decree of Wilhelm II, the school had been declared an instrument to fight social democracy and foster Prussian virtues.

Lag 4 allows measuring the differences between electoral outcomes of students of 1891 and 1896 voting in the elections of 1907 and 1912. As the share of central state spending remained stable between 1891 and 1896—with an overall decrease of only 4 percent—there is not much variation that can be exploited here. If there is any effect of the share of central state spending on the electoral outcomes of future students, we expect to observe this with a lag of 3.

The estimations on voter turnout, shown in Table 3.8, do not show any positive associations between the lags and voter turnout. However, the negative coefficient observed for lags 1 and 2 turns positive in lag 3 and remains positive in lag 4. This is found for the share of central state spending overall (Panel A) as well as when central state spending is decomposed into the share of spending for personnel (Panel B) and the share of spending for buildings (Panel C).

[58] According to a rough estimate, one student cohort could make up about one-third of the electorate once all students of the respective cohort achieved legal voting age.

Table 3.8: Dynamic Model for Voter Turnout

Dep. Var.: Voter Turnout	(1)	(2) Lag 1	(3) Lag 2	(4) Lag 3	(5) Lag 4
			PANEL A: Share Central Overall		
Central spending	0.071*	-0.019	-0.085	0.031	0.097
	(0.040)	(0.045)	(0.065)	(0.067)	(0.090)
Expenditures per student (log)	0.008	-0.003	-0.027	-0.018	-0.017
	(0.019)	(0.021)	(0.029)	(0.038)	(0.033)
R-squared	0.66	0.75	0.78	0.70	0.13
			PANEL B: Share Central for Personnel		
Share central for personnel	0.039	-0.025	-0.065	0.058	0.051
	(0.037)	(0.052)	(0.066)	(0.069)	(0.087)
Expenditures / student for personnel	0.008	-0.014	-0.072*	-0.083*	0.005
	(0.019)	(0.028)	(0.038)	(0.046)	(0.052)
R-squared	0.66	0.75	0.78	0.71	0.12
			PANEL C: Share Central for Buildings		
Share central for buildings	0.019	-0.003	-0.016	0.015	0.022
	(0.012)	(0.014)	(0.021)	(0.044)	(0.047)
Expenditures / student for buildings	0.002	0.001	0.001	0.008	-0.005
	(0.003)	(0.003)	(0.005)	(0.008)	(0.007)
R-squared	0.66	0.75	0.77	0.70	0.12
Controls	Yes	Yes	Yes	Yes	Yes
Constituency FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1194	995	796	597	398

Note: FE estimates. For the definition of the variables, see notes to previous tables. Constituency FE denotes constituency-fixed effects for 199 constituencies. Year FE denotes year-fixed effects for five years, namely, 1891, 1896, 1901, 1906, and 1911. 1886 is naturally excluded. Controls include urbanization, population density, Protestant, non-German students, landownership concentration, and employed in manufacturing. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

Table 3.9 shows the results of the dynamic model for the pro-nationalist vote share. Here, we can clearly see the "indoctrination effect" for lag 3 in Column 4. A higher share of central state spending clearly increases support for pro-nationalist parties (Panel A). If we decompose central state spending into personnel and building expenditures, it becomes evident that it is the share of central state spending on teachers that is driving this effect (Panel B). The share of building expenditures contributed by the central authorities affects the pro-nationalist vote share only immediately, which indicates a classical pork barrel situation where investments are made to secure votes (Panel C). This finding emphasizes the teacher's role in conveying pro-nationalist attitudes to the students. As we learned in Section 3.3.3 that central state funds were likely to be conditioned on more control by central authorities, it might well be that a higher share of central state spending reflects a faculty more in line with pro-nationalist values and more willing to teach those values. Teachers were viewed as a special type of public servant. They were not allowed to embroil themselves in party politics, but were expected to cast their ballots for the right-wing parties supportive of the government's policies (Deppisch and Meisinger, 1992). Receiving more money from the central authorities, possibly increasing teacher salaries, might have motivated teachers to use the curriculum mandated by the General Regulations of 1872 as well as to follow the specific guidelines articulated by Wilhelm II in his Royal Decree.

Table 3.9: Dynamic Model for Pro-nationalist Vote Share

Dep. Var.: Pro-Nationalist Vote Share	(1)	(2) Lag 1	(3) Lag 2	(4) Lag 3	(5) Lag 4
		PANEL A: Share Central Overall			
Central spending	0.208***	0.092	0.117	0.337**	-0.073
	(0.078)	(0.086)	(0.127)	(0.171)	(0.254)
Expenditures per student	0.040	0.044	-0.027	-0.022	0.031
	(0.036)	(0.046)	(0.053)	(0.068)	(0.111)
R-squared	0.33	0.08	0.07	0.08	0.07
		PANEL B: Share Central for Personnel			
Share central for personnel	0.163**	0.124	0.092	0.446**	-0.113
	(0.077)	(0.097)	(0.134)	(0.173)	(0.264)
Expenditures per student for personnel	0.011	0.069	-0.044	-0.080	-0.128
	(0.044)	(0.073)	(0.075)	(0.124)	(0.193)
R-squared	0.32	0.08	0.07	0.09	0.08
		PANEL C: Share Central for Buildings			
Share central for buildings	0.070***	-0.004	0.044	-0.074	0.041
	(0.027)	(0.039)	(0.046)	(0.107)	(0.163)
Expenditures per student for buildings	0.007	0.000	-0.004	0.001	0.021
	(0.006)	(0.007)	(0.009)	(0.016)	(0.026)
R-squared	0.33	0.07	0.07	0.06	0.08
Controls	Yes	Yes	Yes	Yes	Yes
Constituency FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1194	995	796	597	398

Note: FE estimates. For the definition of the variables, see notes to previous tables. Constituency FE denotes constituency-fixed effects for 199 constituencies. Year FE denotes year-fixed effects for five years, namely, 1891, 1896, 1901, 1906, and 1911. 1886 is naturally excluded. Controls include urbanization, population density, Protestant, non-German students, landownership concentration, employed in manufacturing, voter turnout, and a dummy variable for whether the delegate elected in the previous election was pro-nationalist. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

3.6 Conclusion

In this chapter we investigate the effect of increased central state expenditures on education, reflecting a shift in the power over schools from the local to the central level, on voter turnout and pro-nationalism. We look at the effect that this increase in central state expenditures had on different subgroups of Prussian society, exploring whether it resulted in winning minorities to the Prussian cause or whether existing preferences were simply made stronger.

We digitized data on educational expenditures from the Prussian education censuses so as to cover the whole period between 1886 and 1911 in five-year intervals. We merge these data with data on elections for the German federal parliament, the *Reichstag*. We observe 199 constituencies over six years, a total of almost 2,000 observations.

The panel structure of the data allows estimating a model with constituency-fixed effects. Time-invariant characteristics such as the social capital of a constituency or the intensity of previous pro-nationalist feeling within a constituency are thereby captured.

We find that increased central state expenditure increases the vote share for pro-nationalist parties and voter turnout. We thereby demonstrate that it matters whether public funds are provided by local or central state authorities and that looking more closely into the ultimate sources of government spending might explain some conflicting results found in the literature on pork barrel spending. We furthermore show some empirical evidence in line with the stream of the historical literature which argues that the school of the Prussian Kingdom during the Imperial Empire was mainly used to produce loyal subjects, coining the term *Untertanenfabrik* (Kuhlemann, 1991).

Examining subgroup effects, we find that an increase in central state expenditure increases the pro-nationalist vote share especially in constituencies home to minorities that traditionally did not match the ideal Prussian citizen, that is, they were neither Protestant nor German. This finding suggests that increasing central state expenditure on primary education was a form of vote buying, and one that was especially effective among those segments of Prussian society that traditionally opposed the Prussian state. Further exploiting the time dimension of our data by applying a dynamic model, we show that support for pro-nationalist parties increased substantially once the student cohort affected by the increased central state spending in 1888/1889 reached voting age. Further decomposing the share of central state spending into spending on personnel and spending on buildings suggests that teachers played a key role in conveying pro-nationalist attitudes.

However, this aspect needs closer examination. For example, what role did teachers play in conveying pro-nationalist attitudes? This could be an interesting starting point for further qualitative work.

Appendix 3A Data Sources

Table A3.1: 1886/1887 Variables

Voter turnout	Number of votes divided by the electorate in 1887 (Kaiserliches Statistisches Reichsamt, 1872-1918).
Pro-nationalist vote (share)	Sum of votes for the Free Conservative Party, the German Conservative Party, and the National Liberal Party divided by the total number of valid votes in 1887 (Kaiserliches Statistisches Reichsamt, 1872-1918).
Expenditures per student	Total expenditures for public primary education per student of mandatory school age, 6–14, in 1886.
State (share)	Share of total expenditures for public primary education contributed by state grants or funds in 1886.
Urban (share)	Share of total population living in cities that held city rights in 1885 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 89).
Population density	Number of people per hectare in 1885 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 96).
Protestant (share)	Share of Protestants per total population in 1885 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 96).
Non-German students (share)	Share of non-German-speaking students per total students of mandatory school age, 6–14, in 1886.
Linguistic polarization	Linguistic polarization is measured through the polarization index as described in Equation (4.1) and is based on the linguistic groups reported in the education census in 1886: German, Polish, Lithuanian, Wendish, Slavic, Danish, and "other" language.
Landownership concentration	Share of farms larger than 100 ha arable land in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76c).
Employed in manufacturing (share)	Share of people employed in manufacturing (sector B) over total population in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76b).
Swing constituencies (dummy)	Variable takes value 1 if no party reached a share above 50 percent in the first round of elections, 0 otherwise, in 1887 (Kaiserliches Statistisches Reichsamt, 1872-1918).
Pro-nationalist delegate (dummy)	Variable takes value 1 if delegate belonged to the Free Conservative Party, the German Conservative Party, or the National Liberal Party in *Reichstag* of 1884, 0 otherwise (Kaiserliches Statistisches Reichsamt, 1872-1918).

Note: Unless otherwise specified, the data are from the Königliches Statistisches Bureau in Berlin (1861–1934, vol. 101).

Table A3.2: 1891/1893 Variables

Voter turnout	Number of votes divided by the electorate in 1893 (Kaiserliches Statistisches Reichsamt, 1872-1918).
Pro-nationalist vote (share)	Sum of votes for the Free Conservative Party, the German Conservative Party, and the National Liberal Party divided by the total number of valid votes in 1893 (Kaiserliches Statistisches Reichsamt, 1872-1918).
Expenditures per student	Total expenditures for public primary education per student of mandatory school age, 6–14, in 1891.
State (share)	Share of total expenditures for public primary education contributed by state grants or funds in 1891.
Urban (share)	Share of total population living in cities that held city rights in 1890 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 117).
Population density	Number of people per hectare in 1890 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 121a).
Protestant (share)	Share of Protestants per total population in 1890 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 121a).
Non-German students (share)	Share of non-German-speaking students per total students of mandatory school age, 6–14, in 1891.
Linguistic polarization	Linguistic polarization is measured through the polarization index as described in Equation (4.1) and is based on the linguistic groups reported in the education census in 1891: German, Polish, Kashubian, Lithuanian, Wendish, Slavic, Danish, Frisian, Walloon, and "other" language.
Landownership concentration	Interpolated.
Employed in manufacturing (share)	Interpolated.
Swing constituencies (dummy)	Variable takes value 1 if no party reached a share above 50 percent in the first round of elections, 0 otherwise, in (Kaiserliches Statistisches Reichsamt, 1872-1912).
Pro-nationalist delegate (dummy)	Variable takes value 1 if delegate belonged to the Free Conservative Party, the German Conservative Party, or the National Liberal Party in *Reichstag* of 1887, 0 otherwise (Kaiserliches Statistisches Reichsamt, 1872-1912).

Note: Unless otherwise specified, the data are from the Königliches Statistisches Bureau in Berlin (1861–1934, vol. 120).

Table A3.3: 1896/1898 Variables

Voter turnout	Number of votes divided by the electorate in 1898 (Kaiserliches Statistisches Reichsamt, 1872-1918).
Pro-nationalist vote (share)	Sum of votes for the Free Conservative Party, the German Conservative Party, and the National Liberal Party divided by the total number of valid votes in 1898 (Kaiserliches Statistisches Reichsamt, 1872-1918).
Expenditures per student	Total expenditures for public primary education per student of mandatory school age, 6–14, in 1896.
State (share)	Share of total expenditures for public primary education contributed by state grants or funds in 1896.
Urban (share)	Share of total population living in cities that held city rights in 1895 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 143).
Population density	Number of people per hectare in 1895 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 148a).
Protestant (share)	Share of Protestants per total population in 1895 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 148a).
Non-German students (share)	Share of non-German-speaking students per total students of mandatory school age, 6–14, in 1896.
Linguistic polarization	Linguistic polarization is measured through the polarization index as described in Equation (4.1) and is based on the linguistic groups reported in the education census in 1896: German, Polish, Kashubian, Lithuanian, Wendish, Slavic, Danish, Frisian, Walloon, and "other" language.
Landownership concentration	Share of farms larger than 100 ha arable land 1895. (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 142b).
Employed in manufacturing (share)	Share of people employed in manufacturing (sector B) over total population in 1895 (Kaiserliches Statistisches Reichsamt, 1872–1918, vol. 104 and 109).
Swing constituencies (dummy)	Variable takes value 1 if no party reached a share above 50 percent in the first round of elections, 0 otherwise, in 1898 (Kaiserliches Statistisches Reichsamt, 1872-1918).
Pro-nationalist delegate (dummy)	Variable takes value 1 if delegate belonged to the Free Conservative Party, the German Conservative Party, or the National Liberal Party in *Reichstag* of 1893, 0 otherwise (Kaiserliches Statistisches Reichsamt, 1872-1918).

Note: Unless otherwise specified, the data are from the Königliches Statistisches Bureau in Berlin (1861–1934, vol. 151).

Table A3.4: 1901/1903 Variables

Voter turnout	Number of votes divided by the electorate in 1903 (Kaiserliches Statistisches Reichsamt, 1872-1918).
Pro-nationalist vote (share)	Sum of votes for the Free Conservative Party, the German Conservative Party, and the National Liberal Party divided by the total number of valid votes in 1903 (Kaiserliches Statistisches Reichsamt, 1872-1918).
Expenditures per student	Total expenditures for public primary education per student of mandatory school age, 6–14, in 1901.
State (share)	Share of total expenditures for public primary education contributed by state grants or funds in 1901.
Urban (share)	Share of total population living in cities that held city rights in 1900 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 169).
Population density	Number of people per hectare in 1900 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 177).
Protestant (share)	Share of Protestants per total population in 1900 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 177).
Non-German students (share)	Share of non-German-speaking students per total students of mandatory school age, 6–14, in 1901.
Linguistic polarization	Linguistic polarization is measured through the polarization index as described in Equation (4.1) and is based on the linguistic groups reported in the education census in 1901: German, Polish, Kashubian, Masurian, Lithuanian, Moravian, Czech, Wendish, Slavic, Danish, and "other" language.
Landownership concentration	Interpolated.
Employed in manufacturing (share)	Interpolated.
Swing constituencies (dummy)	Variable takes value 1 if no party reached a share above 50 percent in the first round of elections, 0 otherwise, in 1903 (Kaiserliches Statistisches Reichsamt, 1872-1918).
Pro-nationalist delegate (dummy)	Variable takes value 1 if delegate belonged to the Free Conservative Party, the German Conservative Party, or the National Liberal Party in *Reichstag* of 1898, 0 otherwise (Kaiserliches Statistisches Reichsamt, 1872-1918).

Note: Unless otherwise specified, the data are from the Königliches Statistisches Bureau in Berlin (1861–1934, vol. 176).

Table A3.5: 1906/1907 Variables

Voter turnout	Number of votes divided by the electorate in 1907 (Kaiserliches Statistisches Reichsamt, 1872-1918, vol. 250).
Pro-nationalist vote (share)	Sum of votes for the Free Conservative Party, the German Conservative Party, and the National Liberal Party divided by the total number of valid votes in 1907 (Kaiserliches Statistisches Reichsamt, 1872-1918, vol. 250).
Expenditures per student	Total expenditures for public primary education per student of mandatory school age, 6–14, in 1906.
State (share)	Share of total expenditures for public primary education contributed by state grants or funds in 1906.
Urban (share)	Share of total population living in cities that held city rights in 1905 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 200).
Population density	Number of people per hectare in 1905 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 206a).
Protestant (share)	Share of Protestants per total population in 1905 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 206a).
Non-German students (share)	Share of non-German-speaking students per total students of mandatory school age, 6–14, in 1906.
Linguistic polarization	Linguistic polarization is measured through the polarization index as described in Equation (4.1) and is based on the linguistic groups reported in the education census in 1906: German, Polish, Kashubian, Masurian, Lithuanian, Moravian, Czech, Wendish, Slavic, Danish, and "other" language.
Landownership concentration	Share of farms larger than 100 ha arable land 1907. (Königliches Statistisches Bureau in Berlin, 1861–1934).
Employed in manufacturing (share)	Share of people employed in manufacturing (sector B) over total population in 1907 (Kaiserliches Statistisches Reichsamt, 1872–1918, vol. 204 and 209).
Swing constituencies (dummy)	Variable takes value 1 if no party reached a share above 50 percent in the first round of elections, 0 otherwise, in 1907 (Kaiserliches Statistisches Reichsamt, 1872-1918, vol. 250).
Pro-nationalist delegate (dummy)	Variable takes value 1 if delegate belonged to the Free Conservative Party, the German Conservative Party, or the National Liberal Party in *Reichstag* of 1903, 0 otherwise (Kaiserliches Statistisches Reichsamt, 1872-1918, vol. 250).

Note: Unless otherwise specified, the data are from the Königliches Statistisches Bureau in Berlin (1861–1934, vol. 209).

Table A3.6: 1911/1912 Variables

Voter turnout	Number of votes divided by the electorate in 1912 (Kaiserliches Statistisches Reichsamt, 1872-1918).
Pro-nationalist vote (share)	Sum of votes for the Free Conservative Party, the German Conservative Party, and the National Liberal Party divided by the total number of valid votes in 1912 (Kaiserliches Statistisches Reichsamt, 1872-1918).
Expenditures per student	Total expenditures for public primary education per student of mandatory school age, 6–14, in 1911.
State (share)	Share of total expenditures for public primary education contributed by state grants or funds in 1911.
Urban (share)	Share of total population living in cities that held city rights in 1910 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 200).
Population density	Number of people per hectare in 1910 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 206a).
Protestant (share)	Share of Protestants per total population in 1910 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 206a).
Non-German students (share)	Share of non-German-speaking students per total students of mandatory school age, 6–14, in 1911.
Linguistic polarization	Linguistic polarization is measured through the polarization index as described in Equation (4.1) and is based on the linguistic groups reported in the education census in 1911: German, Polish, Kashubian, Czech, English, Hungarian, Italian, Slavic, Wendish, Lithuanian, Masurian, Swedish, Moravian, Frisian, Danish, Dutch, French, and Walloon.
Landownership concentration	Interpolated.
Employed in manufacturing (share)	Interpolated.
Swing constituencies (dummy)	Variable takes value 1 if no party reached a share above 50 percent in the first round of elections, 0 otherwise, in 1912 (Kaiserliches Statistisches Reichsamt, 1872–1918, vol. 250).
Pro-nationalist delegate (dummy)	Variable takes value 1 if delegate belonged to the Free Conservative Party, the German Conservative Party, or the National Liberal Party in *Reichstag* of 1907, 0 otherwise (Kaiserliches Statistisches Reichsamt, 1872-1918).

Note: Unless otherwise specified, the data are from the Königliches Statistisches Bureau in Berlin (1861–1934, vol. 231).

Chapter 4*
The Cost of Decentralization: Linguistic Polarization and the Provision of Education

4.1 Introduction

Decentralization of public services to lower levels of government has been a policy objective in the last decade both in developed and developing countries (World Bank, 2004). Generally, it is argued that decentralization allows responding better to people's preference whereas, in a centralized system, the provision of uniform public goods does not reflect local preferences. The standard approach states that in the absence of spillovers and with heterogeneous preferences a decentralized system is to be preferred (Oates, 1972, 1999). Consistently with this view, recent studies have shown that decentralization increases the responsiveness of local governments to local needs (Faguet, 2004; Barankay and Lockwood, 2007; Galiani et al., 2008), although some effect heterogeneities have been unveiled (Galiani et al., 2008; Hanushek et al., 2013).

In this chapter we argue that heterogeneous preferences at the local level can lead to a lower provision of public goods if the system is highly decentralized. In particular we study the case of the local provision of public primary education in the presence of different linguistic groups. Nineteenth-century Prussia provides an ideal setting to address this question as it was to a large extent characterized by high linguistic polarization between Germans and Poles and had a highly decentralized educational system. Heterogeneous preferences over the local provision of primary education originated from the fact that primary education, and in particular the language of instruction, was used by the German government to *Germanize* the (mainly) Polish-speaking communities (Lamberti, 1989). Primary education was therefore seen by the Poles as a threat to their cultural identity. At the same time, German-speaking local communities might have had no interest in funding primary education with local tax revenues, as the benefits would largely accrue to non-German speaking groups (Alesina et al., 1999). All this is observed in a highly decentralized educational system as decisions on school funding were taken at the municipal level (Hühner, 1998).[59]

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* This chapter is based on joint work with Francesco Cinnirella, Ifo Institute for Economic Research.

[59] This meant explicitly that funding decisions were taken by municipalities, unions of households which were called schooling societies, school foundations or single landlords.

The first comprehensive Prussian education census in 1886 provides detailed information on expenditures on public primary education and on schooling variables such as number of schools, number of teachers, and teacher salaries for the heyday of agitation against the Poles. For the same level of aggregation we have information on the language spoken by students at home which allows constructing a measure for linguistic polarization.

Cross-sectional evidence shows that, for a given level of municipal tax revenues and development, local expenditure on primary education was systematically lower in counties with high levels of linguistic polarization. Accounting for the subsidiary role of the central state and for a rich set of confounding factors does not affect our main result. Consistently, we find that higher levels of polarization were associated with a lower number of schools per students and a lower teacher-student ratio.

A possible explanation of this result, in line with the theoretical model of Alesina et al. (1999), is that different linguistic groups of similar size had no interest in funding public primary education with local funds. In fact non-German speaking groups perceived primary education policy as a threat to their cultural identity. It is therefore possible that different linguistic groups agreed on the provision of neutral public goods, namely goods not threatening cultural identity. Indeed, we find that linguistic polarization has no bearing on local spending on transport infrastructure such as roads, canals, and railroads, which constituted another major item of public spending. These findings are also consistent with the notion that the under provision of public goods in the presence of heterogeneous preferences should be more accentuated when the group benefitting from the service is clearly identifiable (Alesina et al., 1999; Luttmer, 2001; Vigdor, 2004).

Reverse causality and the omitted variable bias do not allow interpreting our cross-sectional estimates as causal. For instance, a persistently underfunded educational system might preserve linguistic polarization, thus generating reverse causality. It is also possible that linguistic polarization and local spending on education are determined by an unobservable variable which varies across counties. We address these issues in the cross-section using an instrumental variable approach. In particular we exploit Prussia's annexation policies to identify arguably exogenous variation in linguistic polarization. The progressive territorial annexations towards Eastern Europe, such as the Partitions of Poland at the end of the eighteenth century, increased the relative number of ethnic Poles in Prussia and thus linguistic polarization. The distance of the newly acquired territories to the eastern border is thus used to identify variation in linguistic polarization. As we include province-fixed effects, annexation-fixed effects, and controls for latitude and longitude, we exploit variation in distance to the border across counties which are otherwise similar in many geographic, institutional, and socio-economic dimensions. The identification strategy therefore rests on the assumption that, conditional on the rich set of controls, distance to the eastern border affects *local* spending on primary education only through linguistic polarization.

Instrumental variable estimates confirm the negative impact of linguistic polarization on local spending on public primary education. Importantly, further specifications exclude that the estimated effect is due to the presence of a small (large) German ruling elite which opposes investments in education which would favor the large (small) non-German community. This result is consistent with our interpretation that similarly large linguistic groups opposed the funding of schools with local resources, which then led to a relative underfunding of public primary education.

Following our interpretation, centralization of educational spending could partially solve the problem of under provision in polarized societies as the public good would be financed by the central state and not through local resources. We can test this hypothesis exploiting a policy change towards centralization that occurred in Prussia between 1888 and 1889. For the municipalities the fiscal burden to fund primary education increased tremendously due to the rising number of students and teachers. With the new law the central state aimed at relieving the municipalities from this burden by increasing its contributions. In particular the state granted the municipalities a subsidy to partially cover the costs of teachers (Hühner, 1998). As a result of this policy change the share of state expenditure on primary education increased from about 10 to 35 percent between 1886 and 1891.

Therefore, we estimate the impact of centralization on the provision of primary education across different levels of linguistic polarization. In particular, we estimate a generalized difference in differences model with county and year-fixed effects. Our estimates show that after the reform *total* spending on primary education increased relatively more in polarized counties. Similarly, we find that the initial gap in the number of teachers and in the teacher-student ratio decreased substantially after the reform in polarized counties. These results are consistent with the interpretation that different linguistic groups did not want to fund public primary education with local tax revenues. Our results suggest that centralization of school funding is a possible solution to this problem.

The chapter is structured as follows: Section 4.2 surveys the related literature. Section 4.3 sets out the historical background. Section 4.4 describes the dataset. Section 4.5 presents OLS results on the relationship between linguistic polarization and spending in education. Section 4.6 addresses the issue of causality by presenting estimations on neutral public goods and instrumental variable estimates. Section 4.7 analyzes the role of centralization in improving the under provision of public education in a panel framework. Section 4.8 concludes.

4.2 Related Literature

This chapter contributes to different strands of literature. First, it contributes to the vast literature on ethnic fractionalization and the provision of public goods. The seminal paper by Alesina et al. (1999) frames a theoretical model linking the heterogeneity of preferences across ethnic groups to the amount and type of public goods provided. The paper furthermore explores the negative association between ethnic fractionalization and a range of public goods using data from U.S. cities, metropolitan areas, and urban counties. The authors argue that the main channel for the negative association is in-group bias, that is, people tending to favor their own kind. Our main result of lower local spending on public primary education in highly polarized counties corroborates the theory of Alesina et al. (1999).

Luttmer (2001) provides support to these results showing that individuals' preferences for income redistribution are affected by the characteristics of others around them. In a similar fashion Vigdor (2004) elaborates a simple model of individual response decision according to which an individual's contribution to local public goods is a positive function of within-group affinity (Vigdor, 2002). Empirically Vigdor (2004) finds that more heterogeneous counties have significantly lower census response rates in 2000, which is intended as an action which generates public benefits.[60]

[60] See also the more detailed literature review in Alesina and La Ferrara (2005).

Miguel and Gugerty (2005) investigate the impact of ethnic diversity on local school funding in Kenya by using historical settlement patterns as an instrument finding that ethnic diversity decreases school funding. In order to establish causality, Dahlberg et al. (2012) and Gerdes (2011) exploit natural experiments that randomly placed refugees across Swedish and Danish municipalities, respectively. Dahlberg et al. (2012) find that previous estimates are positively biased and thereby underestimate the true negative effect of fractionalization on support for redistribution. Gerdes (2011) instead finds no evidence of a decline in the public sector in response to an increase in immigration.[61]

Leong Swee (2015) investigates whether partitioned political jurisdictions provide more public schooling after the war in the context of Bosnia. He finds that partitioned municipalities provide significantly more primary schools and teachers. As partitions induced ethnic homogenization, communities in partitioned municipalities agreed on providing ethnically oriented schools. However, increase in public schooling only benefits children from the dominant ethnic group.

From a historical perspective, Chaudhary and Rubin (2015) show how religious identity affects preferences and therefore public policy. The authors exploit a natural experiment in the Indian Princely States where the religion of each ruler as the decision-making authority upon local matters was arbitrary. They find that the provision of public goods was higher in those cases where the religion of the respective ruler and of the population's majority aligned as well as in the absence of private markets.

Hao and Xue (2015) study the relationship between cultural distance between migrants and natives and primary school enrollment rates in historical China at the beginning of the twentieth century. They find that a greater cultural distance between natives and migrants has a negative impact on primary school enrollment rates. They argue that high coordination costs between culturally distant groups can explain this finding. Despite many similarities, this chapter differs in some crucial aspects. First of all, in our setting we can observe spending on primary education which is a more relevant measure to study the provision of public goods. Second, we focus on a different dimension of heterogeneity, namely linguistic differences. In our context the cultural distance between the linguistic groups would be virtually constant as the linguistic groups were mainly German-speaking and Polish-speaking communities. This implies that cultural distance likely cannot explain our results. As we will see in the analysis below, diversity in religious denominations cannot affect our main finding either.

[61] For an overview of the recent empirical literature with a focus on the experimental literature see the survey by Stichnoth and Van der Straeten (2013).

We also contribute to the literature on decentralization. Recent studies have shown that decentralization increases the responsiveness of local governments to local needs. Faguet (2004) has shown that decentralization in Bolivia changed the pattern of investments in human capital, water and sanitation, making the provision of public services more related to real local needs. Barankay and Lockwood (2007) using a panel data set of Swiss cantons find that decentralization in educational expenditure is associated with higher educational attainment. Similarly, Galiani et al. (2008) find that a longer exposure of secondary schools to decentralization has a positive effect on student test scores in Argentina. However Galiani et al. (2008) uncover some effect heterogeneity as schools located in poor municipalities did not benefit from decentralization. In a cross-country framework Hanushek et al. (2013) show that decentralization in terms of local school autonomy has a positive effect on student achievement in developed countries and a negative impact in developing and low-performing countries.[62]

Finally, this chapter contributes also to the literature which aims at explaining the rise of modern educational systems. Lindert (2004) attributes the advancement of the Prussian primary educational system to its decentralized organization both in terms of decision-making and funding as well as to the low-cost provision of teaching staff. Go and Lindert (2010) argue that the expansion of mass schooling in the U.S. took off through increased political voice which was reflected in the electoral support for tax-based schooling. Chaudhary et al. (2012) find that the impact of decentralization on education differed by the political and economic conditions among the elites in the case of Brazil, Russia, India, and China. Gallego (2010) shows that, in the context of fifty former colonies, democracy has a positive effect on primary education whereas political decentralization has a positive and significant impact on secondary and higher education. Cvrcek and Zajicek (2013) look at the Habsburg Empire and find that the expansion of the educational system was mainly driven by the political and financial support of local political elites when instruction took place in the "right language".

[62] Willis et al. (1999), Bardhan (2002), and Kremer et al. (2003) argue that decentralization leads to inefficient provision of education.

4.3 Historical Background

The following sections describe the characteristics of the Prussian educational system at the end of the nineteenth century and how linguistic polarization in Prussia came about. Furthermore, Prussian language policy after the foundation of the German Empire is described.

4.3.1 Organization and Funding of the Educational System

In 1886 Prussia's educational system was locally organized and funded (Kuhlemann, 1991). According to Lindert (2004) this was largely responsible for the educational system's success. Indeed, Prussia's high school-enrollment and literacy rates made it a role model for other European countries.

At the same time, however, the Prussian administration was aware that the educational system in the East, and especially in those regions with a high share of Polish-speaking people, lagged behind the rest of the country in terms of student-teacher ratios and enrollment rates largely due to low school-related investments. We argue that lower spending in education in the eastern regions of Prussia stemmed from high linguistic polarization in a context of high decentralization. The historical narrative supports this hypothesis by pointing out that municipalities with a linguistically mixed population suffered especially when it came to the provision of school-buildings and teachers, explicitly mentioning the coexistence of different languages as a reason for this situation (Grzes, 1992).

Local organization of schooling meant that the municipality was responsible for levying and allocating school funds (Heinrich et al., 1992; Lamberti, 1989; Lindert, 2004). In many places, provincial or even district legislation regulated school financing, but in the absence of such regional regulations, the *Allgemeines Landrecht*, the Prussian subsidiary law, held. However, regardless of which law applied, the municipality was the decision-making unit when it came to school finance (Königliches Statistisches Bureau in Berlin, 1889). Schools were separated by religious denomination, leading thus to linguistic separation when denomination and language corresponded.[63]

[63] Polish-speaking individuals were mostly Catholic and German-speaking individuals were mostly Protestant. However, there were also German-speaking Catholics and a Polish-speaking Protestant minority (Glück, 1979) leading to the fact that the correlation between the share of Polish-speaking students and the share of Catholics only reaches 63 percent. Furthermore, interdenominational mixed schools (*Simultanschulen*) which were predominant in East Elbia encompassed Catholic and Protestant and therefore Polish- and German-speaking students at the same time (Groeben, 1992b).

School funding came from various local sources, including tuition fees, foundations, schooling societies, municipal taxes, and contributions from the nobility (patronage). Decisions as to how to allocate school funds were made by the school board (*Schulvorstand*), which consisted of the noble landlord in the estates or the mayor in urban and rural municipalities, the local clergyman, and two to four members of the school entity (*Schulgemeinde*) whose election had to be confirmed by the chief administrative officer of the county, the *Landrat*. In 1887, the likelihood that members of the Polish-speaking population would sit on these school boards decreased when a ministerial decree ruled that the county's *Landrat* should confirm members of the school board only if would-be members were inclined to foster the German-language policy imposed by the Prussian authorities. The purpose of this decree was to assure that Polish and other minority languages were effectively eliminated from being taught (Glück, 1979). According to Grzes (1992), linguistic barriers and diverging interests led to particular problems in the organization of primary schools in linguistically mixed regions.

In addition to school funding, the municipality was also responsible for appointing teachers (Glück, 1979). However, in July 1886 a new law regarding the appointment of school teachers in the provinces of Posen and West Prussia was enacted. This law shifted the authority to recruit and hire new teachers from the local to the state level in these two provinces (Lamberti, 1989). Before its enactment all decisions on hiring teachers, teacher pay, and facility upgrades were made by the municipalities.[64]

In 1888/1889 we observe a partial centralization of spending on public primary education. A new law was passed (*Schulunterhaltungsgesetz*) which aimed at relieving municipalities from the fiscal burden to fund primary education. The state contributed a fixed sum for each fully employed teacher which amounted to 500 Mark for the first teacher of each school, 300 Mark for every other teacher (150 Marks for every female teacher), and 100 Mark for supplementary teachers. The same law established that school fees would be abolished and that landlords were exempted from their duty to fund schools. As a result of the reform, state spending on primary education increased on average from 10 percent to 35 percent of the total spending between 1886 and 1891. The shift to centralization is particularly accentuated if we consider the expenditure on teachers: the state contribution increased from 14 percent to 50 percent.

[64] The law was passed in 1886. However, the actual recruitment of teachers for the provinces of West Posen and Prussia only started in 1887 after a regulation which guaranteed that the relocation costs of teachers would be covered by the state.

4.3.2 The Origins of Linguistic Polarization

The presence of German and non-German speaking groups in Prussia at the end of the nineteenth century primarily dates back to the conquest of Pomerania and Silesia in the seventeenth and eighteenth centuries and to the three partitions of Poland at the end of the eighteenth century as well as to the so-called fourth partition of Poland during the Congress of Vienna in 1815 (Hansen and Wenning, 2003). The partitions of Poland had as a consequence that one-third of the Prussian population had formerly belonged to the Polish-Lithuanian Commonwealth (Alexander, 2008). These Slavic regions had experienced an immigration of German settlers since the early Middle Ages following the territorial expansion of both the Holy Roman Empire and the Teutonic Order. The result was that Poles and Germans lived side by side, even before these regions became Prussian (Zernack, 2008).

After coming under Prussian rule, Prussia's active settlement policy, with its objective of populating vacant or devastated land, increased the level of polarization. While settlers initially came from German-speaking regions such as the Palatinate or Franconia, periodic wars and epidemics led to a shortage of German colonizers. This is what ultimately led Lutheran Austrians (*Salzburger*), Masurian Poles, Lithuanians, as well as the French Huguenots,[65] to be invited to settle in the southern and eastern regions of East-Elbian Prussia. After the three partitions of Poland, the Prussian state authorities reengaged in their population-enhancing policies by supporting German colonizers to settle in the newly acquired Grand Duchy of Posen and, especially, in West Prussia (Zbroschzyk, 2014). The West-to-East migration was only reversed after the foundation of the German Empire when people—of both Polish and German origin—began to move to the industrialized regions of the Rhineland in the 1880s and 1890s (Wünsch, 2008).[66]

[65] For the effect of the Huguenot immigration into Prussia on productivity, see Hornung (2014).

[66] The province of Schleswig-Holstein is constituted after the Austro-Prussian War in 1866. As the territories of this newly constituted province formerly belonged to Denmark, a substantial share of Danish speakers became Prussian. While the share of Danish speakers within the province is at 18 percent, the Danish-speaking minority constitutes only 0.7 percent of the total Prussian population. In the analysis we will exclude the province of Schleswig-Holstein because of the relatively low share of Danish speakers and because of the recent territorial annexation relative to our period of interest. Note that the inclusion of the province of Schleswig-Holstein in the regression analysis does not affect our main results.

4.3.3 Prussian Language Policy

Historians concur that it was the foundation of the German Empire in 1871 that ultimately initiated German-Polish antagonism (Alexander, 2008). The German Empire was understood as a nation state, as opposed to the Prussian Empire, which was built on an abstract and fragmentary common identity of its subjects (Clark, 2007).

Until the foundation of the German Empire in 1871, the Prussian authorities considered the Polish- or Slavic-dominated regions as "colonies" with their own cultural identity and, as such, they tolerated the use of Slavic languages and local dialects also in primary schools (Clark, 2007). The right to freely move across inner-Polish borders and to maintain one's Polish identity had been legally protected as early as the Congress of Vienna in 1815 and such rights were strengthened by the edict of 1822, which recognized the importance of language and nationality to Polish-speaking citizens. These rights were also enforced in the primary educational system. For example, a regulation of 1842 mandated that the language of school instruction was to be that of the majority of the students (Lamberti, 1989).

After the foundation of the German Empire, Imperial Chancellor Bismarck began to promote Germanization policy. The primary school was to play a key role in this policy by socializing the Polish-speaking students in the East of Prussia (Lamberti, 1989). Several laws were passed in provinces with Slavic minority populations that gradually established German as the only language of instruction. More than half of the curriculum was devoted to German and history lessons aiming at educating loyal Prussian citizens (Lundgreen, 1976). However, according to the historical narrative, the Germanization policy did not achieve its objective of generating a homogenous German-speaking Prussian nationhood.[67] Instead, Poles began to establish their own parallel society by founding their own banks, organizing themselves in clubs, and passing on Polish-specific human capital in confirmation classes (Alexander, 2008).[68] In fact, the foundation of Polish cooperatives was a central aspect of the Polish national movement (Suesse and Wolf, 2014).

This parallel structure meant that Germans and Poles rarely interacted voluntarily in everyday life, which inhibited the exchange between the two groups that could have resulted in shared values and beliefs, and, consequently, more cooperation. The social conflict between Germans and Poles peaked with the Polish school strikes in the city of Wreschen in 1901 and in the province of Posen in 1906 (Lamberti, 1989). During the

[67] In *Chapter 3*, we partly revisited the historical literature showing that higher educational spending from the central state authorities managed to align religious and linguistic minorities with Prussian values. However, we also do not find any decrease in non-German speakers (not shown) and we solely focus on the effects of educational spending as opposed to other anti-Polish agitation.

[68] Alexander (2008) argues that the Prussian policy against linguistic minorities and especially against the Poles eventually led to Prussia's decline.

school strike in Posen in 1906 46,886 out of 379,633 children in 755 out of the 2,862 schools boycotted school attendance after German had been introduced as the only language of instruction in additional 200 primary school (Unruh, 1992).

Overall, 1886 is described as the heyday of Bismarck's policy against the Poles (Neubach, 1992) due to the discriminatory legislation which included the promotion of "Germanness" (*Deutschtum*) in Posen and West Prussia and the settlement law which aimed at systematically buying land estates possessed by Poles. Another discriminatory law was the ban of Polish student associations at German universities (Kuhlemann, 1991).

4.4 Data

We use data from the first comprehensive education census of 1886 and two subsequent education censuses of 1891 and 1896 which were published by the Royal Statistical Office of Prussia (Königliches Statistisches Bureau in Berlin, 1889). The censuses provide detailed and comprehensive information on enrollment rates, school facilities, teachers, class size, school organization, teacher income, and students' language for a total of 451 counties, the smallest administrative unit in Prussia. The East-Elbian part of Prussia, which constitutes the focus of our cross-sectional analysis, encompasses 214 counties.

For our cross-sectional analysis we use the first comprehensive education census done in 1886 since that was the last census-year in which the educational system was highly decentralized and the central state played only a marginal role. In fact, the share of state contribution was only 10 percent while the rest was financed through local spending. In 1891, instead, state contributions reached already 35 percent of the total expenditure on public primary education.

4.4.1 Measuring Linguistic Polarization in Prussia

The education census of 1886 reports the language spoken in the students' home. The census distinguishes between German, Polish, Lithuanian, Wendish, Slavic, Danish, and "other" languages. The census also contains information on whether the reported language is the only one spoken at home or whether both German and another language are spoken at home. When constructing the index of linguistic polarization we include the latter category of bilingual students in the group of non-German speakers. We assume that the interests of this bilingual group are more aligned with the interests of the non-German speaking community.[69]

[69] In any case, assigning the bilingual group to the German-speaking group does not affect our results.

We measure the antagonism between Germans and other linguistic groups by using the polarization index proposed by Esteban and Ray (1994),[70] which is also employed by Fearon and Laitin (2003) and Collier and Hoeffler (2004), among others. As the Prussian case is characterized mainly by the *dualism* between Germans and Polish people rather than by a conflict between several linguistic groups, the use of the polarization index instead of the fractionalization index is more recommended. Recent work by Esteban et al. (2012) shows that linguistic polarization is related to conflict over public goods, while fractionalization increases conflict over private goods. The polarization index measures how far the distribution of the groups is from a bipolar distribution, which represents the highest level of polarization. Our polarization index has the following form:

$$Pol = 1 - \sum_i \left(\frac{\frac{1}{2} - \pi_{ic}}{\frac{1}{2}} \right)^2 \pi_{ic} \qquad (4.1)$$

where π_{ic} denotes the share of the linguistic group i in county c. Thus, the polarization index varies between 0 and 1. In our case, polarization equals 1 if, for example, 50 percent of the students speak German and the other 50 percent speak Polish at home.

4.4.2 Outcome Variables and Controls

Our outcomes in terms of educational spending are also constructed from the education census of 1886. The education census is very detailed and permits distinguishing between educational expenditures stemming from local and central sources. Local funds are comprised of tuition fees and money from foundations, schooling societies, municipalities, patronage, or other sources. Central funds are comprised of central state funds and central state grants that were mainly targeted at municipalities incapable of independently funding their schools (Lamberti, 1989). We measure local school spending by the amount of local expenditure per child of mandatory school age (6-14). Successively we also look at "real" school variables such as the number of schools per child and the teacher-student ratio.

[70] For a discussion on which polarization index to use, see Duclos et al. (2004), Montalvo and Reynal-Querol (2005) and Esteban and Ray (2012).

To control for initial differences in both the supply and demand for education, we use data on the share of Protestants, the urbanization rate and population density from the population census of 1885, the fraction of people employed in agriculture or manufacturing,[71] and landownership concentration from the occupation census of 1882.[72] We have also digitized data on municipal tax revenues in 1883/1884 from the census of Prussian urban and rural municipalities and use data on secular school inspectors from the *Zentralblatt* of 1886, digitized for *Chapter 5* of this thesis. The latter is an important control variable as we aim at separating the effect of linguistic polarization on public spending on education from the *Kulturkampf,* which aimed at weakening the role of the Catholic Church in providing public secular education in the Catholic-Polish areas.

In the attempt to identify the impact of linguistic polarization, we also account for religious fractionalization in 1871, which, especially in the context of East Prussia, is positively correlated with linguistic heterogeneity. We account for religious fractionalization using the standard measure related to the Herfindahl index:

$$Frac_c = 1 - \sum_i s_{ic}^2 \qquad (4.2)$$

where s_{ic} denotes the share of the religious group i in county c. This index is based on five religious denominations as reported in the census: Catholic, Protestant, other Christian, Jewish, and other religion. The fractionalization index, which varies also between 0 and 1, measures the probability that two individuals randomly drawn from a population belong to a different denomination. The index increases monotonically with the number of groups in a county. For a given number of groups, the index increases as the share of religious groups is more equally distributed.[73]

For the panel analysis on the effect of centralization on school outcomes for different levels of linguistic polarization, we digitized information from the education census of 1891 and 1896. This enables us to exploit a reform that substantially increased the share of state funds on total spending on public primary education in 1888/1889.[74]

[71] The fraction of people employed in agriculture or manufacturing is constructed by dividing the number of workers employed in the respective sector by the total number of workers, as in *Chapter 2*.

[72] Some of the control variables are taken from the ifo Prussian Economic History Database (iPEHD).

[73] Note that since we have five religious denominations, the fractionalization index can only reach the maximum value of 0.8.

[74] Education censuses are available also for 1901, 1906 and 1911. Yet, in 1897 a law on minimum teacher wages was passed and this further changed how state funds were allocated (Lamberti, 1989). Therefore we decided to restrict our panel analysis to the census years 1886, 1891, and 1896.

4.4.3 Descriptive Statistics

Prussia did not pass a universal law on school funding until 1906 (Anderson, 1970; Lamberti, 1989). Prior to the law's passage provincial regulations or customary law at the regional level set out guidelines for school funding. This ultimately led to very different funding schemes across the six eastern provinces. Table 4.1 reports the descriptive statistics of the variables used in our analysis for the East-Elbian counties in 1886.

The table shows that there is a wide variation in local and state spending. Average local spending on primary education in 1886 in East Prussia was about 13 Marks per child aged 6-14. This expenditure varied dramatically from a minimum of 7.75 Marks to a maximum of 37 Marks. State expenditure on primary education was on average 2 Marks per child. The largest part of the local educational expenditure went to teacher salaries: on average, teacher salary constitute 63 percent of total local school spending, whereas expenditures for the construction, expansion and renovation of school buildings account for 15 percent, and expenditures for the maintenance of schools sum up to 22 percent of total school funds.

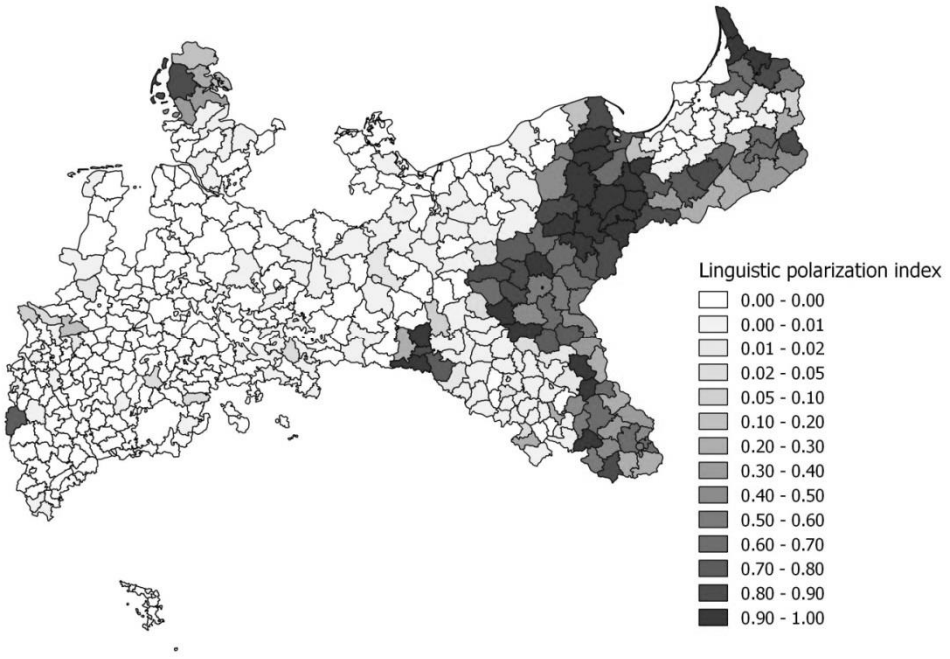
As for the linguistic groups, Germans and Poles are the two dominant groups at 75 and 22 percent, respectively. The polarization index has an average value of 0.29. In our sample, 167 out of 214 counties experienced some level of polarization. There are 47 counties (22 percent) in which non-German speaking people constitute the majority. The geographic distribution of linguistic polarization is shown in Figure 4.1. Overall, linguistic polarization increases the closer a county is to the eastern border of Prussia. Yet, the counties on the border have a comparatively lower level of polarization as in 21 out of 25 counties on the border German-speaking people constitute the minority.

Table 4.1: Descriptive Statistics

	Mean	Std. dev.	Minimum	Maximum
Linguistic polarization	0.29	0.37	0	1
Religious fractionalization	0.19	0.18	0	0.55
Local spending on education per child (6-14)	12.91	3.77	7.75	37.02
State spending on education per child (6-14)	2.07	1.22	0	6.46
Municipal tax revenues per capita	3.25	2.36	0.88	18.61
Teacher expenditures (share)	0.63	0.07	0.34	0.78
Building expenditures (share)	0.22	0.03	0.12	0.40
Maintenance expenditures (share)	0.15	0.07	0.04	0.54
School per 1,000 children (6-14)	6.64	2.21	0.40	11.47
Teacher per 1,000 children (6-14)	95.31	14.82	61.08	142.25
Teacher-student ratio x 100	1.316	0.227	0.825	2.039
German language (share)	0.75	0.34	0.06	1
Polish language (share)	0.22	0.34	0	0.94
Lithuanian language (share)	0.012	0.070	0	0.623
Wendish language (share)	0.008	0.055	0	0.520
Slavic language (share)	0.003	0.025	0	0.326
Other language (share)	0.000	0.002	0	0.027
Protestants (share)	0.68	0.34	0.02	0.995
Urban (share)	0.272	0.191	0	1
Population density	3.52	17.76	0.29	207.59
Employed in agriculture (%)	22.00	6.71	0.33	32.32
Employed in manufacturing (%)	9.55	5.06	2.17	27.07
Employed in administration (%)	1.19	1.73	0.13	14.64
Landownership concentration (standardized)	0	1	-1.58	5.90

Note: Descriptive statistics of selected key variables for East-Elbian counties, excluding Schleswig-Holstein (n=214). Linguistic polarization is measured through the polarization index as described in equation (4.1) and is based on six linguistic groups as reported in the education census in 1886: German, Polish, Lithuanian, Wendish, Slavic, and "other" language. Religious fractionalization is measured through the fractionalization index as in equation (4.2) and is based on five religious groups as reported in the population census in 1871: Protestants, Catholics, other Christians, Jews, and other religion. See Appendix 4A for data sources and details.

Figure 4.1: Linguistic Polarization in 1886



Note: Linguistic polarization is measured through the polarization index as described in equation (4.1) and is based on the linguistic groups as reported in the education census in 1886: German, Polish, Lithuanian, Wendish, Slavic, Danish and "other" language. County borders as in 1871. Source: Own illustration; see main text for details.

4.5 Linguistic Polarization and Local Spending on Education

We start exploring the association between linguistic polarization and local school funding estimating an OLS model as in equation (4.3). We focus on the East-Elbian counties as linguistic polarization in the western part of the country is virtually zero (mean 0.01).

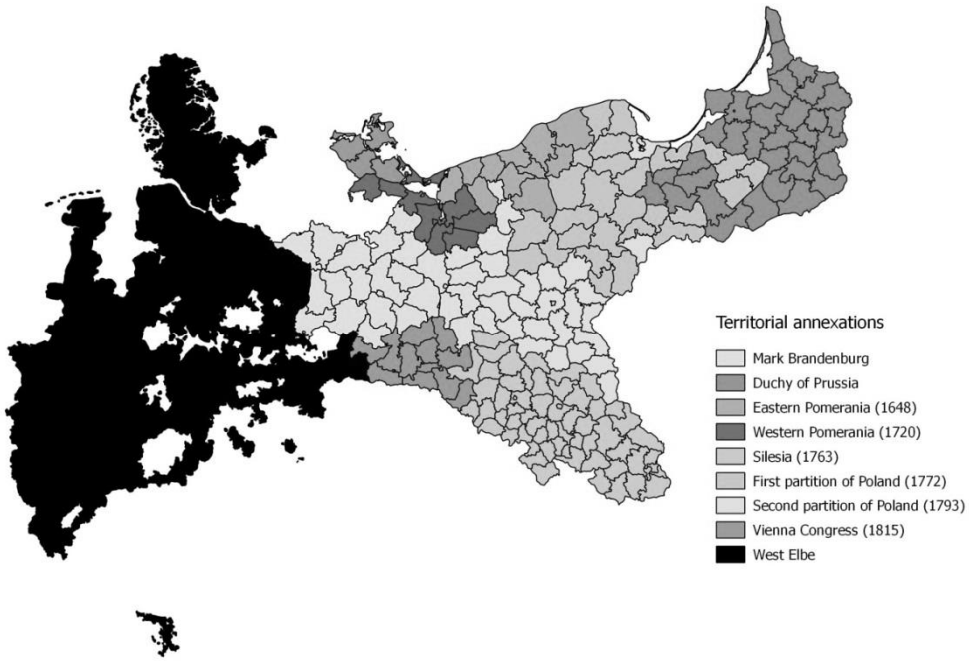
$$Log\ (\text{loc. spending p. c.})_c = \beta_1 Pol_c + X_c'\gamma + \alpha_p + \theta_a + \varepsilon_c \qquad (4.3)$$

We use as dependent variable the logarithm of local spending on primary education per child of mandatory school age (6-14) for county c. Pol_c is the index of linguistic polarization computed at the county level and X is a vector of covariates.

We include also province-fixed effects (α_p) and annexation-fixed effects (θ_a). As school funding was organized locally, funding schemes might have varied substantially across provinces which had different rules concerning the education policy. The period and geography of annexation are also important variables to account for. In fact, different annexations had different "settlement policies" (*Ansiedlungspolitik*) which could be

related to both linguistic polarization and local spending on education. In addition, different annexations imply also a different number of years under the Prussian rule which might have an impact on both polarization and spending on education. In Figure 4.2 we show a map of the Prussian territorial annexations which occurred at different points in time. In the regression we include indicators for the following annexations: the Margraviate of Brandenburg, the Duchy of Prussia, Eastern and Western Pomerania, Silesia, the First and Second Partitions of Poland, and the territories acquired with the Vienna Congress. [75]

Figure 4.2: Territorial Annexations of the Kingdom of Prussia



Note: County borders as in 1871. Source: Own illustration; see main text for details.

The OLS estimates are presented in Table 4.2. The unconditional correlation between linguistic polarization and local school funding is negative and highly significant (Column 1). In Column 2 we include the province and annexation-fixed effects. The negative impact of linguistic polarization remains highly significant even when we exploit variation within provinces or variation within annexations.

[75] As the counties in Magdeburg east of the river Elbe are only 4, in the empirical analysis we merge these counties with the Margraviate of Brandenburg.

The coefficient in Column 2 implies that moving from a county with zero polarization (i.e. 100 percent German-speaking) to a county with full polarization (i.e. 50 percent German speaking and 50 percent Polish speaking) is associated with a decrease in local spending on primary education of about 22 percent.

In Column 3 we include our set of covariates, namely the share of Protestants, the share of people living in cities, population density, landownership concentration, the share of people employed in agriculture and in manufacturing, respectively. The share of Protestants accounts for the fact that Protestant regions have higher levels of literacy as a result of Luther's preach that every Protestant should be able to read the Bible (Becker and Woessmann, 2009). Counties with a large share of Protestants are thus expected to have also a higher spending on education. Throughout the analysis we will find such a positive association.

As for the percentage of people employed in agriculture and manufacturing, Becker et al. (2011) have shown that primary education played an important role in Prussia's effort to catch up with early-industrializer Britain. The estimates in Column 3 show a weak positive association between the percentage of people employed in manufacturing and local school spending. Cinnirella and Hornung (2016) showed that the concentration of large landownership and the institution of serfdom slow the accumulation of education. In our OLS specifications we do not find a significant relationship between landownership concentration and local spending in education. Instead, we find that population density and urbanization are positively related to school spending. Compared to the bivariate model in Column 1, the coefficient for linguistic polarization in Column 3 is smaller in size but still precisely estimated. This specification explains 67 percent of the variation in local spending in primary education.

Religious fractionalization could be an important confounding factor as in the context of East Prussia linguistic differences overlap to a considerable extent with religious denominations. In Column 4 we include the measure for religious fractionalization based on the Herfindahl index. The coefficient has a negative sign but is not statistically significant. One could argue that linguistic polarization has an impact on education spending which varies with religious fractionalization. However, the interaction between linguistic polarization and religious fractionalization (centered at the mean) in Column 5 is not significant and the coefficient for polarization is virtually unaffected.

Table 4.2: Linguistic Polarization and Local Spending on Education: OLS Estimates

Dep. Var.: Local spending on public primary education per child (6-14) (log)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8) Full sample
Linguistic polarization	-0.334***	-0.221***	-0.131***	-0.130***	-0.139***	-0.165***	-0.157***	-0.148***
	(0.038)	(0.042)	(0.043)	(0.046)	(0.051)	(0.044)	(0.047)	(0.042)
Religious fractionalization				-0.006	-0.061		-0.079	0.076
				(0.120)	(0.140)		(0.113)	(0.056)
Linguistic polarization x religious fractionalization					0.128			
					(0.199)			
Municipal tax per capita (log)						0.141***	0.145***	0.160***
						(0.036)	(0.036)	(0.031)
Protestant			0.077	0.078	0.081	0.100*	0.119*	0.150***
			(0.055)	(0.064)	(0.062)	(0.052)	(0.061)	(0.034)
Urbanization			0.583***	0.583***	0.586***	0.408***	0.406***	0.286***
			(0.126)	(0.126)	(0.126)	(0.127)	(0.126)	(0.071)
Population density			0.002***	0.002***	0.002***	0.002***	0.002***	0.001
			(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Landownership concentration			-0.002	-0.002	-0.003	-0.001	0.001	0.015
			(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.013)
Employed in agriculture (%)			0.005	0.005	0.005	0.008*	0.008*	-0.003
			(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Employed in manufacturing (%)			0.011*	0.011*	0.011*	0.009	0.009	0.002
			(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)
Province FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Annexation FE	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Observations	214	214	214	214	214	214	214	451
R-squared	0.25	0.38	0.67	0.67	0.67	0.70	0.70	0.71

Note: OLS estimates. The dependent variable is the logarithm of local spending on public primary education per child of mandatory school age (6-14). Linguistic polarization is measured through the polarization index as described in equation (4.1) and is based on six linguistic groups as reported in the education census in 1886: German, Polish, Lithuanian, Wendish, Slavic, and "other" language. Religious fractionalization is measured through the fractionalization index as in equation (4.2) and is based on five religious groups as reported in the population census in 1871: Protestants, Catholics, other Christians, Jews, and other religion. Log municipal tax per capita denotes the log municipal tax revenues per capita for the fiscal year 1883/1884. Protestant denotes the share of Protestants in 1885. Urbanization is the share of people living in cities in 1885. Population density is the number of people per hectare in 1885. Landownership concentration is constructed as the number of farms larger than 100 ha over the total number of farms in 1882 and is standardized with zero mean and unit standard deviation. Employed in agriculture (manufacturing) denotes the percentage of workers employed in agriculture (manufacturing) in 1882. Province-fixed effects include six provinces. Annexation-fixed effects include eight territories. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

Counties characterized by high levels of linguistic polarization could be less economically prosperous and therefore could afford less education. It is therefore crucial to account for systematic differences in economic prosperity. In fact, since we hypothesize that different linguistic groups had different preferences on how to locally fund primary education, it is important to level out differences in tax revenues. The best measure available at the county level for the period under consideration is municipal tax revenues per capita for the years 1883/1884. We include this variable in Column 6. Indeed, we find that log municipal tax revenues are strongly positively associated with log local spending on primary education. Since municipal tax rates are also measured in logarithm, we can interpret the coefficients as elasticity: an increase of municipal tax revenues by 1 percent is associated with an increase in school spending of 0.14 percent. Importantly, we find that accounting for the level of municipal tax revenues, local spending on public primary education is still significantly lower in counties with higher levels of linguistic polarization. If anything, accounting for differences in municipal tax revenues increases the coefficient on linguistic polarization.

In Column 7, we include all control variables, with the exclusion of the interaction between linguistic polarization and religious fractionalization which is never significant. The coefficient on linguistic polarization is highly significant and virtually unchanged in magnitude.

Finally, in Column 8 we test whether the association between polarization and local spending on education holds also for entire Prussia. The negative coefficient remains highly significant and similar in magnitude.

4.6 Addressing Causality

The previous estimates indicate that the negative relationship between linguistic polarization and local spending on public primary education is not due to differences in religious affiliation, municipal tax revenues, urbanization, and the industrial structure. Despite our rich set of control variables, omitted variables and reverse causality might bias the OLS estimates. It is reasonable to assume that a systematically underfunded educational system contributed to the persistence of a high level of linguistic polarization. Additionally, there could be an omitted variable that affects both local spending on education and the linguistic composition of the population. Segregated labor markets or occupational sorting between German and non-German speaking groups could constitute such omitted variable.

4.6.1 Linguistic Polarization and Neutral Public Goods

A first attempt to address the issue of causality is by looking at the provision of neutral public goods. Our hypothesis is that different linguistic groups have polarized preferences over the type of public education to provide and they are reluctant to fund public education with local tax revenues. If this is the case, we should not find any relationship between linguistic polarization and the provision of other neutral public goods. In particular, we expect that the provision of public goods not related to any specific cultural trait is not correlated with linguistic polarization.

We can test this hypothesis by looking at local spending on transport infrastructure such as roads, canals, bridges, harbors, railways, street cleaning, surveying and mapping, gardening, and other related tasks which also fell within the ambit of the municipal administration (Hühner, 1998). Data on local spending on infrastructure have been digitized from the official statistics on municipal taxes for the years 1883/1884 (Königliches Statistisches Bureau in Berlin, 1884). The same source provides data also on local spending on institutions for poor relief. Poor relief was regulated through the *Allgemeines Landrecht*. Groups of municipalities or land estates were responsible for the local poor and set the level of financial support. Poor relief encompassed preventive and direct support. Preventive support included the allocation of labor, the education of disadvantaged children, and free healthcare. Direct support included the provision of working houses and orphanages as well as monetary and nonmonetary contributions (Hühner, 1998).

As discussed above, we expect linguistic polarization to be uncorrelated with the local provision of transport infrastructure as both linguistic groups probably benefited from such public good. The expected impact of linguistic polarization on poor relief is instead ambiguous. In a polarized society, spending on poor relief might have been kept low not to favor the disadvantaged rival group. We also have to bear in mind that part of the poor-relief expenditure was devoted to educational items such as the coverage of school fees for disadvantaged children.

In Columns 1 and 2 of Table 4.3 we provide OLS estimates using as dependent variable log local spending on transport infrastructure and poor relief per capita, respectively. The estimates in Column 1 provide support to our hypothesis that linguistic polarization has no bearing on the provision of neutral public goods. The coefficient for linguistic polarization is basically zero.

The coefficient for linguistic polarization using local spending on poor relief as dependent variable (Column 2) is negative and similar in size to the estimates of Table 4.2, though not significant. Since the potential beneficiaries of poor relief were clearly identifiable across linguistic group, this result is consistent with the interpretation that equally large linguistic groups oppose the local provision of public goods which would benefit the antagonistic group.

Table 4.3: Linguistic Polarization and Alternative Local Spending

Dep. Var.:	Local spending on transport infrastructure per capita (log)	Local spending on poor relief per capita (log)
	(1)	(2)
Linguistic polarization	0.002	-0.174
	(0.135)	(0.199)
Religious fractionalization	-0.805*	-0.284
	(0.426)	(0.441)
Municipal tax per capita (log)	0.805***	0.839***
	(0.118)	(0.179)
Protestant	0.915***	0.647**
	(0.165)	(0.273)
Urbanization	1.913***	3.176***
	(0.416)	(0.823)
Population density	-0.000	0.077***
	(0.001)	(0.008)
Landownership concentration	-0.108**	0.021
	(0.048)	(0.056)
Employed in agriculture (%)	0.045**	-0.002
	(0.017)	(0.033)
Employed in manufacturing (%)	0.023	0.012
	(0.018)	(0.043)
Province FE	Yes	Yes
Annexation FE	Yes	Yes
Observations	214	214
R-squared	0.66	0.89

Note: OLS estimates. The dependent variable is the logarithm of local spending on transport infrastructure per capita (Column 1) and on poor relief per capita (Column 2) in 1886. Linguistic polarization is measured through the polarization index as described in equation (4.1) and is based on six linguistic groups as reported in the education census in 1886: German, Polish, Lithuanian, Wendish, Slavic, and "other" language. Religious fractionalization is measured through the fractionalization index as in equation (4.2) and is based on five religious groups as reported in the population census in 1871: Protestants, Catholics, other Christians, Jews, and other religion. Log municipal tax per capita denotes the log municipal tax revenues per capita for the fiscal year 1883/1884. Protestant denotes the share of Protestants in 1885. Urbanization is the share of people living in cities in 1885. Population density is the number of people per hectare in 1885. Landownership concentration is constructed as the number of farms larger than 100 ha over the total number of farms in 1882 and is standardized with zero mean and unit standard deviation. Employed in agriculture (manufacturing) denotes the percentage of workers employed in agriculture (manufacturing) in 1882. Province-fixed effects include six provinces. Annexation-fixed effects include eight territories. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

4.6.2 Instrumental Variable Approach

In this section we propose an instrumental variable which addresses the issues of omitted variable bias and reversed causality. In particular we exploit the geographic distribution of the non-German speaking groups driven by the territorial acquisitions of Prussia towards East. As displayed in Figure 4.1, linguistic polarization tends to increase as we move towards the eastern border. Thus, we identify variation in linguistic polarization using the geodesic distance of the county centroid to the eastern border. We use a quadratic function of distance as the impact on linguistic polarization is expected to decrease with distance. A similar identification strategy based on distance to borders or "gateways" is adopted in the migration literature (Ottaviano and Peri, 2005, 2006; Peri, 2012).

Our instrumentation relies on the assumption that, conditional on the rich set of covariates, distance to the eastern border has an impact on local spending on education only through linguistic polarization. Admittedly, distance to the eastern border could capture also other aspects related to both spending on education and linguistic polarization, thus not solving the omitted variable bias. In order to make the instrumentation more stringent we include an indicator for the counties on the border, latitude, longitude, and their interaction, distance to the province capital, and distance to Berlin. Since we have also province-fixed effects and annexation-fixed effects, we end up exploiting variation of neighboring counties, arguably similar in their geographic and socio-economic characteristics.
Formally our first stage is the following:

$$Polarization_c = \beta_1 Dist_c + \beta_2 Dist_c^2 + X_c'\gamma + \alpha_p + \theta_a + \varepsilon_c \qquad (4.4)$$

where $Polarization$ denotes the linguistic polarization index in 1886; $Dist$ is the geodesic distance (in 100 km) from the county centroid to the eastern border. The vector X includes the control variables as in equation (4.3), plus an indicator for the counties on the border, latitude, longitude and their interaction, distance to the capital of the province, and distance to Berlin.

Estimates from the instrumental variable approach are presented in Table 4.4. In the sake of comparison we report in Column 1 the baseline OLS estimates corresponding to Column 7 of Table 4.2. First stage estimates are presented in Column 2. The coefficients on distance and its quadratic term support our assumption of a negative and decreasing relationship between distance to the eastern border and linguistic polarization.[76] Second stage estimates in Column 3 confirm the negative impact of linguistic polarization on local spending on education. In Column 4 we include latitude, longitude, and their interaction.

[76] The variable distance to the eastern border has a mean of 221 km (std. dev. 165 km) and ranges from 7 km to 667 km in the regression sample. The distance from the eastern border that minimizes the quadratic function in the richest specification in column 5 of Table 4.4 is 591 km.

Table 4.4: Linguistic Polarization and Local Spending on Education: IV Estimates

Dep. Var.: Local spending on public primary education per child (6-14) (log)	OLS (1)	First stage (2)	Instrumental variables (3)	(4)	(5)
Linguistic polarization	-0.157***		-0.254*	-0.258**	-0.226*
	(0.047)		(0.136)	(0.124)	(0.121)
Distance		-0.180***			
		(0.048)			
Distance squared		0.019***			
		(0.006)			
Religious fractionalization	-0.079	0.782***	-0.005	-0.132	-0.180
	(0.113)	(0.200)	(0.151)	(0.130)	(0.149)
Municipal tax per capita (log)	0.145***	0.120*	0.157***	0.165***	0.164***
	(0.036)	(0.065)	(0.039)	(0.035)	(0.034)
Protestant	0.119*	-0.232**	0.082	0.113*	0.134*
	(0.061)	(0.101)	(0.077)	(0.067)	(0.072)
Urbanization	0.406***	-0.514***	0.349***	0.389***	0.406***
	(0.126)	(0.142)	(0.135)	(0.125)	(0.122)
Population density	0.002***	-0.000	0.002***	0.002***	0.002***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)
Landownership concentration	0.001	-0.058***	-0.006	-0.024*	-0.027**
	(0.011)	(0.018)	(0.013)	(0.013)	(0.013)
Employed in agriculture (%)	0.008*	-0.010	0.007	0.012***	0.013***
	(0.005)	(0.007)	(0.005)	(0.004)	(0.004)
Employed in manufacturing (%)	0.009	-0.017*	0.006	0.012*	0.013**
	(0.006)	(0.009)	(0.007)	(0.006)	(0.006)
Latitude, longitude and their interaction	No	No	No	Yes	Yes
Additional controls	No	No	No	No	Yes
Province FE	Yes	Yes	Yes	Yes	Yes
Annexation FE	Yes	Yes	Yes	Yes	Yes
Observations	214	214	214	214	214
Kleibergen-Paap rk Wald F statistic			7.1	12.2	12.1

Note: OLS and IV estimates. The dependent variable is the logarithm of local spending on public primary education. In Column 2 the dependent variable is linguistic polarization. Linguistic polarization is measured through the polarization index as described in equation (4.1) and is based on six linguistic groups as reported in the education census in 1886: German, Polish, Lithuanian, Wendish, Slavic, and "other" language. Religious fractionalization is measured through the fractionalization index as in equation (4.2) and is based on five religious groups as reported in the population census in 1871: Protestants, Catholics, other Christians, Jews, and other religion. Log municipal tax per capita denotes the log municipal tax revenues per capita for the fiscal year 1883/1884. Protestant denotes the share of Protestants in 1885. Urbanization is the share of people living in cities in 1885. Population density is the number of people per hectare in 1885. Landownership concentration is constructed as the number of farms larger than 100 ha over the total number of farms in 1882 and is standardized with zero mean and unit standard deviation. Employed in agriculture (manufacturing) denotes the percentage of workers employed in agriculture (manufacturing) in 1882. Province-fixed effects include six provinces. Annexation-fixed effects include eight territories. Additional controls include: an indicator for counties at the border, distance to the provincial capital, and distance to Berlin. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5%, and 1%, respectively.

This strengthens the power of our instrumentation as indicated by the first-stage F-statistics reported at the bottom of the table. The effect of polarization remains similar in size and is more precisely estimated. In Column 5 we further include the indicator variable for the counties at the border, distance to the capital of the province,[77] and distance to Berlin. It can be argued that educational policies were more strictly enforced the closer a county is to the capital Berlin, or to the main provincial city. However, these additional controls have no impact on the effect of linguistic polarization on local spending on primary education.

The magnitude of the IV coefficient indicates that the OLS estimates slightly underestimate the effect of polarization on local spending. It is likely that distance to the border identifies conflict areas where the impact of linguistic polarization is more salient, granting then a LATE interpretation of the IV estimates.

4.6.3 Robustness Checks

The rich specifications in Table 4.4 already provided some tests about the validity of our instrumentation. In this section we test the robustness of our main results accounting for further possible confounding variables. The estimates are shown in Table 4.5.

As discussed previously, the state subsidized primary education in fiscally-challenged municipalities (Neugebauer, 1992). Relying on central state grants or central state funds might have decreased local spending on education. This reliance on central funding might be also related to linguistic polarization and thus partially explain our results. In Column 1 of Table 4.5 we include log state spending on education per 1,000 children in school age (6-14). The coefficient for state spending suggests a "substitution" between state and local spending on education. This confirms that state expenditures were largely used as subsidies where local spending was insufficient.

Different linguistic groups might have different fertility levels which, in turn, could affect local educational policy. To account for differences in fertility we use the crude birth rate constructed as the ratio of children born over 10,000 people in 1885. This variable is included in Column 2. There is no significant relationship between our fertility measure and local spending on education and the inclusion of this variable does not affect the effect of linguistic polarization.

[77] The cities are: Breslau, Danzig, Koenigsberg, Magdeburg, Posen, Potsdam, and Stettin.

The size of the bureaucracy could have an impact on the enforcement of rules and thus also on local spending on education. The size of the bureaucracy, in turns, could also be related to different levels of linguistic polarization. In Column 3 we include the share of people employed in the public administration (including the military) as reported in the occupation census in 1882. We find that the size of the bureaucracy is positively and significantly associated with local spending on education, supporting our line of argumentation that a larger bureaucracy enforces higher levels of local spending on primary education.

The Prussian state also aimed at monitoring primary schools by replacing clerical school inspectors with secular ones who were required to report directly to the Prussian authorities in Berlin (Lamberti, 1989). One could argue that a higher share of secular school inspectors increased local school spending as the inspectors would report to the Prussian state authorities on deficiencies in both personnel and buildings, thereby putting pressure on the municipalities to invest in their educational systems. Using information from the Prussian *Zentralblatt*, a monthly publication of the Prussian Ministry of Ecclesiastical and Education Affairs, we can include the share of central school inspectors over all school inspectors in 1886. By including this variable in the regression (Column 4) our main result does not change. When controlling for the number of inspectors per school the results are also virtually unchanged (not shown).

The polarization index captures the extent to which a society is bipolar but it does not address the issue of the identity of the largest group. For example the counties *Preußisch Stargard* and *Rössell* have both a polarization index equal to 0.66. Yet, in the first county the share of German speaking people is 0.21 and that of Polish-speaking people is 0.79; in the second county the linguistic composition is exactly the opposite. In order to test whether the identity of the largest group plays a role we include a binary variable in Column 5 which takes on value 1 if the German-speaking people are the minority (27 percent of the counties). This variable is not correlated with local spending on education and the coefficient for linguistic polarization remains unaltered.[78]

[78] We have also included the interaction between the dummy for German-speaking minority with polarization but we did not obtain any significant result.

Another way to test whether the presence of a small (large) German ruling elite opposed investments in education which otherwise would favor the large (small) non-German community is by including the ratio of the size of the respective groups. In particular in Column 6 we include the ratio of the number of non-German speaking people over the number of German-speaking people. Our results indicate that the higher the ratio, i.e. the larger the number of people who do not speak German, the lower is local spending on public primary education. This result is consistent with the notion that a small local German elite blocked investments in education in counties largely populated by non-German speaking people. However our main result remains unchanged: counties with different linguistic groups of similar size tend to provide less public primary education.

Table 4.5: Linguistic Polarization and Local Spending on Education – Robustness Checks

Dep. Var.:	Local spending on education per child (log)					
	(1)	(2)	(3)	(4)	(5)	(6)
Linguistic polarization	-0.330***	-0.249**	-0.280***	-0.284***	-0.372**	-0.245***
	(0.101)	(0.119)	(0.097)	(0.109)	(0.151)	(0.095)
State expenditures in education per child (log)	-0.101*					
	(0.052)					
Crude birth rate		-0.000				
		(0.000)				
Employed in military or administration (%)			0.020**			
			(0.008)			
Share school inspectors				0.007		
				(0.037)		
German minority (dummy)					0.056	
					(0.066)	
Non-Germans/Germans						-0.014***
						(0.005)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Annexation FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	214	214	214	214	214	214
Kleibergen-Paap rk Wald F statistic	16.4	12.2	16.4	15.0	9.4	16.6

Note: IV estimates. The dependent variable is the logarithm of local spending on public primary education. Linguistic polarization is measured through the polarization index as described in equation (4.1) and is based on six linguistic groups as reported in the education census in 1886: German, Polish, Lithuanian, Wendish, Slavic, and "other" language. Log state exp. in educ. (per child) measures the level of state funding on education. The crude birth rate is the total number of births over the total population in 1885. Employed in military or administration (%) measures the number of workers employed in administration and military over the total population in 1882. The share of central school inspectors denotes the number of central school inspectors over total school inspectors. German minority is a dummy variable taking the value 1 if the share of German-speaking people is below 50 percent. The variable non-Germans/Germans is the ratio of the number of non-German speaking people over the number of German speaking people in 1886. Controls include: Share of Protestants, share urbanization, population density, percentage of workers employed in agriculture, percentage of workers employed in manufacturing, landownership concentration, an indicator for counties at the border, distance to the provincial capital, distance to Berlin, latitude, longitude, and latitude*longitude. Province-fixed effects include six provinces. Annexation-fixed effects include eight territories. Robust standard errors are reported in parentheses. ***, ** and * denote significance at 10%, 5% and 1%, respectively.

4.6.4 Linguistic Polarization and School Inputs

We now shift our attention to the effect of linguistic polarization on schooling variables such as school density, measured as the number of schools per 1,000 children of school-age (6-14), and the number of teachers. We use our instrumental variable approach which exploits variation in linguistic polarization stemming from the conditional distance to the eastern border. Our standard set of control variables is also included. The results are presented in Table 4.6.

In general we find that linguistic polarization affects negatively all school inputs with a similar magnitude. In Column 1 we consider the number of schools per 1,000 children of school-age (6-14). The negative effect of linguistic polarization is substantial and highly significant. The size of the coefficient indicates that moving from a county with zero polarization to a county with unit polarization decreases the number of schools per 1,000 children by 1.8 units. This corresponds to about 30 percent of the mean.

Fewer schools per children do not necessarily mean lower quality of schooling. Large urban schools in particular benefited from school standardization in ensuring a certain quality, school-based diversification and economies of scale (Kahlert, 1978). However, if we exclude the nine city-counties from our regression, the negative effect of polarization increases to 2.4 schools (Column 2). Furthermore, we always control for the share of people living in urban centers which should account for the higher likelihood of larger schools in cities.

In Column 3 we use the number of teachers per 1,000 children in school-age as dependent variable. Also in this case the coefficient is negative and highly significant. The size of the coefficient indicates a reduction of circa 25 percent with respect to the mean value.

In Column 4 we standardize the number of teachers by the number of students, computing a teacher-student ratio (per 100 students). This variable can be interpreted as a measure of the quality of teaching as it broadly captures class size. In our regression sample the average number of teachers per 100 students is 1.3, i.e. 77 students are instructed by one teacher on average. A unit change in polarization decreases the teacher-student ratio (per 100 students) by 0.3 units, which is equal to 23 percent of the mean value.

Table 4.6: Linguistic Polarization and Schooling Inputs

Dep. Var.:	(1) Number of schools (per 1,000 children)	(2) Number of schools w/o cities (per 1,000 children)	(3) Number of teachers (per 1,000 children)	(4) Teacher-student ratio (per 100 students)
Linguistic polarization	-1.817**	-2.435***	-2.711***	-0.306***
	(0.739)	(0.861)	(0.731)	(0.085)
Controls	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Annexation FE	Yes	Yes	Yes	Yes
Observations	214	205	214	214
Kleibergen-Paap rk Wald F statistic	16.0	12.8	16.0	16.0
Mean dep. var.	6.6	6.9	10.6	1.3

Note: IV estimates. Linguistic polarization is measured through the polarization index as described in equation (4.1) and is based on six linguistic groups as reported in the education census in 1886: German, Polish, Lithuanian, Wendish, Slavic, and "other" language. Controls are: share of Protestants, share urbanization, population density, landownership concentration, the percentage of workers in agriculture and manufacturing, respectively, an indicator for counties at the border, distance to the provincial capital, and distance to Berlin, latitude, longitude, and their interaction. Province-fixed effects include six provinces. Annexation-fixed effects include eight territories. Robust standard errors are reported in parentheses. ***, ** and * denote significance at 10%, 5% and 1%, respectively.

4.6.5 Sorting Bias: Urban and Rural Municipalities

There is the possibility that individuals with heterogeneous preferences sort themselves into communities that provide the typology of public goods they prefer (Tiebout, 1956). In particular, different linguistic groups could sort themselves into urban and rural municipalities, thus biasing our results.[79]

Unfortunately data on students' language *directly* at the municipal level for the period under investigation do not exist. However, the data from the education census of 1886 and the financial statistics of 1883/1884 are reported separately for urban and rural municipalities, though always aggregated by county.[80] In the case of urban municipalities we can look at counties with one, two, three, or more municipalities and compare the impact of linguistic polarization on local spending on education. In this way we can investigate whether and to what extent the estimates at the county level suffer from sorting or aggregation bias.[81]

[79] In addition funding decisions on public primary education were taken at the municipal level whereas our data are at the county level which can include several municipalities.

[80] A municipality is defined as urban when the residing population is larger than 10,000 inhabitants. The correlation between linguistic polarization in the urban municipalities of a county and total polarization in the respective county is 0.73. The correlation of linguistic polarization in rural areas and total polarization in the respective county is 0.85.

[81] In principle we could estimate a model with county-fixed effects which exploits variation between urban and rural municipalities. Yet the variation in polarization between urban and rural municipalities within a county is too low to obtain any significant result.

The first thing to note is that linguistic polarization does not differ systematically between urban and rural municipalities: average polarization is 0.26 (std. dev. 0.38) in the urban sample and 0.28 (std. dev. 0.36) in the rural one.[82] In the regression analysis by urban and rural municipalities only the share of Protestant students and municipal tax revenues are available at that level of aggregation. Since the state subsidized primary education in fiscally-challenged municipalities, we include also the log of state expenditure in education per child in school-age. We include controls for the share of people employed in agriculture, the share of people employed in manufacturing and landownership concentration at the county-level.

We present OLS estimates by urban and rural municipalities across counties in Table 4.7.[83] The estimates in Columns 1-5 regard urban municipalities, whereas the specification in Column 6 focuses on the rural municipalities. In Column 1 we use the whole sample of urban municipalities and we control for the number of municipalities.[84] Note that the average number of urban municipalities per county is about 3. The coefficient for linguistic polarization is significantly negative and similar in magnitude to the OLS estimates in Table 4.2.

In Column 2 we restrict the sample to 41 counties that have a single urban municipality. In this case linguistic polarization and local spending on education are observed at the "relevant" jurisdiction level for what concerns the provision of public primary education. The negative coefficient is similar in size when compared to the full urban sample and the OLS estimates in Table 4.2. The coefficient is not precisely estimated because of the small sample size. In Column 3 we restrict the sample to counties with up to two urban municipalities and the negative coefficient for polarization becomes larger. When progressively enlarging the sample with counties with more urban municipalities (Columns 4 and 5) the coefficients for polarization are again in line with the OLS estimates of Table 4.2.

[82] The urban sample declines from 214 to 203 observations as there are six counties that are solely constituted of rural municipalities which are Koenigsberg Landkreis, Zarbze, Niederung, Heydekrug, Karthaus and Breslau Landkreis and another five counties with missing information on the municipal taxes which are Danzig Landkreis, Pillkallen, Preussisch Stargard, Preussisch Holland and Mohrungen. The rural sample is reduced by nine counties as the city-counties of Berlin, Danzig Stadtkreis, Potsdam, Breslau Stadtkreis, Stettin, Frankfurt/Oder, Posen Stadtkreis, Liegnitz Stadtkreis and Koenigsberg Stadtkreis do not comprise rural parts.

[83] We present OLS estimates here as IV estimates with weak instruments and small sample size are biased and highly inconsistent. However, we performed IV estimates for the full sample of urban and rural counties and the results are qualitatively similar.

[84] We have also run a specification with separate dummy variables for the number of counties. The results are virtually the same (available on request).

In Column 6 we report the specification for rural municipalities. Also in this case the coefficient for linguistic polarization is negative, highly significant, and similar in size to the OLS estimates as in Table 4.2. Since a county generally encompasses a large number of rural municipalities, data for the single rural municipalities are not provided in the original sources. Therefore we cannot perform an analysis similar to the one carried out for the urban municipalities addressing the issue of aggregation bias. However, the fact that the estimates by urban and rural municipalities are much in line with the OLS estimates in Table 4.2 suggests that Tiebout sorting between rural and urban municipalities is not a crucial issue. This last set of estimates suggests also that observing our variables at a higher level of jurisdiction with respect to the municipal level does not constitute a problem.

Table 4.7: Linguistic Polarization and Spending on Education by Number of Municipalities

Dep. Var.: Local spending on public primary education per child (6-14) (log)	Urban					Rural
	(1) Full sample	(2) Single mun.	(3) <=2 mun.	(4) <=3 mun.	(5) <=4 mun.	(6) Full sample
Linguistic polarization	-0.177**	-0.183	-0.322***	-0.181*	-0.144*	-0.182***
	(0.078)	(0.352)	(0.113)	(0.097)	(0.086)	(0.040)
Number of municipalities	0.003					
	(0.012)					
Municipality level controls	Yes	Yes	Yes	Yes	Yes	Yes
County level controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	203	41	86	134	161	205
R-squared	0.26	0.36	0.30	0.24	0.23	0.46

Note: OLS estimates. The dependent variable is the logarithm of local spending on public primary education per child of school age (6-14). Linguistic polarization is measured through the polarization index as described in equation (4.1) and is based on six linguistic groups as reported in the education census in 1886: German, Polish, Lithuanian, Wendish, Slavic, and "other" language. Municipality level controls are the share of Protestants and the log of municipal taxes per capita in 1883/1884. County level controls include the percentage of workers employed in agriculture, the percentage of workers employed in manufacturing and landownership concentration. Robust standard errors are reported in parentheses. ***, **, and * denote significance at 10%, 5% and 1% respectively.

4.7 Linguistic Polarization under Centralization

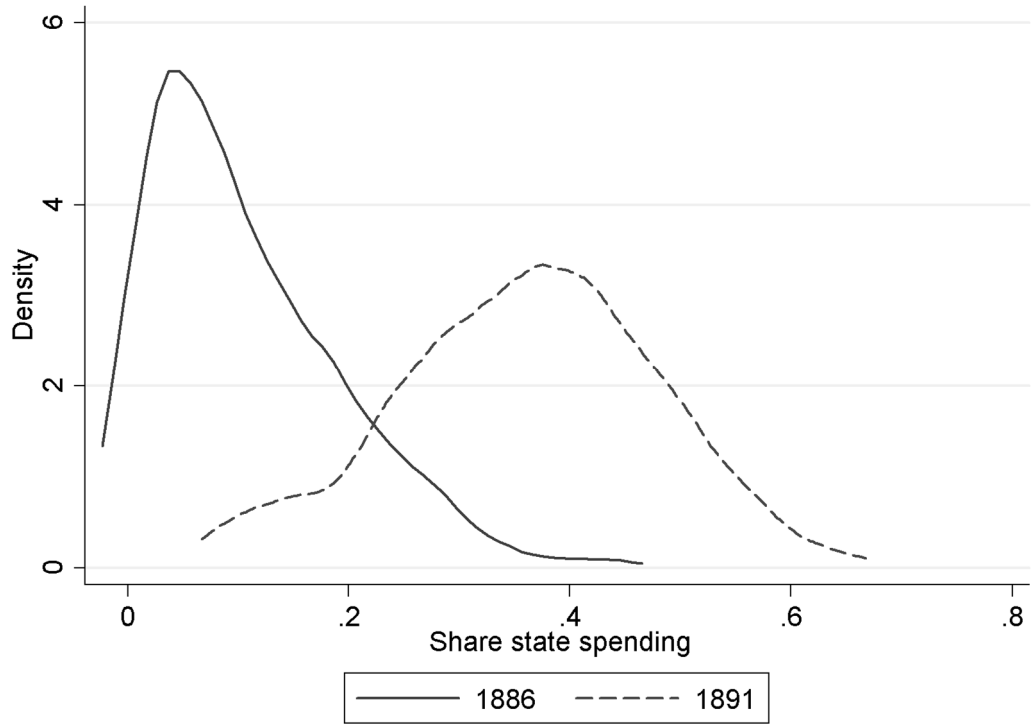
The hypothesis of this chapter is that linguistic polarization in a decentralized system leads to under provision of public primary education. The cross-sectional estimates presented so far provide ample support to this hypothesis. Our interpretation of this result builds on the theoretical model proposed by Alesina et al. (1999) according to which different ethnic or linguistic groups do not want to invest local resources in the production of public goods which benefits can accrue to other groups. If this interpretation is correct, a shift to centralization in the form, for example, of state subsidies, could partially solve this coordination problem alleviating the under provision of the public good.

We can test this additional hypothesis by exploiting a reform on education spending occurred in 1888/1889 which determined a partial centralization of the expenditure on primary school teachers. The objective of the law (*Schulunterhaltungsgesetz*) was to relieve municipalities from the fiscal burden to fund primary school. This new law introduced a fixed financial support from the state for each full employed teacher which amounted to 500 Mark for the first teacher of each school, 300 Mark for every other teacher (150 Marks for every female teacher), and 100 Mark for supplementary teachers. The state contributions for each municipality were calculated on the basis of the number of teachers reported in the previous education census (*i.e.* in 1886 for 1891, 1891 for 1896). The same law established that school fees would be abolished and that landlords were exempted from their duty to fund schools. Since, from 1897, the state guaranteed also a uniform minimum wage for teachers which altered the allocation of state funds, we restrict our panel analysis to the years 1886, 1891, and 1896.

As a result of the policy change, state spending on primary education increased on average from 10 percent to 35 percent of the total spending between 1886 and 1891. Figure 4.3 shows the distributions of the share of state spending in 1886 and 1891. We can see that not only the average level of central spending increased significantly, but also the distribution is much less skewed in 1891. The shift to centralization is particularly accentuated if we consider the expenditure on teachers: the state contribution increased from 14 percent to 50 percent.

By shifting part of the expenditure on education to the central state, we expect this policy change to solve partially the coordination problem between different linguistic groups and increase the provision of public education. Therefore, we expect the linguistically polarized counties to benefit the most from this policy change.

Figure 4.3: Density Function of the Share of State Spending in 1886 and 1891



Note: Own illustration.

We estimate a model similar in logic to a difference in differences approach. Including county and year-fixed effects we estimate whether *total* spending on education is significantly different after the reform in 1886 in highly polarized counties with respect to low polarized ones. By including county and year-fixed effects we can account for time-invariant unobserved heterogeneity across counties and common shocks, respectively. The identification relies on the assumption that there are no other changes, beyond those we have controlled for, that occurred between 1886 and 1891 which affected the education outcomes. It is also crucial that the increased state contributions were not targeted to counties with high linguistic polarization.

The model estimated is the following:

$$Y_{it} = \alpha_i + \delta_t + \beta_1 \, pola \, r_{it} + \beta_2 \, pola \, r_{it} \, post_{\,t} + X'_{it} \, \gamma + \epsilon_{\,it} \qquad (4.5)$$

where α_i and δ_t denote, respectively, county and year-fixed effects; $polar$ is our variable for linguistic polarization which varies across counties and over time;[85] X_{it} is a vector of covariates which includes the share of Protestants, urbanization rate, population density, landownership concentration, share of people employed in agriculture, and the share of people employed in manufacturing; ϵ_{it} is the error term. The coefficient of interest is β_2 which captures the difference in outcomes for polarized counties relative to non-polarized counties after the reform.

In a more flexible approach we allow the coefficient for polarization to vary over time and estimate equation (4.6). In this case the coefficient β_t shows for the indicated year the difference in the outcome variable between high and low polarized counties with respect to the baseline year 1886. More formally, the flexible model estimated is the following:

$$Y_{it} = \alpha_i + \delta_t + \sum_{t=1891}^{1896} \beta_t pola \, r_{it} + X'_{it} \, \gamma + \epsilon_{\,it} \qquad (4.6)$$

As dependent variable we consider the log of *total* expenditure on primary education, the number of teachers per 1,000 children aged 6-14, and the teacher-student ratio. Consistently with our hypothesis we expect total spending on education and the provision of teachers to increase comparatively more in linguistically polarized counties after the reform in 1888/1889.

The panel estimates are presented in Table 4.8. In this case we consider the whole Prussia as it increases the counterfactual group, namely the number of counties with no polarization. We will show that we obtain the same results when focusing on the East Elbian sample.

[85] It is important to note that the time-variation of linguistic polarization is extremely low.

In Columns 1 to 4, we use the log of total spending on public primary education as dependent variable. In Column 1 we report the estimates of equation (4.5), where we estimate the impact of the reform in polarized counties. The coefficient of the interaction between linguistic polarization and the post-reform dummy is positive and significant. This lends support to our hypothesis that linguistically polarized counties benefitted the most from the shift to centralization by increasing relatively more total spending on education. In Column 2 we estimate the flexible model as in equation (4.6). We can see that the positive effect of the reform in polarized counties persists with a similar magnitude until 1896.

In Column 3 we include province-by-year-fixed effects. This is to account for regulations complementary to the policy reform which varied across provinces. For instance, for the provinces of Posen and West Prussia, beyond the contributions to cover the costs of teachers, the central state retained also the right to decide about the number and quality of teachers. Furthermore, the state granted also subsidies for the maintenance and construction of new schools. The inclusion of province-by-year-fixed effects does not affect our coefficients of interest which remain significant and similar in size. The same applies when estimating the model only for counties east of the river Elbe (Column 4).

In Columns 5-8 we use the number of teachers per 1,000 children of school age (6-14) as dependent variable. The estimates show a similar pattern: after the reform the provision of teachers increases relatively more in polarized counties. However, the flexible estimates seem to suggest that the impact of the reform on the number of teachers in polarized counties diminishes between 1891 and 1896.

Finally in Columns 9-12 we consider the teacher-student ratio (per 100 students) as dependent variable to account for differences in enrollment rates. Also in this case, in the census year after the reform the initial gap in teacher-student ratio is completely closed in polarized counties. The positive effect of the reform diminishes, however, in 1896.

The results of the panel approach thus support our hypothesis that a change to centralization, by shifting part of the costs of education from the local to the central level, can improve the under provision of public goods in linguistically polarized counties.

Table 4.8: Linguistic Polarization, Total Spending on Education, and the Number of Teachers under Centralization

Dep. Var.:	Total spending on education (log)				Teachers (per 1,000 children)				Teacher-student ratio (* 100 students)			
	(1)	(2)	(3)	(4) East Elbe	(5)	(6)	(7)	(8) East Elbe	(9)	(10)	(11)	(12) East Elbe
Linguistic polarization	0.116	0.110	0.140	-0.054	-2.074	-2.768*	-2.345	-1.206	-0.216	-0.292**	-0.282**	-0.152
	(0.184)	(0.186)	(0.174)	(0.189)	(1.480)	(1.481)	(1.435)	(1.604)	(0.136)	(0.141)	(0.135)	(0.144)
Linguistic polarization x Post	0.084***				1.341***				0.141***			
	(0.021)				(0.203)				(0.026)			
Linguistic polarization x 1891		0.089***	0.070**	0.085***		1.976***	2.107***	2.374***		0.210***	0.193***	0.219***
		(0.023)	(0.030)	(0.031)		(0.314)	(0.381)	(0.391)		(0.044)	(0.039)	(0.041)
Linguistic polarization x 1896		0.079***	0.080***	0.097***		0.749***	0.637***	0.794***		0.076***	0.061***	0.073***
		(0.023)	(0.028)	(0.028)		(0.185)	(0.220)	(0.226)		(0.019)	(0.022)	(0.023)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province*Year FE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Observations	1355	1355	1355	642	1355	1355	1355	642	1356	1356	1356	642
R-squared (within)	0.81	0.81	0.84	0.84	0.56	0.56	0.74	0.72	0.54	0.55	0.71	0.66
Mean of the dependent variable	3.22	3.22	3.22	3.12	14.14	14.14	14.14	13.60	1.51	1.51	1.51	1.47

Note: Panel estimates. Linguistic polarization is measured through the polarization index as described in equation (4.1) and is based on the linguistic groups as reported in the education censuses in 1886, 1891 and 1896. Post is a dummy variable for the years 1891 and 1896 after the reform. Controls are: share of Protestants, share urban, population density, landownership concentration, the percentage of workers employed in agriculture and manufacturing, respectively. Robust standard errors reported in parentheses are clustered at the county level. ***, ** and * denote significance at 10%, 5% and 1%, respectively.

4.8 Conclusion

Recent literature has shown that fiscal decentralization is positively related to education outcomes. In this chapter we test the hypothesis that heterogeneous preferences over the local provision of public education, in a context of strong decentralization, can lead to under provision of primary education. Nineteenth-century Prussia is an ideal laboratory to study this issue because of a highly decentralized educational system and a linguistically polarized society which led to conflicting interests over the provision of primary education.

Exploiting unique county-level data on local and central expenditure on public primary education in 1886 we show that for a given level of development and municipal tax revenues, linguistically polarized counties invested fewer local resources in primary education. Consistent with the notion that public education was a contested public good between linguistic groups, we find that linguistic polarization has no bearing on local spending on transport infrastructure.

Instrumental variable estimates using distance to the eastern border, motivated by the progressive eastward annexations of Slavic populations which determined different levels of linguistic polarization, suggest a causal interpretation of our results. Consistently, we find that linguistic polarization has a negative impact also on the number of schools and teachers per children in school age.

We further test the hypothesis that centralization, by shifting part of the education costs from the local to the central level, can alleviate the under provision of education. Thus, we exploit a policy change in education funding that increased the state contributions to cover teachers' costs. By estimating a model similar to a difference in differences approach we show that, after the reform towards centralization, the number of teachers per child (6-14) and the teacher-student ratio increased relatively more in polarized counties.

This chapter presents a case under which centralization can lead to better outcomes. In a society characterized by high levels of diversity in terms of culture, ethnicity, and language, heterogeneity of preferences in the presence of strong decentralization can lead to a standstill and to a relatively lower provision of contested public goods. We show that changing the way the production of public goods is financed can partially solve coordination problems and improve the provision of contested public goods.

Appendix 4A Data Sources

Table A4.1: 1886 Variables

Linguistic polarization	Linguistic polarization is measured through the polarization index as described in equation (4.1) and is based on the linguistic groups as reported in the education census in 1886: German, Polish, Lithuanian, Wendish, Slavic, Danish and "other" language.
Religious fractionalization	Religious fractionalization is measured through the fractionalization index as in equation (4.2) and is based on five religious groups as reported in the population census in 1871: Protestants, Catholics, other Christians, Jews, and other religion. (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 30).
Local spending on education per child (6-14)	Local spending on public primary education per child of mandatory school age (6-14) in 1886.
State spending on education per child (6-14)	State spending on public primary education per child of mandatory school age (6-14) in 1886.
Municipal tax revenues per capita	Municipal tax revenues per capita for the fiscal year 1883/1884 (Königliches Statistisches Bureau in Berlin, 1884).
School per 1,000 children (6-14)	Number of primary schools per 1,000 children of mandatory school age (6-14) in 1886.
Teacher per 1,000 children (6-14)	Number of fully employed teachers per 1,000 children of mandatory school age (6-14) in 1886.
Teacher-student ratio (x 100)	Ratio of fully employed teachers over 100 students attending public or private primary school in 1886.
Protestant (share)	Share of Protestants per total population in 1885 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 96).
Urban (share)	Share of total population living in cities that held city rights in 1885 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 89).
Population density	Number of people per hectare in 1885 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 96).
Employed in agriculture (%)	Share of people employed in agriculture and animal husbandry (sector A) over working population in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76b).
Employed in manufacturing (%)	Share of people employed in manufacturing (sector B) over working population in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76b).
Employed in administration (share)	Percentage of people employed in public administration and military (sector E) over working population in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76b).
Landownership concentration	Share of farms larger than 100 ha arable land in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76c).

Note: Unless otherwise specified, the data stem from Königliches Statistisches Bureau in Berlin (1861–1934, vol. 101).

Table A4.2: 1891 Variables

Linguistic polarization	Linguistic polarization is measured through the polarization index as described in equation (4.1) and is based on the linguistic groups as reported in the education census in 1891: German, Polish, Kashubian, Lithuanian, Wendish, Slavic, Danish, Frisian, Walloon and "other" language.
Total spending on education per child (6-14)	Total spending on public primary education per child of mandatory school age (6-14) in 1891.
Teacher per 1,000 children (6-14)	Number of fully employed teachers per 1,000 children of mandatory school age (6-14) in 1891.
Teacher-student ratio (x 100)	Ratio of fully employed teachers over 100 students attending public or private primary school (6-14) in 1891.
School per 1,000 children (6-14)	Number of primary schools per 1,000 children of mandatory school age (6-14) in 1891.
Protestant (share)	Share of Protestants per total population in 1890 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 121a).
Urban (share)	Share of total population living in cities that held city rights in 1890 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 117).
Population density	Number of people per hectare in 1890 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 121a).
Employed in agriculture (%)	Interpolated.
Employed in manufacturing (%)	Interpolated.
Landownership concentration	Interpolated.

Note: Unless otherwise specified, the data stem from Königliches Statistisches Bureau in Berlin (1861–1934, vol. 120).

Table A4.3: 1896 Variables

Linguistic polarization	Linguistic polarization is measured through the polarization index as described in equation (4.1) and is based on the linguistic groups as reported in the education census in 1896: German, Polish, Kashubian, Lithuanian, Wendish, Slavic, Danish, Frisian, Walloon and "other" language.
Total spending on education per child (6-14)	Total spending on public primary education per child of mandatory school age (6-14) in 1896.
Teacher per 1,000 children (6-14)	Number of fully employed teachers per 1,000 children of mandatory school age (6-14) in 1896.
Teacher-student ratio (x 100)	Ratio of fully employed teachers over 100 students attending public or private primary school in 1896.
School per 1,000 children (6-14)	Number of primary schools per 1,000 children of mandatory school age (6-14) in 1896.
Protestant (share)	Share of Protestants per total population in 1895 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 148a).
Urban (share)	Share of total population living in cities that held city rights in 1895 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 143).
Population density	Number of people per hectare in 1895 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 148a).
Employed in agriculture (%)	Share of people employed in agriculture and animal husbandry (sector A) over working population in 1895 (Kaiserliches Statistisches Reichsamt, 1872-1918, vol. 104 and 109).
Employed in manufacturing (%)	Share of people employed in manufacturing (sector B) over working population in 1895 (Kaiserliches Statistisches Reichsamt, 1872-1918, vol. 104 and 109).
Landownership concentration	Share of farms larger than 100 ha arable land 1895. (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 142b).

Note: Unless otherwise specified, the data stem from Königliches Statistisches Bureau in Berlin (1861–1934, vol. 151).

Chapter 5
Centralized Monitoring, Resistance, and Reform Outcomes: Evidence from School Inspections

5.1 Introduction

Can a reform opposed by the targeted population improve school conditions? Introducing school accountability has generally shown positive effects on student test scores (Figlio and Loeb, 2011). The introduction of a school inspection reform in Prussia against the background of the *Kulturkampf*, a conflict between the Prussian government and the Catholic Church, provides an ideal laboratory to test the effectiveness of an early form of school accountability in a setting where the targeted population vehemently opposed the introduction of the reform. The reform introduced school inspectors, who were selected, mandated and paid by the central government and replaced the clergy who had previously exercised this task gratuitously and additional to their clerical office. The task of the centrally installed school inspectors was to enforce school attendance and to improve the school system in general (Lamberti, 1989).

In order to observe the introduction of the reform, I hand-collected data on school inspectors for the period 1876 to 1886, containing information on the names, employment status (i.e. whether the school inspector was mandated through the central state or through the church) and location of on average 552 inspectors per year, from a publication of the Prussian Ministry of Ecclesiastical and Education Affairs. I combine these data with Prussian county-level census data from 1864 and 1886 allowing measuring outcomes both before and after the reform.

The setting and data allow applying a difference in differences approach, comparing the different trends of the outcome variables between the counties under centralized monitoring versus the counties not affected by the reform. As the objective of the reform was to increase school attendance, school enrollment will be looked upon as the main outcome variable and is expected to increase through the reform. To get closer at the underlying mechanisms of the reform, I furthermore examine school density, the student-teacher ratio and private enrollment as intermediate channels. As the school inspector's task encompassed observing the resource deficiencies of the schools and to recommend remedies to the local bureaucracy (Lamberti, 1989), I expect, an improvement in the provision of schools and teachers. Given the prior that the quality of the public educational system improved through the introduction of centralized monitoring, sending

children to private schools becomes less pressing which is why I expect private enrollment to decrease. The historical narrative stresses resistance against the reform coming from the Catholic population that opposed the introduction of the reform. To identify possible resistance effects a triple interaction of the treatment effect and the share of Catholics is introduced in a second step.

Centralized monitoring increases school enrollment overall. When examining the intermediate channels, centralized monitoring amplifies the overall increase in teacher supply. The general shift towards more private schooling is mitigated in counties with centralized monitoring, suggesting higher adherence to the public school system as hypothesized. No significant effect for school density is found.

When it comes to detecting resistance effects, the positive effect on school enrollment is mitigated in predominantly Catholic regions. Observing the intermediate channels shows that resistance comes especially from the predominantly Catholic counties in Prussia west of the Elbe. As an evasion mechanism, private enrollment increases in mainly Catholic regions west of the Elbe and the supply of teachers stays flat despite the overall increase in teacher supply.

The chapter combines two strands of the literature, namely the literature on school inspections and put broadly, school accountability, and the literature on the resistance to reforms. In detecting resistance effects, I follow Acemoglu et al. (2011) who examine the effect of the enforced introduction of the French Civil Code in Germany to see whether "designed" and externally imposed institutions can foster economic progress or whether they are, instead, ineffective due to resistance from the targeted population. Acemoglu et al. (2011) find positive effects of the French reforms, arguing that imposed institutions can lead to more growth and higher prosperity if the newly imposed institutions replace growth-impeding ancient institutions. I expand this inquiry to educational interventions, considering that identity might play a bigger role when carrying out reforms in the educational as opposed to the economic sphere. In this line, Austen-Smith and Fryer (2005) theoretically explain the black-and-white achievement gap in the U.S. by the loss of identity. By choosing white and thereby on average better-performing schools, blacks lose their adherence to the group. Fearing exclusion from their social group, they avoid white schools, consequently leading to lower school performance. This theoretical argumentation goes in line with the alleviated effect found for school enrollment in counties with a high share of Catholics as Catholics would want to avoid losing their Catholic identity by attending schools promoting Prussian-Protestant values and a German identity.[86]

[86] On nation and identity building through primary schools, see *Chapter 3*.

The literature on school monitoring discusses the effectiveness of school inspections in countries such as England, the Netherlands and Sweden (e.g., Patrinos, 2011; Rosenthal, 2004). Beyond this, introducing central school inspectors can be understood as an early form of school accountability. Evidence on school accountability mainly comes from intra-U.S.-state comparisons finding that the introduction of accountability systems leads to increased student achievement (e.g., Carnoy and Loeb, 2002; Dee and Jacob, 2011; Hanushek and Raymond, 2005; Jacob, 2005). Figlio and Loeb (2011) argue that accountability systems work in settings where community members and parents have an interest in improving school performance and are eager to pursue the objectives of the reform, which is clearly not the case in the historical setting provided by the School Inspection Law. While the existing literature often lacks an appropriate control group to clearly determine a causal effect (Hanushek and Raymond, 2005), the introduction of the reform in regions with a substantial share of Catholics as opposed to predominantly Protestant regions allows comparing the variation of outcomes between the treatment and control group both before and after the reform.[87]

The chapter is structured as follows: Section 5.2 sets out the historical background of nineteenth-century Prussia; the *Kulturkampf* and the School Inspection Law; Section 5.3 describes the dataset; Section 5.4 presents results on the effect of the School Inspection Law on school outcomes; Section 5.5 explores the resistance effects for the Catholic population; Section 5.6 concludes.

5.2 Historical Background

The foundation of the German Empire in 1871 led to the foundation of a German nation state excluding German-speaking Austria. As Prussia was the largest and most powerful state in the German Empire, Prussian-Protestant hegemony arose with the Prussian King meanwhile being the German Emperor (e.g. Landry, 2011). As Catholic Austria was excluded, the Catholics became a decided minority in the new Empire. 40 percent of the population was Catholic and concentrated in the Rhenish and Westphalian provinces in the West and in the eastern provinces of Silesia, Posen, and both East and West Prussia (Hatfield, 1981).

[87] Similarly for the U.S., Wong, et al. (2009) compare the improvement of public schools which are covered by the No Child Left Behind Policy which introduced school accountability in U.S. states to Catholic and non-Catholic private schools which are excluded from this policy.

5.2.1 *Kulturkampf*

As the German unification movement represented a triumph of Protestant state interests over the Catholics, the grounds were paved for a serious conflict between the Prussian state and the Catholic Church, the so-called *Kulturkampf,* which coined the Protestant-Catholic relationship throughout the first decade of the newly founded Empire (Hatfield, 1981).[88]

The *Kulturkampf* was fuelled by the fear of organized Catholicism. First of all, the Papal infallibility decree that was passed during the First Vatican Council in 1869/1870 in order to declare that the Pope's decisions concerning theological matters were preserved from the possibility of error was understood as being incompatible with the sovereignty of the German Emperor as the head of the state. The Center party emerged as the Catholic stronghold in the party system and the Polish nationalist current in Prussia's eastern provinces increasingly identified with the Catholic confession (Hatfield, 1981).

Laws on both the German federal and the Prussian state level were passed to decrease the power of the Catholic Church. The first active step at the Prussian state level was the dissolution of the Catholic division of the Ministry of Ecclesiastical and Education Affairs in July 1871. The so-called "Pulpit Paragraph" followed in December 1871 which ruled that clergymen were prohibited to use their positions to influence public assemblies for political means. The School Inspection Law of 11 March 1872—which will be described in detail below—shifted the authority to appoint inspectors for all levels of public and private schools from the church to the state and left to the state to define the extent of the inspector's supervisory power. Its objective was to eliminate the clerical domination of the schools both at the local and district level.[89] On 4 July 1872, another law ruled on the expulsions of the Catholic order of the Jesuits from Germany. Finally, the May Laws of 1873, 1874 and 1875, restricted the recruitment for and practice of clerical posts, making a "culture exam" mandatory for becoming a priest and allowing expelling priests in case of non-obedience as well as the dissolution of all clerical orders (Hatfield, 1981).

The *Kulturkampf* coincided with the *Germanization* policy of the Prussian state in the eastern provinces aiming at *Germanizing* the Polish (or other Slavic) minorities. In 1873/1874 language decrees introduced German as the only language of instruction in primary schools—with religious education being the only exception allowing for the instruction in a minority language—in the provinces of Posen and West Prussia (Lamberti, 1989). This historical simultaneity led to the fact that the common historical narrative describes the so-called Polish question and the *Kulturkampf* as being strongly intertwined.

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[88] For a detailed narrative on this historical period and the *Kulturkampf*, see Mommsen (1993).

[89] Lamberti (1989), arguing that the *Kulturkampf* was especially fought in the schools, describes the School Inspection Law as the actual initiator of the *Kulturkampf*.

How rigorously the *Kulturkampf* legislation was enforced varied across provinces. In the province of East Prussia, the highest administrative official of the province (the so-called *Oberpräsident*) decided upon the implementation of the *Kulturkampf* legislation (Groeben, 1992a). In the province of Posen, on the other hand, the laws were implemented at the lowest administrative level which especially fuelled the conflict between Germans and Poles (Unruh, 1992).

Wherever possible, the Catholic clergy reacted to the laws with noncompliance. Regarding the May laws, no Catholic student ever presented himself as a candidate for the state's "culture exam" which—as a response—made the Prussian authorities intensify their measures. Bishops and other responsible clergymen were fined, imprisoned for short sentences or removed from office. The consequence was that by 1879 when the *Kulturkampf* practically ended, nine of 12 Prussian bishoprics and 955 parishes were vacant (Hatfield, 1981) and 2,848 priests had lost their right to teach religious education (Kuhlemann, 1991).

Due to the strong enforcement of the *Kulturkampf* legislation through the Westphalian *Oberpräsident*, resistance against the *Kulturkampf* measures was particularly strong in the province of Westphalia, culminating in demonstrations held to manifest the Catholic solidarity. The resistance in Westphalia was mainly led by the bishops of Muenster and Paderborn and ranged from the passive resistance by the Catholic population to strikes of Catholic industrial workers and boycotts of national holidays such as the Day of Sedan to celebrate the victory over the French army in 1870 or the Anniversary of the Emperor. The Catholic press supported and fuelled the resistance. As a consequence of the resistance, many Catholic chief administrative officers of a county (*Landrat*) lost their office. The school again became a battleground of the *Kulturkampf* as Catholic parents withdrew their children from joining military parades in honor of the Emperor (Roerkohl, 1992).

Despite all this agitation, the *Kulturkampf* did not achieve its aim to undermine the power of the Catholic Church. Instead, it ultimately strengthened the unity of the Catholic Church and established a solidarity between the clergy and the Catholic population and increased support for political Catholicism, namely the Center party (Hatfield, 1981). Instead of generating a homogeneous nation, it widened and deepened the inter-confessional split in Germany (Hatfield, 1981) and gave rise to the so-called "Catholic social milieu" (Lepsius in (Landry, 2011)).

After diplomatic negotiations between the Prussian state and the Vatican, the *Kulturkampf* was officially ended in 1886/1887 by the so-called Peace Laws.

5.2.2 The School Inspection Law of 1872, its Implementation, and Resistance

The functioning and quality of the Prussian educational system was guaranteed by school inspectors and as a consequence, the backwardness of schools in mainly Catholic regions was ascribed to Catholic school inspectors who did not exercise their office dutifully (Groeben, 1992b).

The principal task of school inspectors was to monitor school attendance. Catholic school inspectors were accused of systematically exempting students from school in the harvesting season, leading to lower school enrollment in Catholic regions (Kuhlemann, 1991). Furthermore, school inspectors examined the achievement of pupils and the effectiveness of teacher's instruction and reported those to the district government in the form of annual reports (Geissler, 2011).

When in March 1872, the School Inspection Law was introduced by Adalbert Falk, the Minister of Ecclesiastical and Education Affairs, school inspection was shifted from the church to the state. School supervision was supposed to professionalize through the installment of full-time and paid school inspectors which consequently should make primary school more effective (Glück, 1979).

Even though the law did not specify any qualifications of central inspectors (Tews, 1914), they constituted themselves of secondary schoolteachers, school principals, and instructors in teacher seminars (Lamberti, 1989). They were state officials (Unruh, 1992) and received a fixed salary (Neugebauer, 1992).

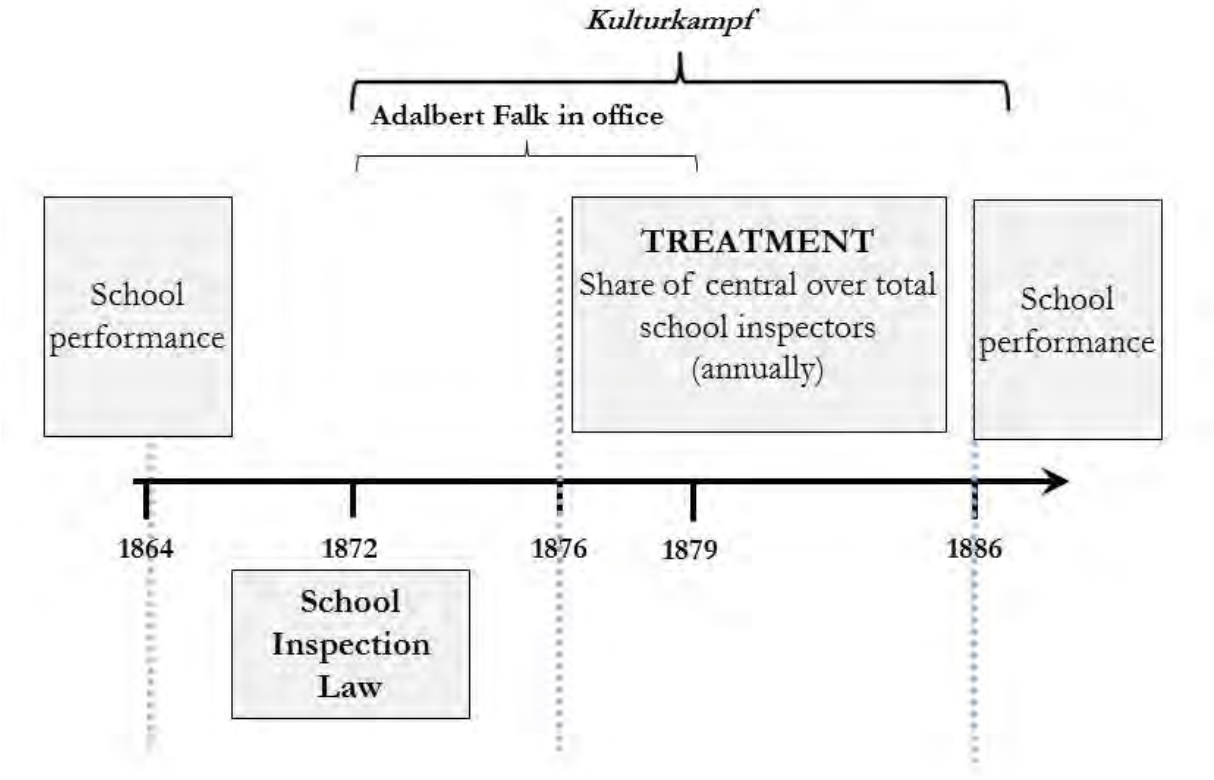
There was no implementing rule for the law (Kuhlemann, 1991). In 1873, the implementation of central school inspectors was restricted to 50 counties due to a limited state budget. Decisions on the reorganization of school supervision were taken case by case. As the law was implemented triggering the *Kulturkampf* and as it had the objective to improve the poor school conditions of the Catholic and especially the formerly Polish regions, central school inspectors were first of all introduced in Polish-speaking Catholic counties as a testing field which geographically meant that central school inspectors were clustered in the Catholic regions east of the Elbe which had formerly belonged to the Polish-Lithuanian Commonwealth.

The provinces of Rhineland and Westphalia in the West which were also predominantly Catholic followed. The implementation of the law in the East as opposed to the West of Prussia differed in the way that the school inspectors installed in the East, especially in the province of Posen, originated from other provinces. They were German-speaking Prussians who had little knowledge on the local educational system leading to resentment of the local Polish-speaking population towards the newly imposed inspectors (Lamberti,

1989). The strict implementation of the law in Catholic regions, mandated by the central state authorities, led to the fact that the historical literature describes the law as clearly anti-Catholic and anti-Polish (Kuhlemann, 1991).

The implementation of the law was closely connected to the figure of Adalbert Falk who aimed at modernizing the Prussian educational system. When the *Kulturkampf* was practically brought to an end in 1879, Adalbert Falk had to bear the consequences as the School Inspection Law was understood as one of the laws having triggered the *Kulturkampf*. He had to lay down his office in 1879 which led to an immediate stop of the implementation of the reform. Even though the new Minister of Ecclesiastical and Education Affairs, Robert Viktor von Puttkamer aimed at reintroducing the distinct denominational educational system, the reform was never reversed which meant that central and clerical school inspectors stayed in office simultaneously and the non-uniform implementation of the reform remained in practice until the end of World War I in 1918 (Kuhlemann, 1991). The timeline in Figure 5.1 depicts the timing of the historical events.

Figure 5.1: Timeline of Historical Events and Data, 1864 – 1887



Note: Own illustration.

The historical literature judged that the law did not bring about big changes in its ultimate goal of improving school performance. Temporary observers stressed the resistance against the law and how it changed the relationship between the Catholic Church and the state. Tews (1914) reports that citizens in Catholic counties were less willing to follow

what is taught in primary school as they understood the School Inspection Law as a means to fight the Catholic clergy. The more recent literature is more favorable in its evaluation of the law, conceding that school inspectors especially served as catalysts to improve school performance in the Rhine Province (Lamberti, 1989).

5.3 Data

To examine whether introduction of central school inspectors had a positive impact on school performance and its intermediate channels, I digitized data on central and clerical school inspectors and combine these newly digitized data with Prussian county-level census data.

5.3.1 Data on School Inspectors

The data on county school inspectors stem from the *Zentralblatt*, a monthly publication of the Prussian Ministry of Ecclesiastical and Education Affairs that informed on current topics in education (Ministerium der geistlichen Unterrichts- und Medizinal-Angelegenheiten, 1876-1878, 1880-1886).[90] Issues of the *Zentralblatt* from 1876 to 1878 contain information on central school inspectors appointed by the central state authorities, including their last names and the county, municipality or parish in which they were installed. Furthermore, vacant positions are advertised. I collected data for each location and allocated school inspectors to the corresponding county in order to be able to ultimately merge the data on school inspectors with Prussian county-level data. For the years 1880 to 1886, the *Zentralblatt* additionally includes information on clerical positions. This information equally includes the school inspector's last name and his location, as well as his main profession (i.e., priest, pastor, deacon, superintendent, among others) if he held a clerical office. This information provides the total number of school inspectors and allows observing whether central and clerical school inspectors were in office simultaneously. On average information about 552 school inspectors is collected for each year.

[90] An example of a page reporting information on central and clerical school inspectors for the year 1886 can be found in the Appendix, Figure A5.1.

I compute the share of central county school inspectors among all county school inspectors to capture the intensity of the treatment. For the years 1876 to 1878, for which I lack information on the total number of school inspectors, I assume that the number of school inspectors stayed fairly constant over time and use the total number of county school inspectors for the year 1880.[91]

To capture the gradual implementation of central school inspectors over time and account for the fact that some counties were treated from the beginning while others received a central school inspector only later, I sum up the shares of central county school inspectors per total county school inspectors and divide the sum by the period of observation, that is, 10 years, applying the following formula:

$$c_i = \frac{1}{10}\left(\sum_{1876}^{1878} \frac{central\ inspectors_{it}}{total\ inspectors_{1880}} + \sum_{1880}^{1886} \frac{central\ inspectors_{it}}{total\ inspectors_{it}}\right) \qquad (5.1)$$

The treatment variable c_i, therefore, measures the average annual share of central school inspectors in a county *i* over the period of 1876 to 1886. It is bound between 0 and 1, taking the value of 0 if the county was never under central school inspection and taking the value of 1 if school inspection was carried out by a central school inspector during the entire period of observation. This measure of the treatment allows observing the implementation of the reform—both concerning its timing and its intensity.[92]

As can be seen in Figures 5.2 and 5.3, the share of central school inspectors was especially high in those regions of Prussia that also faced a high concentration of Catholics, i.e. in the provinces of Westphalia and the Rhineland in the West and the eastern provinces of Silesia, East and West Prussia and Posen. This illustrates the above described implementation of the reform in mainly Catholic areas of Prussia.

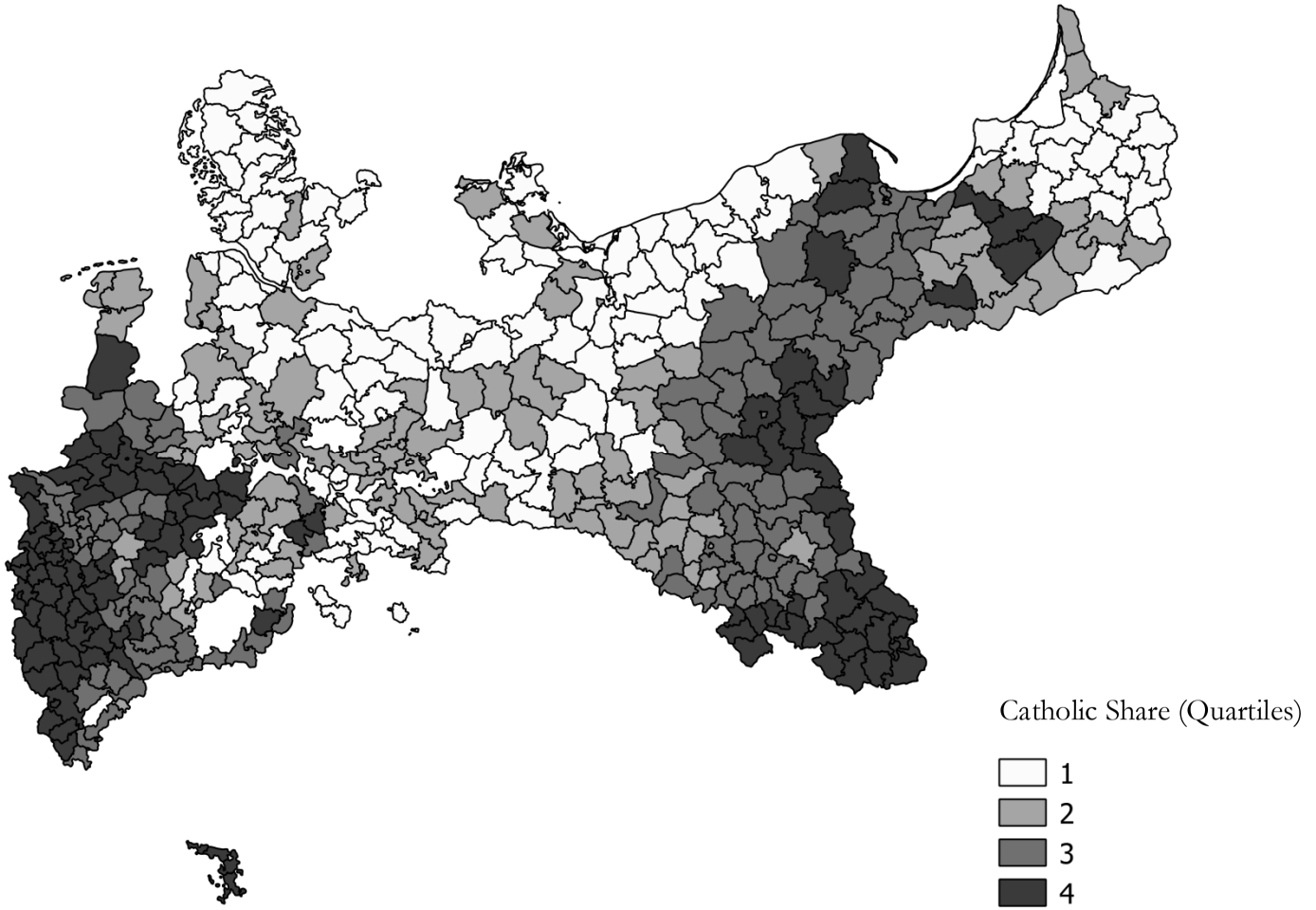
Figure 5.4 stresses that the implementation of central county school inspectors clearly followed ideological motives. Central school inspectors were introduced in those regions where the share of Catholics was highest. Figure 5.4 also illustrates that the introduction of central county school inspectors stopped when Adalbert Falk, Minister of Ecclesiastical and Education Affairs, stepped down from office in 1879. After this, the share of central county school inspectors even slightly decreased in predominantly Catholic counties (i.e., counties with a Catholic share exceeding 90 percent in 1885) due to the period of

[91] For 1880 and 1881, the number of total school inspectors is indeed quite stable with a total of 602 school inspectors in 1880 and a total of 613 school inspectors in 1881. After a sharp drop in 1882 the number of school inspectors increases from 1883 onwards reaching 631 inspectors in 1885. Instead of assuming a constant number of school inspectors between 1876 and 1878, I could have interpolated the number of total school inspectors for the years 1876 to 1878.

[92] In employing this measure, I assume that a central school inspector in office in 1876 had the same effect on outcomes as a school inspector in office in 1886.

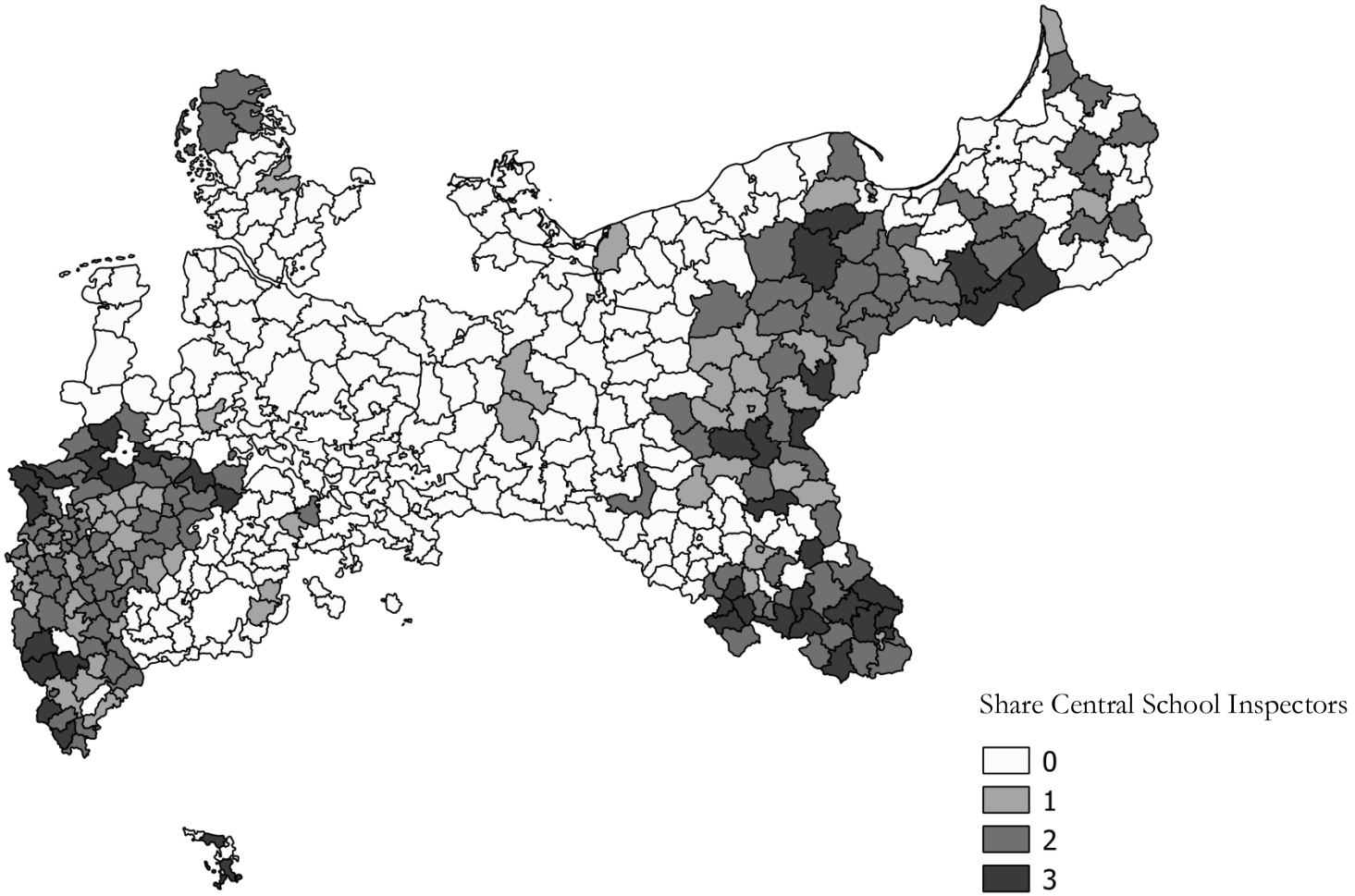
reconfessionalizing primary schools, and stayed fairly constant in predominantly Protestant (i.e., counties with a Protestant share exceeding 90 percent in 1885) and interdenominational counties. For the identification—especially of the resistance effects below—it is important to bear in mind that central school inspection was introduced both in predominantly Catholic and interdenominational counties. I will exploit these degrees of Catholicism in the introduction of the reform to detect resistance effects.

Figure 5.2: Catholic Share in 1886



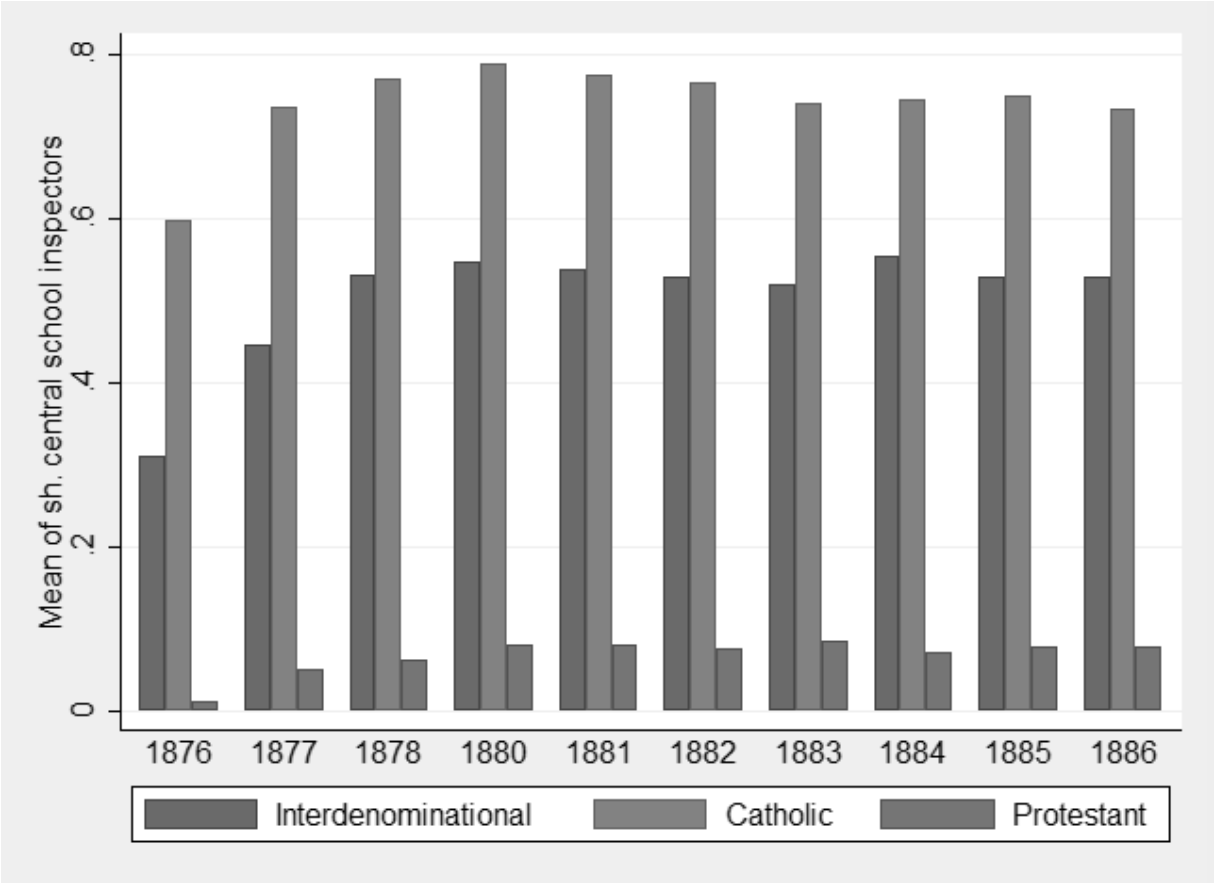
Note: The share of Catholics is constructed as the number of Catholics over the total population in 1885. Quartile 1 comprises the share of Catholics from 0 to 1.32 percent; Quartile 2 from 1.32 to 16.1 percent; Quartile 3 from 16.1 to 73.3 percent; Quartile 4 from 73.3 to 100 percent. County borders as in 1871. Source: Own illustration; see main text for details.

Figure 5.3: Share of Central School Inspectors, 1876 to 1886



Note: The share of central school inspectors is estimated following equation (5.1). The category 0 comprises counties with 0 central school inspectors. The category 1 comprises counties with a share of central school inspectors of above 0 and below 50 percent. The category 2 comprises counties with a share of central school inspectors of above 50 and below 100 percent. The category 3 comprises counties with full central school inspectorate. County borders as in 1871. Source: Own illustration; see main text for details.

Figure 5.4: Share of Central School Inspectors by Major Denomination, 1876–1886



Note: "Catholic" comprises 59 counties with more than 90 percent Catholics in 1885. "Protestant" comprises 151 counties with more than 90 percent Protestants in 1885. The 145 "interdenominational" counties have a population with both less than 90 percent Catholics and Protestants.

Table 5.1 (Panel A) shows that the average treatment with central school inspectors amounted to 37 percent throughout the ten years of observation. Counties west of the Elbe were treated in 44 percent of the cases, while counties east of the Elbe were only treated in 33 percent of the cases. In 1886, there were on average close to two school inspectors per county (including both central and clerical school inspectors). As the implementation of the School Inspection Law was taken case by case, geographical patterns emerge for different districts. In the predominantly Catholic districts of Muenster in Westphalia and Breslau in Silesia, the implementation of the School Inspection Law meant a complete substitution of clerical inspectors by central inspectors. In the district of Posen with a large Polish-speaking Catholic population, clerical and central inspectors were in office simultaneously (which is counted as an annual value of 0.5). In other districts multiple clerical inspectors were in office simultaneously. There were 35 counties which faced centralized school inspection over the whole period of observation which were mainly situated in the provinces of Silesia, the Rhineland and Westphalia whereas 152 counties never experienced the introduction of the reform. On average, one school inspector, irrespective of whether he was a clerical or central school inspector, was in charge of 50 schools and consequently 7,010 students in 1886. The ratio of inspectors over schools was slightly better in the western provinces of Prussia where one school inspector was in charge of 45 schools while one school inspector had to inspect 53 schools in Prussia east of the Elbe.

Table 5.1: Descriptive Statistics

	Full sample		West Elbia		East Elbia	
	1864	1886	1864	1886	1864	1886
PANEL A - Treatment						
Central school inspectors 1876 - 1886 (share)		0.373		0.439		0.33
		0.414		*0.416*		*0.409*
Inspectors per county		1.877		1.735		1.97
		1.176		*1.184*		*1.164*
Schools per inspectors		50.36		45.326		53.341
		27.579		*26.877*		*27.621*
Students per inspector		7,010		7,075		6,972
		4,046		*4,052*		*4,052*
PANEL B - School Attendance						
Enrollment rate	0.724	0.874	0.776	0.878	0.690	0.871
	0.108	*0.033*	*0.089*	*0.026*	*0.107*	*0.037*
PANEL C - Intermediate Outcomes						
School density	1.723	1.462	2.359	1.934	1.309	1.156
	6.221	*2.764*	*9.040*	*3.441*	*3.250*	*2.170*
Student-teacher ratio	78.323	81.495	83.808	79.937	74.756	82.508
	16.982	*11.8*	*17.591*	*11.286*	*15.612*	*12.043*
Private enrollment (ratio)	0.014	0.06	0.009	0.055	0.017	0.064
	0.054	*0.075*	*0.010*	*0.069*	*0.068*	*0.079*
PANEL D - Controls						
Protestant (share)	0.594	0.596	0.442	0.448	0.693	0.693
	0.387	*0.385*	*0.415*	*0.408*	*0.334*	*0.336*
Urban (share)	0.26	0.285	0.283	0.319	0.245	0.262
	0.194	*0.202*	*0.228*	*0.241*	*0.167*	*0.169*
Employed in manufacturing (share)	0.08	0.116	0.108	0.149	0.062	0.094
	0.048	*0.058*	*0.051*	*0.055*	*0.036*	*0.049*
Employed in agriculture (share)	0.186	0.203	0.151	0.171	0.210	0.224
	0.066	*0.073*	*0.062*	*0.079*	*0.058*	*0.060*
Child dependency ratio	0.602	0.903	0.580	0.890	0.616	0.911
	0.067	*0.111*	*0.051*	*0.092*	*0.072*	*0.121*
Population density	2.236	3.194	0.002	0.014	0.212	0.209
	11.238	*17.613*	*0.027*	*0.032*	*0.291*	*0.290*
First language not German (1864 and 1890) (share)	0.129	0.132	2.949	4.058	1.772	2.633
	0.249	*0.246*	*14.120*	*18.972*	*8.886*	*16.695*
Landownership concentration	0.025	0.009	0.008	0.002	0.036	0.014
	0.026	*0.009*	*0.007*	*0.004*	*0.028*	*0.008*
Inheritance (dummy)		0.245	0.500	0.485	0.079	0.089
		0.431	*0.502*	*0.502*	*0.270*	*0.285*
State expenditure on education per child		1.898		1.584		2.102
		1.476		*1.780*		*1.200*

Note: Standard deviations in italics. 335 observations for the full sample, 132 for West Elbia and 293 for East Elbia. Source: See Tables A5.1 and A5.2 in the Appendix for data sources and details.

5.3.2 Prussian Census Data

To examine the effects of the school inspection reform, I manually allocate the data on school inspectors to Prussian county-level census data stemming from the Royal Statistical Office of Prussia.

5.3.2.1 School Attendance

As the goal of the reform was to improve school attendance, I use school enrollment as the main outcome variable. I construct the dependent variables, both before and after the treatment, from the population census of 1864 and the education censuses of 1886. School enrollment is measured by the number of students attending public or private primary school among all children of mandatory school age, that is, between six and 14 years old.

The descriptive statistics in Table 5.1 (Panel B) show an increase for the overall enrollment rate. The standard deviation decreases tremendously, hinting at convergence in enrollment rates over the 22 years of observation which can be attributed to the fact that school enrollment is censored between 0 and 1. The convergence of school enrollment is also illustrated by the subsamples east and west of the Elbe. While school enrollment started off at 69 percent in the sample east of the Elbe, average enrollment rates of 78 percent were already achieved in Prussia west of the Elbe in 1864. However, East Elbian counties managed to catch up to the counties west of the Elbe with school enrollment rates above 87 percent in both parts of Prussia in 1886.

5.3.2.2 Intermediate Outcomes

In order to explore the channels on how the introduction of central school inspectors might have improved the ultimate goal of increasing school enrollment, I furthermore examine the effects of the reform on school density, the student-teacher ratio, and the ratio of private over public students as inputs into the production function, following the logic of an educational production function. Data equally stem from the population census of 1864 and the education census of 1886. School density is the number of primary schools per 10 km^2.[93] The student-teacher ratio is constructed by the ratio of students attending public or private primary school over the total number of primary school teachers. Private enrollment is the ratio of private over public students attending primary school.

[93] In *Chapter 4* school density was defined as the number of schools per 1,000 children of school age (6-14). I alternatively use this measure here (not shown). The pure treatment effect when applying this measure is 0 for all samples. When it comes to the resistance effect a slightly positive effect of centralized monitoring on school density is found for mainly Catholic counties.

Table 5.1 (Panel C) again gives insights into the changes of the intermediate variables of interest. The small decrease in school density—observed in all three samples—is likely to go back to the fact that inefficient small rural schools were consolidated into larger and therefore supposedly more efficient schools. The decrease in the standard deviation shows that schools became more evenly distributed across Prussia between 1864 and 1886. The increasing student-teacher ratio observed for the full sample is due to the population increase at the end of the nineteenth century. Once splitting the sample into the East and the West, it becomes evident that this increase is driven by the eastern provinces of Prussia. As private schools played a minor role in the Prussian educational system (Geissler, 2011), the increase in the private-public enrollment ratio from 1 to 6 percent is remarkable.

5.3.2.3 Other Determinants of Educational Outcomes

Data for covariates are from the population censuses of 1864 and 1885 and the occupation censuses of 1867 and 1882. Additionally, state expenditures per child are constructed from the education census of 1886 to control for interventions from the central government.[94] For a placebo test, presented in section 5.4.3, data from the population and occupation census in 1849 are used.

I include standard covariates to capture differences in the supply of and demand for education across counties. The share of Protestants accounts for the fact that Protestants had a higher demand for education as demonstrated by Becker and Woessmann (2009). The share of urban citizens among the total population captures that people living in cities need different skills than those living in rural areas, which might increase the demand for schooling in cities, and equally accounts for the fact that the urban schooling system was generally more advanced. The share of people working in manufacturing or agriculture, respectively, accounts for the demand for schooling in counties that have different industrial structure.[95] The dependency ratio captures that the provision of schooling is more difficult where many young people in school age face few people in active labor force age, being able to pay for the public educational system.[96] The share of people who indicate another language than German as their first language controls for the possibly lower demand for education by ethno-linguistic minorities. As one of the aims of the School Inspection Law was to generate a homogeneous German nation, the population that

[94] State expenditures for primary education were marginal in 1886 as school funding was organized locally.

[95] As in *Chapter 3*, the share of people working in manufacturing or agriculture is constructed by dividing the number of workers employed in the respective sector by the total population.

[96] The child dependency ratio is measured as the number of people below 19 years over the population between 20 and 70 years old in 1885 and as the number of people below 15 years over the population between 15 and 65 years old in 1864.

did not identify as German might have been less willing to comply with its provision.[97] By including population density, I control for the claim made in the historical literature that densely populated parishes suffered particularly from clerical school inspection resulting in lower provision of schooling (Lamberti, 1989). Furthermore, I control for landownership concentration by including the share of large landholdings as Cinnirella and Hornung (2016) show that the presence of large landowners lowered school enrollment. A dummy for whether the county was mainly under partible inheritance law captures historical inheritance patterns, which might have influenced the demand for schooling as non-partible inheritance could have led to a higher demand for schooling because non-inheriting children would have to look for work outside agriculture. Finally, I control for central expenditures. Funding for primary schools had for a long time been the responsibility of the municipality. Even though central school funding only increased after a shift in legislation in 1888/1889 and constituted on average only about 10 percent of school funds in 1886, including this variable rules out that improvements in the educational system are simply driven by higher financial support by the state.[98] When looking at the student-teacher ratio, I additionally include school density in order to capture the intensive margin.[99]

Table 5.1 (Panel D) depicts the industrial and social trends in the 20-years window of observation. The denominational composition of Prussia stayed fairly constant with the Prussian population being nearly 60 percent Protestant. The increasing urban and industrial shares capture the industrialization taking place during this period. The tremendous population increase is mirrored by the increasing child dependency ratio and the rising population density. The share of the population whose first language is not German stays fairly constant over time.

5.4 Centralized Monitoring and Reform Outcomes

The historical narrative has overall described the introduction of centralized monitoring as having failed in increasing school enrollment and schooling conditions. By first looking at pure correlations between centralized monitoring and school outcomes, I illustrate the historical narrative. Using a difference in differences approach in a second step permits comparing differences in outcomes between those counties that came under central school inspection and those that remained under clerical inspection which allows detecting the true effects of the reform and revisiting the historical narrative.

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[97] On the effect of linguistic polarization on the provision of public goods, see *Chapter 4*.

[98] In *Chapter 4*, I showed that coordination failure impeding the provision of primary education in ethno-linguistically polarized regions of Prussia might be overcome by central state interventions induced in 1888/1889.

[99] Tables A5.1–A5.3 in the Appendix contain a detailed description of the variables and their sources.

5.4.1 Conditional Correlations – the Contemporary Narrative

I first look at central school inspectors in a cross-sectional setting by estimating the following estimation equation:

$$Y_i = \beta_0 + \beta_1 c_i + X_i \beta_2 + \alpha_p + \varepsilon_i \qquad (5.2)$$

where Y_i denotes school enrollment rate in county *i* in 1886. In a second step, I look at the intermediate channels by observing school density, the student-teacher ratio, and the ratio of private over public students as outcome variables. c denotes the treatment variable, measuring the annual average share of central county school inspectors between 1876 and 1886. It therefore measures how intensively the county has been treated by centralized monitoring over the period of 1876 to 1886. X denotes the vector of covariates. α_p denotes province-fixed effects for eight provinces. ε denotes the error term.

As the Prussian state had a particular objective in the formerly Polish regions in the East (i.e., Germanizing the Polish-speaking population) as opposed to the Catholic provinces of Rhineland and Westphalia, I split the sample into the counties west and east of the river Elbe in a next step. I furthermore exclude city-counties from the sample as the professionalization of school inspectors had begun in cities starting in 1848 (cf. Neugebauer, 1992), reducing the sample by 12 observations.

The results—as shown in Table 5.2, Panel A—back up the common-held view of the historical narrative that the school inspection reform did not achieve its objective. The coefficients of regressing school enrollment on the share of central school inspectors do not show up significantly; an exception being the coefficient for the sample east of the Elbe which is positive and significant (column 4).

Panel B (Table 5.2) presents the coefficients for the intermediate outcomes on centralized monitoring. The estimates of regressing school density on the share of central school inspectors, depicted in the first bloc of Panel B are negative throughout all specifications, though not significant. The student-teacher ratio is positively correlated with the share of central school inspectors in the parsimonious model (second bloc of Panel B, column 1). Ergo, the number of teachers was lower in regions facing the implementation of the reform. This could be due to the fact that the reform was introduced in counties that lagged behind in terms of school capacity and also economic development impeding school expansion. Once conditioning on covariates, no significant association can be depicted for the student-teacher ratio, except for the sample east of the Elbe with a positive correlation between centralized monitoring and the student-teacher ratio. Private enrollment is negatively and significantly associated with the share of central school inspectors in the parsimonious model (third bloc of Panel B, column 1). Again the

significant association disappears once covariates are accounted for. The finding that a higher share of central school inspectors is related to both lower provision of schools and teachers in the parsimonious model and east of the Elbe suggests that centralized monitoring was introduced in regions that initially lagged behind in terms of school capacity.

Table 5.2: Centralized Monitoring and Outcomes in the Cross-Section of 1886

	PANEL A: Dep. Var. School Enrollment				
	(1)	(2)	(3)	(4)	(5)
	Full Sample		West Elbia	East Elbia	w/o cities
School Enrollment	-0.006	0.006	-0.003	0.020**	0.006
	(0.004)	(0.006)	(0.010)	(0.008)	(0.006)
	PANEL B: Intermediate Outcomes				
School Density	-0.069	-0.159	-0.164	-0.082	-0.006
	(0.199)	(0.115)	(0.165)	(0.079)	(0.050)
Student-Teacher Ratio	4.655***	1.579	-0.112	3.440*	1.452
	(1.553)	(1.496)	(2.177)	(1.854)	(1.385)
Private Enrollment	-0.040***	-0.007	-0.006	0.000	-0.005
	(0.008)	(0.007)	(0.010)	(0.010)	(0.007)
Controls	No	Yes	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes	Yes
Observations	335	335	132	203	323

Note: OLS estimates at the county level. The coefficients follow from estimation (5.2), regressing school enrollment, school density, the student-teacher ratio and private enrollment, respectively, on the average annual share of central school inspectors over the period of 1876 to 1886. School enrollment is measured by the total number of students attending public or private primary schools over total number of children of mandatory school age. School density is measured by the number of total schools per 10 km^2. The student-teacher ratio is measured by the number of public and private students over all fully employed teachers. Private enrollment is measured by the ratio of private over public students. Controls include Protestant (share), urban (share), employed in manufacturing (share), employed in agriculture (share), dependency ratio, non-German (share), population density, landownership concentration, the inheritance dummy and state expenditures on education. Estimations on the student-teacher ratio additionally include school density. Province FE denote province-fixed effects for eight provinces in the full sample, three provinces in the sample west of the Elbe and five provinces in the sample east of the Elbe. Constant omitted. Robust standard errors in parentheses. Significance: * p<0.10, ** p<0.05, *** p<0.01. Source: See Table A5.1 in the Appendix for data sources and details.

5.4.2 Establishing Causality

If central county school inspectors were introduced in counties that had a special need to improve schools, because school enrollment, school density, and the provision of teachers were low, OLS results might simply capture the generally lower levels of educational infrastructure in these counties and might hence be biased. Being able to observe measures for school performance and the intermediate channels in 1864 and exploiting the gradual and partial implementation of the School Inspection Law allows applying a difference in differences approach.

5.4.2.1 The Difference in Differences Model

By looking at changes in the variables of interest, I can capture the actual improvements in schooling due to the introduction of central county school inspectors. I estimate the following equation:

$$Y_{it} = \beta_0 + \theta(c_i * Post) + \beta_1 c_i + \beta_2 \cdot Post + X_{it}\beta_3 + \alpha_p + \varepsilon_{it} \quad (5.3)$$

where c_i again denotes the average annual share of central county school inspectors in county i between 1876 and 1886. $Post$ is a dummy variable for the year 1886. The treatment effect is measured by θ. X again denotes the vector of controls. α_p denotes province-fixed effects for eight provinces. ε is the error term. Standard errors are clustered at the county-level.

The assumptions underlying the identification are standard for applying a difference in differences approach. The timing of the school inspection reform has to be uncorrelated with any trends in outcomes or any county-specific shocks that affected school outcomes at the same time or with any other policies influencing the observed school outcomes.

When thinking of other major changes that might have affected the demand and supply of education between 1864 and 1886, it might be that different development patterns such as a different uptake of industrialization and urbanization increased the demand for education and triggered school improvements. I therefore include the changes in all covariates in order to account for possible confounding factors over time which are not attributable to the School Inspection Law. The first comprehensive Prussia-wide school law was only passed in 1906. Moreover, central funding of primary schools, which increased the central government's influence on educational matters, was only introduced in 1888/1889.

5.4.2.2 The Effect of Centralized Monitoring on School Attendance

Following the structure of the OLS design, I first look at the full sample, observing the effects of the reform both in the parsimonious model and subsequently accounting for confounding factors. I subsequently restrict the sample to the counties west and east of the Elbe and finally exclude city-counties.

By employing the difference in differences framework, I find that central school inspectors increase school enrollment significantly, reinforcing the overall positive secular trend captured by the post dummy, except for the sample west of the Elbe (see Table 5.3). Conditional on covariates, full centralized monitoring[100] amplifies the overall increase in

[100] Full centralized monitoring means that school inspection is completely pursued by central school inspectorate between 1876 and 1886.

school enrollment in the full sample by 2.4 percentage points (column 2). The effect is notably stronger for the sample east of the Elbe. Here, full centralized monitoring increases the overall positive rise in school enrollment by 5.9 percentage points on average. The negative, though statistically insignificant coefficient found for the sample west of the Elbe, might already hint at resistance effects. The sample west of the Elbe contains counties situated in the provinces of Rhineland, Westphalia and Saxony. The provinces of Rhineland and Westphalia were predominantly Catholic and as described in section 5.2.2 the population in Westphalia strongly combatted the centrally imposed school inspectorate while in predominantly Protestant Saxony clerical school inspectors remained in office. The null effect found for West Elbia consequently hints at the fact that the population in the Rhineland and in Westphalia might have "successfully" hampered the central school inspector's task to increase school enrollment. Section 5.5 will examine the resistance effects more closely. Beyond potential higher resistance in West Elbia, another possible explanation for the negative and insignificant coefficient might be ceiling effects. As noted above, school enrollment in the provinces east of the Elbe was only at 69 percent in 1864, whereas it was at 78 percent in western Prussia. Thus, there was more potential for catch-up in the eastern counties.

Table 5.3: The Effect of Centralized Monitoring on School Performance

Dep. Var. School Enrollment					
	(1)	(2)	(3)	(4)	(5)
	Full Sample		West Elbia	East Elbia	w/o Cities
Central school	0.023*	0.024**	-0.011	0.059***	0.032***
inspectors x Post	(0.013)	(0.012)	(0.017)	(0.015)	(0.012)
Post	0.141***	0.109***	0.089**	0.138***	0.097***
	(0.007)	(0.018)	(0.035)	(0.026)	(0.017)
Central school	-0.029**	-0.005	0.018	-0.016	-0.014
inspectors	(0.014)	(0.012)	(0.019)	(0.015)	(0.012)
Controls	No	Yes	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes	Yes
Observations	670	670	264	406	646
R-squared	0.47	0.65	0.47	0.75	0.68

Note: Difference in differences estimates at the county level. The dependent variable is school enrollment, measured by the total number of students attending public or private primary schools over total number of children of mandatory school age. Central school inspectors captures the average annual share of central school inspectors over the period of 1876 to 1886. Post denotes a dummy variable which takes the value 1 if the year is 1886, 0 otherwise. Controls include changes in the Protestant (share), the urban (share), employed in manufacturing (share), employed in agriculture (share), dependency ratio, non-German (share), population density, the inheritance dummy, and landownership concentration. Province FE denote province-fixed effects for eight provinces in the full sample, three provinces in the sample west of the Elbe and five provinces in the sample east of the Elbe. Constant omitted. Standard errors are clustered at the county level. Significance: * p<0.10, ** p<0.05, *** p<0.01. Source: See Tables A5.1 and A5.2 in the Appendix for data sources and details.

5.4.2.3 The Effect of Centralized Monitoring on Intermediate Outcomes

Following the logic of the educational production framework, I now shift the focus to the intermediate outcomes of the reform which might have led to the increase in school enrollment; namely school density, the student-teacher ratio and private enrollment.

Table 5.4 (Panel A) shows a statistically significant mitigating effect of full centralized monitoring on overall decreasing school density in the sample excluding city-counties (column 5), though not in any other sample. The overall secular trend in school density, captured by the post dummy is negative in all models. As discussed in section 5.3.2.2 this might be due to the fact that inefficient small schools were consolidated.

Central school inspectors amplify the decrease in the student-teacher ratio, as displayed in Panel B, showing that the overall improvement in the provision of teachers is reinforced by centralized monitoring. The coefficient on the sample west of the river Elbe is insignificant, again suggesting resistance effects. In the full sample, full centralized monitoring further decreases the student-teacher ratio by more than four students (column 2). Consequently, the student-teacher ratio in counties with full centralized monitoring decreased by 13 students overall over the period between 1864 and 1886. Given the average student-teacher ratio of 78 students per teachers in 1864, this is a decrease of 17 percent. The pure treatment effect supports the fact that the reform was introduced in regions with a low initial provision of teachers.

Centralized monitoring reduces the overall increase in private enrollment (Panel C). Given that the secular increase in private enrollment over time is high in all samples, this smaller increase can be considered substantial.

While the supply of teachers experienced an increase through centralized monitoring, the secular increase of private enrollment (which can be considered as a kind of evasion mechanism from the public educational system) was reduced in counties facing full centralized monitoring. This suggests that the higher attachment to the public educational system shown in Table 5.3 must have worked both through a higher attachment to the public system and through improving school capacity or quality.

Table 5.4: The Effect of Centralized Monitoring on Intermediate Outcomes

PANEL A: Dep. Var. School Density					
	(1)	(2)	(3)	(4)	(5)
	Full Sample		West Elbia	East Elbia	w/o Cities
Central school inspectors x Post	0.097	0.070	-0.068	0.257	0.070**
	(0.094)	(0.201)	(0.277)	(0.181)	(0.028)
Post	-0.297	-1.888	-5.654	-0.223	-0.142**
	(0.224)	(1.384)	(3.674)	(0.428)	(0.065)
Central school inspectors	-0.166	-0.594*	-0.474	-0.216	-0.042
	(0.235)	(0.344)	(0.573)	(0.197)	(0.055)
Controls	No	Yes	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes	Yes
Observations	670	670	264	406	646
R-squared	0.00	0.63	0.71	0.72	0.78
PANEL B: Dep. Var. Student-Teacher Ratio					
	(1)	(2)	(3)	(4)	(5)
	Full Sample		West Elbia	East Elbia	w/o Cities
Central school inspectors x Post	-3.350*	-4.513**	-1.366	-4.291*	-3.455*
	(1.927)	(2.002)	(3.145)	(2.466)	(1.910)
Post	4.423***	-8.721***	-14.768***	-1.489	-14.094***
	(0.912)	(2.748)	(5.143)	(3.636)	(2.875)
Central school inspectors	8.005***	3.598	1.064	5.267**	2.852
	(2.271)	(2.242)	(3.564)	(2.255)	(2.028)
Controls	No	Yes	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes	Yes
Observations	670	670	264	406	646
R-squared	0.05	0.43	0.41	0.58	0.52
PANEL C: Dep. Var. Private Enrollment					
	(1)	(2)	(3)	(4)	(5)
	Full Sample		West Elbia	East Elbia	w/o Cities
Central school inspectors x Post	-0.039***	-0.023***	-0.033**	-0.025***	-0.025***
	(0.009)	(0.008)	(0.013)	(0.009)	(0.006)
Post	0.061***	0.127***	0.147***	0.100***	0.112***
	(0.007)	(0.021)	(0.024)	(0.038)	(0.015)
Central school inspectors	-0.001	0.013**	0.015*	0.018**	0.010**
	(0.004)	(0.006)	(0.008)	(0.009)	(0.005)
Controls	No	Yes	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes	Yes
Observations	670	670	264	406	646
R-squared	0.14	0.42	0.48	0.50	0.45

Note: Difference in differences estimates at the county level. The dependent variable is school density, measured by the number of total schools per 10 km^2 in Panel A, the student-teacher ratio, measured by the number of public and private students over all fully employed teachers in Panel B, private enrollment, measured as the ratio of private over public students in Panel C. Central school inspectors captures the average annual share of central school inspectors over the period of 1876 to 1886. Post denotes a dummy variable which takes the value 1 if the year is 1886, 0 otherwise. Controls include changes in the Protestant (share), the urban (share), employed in manufacturing (share), employed in agriculture (share), dependency ratio, non-German (share), population density, the inheritance dummy, and landownership concentration. Province FE denote province-fixed effects for eight provinces in the full sample, three provinces in the sample west of the Elbe and five provinces in the sample east of the Elbe. Constant omitted. Standard errors are clustered at the county level. Significance: * p<0.10, ** p<0.05, *** p<0.01. Source: See Tables A5.1 and A5.2 in the Appendix for data sources and details.

5.4.3 Specification Tests

A difference in differences approach relies on the common trend assumption in outcomes, meaning that the outcomes in both the treatment and the control group would follow the same trend in absence of the treatment. Applied to this setting, school enrollment and the intermediate outcomes would increase or decrease at the same rate both in counties facing centralized monitoring and in those remaining under clerical inspection. This assumption cannot be tested as this would require a parallel world allowing observing the trend in absence of the treatment. However, by examining whether centralized monitoring affected other variables, not directly related to the objectives of the reform, I can reduce the concern by showing that the introduction of the reform was not related to any other fundamental changes.

Table 5.5 shows estimates for regressing the standard covariates, namely the share of Protestants, the urban share, the share employed in manufacturing and agriculture, the dependency ratio, the share of non-Germans, the population density, landownership concentration and inheritance on the treatment. The estimates for the different dependent variables illustrate that even though levels of the share employed in manufacturing or the share of non-German speakers vary between the treated and the control counties, most of the variables are not related to full centralized monitoring. A slight concern arises when looking at the share employed in agriculture, the dependency ratio and landownership concentration which all show up positive and significant.[101] The measure for the introduction of centralized monitoring naturally captures the intensity of the *Kulturkampf* in general, beyond the direct effect of the School Inspection Law. It remains to reflect whether there are any reasons how those variables could be connected to the *Kulturkampf* or also more specifically to the School Inspection Law. Population density is affected by previous fertility and migration. It could be that men in working age were more likely to leave their home county if they faced the *Kulturkampf* leading to an increase in the dependency ratio if the younger population remained. A hint to this could be the decreasing, though insignificant coefficient on the population density. With the population in prime working age leaving the counties facing the *Kulturkampf*, it could equally be that it is those leaving that are qualified to hold jobs outside of agriculture, consequently increasing the relative share of people employed in agriculture in the remaining population. It would therefore be interesting to further explore if the *Kulturkampf* had economic consequences. However, this is beyond the scope of this chapter.

[101] Note that both population density and landownership concentration are defined slightly differently for 1864 and 1886. The dependency ratio in 1864 captures the population under 15 years over the total population between 15 and 65 years old. The dependency ratio in 1886 (1885) includes the population under 19 years over the population between 19 and 69 years. Landownership concentration is defined as the share of farms larger than 300 ha arable land in 1864 and as the share of farms larger than 100 ha arable land in 1886 (1882). Anyways, the differences in the definition of the variables should be captured by the post dummy.

Table 5.5: Common Underlying Trends, 1849 – 1896

	(1) Protestant	(2) Urban	(3) Manufacturing	(4) Agricultural	(5) Dependency Ratio	(6) Non-German	(7) Population density	(8) Landownership concentration	(9) Inheritance
Central school inspectors x Post	0.002	0.003	-0.001	0.016***	0.060***	0.010	-0.692	0.006**	0.018
	(0.003)	(0.005)	(0.003)	(0.005)	(0.009)	(0.009)	(0.617)	(0.002)	(0.020)
Post	0.002	0.023***	0.036***	0.011***	0.279***	-0.000	1.217**	-0.018***	-0.007
	(0.002)	(0.003)	(0.001)	(0.002)	(0.005)	(0.004)	(0.595)	(0.002)	(0.006)
Central school inspectors	-0.464***	-0.032	-0.017**	-0.005	0.026**	0.201***	-1.266	-0.006**	0.109**
	(0.043)	(0.026)	(0.007)	(0.009)	(0.011)	(0.036)	(1.617)	(0.003)	(0.047)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	670	670	670	670	670	670	670	670	670
R-squared	0.70	0.11	0.44	0.23	0.81	0.53	0.02	0.49	0.47

Note: Difference in differences estimates at the county level. The dependent variable is the share of Protestants (Column 1), the urban share (Column 2), the share employed in manufacturing (Column 3), the share employed in agriculture (Column 4), the dependency ratio (Column 5), the share of non-German speakers (Column 6), population density (Column 7), landownership concentration (Column 8) and inheritance (Column 9). Central school inspectors captures the average annual share of central school inspectors over the period of 1876 to 1886. Post denotes a dummy variable which takes the value 1 if the year is 1886, 0 otherwise. Province FE denote province-fixed effects for eight provinces. Constant omitted. Standard errors are clustered at the county level. Significance: * p<0.10, ** p<0.05, *** p<0.01.
Source: See Tables A5.1 and A5.2 in the Appendix for data sources and details.

Another possibility to support the common trend assumption is to observe the effect of a so-called placebo treatment which means artificially shifting the treatment to a time period where it *did not* take place. Data on school enrollment in 1849 permit such a placebo test. The estimation follows equation (5.3), now assuming that the reform took place between 1849 and 1864. In absence of a treatment between 1849 and 1864, I expect zero effects here.

Table 5.6 shows no effect of the placebo treatment between 1849 and 1864 on school enrollment, thus supporting the hypothesis that the increase in school enrollment between 1864 and 1886 can be attributed to the introduction of centralized monitoring in 1872.

Table 5.6: Placebo 1849–1864

Dep. Var. School Enrollment				
	Full Sample		West Elbia	East Elbia
	(1)	(2)	(3)	(4)
Central school	-0.000	-0.026	-0.003	-0.023
inspectors x Post	(0.000)	(0.017)	(0.021)	(0.022)
Post	0.000	-0.093	-0.026	-0.138
	(0.000)	(0.059)	(0.049)	(0.086)
Central school	0.029	0.025	-0.037	0.035
inspectors	(0.039)	(0.047)	(0.072)	(0.047)
Controls	No	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes
Observations	670	670	264	406
R-squared	0.00	0.11	0.19	0.10

Note: Difference in differences estimates at the county level. The dependent variable is school enrollment, measured by the total number of students attending public or private primary schools over total number of children of mandatory school age. Central school inspectors captures the average annual share of central school inspectors over the period of 1876 to 1886. Post denotes a dummy variable which takes the value 1 if the year is 1864, 0 otherwise. Controls include changes in the Protestant (share), the urban (share), employed in manufacturing (share), employed in agriculture (share), dependency ratio, population density, and the inheritance dummy. Province FE denote province-fixed effects for eight provinces in the full sample, three provinces in the sample west of the Elbe and five provinces in the sample east of the Elbe. Constant omitted. Standard errors are clustered at the county level. Significance: * $p<0.10$, ** $p<0.05$, *** $p<0.01$. Source: See Tables A5.1 and A5.2 in the Appendix for data sources and details.

5.5 Resistance

As discussed in Section 5.2, the historical literature claims that the *Kulturkampf* triggered massive resistance from the German-speaking Catholics in the Rhineland and Westphalia and the Polish-speaking Catholics in the territories that formerly belonged to the Polish-Lithuanian Commonwealth.[102] So far, I tested the average effect of centralized monitoring. As shown in Figure 5.4, centralized monitoring was introduced first of all in regions with a Catholic majority. However, interdenominational counties also faced the introduction of centralized school inspectors. In fact, interdenominational counties, which made up 43 percent of all counties, faced central school inspectors in half of the cases on average while predominantly Catholic counties, which made up 18 percent of all counties, were treated in three quarters of all cases.[103] Now, I want to compare effects in the predominantly Catholic counties to those in interdenominational counties, exploiting degrees of Catholicism.

By including a triple interaction term of the share of centralized school inspectors, the post-treatment dummy, and the share of Catholics in 1886, I examine whether resistance in predominantly Catholic counties as opposed to interdenominational counties can be observed. I estimate the following equation:

$$Y_{it} = \beta_0 + \gamma(c * Cath_{it} * Post) + \theta \cdot c_i \cdot Post + \beta_1 \cdot c_i \cdot Cath_{it} + \beta_2 \cdot Cath_{it} \cdot Post + \beta_3 c_i + \beta_4 \cdot Post + \beta_5 \cdot Cath_{it} + X_{it}\beta_7 + \alpha_p + \varepsilon_{it} \quad (5.4)$$

where $c_i \cdot Post$ denotes the pure treatment effect θ as in equation 5.3, while γ captures the resistance effect, that is, the triple interaction between the share of central school inspectors, the post-treatment dummy, and the share of Catholics in 1886. I include the average annual share of central county school inspectors between 1876 and 1886 (c), the post-treatment dummy ($Post$), and the share of Catholics ($Cath$) separately. I add the interactions between all these variables. X again denotes the vector of controls and α_p province-fixed effects; ε is the error term.

When looking at school enrollment in Table 5.7, a high share of Catholics substantially mitigates the overall positive impact of the treatment in all three samples.

[102] In East Elbia, the share of Catholic and of non-German speakers is correlated at 67 percent. In regions of the former Polish-Lithuanian Commonwealth, the correlation coefficient reaches 75 percent.

[103] Predominantly Protestant counties face centralized monitoring in 7 percent of the cases.

Table 5.7: The Resistance Effect – School Enrollment

Dep Var. School Enrollment				
	(1)	(2)	(3)	(4)
	Full Sample		West Elbia	East Elbia
Central school inspectors x Catholic x Post	-0.150***	-0.164***	-0.115**	-0.169***
	(0.038)	(0.038)	(0.057)	(0.064)
Central school inspectors x Post	0.134***	0.133***	0.074*	0.120***
	(0.024)	(0.023)	(0.044)	(0.024)
Central school inspectors x Catholic	0.141***	0.087**	0.027	0.119*
	(0.044)	(0.039)	(0.057)	(0.064)
Catholic x Post	-0.003	0.014	0.021	0.077
	(0.025)	(0.026)	(0.030)	(0.050)
Post	0.140***	0.103***	0.085**	0.129***
	(0.008)	(0.019)	(0.035)	(0.026)
Central school inspectors	-0.130***	-0.063***	-0.000	-0.058**
	(0.026)	(0.021)	(0.039)	(0.024)
Catholic	-0.003	-0.028	-0.016	-0.100*
	(0.030)	(0.028)	(0.032)	(0.054)
Controls	No	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes
Observations	670	670	264	406
R-squared	0.49	0.66	0.48	0.75

Note: Difference in differences estimates at the county level. The dependent variable is school enrollment, measured by the total number of students attending public or private primary schools over total number of children of mandatory school age. Central school inspectors captures the average annual share of central school inspectors over the period of 1876 to 1886. Catholic captures the share of Catholics in 1886. Post denotes a dummy variable which takes the value 1 if the year is 1886, 0 otherwise. Controls include changes in the urban (share), employed in manufacturing (share), employed in agriculture (share), dependency ratio, non-German (share), population density, the inheritance dummy, and landownership concentration. Province FE denote province-fixed effects for eight provinces in the full sample, three provinces in the sample west of the Elbe and five provinces in the sample east of the Elbe. Constant omitted. Standard errors are clustered at the county level. Significance: * p<0.10, ** p<0.05, *** p<0.01. Source: See Tables A5.1 and A5.2 in the Appendix for data sources and details.

Table 5.8 shows results on the intermediate outcomes. In Panel A, results for school density are depicted. The coefficients on the triple interactions are considerably large, though not significant throughout all specifications. The overall decrease in school density is substantially mitigated by centralized monitoring in predominantly Catholic regions in the West and even reverses to an increase of 4 schools per 10 km^2 in the East Elbian sample.

Panel B, depicting the estimates on the student-teacher ratio brings about an interesting pattern between the western and the eastern sample. While the coefficient on the triple interaction is positive and significant in the sample west of the Elbe, it is negative and significant in the eastern sample. The secular decrease of the student-teacher ratio, amplified by centralized monitoring, is substantially mitigated in predominantly Catholic counties west of the Elbe. In contrast, centralized monitoring in predominantly Catholic counties decreased the student-teacher ratio by about 32 students per teacher in the East Elbian sample. In short, the evidence on the western and eastern sample suggests that there was substantial resistance in the western regions while the student-teacher ratio could be decreased in the predominantly Catholic counties east of the Elbe. As the

historical narrative showed that resistance in the provinces of the Rhineland and Westphalia was especially strong and that the protest of the clergy led to arrest and expatriation of priests who simultaneously functioned as (religious education) teachers in primary schools, this might have led to persistent teacher shortage in the predominantly Catholic regions of West Elbia.

Panel C presents results on the estimations on private enrollment. The positive and significant coefficient on the triple interaction in the sample west of the Elbe again suggests resistance from the predominantly Catholic counties. In those counties even more parents seem to have evaded the public school system by sending their children to private institutions. This resistance effect underlines that Catholics tended to adhere to the Catholic Church's edict to send every child to a Catholic school especially when facing marginalization. Along these lines, West and Woessmann (2010) show that counties with a high share of Catholics in the nineteenth century still have a higher share of private schools today.

Overall, I find strong resistance effects against the reform in counties that are mainly inhabited by Catholics when it comes to school attendance. A high share of Catholics in a treated county mitigates the overall positive effect of centralized monitoring on school enrollment and, as a kind of evasion mechanism, increases the ratio of students enrolled in private institutions in counties west of the Elbe. The resistance from the Catholic population in the western parts of Prussia is also shown by a mitigating effect on decreasing the student-teacher ratio. Evidence on both the student-teacher ratio and private enrollment suggests that resistance mainly came from the Catholics in the Rhineland and Westphalia and not from the Catholics of Polish decent in the eastern parts of Prussia. This casts some doubt on the commonly held view that the Polish question and the *Kulturkampf* were inseparably interwoven.

Table 5.8: The Resistance Effect – Intermediate Outcomes

PANEL A: Dep. Var. School Density				
	(1)	(2)	(3)	(4)
	Full sample		West Elbia	East Elbia
Central school inspectors x Catholic x Post	2.298	2.837	1.936	1.049
	(2.074)	(2.598)	(3.277)	(1.411)
Central school inspectors x Post	-0.304	-0.591	0.102	-0.490
	(0.522)	(0.676)	(0.893)	(0.778)
Central school inspectors x Catholic	-4.399	-2.515	-1.418	-0.973
	(3.193)	(1.722)	(1.640)	(1.071)
Catholic x Post	-1.927	-2.174	-2.696	0.158
	(2.037)	(2.611)	(3.066)	(0.485)
Post	0.011	-1.546	-4.816*	-0.150
	(0.133)	(1.040)	(2.819)	(0.393)
Central school inspectors	0.543	0.335	-0.137	0.363
	(0.721)	(0.411)	(0.792)	(0.580)
Catholic	3.777	1.817	2.338	0.065
	(3.185)	(1.646)	(2.393)	(0.484)
Controls	No	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes
Observations	670	670	264	406
R-squared	0.02	0.63	0.71	0.72

PANEL B: Dep. Var. Student-Teacher Ratio				
	(1)	(2)	(3)	(4)
	Full Sample		West Elbia	East Elbia
Central school inspectors x Catholic x Post	-6.302	-5.579	28.405**	-37.065***
	(7.031)	(7.016)	(11.582)	(12.312)
Central school inspectors x Post	5.578	3.333	-21.448**	8.807**
	(4.196)	(4.399)	(10.142)	(3.883)
Central school inspectors x Catholic	5.655	4.375	-25.049*	36.925***
	(7.946)	(6.477)	(14.123)	(9.978)
Catholic x Post	-6.517	-5.908	-6.245	16.886*
	(4.078)	(4.100)	(4.519)	(9.045)
Post	5.280***	-8.377***	-13.552**	-4.159
	(0.977)	(2.752)	(5.362)	(3.562)
Central school inspectors	-1.115	-1.454	18.515	-6.462**
	(4.443)	(4.081)	(12.597)	(3.242)
Catholic	7.518*	-0.326	4.559	-25.968***
	(4.449)	(4.700)	(7.315)	(7.188)
Province FE	No	Yes	Yes	Yes
Observations	670	670	264	406
R-squared	0.06	0.44	0.42	0.60

Table 5.8: The Resistance Effect – Intermediate Outcomes - Continued

PANEL C: Dep. Var. Private Enrollment				
	(1)	(2)	(3)	(4)
	Full Sample		West Elbia	East Elbia
Central school inspectors x Catholic x Post	0.036*	0.033	0.066**	0.004
	(0.021)	(0.021)	(0.032)	(0.037)
Central school inspectors x Post	-0.030**	-0.023	-0.047*	-0.008
	(0.014)	(0.014)	(0.026)	(0.018)
Central school inspectors x Catholic	-0.013	-0.026*	-0.013	-0.031
	(0.016)	(0.014)	(0.018)	(0.026)
Catholic x Post	-0.052***	-0.037**	-0.063***	-0.033
	(0.015)	(0.016)	(0.019)	(0.032)
Post	0.069***	0.131***	0.162***	0.101***
	(0.009)	(0.022)	(0.027)	(0.038)
Central school inspectors	0.010	0.017*	0.007	0.016
	(0.011)	(0.009)	(0.015)	(0.012)
Catholic	-0.002	0.022**	0.012	0.030
	(0.007)	(0.010)	(0.010)	(0.022)
Controls	No	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes
Observations	670	670	264	406
R-squared	0.16	0.43	0.51	0.51

Note: Difference in differences estimates at the county level. The dependent variable is school density, measured by the number of total schools per 10 km2 in Panel A, the student-teacher ratio, measured by the number of public and private students over all fully employed teachers in Panel B, private enrollment, measured as the ratio of private over public students in Panel C. Central school inspectors captures the average annual share of central school inspectors over the period of 1876 to 1886. Catholic captures the share of Catholics in 1886. Post denotes a dummy variable which takes the value 1 if the year is 1886, 0 otherwise. Controls include changes in the urban (share), employed in manufacturing (share), employed in agriculture (share), dependency ratio, non-German (share), population density, the inheritance dummy, and landownership concentration. Province FE denote province-fixed effects for eight provinces in the full sample, three provinces in the sample west of the Elbe and five provinces in the sample east of the Elbe. Constant omitted. Standard errors are clustered at the county level. Significance: * p<0.10, ** p<0.05, *** p<0.01. Source: See Tables A5.1 and A5.2 in the Appendix for data sources and details.

5.6 Conclusion

Did the introduction of centralized monitoring improve primary education in Prussia? To answer this question, I combine data on central school inspectors, derived from a publication of the Prussian Ministry of Ecclesiastical and Education Affairs, with Prussian census data.

As the law was passed against the background of the *Kulturkampf*, a struggle between the Prussian Protestant authorities and the Catholic Church, it was mainly introduced in the Catholic regions of Prussia, which enables applying a difference in differences approach.

Results show that introducing central school inspection increased school attendance measured by school enrollment. To test whether these results were mitigated in areas with an especially high share of Catholics, I add an interaction term of the share of Catholics to the treatment effect. I find that the overall positive effect on school enrollment is mitigated by a high share of Catholics, while positive secular trends in private enrollment are reinforced by a high share of Catholics.

I contribute to the literature on the resistance to reforms by showing that resistance is substantial in a context where reforms tackle the identity of the targeted population. As the introduction of centralized monitoring in late nineteenth-century Prussia can be understood as an early form of school accountability, I contribute to modern educational economics by showing that accountability systems are ineffective if introduced without the consent of the local population.

Applying a difference in differences approach stresses the importance of examining differences induced by the reform as opposed to comparing levels which proves wrong the contemporary evaluations of the reform which considered the law as being ineffective. However, the presence of central school inspectors captures other effects of the *Kulturkampf* which makes it interesting to examine the effect of this penetrative cultural struggle on other outcomes, such as economic development.

Appendix 5A Data Sources

Figure A5.1: Extract from *Zentralblatt* 1886

C. Kreis-Schulinspektoren.

I. Provinz Ostpreußen.

Aufsichtsbezirke:

1. Regierungsbezirk Königsberg.

a. Ständige Kreis-Schulinspektoren.

1. Allenstein I. Spohn zu Allenstein.
2. Allenstein II. Vigouroux zu Wartenburg.
3. Braunsberg. Seemann zu Braunsberg.
4. Heilsberg I. Mühlhoff zu Guttstadt.
5. Heilsberg II. Dr. Robels zu Heilsberg, kommissarisch.
6. Memel I. Schröder zu Prökuls.
7. Neidenburg. Dr. Gitschmann zu Neidenburg, kommissarisch.
8. Ortelsburg. Pöhlmann zu Ortelsburg, kommissarisch.
9. Osterode. Kob zu Osterode.
10. Rössel. Schlicht zu Rössel.

b. Kreisschulinspektion im Nebenamte.

1. Prß. Eylau I. Schröder, Pfarrer zu Eichhorn, kommiss.
2. Prß. Eylau II. Schröder, desgl. zu Eichhorn.
3. Prß. Eylau III. Bandisch, dsgl. zu Uderwangen.
4. Fischhausen I. Steinwender, dsgl. zu Germau.
5. Fischhausen II. Steinwender, dsgl. daselbst, kommiss.
6. Fischhausen III. Horn, Superintendent zu Powunden.
7. Friedland I. Eschenbach, Pfarrer zu Friedland.
8. Friedland II. Henschke, dsgl. zu Bartenstein.
9. Gerdauen I. Pichier, dsgl. zu Nordenburg.
10. Gerdauen II. Rouselle, dsgl. zu Moltheinen.
11. Heiligenbeil I. Eysenblätter, Superint. zu Heiligenbeil.
12. Heiligenbeil II. v. Rozynsky, Pfarrer zu Dt. Thierau.
13. Heilsberg III. Kähler, Superint. zu Heilsberg.
14. Prß. Holland I. Kruckenberg, dsgl. zu Prß. Holland.
15. Prß. Holland II. Kirschstein, Pfarrer zu Herrendorf.
16. Königsberg Stadt. Lackner, Diakonus zu Königsberg, auftragsw. (s. a. Nr. 18).
17. Königsberg Land I. Horn, Superintendent zu Powunden.
18. Königsberg Land II. Lackner, Diakonus zu Königsberg (s. a. Nr. 16).
19. Königsberg Land III. Eilsberger, Superint. zu Königsberg.
20. Labiau I. Kühn, desgl. zu Laukischken.
21. Labiau II. Dengel, Pfarrer zu Mehlauken.
22. Memel II. Habrucker, Superintendent zu Memel.
23. Mohrungen I. Ebner, Pfarrer zu Jäskendorf.

Source: Ministerium der geistlichen Unterrichts- und Medizinal-Angelegenheiten (1886)

Table A5.1: 1886 Variables

Enrollment rate (5–14 years)	Total number of students attending public or private primary schools over total number of children of mandatory school age, i.e., between 5 and 14 years old in 1886.
Student-teacher ratio	Ratio of students attending public or private primary school over total number of primary school teachers in 1886 (i.e., fully-employed and support teachers; support teachers counting half).
School density	Total number of primary schools per 10 km^2.
Private enrollment	Ratio of private over public students attending primary school in 1886.
Central school inspectors 1876–1886 (share)	Average annual share of central school inspectors over total school inspectors between 1876 and 1886 (Ministerium der geistlichen Unterrichts- und Medizinal-Angelegenheiten, 1876-1878, 1880-1886).
Protestant (share)	Share of Protestants per total population in 1885 (Königliches Statistisches Bureau in Berlin, 1861-1934, vol. 96).
Urban (share)	Share of total population living in cities that held city rights in 1880 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 61).
Employed in manufacturing (share)	Share of people employed in manufacturing (sector B) over total population in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76b).
Employed in agriculture (share)	Number of people employed in agriculture and animal husbandry over total population in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76b).
Dependency ratio	Population under 19 years over population between 19 and 69 years old in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76b).
Non-German (share)	Share of total population whose mother tongue is not German in 1890 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 121a) .
Population density	Population per total ha of land in 1885 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 96).
Landownership concentration	Share of farms larger than 100 ha arable land in 1882 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 76c).
Inheritance (dummy)	Unity for counties that predominantly practiced partible inheritance (*Naturalteilung*) and zero for counties that predominantly practiced non-partible inheritance (*Anerbenrecht*). Coded using county-level maps of historical inheritance laws from ca. 1900 (Sering, 1897–1905).
State expenditure on education (per child)	The amount of school expenditures contributed by state grants or funds per child of mandatory school age in 1886.

Note: Unless otherwise specified, the data stem from Königliches Statistisches Bureau in Berlin (1861–1934, vol. 101).

Table A5.2: 1864 Variables

Enrollment rate (6–14 years)	Total number of students attending public or private primary schools over total number of children of mandatory school age, i.e., between 6 and 14 years old in 1864.
Student-teacher ratio	Ratio of students attending public or private primary school over total number of primary school teachers in 1864 (i.e., private and public primary school teachers).
School density	Total number of primary schools per 10 km^2.
Private enrollment	Ratio of private over public students attending primary school in 1864.
Protestant (share)	Share of Protestants per total population in 1864.
Urban (share)	Share of total population living in cities that held city rights in 1864.
Employed in manufacturing (share)	Share of people employed in mining and industry (including construction) over total population in 1867 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 16b).
Employed in agriculture (share)	Number of people employed in agriculture, forestry and hunting, and fishing over total population in 1867 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 16b).
Dependency ratio	Population under 15 years over population between 15 and 65 years old in 1864.
Non-German (share)	Share of total population whose mother tongue is not German in 1861 (Königliches Statistisches Bureau in Berlin, 1861–1934, vol. 5).
Population density	Population per total ha of land in 1864.
Landownership concentration	Share of farms larger than 300 ha arable land in 1864.
Inheritance (dummy)	Unity for counties that predominantly practiced partible inheritance (*Naturalteilung*) and zero for counties that predominantly practiced non-partible inheritance (*Anerbenrecht*). Coded using county-level maps of historical inheritance laws from ca. 1900 (Sering, 1897–1905).

Note: Unless otherwise specified, the data stem from Königliches Statistisches Bureau in Berlin (1861–1934, vol. 10).

Table A5.3: 1849 Variables

Enrollment rate (6–14 years)	Total number of students attending public primary schools and public middle schools for boys or girls over total number of children of mandatory school age, i.e., between 6 and 14 years old in 1849.
Protestant (share)	Share of Protestants per total population in 1849.
Urban (share)	Share of total population living in cities that held city rights in 1849.
Employed in manufacturing (share)	Share of people employed in mining and industry over total population in 1849.
Employed in agriculture (share)	Number of people employed in agriculture over total population in 1849.
Dependency ratio	Population under 15 years over population between 15 and 60 years old in 1849.
Population density	Population per total ha of land in 1849.
Landownership concentration	Share of farms larger than 300 PM in 1849.
Inheritance (dummy)	Unity for counties that predominantly practiced partible inheritance (*Naturalteilung*) and zero for counties that predominantly practiced non-partible inheritance (*Anerbenrecht*). Coded using county-level maps of historical inheritance laws from ca. 1900 (Sering, 1897–1905).

Note: Unless otherwise specified, the data stem from Königliches Statistisches Bureau in Berlin (1851–1855, vol. 1-6b).

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10/2012 – 11/2016	Junior Economist, Ifo Institute, Center for the Economics of Education PhD in Economics, Ludwig-Maximilians-Universität München
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03/2006	Abitur, Gymnasium am Kurfürstlichen Schloß zu Mainz