EDUCATION, IMMIGRATION, AND ECONOMIC DEVELOPMENT: EVIDENCE FROM 19TH AND 20TH CENTURY BAVARIA

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Preface

"*Truly, the most distinctive feature of our economic system is the growth in human capital. Without it there would be only hard, manual work and poverty except for those who have income from property*" (Schultz 1961, p. 16).

Human capital is an essential ingredient in economic development and growth. While human capital is shaped through various mechanisms including experience, medical care, and on-the-job training, schooling has been identified as the most influential device (Becker 1993, p. 17). Starting with the seminal works by Becker (1964), Denison (1962), and Schultz (1961, 1963) in the 1960s, a continuously growing body of empirical and theoretical studies has emphasized the importance of education for economic development and growth in current and past societies.[1] Besides affecting the overall economy, human capital also influences private returns. Better educated people earn more (e.g. Angrist and Krueger 1991; Mincer 1974), have lower unemployment risks (e.g. Nickell 1979), and higher chances of upward mobility (e.g. Sicherman 1990). Thus, education can contribute to a more equal society by reducing income inequality – provided of course, that the access to schooling is open to all classes of society. The literature has linked schooling also to a variety of non-market outcomes including for example reduced crime (e.g. Ehrlich 1975; Lochner 2004), lower fertility (e.g. Willis 1973), improved health (e.g. Grossman 1975), higher investments in 'quality' of children (Leibowitz 1974), civic behavior (e.g. Dee 2004), and happiness (e.g. Easterlin 2003; Hartog and Oosterbeek 1998).[2] Consequently, education seems to be of utmost importance in attaining and preserving a prosperous and stable society.

Yet most of the evidence stresses the importance of formal education – providing children with the basic skills of reading, writing, and counting – and the role of secondary education, especially in economic development is less clear.[3]

This thesis sets out to improve our understanding not only about the role of secondary education in economic development, but also about the social recruitment of secondary students, and, in addition, about the influence of immigrants on secondary educational development of the receiving country. Each of the three essays highlights a unique social or economic aspect of secondary education in the German state of Bavaria during the 19th and 20th century.

[1] The literature on the importance of education in economic development is vast. See for example Hanushek and Woessmann (2008), Krueger and Lindhal (2001), and Schultz (1988) for literature overviews.
[2] See also Grossman (2006) and Haveman and Wolfe (1984) for extensive reviews of the literature on education and non-market outcomes.
[3] Notable exceptions are provided for developing countries by Psacharopolous and Patrinos (2004) and Goldin (1998, 1999) and Goldin and Katz (2000) for early 20th century United States.

Bavaria entered the age of the industrial revolution[4] fairly late when compared to the other German states Prussia and Saxony (Bosl 1985; Götschmann 2010, p. 13). While England started to industrialize already towards the end of the 18th century, and Prussia and Saxony followed around 1840 (Hahn 1998, pp. 24-6), it took Bavaria until the end of the 19th century to reach an economic state that can be determined as the first phase of Bavarian industrialization (Bosl 1985, p. 35). In addition, the pace of economic, technological, and social changes associated with the phenomenon of the industrial revolution was relatively slow in Bavaria. Bosl (1985, p. 22) argues that this lessened industrialization ("*geminderte Industrialisierung*") was not only a result of the geographical preconditions (i.e. absence of fundamental natural resources and the landlocked position) but also of the anti-modernization attitude of the governing – mostly aristocratic – elite.[5] Economic backwardness led not only to high rates of emigration but also to high rates of infant mortality (Götschmann 2010, pp. 148-51).[6] As a result, annual population growth in Bavaria was far below the average rate across all German states up to WWI.[7] Furthermore, Bavaria was also a latecomer to the fertility transition[8] compared to Prussia (and most other Western European countries). It was not before 1900 that fertility in Bavaria started to decline. Research has stressed the role of religion in the fertility transition. Bavaria was (and still is) overwhelmingly Catholic. Specifically Catholicism has been argued to be unconducive to fertility restriction due to its moral standpoint on fertility control (Galloway et al. 1994, p. 144). In fact, Catholic areas experienced the fertility transition later than Protestant regions. Even though Brown and Guinnane (2002) show that religious beliefs deferred the fall of fertility rates in Bavaria, they also find that economic factors – above all female employment opportunities – were more important for fertility decline. Moreover, religious denominations might also influence economic development. While evidence for Prussia reveals that Protestants were economically more successful than Catholics especially in rural areas (Becker and Woessmann 2009), Cantoni (2014) finds no difference between Catholicism and Protestantism for long-term economic growth in a sample of cities

[4] Borchardt (1985, p. 39) defines the industrial revolution as a period characterized by (1) the emergence of new technologies, especially used to substitute manpower, (2) the beginning of large-sale use of natural resources coal and iron, (3) the expansion of the factory system based on the division of labor as the predominant form of industrial production, (4) the propagation of work labor as the prevailing form of employment, and (5) the rise of the capital to one of the major factors of production.

[5] In Bosls opinion, the term 'industrial revolution' cannot be applied to Bavaria since there was nothing revolutionary or dynamic about the social and economic developments taking place during Bavaria's industrialization. According to him, Bavarian industrialization was rather an industrializing process, prevalent only in the large Bavarian cities (Bosl 1985, p. 22).

[6] Infant mortality rates staggered around 30 percent between 1840 and 1880 (Götschmann 2010, p. 149).

[7] Between 1820 and 1870, Bavarian annual population growth was only 0.5 percent (Brown and Guinnane 2002, p. 37). See Götschmann (2010, p. 150) for a comparison of annual population growth rates between Bavaria and Germany as a whole.

[8] The fertility transition is defined as that point in time when couples began to deliberately decide about the timing and number of children. Before that, fertility was mainly confined by staying single or postponing marriage (Brown and Guinnane 2002, p. 35). This transition took place in most European countries as well as in North America during the 19th and early 20th century. As a result, fertility dropped dramatically (Guinnane 2011).

of the Holy Roman Empire.[9] This suggests that Catholicism might have hampered economic development in the Bavarian countryside, while it did not much influence economic prosperity of the large cities. In fact, except for the large, highly industrialized, and modern cities of Munich, Augsburg, and the Nuremberg area, most of Bavaria remained agricultural (and thus less developed) up to WWII (Bosl 1985). After WWII, Bavaria underwent substantial changes in its economic, political, and social order (Zorn 1975). The integration of millions of expellees (*Vertriebene*) from former Eastern territories of the German Reich profoundly shaped the face of post-war Bavaria. Especially expellees from highly industrialized Sudetenland used their artisanal skills and re-established their old businesses in Bavaria (Bohmann 1959; Prinz 1987). But also other German expellee groups contributed to the expansion of the industrial and commercial sectors since job opportunities in agriculture were limited (Götschmann 2010, p. 629). Hence, Bavaria experienced a further wave of industrialization and was eventually able to overcome its relative economic backwardness during the post-war years.

Bavarian authorities recognized already at the beginning of the 19th century that the backward state was in need of profound changes to catch up to neighboring Prussia and Saxony. Besides reforming the social system, and liberalizing industrial and commercial regulations, Bavaria also participated in the German Customs Union (*Deutscher Zollverein*, established 1834). Furthermore, in order to derive recommendations for socio-economic policies, Bavaria started to systematically collect and publish statistical data with the establishment of the royal Bavarian statistical office (*Königlich-Bayerisches Statistisches Bureau*) in 1850 (Götschmann 2010, pp. 39-41). These publications provide a rich source of statistical material and thus serve as the main basis of statistical data in this thesis. In addition to these structural reforms, Bavaria substantially modernized its educational system by introducing an applied kind of secondary education in form of the Gewerbeschule in 1829. This modern secondary school was supposed to benefit the economy by providing children with skills conducive to economic activities.

The introduction of the Gewerbeschule serves as a starting point to this thesis. While chapter 1 focuses on the economic impact of this school in underdeveloped Bavaria, chapter 2 analyzes the social composition of traditional (Gymnasium) and modern secondary schools (Gewerbeschule/Realschule). Chapter 3 extends the historical scope into the 20th century by studying the impact of displaced Germans on the educational development of Bavaria, once again focusing on applied secondary education.

[9] Becker and Woessmann (2009) find that literacy rates were higher in Protestant counties resulting from the wish to read the Bible. Literacy in turn positively affected economic outcomes, leading to a positive association between Protestantism and economic development. According to Cantoni (2014, pp. 31-2) these seemingly opposing findings of the economic effect of Protestantism result from different settings: while Becker and Woessmann (2009) focus mainly on rural counties, his dataset contains only cities. In cities, however, literacy was high – irrespective of the predominant religious affiliation. Hence, the effect of Protestantism on literacy was more pronounced in the countryside where literacy was low.

More precisely, chapter 1 focuses on secondary education and its role in economic development. The introduction of the Gewerbeschule and its later replacement through the Realschule serves as an optimal setting for analyzing the impact of practical and business-related education on economic performance in an underdeveloped state. In contrast to the Gymnasium – the predominant secondary school throughout the 19th century – modern secondary schools included modern languages instead of Old Greek and Latin, applied mathematics such as accounting, and various natural scientific subjects. Hence, it can be supposed that training of these skills – which are useful for commercial and industrial businesses – contributed to economic growth. Since the majority of these schools were opened in large and prosperous cities, the estimated treatment effect capturing the economic influence of the Gewerbeschule/Realschule will most likely lead to biased results. To alleviate this bias, I adopt an empirical strategy commonly applied in health and labor economics: propensity score matching.[10] Propensity score matching, as originally proposed by Rosenbaum and Rubin (1983), can be employed to deal with endogeneity issues resulting from non-random assignment of treatment (here: modern school opening). Thus, propensity scores summarize the probability of a modern secondary school opening for a given county. By comparing economic performance of similar counties – based on propensity scores – with and without this school type it is possible to capture the economic effect of modern secondary education. Using historical county-level data on tax revenues, business formations, employment structure, and patent holdings, OLS regression analysis reveals that the opening of a modern secondary school is in general positively associated with economic performance several years later. Consequently, this case study of 19th century Bavaria provides evidence on the importance of practice-oriented, scientific-technical secondary schooling for economic development.

Chapter 2 complements chapter 1 by studying the social composition of Bavarian secondary schools during the 19th century. Thereby, it focuses both on differences between modern (Gewerbeschule/Realschule) and traditional secondary education (Gymnasium) as well as on changes in the social composition across time. Bavaria experienced an enormous expansion of secondary education in the course of the 19th century, also due to the introduction of modern secondary education. In this context, this chapter asks whether educational expansion (1) led to changes in the association between social class and educational attainment, and especially so after the introduction of the Gewerbeschule; (2) weakened the link between social class of origin (father's occupation) and class of destination (son's occupation) and thereby increased social mobility? To answer these questions, I employ annual school reports of 18 Bavarian cities covering the 19th century. Since these reports include the occupations of students' fathers, they provide valuable information about the social background of students. In order to compile a dataset on students' social background that is consistent

[10] Application of this method is however not confined to these fields. For example, propensity score matching has been applied in studies on the influence of the euro on trade (Chintrakarn 2008), gang membership and violent victimization (Gibson et al. 2009), antipoverty programs (Jalan and Ravallion 2003), and the impact of out-of-wedlock childbearing on educational attainment of teenagers (Levine and Painter 2003).

both across time and space, I adopt two classification systems developed by historians and sociologists: the Historical International Standard Classification of Occupations (HISCO) and the Historical International Social Class Scheme (HISCLASS) (van Leeuwen and Maas 2011; van Leeuwen et al. 2002). While the first scheme enables international and time-independent comparisons of occupations, the second one assigns each occupational HISCO code to one of twelve social classes. Analyzing the development of social participation in secondary schools based on HISCO/HISCLASS categorization of over 15,000 students, reveals that even though the Gymnasium was mainly attended by children of high social background, there was a slight tendency to open up to lower classes of society until the introduction of modern secondary education. Once this new kind of schooling became available, the Gymnasium became the true institution of the elite whereas children of the middle class self-selected into the modern school types. Even though educational expansion did not increase participation of the lowest social classes, the prospect of social mobility for underprivileged classes was high especially in the Gymnasium. Since children of high socio-economic background are much more likely to continue to secondary education than their less fortunate peers in present-day Germany, and especially so in Bavaria (e.g. Freitag and Schlicht 2009), this analysis of 19th century Bavaria reveals that the roots of social inequality in secondary education can be traced back to the 19th century.

Finally, chapter 3 analyzes long-term effects of WWII forced migration on educational outcomes in Bavaria. At the end of WWII, Ethnic Germans living in the eastern parts of the collapsing German Reich were forced to migrate to the areas which would later form post-war West and East Germany. Bavaria received a huge number of these displaced Germans, most of them coming from highly industrialized areas in Czechoslovakia known as the Sudetenland. These Sudeten German expellees had strong preferences for higher secondary schooling, especially in form of a practical, business-related, and general education school. As a result they became actively engaged in the development of post-war middle track education (Realschule, Fachschule) in Bavaria and several school foundings can be traced back to their engagement. I argue that Sudeten Germans enhanced educational performance of native Bavarians by increasing the supply of applied secondary schools as well as by expressing their value for applied secondary education. To establish this relationship I employ county level data on student numbers and graduates of secondary education which is used in several empirical approaches including instrumental variables and differences-in-differences models. Results indicate that counties housing higher shares of Sudeten Germans in 1950 were associated with higher educational performance some 20 years later. Calculations suggest that these effects were not mechanically caused by Sudeten Germans and their children demanding education, but were the actual result of educational spillovers to the local population. Thus, this chapter provides evidence that under certain preconditions, immigrants can permanently alter educational behavior of the native population.

Chapter 1

Modern secondary education and economic performance: the introduction of the Gewerbeschule and Realschule in 19th century Bavaria[1]

1.1 Introduction

The importance of human capital for economic development has been understood since the seminal works of Schultz (1961) and Becker (1964) in the early 1960s. However, the positive role of education has mainly been ascribed to elementary schooling providing basic skills such as literacy.[2] The role of secondary education is less clear and empirical results are more ambiguous.[3]

This paper analyzes the introduction of so-called 'modern secondary education' in Bavaria, i.e. the Gewerbeschule,[4] introduced in 1829, and the Realschule, in 1877, and their impact on economic performance.

The Gewerbeschule was introduced in several Bavarian cities between 1829 and 1835 and paved the way for modern secondary education: in contrast to the Gymnasium – the predominant type of secondary schooling at that time – which focused mainly on classical languages and abstract teaching of mathematics, the curriculum of the Gewerbeschule contained a high proportion of so-called 'realistic' subjects such as modern languages and natural sciences (Döllinger 1838, pp. 1691-8). These skills were (and still are) considered important contributors to economic growth. In 1877 all 40 Gewerbeschulen were replaced by Realschulen. By 1907 there were more than 50 Realschulen on

[1] For the published version of this paper see Semrad (2015).
[2] See for example Becker et al. (2011) and Easterlin (1981).
[3] Goldin (1998, 1999) and Goldin and Katz (2000) study the diffusion of secondary education across the United States during the first half of the 20th century, also called the 'high school movement'. This study shows that expansion of school enrollment rates took place in relatively wealthy states lacking a large manufacturing sector since the availability of manual jobs increased youth's opportunity costs. Furthermore, empirical results indicate that returns to education were substantial at the beginning of the movement but mainly resulted from changing from manual to white-collar jobs. For evidence on practice-oriented secondary education, see Psacharopoulos and Patrinos (2004).
[4] Note that although Gewerbeschulen were called 'Landwirtschafts- und Gewerbeschulen' until 1864, in the following analyses I will use the term Gewerbeschule as an umbrella term.

Bavarian soil. The curriculum introduced an obligatory third language, natural sciences, and a redefined focus on mathematics; moreover, three more years of schooling were added (*Ministerialblatt* 1877, pp. 197-205). Over the years, modern secondary education established itself as a popular alternative to traditional secondary education, i.e. Gymnasium.

Rudolf Diesel – the inventor of the Diesel engine – is a prominent example of a modern secondary school career: growing up in Paris, he convinced his parents to send him to Augsburg to attend the local Gewerbeschule where his uncle was a teacher. Still at the Gewerbeschule (1870-3) he decided to become an engineer. Therefore, he continued to the Industrieschule and then to the Technische Hochschule in Munich to study industrial engineering (Diesel 1983, pp. 57-83; Luther 1987b, pp. 143-53). Other prominent former students of modern secondary education are Heinrich von Buz, industrialist and manager of MAN (Gewerbeschule Augsburg, 1845-9) (Luther 1987a, p. 133) and Friedrich Fischer, inventor, industrialist, and founder of Kugelfabrik Fischer (Gewerbeschule Schweinfurt, ca. 1861-6) (Meer 1987, pp. 237-8).

To assess the economic impact of modern secondary schooling, county data on business formations, tax revenues, and employees in services and industry is employed. In case of the Realschule, the number of granted patents is used as an additional measure of economic performance. All variables capturing economic performance are measured several years after the opening of a Gewerbeschule/Realschule to account for the fact that innovations in schooling might need some time to materialize in the economy. As the introduction of modern secondary education in a city is likely to be correlated with the city's current and future level of economic development, I employ propensity score matching following Rosenbaum and Rubin (1983) and Crump et al. (2009).

The empirical results show that modern secondary education indeed had a positive impact on economic performance. Counties that introduced a Gewerbeschule by 1835 are associated with a significantly higher share of the population employed in services and industry in 1882 and a higher per-capita number of business openings some forty years later than comparable counties without modern secondary schooling. Counties that opened a Realschule by 1896 have a higher share of the population employed in services and industry as well as a higher degree of innovativeness as captured by patents grants, several years later. These effects are all statistically significant even when accounting for a wide range of control variables. This analysis contributes to the existing literature in several dimensions. In a broader context, it adds to the literature on the impact of schooling – and thus human capital – on economic growth.

Human capital plays a prominent role in various growth models. In these models, human capital can either enter the production function on its own (e.g. Romer 1990; Mankiw et al. 1992)[5] or by

[5] In Romer's (1990) model human capital is used in the research sector to produce new designs or generate new knowledge which in turn determines technological change. As a consequence, the larger the stock of human capital in the economy, the faster is economic growth as technological progress speeds up. Mankiw et al. (1992)

influencing the ability to absorb new technologies. Models of the last kind are based on the seminal work of Nelson and Phelps (1966); these models focus on the importance of human capital for technology diffusion: the higher the level of human capital in a country, the higher is the ability to adopt and implement new technologies and hence, the faster is the rate at which this country will catch up to the technological leader nation. Empirical applications of models in this spirit – such as Benhabib and Spiegel (1994) and Barro (1991, 2001) – support the model predictions and reveal that the human capital stock determines income growth rates and thus convergence rates. However, there is also evidence that not only the initial level of human capital but also changes to it through education policies influence economic growth (Krueger and Lindahl 2001).

One problem in the above named studies is that human capital is mainly proxied by years of schooling.[6] For example, Easterlin (1981) compares primary school enrollment rates of several nations and concludes that expansion of schooling preceded economic growth. Walters and Rubinson (1983) focus on the impact of educational expansion on economic output in the United States from 1890 to 1969. They find time-specific economic effects of secondary and doctorate education. Barro (2001) shows that economic growth is positively associated with secondary and higher educational attainment of males. However, using this quantity measure of human capital might be misleading since 'years of schooling' yields no information about the educational value of schooling. Hence, Barro (2001) also adopts students' scores on internationally comparable examinations and finds that especially results in science tests are strongly related to growth. This 'quality approach' to human capital is also supported by findings of Hanushek and Kimko (2000) who show that differences in the labor force quality are more able to explain growth rates than quantitative measures.[7] In this context, Behrman and Birdsall (1983, p. 929) argue that "*the incorporation of school quality into the analysis of income returns to schooling not only is theoretically plausible and of empirical importance, but may lead to better policy formulations in areas in which substantial scarce resources currently are being invested in poor countries*". The role of school quality in historical economic development is also stressed by Easterlin (1981, p. 10) who claims that "*the content of education conducive to economic growth is that of a secular and rationalistic type*".

use a Solow Model where they include human capital as an independent input factor in the production function. Comparing the standard Solow Model (Solow 1956) with their augmented version, they show that their model is able to explain cross-country variations in income far better than the standard model without human capital. They conclude that differences in education across countries can explain low levels of convergence in income between countries. However, in contrast to endogenous growth models such as Romer's, technology (and labor) is assumed to grow exogenously.

[6] For example, Barro (1991) uses school enrollment rates in 1960 to proxy human capital. However, he is well aware that this variable is not able to account for school quality. Therefore, he also adopts the student-teacher ratio yielding insignificant and ambiguous results.

[7] Focusing on school quality rather than quantity is also supported by Fuller et al. (1986). In this case study of Mexico between 1888 and 1940, they find that variation in educational quality (literacy levels) influences subsequent manufacturing output whereas educational quantity (school expansion) lacks economic impact.

Literacy rates are commonly used in historical studies to proxy for the quality of human capital. For example, by analyzing Prussian county data, Becker and Woessmann (2009) find that predominantly Protestant counties took the lead in economic development due to their higher literacy rates, and Becker et al. (2011) show that initially better educated regions – proxied by literacy – were able to catch up faster to the economic leader Britain. Cinnirella and Streb (2013) find that literacy had a positive influence on income as well as on innovative activities, which again raises income levels.[8] This evidence suggests that basic education – providing kids with the knowledge to read – is decisive for economic development. However, as Barro (2001) demonstrates, there might also be an important role for secondary education.

Research on different types of secondary schooling in contemporary – mostly developing – countries suggest that social and private returns of general academic education offset those of pre-vocational education (e.g, Bennell 1996; Psacharopoulos 1987; Psacharopoulos and Patrinos 2004). However, during industrialization, pre-vocational and practical education could have played a completely different role. In case of industrialization in England, the existence of private lecturers,[9] mechanics institutes,[10] and other intellectual associations illustrate that society clearly demanded technical and scientific education (Musson and Robinson 1969, p. 113; Mitch 2008, pp. 248-51). Scientific associations and polytechnic societies also existed in 19th century Germany. Especially in Bavaria, these organizations thrived during the 19th century reflecting a demand for practical knowledge (Buchinger 1983, pp. 108-10).

This paper also complements the literature on the evaluation of the Bavarian schooling system during the 19th century. While there are several narrative studies concerning the Prussian higher education system (e.g. Punke 1930a, 1930b; Ringer 1967, 1979; Kraus 2008), only Buchinger (1983) provides an in-depth analysis of modern secondary education in Bavaria. However, his analysis does not explore any economic effect of these schools. To the best of my knowledge, this paper provides the first econometric analysis of the impact of specific Bavarian school types, in this case the Gewerbeschule and Realschule, on economic outcomes.

By focusing on Bavaria, I circumvent the problems associated with cross-country analyses: since comparing different counties within one sovereign territory, there are no major institutional, cultural, geographical or technological differences between these counties. Furthermore, Bavaria provides an interesting example to study the economic impact of educational innovations. As a state

[8] Cinnirella and Streb (2013) use the number of high-valuable patents held in Prussian counties as a proxy for innovativeness. I will use this variable in the econometric specification in section 1.3 as an additional outcome variable.

[9] For example, John Banks gave lectures in Manchester on mechanics during the late eighteenth century. His lectures and books focused on solving problems commonly encountered by engineers and on increasing the mechanical knowledge of his audience (Musson and Robinson 1969, p. 107).

[10] Mechanics institutes evolved in English towns during the late 19th century and offered instruction and practical application of science to the working class (Mitch 2008, pp. 248-9). For example, there existed 39 mechanic institutes in Liverpool in 1850 (Inkster 1991, p. 79).

relying mostly on the agrarian sector, it was relatively backward in economic terms – especially when compared to Prussia – and available secondary schooling (i.e. Gymnasium) lacked practical orientation (Buchinger 1983, pp. 106-12). Hence, the introduction of the Gewerbeschule and Realschule as new school types focusing on scientific content and its practical application provides the unique opportunity to assess the impact of innovations in education on the economy.

The remainder of the paper is structured as follows: first, an overview of the German educational system during the 19th and early 20th century is given in section 1.2. A special emphasis is thereby placed on the Bavarian schooling system. Moreover, this section explores the channel through which the Gewerbeschule and Realschule might influence the economy. This is followed by an introduction of the empirical model and a description of the data in section 1.3. This section also discusses the endogeneity associated with the opening of a modern secondary school and introduces an empirical approach to deal with this problem. The subsequent section 1.4 presents the empirical results. The final section concludes.

1.2 Historical background

1.2.1 Bavarian schooling system

The most important form of German secondary schooling[11] throughout the 19th century was the Gymnasium (Ringer 1967, p. 128). Children usually transferred around age eight after two years of primary education – acquired either at a public school (Volksschule) or private institution (Vorschule) – to the Lateinschule (Ringer 1979, p. 33; Punke 1930a, p. 576). Students were required to complete the four-year Lateinschule (after 1874: five-year) in order to be entitled to attend the four-year Gymnasium. After the Gymnasium they could attend a Lyzeum, further preparing them for university studies (Buchinger 1983, p. 128).

The curriculum of the Gymnasium focused on the classical languages Greek and Latin and abstract teaching of mathematics. The Gymnasium understood itself as an institution providing higher general, religious, and moral education and preparing students for independent studies at the university (*Ministerialblatt* 1874, p. 327). Throughout the 19th century, only the Gymnasium possessed the right to confer the Abitur – a prerequisite for university admittance (Ringer 1979, p. 34; Kraus 2008, p. 42). Consequently, the Gymnasium was seen as an institution for the elite, raising a new generation of state officials, academics, and clerics.[12]

[11] Note that during the 19th and early 20th century, Bavarian secondary schools were separated by gender. Secondary education was more common for boys; girls rarely continued to secondary schools after primary education. Except for the Vorschule and Volksschule, all schools named in this paper were only open to boys.

[12] This perception is confirmed by the fact that the majority of students at the Gymnasium came from high socio-economic backgrounds (i.e. state officials, academics, physicians, artists, military, teachers, church, and civil services). See BSKB XXVII.

The Realschule as a lower type of secondary education emerged during the eighteenth century in Prussia. Inspired by Hecker's 'ökonomisch-mathematische Realschule' founded in Berlin in 1747, six-year Realschulen were opened all over Germany. The educational objective of the Realschule was to provide prevocational as well as general education, thereby focusing on mathematics, natural sciences, and modern languages such as English and French (Hecker 1797; Hamann 1993, pp. 95-8).

In Bavaria in particular, Realschulen were already quite popular at the beginning of the 19th century – although by no means as popular as the Gymnasium as the predominant type of secondary education. Between 1808 and 1816 there existed Realschulen focusing on technical education and preparing for transfer to Realinstitute which in turn entitled to university studies. In 1816 these early Realschulen were transformed into Höhere Bürgerschulen which combined general education and occupational training and Realinstitute were closed (Buchinger 1983, pp. 76-9). These Höhere Bürgerschulen were then replaced by Gewerbeschulen.

The Gewerbeschule was officially introduced in 1829 by the Bavarian King Ludwig I, who commanded the opening of a Gewerbeschule in all big cities of Bavaria;[13] in these cities, Bürgerschulen should be transformed into Gewerbeschulen (Buchinger 1983, p. 127). Gewerbeschulen were set up in close cooperation with industrial and trade associations. These groups were not only supposed to support the state in financing Gewerbeschulen but also to manage these schools together with state officials (Döllinger 1838, pp. 1691-2). Hence, these associations – or lobby groups – played a decisive role in the emergence and management of modern secondary education.

Gewerbeschulen were designed as three-year schools and pupils directly transferred to them after having completed the Volksschule/Lateinschule around age 12 (Döllinger 1838, p. 1692). A degree of the Gewerbeschule entitled to transfer to the Polytechnische Schule. This institution prepared for studies at the Technische Hochschule (i.e. a technical university) until they were replaced by Industrieschulen in 1868 (Buchinger 1983, pp. 123-8; *Regierungsblatt* 1868, pp. 1698-1700). Since the original curriculum of 1833 mainly provided a technical education – which clearly differentiates them from former Bügerschulen – these early Gewerbeschulen can be understood as professional schools (Buchinger 1983, pp. 127-8). Furthermore, Gewerbeschulen had to include an agricultural department (*Regierungsblatt* 1833, pp. 183-6); thus they were called 'Landwirtschafts- und Gewerbeschulen'. Table 1.1 illustrates the official curriculum for students of the Gewerbeschule. Besides the courses in Table 1.1, students had to visit the so-called 'Realienunterricht' – i.e. general education – at a Gymnasium as depicted by Table 1.2.

[13] "*In allen größeren Städten des Reichs sollen nach und nach Gewerbsschulen angelegt werden, zu deren Erhaltung angemessene Beiträge aus dem Staatsvermögen geleistet werden*" (Döllinger 1838, p. 1691).

Table 1.1 – Curriculum of the Gewerbeschule (1833-64)

Subject	Grade		
	1	2	3
Arithmetic/algebra	6	6	6
Planimetry	6	-	-
Stereometry	-	6	-
Descriptive geometry	-	-	6
Graphics	6	12	12
Natural history	6	3	-
Physical science	-	3	-
Chemistry	-	-	6
Encyclopedia of industry	3	3	3
Accounting	-	-	3

Notes: Table depicts weekly school hours per subject.
Source: Adapted from Buchinger (1983, pp. 123-4).

Table 1.2 – Curriculum of the 'Realienunterricht' for students of the Gewerbeschule at the Gymnasium (1833-64)

Subject	Grade		
	1	2	3
Religion	6	4	4
History and geography	4	6	6
German grammar	4	-	-
Rhetoric	-	4	4
French[a]	4	4	4

Notes: Table depicts weekly school hours per subject.
[a] voluntary
Source: Adapted from Buchinger (1983, p. 124).

By the school year of 1835/1836, 30 Landwirtschafts- und Gewerbeschulen existed in Bavaria (Döllinger 1838, pp. 1625-6).

The technical orientation and the corresponding lack of general education of the Landwirtschafts- und Gewerbeschulen were widely criticized. Especially the rectors of the Bürgerschulen that had to be transformed into Gewerbeschulen stressed the importance of general education. As a consequence, the curricula of many Gewerbeschulen deviated from the official curriculum (see Tables 1.1 and 1.2) already in 1833 (Buchinger 1983, pp. 127-9). For example, the syllabus of the Gewerbeschule in Kaiserslautern contained eleven hours per week of French but only three hours of chemistry (Buchinger 1983, p. 136).

In 1864, Landwirtschafts- und Gewerbeschulen were substantially reformed. Weekly hours devoted to general education in form of the 'Realienunterricht' were expanded. The resulting school – henceforth only called Gewerbeschule – provided general education and prepared for commercial and industrial professions (*Regierungsblatt* 1864, p. 546). In order to meet the specific needs of their local environment, Gewerbeschulen were free to set up agricultural and commercial departments (*Regierungsblatt* 1864, pp. 546-8; Buchinger 1983, pp. 153-9). Table 1.3 shows the curriculum of the

reformed Gewerbeschule. The curriculum consisted of courses for all students (first eight subjects) and of courses depending on the respective departments.

Table 1.3 – Curriculum of the reformed Gewerbeschule (1864-76)

Subject	Grade		
	1	2	3
Religion	2	2	2
German	5	4	3
Geography	2	2	-
History	2	2	2
Arithmetic	5	-	-
Natural history	4	-	-
Physical science	-	4	-
Chemistry	-	-	6
Additional courses for students of the industrial department			
Algebra	-	2	3
Plane geometry	-	4	-
Descriptive geometry	-	-	2
Graphics	8	8	6
Mechanics	-	-	4
French	2	2	2
Additional courses for students of the commercial department			
Commercial arithmetic	-	5	-
Commerce	-	6	6
Commercial geography and history	-	-	3
French	5	5	5
English	-	-	5
Calligraphy	5	-	-
Additional courses for students of the agricultural department			
Agriculture	6	6	8
Arithmetic exercises	-	2	-
Geometry	-	-	3
Graphics	4	2	2

Notes: Table depicts weekly school hours per subject.

Source: Adapted from Buchinger (1983, pp. 154-5).

As Table 1.3 illustrates, Gewerbeschulen now combined general education with specific – department related – subjects. Hence, as Kleinfeller (1883, pp. 39-40) – a contemporary witness – points out, the reformed Gewerbeschulen were in fact schools focusing on general secondary education, i.e. the definition of a Realschule.

In 1877, all three-year Gewerbeschulen were officially transformed into six-year Realschulen. Realschulen were supposed to provide higher civic education on the basis of modern languages, mathematics, sciences, and history. The curriculum of the Realschule now included an obligatory third language (in this case English), a redefined focus on mathematics and natural sciences such as physics, as well as physical training (*Ministerialblatt* 1877, pp. 197-255). Table 1.4 gives the curriculum of the

Realschule. This curriculum was more or less effective throughout the existence of the Realschule[14] which lasted until 1907 when it was integrated into the new system of Oberrealschulen (*Ministerialblatt* 1907, pp. 325-37).

Table 1.4 – Curriculum of the Realschule (1877)

Subject	Grade					
	1	2	3	4	5	6
Religion	2	2	2	2	2	2
German	6	6	4	4	3	3
French	6	6	5	5	3	3
English	-	-	-	-	5	5
Geography	2	2	2	2	1	1
History	-	-	2	2	2	2
Arithmetic	5	4	4	2	1	1
Mathematics	-	-	-	6	6	6
Description of nature	-	3	3	-	-	-
Physics	-	-	-	2	2	2
Chemistry/mineralogy	-	-	-	-	3	3
Calligraphy	3	2	2	-	-	-
Graphics	3	3	4	4	4	4
Physical education	2	2	2	2	2	2
Hours per Week	29	30	30	31	34	34

Notes: Table depicts weekly school hours per subject.

Source: Adapted from *Ministerialblatt* (1877, p. 224).

Table 1.5 shows the curriculum of traditional secondary education, i.e. the Lateinschule and Gymnasium, from 1874 onwards.[15] Admittance to the Gymnasium required that students visited a Lateinschule first (*Ministerialblatt* 1874, pp. 323-63; *Ministerialblatt* 1891, pp. 238-62; *Ministerialblatt* 1894, pp. 189-215). Thus, in combination with the Lateinschule, the Gymnasium comprised three more classes than the Realschule, making it a nine-year institution. With the introduction of the Realschule, students started both school types – modern and traditional secondary education – around age 11; hence, at graduation, students were on average 16 in the Realschule and 19 in the Gymnasium.[16]

[14] In 1894, this curriculum was slightly reformed. For instance, calligraphy was added to the schedule of classes 1 and 2 and writing as an independent subject was removed from the curriculum (*Ministerialblatt* 1894, p. 292).

[15] In 1891, this curriculum was slightly reformed. Weekly hours devoted to Latin and calligraphy were cut and nature study and graphics were added to the curriculum (*Ministerialblatt* 1891, pp. 241-62).

[16] For admission, children had to be between 9 and 11 in the Gymnasium and between 10 and 12 in the Realschule (*Ministerialblatt* 1874, p. 344; *Ministerialblatt* 1877, p. 204; *Ministerialblatt* 1891, p. 262; *Ministerialblatt* 1894, p. 310).

Table 1.5 – Curricula of the Lateinschule and Gymnasium (1874)

Subject	Lateinschule					Gymnasium			
	1	2	3	4	5	I	II	III	IV
Religion	2	2	2	2	2	2	2	1	1
German	6	3	3	2	2	2	2	3	3
Latin	7	10	10	8	8	8	8	7	7
Greek	-	-	-	6	6	6	6	6	6
French	-	-	-	-	-	2	2	2	2
History	-	-	2	2	2	2	2	3	3
Geography	2	2	2	2	2	-	-	-	-
Arithmetic, mathematics, and physics	3	3	3	2	4	4	4	4	4
Calligraphy	3	3	2	1	-	-	-	-	-
Physical education	2	2	2	2	2	2	2	2	2
Hours per Week	25	25	26	27	28	28	28	28	28

Notes: Table depicts weekly school hours per subject. Hebrew, English, Italian and stenography were offered as optional subjects in the Gymnasium. Graphics, music and singing were offered as optional subjects in the Lateinschule and Gymnasium. See *Ministerialblatt* (1874, p. 329).
Source: Adapted from *Ministerialblatt* (1874, p. 329).

Comparison of the curricula of modern with traditional secondary education reveals that modern secondary education placed a greater emphasis on scientific subjects and modern languages: the Realschule devoted more weekly hours to mathematics, arithmetic, and physics – these were even combined to one subject in the traditional schools – and taught more hours of French than the Gymnasium. English and chemistry were absent from the obligatory curriculum of the Gymnasium, whereas Latin and Greek clearly dominated the curriculum.

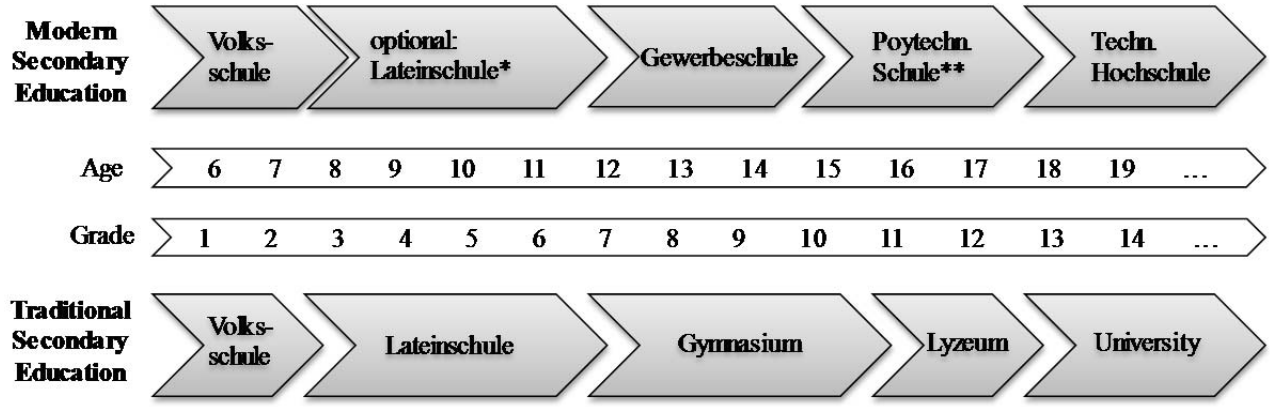
After the Realschule, children could transfer to the Industrieschule. This institution was established as a replacement for the Polytechnische Schulen in 1868 and served as a technical middle-school building up on the Gewerbeschule and later on the Realschule. Pupils were either prepared for consecutive studies at the Technische Hochschule (after having passed the final exam at the end of the second year) or for a career in business and industry (after three years of schooling). The Industrieschule comprised three departments focusing on mechanical, technical, and constructional techniques (*Regierungsblatt* 1868, pp. 1698-1700). Hence, modern secondary education provided an alternative in entitling to university studies (however, only at the technical university). In 1907, Industrieschulen were replaced by Oberrealschulen.

These Oberrealschulen resulted from integrating Realschulen and Industrieschulen into one school type. Oberrealschulen included nine classes and entitled students to general university admittance. Thus, Oberrealschulen were on equal footing with Gymnasien (Buchinger 1983, pp. 105-12; *Ministerialblatt* 1907, pp. 325-37).

The Bavarian schooling system also comprised Realgymnasien which can be understood as a compromise between traditional and modern secondary education. Since there were only four institutions – Augsburg, Munich, Nuremberg, and Wuerzburg – this institution played a rather minor

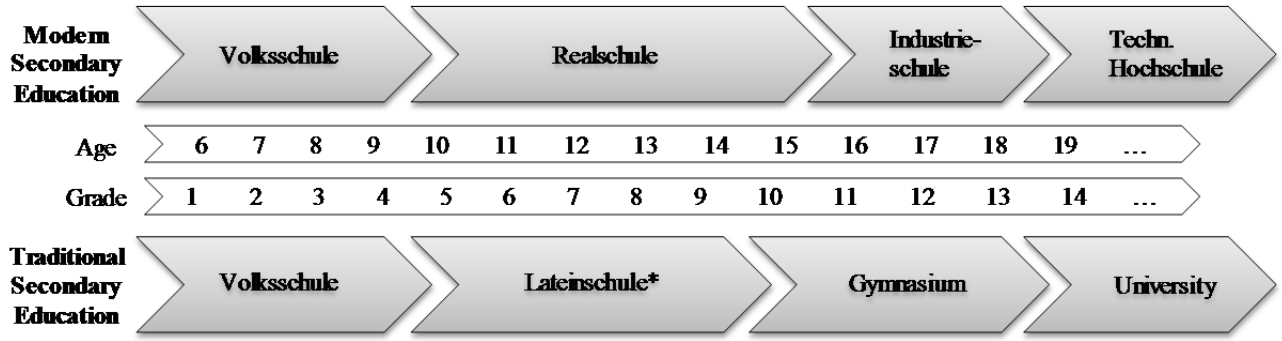
role in secondary education (Buchinger 1983, p. 153; *Regierungsblatt* 1864, pp. 538-44). Figures 1.1 and 1.2 summarize the Bavarian schooling system from 1833 to 1876 and 1876 to 1907, respectively.

Figure 1.1 – Bavarian schooling system (1833-76)



Notes: * Children could transfer after the second grade to the Lateinschule; transfer to the Gewerbeschule was possible from both school types. ** Polytechnische Schule was abolished in 1864 and reopened as Industrieschule in 1868. See Buchinger (1983, pp. 123-8), and *Regierungsblatt* (1868, pp. 1698-70).
Source: Own illustration based on Buchinger (1983, p. 128).

Figure 1.2 – Bavarian schooling system (1877-1907)



Notes: * Gymnasien were nine-year institutions including the five-year Lateinschulen. In cities without a Gymnasium, Lateinschulen could exist on their own. From 1894 onwards, the first six grades of the Gymnasium were called 'Progymnasium'. Progymnasien existed only in combination with a Gymnasium whereas Lateinschulen also existed in cities without Gymnasien. Lateinschulen comprised up to five classes and prepared for transfer to a Progymnasium (in another city). See *Ministerialblatt* (1874, pp. 323-62) and *Ministerialblatt* (1894, pp. 189-95).
Sources: Own illustration based on *Ministerialblatt* (1874, pp. 323-62); *Ministerialblatt* (1877, pp. 197-255); *Ministerialblatt* (1891, pp. 239-86); *Ministerialblatt* (1894, pp. 189-95, 287-323).

All in all, modern secondary schooling in form of the Gewerbeschule and Realschule provided general education preparing for commercial and industrial professions; the focus on modern languages, applied mathematics, and natural sciences uniquely differentiates this school type from the traditional Gymnasium. In contrast to the Gymnasium as an institution mainly preparing for consecutive university studies, the Realschule and Gewerbeschule prepared its students for both, technical studies and the (industrial and mercantile) labor market.

1.2.2 Advocates of modern secondary education

The educational system of 19th century Germany was subject to profound changes reflecting political, economic, and social struggles and movements of that time (Jeismann 1987, p. 152); thus, the

formation of new forms of secondary schooling such as the Realschule, Realgymnasium, Oberrealschule, Industrieschule, and Gewerbeschule can only be understood in light of these movements. As the Gymnasium with its emphasis on classical languages could not offer an education preparing for commercial and industrial occupations, the mercantile middle class demanded the introduction of so-called modern schools: the curricula should focus more on modern languages, mathematics, and natural sciences (Buchinger 1983, pp. 93-112; Hamann 1993, pp. 95-6; Ringer 1967, p. 128). These demands were supported by an increasing number of critics who claimed that traditional secondary schools could not prepare their pupils for the changes taking place in the scientific, technical, industrial, and commercial environment of that time (Albisetti 1989, p. 182).

Support also came from polytechnic advocacy groups promoting general technical education through journals, lectures, exhibitions, and prize competitions, and by setting up special libraries (Kraus 2008, pp. 39-40). In Bavaria for instance, industrial, polytechnic, and agricultural associations as well as representatives of industry and commerce, individual persons, and the press lobbied for a scientific-technical education in form of Gewerbeschulen, Realschulen, and Industrieschulen. A profound scientific-technical education of the labor force was expected to stimulate the economy (Buchinger 1983, pp. 108-9). The important role of industrial and trade groups in modern secondary education is also manifested by the fact that these groups helped to manage and finance early Gewerbeschulen (Döllinger 1838, pp. 1691-2).

1.2.3 Modern secondary graduates and the economy

According to Kleinfeller (1883, pp. 97-101), the majority of modern secondary graduates started working in businesses and industrial occupations directly. As Ringer (1979, pp. 71-9) shows for Prussia in the years between 1875 and 1899, most graduates of modern schools intended to seek positions in technical occupations such as engineering, mining, and architecture or in commerce and industry. In contrast, only a minority of graduates of the traditional Gymnasium opted for a technical profession or a career in commerce and industry.

This is also illustrated by Table 1.6 which provides information about career choices of graduates of the Realschule Munich between 1878 and 1883. Since the Realschule was introduced in 1877/78, graduates of 1878 obtained their education predominantly at the predecessor institution, i.e. the Gewerbeschule. Graduates of 1883 were the first ones to pass through all six classes of the Realschule. The numbers show that over the years, more and more students opted for careers in trade, commerce, and industry. Since the number of graduates remained nearly constant over time, this increasing interest in mercantile and industrial careers suggests that the education of the Realschule encouraged young people to work in these sectors more than the Gewerbeschule did. Of course, Munich is not a representative case. Being the largest and economically most advanced city in Bavaria, it offered a wide range of job opportunities. However, as Buchinger (1983, p. 173) argues, the

fact that Munich was also not comparable to other Bavarian cities in terms of the provision of different kinds of secondary schools[17] shows that the Realschule was able to compete with other secondary school types – as the following student numbers in Table 1.7 illustrate – and prepare its students for industrial, commercial, and trade professions.

Table 1.6 – Intended careers of graduates at the Realschule Munich

Year	Number of graduates	Trade, commerce, and industry	Middle-level civil service	Study
1878	37	8	7	22
1879	41	11	11	19
1880	45	21	15	9
1881	42	25	5	12
1882	47	23	10	14
1883	48	33	4	11

Source: Adapted from Buchinger (1983, p. 172).

Education and practical knowledge of Realschule graduates were highly acknowledged by the business environment: merchants, manufacturers, master craftsmen, and other businessmen frequently asked rectors of Realschulen to recommend graduates of their institutions to them. These graduates were also better able to climb the career ladder due to their valuable knowledge obtained at the Realschule (Kleinfeller 1883, pp. 101-4).

However, in order to determine the effect of modern secondary education on economic outcomes, precise information about the educational background of the people employed in industrial and trade-related occupations some years after the introduction of these modern schools is needed. In absence of this information, career aspirations and the number of students attending modern secondary education are indispensable factors in the analysis. It can be supposed that there is a link between the strength of the effect of the school on economic outcomes and the number of students at this school. The following table lists the number of students attending secondary schools from 1834 to 1907 in total as well as per 1,000 people.

[17] For instance, by 1905/06, Munich had four Realschulen, five Gymnasien, and one Realgymnasium (*Ministerialblatt* 1906, pp. 16-22).

Table 1.7 – Number of students at secondary schools

Year	Gewerbeschule/Realschule		Gymnasium	
	Students (per 1,000 people)	Schools	Students (per 1,000 people)	Schools
1834/35	1,450 (0.33)	28	2,334 (0.53)	25
1841/42	1,105 (0.25)	24	n.a.	n.a.
1851/52	2,549 (0.56)	26	3,529 (0.77)	28
1862/63	3,539 (0.75)	29	2,508 (0.53)	28
1871/72	3,745 (0.78)	36	2,640 (0.55)	28
1876/77*	5,375 (1.07)	40	n.a.	n.a.
1877/78**	7,685 (1.53)	40	n.a.	n.a.
1885/86	8,451 (1.56)	46	14,120 (2.60)	33
1894/95	13,278 (2.28)	51	17,039 (2.93)	37
1906/07	14,031 (2.15)	55	19,475 (2.98)	45

Notes: Number in brackets indicates students per 1,000 people (total Bavarian population) in 1840, 1852, 1861, 1871, 1875, 1880, 1885, 1895, and 1905.

* Last year of the Gewerbeschule

** First year of the Realschule

*Source*s: Own calculations based on BSKB, I (1850); BSKB, V (1855, pp. 10-11, 26-7); BSKB, XIV (1866, pp. 9-13); BSKB, XXVII (1873, pp. 68-9, 196-7); *Ministerialblatt* (1877, pp. 114, 473); *Ministerialblatt* (1886, pp. 278-9); *Ministerialblatt* (1895, pp. 9-11); *Ministerialblatt* (1907, pp. 14-6); ZKBSB, 20 (1888, pp. 38-9); Buchinger (1983, p. 145); BSB, 192 (1953, pp. 10-11).

According to Table 1.7, an increasing number of children continued to secondary education between 1834 and 1907. Except for the school year of 1841/42 and 1906/07 in case of modern secondary education and 1862/63 in case of traditional secondary education, total student numbers as well as students per 1,000 people rose continuously in both school types. The first years after the Gewerbeschule was introduced, the overall number of students as well as the number of schools declined. However, after 1851/52, student and school numbers in modern secondary schools rose steadily – exceeding even those of the Gymnasium in the 1860s and early 1870s. In the closing year of the Gewerbeschule, i.e. 1876/77, 5,375 children attended altogether 40 schools – a number almost four times larger than that of the second school year after its introduction, i.e. 1834/35. This increase is even more remarkable since the number of schools did not even double between these thirty years. The Realschule started with 7,685 students and 40 schools in 1877/78 and experienced a constant increase in both students and schools. In the last year of its existence – before it was converted into the Oberrealschule – 14,031 children attended altogether 55 schools.

The increase of student numbers at the Gymnasium is almost as extreme as that of the Gewerbeschule/Realschule: numbers rose from less than 3,000 in 1871 to almost 20,000 students in 1907. A large fraction of this increase can be attributed to the extension of the Gymnasium from a six-year to a nine-year institution in 1874 (including the Lateinschule). Another reason for this huge difference in student numbers after 1873 is that in case of modern secondary education, counties were sometimes allowed to open three-year instead of six-year Realschulen (*Ministerialblatt* 1877, p. 201; *Ministerialblatt* 1894, p. 289).[18]

[18] For instance, in 1885/76, 13 out of 46 Realschulen only offered four classes (*Ministerialblatt* 1885, pp. 278-9). Students could transfer after these four years to six-year Realschulen in other counties (*Ministerialblatt* 1877, p. 201). See also *Ministerialblatt* (1894, p. 289).

Altogether, the almost constant increase of student and school numbers – besides the slight cutback in the 1840s in case of the Gewerbeschule – demonstrates the rise of both modern and traditional secondary education. The fact that graduates of modern secondary education mainly pursued industrial and business-related careers and were highly esteemed by the local business environment suggests that these schools could have had a positive effect on the economy. This economic role of the Gewerbeschule and Realschule will be analyzed empirically in the subsequent chapters.

1.3 Econometric specification and data

In this paper, I compare counties with a Gewerbeschule or Realschule to counties without modern secondary schooling. The implicit assumption underlying the subsequent analysis is that students of modern secondary education do not leave counties after education in order to seek employment or start businesses in other counties. This migration would bias the modern secondary education effect – presumably – downwards if former students settled in counties without this school type. If, however, these students decided to move to counties that also offered modern secondary education, the estimates would remain unbiased. Due to data limitations there is no possibility to control for migration of graduates. However, it is likely that migration does not severely bias the estimates. First – as the examples of Heinrich von Buz, Friedrich Fischer, and Rudolf Diesel illustrate – most former students probably stayed in the city where they obtained their education. Second, since children started modern secondary education already at age 11, it seems unlikely that they were sent from towns without to towns with a Gewerbeschule/Realschule in many cases – Rudolf Diesel being a prominent exception. Thus, the problem resulting from moving back to their home towns after graduation remains in my opinion relatively small. However, I will account for the potential bias induced by migration by using data reflecting the overall level of mobility in the counties. Therefore, I run regressions weighted by the share of non-immigrants and the share of people born in municipality in case of the Gewerbeschule and Realschule, respectively.[19]

Did the introduction of modern secondary schooling boost economic performance? To answer this question, I separately estimate the following models in case of the Gewerbeschule and Realschule:

$$y = \alpha + \beta * ModSec + \gamma X + u \tag{1.1}$$

where y is a per-capita measure of economic performance and X is a vector of control variables including geography, administrational independence, religious shares, other schools, and advocacy groups. $ModSec$ is a dummy variable indicating whether there was a Gewerbeschule in 1835 or

[19] Using these weights ensures that counties with high migration patterns will receive lower weights in the estimation of a modern secondary education effect.

Realschule in 1896 in the respective county. Hence, β is the coefficient of interest capturing the economic effect of modern secondary education.

However, as mentioned above, assignment of these schools to counties did not occur randomly, thereby limiting the validity of the estimated treatment effect. I will account for this problem by sample restriction using propensity scores in section 1.3.2.

1.3.1 Database and main variables

The main source of data is taken from censuses conducted by the royal Bavarian statistical office (*Königlich-Bayerisches Statistisches Bureau*) between 1850 and 1907 and its predecessor institutions.[20] These censuses were either published in *Beiträge zur Statistik des Königreiche Bayern* (BSKB) or in *Zeitschrift des Königlich Bayerischen Statistischen Bureau* (ZKBSB). Description and source of the employed data is listed in Table A1.1 in Appendix 1; summary statistics are given in Table A1.2 in Appendix 1.

Counties. The observational unit is a county (*Bezirksamt*) implying that cities and their respective counties are combined to one observational unit, i.e. county. This applies to all variables: population numbers, existing schools,[21] and measures of economic performance. There are two reasons for merging cities and corresponding counties: first, this allows for the possibility that children from the surrounding countryside visited city schools and second, it can be supposed that any economic effect of modern secondary schooling was not only restricted to the city, but also to the proximate rural districts.

Gewerbeschule. Gewerbeschulen were first introduced in Bavaria 1833 as 'Landwirtschafts- und Gewerbeschulen'. By 1835 there were 30 Gewerbeschulen in Bavaria. The data is based on Gewerbeschulen that received district funds and revenues generated by funds of former Bürgerschulen in 1835 as listed in Döllinger (1838, pp. 1625-6). By 1871 there existed 36 Gewerbeschulen. The information on Gewerbeschulen in 1871 originates from educational censuses. I restrict my sample to those counties that either had a Gewerbeschule both in 1835 and 1871 and to counties that had no Gewerbeschule both in 1835 and 1871. Therefore, counties that set up or closed a Gewerbeschule in the years between 1836 and 1870 are excluded from the sample.[22] In sum, four towns closed[23] and ten

[20] For more details on the history of the royal Bavarian statistical office see: https://www.statistik.bayern.de/ueberuns/geschichte/

[21] For instance, the city of Munich opened a Gewerbeschule in 1833 and therefore the whole observational unit consisting of the city and its two counties is counted as having a Gewerbeschule.

[22] Counties are only excluded if the closure lasted more than five years. For instance, Kaufbeuren closed its Gewerbeschule between 1839 and 1841 (Buchinger 1983, p. 140) and will consequently not be excluded from the sample.

[23] Burghausen, Dillingen, Rothenburg, and Schwabach had to close their schools in the following years (Buchinger 1983, pp. 139-40). Only Rothenburg reopened its school in 1865 (Keyser 1874, p. 278) but will nevertheless also be excluded from the sample since the timespan of closure exceeded five years.

opened Gewerbeschulen[24] and are consequently disregarded from the Gewerbeschule sample. Hence, the sample includes 26 cities with a Gewerbeschule.

Since the observational unit is a county, once a city opens a Gewerbeschule, the respective observational unit 'county' is counted as having a Gewerbeschule. Counties with a Gewerbeschule in 1835 and 1871 are shown in Appendix 1 by Figures A1.1 and A1.2, respectively.

Realschule. Realschulen were introduced in 1877 in Bavaria and replaced all existing 40 Gewerbeschulen. By the school year of 1906/07 another 15 Realschulen had been opened in 13 counties. Except for Munich and Nuremberg[25] – which opened additional Realschulen – all new Realschulen were opened in cities that previously had not offered modern secondary education. Unlike the Gewerbeschule, there is no case of a Realschule documented that had to close in the subsequent years. The data is based on publications of the Bavarian Ministry of Interior and Education (*Ministerialblätter*). Counties with a Realschule in 1877 and 1896 are shown in the Appendix 1 by Figures A1.3 and A1.4, respectively.

Other controls. Data on population numbers are taken from censuses conducted on a county basis in Bavaria in 1840, 1871, 1880, and 1905. These censuses also state religious affiliations of the population. Becker and Woessmann (2009) show that Protestantism led to higher literacy in Prussian counties – imposed by the need to be able to read the Bible – explaining the lead of Protestant counties in economic outcomes in 19th century Prussia. The reported summary statistics in Table A1.2 reveal that counties introducing modern secondary education were on average dominated by Protestants. Disregarding religious denominations might lead to omitted variable bias if certain religions might also affect economic prosperity. Thus, I include the population shares of Jews and Protestants as control variables.

As outlined in section 1.2.2, industrial and trade associations played a decisive role in modern secondary education. Hence, I control for these lobby groups by using numbers on advocacy groups lobbying for science, economy, and education in 1839 (Gewerbeschule) and 1872 (Realschule). Other controls include administrational independence in 1830, 1871, 1896, and 1906, a dummy for the Bavarian Palatinate, an exclave lying west of the Rhine, the presence of Gymnasien in 1862, 1871 and 1906, and of savings banks in 1835.

Economic performance. Investments in schooling can be supposed to have a lagged effect on the economy. Therefore, I focus on measures capturing economic performance with a time lag. As outlined in section 1.2.1, the curricula of modern secondary schools focused on applied teaching of mathematics such as commercial arithmetic and modern languages; hence I adopt measures capturing

[24] Counties that set up a Gewerbeschule between 1836 and 1871 are: Dinkelsbühl (opened 1869; Keyser 1971, p. 158), Ingolstadt (opened 1858; Keyser 1971, p. 471), Kissingen (opened 1871; Keyser 1971, p. 82), Kitzingen (opened 1871; Keyser 1971, p. 82), Lindau (opened 1859; Keyser 1974, p. 349), Memmingen, Neuburg (opened 1859; Keyser 1971, p. 458), Neustadt a.d.H. (opened 1869; Keyser 1964, p. 317), Rothenburg (1865; Keyser 1874, p. 278), and Weiden (opened 1869; Keyser 1974, p. 729).

[25] In 1906/07 Munich had four and Nuremberg two Realschulen (*Minsterialblatt* 1906, pp. 21-2).

the trade business environment. Furthermore, the curricula included subjects that can be supposed to be beneficial for industrial occupations such as graphics, chemistry, and natural science; hence I also use measures of industrial performance.

In case of the Gewerbeschule I use four measures: the number of self-employed in industry and trade, expected tax revenues, the average number of businesses registrations per year, and the number of employees in services and industry. The average value of expected tax revenues (*Steuer-Soll*) between 1881 and 1884 stems from publications on the Bavarian state budget. These publications report expected tax revenues – i.e. direct state income taxes – per county (in Mark).[26] Direct taxes in 19th century Bavaria were taxes on land, houses, trade, capital, and income (Eheberg 1894, pp. 124-6). These taxes are good proxies for economic development.[27] The average number of new trade businesses per year is captured by taking the average difference between the number of registrations and closures within one year in one county (*Handelsgewerbebewegung*). I focus on the time period between 1869 and 1875. The data is taken from industrial censuses. The number of business registrations within one year provides information about the dynamics and quality of the business environment and hence is a proxy for economic performance of a county. The number of self-employed in 1871 and the data on employees in industry and services in 1882 is taken from occupational censuses. It can be supposed that the higher the number of people self-employed in industry and trade as well as people working in services and industry, the higher the industrial development of a county.

In case of the Realschule I use three measures:[28] the number of trade and industrial businesses, the number of employees in services and industry, and the average number of new patents. I concentrate on the number of existing businesses in 1907 in two main categories, i.e. trade and industry. I suppose that counties with a Realschule had more businesses and people employed in these sectors as modern secondary schools provided educational training required for these occupations. The data on businesses and employees is taken from the establishment census in 1907. As a final measure I employ the average number of newly granted patents between 1902 and 1913. I use the Baten/Streb patents database.[29] This database includes all patents granted between 1877 and 1918 by the German patent office that were economically valuable, indicated by the lifespan of a patent. Since patent holders had to pay annual renewal fees to maintain the patent, Streb et al. (2006, pp. 349-50) argue that a patentee would only do so if patenting provided economic benefits.[30]

[26] The available data only allows using expected instead of actual tax revenues. However, since these were reported on an annual basis it can be supposed that expected tax revenues would have been adjusted if previous expectations had not been met. Hence, they provide a good approximation of actual tax revenues.
[27] Tax revenues are a proxy for GDP commonly used in the literature.
[28] Note that due to data availability, it is not possible to use the same kind of economic measures to estimate the impact of the Gewerbeschule and Realschule.
[29] For details on the database, see Streb et al. (2006).
[30] See also Streb et al. (2007), Richter and Streb (2011), and Cinnirella and Streb (2013).

1.3.2 Propensity score matching

As Figures A1.1 to A1.4 show, Gewerbeschulen and Realschulen were opened in most instances in big, prosperous, and economically developed counties; this is especially true in case of the Gewerbeschule: the three largest Bavarian cities in population in 1840 – Munich, Landau (Bav. Palatinate), and Nuremberg – all opened a Gewerbeschule.[31] After all, it was the Bavarian King Ludwig I himself who demanded the opening of a Gewerbeschule in all big cities (Döllinger 1838, p. 1691). In case of the Realschule, Figure A1.3 implies a weaker relationship between economic development and population of a county and the opening of a Realschule by 1877. However, the difference in population between counties opening and not opening one in 1871 is still positive and significant on the 1 percent level.[32] According to the summary statistics given by Table A1.2, counties introducing modern secondary education were not only bigger in terms of population but also more likely to be administrational independent, making them a higher class of Bavarian cities. Furthermore, they housed a higher share of Protestants and military and counted more advocacy groups. In case of the Gewerbeschule this is not surprising since these schools were founded in cooperation with local trade and industrial associations, as outlined in section 1.2. It can be supposed that existence of these lobby groups is closely linked to economic prosperity of the respective region.

Therefore, the introduction of modern secondary education was presumably driven by endogenous factors (such as population size[33] and economic prosperity). Any OLS estimation not accounting for this endogeneity will lead to biased and inconsistent estimates. Here, endogeneity is likely to arise from two sources: reverse causality and omitted variables.

Reverse causality would imply that especially prosperous counties or cities opened a Gewerbeschule and/or later a Realschule. This is in line with Diebolt and Fontvieille (2001) who argue that in case of Germany and France, human capital investments prior to 1945 were a response to economic growth.[34] Omitted variables could comprise for example economic spirit. Counties with a population with a high interest in the economy would be more likely to have a business or industrial associations lobbying for their interests and hence more likely to adopt this new school type. Consequently, the adopted econometric specification in section 1.3.1 is not necessarily able to determine a causal relationship between economic performance and the introduction of the

[31] Gewerbeschulen were opened in counties with an average population of 35,966 vs. 18,023 in counties that not opened a Gewerbeschule by 1835. Thus, the difference between these two groups yielded by two-sample T-test amounts to 17,943 people and is significant on the 1%-level. See Table A1.2 for details.
[32] The difference in average population obtained by a two-sample T-test is -20,002, implying that counties with a Realschule in 1877 were on average significantly bigger in 1871 than counties without one. See Table A1.2 for details.
[33] In fact, population size, population density, and urbanization are frequently used in the literature as proxies for economic development. See for example Acemoglu et al. (2002).
[34] According to North and Thomas (1973, p. 2), education is not a cause of economic growth; it is growth itself.

Gewerbeschule. However, it implicates that there exists a positive correlation between these two variables.

An alternative econometric specification that can be adopted to estimate the economic effect of modern secondary education is propensity score matching as proposed by Rosenbaum and Rubin (1983). Propensity score matching uses observational characteristics to estimate the probability of treatment in terms of the propensity score (which is strictly between 0 and 1). Individuals are then matched according to their propensity scores and treatment effects can be estimated by comparing alike individuals – based on observable characteristics – with and without treatment. This approach enables estimation of treatment effects if treatment is not assigned randomly.

In case of the Gewerbeschule and Realschule this means that additional county characteristics prior to 'treatment' – i.e. opening of these schools – are needed. These characteristics – comprising for example city size, measures reflecting economic development, religion, number and type of existing schools, universities, public health sector, local business and industrial associations, and so on – help to predict the opening of a Gewerbeschule and/or Realschule. By accounting for these additional variables it is possible to circumvent the endogeneity associated with introduction of these schools and hence estimate a consistent effect on economic outcomes – under the assumption that these observables solely determine the endogeneity.

Several variables are used to predict the introduction of modern secondary education.[35] In case of the introduction of a Gewerbeschule by 1835, these are population structure in 1840 (including share of children, religious affiliations, and stationed military), administrational independence in 1830, geography (dummy variable for Bavarian Palatinate), advocacy groups for education and economy in 1839, economic development in 1840 (proxied by employment structure), and financial development in 1835 (proxied by the existence of a savings bank). Characteristics predicting the opening of a Realschule by 1896 include population structure in 1871 (religious affiliations and stationed military), administrational independence in 1871, geography (dummy variable for Bavarian Palatinate), advocacy groups for education, economy and science in 1872, economic development in 1871 (proxied by number of self-employed in trade and industry), and other schools in 1871 (Lateinschule and Gymnasium).

Propensity scores are then calculated using probit regressions based on respective county characteristics. Tables A1.3 and A1.4 in Appendix 1 list for each county the respective propensity scores for the introduction of the Gewerbeschule by 1835 and Realschule by 1896.

According to Table A1.3, the majority of counties have a relatively low probability of opening a Gewerbeschule. Except for Freising (which opened one despite having a low propensity score), Eichstaett and Germersheim (which both did not open one despite having a high score), the sample is

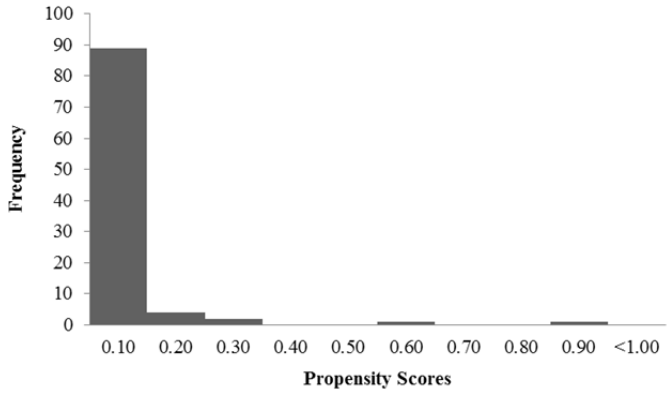
[35] Note that due to data availability, I have to use data that were in some instances collected some years after introduction of these schools.

divided into two kinds of counties: those with low propensity scores and no Gewerbeschule and those with high scores and a Gewerbeschule. Thus, calculated propensity scores confirm the prediction that the introduction of a Gewerbeschule was driven by endogenous factors.[36]

Propensity scores for the introduction of the Realschule in Table A1.4 are less divided between treated and non-treated counties: four counties with a propensity score less than 0.1 (i.e. Weilheim, Neumarkt, Kronach, and Wasserburg) opened a Realschule, whereas two counties with a score above 0.8 (i.e. Dillingen and Schwabach) did not open one. This implicates that introduction of a Realschule did not entirely depend on observable economic characteristics, which may be endogenous to the outcome considered. Thus, the introduction of the Realschule exhibits a higher degree of randomness than the introduction of the Gewerbeschule.

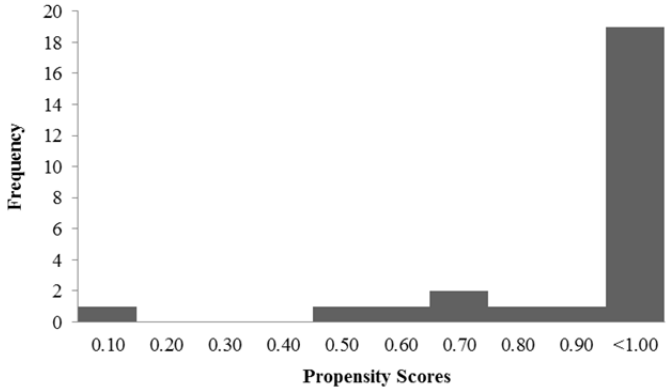
Figures 1.3 to 1.6 display corresponding histograms of the frequency distribution of the propensity scores for treated and control groups.

Figure 1.3 – Histogram propensity scores for counties without Gewerbeschule by 1835



Notes: Figure depicts propensity scores for counties without a Gewerbeschule by 1835.
Source: Own illustration; see Table A1.1 in Appendix 1 for data details.

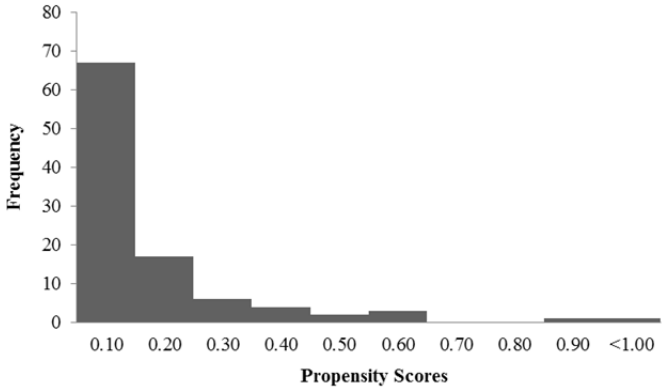
Figure 1.4 – Histogram propensity scores for counties with Gewerbeschule by 1835



Notes: Figure depicts propensity scores for counties with a Gewerbeschule by 1835.
Source: Own illustration; see Table A1.1 in Appendix 1 for data details.

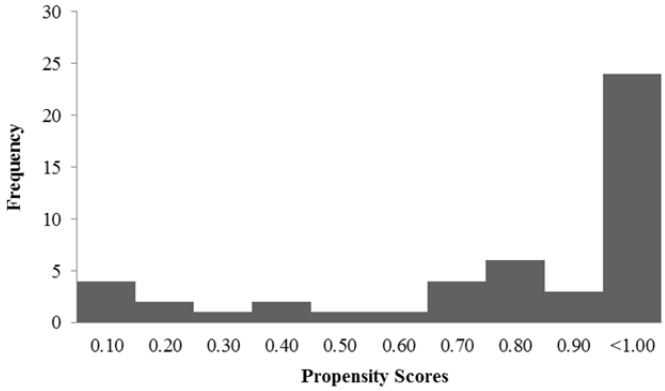
[36] Probit regression used to predict the introduction of a Gewerbeschule implicates that administrational independence and advocacy groups lobbying for education played a significant (positive) role in deciding whether a county opened this school or not.

Figure 1.5 – Histogram propensity scores for counties without Realschule by 1896



Notes: Figure depicts propensity scores for counties without a Realschule by 1896.
Source: Own illustration; see Table A1.1 in Appendix 1 for data details.

Figure 1.6 – Histogram propensity scores for counties with Realschule by 1896



Notes: Figure depicts propensity scores for counties with a Realschule by 1896.
Source: Own illustration; see Table A1.1 in Appendix 1 for data details.

According to Figures 1.3 and 1.4, there exists a considerable lack of overlap between control and treatment group in the Gewerbeschule sample. In case of the Realschule, Figures 1.5 and 1.6 indicate some – albeit very low – degree of overlap.

Hence, conducting traditional propensity score matching using matching methods does not seem feasible in this case.[37] Crump et al. (2009) suggest restricting samples with clear lack of overlap of propensity scores between treated and control groups from 0.1 to 0.9. In case of the Gewerbeschule, the number of observations would shrink to a mere 14 (6 treated). Therefore, I restrict the Gewerbeschule sample to counties with corresponding propensity scores between 0.01 and 0.9. The resulting sample then comprises 34 observations, with 7 of them treated (corresponding to all framed counties in Table A1.3). In case of the Realschule, I follow Crump et al. (2009) and restrict the sample

[37] In case of the Gewerbeschule and Realschule, propensity score matching still yields 6 balanced blocks indicating that there is no difference in controls and propensity scores between treated and control variables. However, the size of blocks differs from only 2 to 94 (Gewerbeschule) and 7 to 90 (Realschule) observations.

to observations with corresponding propensity scores between 0.1 and 0.9.[38] This yields a sample with 53 counties, with 20 of them treated (corresponding to all framed counties in Table A1.4).

1.4 Results

1.4.1 Economic impact of modern secondary education

The economic impact of the introduction of a Gewerbeschule in a county is presented by Table 1.8. In the first row, results for Panel A, i.e. an OLS regression – weighted by share of non-immigrants – without any control variables, are shown. The correlation of the Gewerbeschule with all dependent variables is significant on the 1 or 5 percent level: introduction of the Gewerbeschule by 1835 is associated with a higher share of the population self-employed in trade and industry in 1871 (columns 1 and 2), a higher share of the population working in services and industry in 1882 (columns 4 and 5), more expected tax revenues (column 3), and a higher average number of business registrations per capita 1869-1875 (column 6). Panel B includes geography (i.e. a dummy variable for counties in the Bavarian Palatinate), infrastructure (i.e. a dummy variable for administrational independence in 1871), and population structure in 1871 (columns 1, 2 and 6) and 1880 (columns 3, 4, and 5). Except for the coefficients on self-employed and business registrations, results stay significant. More variables controlling for Gymnasien in 1862 and advocacy groups in 1872 are added in Panel C. Hence, Panel C controls for the widest range of socio-economic factors – in fact potential endogenous factors themselves – in Table 1.8 and in all following regressions. Even if this wide set of controls is accounted for, the Gewerbeschule stays positively and significantly correlated with the share of population employed in services and industry as well as with tax revenues. This suggests that counties with a Gewerbeschule since 1835 are associated with a 0.8 and 3 percentage point higher share of the population employed in services and industry, respectively, and with 3 Marks more expected tax revenues per capita. However, these results are likely to be biased by endogeneity problems. I will deal with this problem below.

[38] Note that three observations (i.e. Hemau, Velburg, and Heilsbronn) will not be used in the subsequent empirical analyses due to the lack of data resulting from local government reorganizations. In 1880 Hemau and Velburg were merged to one county, i.e. Parsberg (Volkert 1983, p. 546) and Heilsbronn was dissolved (Volkert 1983, p. 480). All three counties are used in the calculation of propensity scores but are disregarded from subsequent regressions estimating economic effects after 1880.

Table 1.8 – Economic effect of the Gewerbeschule (introduction by 1835)

Dependent variable	% of self-employed in total population (1871) in		Expected tax revenues per capita (1881-4)	% of population employed (1882) in		Business registrations per 1,000 inhabitants (1869-75)
	Trade	Industry		Services	Industry	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: no controls						
Gewerbeschule by 1835	0.475***	1.195**	1.655***	1.782***	4.284***	0.278**
	[0.119]	[0.556]	[0.509]	[0.329]	[0.932]	[0.136]
Panel B: small set of controls						
Gewerbeschule by 1835	0.371	1.938	2.442*	0.716*	2.356***	0.022
	[0.263]	[1.170]	[1.426]	[0.375]	[0.891]	[0.131]
Panel C: large set of controls						
Gewerbeschule by 1835	0.533	2.605	3.150*	0.805**	2.917**	0.005
	[0.372]	[1.790]	[1.729]	[0.320]	[1.293]	[0.160]
Observations	123	123	121	121	121	123

Notes: Table reports OLS estimates, weighted by share of non-immigrants (1862-75) in total population (1871). Unit of observation is a county. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. Panel A includes no controls. Panel B includes geography (Bavarian Palatinate), administrational independence (1871), and population structure (i.e. population shares of Catholics, Protestants, Jews, and military) (1880) as controls. Panel C includes geography, administrational independence (1871), population structure (1880), Gymnasium (1862), and advocacy groups (1872) as controls.

Table 1.9 reports the estimated impact of the Realschule obtained by OLS, weighted by share of population born in municipality. The table follows the same structure as Table 1.8: Panel A includes no controls, Panel B adds geography (i.e. a dummy variable for Bavarian Palatinate), administrational independence in 1896, and population structure in 1905, and Panel C once again controls for the other type of secondary schooling, i.e. the Gymnasium (1906), as well as for advocacy groups in 1872, and the share of self-employed in trade and industry in 1871. First-row estimates of Panel A are once again positive and significant in almost all cases. For example, counties which opened a Realschule by 1896 are associated on average with 1.8 more trade businesses per 1,000 inhabitants, a 1.3 and 4.6 percentage point higher share of the population employed in services and industry, respectively, and 0.8 more patents per 100,000 inhabitants than counties without a Realschule. Significance and magnitude are hardly affected if population structure, advocacy groups and other factors are controlled for: estimates in Panel B and C stay in most cases significant. Hence, counties that introduced a Realschule between 1877 and 1896 are significantly associated with a higher population share employed in services and industry and a higher yearly number of new patents some ten to thirty years later, even when controlling for the widest range of socio-economic factors. As in case of the Gewerbeschule, effect sizes are quite substantial: while the average amount of newly granted patents per 100,000 inhabitants was 0.37 in all Bavarian counties from 1902-13 (Table A1.2 in Appendix 1), counties with a Realschule had 0.4 additional patents per 100,000 inhabitants compared to counties without modern secondary education. This finding is in line with the hypothesis that modern secondary education is associated with an industrialized workforce and higher innovativeness proxied by patent grants.

Table 1.9 – Economic effect of the Realschule (introduction between 1877 and 1896)

Dependent variable	Number of businesses per 1,000 inhabitants (1907) in		% of population employed (1907) in		New patents per 100,000 inhabitants (1902-13)
	Trade	Industry	Services	Industry	
	(1)	(2)	(3)	(4)	(5)
Panel A: no controls					
Realschule by 1896	1.783*	-2.359	1.312***	4.595***	0.783***
	[0.961]	[2.249]	[0.273]	[1.129]	[0.279]
Panel B: small set of controls					
Realschule by 1896	-0.740	-2.069	1.011***	2.801**	0.553**
	[1.166]	[2.923]	[0.384]	[1.404]	[0.225]
Panel C: large set of controls					
Realschule by 1896	-0.601	-1.958	0.831**	1.981*	0.400*
	[1.157]	[2.720]	[0.419]	[1.119]	[0.216]
Observations	146	146	146	146	146

Notes: Table reports OLS estimates, weighted by share of population born in municipality (1900). Unit of observation is a county. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. Panel A includes no controls. Panel B includes geography (Bavarian Palatinate), administrational independence (1896), and population (i.e. population shares of Catholics, Protestants, Jews, and military) (1905) as controls. Panel C includes geography, administrational independence (1905), population structure (1905), share of self-employed in trade and industry (1871), Gymnasium (1906), and advocacy groups (1872) as controls.

As outlined in section 1.3.2, simple OLS regressions based on the whole sample of counties may not be reliable since the opening of a modern secondary school in a county was probably driven by endogenous factors. This implies that any estimation based on the whole sample is comparing completely different kinds of counties. Thus, the following analysis approaches this problem by sample restriction via propensity scores.

1.4.2 Economic impact based on propensity score matching

OLS results based on restricted samples as outlined in section 1.3.2 are given in Table 1.10 for the Gewerbeschule and Table 1.11 for the Realschule. Note that these tables present economic effects of modern secondary education for comparable counties – based on propensity scores. Consequently, counties differ substantially only in terms of having opened a Gewerbeschule and/or Realschule or not.

Table 1.10 – Economic effect of the Gewerbeschule (introduction by 1835), restricted sample

Dependent variable	% of self-employed in total population (1871) in		Expected tax revenues per capita (1881-4)	% of population employed (1882) in		Business registrations per 1,000 inhabitants (1869-75)
	Trade	Industry		Services	Industry	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: no controls						
Gewerbeschule by 1835	0.145	0.0609	1.053***	0.657*	2.436*	0.418**
	[0.114]	[0.467]	[0.378]	[0.350]	[1.229]	[0.183]
Panel B: small set of controls						
Gewerbeschule by 1835	-0.0536	-0.0445	0.758	0.267	3.348**	0.0199
	[0.190]	[0.677]	[0.599]	[0.582]	[1.543]	[0.202]
Panel C: large set of controls						
Gewerbeschule by 1835	-0.0304	-0.516	0.315	0.407	3.447*	0.169
	[0.182]	[0.636]	[0.515]	[0.494]	[1.917]	[0.158]
Observations	34	34	34	34	34	34

Notes: Table reports OLS estimates, weighted by share of non-immigrants (1862-75) in total population (1871). Unit of observation is a county. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. Sample includes observations with propensity scores 0.01<pscore<0.9. Panel A includes no controls. Panel B includes geography (Bavarian Palatinate), administrational independence (1871), and population structure (i.e. population shares of Catholics, Protestants, Jews, and military) (1880) as controls. Panel C includes geography, administrational independence (1871), population structure (1880), Gymnasium (1862), and advocacy groups (1872) as controls.

Results of Panel A in Table 1.10 are once again positive and significant in columns 3-6: counties that opened a Gewerbeschule in 1835 are associated with more expected tax revenues between 1881 and 1884, a higher share of the population employed in services and industry in 1882, and a higher number of business openings between 1869 and 1875 than comparable counties without such a school. Estimates in Panel B and C successively controlling for more (potentially endogenous) variables, are in most cases statistically insignificant; only the share of population working in industrial professions remains significantly and positively associated with having a Gewerbeschule. This supports the hypothesis that the presence of a Gewerbeschule led to a higher share of the population working in the industrial sector.

Table 1.11 presents estimates of the economic effect of having opened a Realschule by 1896 based on comparable counties. Panel C now also controls for the existence of a Gewerbeschule to account for the fact that a long history of modern secondary education in a county might affect outcomes as well. Results obtained by this selected sample confirm previous findings: counties with a Realschule are significantly associated with a higher population share employed in industry even when controlling for a wide range of socioeconomic factors. Furthermore, the Realschule is once again associated with a higher degree of innovativeness several years later – as captured by patents grants. Results are even more significant than those obtained by the full sample.

Table 1.11 – Economic effect of the Realschule (introduction between 1877 and 1896), restricted sample

Dependent variable	Number of businesses per 1,000 inhabitants (1907) in		% of population employed (1907) in		New patents per 100,000 inhabitants (1902-13)
	Trade	Industry	Services	Industry	
	(1)	(2)	(3)	(4)	(5)
Panel A: no controls					
Realschule by 1896	0.410	4.783	0.827**	5.120***	0.402***
	[1.618]	[2.976]	[0.398]	[1.65]	[0.134]
Panel B: small set of controls					
Realschule by 1896	-1.966	4.814	1.050	5.545**	0.583***
	[1.889]	[4.114]	[0.628]	[2.081]	[0.213]
Panel C: large set of controls					
Realschule by 1896	1.006	8.549	1.125	5.931*	0.440***
	[3.855]	[7.712]	[0.785]	[3.317]	[0.157]
Observations	53	53	53	53	53

Notes: Table reports OLS estimates, weighted by share of population born in municipality (1900). Unit of observation is a county. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. Sample includes observations with propensity scores 0.1<pscore<0.9. Panel A includes no controls. Panel B includes geography (Bavarian Palatinate), administrational independence (1896), and population (i.e. population shares of Catholics, Protestants, Jews, and military) (1905) as controls. Panel C includes geography, administrational independence (1905), population structure (1905), share of self-employed in trade and industry (1871), Gymnasium (1906), Gewerbeschule (1871), and advocacy groups (1872) as controls.

As outlined in section 1.3.2, I restrict the samples based on propensity scores following Crump et al. (2009) who propose a sample restriction from 0.1 to 0.9. In case of the Gewerbeschule I depart from this approach since this restriction would shrink the sample size considerably. However, I use this cutoff as a robustness check for the results obtained for the restricted sample of the Gewerbeschule above.

Table 1.12 reports results of this further restricted sample consisting of six with and eight counties without a Gewerbeschule. Note that this sample includes only 14 observations. Since the inclusion of control variables would substantially reduce the degrees of freedom, only results obtained by Panel A are shown.

Table 1.12 – Robustness check: economic effect of the Gewerbeschule (introduction by 1835)

Dependent variable	% of self-employed in total population (1871) in		Expected tax revenues per capita (1881-4)	% of population employed (1882) in		Business registrations per 1,000 inhabitants (1869-75)
	Trade	Industry		Services	Industry	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: no controls						
Gewerbeschule by 1835	-0.075	-0.117	0.942*	0.534	3.103**	0.330
	[0.195]	[0.462]	[0.460]	[0.478]	[1.383]	[0.261]
Observations	14	14	14	14	14	14

Notes: Table reports OLS estimates, weighted by share of non-immigrants (1862-75) in total population (1871). Unit of observation is a county. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. Sample includes observations with propensity scores 0.1<pscore<0.9. Panel A includes no controls.

The positive significant effect of the Gewerbeschule on expected tax revenues and the share of population employed in industry are confirmed. However, the effect on business registrations and share of population working in services is no longer significant. Since the estimates do not change much in magnitude, this results mainly from increasing standard errors due to the smaller sample size.

All in all, comparing similar counties with and without modern secondary education confirms previous results obtained for the full sample: the effect of modern secondary education on innovation and the share of people employed in industry and services is highly significant. Hence, counties that introduced this new type of school increased their economic performance in the following years.

1.5 Conclusion

This paper analyzes the role of secondary education in economic development, thereby focusing on innovations taking place in the Bavarian schooling system during the 19th century. The introduction of the Gewerbeschule in 1829 and the Realschule in 1877 provide a unique opportunity to study this question in a historical context: polytechnic advocacy groups and the mercantile middle class lobbied for introduction of these schools claiming that the Gymnasium could not offer an education preparing for commercial and industrial occupations. The Gewerbeschule, and later the Realschule, were supposed to meet this demand by offering scientific-technical as well as general education.

Since the curricula of these schools focused on subjects training commercial and industrial skills, the empirical analysis employs county-level data on business formations, tax revenues, and people employed in services and industry, as well as the number of newly granted patents. Counties with are then compared to counties without modern secondary education in respect to these outcome measures capturing economic performance. Results obtained by OLS indicate that the opening of a Gewerbeschule in a county by 1835 is significantly associated with more expected tax revenues and with a higher population share employed in services and industry some 50 years later. In case of the Realschule, school counties are significantly associated with a higher number of new patents per

capita between 1902 and 1913 as well as a higher population share employed in services and industry in 1907. Using propensity score matching to deal with the underlying endogeneity of a school opening confirms these results: modern secondary education is associated with a higher share of the population employed in industry and a higher level of innovativeness several years after introduction. These results are robust to including a wide range of control variables. Hence, these findings indicate that graduates indeed chose industrial and trade related careers justifying empirically Kleinfeller's (1883) perception that the majority of modern secondary students started working in businesses and industrial occupations directly after graduation. Counties opening modern secondary education therefore forged ahead in economic terms.

This finding highlights the importance of education for economic development. Even though it is not possible to determine the exact channel through which modern secondary education might have influenced economic outcomes due to data limitations,[39] the empirical analysis reveals that there exists a link between economic performance of a county and the presence of a modern secondary school. Since 19th century Bavaria was still mainly an agrarian state, secondary education promoting industrial, commercial, and scientific knowledge might have not only influenced economic outcomes directly but may have also provided the basis needed to catch up to technologically advanced Prussia.

Besides effects on the economy, modern secondary education might have also affected social mobility. As the Gymnasium understood itself as an institution for the elite, the introduction of the Gewerbeschule and Realschule might have encouraged other social classes to also participate in secondary schooling.

Related to the issue of social mobility is whether modern secondary education increased private returns of schooling. As Kleinfeller (1883, pp. 101-4) argues, graduates were highly valued by the local business environment. In addition, education obtained at the Realschule/Gewerbeschule enabled former students to reach advanced occupational positions more easily. As Goldin (1998) and Goldin and Katz (2000) show for the United States, private returns to secondary education were substantial at the beginning of the 20th century: these amounted to 11 percent for males. Moreover, a High School degree enabled graduates to find employment in profitable, well-paid white collar jobs. Since the American High School with its emphasis on general academic as well as on vocational, commercial, technical, and industrial courses and its self-imposed aim "*to prepare students for life, rather than for college*" (Goldin 1998, p. 352) bore more resemblance to the Bavarian Gewerbeschule/Realschule than to the Gymnasium,[40] returns to Bavarian modern secondary education might have been

[39] For instance, it could well be that the presence of a modern secondary school itself attracted companies if these believed in the superior technical and commercial skills of graduates. Then the share of people working in industrial and service-related professions would increase due to the higher supply of jobs in these sectors.

[40] In fact, the American secondary schooling system in form of the High School underwent a substantial reform comparable to the Bavarian system imposed by the introduction of the Gewerbeschule. Around 1900 most secondary schools still taught a classical curriculum preparing students for college/university. Like in Bavaria, this school program was conceived as elitist and critics claimed that this education could not meet the demands

substantial as well. Therefore, the impact of modern secondary education on social mobility as well as on private returns of education provides an interesting field for future research.

imposed by the American industry. The curriculum was gradually reformed and courses such as chemistry, shorthand, and accounting were added to the curriculum on the cost of Latin, Greek, and rhetoric (Goldin 1999). An important difference between the American and Bavarian secondary schooling system is that the American High School was open to both genders.

Appendix 1

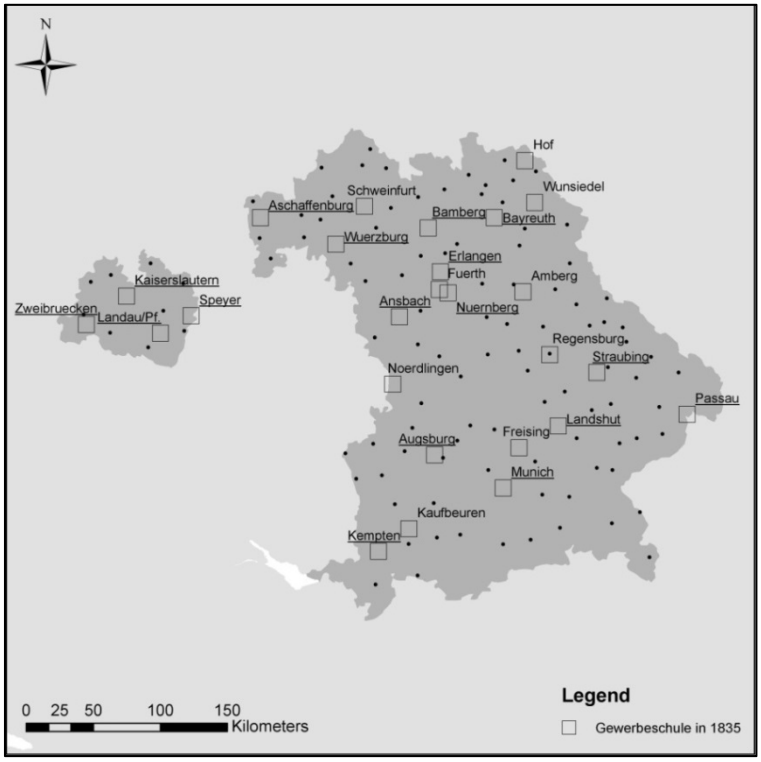
Table A1.1 – Data description and source

Variable	Description	Source
Schools		
Gewerbeschule by 1835	Binary, 1 if county opened a Gewerbeschule by 1835 indicated by receiving district funds and revenues by funds of former Bürgerschulen	Döllinger (1838)
Gewerbeschule in 1871	Binary, 1 if county is listed has having a Gewerbeschule	BSKB, XXVII: 1, 2 (1873)
Gymnasium in 1862, 1871, and 1906	Binary, 1 if county had a Gymnasium and/or Lateinschule/Progymnasium	BSKB, XIV (1866); BSKB, XXVII: 1, 2 (1873); *Ministerialblatt* (1906)
Realschule in 1878, 1896	Binary 1, if county opened a Realschule by 1896	*Ministerialblatt* (1877, 1896)
County characteristics		
Administrational independence	Binary, 1 if county was administrational independent (*kreisfrei*/*kreisunmittelbar*), i.e. city that fulfils certain governmental functions in ist jurisdiction (including a corresponding county) granted by the Bavarian state government	Keyser (1964, 1971) and Volkert (1983)
Bavarian Palatinate	Binary, 1 if county was located in the Bavarian Palatinate	Keyser (1964, 1971) and Volkert (1983)
Advocacy group in 1839, 1872	Three categories: science, education and economy; Binary, 1 if county has at least one advocacy group of the respective category	BSKB, XXX (1874)
Savings bank in 1835	Binary, 1 if county had a savings bank	BSKB, XXVI (1873)
Economic development in 1840	Number of people dependent on rents or industry divided by total population 1840	BSKB, I (1850)
Population in 1840, 1852, 1861, 1871, 1880, 1895, and 1905	Population of a county and respective population shares of Military, Catholics, Protestants and Jews	BSKB, I (1850); BSKB, XXVIII (1873); BSKB, XXXXVI (1883); BSKB, LXVIII (1906); BSB, 192 (1953)
Share of immigrants 1862-75	Number of immigrants between 1862-75 divided by total population 1871	BSKB, XXVIII (1873); BSKB, XXXIII (1878)
Share of population born in municipality in 1900	Number of people born in municipality 1900 divided by total population 1900	BSKB, LXIX (1912)
Economic outcomes		
Business registrations per capita 1869-75	Average number of new trade businesses per year obtained by taking the average difference between the number of registrations and closures within one year in one county (*Handelsgewerbebewegung*) between 1869 and 1875 divided by total population in 1871	ZKBSB, 12 (1880)
Expected tax revenues per capita 1881-4	Average value of expected tax revenues in Mark between 1881 and 1884 divided by total population 1880	ZKBSB, 15 (1883); BSKB, LV (1889)
Share of population self-employed in trade and industry in 1871	Number of people self-employed in trade or industry in 1871 divided by total population in 1871	BSKB, XXXIIII (1885)
Share of population employed in services and industry in 1882	Number of people employed in services or industry in 1882 divided by total population in 1880	BSKB, L (1886)
Number of trade and industrial businesses per capita in 1907	Number of trade or industrial businesses in 1907 divided by total population in 1905	BSKB, LXXXII (1911)
Granted patents per capita between 1902-13	Average number of newly granted patents that were economically valuable (indicated by lifespan of patent) between 1902 and 1913 divided by total population in 1905	Baten/Streb Patents Database. See Streb et al., (2006)

Table A1.2 – Summary statistics

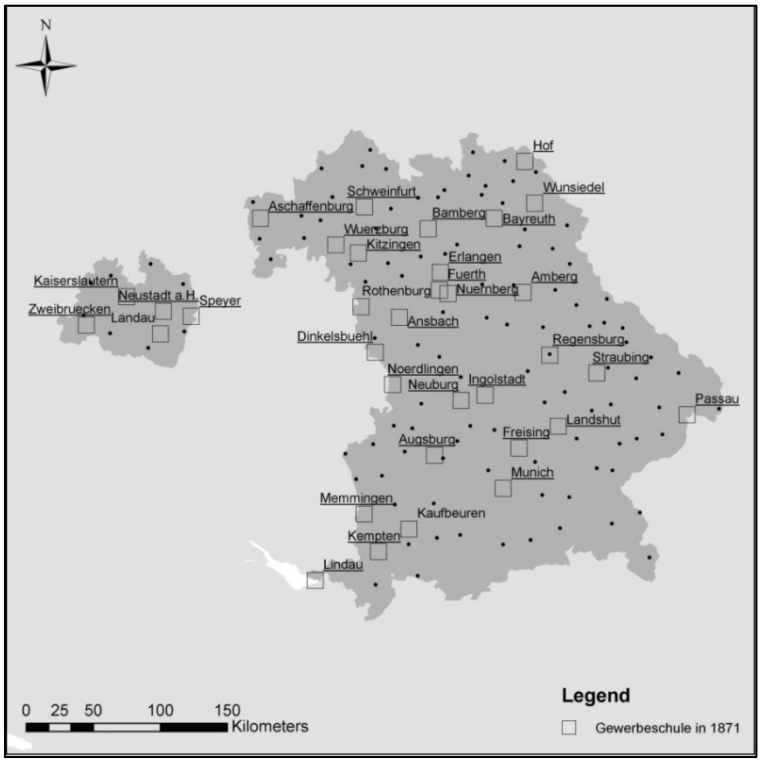
Variable						Counties by treatment status				
						No Modern sec. school		Modern sec. school		
	Obs.	Mean	Std. dev.	Min	Max	Mean	Std. dev.	Mean	Std. dev.	t-stat
Gewerbeschule Sample										
Schools										
Gewerbeschule by 1835	123	0.2114	0.4100	0	1	0	0	1	0	.
Gymnasium in 1862	123	0.1707	0.3778	0	1	0.0103	0.1015	0.7692	0.4297	-15.97
County characteristics										
Administrational independence in 1830	123	0.1707	0.3778	0	1	0.0103	0.1015	0.7692	0.4297	-15.97
Administrational independence in 1871	123	0.2033	0.4041	0	1	0.0412	0.1999	0.8077	0.4019	-13.61
Bavarian Palatinate	123	0.0894	0.2865	0	1	0.0722	0.2601	0.1538	0.3679	-1.29
Advocacy group science in 1839	123	0.1220	0.4166	0	2	0.0103	0.1015	0.5385	0.7606	-6.69
Advocacy group education youth in 1839	123	0.1220	0.3752	0	2	0.0206	0.1428	0.5000	0.6481	-6.76
Advocacy group economy in 1839	123	0.5772	0.7997	0	5	0.4948	0.6312	0.8846	1.2108	-2.24
Savings bank in 1835	123	0.2764	0.4491	0	1	0.1649	0.3731	0.6923	0.4707	-6.04
Population in 1840	123	21816	14275	4709	115073	18023	8036	35966	21963	-6.61
Share of military in total population in 1840	123	0.0108	0.0268	0	0.1217	0.0018	0.0090	0.0443	0.0412	-9.48
Share of Catholics in total population in 1840	123	0.7307	0.3425	0.0049	1	0.7832	0.3262	0.5346	0.3365	3.43
Share of Lutherans in total population in 1840	123	0.2372	0.3302	0	0.9950	0.1946	0.3135	0.3963	0.3481	-2.85
Share of kids in total population in 1840	123	0.2780	0.0379	0.1444	0.3704	0.2809	0.0357	0.2673	0.0442	1.63
Share of population dependent on industry in 1840	123	0.2596	0.1415	0.0118	0.9740	0.2259	0.1072	0.3855	0.1806	-5.74
Share of population dependent on rents in 1840	123	0.0535	0.0655	0.0010	0.6170	0.0392	0.0217	0.1069	0.1241	-5.14
Advocacy group science in 1872	123	0.5447	1.7238	0	12	0.0619	0.2421	2.3462	3.1615	-7.12
Advocacy group education youth in 1872	123	0.6016	1.1646	0	7	0.2990	0.6152	1.7308	1.8667	-6.42
Advocacy group economy in 1872	123	4.4390	5.5532	1	50	3.5361	3.2309	7.8077	9.7694	-3.66
Population in 1871	123	33900	24183	12982	239393	27782	8757	56721	43273	-6.19
Share of military in total population in 1871	123	0.0077	0.0083	0.0015	0.0488	0.0055	0.0059	0.0159	0.0107	-6.58
Share of Catholics in total population in 1871	123	0.7359	0.3300	0.0136	0.9971	0.7701	0.3131	0.6081	0.3650	2.26
Share of Lutherans in total population in 1871	123	0.2374	0.3199	0.0002	0.9802	0.2045	0.3016	0.3602	0.3605	-2.24
Share of Jews in total population in 1871	123	0.0089	0.0118	0	0.0681	0.0080	0.0107	0.0125	0.0152	-1.74
Population in 1880	121	37323	30630	13776	301494	28922	9002	68019	54319	-6.75
Share of military in total population in 1880	121	0.0052	0.0110	0.0000	0.0818	0.0029	0.0103	0.0135	0.0098	-4.70
Share of Catholics in total population in 1880	121	0.7540	0.3218	0.0176	0.9992	0.7952	0.3008	0.6034	0.3560	2.77
Share of Lutherans in total population in 1880	121	0.2367	0.3175	0.0007	0.9820	0.1974	0.2979	0.3803	0.3505	-2.67
Share of Jews in total population in 1880	121	0.0083	0.0109	0	0.0598	0.0068	0.0094	0.0136	0.0142	-2.93
Share of new immigrants between 1862-75 in total population 1871	123	0.0084	0.0164	0.0000	0.1320	0.0063	0.0154	0.0160	0.0182	-2.75
Economic outcomes										
% of population self-employed in trade in 1871	123	0.9403	0.4205	0.2417	3.4602	0.8394	0.2889	1.3170	0.5960	-5.79
% of population self-employed in industry in 1871	123	5.1833	2.0043	1.5742	17.542	4.9299	1.6974	6.1288	2.7132	-2.78
Expected tax revenues per capita 1881-4	121	4.1690	1.6350	1.0441	15.216	3.8121	1.0368	5.4732	2.5565	-5.03
% of population employed in services in 1882	121	2.6065	1.2808	1.1042	8.5597	2.2212	0.8157	4.0144	1.6572	-7.72
% of population employed in industry in 1882	121	10.6316	4.0047	4.1003	24.8171	9.70288	3.3120	14.0249	4.5261	-5.42
Business registrations per 1,000 inhabitants 1869-75	123	0.7392	0.6411	-0.3644	3.4488	0.6804	0.6395	0.9584	0.6098	-1.99
Realschule Sample										
Schools										
Realschule by 1896	149	0.3221	0.4689	0	1	0	0	1	0	.
Gewerbeschule in 1871	149	0.2349	0.4254	0	1	0	0	0.7292	0.4491	-16.38
Gymnasium in 1871	149	0.3960	0.4907	0	1	0.1980	0.4005	0.8125	0.3944	-8.79
Gymnasium in 1906	146	0.3425	0.4762	0	1	0.1531	0.3619	0.7292	0.4491	-8.33
County characteristics										
Administrational independence in 1871	149	0.2282	0.4211	0	1	0.0297	0.1706	0.6458	0.4833	-11.43
Administrational independence in 1896	149	0.2752	0.4481	0	1	0.0594	0.2376	0.7292	0.4491	-11.91
Administrational independence in 1905	149	0.2752	0.4481	0	1	0.0594	0.2376	0.7292	0.4491	-11.91
Bavarian Palatinate	149	0.0872	0.2832	0	1	0.0693	0.2552	0.1250	0.3342	-1.12
Advocacy group science in 1872	149	0.5101	1.5965	0	12	0.0495	0.2180	1.4792	2.5515	-5.61
Advocacy group education in 1872	149	0.5705	1.1405	0	7	0.2475	0.5178	1.2500	1.6822	-5.48
Advocacy group economy in 1872	149	4.1275	5.1390	1	50	3.3366	3.1883	5.7917	7.5736	-2.79
Population in 1871	149	32896	22622	9905	239393	26453	8355	46455	34439	-5.52
Share of military in total population in 1871	149	0.0084	0.0133	0.0014	0.1351	0.0051	0.0056	0.0154	0.0204	-4.70
Share of Catholics in total population in 1871	149	0.7237	0.3276	0.0136	0.9971	0.7746	0.3067	0.6165	0.3473	2.82
Share of Lutherans in total population in 1871	149	0.2552	0.3249	0.0002	0.9802	0.2085	0.3050	0.3534	0.3462	-2.59
Share of Jews in total population in 1871	149	0.0088	0.0117	0	0.0681	0.0077	0.0104	0.0111	0.0137	-1.69
Share of population self-employed in trade in 1871	149	0.0092	0.0034	0.0036	0.0221	0.0083	0.0029	0.0109	0.0036	-4.64
Share of population self-employed in industry in 1871	149	0.0513	0.0164	0.0262	0.1348	0.0495	0.0171	0.0550	0.0144	-1.93
Share of population born in municipality 1900	149	0.7589	0.1064	0.3783	0.9132	0.8003	0.0696	0.6734	0.1184	8.14
Population in 1905	146	44164	55729	13017	584841	29324	10148	74463	89286	-4.96
Share of military in total population in 1905	146	0.0060	0.0152	0	0.1056	0.0012	0.0059	0.0157	0.0223	-6.03
Share of Catholics in total population in 1905	146	0.7416	0.3129	0.0227	0.9983	0.7980	0.2899	0.6265	0.3291	3.21
Share of Protestants in total population in 1895	146	0.2488	0.3101	0.0013	0.9766	0.1963	0.2878	0.3561	0.3288	-3.01
Share of Jews in total population in 1895	146	0.0061	0.0078	0	0.0326	0.0050	0.0071	0.0083	0.0086	-2.48
Economic outcomes										
Trade businesses per 1,000 inhabitants in 1907	146	28.2942	5.5669	16.8552	51.1163	27.6984	5.4286	29.5107	5.7041	-1.86
Industrial businesses per 1,000 inhabitants in 1907	146	47.0611	13.8123	29.3171	138.4483	47.8100	14.8975	45.5321	11.2687	0.94
% of population employed in services in 1907	146	4.0902	1.7468	2.1704	14.8599	3.6199	1.5046	5.0506	1.8271	-5.02
% of population employed in industry in 1907	146	12.7891	6.3352	4.5204	34.8047	11.1582	10.1174	16.1188	14.0384	-4.77
Newly granted patents per 100,000 inhabitants 1902-13	146	0.3716	1.2321	0	11.95518	0.0952	0.4225	0.9361	1.9571	-4.08

Figure A1.1 – Gewerbeschulen in 1835



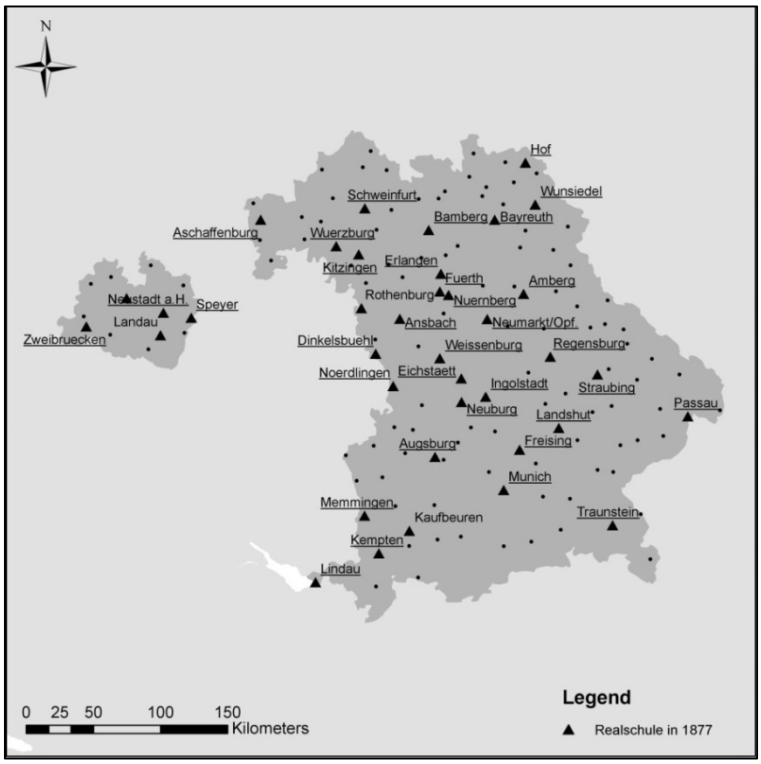
Notes: Counties with a Gewerbeschule in 1835 are indicated by a square. Population exceeds 25,000 in 1840 if county name is underlined. Counties in the control group are indicated by a dot (without a name).
Source: Own illustration; see Table A1.2 for data details.

Figure A1.2 – Gewerbeschulen in 1871



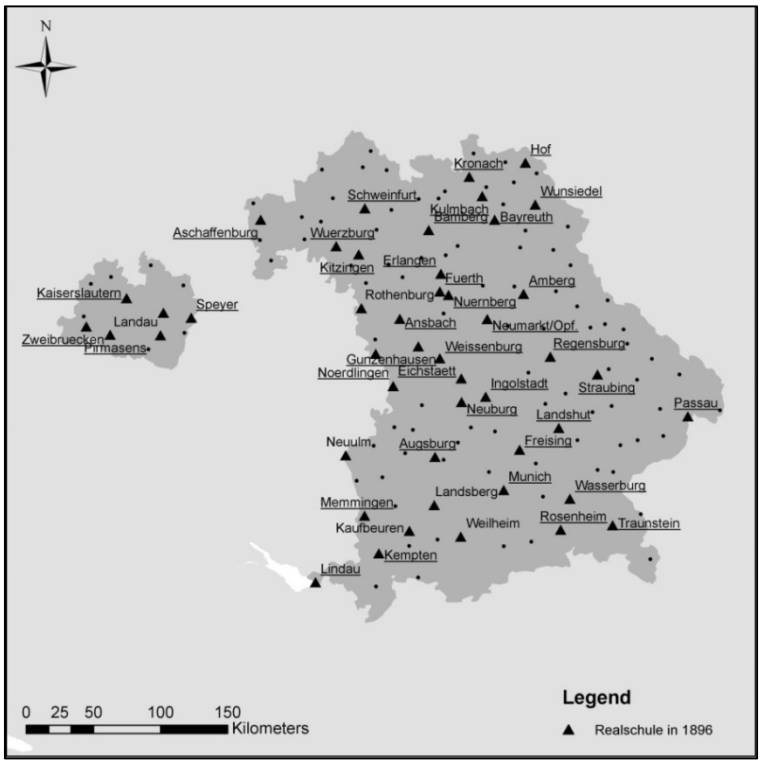
Notes: Counties with Gewerbeschule in 1871 are indicated by a square. Population exceeds 25,000 in 1871 if county name is underlined. Counties in the control group are indicated by a dot (without a name).
Source: Own illustration; see Table A1.2 for data details.

Figure A1.3 – Realschulen in 1877



Notes: Counties with Realschule in 1877 are indicated by a triangle. Population exceeds 25,000 in 1871 if county name is underlined. Counties in the control group are indicated by a dot (without a name).
Source: Own illustration; see Table A1.2 for data details.

Figure A1.4 – Realschulen in 1896



Notes: Counties with Realschule in 1896 are indicated by a triangle. Population exceeds 25,000 in 1871 if county name is underlined. Counties in the control group are indicated by a dot (without a name).
Source: Own illustration; see Table A1.2 for data details.

Table A1.3 – Propensity scores 'Introduction of Gewerbeschule by 1835'

County	*Prop. Score*	*Gew 1835*	*County*	*Prop. Score*	*Gew 1835*	*County*	*Prop. Score*	*Gew 1835*	*County*	*Prop. Score*	*Gew 1835*
Kusel	0.00000000	0	Obernburg	0.00024650	0	Stadtamhof	0.00564882	0	Kaiserslautern	0.45123668	1
Feuchtwangen	0.00000000	0	Beilngries	0.00027400	0	Vilsbiburg	0.00577924	0	Speyer	0.50481166	1
Neuulm	0.00000000	0	Gerolzhofen	0.00034069	0	Aichach	0.00600040	0	Germersheim	0.54654626	0
Ebermannstadt	0.00000001	0	Waldmuenchen	0.00040183	0	Friedberg	0.00776956	0	Kaufbeuern	0.62904575	1
Marktheidenfeld	0.00000002	0	Kehlheim	0.00049445	0	Deggendorf	0.00863467	0	Zweibruecken	0.69628186	1
Gunzenhausen	0.00000022	0	Neumarkt	0.00058634	0	Burglengenfeld	0.00967336	0	Kempten	0.74032060	1
Sulzbach	0.00000034	0	Wolfstein	0.00059623	0	Freising	0.01477972	1	Eichstaett	0.88158090	0
Ebern	0.00000046	0	Brueckenau	0.00067487	0	Dachau	0.01750575	0	Landshut	0.88891534	1
Forchheim	0.00000063	0	Grafenau	0.00067813	0	Wertingen	0.01894067	0	Wunsiedel	0.91672999	1
Uffenheim	0.00000169	0	Viechtach	0.00072822	0	Dingolfing	0.01923297	0	Straubing	0.92553182	1
Hersbruck	0.00000408	0	Bogen	0.00072924	0	Landau	0.02194617	0	Schweinfurt	0.95781309	1
Karlstadt	0.00000415	0	Hassfurt	0.00077826	0	Eschenbach	0.02534069	0	Amberg	0.96671162	1
Ochsenfurt	0.00000490	0	Altoetting	0.00114377	0	Regen	0.02661892	0	Landau (Bav. Pal.)	0.96719291	1
Mellrichstadt	0.00000515	0	Hammelburg	0.00116846	0	Traunstein	0.02669352	0	Aschaffenburg	0.98747685	1
Pfarrkirchen	0.00000661	0	Ebersberg	0.00118243	0	Illertissen	0.03019956	0	Hof	0.98778477	1
Kulmbach	0.00000942	0	Wasserburg	0.00118968	0	Miltenberg	0.03933754	0	Noerdlingen	0.99541633	1
Hoechstadt	0.00000984	0	Rottenburg	0.00172130	0	Cham	0.03977072	0	Ansbach	0.99641537	1
Miesbach	0.00001182	0	Koetzting	0.00204177	0	Kemnath	0.04152793	0	Fuerth	0.99777476	1
Toelz	0.00001293	0	Neustadt a.d.S.	0.00226500	0	Krumbach	0.05214097	0	Erlangen	0.99912691	1
Tirschenreuth	0.00001389	0	Stadtsteinach	0.00236657	0	Muenchberg	0.05295977	0	Bayreuth	0.99999642	1
Koenigshofen	0.00001612	0	Eggenfelden	0.00243651	0	Vilshofen	0.05300396	0	Passau	0.99999979	1
Fuessen	0.00002224	0	Roding	0.00298765	0	Weissenburg	0.07056789	0	Regensburg	0.99999982	1
Griesbach	0.00002285	0	Laufen	0.00301985	0	Landsberg	0.07376489	0	Augsburg	1	1
Alzenau	0.00003884	0	Muehldorf	0.00308007	0	Kronach	0.08393671	0	Nuernberg	1	1
Heilsbronn	0.00005147	0	Rosenheim	0.00318161	0	Primasens	0.08396556	0	Wuerzburg	1	1
Nabburg	0.00009205	0	Neunburg v./W.	0.00338780	0	Vohenstrauss	0.08852760	0	Bamberg	1	1
Donauwoerth	0.00010729	0	Weilheim	0.00343122	0	Guenzburg	0.11446692	0	Munich	1	1
Sonthofen	0.00011284	0	Pfaffenhofen	0.00345250	0	Mindelheim	0.11967273	0			
Berneck	0.00016717	0	Erding	0.00364939	0	Lichtenfels	0.12169397	0			
Lohr	0.00019007	0	Schongau	0.00394871	0	Bergzabern	0.16355072	0			
Schrobenhausen	0.00021281	0	Naila	0.00541374	0	Kirchheimbolanden	0.25738320	0			
Hemau	0.00023576	0	Rehau	0.00556483	0	Frankenthal	0.28293294	0			

Notes: Table reports propensity scores predicting the introduction of a Gewerbeschule by 1835 using probit regression based on population structure (i.e. total population and population shares of kids, Catholics, Protestants, and military) (1840), administrational independence (1830), geography (Bavarian Palatinate), economic development (1840), advocacy groups (1839), and financial development (1835). Propensity scores lie strictly between 0 and 1; depicted propensity scores are rounded to 8 decimal figures. Framed counties with propensity scores 0.01-0.9 will be used in the restricted sample.

Table A1.4 – Propensity scores 'Introduction of Realschule by 1896'

County	*Prop. Score*	*Real 1896*	*County*	*Prop. Score*	*Real 1896*	*County*	*Prop. Score*	*Real 1896*	*County*	*Prop. Score*	*Real 1896*	*County*	*Prop. Score*	*Real 1896*
Mellrichstadt	0.00400615	0	Kemnath	0.03639299	0	Tirschenreuth	0.08093628	0	Bergzabern	0.28549440	0	Freising[a]	0.96877014	1
Ebern	0.01247398	0	Muenchberg	0.03669276	0	Neunburg v.W.	0.08328640	0	Kelheim	0.30327481	0	Fuerth[a]	0.97370412	1
Brueckenau	0.01346932	0	Ochsenfurt	0.03803134	0	Wasserburg	0.08742052	1	Guenzburg	0.30594024	0	Speyer[a]	0.97557420	1
Wertingen	0.01497947	0	Obernburg	0.03837936	0	Berneck	0.08800818	0	Aichach	0.36744534	0	Straubing[a]	0.98338305	1
Toelz	0.01632981	0	Koetzting	0.03877813	0	Naila	0.08829156	0	Kulmbach	0.36964623	1	Ingolstadt[a]	0.98383820	1
Zusmarshausen	0.01750079	0	Ebersberg	0.03921243	0	Hemau	0.08990417	0	Kirchheimbolanden	0.37173112	0	Aschaffenburg[a]	0.98827584	1
Werdenfels	0.01754602	0	Cham	0.03956050	0	Lichtenfels	0.09304304	0	Traunstein[a]	0.39196065	1	Kempten[a]	0.99554556	1
Fuessen	0.01788620	0	Gerolzhofen	0.03966480	0	Neuulm	0.10033038	1	Germersheim	0.43324553	0	Landshut[a]	0.99948648	1
Ebermannstadt	0.01811158	0	Wolfstein	0.04121859	0	Erding	0.10386019	0	Landau (Bav. Pal.)[a]	0.44827737	1	Schweinfurt[a]	0.99957825	1
Krumbach	0.01837520	0	Bruck	0.04155280	0	Deggendorf	0.10504537	0	Mindelheim	0.45119751	0	Memmingen[a]	0.99963047	1
Grafenau	0.01879839	0	Beilngries	0.04271261	0	Vilshofen	0.10575927	0	Sonthofen	0.54060338	0	Ansbach[a]	0.99974722	1
Alzenau	0.02136045	0	Eschenbach	0.04326968	0	Vilsbiburg	0.10859287	0	Pirmasens	0.55205020	1	Passau[a]	0.99997742	1
Weilheim	0.02251629	1	Neustadt a.d.S.	0.04535725	0	Marktheidenfeld	0.11001622	0	Donauwoerth	0.55800974	0	Erlangen[a]	0.99999945	1
Oberdorf	0.02360980	0	Koenigshofen	0.04624243	0	Landau	0.11066212	0	Uffenheim	0.57625022	0	Neustadt a.H.[a]	0.99999986	1
Staffelstein	0.02404579	0	Velburg	0.04728804	0	Lohr	0.11636461	0	Landsberg	0.60286253	1	Bayreuth[a]	0.99999990	1
Berchtesgaden	0.02423028	0	Illertissen	0.04737809	0	Forchheim	0.12432965	0	Zweibruecken[a]	0.63993599	1	Regensburg[a]	1	1
Waldmuenchen	0.02540181	0	Hoechstadt	0.05197634	0	Muehldorf	0.13092165	0	Kaiserslautern[a]	0.64551591	1	Bamberg[a]	1	1
Dingolfing	0.02543323	0	Laufen	0.05394744	0	Homburg	0.13867600	0	Rothenburg[a]	0.67425086	1	Nuremberg[a]	1	1
Nabburg	0.02637948	0	Vohenstrauss	0.05482266	0	Griesbach	0.13917025	0	Wunsiedel[a]	0.72188473	1	Munich[a]	1	1
Schongau	0.02664647	0	Hassfurt	0.05859604	0	Scheinfeld	0.14116578	0	Weissenburg[a]	0.72605179	1	Wuerzburg[a]	1	1
Viechtach	0.02738445	0	Stadtsteinach	0.05897864	0	Pegnitz	0.14761744	0	Eichstaett[a]	0.74822489	1	Augsburg[a]	1	1
Schrobenhausen	0.02764558	0	Bogen	0.06111553	0	Hammelburg	0.16146656	0	Rosenheim	0.74833617	1			
Wegscheid	0.02833802	0	Neustadt (W.N.)	0.06157970	0	Gunzenhausen	0.17230658	1	Lindau[a]	0.74992834	1			
Karlstadt	0.02983291	0	Mallersdorf	0.06420841	0	Frankenthal	0.17730049	0	Kaufbeuren[a]	0.76487790	1			
Dachau	0.03106451	0	Stadtamhof	0.06649176	0	Feuchtwangen	0.18616549	0	Dinkelsbuehl[a]	0.81085477	1			
Miesbach	0.03193912	0	Pfarrkirchen	0.06680886	0	Rottenburg	0.19097096	0	Amberg[a]	0.83758968	1			
Friedberg	0.03300051	0	Kronach	0.06703092	1	Miltenberg	0.22035489	0	Dillingen	0.84839902	0			
Heilsbronn	0.03460483	0	Pfaffenhofen	0.06938805	0	Kusel	0.22200859	0	Kitzingen[a]	0.86979060	1			
Teuschnitz	0.03519672	0	Rehau	0.07390821	0	Neustadt a.A.	0.25186034	0	Neuburg[a]	0.91023330	1			
Roding	0.03568193	0	Neumarkt/Opf.	0.07441592	1	Kissingen[a]	0.25570521	1	Schwabach	0.91646409	0			
Burglengenfeld	0.03569828	0	Eggenfelden	0.07520850	0	Hersbruck	0.26591032	0	Noerdlingen[a]	0.92028545	1			
Regen	0.03626350	0	Sulzbach	0.07645861	0	Altoetting	0.28436290	0	Hof[a]	0.93726518	1			

Notes: Table reports propensity scores predicting the introduction of a Realschule by 1896 using probit regression based on population structure (i.e. total population and population shares of Catholics, Protestants, Jews, and military) (1871), administrational independence (1871), geography (Bavarian Palatinate), economic development (1871), advocacy groups (1872), and traditional schools (i.e. Lateinschulen and/or Gymnasien) (1871). Propensity scores lie strictly between 0 and 1; depicted propensity scores are rounded to 8 decimal figures. Framed counties with propensity scores 0.1-0.9 will be used in the restricted sample.
[a] Realschule in 1877.

Chapter 2

Educational expansion and social composition of secondary schools: evidence from Bavarian school registries 1810-90

2.1 Introduction

Education plays an important role in studies on social mobility since it can serve as a mediating device between an individuals' social background and the social class she will reach during her life time. The expansion of education may then not only change the social composition in schools, but also help to improve the chances of social mobility for underprivileged parts of society.

In fact, 19th century Bavaria experienced a substantial degree of educational expansion: in less than 90 years, the share of secondary students in total population increased more than tenfold. Although much of this increase was demand-driven, it can also be ascribed to the introduction of a new form of secondary schooling, i.e. the Gewerbeschule, in 1829, which was later replaced by the Realschule. Both schools were supposed to provide an alternative to the humanist Gymnasium – the predominant type of secondary education. While the curriculum of the Gymnasium focused on the classics and liberal arts, the focus of the Gewerbeschule/Realschule was on modern languages, applied mathematics, and natural sciences. Hence, its introduction was greatly welcomed by trade and industrial organizations as well as by the commercial and industrial middle class. Since the Gymnasium understood itself as an institution for the elite, the introduction of an applied alternative form of secondary education can be supposed to have encouraged educational participation of the remaining social classes, particularly the middle class.

In this context, the following questions arise: did expansion of secondary education in 19th century Bavaria (1) lead to changes in the association between social class and educational attainment, in particular after the introduction of the Gewerbeschule; (2) weaken the link between social class of origin (father's occupation) and class of destination (son's occupation) and thus increase social mobility? To answer these questions, annual school reports of Bavarian secondary schools throughout the 19th century are employed. These reports provide information on the social background of students by including the father's occupation. In order to allocate occupational titles into social classes and

obtain a dataset that is consistent across time (1810-90) and space (Bavarian regions), this paper adopts the HISCO/HISCLASS system (van Leeuwen and Maas 2011; van Leeuwen et al. 2002). While the analysis of school registries based on HISCO/HISCLASS yields profound insights into the relationship between social class and education, the role of education in social mobility is explored by employing related studies on occupational careers of graduates. Results indicate that the Gymnasium became less elitist until the introduction of the Gewerbeschule; however, once this applied form of secondary education had been introduced, especially artisanal middle class children began to select into the Gewerbeschule/Realschule whereas higher classes chose the Gymnasium. Throughout the 19th century, there is no indication that expansion of secondary education increased participation of lower social classes. However, the chances of social mobility especially for children of lower classes attending a Gymnasium were high since a degree of this institution enabled entry into civil service positions. But also the Gewerbeschule/Realschule provided the possibility of social advancement, as a related study on the background of entrepreneurs and industrialist reveals (Kaelble 1973).

The literature on the importance of education and its expansion for economic growth is vast, both for current and past societies.[1] This is also the case for research on intergenerational mobility[2] and the role of education in mediating the relationship between social origin and social destination.[3] For example, models on the transmission of earnings between parents and children in the spirit of Becker and Tomes (1986) emphasize the role of government spending on education for the degree of intergenerational mobility. However, according to Iyigun (1999) public investments in education have to be large enough to outweigh the positive impact of educated parents on educational attainment of children. On the empirical side, international comparative studies reveal that educational attainment is highly dependent on social background[4] and academic credentials for class allocation become more important the more bureaucratic the state is (Ishida et al. 1995; Müller et al. 1989). Both links were especially pronounced in 20th century Germany which Müller et al. (1989, p. 25) claim to be a result of "*its early selection procedures, its class-bound three-tier system, and its historically deeply-rooted links between the educational system and the class system*". Furthermore, studies on German

[1] See for example Easterlin (1981) or the studies by Goldin (1999), Goldin and Katz (2000), and Parman (2011) on the expansion of the American High School at the beginning of the 20th century. In respect to human capital inequality, Crayen and Baten (2010) show that lower inequality in numeracy increased economic growth in the US towards the end of the 19th century.

[2] Solon (1999) and Black and Devereux (2011) provide an extensive overview on the intergenerational mobility literature. Historical studies on intergenerational mobility have traditionally focused on vital registers such as marriage records. See for example van Leeuwen and Maas (2010) for an overview or Miles and Vincent (1993) for a European comparison. An exception is the recent study by Long (2013) who is able to link British census data across the second half of the 19th century. His analysis reveals that both inter- and intragenerational mobility was surprisingly high in Victorian Britain.

[3] This is known as the 'OED triangle': O (social origin) influences E (educational attainment) which in turn determines D (social destination). The direct impact of O on D – which remains and is not mediated through E – completes the triangle (Goldthorpe 2014).

[4] A recent historical contribution is provided by Paik (2014). In analyzing Korean exam and census data he finds that that educational attainment in 1985 and 2000 is positively influenced by the social status of an individual's ancestors living between 1392 and 1897.

educational expansion during the 20th and early 21st century show that even though overall participation increased, class-specific inequality in the transition to upper secondary education (Gymnasium) and to university education persisted (Becker 2003; Blossfeld 1993).[5] Hence, the role of education in social mobility in the course of the 20th/21st century has been extensively investigated primarily by sociologists.[6] However, studies for earlier periods focusing on the historical role of educational expansion on social mobility in Germany and also other countries are less abundant. The studies of Ringer (1980) for Germany and Rauscher (2015) for the U.S. provide valuable exceptions. Ringer (1980) studies the social composition and intended careers of students in Prussian secondary education during the final decades of the 19th century. According to his findings, the Gymnasium enabled social mobility through preparation for academic careers and civil service positions. Rauscher (2015) focuses on primary educational expansion induced by the introduction of compulsory schooling laws between 1852 and 1918 in the U.S. Her results show that these laws raised school attendance rates, thereby leading to a higher proportion of skilled and non-manual occupations and consequently enhanced social mobility.

By increasing the chances of social mobility, educational expansion might have also contributed to a more equal distribution of incomes. Starting with the seminal work by Kuznets (1955),[7] a growing number of empirical studies has revealed that especially the early 20th century experienced a rapid decline in income inequality.[8] In Germany, the corresponding drop was most severe after WWI (Atkinson et al. 2011), and thus followed educational expansion of the 19th century. Indeed, various theoretical and empirical analyses stress the importance of an equal distribution of educational opportunity and attainment in the population for reducing income inequality.[9]

Hence, this paper complements the research on the association between social background and educational attainment in the 19th century and further relates it to social mobility. Although this paper is not the first one to employ data provided by annual school reports in order to study the social composition of students, it provides the first comprehensive investigation into the social composition of Bavarian secondary schooling throughout the 19th century.[10] In contrast to other studies focusing

[5] This conclusion is challenged by studies revealing decreasing class differentials in educational attainment through the course of the 20th century in Germany. See for example Jonsson et al. (1996) and Müller and Haun (1994).

[6] See Breen and Jonsson (2005) for a review of sociological studies on education and social mobility.

[7] According to Kuznets, income inequality follows an inverse U-shaped curve during the course of economic development (Kuznets 1955).

[8] See Piketty and Saez (2014) for a review on income and wealth inequality in Europe and the U.S.

[9] For example, Becker and Chiswick (1966) find that in the U.S. of the 1960s income inequality tended to rise with schooling inequality but fell with the average level of education. Sylwester (2002) shows that countries with higher public education expenditures in the 1960s were associated with lower levels of income inequality in subsequent years. See also Psacharopoulos (1977) or De Gregorio and Lee (2002) for further cross-country analyses, among others. For a theoretical model on the relationship between education and income inequality, see for example Saint-Paul and Verdier (1993).

[10] These studies usually focus on one single institution. See for example, Kraul (1976) who focuses on the Gymnasium Minden 1822-1847 or Müller (1975) who studies reports of Munich's oldest Gymnasium at the end

only on occupational background of students, this analysis adopts sociological methods to obtain a profound picture of the relationship between social class and educational attainment.

The remainder of the paper proceeds as follows: Section 2.2 provides a brief overview on the Bavarian secondary schooling system during the 19th century. Section 2.3 explains how occupational data from annual school records is coded in order to allocate students into a coherent social class scheme. Section 2.5 presents the results on the link between students' social class and their participation in secondary schooling, followed by a discussion on the implications of education and educational inequality for social mobility. Section 2.7 concludes.

2.2 Historical background: Bavarian secondary education[11]

Up to 1833, the Bavarian secondary schooling system consisted of one institution, i.e. the (humanist) Gymnasium. This school type has a long history in Germany reaching back to 1526 when the first Gymnasium was opened in the Bavarian city of Nuremberg (Keyser 1971, p. 412). The purpose of the Gymnasium was to prepare children for university studies by providing general, religious, and moral education (*Ministerialblatt* 1874, p. 327). Correspondingly, the curriculum of the Gymnasium focused on classical languages (i.e. Old Greek and Latin), the liberal arts, and an abstract teaching of mathematics. Hence, a widespread point of criticism concerned the absence of practical subjects in the curriculum. According to general perception, the Gymnasium was an elitist institution unable to prepare students for commercial or industrial professions (Stocker 1911, p. 4).[12] An increasing number of critics consisting for example of industrial and mercantile representatives, polytechnic, industrial, and agricultural associations began to lobby for the introduction of a 'modern' form of secondary education (Buchinger 1983, pp. 93-112; Hamann 1993, pp. 95-6; Ringer 1967, p. 128).

Finally, in 1829, Bavarian King Ludwig imposed a structural and substantial reform of the Bavarian schooling system by introducing a new kind of secondary school, i.e. the Gewerbeschule[13] (Döllinger 1838, p. 1691). This school type was supposed to provide an alternative to the Gymnasium by teaching so-called realistic or practical subjects, i.e. modern languages such as French and English, applied mathematics such as commercial arithmetic, and natural sciences. In 1833 the first Gewerbeschulen were founded in several Bavarian cities. These new schools enjoyed increasing popularity and by 1877 there existed 40 Gewerbeschulen all over Bavaria. In 1877, all Gewerbeschulen ware transformed into Realschulen. Hence, after 1833 modern secondary education in form of the Gewerbeschule and later Realschule provided an alternative in secondary education to

of the 18th century. Stocker (1911) provides the most comprehensive of these analyses by focusing not only on one but on all Bavarian secondary institutions in 1910.

[11] See Semrad (2015) for a summary of the 19th century Bavarian school system.

[12] See for example Kraul (1976) and Müller (1977, pp. 25-36) for discussions on contemporary perceptions on German secondary institutions.

[13] Gewerbeschulen were originally called 'Landwirtschafts- und Gewerbeschulen' since most schools also included agricultural departments until 1864 (Semrad 2015, p. 8).

the traditional kind of secondary education, i.e. the Gymnasium. The Gymnasium remained the predominant form of secondary schooling throughout the 19th century.

Children entered both forms of secondary education with age 11 (Gymnasium) or 12 (Gewerbeschule) (Döllinger 1838, pp. 1691-2; *Ministerialblatt* 1874, p. 344). In case of the Gymnasium, educational attainment of the Lateinschule (Latin school) was a prerequisite (Ringer 1979, p. 33; *Regierungsblatt* 1830, p. 923).[14] Duration of education differed not only between modern and traditional education but also within both school types over time: until 1874 the Gymnasium comprised four years, afterwards nine years (*Ministerialblatt* 1891, p. 239; *Ministerialblatt* 1874, p. 327; *Regierungsblatt* 1830, p. 908). However, overall school time did not change since the mandatory four-year Lateinschule was incorporated into Gymnasien in 1874 (*Ministerialblatt* 1874, pp. 323-7). In case of modern secondary education, there were actually profound changes in schooling duration: starting as a three-year institution in 1833, it was extended into a six-year school with the transformation into Realschulen in 1877 (Döllinger 1838, pp. 1691-2; *Ministerialblatt* 1877, pp. 197-255). Since the Realschule took in children around age 11 – as in the Gymnasium – graduates were on average 19 years in the Gymnasium, 15 in the Gewerbeschule, and 16 in the Realschule. Only a degree of the Gymnasium (i.e. *Abitur*) entitled to general university studies. However, graduates of modern secondary education could continue to technical middle schools (i.e. Polytechnische Schule until 1868, and Industrieschule afterwards) preparing them for consecutive studies at the Technische Hochschule (*Regierungsblatt* 1868, pp. 1698-1700). Thus, both secondary school types entitled to university studies.

Furthermore, Realgymnasien existed as a third secondary school type since 1864. These institutions can be considered as a compromise between traditional and modern secondary education (*Regierungsblatt* 1864, pp. 538-44). However, they played a rather minor role in Bavarian secondary schooling since only a small number of cities had a Realgymnasium.[15] Consequently, the subsequent analysis will focus on the main forms of secondary schooling, i.e. the Gymnasium and Gewerbeschule/Realschule.

2.3 Coding occupational data of annual school reports into a social class scheme

To analyze the relationship between social class and educational choices, this paper employs data from Bavarian school registries (*Jahresberichte*) in 1810, 1830, 1850, 1870, and 1890. Schools were

[14] Entry from private schooling was possible if the admission examination to the Gymnasium had been passed successfully (*Regierungsblatt* 1830, p. 923).

[15] Realgymnasien were opened in Augsburg, Munich, Nuremberg, Regensburg, Speyer, and Würzburg (*Regierungsblatt* 1864, p. 539). However, schools in Regensburg and Speyer were closed in 1880 and 1883, respectively (Keyser 1974, p. 594).

supposed to issue annual reports containing information on the curriculum, teaching staff, and students. Student records include name, place of birth, father's occupation[16] and place of residence, and in most instances also the student's grades. However, it is the father's occupation that provides valuable information about the student's social background.

In order to evaluate whether the association between social class and schooling choice changed over time and especially after the introduction of modern secondary education in 1833, a sample of Bavarian cities is constructed in the following way. First, all cities with operating Gymnasien throughout the 19th century, (here: between 1810 and 1890) are chosen (i.e. 25 cities). It was necessary to disregard seven cities – i.e. Eichstätt, Erlangen, Freising, Hof, Metten, Schweinfurt, and Zweibrücken – from the analysis since annual school reports of these cities are not available prior to 1820.[17] Since the city of Neuburg opened a Gewerbeschule several years after 1835 (in 1870), it was also excluded. Furthermore, due to the tremendous amount of data, the sample had to be further reduced: Augsburg, Speyer, and Münnerstadt are also disregarded from the analysis.[18] Second, all cities with Gewerbeschulen opened between 1833 and 1835 and which had not been excluded from the Gymnasium sub-sample, are selected into the sample (i.e. 17). Hence, the sample contains a total of 18 cities. These cities are listed in Table A2.1 in Appendix 2.

Note that due to data availability, it was in some cases necessary to employ annual reports issued a few years before or after the respective time period (see Table A2.2 in Appendix 2 for details). In some cities – i.e. Bamberg, Munich, Nuremberg, Regensburg, and Würzburg – additional Gymnasien were opened between 1830 and 1890. These Gymnasien are also included in the sample.[19]

In total, employed school reports provide information on 15,323 students and their occupational backgrounds. Table A2.3 in Appendix 2 lists student numbers of all Bavarian secondary schools and compares them to the selected sample schools.

In the next step, each of the 15,323 students has to be allocated into the appropriate social class, based on his social background. In order to code the father's occupational title into a consistent social class scheme, this paper adopts several classification systems. The first one, HISCLASS, is widely used in sociological and economic research.[20] It is based on HISCO.[21]

[16] In case the father has deceased or left the family the occupation of the mother or of the grandfather is listed.
[17] It remains unclear whether this lack of data is due to reports lost or to other reasons.
[18] Obviously, there are no objective reasons leading to the exclusion of these three cities. However, it is unlikely that disregard of these cities will substantially bias the results for two reasons: first, the sample includes 18 cities with more than 15,000 students; second, these cities are evenly distributed across Bavaria (with exception of the Bavarian Palatinate) and are not selected on economic terms since they range from rather underdeveloped cities such as Kempten to economic powerhouses Munich and Nuremberg.
[19] To be precise, although Regensburg opened a second Gymnasium in 1880 (Keyser 1974, p. 594), only one institution enters the dataset. This is due to the fact that the 1890 annual report of the old Gymnasium is unavailable. Hence, data for Regensburg in 1890 originates from the school registry of the new Gymnasium.
[20] Studies employing HISCO and HISCLASS commonly use these tools for the analysis of marriage certificates. See for example Abramitzky et al. (2011) and Maas and Van Leeuwen (2005).
[21] Besides HISCLASS, historians and sociologists have developed a variety of tools to measure social structure

The Historical International Standard Classification of Occupations (HISCO) is a detailed classification system introduced by van Leeuwen et al. (2002) to enable comparisons of occupational data across time and countries. HISCO is based on a coding system for contemporary professions, that is, the International Standard Classification of Occupations (ISCO68) developed by the International Labor Organization. The occupational titles used in the creation of HISCO originate from historical sources (e.g. marriage certificates or other clerical data) gathered in eight countries between 1692 and 1971.[22] The scheme contains ten major groups, divided into several minor groups which are in turn sub-divided into various unit groups. Table 2.1 reports the ten major groups in HISCO.

Table 2.1 – Major groups in HISCO

Major groups	Group label
0/1	Professional, technical, and related workers
2	Administrative and managerial workers
3	Clerical and related workers
4	Sales workers
5	Service workers
6	Agricultural, animal husbandry and forestry workers, fishermen, and hunters
7/8/9	Production and related workers, transport equipment operators and laborers

Notes: Table depicts HISCO major groups and respective characteristics.
Source: Adapted from van Leeuwen et al. (2002, p. 39).

HISCO codes consist of five digits. Hence, sales workers are assigned a HISCO code in the form of 4-xx.xx. Each digit indicated by an x provides more information on the nature of the occupation. For example, 4-3x.xx refers to 'Technical salesmen, commercial travelers, and manufacturers' agents' (minor group), 4-31.xx to 'Technical sales and service advisers', and finally 4-31.20 to 'Technical sales man' (unit group). In total, HISCO contains about 1,600 unit groups.

To allow not only cross-national and time-independent comparisons of occupations but also of social status, the Historical International Social Class Scheme (HISCLASS) has been developed by van Leeuwen and Maas (2011). HISCLASS assigns each HISCO unit group one of twelve social classes. According to Maas and van Leeuwen (2005, p. 280) social class "*is a set of persons with the same life-chances*". HISCO codes are classified into social classes by the use of information provided by the 1965 Dictionary of Occupational Titles (DOT). DOT contains 13,000 occupational categories,

in past societies. See Zijdeman and Lambert (2010) for a survey.

[22] These countries are: Belgium, Britain, Canada, France, Germany, Netherlands, Norway, and Sweden (van Leeuwen et al. 2002, pp. 11-25).

respective job descriptions, and thereby provides indicators to allocate HISCO codes into social dimensions (van Leeuwen and Maas 2011, pp. 29-35). Furthermore, expert judgement by historians was consulted to test and improve the transformation of HISCO into HISCLASS through the usage of DOT (van Leeuwen and Maas 2011, pp. 61-75). Finally, HISCLASS distinguishes between four dimensions: manual and non-manual work, skill level, supervision, and sector. Table 2.2 presents the social classes in HISCLASS.

Table 2.2 – Social classes in HISCLASS

Class number	Class label	Manual/non-manual	Skill level	Supervision	Sector
1	Higher managers	non-manual	high	yes	mainly other
2	Higher professionals	non-manual	high	no	other
3	Lower managers	non-manual	medium	yes	mainly other
4	Lower professionals, and clerical and sales personnel	non-manual	medium	no	other
5	Lower clerical and sales personnel	non-manual	low	no	other
6	Foreman	manual	medium	yes	other
7	Medium skilled workers	manual	medium	no	other
8	Farmers and fishermen	manual	medium	no	primary
9	Lower skilled workers	manual	low	no	other
10	Lower skilled farm workers	manual	low	no	primary
11	Unskilled workers	manual	unskilled	no	other
12	Unskilled farm workers	manual	unskilled	no	primary

Notes: Table depicts HISCLASS classes and respective class characteristics.
Source: van Leeuwen and Maas (2011, p. 57).

Hence, in this paper, the student's father's occupation is first coded into HISCO using van Leeuwen et al. (2002) who provide an extensive collection of German occupational titles, respective descriptions, and corresponding HISCO codes. In addition, the History of Work Information System website contains a search engine tool to match occupational titles in several languages with HISCO codes.[23] In the next step, HISCO codes are transformed into HISCLASS by employing the crosswalk list provided by van Leeuwen and Maas (2011). For example, the above mentioned 'Technical sales man' with HISCO code 4-31.20 is assigned into HISCLASS 4, i.e. the class of lower professionals, and clerical and sales personnel. HISCLASS further acknowledges supervisory and inferior positons. If artisans are denoted as 'masters' they are promoted to class 6 and if occupations include the characterization 'principal' these are promoted one class higher within the manual/non-manual group

[23] The website is accessible at: http://historyofwork.iisg.nl/index.php.

(from class 2 to 1, 4 to 3, 5 to 4, 7 to 6, and 9 to 6). However, if a job title includes 'apprentice', 'learner', or 'subordinate' it is demoted one skill level lower within the manual/non-manual divide (from class 1 to 3, 2 to 4, 4 to 5, 7 to 9, 8 to 10, 9 to 11, 10 to 12). Furthermore, 'nobles' and 'owners' without more occupational information are classified into class 1 (van Leeuwen and Maas 2011, pp. 57-60). Finally, HISCLASS excludes retirees, pensioners, and also private gentlemen if no further occupational information is provided. However, since a considerable number of students listed in annual reports falls into this category, this paper adds 'Retirees, pensioners and independent gentlemen' as class 13 to the class scheme. In addition, this class includes cases that could not be matched with HISCO, mainly due to missing occupational data.[24] In total, 999 different occupational titles for 15,323 students in 18 cities have been classified by this procedure. Table A2.4 in Appendix 2 presents the number of students in the selected Bavarian sample according to their HISCLASS categorization.

Instead of using the full HISCLASS scheme depicted by Table 2.2, this paper follows the literature by employing a condensed version of HISCLASS in order to increase the number of observations in each class.[25] This modified scheme combines social classes as follows: 1, 2 to 'higher managers and professionals'; 3, 4, 5 to 'lower managers, professionals, clerical and sales personnel'; 6,7 to 'foreman and medium skilled workers'; 8 to 'farmers and fishermen'; 9 to 'lower skilled workers'; 11 to 'unskilled workers'; 10, 12 to 'lower and unskilled farm workers'. Consequently, in this paper, class 1, 2 is considered as society's elite, classes 3, 4, 5 and 6, 7 as middle class, and classes 9, 11 and 10, 12 as working class. Agricultural class 8 is placed between middle and working class.

Besides HISCLASS, this paper adopts another classification system of occupations which had been used by the royal Bavarian statistical office (*Königlich-Bayerisches Statistisches Bureau*) to categorize occupational data from 1850 onwards. This categorization divides occupations along the five economic sectors: agriculture, industry, trade and transportation, personal services, and civil services. Further, it includes a category for unemployed and people living on pensions and private means. Occupational data is available for 1852, 1882, and 1895. This data includes not only the population actually working in these sectors but also the number of children or relatives dependent on the income of these workers. In order to enable comparisons with employed annual reports, this data is used in an interpolation to attain respective data for 1870 and 1890. Note that since the occupational census of 1852 reports only three sectors – i.e. agriculture, industry, trade and services, state officials (incl. clergy) and others (i.e. retirees, pensioners, scholars, physicians, and artists) – data of 1882 and 1895 is used in the interpolation to obtain data for all sectors in 1870 and 1890.

[24] In some very few cases it was either impossible to identify the meaning of an occupational title or the title was to general to assign a suitable HISCO match. These titles were: 'Heumeister', 'Bereiter', 'Högner', 'Groß-Hetmann', 'Vorleger', 'Inzipient', and 'Geniewart'.
[25] See for example Abramitzky et al. (2011) and Maas and van Leeuwen (2005).

Table 2.3 depicts these sectors and respective economic sizes in 1852, 1882, 1895 as well as the interpolated numbers for 1870 and 1890.

Table 2.3 – Occupational classification used by the royal Bavarian statistical office (BSKB)

BSKB code	Occupational category	% of population in BSKB sectors				
		1852	1870[c]	1882	1890[d]	1895
A	Agriculture and forestry	67.8	55.6	50.9	47.8	45.8
B	Industry, crafts, and mining	22.7	25.8	28.3	30.0	31.0
C	Trade and transportation		6.7	8.3	9.3	9.8
D	Household services, servants, and day laborers		0.6	0.7	0.8	0.8
E	Civil services[a]	9.4	4.1	4.6	4.9	5.1
F	Pensioners, independent gentlemen, and unemployed[b]		7.0	7.2	7.4	7.5

Notes: Table reports % of total population working or dependent on relatives working in the respective sector and year.

[a] Including military, church, school, medical, and court personnel as well as artists and freelancers.

[b] Including people without occupational information.

[c,d] Data of 1870 and 1890 are the result an interpolation based on 1882/1895 occupational data.

Sources: Own calculations based on BSKB, XXVII (1873), BSKB, L (1886), BSKB, LXII (1902). See Table A2.2 in Appendix 2 for data details.

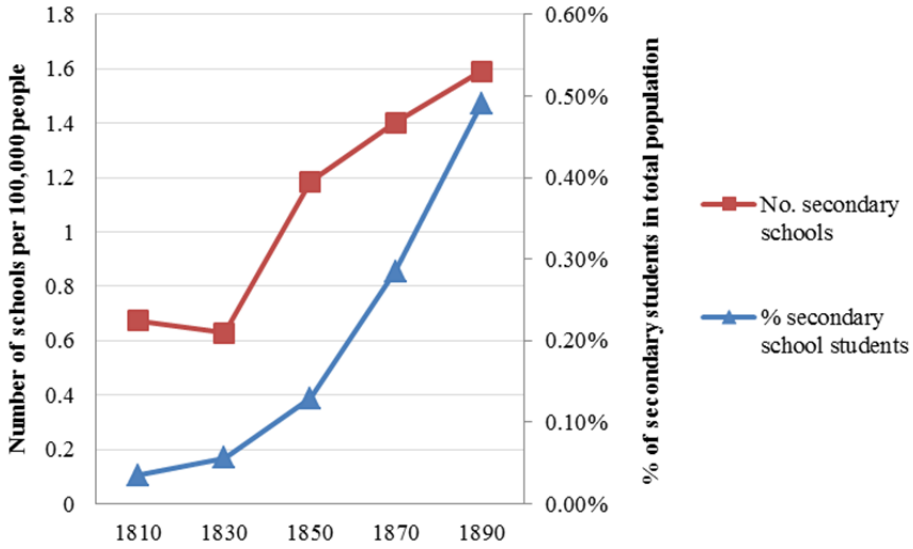
According to Table 2.3, the majority of people worked in (or were dependent on) agriculture throughout the 19th century although this share constantly declined. An obvious drawback of this kind of classification is that it is unable to provide information on social status. For instance, the agricultural category includes occupations ranging from peasants, husbandmen, and farmers to forest officers or aristocratic landowners. On the other side, however, usage of this scheme enables comparisons between the occupational structure in schools and the overall structure of the economy. In fact, the royal Bavarian statistical office started to include sectoral affiliations of students in their publications on educational statistics from 1873 onwards (BSKB XXVII). However, these are reported only on the state instead of school-level. Thus, respective sector codes (BSKB codes) had to be assigned manually to each of the 999 HISCO titles based on a detailed overview of professions attached to the occupational census in 1882 (BSKB XXXXVIII, pp. 257-60). This overview lists 19th century Bavarian occupations according to the six BSKB codes. Table A2.5 in Appendix 2 lists students in the selected Bavarian sample according to their BSKB categorization.

Furthermore, this paper follows Stocker (1911) who provides a qualitative analysis of students' social backgrounds in the Gymnasium and Realschule at the beginning of the 20th century. Instead of focusing on sectoral affiliations, he concentrates on the social and financial situation of students. For this purpose he uses the occupational information stated in annual school reports to identify sons of civil servants. Since most civil service professions demanded a certain level of education, it is possible to draw conclusions about the school achievement of fathers. Furthermore, he distinguishes remaining – i.e. non civil service – occupations according to wealth and social position (as far as possible given the informative content of the data). Hence, this paper further allocates professions into social categories based on Stocker's classification.

2.4 Extensive margin: educational expansion during the 19th century

19th century Bavaria saw a tremendous increase not only in population[26] but also in secondary student numbers, presented by Figure 2.1. While at the beginning of the century only a minority of children continued to secondary education, the share of students in total population reached almost 0.5 percent at the end of the century.[27] According to the figure, student shares steadily increased up to 1850 and virtually shot up afterwards. This development was not paralleled by the number of secondary schools since these could not keep pace with the vast increase in students: whereas the average school had 52 children in 1810, this number was more than four times larger at the end of the century when on average 308 pupils visited one school (see Table A2.6 in Appendix 2).[28]

Figure 2.1 – Development of secondary school numbers and student shares during the 19th century



Notes: Figure depicts share of all Bavarian secondary schools and students in total population.
Source: Own illustration; see Table A2.2 in Appendix 2 for data details.

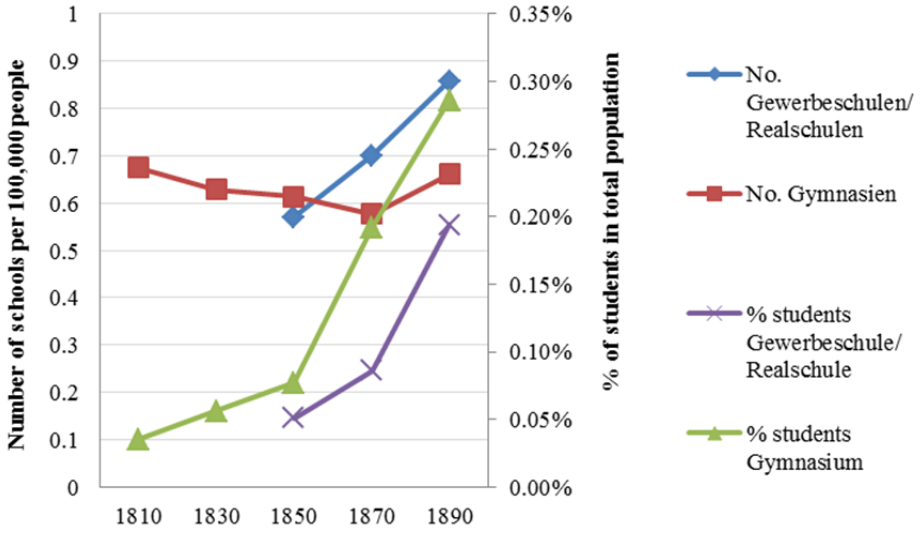
[26] The Bavarian population increased from 3,707,966 in 1818 to 4,559,452 in 1852 and finally to 5,594,982 in 1890 (BSB 192). Compared to other states of the German Confederation (without Austria), population growth was however rather low: while population in these states increased by 60 percent between 1816 and 1865 and 61 percent between 1867 and 1910, the corresponding rates in Bavaria were 35 and 43 percent, respectively. This gap was a direct consequence of Bavaria's economic backwardness resulting not only in high rates of emigration but also in high infant mortality (Götschmann 2010, pp. 148-51).

[27] Detailed information on the age structure of the population is available for 1870 and 1890. Thus, the share of secondary students in school-aged population (age 11-20) was 1.6 in 1870 and 2.4 percent in 1890. Corresponding shares for Prussia were 2.3 and 2.5 percent, respectively (Ringer 1980, p. 11).This is comparable to rates in most western countries, where the share of school-aged children in secondary education did not exceed 2 or 3 percent in 1870 (Craig 1981, p. 185).

[28] Note that these numbers also include six Realgymnasien with 364 students in 1870 and 4 Realgymnasien with 496 students in 1890 (see Table A2.6).

As outlined in section 2.2, the Gewerbeschule was introduced as an additional form of secondary education in 1829. Hence, with the opening of various Gewerbeschulen across Bavaria between 1833 and 1835, the supply of secondary schools was substantially increased. Thus, the rise of student numbers after 1850 depicted in Figure 2.1 might just be a result of greater school supply. However, as Figure 2.2 shows, this is rather unlikely: much of the increase in student numbers is due to the 'explosion' of students in traditional secondary education, i.e. the Gymnasium – even though the number of Gymnasien more or less stagnated up to 1870.

Figure 2.2 – School numbers and student shares in traditional and modern secondary education



Notes: Figure depicts share of traditional and modern secondary schools and respective students in total population.
Source: Own illustration; see Table A2.2 in Appendix 2 for data details.

Hence, Bavaria experienced a substantial degree of educational expansion during the 19th century. But what were the reasons behind this huge expansion?[29] The answer might be found in the phenomenon of industrialization. Although Bavaria started to industrialize fairly late compared to other German states (Bosl 1985) and remained predominantly agrarian up to WWII (Kohlbauer 2013, p. 37), the 19th century brought new technologies and industries to the rather backward state as well. These led to substantial changes, best seen for the labor market: first, industrialization increased the demand for skilled workers such as engineers, technicians and scientists and also of other industrial laborers such as blue collar workers. This was accompanied by the demand for civil servants with administrative and technical skills required by the state to manage growing cities, monitor economic expansion, and deal with an increasing working class (Kaelble 1973, pp. 47-8). Hence, increased job opportunities might have led to a growing demand for secondary education in the population. This is in line with the 'human capital hypothesis' which maintains that an increase in the demand for skilled

[29] See Craig (1981) for a detailed summary of so-called 'extant hypotheses' regarding the educational expansion experienced in most western countries during the 19th or early 20th century.

labor leads to higher monetary returns to education (everything else equal) and thus people start to invest more in schooling (Craig 1981, pp. 152-3).[30] Second, growing industrialization led to increased levels of urbanization, especially towards the end of the century (Götschmann 2010, p. 155). This was accompanied with transitions from agricultural into urban occupations, thereby reducing the need of children as helpers on family farms. According to Treiman (1970, p. 216) this resulted in higher schooling rates since urban parents had fewer incentives to withhold their children from schooling.[31] Finally, industrialization led to increases in income per capita, at least during the last decades of the 19th century (Götschmann 2010, pp. 168-75). This might have made secondary education more affordable for parents. On the other side, supply factors might have also triggered educational expansion. Hence, the state might have expanded secondary schooling to meet its own demand for educated employees as well as that of the overall economy. As outlined in section 2.2, lobbying by the mercantile middle class played a decisive role in the introduction of modern secondary education. According to Figures 2.1 and 2.2, even though school numbers were relatively stagnant until 1830, they sharply increased afterwards, mainly due to the expansion of modern secondary education. Consequently, both demand and supply of secondary education resulted in higher student numbers.

2.5 Compositional effect: secondary education and social class

Was this dramatic increase in student numbers complemented by a change in the composition of participating social classes in secondary education? To answer this question, occupational information given by annual reports of secondary schools has been categorized based on various systems as outlined in section 2.3.

2.5.1 Social composition of secondary students

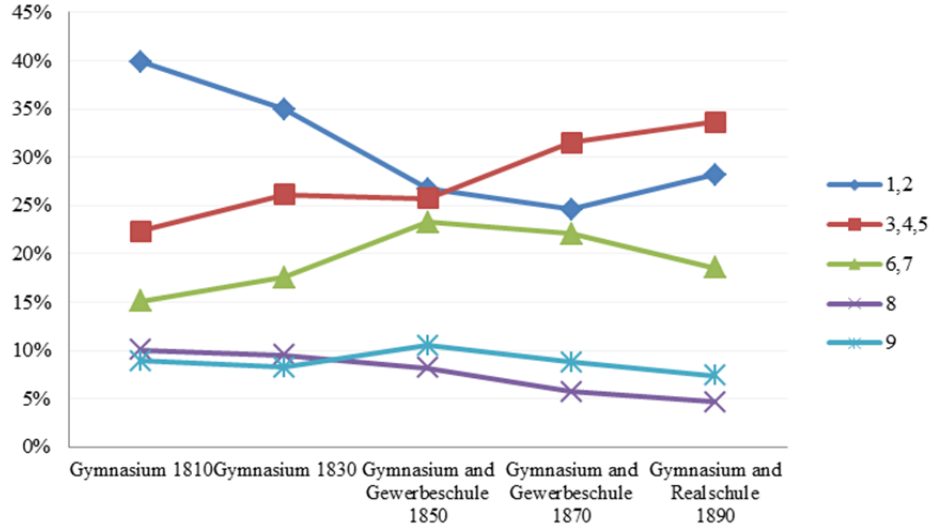
Figures 2.3 and 2.4 depict the share of secondary students according to their social background based on HISCLASS. Since the number of cases falling into HISCLASS 10-13 is relatively small, Figure 2.3 depicts HISCLASS categories 1-9, while Figure 2.4 focuses on classes 10-12 and 13. Note that modern secondary education in form of the Gewerbeschule enters the dataset in 1850. Hence, prior to 1850, the Gymnasium is the only secondary school type in Bavaria. Figure 2.3 shows clearly that secondary education became less elitist during the 19th century as indicated by the sharp decrease in children belonging to class 1, 2: while at the beginning of the century, more than 40 percent of

[30] In this context, it has been argued that students (or their parents) overestimated the returns to education in terms of labor market outcomes. Consequently, the increase in graduate numbers lowered individual returns and produced an 'academic proletariat' (Craig 1981, p. 187; Musgrove 1959).

[31] In addition, parents working outside the home might have appreciated the fact that schools took care of children during daytime. However, it could also be that especially working class parents depended on additional income generated through child work. Hence, urbanization could also negatively influence educational participation. For example, Parsons and Goldin (1989) show that in the US child labor was quite common in industrial families at the end of the 19th century.

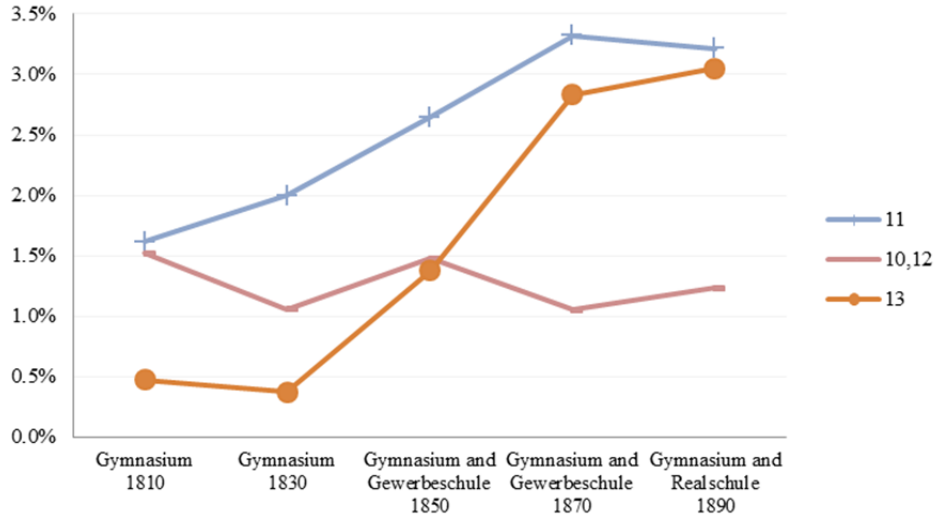
children belonged to the highest social class, their share fell under 30 percent by 1890. The share of (upper) middle class children (i.e. 3, 4, 5) markedly increased after 1850 with the opening of Gewerbeschulen. Noticeable is also the development of the artisanal middle class denoted by 6, 7: there was an upward trend up to introduction of the Gewerbeschule in 1850; afterwards, however, this share slightly decreased. There is no indication that lower social classes were able to substantially increase their student shares in secondary schools during the 19th century. However, taken together (i.e. 8. 9, 11, 10, 12) they accounted for about one fifth of all secondary students. Figure A2.1 in Appendix 2 depicts students' classes according to the full range of HISCLASS classes.

Figure 2.3 – Participation of upper (1-2), middle (3-7), agricultural class (8), and working class (9) children in secondary education (HISCLASS)



Notes: Figure depicts students' social classes according to HISCLASS categorization of fathers' occupations as share of all secondary school students in the respective year.
Source: Own illustration; see Table A2.2 in Appendix 2 for data details.

Figure 2.4 – Participation of lower working (10-12) and undefined (13) class children in secondary education (HISCLASS)

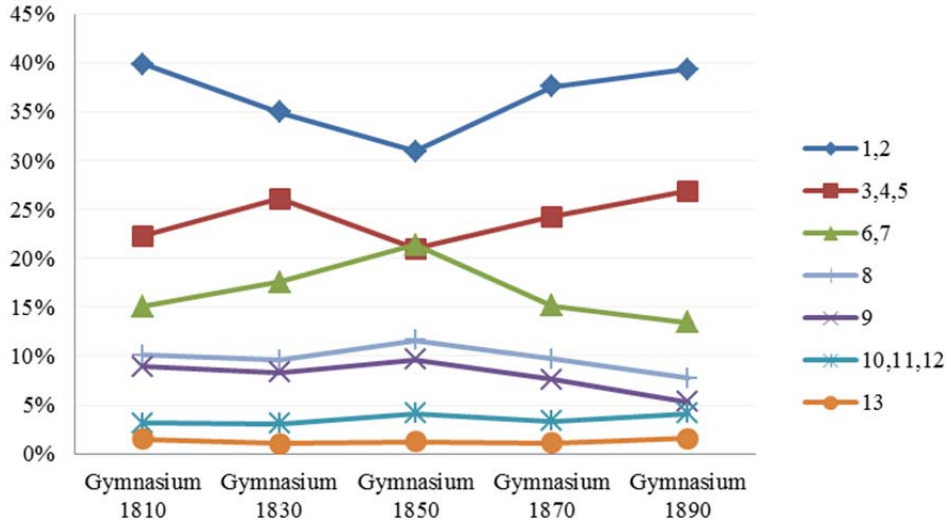


Notes: Figure depicts students' social classes according to HISCLASS categorization of fathers' occupations as share of all secondary school students in the respective year.
Source: Own illustration; see Table A2.2 in Appendix 2 for data details.

Thus, throughout the 19th century, secondary schools were mainly attended by upper and middle class children. But were there differences between modern and traditional secondary education in terms of social composition?

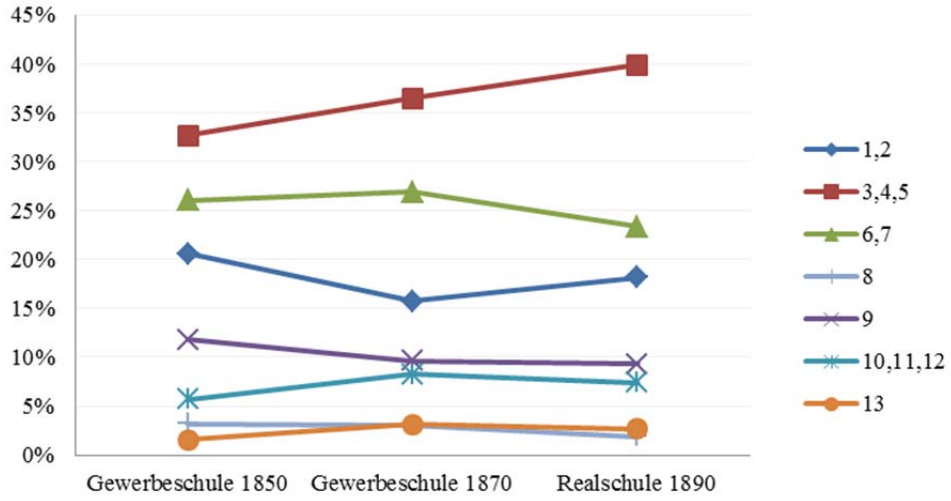
To answer this question, the following Figures depict students' classes separately for the Gymnasium and Gewerbeschule/Realschule. Figure 2.5 and 2.6 present the social composition of students in traditional and modern secondary education, respectively, based on HISCLASS. In order to increase the sample size in lower classes, HISCLASS categories 10, 11, and 12 are combined into one category representing the (lower) working class.

Figure 2.5 – Students' social background in the Gymnasium (HISCLASS)



Notes: Figure depicts students' social classes according to HISCLASS categorization of fathers' occupations as share of all students in Gymnasium in the respective year.
Source: Own illustration; see Table A2.2 in Appendix 2 for data details.

Figure 2.6 – Students' social background in the Gewerbeschule/Realschule (HISCLASS)



Notes: Figure depicts students' social classes according to HISCLASS categorization of fathers' occupations as share of all students in Gewerbeschule/Realschule in the respective year.
Source: Own illustration; see Table A2.2 in Appendix 2 for data details.

As expected – given the elitist conception of the Gymnasium – students in this institution were mainly recruited from the highest social classes, i.e. 1 and 2. Throughout the 19th century, at least every third student in the Gymnasium was the son of a higher state official, manager, school teacher, physician, or of other related free professions. In modern secondary schools, however, this was only the case for every fifth student. It is interesting to note that participation of the top class in the Gymnasium steadily declined up to 1850 when it reached its trough with the introduction of modern secondary education. Afterwards, it started to rise again to reach previous levels of 40 percent. The picture for artisanal middle class children (i.e. 6, 7) is quite reverse: their share grew up to 1850 and declined afterwards. In contrast, participation of the upper class in the Gewerbeschule was never again as high as in 1850, i.e. the year modern secondary education enters the data series, while the share of artisanal children remained relatively constant from the beginning. These findings suggests that in the Gymnasium the share of children belonging to the elite declined at the cost of an increasing number of craftsmen's children until 1850. Hence, the Gymnasium seems to have become less socially segregated or elitist during the first decades of the 19th century. Introduction of the Gewerbeschule might have then triggered a selection process, leading to self-selection of upper class children into the Gymnasium and artisanal middle class children into the Gewerbeschule/Realschule.

The majority of students in modern secondary education belonged to the group of lower managers, professionals, clerical and sales personnel (i.e. 3, 4, 5) and their share steadily increased up to 1890. As will be shown in the subsequent analysis of specific occupations, this was mainly driven by merchants. The participation of remaining social classes was relatively stable throughout the time period.

Consistent with contemporary perception, farmers (i.e. 8) sent their children primarily to the Gymnasium even though most Gewerbeschulen included specific agricultural departments up to 1877 (*Ministerialblatt* 1877, pp. 197-201). According to Stocker (1911, p. 8), most farmers would send their sons only to secondary education if these were willing to pursue a clerical career. In this case, the Gymnasium constituted the optimal schooling choice since only this institution prepared for theological university studies. Furthermore, scholarships provided by the church played a decisive role in rural areas. Moreover, children from class 13 coming mainly from wealthy households without further occupational information attained noticeable numbers only at the end of the century when they constituted about 4 percent of all secondary school children. In both institutions, the lowest social classes (i.e. 10, 11, and 12) consisting mainly of husbandmen, day laborers, and factory workers, participated the least in secondary education. It is likely, that this is due to the lack of financial means, resulting in labor market entry of children after primary education even though waiving of school fees was common for students unable to pay tuition and scholarships were available.[32]

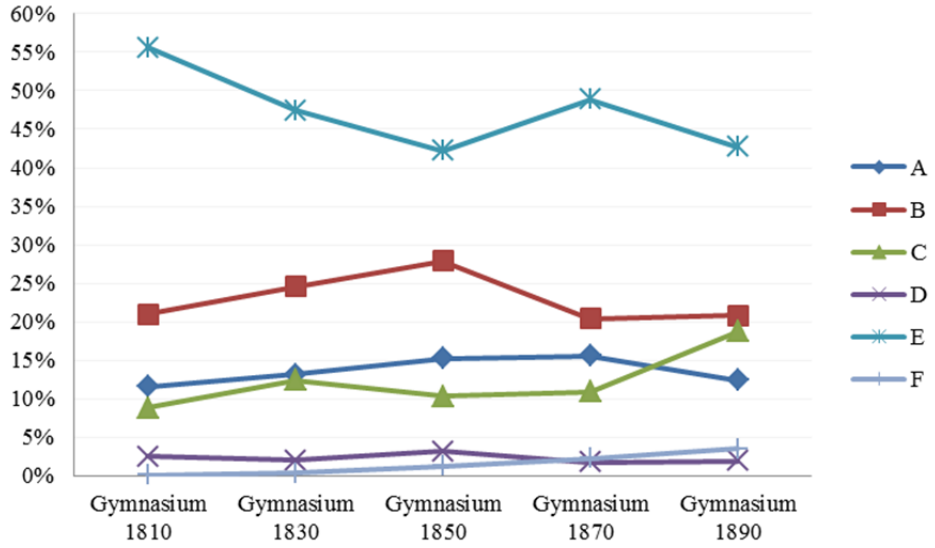
To sum up, in case of traditional secondary education, there seems to have existed a strong positive relationship between social status and participation of children, while modern secondary schools were mainly visited by middle class children.

2.5.2 Composition of students relative to overall population

Do above findings suggest that secondary education was exclusive in terms that it was only attained by privileged groups of society? Not necessarily. If these social groups included most of the population then the social composition of secondary schools might just resemble the composition of the overall population. Hence, in order to evaluate whether secondary education was exclusive, the occupational background of students has to be compared to the overall occupational distribution of the population. For this purpose, data on the occupational structure in 1852, 1882, and 1895 provided by the royal Bavarian statistical office is employed and students' occupational backgrounds are coded into the six occupational dimensions (BSKB) as outlined in section 2.3. The composition of students in traditional and modern secondary education according to this BSKB categorization is presented in Figure 2.7 and 2.8, respectively.

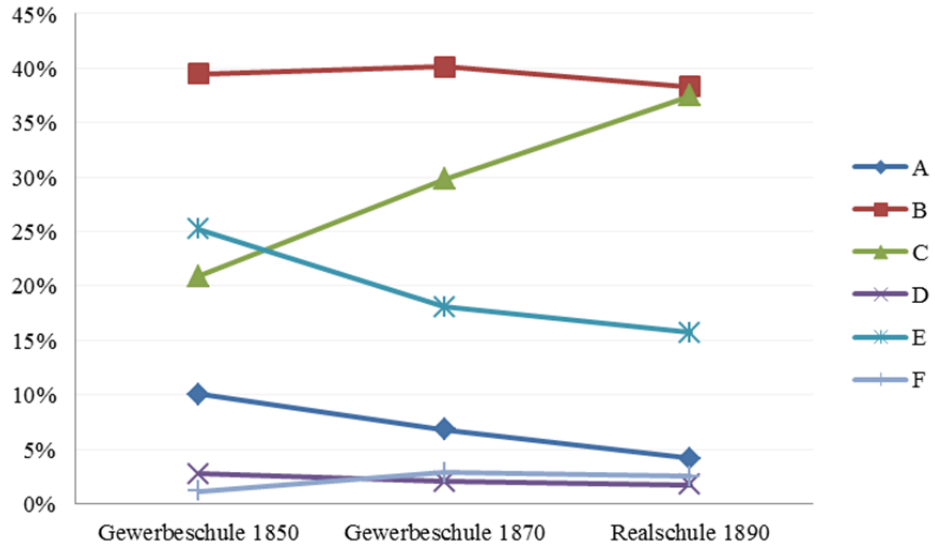
[32] For example, only 77 and 84 percent of students at the Gymnasium and Realschule, respectively, paid tuition in 1870 (BSKB XXVII). Scholarships were mainly granted by clerical institutions for the Gymnasium, and hence, in preparation for subsequent theological studies.

Figure 2.7 – Students' social background in the Gymnasium (BSKB)



Notes: Figure depicts students' social classes according to BSKB categorization of fathers' occupations as share of all students in Gymnasium in the respective year.
Source: Own illustration; see Table A2.2 in Appendix 2 for data details.

Figure 2.8 – Students' social background in the Gewerbeschule/Realschule (BSKB)



Notes: Figure depicts students' social classes according to BSKB categorization of fathers' occupations as share of all students in Gewerbeschule/Realschule in the respective year.
Source: Own illustration; see Table A2.2 in Appendix 2 for data details.

Consistent with the social composition based on HISCLASS, the overwhelming majority of students in the Gymnasium came from category E, i.e. households employed as state officials such as administrative personnel and teachers, engaged in the military sector, or working in the free professions (e.g. as lawyers or physicians). However, as argued before, the BSKB scheme is unable to capture social power or prestige dimensions since it concentrates only on sectoral affiliations of occupations. Hence, this class E contains also lower personnel such as medical service staff, school janitors, policemen, and soldiers. Furthermore, it does not include managers, industrialists, and factory

owners – a group of high social status growing rapidly at the end of the century with emerging industrialization. These belong to industry (i.e. B) and thus contributed to a weaker drop after 1850 compared to the downfall of class 6, 7 in Figure 2.5. Once again, students with agricultural background (i.e. A) were mainly found at the Gymnasium. Results for modern secondary education are also consistent with HISCLASS findings: most students had an industrial or trade and transportation-related background, denoted by categories B and C.

Table 2.4 – Social composition of secondary schools relative to overall population, 1850-90

BSKB code	Occupational category	Ratio between % of students and % of population in respective BSKB classes					
		Gymnasium			Gewerbeschule/Realschule		
		1850	1870	1890	1850	1870	1890
A	Agriculture and forestry	0.22	0.28	0.26	0.15	0.12	0.09
B	Industry, crafts, and mining	n.a.	0.79	0.69	n.a.	1.56	1.28
C	Trade and transportation	n.a.	1.54	2.01	n.a.	4.45	4.03
D	Services and day laborers	n.a.	2.95	2.35	n.a.	3.40	2.19
	B-D	1.82	0.99	1.03	2.78	2.16	1.94
E	Civil services[a]	n.a.	11.87	8.72	n.a.	4.39	3.20
F	Pensioners, retirees, private gentlemen, and unemployed[b]	n.a.	0.18	0.47	n.a.	0.40	0.34
	E-F	4.62	4.60	3.75	2.80	1.88	1.48

Notes: Table lists student shares according to their social background based on BSKB classes divided by share of population in respective BSKB classes.

[a] Including military, church, school, medical, and court personnel as well as artists and freelancers.

[b] Including people without occupational information.

Source: Own calculations; see Table A2.2 in Appendix 2 for data details.

Table 2.4 compares the occupational structure of the economy in 1850, 1870, and 1890 to the sectoral composition in schools by presenting ratios reflecting the over- or underrepresentation of classes in secondary schools. A ratio below (above) one suggests that the occupational category is underrepresented (overrepresented) in schools.[33] According to these ratios, children coming from the agricultural sector were severely underrepresented not only in modern but also in traditional schools. While representation of the agricultural sector even more decreased in modern schools, it slightly increased in traditional schools. This finding once more confirms that families working in agriculture and forestry preferred the Gymnasium over the Gewerbeschule/Realschule. Interesting to note is also the development of student numbers belonging to industrial, trade, and services sectors as indicated by aggregate numbers in sectors B-D: while these students were overrepresented in modern secondary schools across all time periods, this only applied to 1850 in case of the Gymnasium. As individual

[33] As outlined in section 2.3, sectors B, C, and D as well as E and F are combined in 1850.

sector ratios reveal, this might have been a result of the low (and decreasing) representation of children from sector B. These children were also only moderately overrepresented in modern schools. Hence, it seems as if secondary school participation of sector B could not keep pace with its growth in the economy as indicated by Table 2.3. Children from parents working in trade and transportation were overrepresented in both schools in 1870 and 1890; however, only at the Gymnasium this overrepresentation grew between 1870 and 1890 suggesting that the Gymnasium became more popular among these parents. Yet the highest degree of overrepresentation is provided by aggregated sectors E-F in the Gymnasium. Although the share of these children in modern secondary education exceeded the respective share in the economy as well, corresponding student shares in the Gymnasium were more than 4 times higher than respective population shares. This was a result of the extreme overrepresentation of civil service children, as individual shares for sector E in 1870 and 1890 reveal. However, overrepresentation of these children declined steadily.

Thus, besides sector A (and individual ratios of sector F), ratios of the remaining sectors constantly declined towards 1 in the Gewerbeschule/Realschule indicating that the composition of modern secondary schools more and more resembled the overall sectoral affiliations of the population. The picture for the Gymnasium is more diverse: while representation of the agricultural sector increased, representation of the industrial sector further decreased. Only the development of children from sector E-F became more representative of the overall sectoral distribution in the economy.

Consequently, compared to the occupational structure of the economy, it is evident that students in both school types did not resemble the common school-aged child which should have had an agricultural background. Especially the social composition of the Gymnasium differed from that of the overall economy: while only 4 to 5 percent of the labor force worked in sector E between 1870 and 1895 (see Table 2.3), this class accounted for more than 40 percent of all students. However, as outlined in section 2.3, BSKB codes are unable to reflect social status since they only capture sectoral affiliations. The next section approaches this shortcoming by combining BSKB sectoral codes with HISCLASS.

2.5.3 Occupational composition of secondary students

While HISCLASS concentrates on the social class of occupations and BSKB codes focus on sectoral affiliations, this section combines both approaches by distinguishing between several occupational groups. Focusing on the fathers' occupation directly – instead of studying aggregate HISCLASS and BSKB codes distributions – provides deeper insights into the social background of students since especially occupations falling into the upper and middle class can differ in terms of educational entry requirements, entrepreneurism, or wealth. This is best seen for occupations falling into the upper class: for example, high state officials, industrialists, and also large landowners belong to HISCLASS 1, 2 and the associated BSKB codes are E, B, and A, respectively. Yet these occupations are quite

different: state officials are usually university-educated, industrialists may be self-made entrepreneurs, and major landowners are heirs of family wealth. Hence, aggregate results in sections 2.5.1 and 2.5.2 are not able to provide information about the actual 'nature' of the occupation. Therefore, this paper follows the categorization suggested by Stocker (1911) who differentiates between fathers working as civil servants, in academic professions, as self-employed in trade and industry, and in agriculture (see section 2.3).

Table 2.5 lists students coming from civil service households, based on a wide range of civil service professions.[34] In addition, the table reports HISCLASS and BSKB codes associated with occupations falling into the respective civil service category. According to the table and consistent with previous findings, sons of civil servants were much more likely to be found at the Gymnasium than at modern secondary schools. However, within the group of civil servants, substantial redistribution in participation rates took place during the 19th century. This is best seen in the case of ministers, administrative officers,[35] fiscal officers, and teachers in the Gymnasium. While in 1810 the first three groups contributed most of the students coming from civil servant households, their contributions slightly decreased (or remained constant) over the following decades. In contrast, the number of students with fathers working as teachers increased from decade to decade; from 1850 onwards, this group constituted the majority within students from civil service households.

Further, the growing participation of civil servants working in transport and communication in both school types is a result of the increasing influence of the railway towards the end of the century. Bavaria had been the first German state to adopt the railway with the opening of the line Nuremburg-Fürth in 1835, followed by the line Munich-Augsburg in 1840 (Seiderer 2013, pp. 65-7). In the following years several more routes were added, especially after 1860 when the state started to invest heavily in railway projects connecting rural areas (Götschmann 2010, p. 51). This was accompanied by the expansion of the communicational infrastructure: the postal and telegraphy sector experienced rapid growth starting in mid-century (Götschmann 2010, pp. 114-6). Thus, a variety of new job positions had to be filled, ranging from line keepers and conductors to higher railway and postal officials.[36] The latter fell into HISCLASS categories 3, 4, 5 and are thus also responsible for an increase of these classes in both institutions as depicted by Figures 2.5 and 2.6. It is interesting to note however, that this 'modern' type of civil service preferred the Gewerbeschule/Realschule and thus a modern kind of secondary education (except for 1890).

[34] Tables A2.7-A2.9 in Appendix 2 report students according to occupational background as share of total student numbers.

[35] Administrative officers were mainly higher members of the government such as council members, mayors, state administrators or other highly ranked state professions. Hence, the majority of these civil servants fell into HISCLASS categories 1 or 2.

[36] The extension of civil service to include even the postal and railway sector, is extreme in international comparison as Müller et al. (1989, p. 30) point out.

Table 2.5 – Students with fathers employed as civil servants

Father's occupation	No. of students with fathers working as civil servants								HISCLASS codes	BSKB codes
	Gymnasium					Gewerbeschule/Realschule				
	1810	1830	1850	1870	1890	1850	1870	1890		
Head teacher, principal	4	2	3	2	15	0	1	2	1	E
University professor	7	8	25	21	28	3	3	3	2	E
Teacher	37	87	173	133	220	60	66	80	2	E
Minister	54	47	75	57	54	25	9	5	2	E
Administrative officer	142	119	100	105	121	44	54	54	1, 2, 3, 4, 5	E
Forest officer	11	44	59	69	61	75	57	21	3	A
Customs officer	11	26	46	19	30	26	15	19	1, 2, 3, 4	E
Transport and communication officer	7	14	20	24	49	24	57	46	3, 4, 5	C
Fiscal officer	59	69	70	42	51	25	20	24	1, 2, 3, 4	E
Public medical officer	21	33	27	20	34	9	8	3	1, 2	E
Technician	10	15	20	11	29	17	12	21	1, 2, 3, 4	E
Military officer	23	30	34	38	90	33	26	18	1, 3	E
Physician	26	37	58	37	41	15	10	6	2	E
Judge	35	58	54	50	40	12	19	8	2	E
Notary	1	0	1	10	18	0	2	7	2	E
Lawyer	39	58	51	61	60	13	18	6	2	E
Total	487	647	816	699	941	381	377	323		

Notes: Table depicts students according to occupational background as share of total student number in respective school and year.
Source: *Jahresberichte*, various years. See Table A2.2 in Appendix 2 for data details.

Hence, throughout the 19th century, people working in the civil service sent their children predominantly to the Gymnasium. Since most of these civil service occupations are associated with high social status as indicated by the HISCLASS code, this made the Gymnasium an institution for the elite.

Table 2.6 presents participation in secondary education for the population engaged in trade and industry. As expected, students with these backgrounds were primarily found at the Gewerbeschule/Realschule where they accounted for 50 to 60 percent of all children.[37] Especially merchants seem to have appreciated the commercial focus of modern secondary education. Moreover, industrialists' sons were much more likely to visit modern secondary schools, even though their numbers in the Gymnasium substantially increased at the end of the century. Again, as aggregate trends in Figures 2.5 and 2.6 indicate, there was an interesting development concerning middle class participation: up to 1850, the number of contractors' and craftsmen's children increased in the Gymnasium; after 1850, with the entry of the Gewerbeschule into the dataset, this development reverses (especially when taking relative numbers into account, depicted in Table A2.8). Hence, contractors and craftsmen obviously preferred the Gewerbeschule/Realschule over the Gymnasium and self-selected into this new kind of education. However, it seems as if this pattern changed once a higher skill level had been attained since the number of children of master craftsmen as a fraction of all craftsmen students in traditional exceeds that of modern secondary schools. Except for contractors and craftsmen, participation of industrial and trade-related professions increased in both secondary

[37] Total student numbers (of the selected sample) in the Gewerbeschule/Realschule amounted to 1,598 in 1850, 2,302 in 1870, and 2,512 in 1890. See Table A2.3 in Appendix 2.

school forms during the last decades of the 19th century, reflecting the influence of progressing industrialization in Bavaria and associated shifts towards industrial and mercantile occupations.

Table 2.6 – Participation of industrial and trade-related occupations in secondary education

Father's occupation	No. of students with fathers working in industrial or trade-related professions								HISCLASS codes	BSKB codes
	Gymnasium					Gewerbeschule/Realschule				
	1810	1830	1850	1870	1890	1850	1870	1890		
Engineer	0	0	2	1	9	8	5	15	2, 4	B
Architect	1	3	3	1	10	8	9	40	2	B
Industrialist	22	24	34	23	92	57	112	173	1	B
Merchant	43	101	123	78	217	185	439	524	4	C
Travelling salesman or commissioner	0	0	2	0	10	0	3	17	4	C
Contractor or craftsman	191	342	581	275	348	511	742	661	6, 7, 9	B
whereof master craftsman	47	71	206	126	164	180	255	279	6	B
Total	257	470	745	378	686	769	1310	1430		

Notes: Table depicts students according to occupational background as share of total student number in respective school and year.
Source: *Jahresberichte*, various years. See Table A2.2 in Appendix 2 for data details.

Finally, Table 2.7 lists four 'professions' that are worth taking a closer look at to understand social recruitment at 19th century secondary schools. First, the categories private gentleman and major landowner provide information about financial means. Although the importance of both groups increases over time, there is no clear pattern reflecting preferences of wealthy parents for either school type discernible. It seems as if these parents were quite indifferent between modern and traditional secondary education. Finally, as expected given the aggregate findings, farmers sent their sons primarily to the Gymnasium. As Tables 2.5 and 2.7 show, children of sector A were mostly coming from farming households – even though the number of children of forest officers steadily increased. Taking into account that children from sector A were extremely underrepresented (Table 2.4) in both school types throughout the 19th century, it seems as if children of farmers had very little access to secondary schools and were thus unaffected by educational expansion taking place among other occupational groups.

Table 2.7 – Students with fathers of considerable wealth or working as farmers

Father's occupation	No. of students with fathers with fathers being/working as…								HISCLASS codes	BSKB codes
	Gymnasium					Gewerbeschule/Realschule				
	1810	1830	1850	1870	1890	1850	1870	1890		
Private gentleman	0	3	17	22	42	15	53	39	/	F
Major landowner	4	8	15	17	22	23	20	20	1	A
General farmers	98	150	266	152	176	47	66	43	8	A
Total	102	161	298	191	240	85	139	102		

Notes: Table depicts students according to occupational background as share of total student number in respective school and year.
Source: *Jahresberichte*, various years. See Table A2.2 in Appendix 2 for data details.

Hence, focusing on specific occupations reveals that the Gymnasium was predominantly attended by sons of civil servants, while modern secondary education attracted mainly children of merchants, craftsmen, and other industrial and trade-related professions. A precondition of all civil service professions stated in Table 2.5 was university entitlement (for teachers, military officers, and

some forest officers) or even university studies (remaining categories). Since the fraction of civil servant sons was substantially higher in the Gymnasium than in the Gewerbeschule/Realschule, this suggests that overall educational attainment of fathers in traditional schools exceeded that of modern secondary schools. The fact, that entry into architectural and engineer occupations demanded at least university entitlement, does not change the overall picture. Throughout the 19th century the Gymnasium was the only institution to confer the Abitur, which entitled to university studies (Ringer 1979, p. 34; Stocker 1911, p. 8). Thus, it comes as no surprise that fathers who had been educated at the Gymnasium themselves preferred this institution also for the education of their children. This also applies to mercantile and industrial middle class parents who sent their sons to modern secondary schools in order to prepare them with valuable education for taking over family businesses.

All in all, analysis of annual school reports for traditional and modern secondary education reveals that throughout the 19th century, the Gymnasium was the institution of the social elite while the Gewerbeschule/Realschule attracted mainly middle class children. There was a slight tendency in the Gymnasium to become more socially open, however, this changed with the introduction of the Gewerbeschule. After that, segregation of social classes into respective institutions started to rise. Since the Gymnasium prepared for university studies, and careers in clerical and civil service, while the Gewerbeschule and Realschule trained for industrial, technical, and mercantile professions, this suggests that especially the second half of the 19th century was characterized by a high level of occupational consistency between fathers and sons. This naturally brings up the question whether 19th century secondary education provided any opportunity for social mobility.

2.6 Secondary education and social mobility

What do above findings on the social composition of secondary schools suggest for social mobility? According to sociological theory, education is a key determinant of social mobility, affecting the prospect of upward mobility on various dimensions. For example, as an ingredient to human capital it influences the productive resources of individuals, as a signaling device it facilitates the identification of suitable candidates by employers, and finally, as an institution of socialization it endows individuals with values and norms (e.g. punctuality, respect, diligence) also relevant for a successful work life (Goldthorpe 2014). In order to evaluate whether traditional and modern secondary education enabled children to reach higher social classes than their parents (or saved them from social relegation if they were already upper class), subsequent labor market outcomes of graduates are required. Given the unavailability of this data,[38] intended career options of graduates are the closest to get, even though these are only available for some institutions or time periods.

[38] Unfortunately, the employed data does not allow matching with occupational census data. In fact, individual-level Bavarian census data is not available prior to the 1950s.

According to Buchinger (1983, p. 172) who lists intended careers of graduates at the Realschule Munich between 1878 and 1883, the majority of students opted for careers in trade, commerce, and industry (46 percent), followed by subsequent university studies (33 percent), and finally middle-level civil service (20 percent).[39] This is in line with survey results for Prussia: the majority of modern secondary school graduates between 1875 and 1899 intended to work in technical occupations such as engineering or architecture or pursue a commercial or industrial career (Ringer 1979, pp. 71-9).[40]

Information on actual careers of modern secondary graduates is provided by Kleinfeller (1883, pp. 97-101). As a contemporary witness, Kleinfeller studies the development of the Bavarian modern secondary education system and concludes that most students entered commercial or industrial professions directly after graduation.

To some extent, these career patterns of modern secondary graduates are corroborated by data on the social background of German entrepreneurs. Between 1800 and 1870, 67 percent of entrepreneurs were sons of entrepreneurs themselves, 29 percent of merchants, innkeepers, craftsmen, and lower civil servants, and finally 12 percent of civil servants, majors, teachers, clerics, large landowners, physicians, and farmers (Kaelble 1973, p. 52).[41] Since the first two groups were more likely to send their children to modern secondary education while the latter group preferred traditional schools (based on the participation rates of these social groups in modern and traditional schools as outlined in section 2.5), entrepreneurs were mainly educated at modern secondary schools (after 1833). This suggests that the opportunity for social mobility existed especially for middle class children.

Career intentions of students at the Gymnasiums differed hugely compared to that of modern secondary education. Müller (1975) analyzes school reports of Munich's oldest Gymnasium between 1780 and 1800. According to his figures, this Gymnasium was mainly attended by middle class children coming from lower civil servant, artisanal or merchant households.[42] Graduates of this school primarily intended to enter the clerical or civil service. It seems as if this tendency endured throughout the 19th century, as illustrated by Prussian data for 1875 to 1899: 75 percent of students opted for academic careers as jurists, higher state officials, secondary and university teachers, theologists and ministers, or physicians. Only 4 percent wanted to enter industrial or commercial professions (Ringer 1980, p. 17). These findings are especially relevant since only 21 percent of students at the Prussian

[39] Buchinger cites career intentions of students gathered by Bavarian modern secondary teachers between 1873 and 1883 (Buchinger 1983, p. 172).

[40] Ringer (1979) refers to a survey on all students receiving the Abitur between 1875 and 1899. See also Ringer (1967).

[41] Kaelble (1980, pp. 406-10) explains the low fraction – especially in comparison to corresponding rates in Britain and the U.S. – of entrepreneurs coming from agricultural backgrounds (i.e. farmers and large landowners) as a result of their "*tenacious anti-industrial value system*". In addition, common farmers had lower access to capital compared to the U.S. and Britain where agricultural productivity and profitability was higher.

[42] The composition of students was as follows: 9 percent sons of noblemen who were working exclusively as high state officials; 32 percent sons of lower state officials, clerics, or municipal employees; 50 percent sons of craftsmen, merchants, innkeepers, and also some day laborers and servants (Müller 1975, pp. 134-5).

Gymnasium had an academic background while 32 percent of students came from industry and commerce, 11 percent from agriculture, and 12 percent from middle and lower civil service. This suggests that in Bavaria where these shares were about the same size in 1870 and 1890 (see Tables A2.7, A2.8, and A2.9 in Appendix 2) sons of middle class parents or farmers intended to pursue academic careers as well. If these intentions were actually implemented, then the Gymnasium was indeed able to provide some degree of social mobility in terms that it prepared for state positions.

In fact, especially the civil service sector should have provided the possibility for social mobility since entry into state positions depended (and still depends) highly on educational credentials and thereby weakens the direct influence of social background on class attainment.[43]

2.7 Conclusion

To return to the questions at the beginning, i.e. is there reason to believe that secondary schooling became less elitist over time? Overall, yes. The introduction of modern secondary education led to entry of higher rates of middle class children into secondary education. Within schools, no. Although the Gymnasium became less elitist between 1810 and 1850, this development was reversed after the introduction of the Gewerbeschule. There is no reason to believe that within both modern and traditional secondary schools there was a tendency to become less elitist or more open to lower ranks of the society over time. The occupational structure in both schools reflected the increasing influence of industrialization towards the end of the century, resulting in a higher proportion of industrial and mercantile professions as well as state officials in transport and communication sectors. Throughout the 19th century, the Gymnasium remained the institution of the elite, attracting sons of civil servants, academics, and to a small extent also of farmers and other lower classes, while the Gewerbeschule and Realschule were the preferred choice of the middle class. In comparison to the structure of the overall economy, students coming from agricultural occupations were highly underrepresented in secondary schools whereas especially students from civil service households were extremely overrepresented.

Although it is not possible to obtain reliable conclusions on the mediating role of educational expansion on social mobility, employed findings by related studies suggest that both school types enabled upward mobility: the Gymnasium by conferring credentials required for state positions and the Gewerbeschule/Realschule by preparing for entrepreneurial activities.

What do these results for 19th century Bavaria propose for today? It has become a well-established fact that in international comparison, the relationship between social background and attainment of higher qualifications is especially strong in Germany, and particularly so in Bavaria

[43] Müller et al. (1989) show that in international comparison the link between educational credentials and access into civil service occupations is extremely strong in Germany.

(Freitag and Schlicht 2009; Müller et al. 1989).[44] Thus, the roots of educational inequality can be traced back to the 19th century.

19th century Bavaria did not only experience vast educational expansion for boys; educational participation of girls increased as well, especially towards the end of the century: between 1888 and 1902 the share of girls in secondary education in school-aged[45] population increased from 1 to 1.3 percent. Since it can be supposed that it were mainly girls from higher social classes continuing to secondary education (which is also indicated by the high share of these girls belonging to BSKB category E),[46] the expansion of secondary education might have drastically altered the social composition in girls' schools. According to a study on the relationship between women's education and fertility in 19th century Prussia, mothers with formal education tended not only to have fewer children but to attach greater emphasis on the education of their children as well (Becker et al. 2013). As a result, expansion of female education might not only have raised current educational attainment but also future levels of human capital. Hence, the study of the impact of educational expansion on social composition (and vice versa) in secondary schools for girls provides an interesting topic for future research.

[44] Of all German states, present-day Bavaria exhibits the highest rate of social inequality in secondary education: the chances for children of high socioeconomic status to attend a Gymnasium are about 7 times higher than for working class children (Freitag und Schlicht 2009).
[45] Population aged 11-20 years.
[46] This exclusiveness also applies to university education. According to Craig (1982, p. 221) the social background of female students in early 20th century German universities was much more privileged than that of their male peers.

Appendix 2

Table A2.1 – Sample of Bavarian school cities

City	Gymnasium	Gewerbeschule/Realschule
Amberg	1	1
Ansbach	1	1
Aschaffenburg	1	1
Bamberg[a]	1	1
Bayreuth	1	1
Fürth	0	1
Dillingen	1	0
Kaufbeuren	0	1
Kempten	1	1
Landshut	1	1
Munich[b]	1	1
Nördlingen	0	1
Nuremberg[c]	1	1
Passau	1	1
Regensburg	1	1
Straubing	1	1
Würzburg[d]	1	1
Wunsiedel	0	1

Notes: Table reports school locations of employed sample.

[a] Bamberg opened second Gymnasium in 1890 (Keyser 1971, p.110).

[b] Munich opened second Gymnasium in 1824 and third in 1849 (Keyser 1974, p. 431).

[c] Nuremberg opened second Gymnasium in 1889 (Keyser 1971, p. 414).

[d] Würzburg opened second Gymnasium in 1886 (Keyser 1971, p. 622).

Table A2.2 – Data description and source

Variable	Description	Source
Population 1818, 1830	Total population based on 1837 territory	BSKB, I (1850)
Population 1852, 1871, 1890	Total population based on territory of the respective year	BSB, 192 (1953)
Occupational structure 1852	Population shares employed/self-employed in respective sectors	BSB, IV (1855)
Occupational structure 1870, 1890	Interpolation based on 1882 and 1895 occupational data	own calculations; see main text
Occupational structure 1882	Population shares employed/self-employed in respective sectors	BSKB, L (1886)
Occupational structure 1895	Population shares employed/self-employed in respective sectors	BSKB, LXII (1902)
School-aged population in 1870, 1880, 1890	Population aged 11 to 20 years divided by total population	BSKB, LXIII (1902)
Students and schools		
Gewerbeschule 1850, 1870	Student and school numbers	BSKB, XXVII (1873)
Gymnasium 1833, 1851	Student and school numbers	BSKB, V (1855)
Gymnasium 1870	Student and school numbers	BSKB, XXVII (1873)
Realgymnasium 1870	Student and school numbers	BSKB, XXVII (1873)
Realschule 1890	Student and school numbers	*Ministerialblatt* (1890)
Gymnasium 1892	Student and school numbers	ZKBSB, 26 (1894)
Realgymnasium 1892	Student and school numbers	ZKBSB, 26 (1894)
Female secondary school students 1888, 1902	Students in Höhere Töchter-Schulen	ZKBSB, 20 (1888); 26 (1894)
Specific Gymnasien		
Amberg	1811, 1830, 1850, 1870, 1890	*Jahresberichte*
Ansbach	1811, 1830, 1850, 1870, 1890	*Jahresberichte*
Aschaffenburg	1818, 1830, 1850, 1870, 1890	*Jahresberichte*
Bamberg	1811, 1830, 1850, 1870, 1890 (2x)	*Jahresberichte*
Bayreuth	1811, 1830, 1849, 1870, 1890	*Jahresberichte*
Dillingen	1811, 1830, 1850, 1870, 1890	*Jahresberichte*
Kempten	1811, 1830, 1850, 1870, 1890	*Jahresberichte*
Landshut	1812, 1831, 1850, 1870, 1890	*Jahresberichte*
Munich	1812, 1830 (2x), 1850 (3x), 1870 (3x), 1890 (3x)	*Jahresberichte*
Nuremberg	1811, 1834, 1850, 1870, 1890 (2x)	*Jahresberichte*
Passau	1811, 1831, 1850, 1870, 1890	*Jahresberichte*
Regensburg	1811, 1830, 1850, 1870, 1890	*Jahresberichte*
Straubing	1811, 1830, 1850, 1870, 1890	*Jahresberichte*
Würzburg	1814, 1830, 1850, 1870, 1890 (2x)	*Jahresberichte*
Specific Gewerbeschulen/Realschulen		
Amberg	1850, 1870, 1890	*Jahresberichte*
Ansbach	1850, 1870, 1890	*Jahresberichte*
Aschaffenburg	1850, 1870, 1890	*Jahresberichte*
Bayreuth	1850, 1870, 1890	*Jahresberichte*
Fürth	1850, 1870, 1890	*Jahresberichte*
Kaufbeuren	1850, 1870, 1890	*Jahresberichte*
Kempten	1850, 1870, 1890	*Jahresberichte*
Landshut	1850, 1870, 1890	*Jahresberichte*
Munich	1850, 1870, 1890	*Jahresberichte*
Nördlingen	1850, 1870, 1890	*Jahresberichte*
Nuremberg	1850, 1870, 1890	*Jahresberichte*
Passau	1850, 1870, 1890	*Jahresberichte*
Regensburg	1850, 1870, 1890	*Jahresberichte*
Straubing	1850, 1870, 1890	*Jahresberichte*
Wunsiedel	1850, 1870, 1890	*Jahresberichte*
Würzburg	1850, 1870, 1890	*Jahresberichte*

Table A2.3 – School and student numbers, all Bavarian schools and selected sample schools

Year	Bavaria, all schools				Bavaria, selected sample schools			
	Gymnasium		Gewerbeschule/Realschule		Gymnasium		Gewerbeschule/Realschule	
	Students (per 1,000 people)	No. of schools	Students (per 1,000 people)	No. of schools	Students (per 1,000 people)	No. of schools	Students (per 1,000 people)	No. of schools
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1810	1,304 (0.35)[a]	25			1,052 (0.28)	14		
1830	2,334 (0.56)[b]	25			1,603 (0.39)	15		
1850	3,529 (0.77)[c]	28	2,325 (0.51)	26	2,330 (0.51)	16	1,598 (0.35)	17
1870	9,323 (1.92)	28	4,156 (0.86)	34	1,583 (0.33)	16	2,302 (0.47)	17
1890	16,032 (2.86)[d]	37	10,879 (1.94)	48	2,344 (0.42)	20[e]	2,512 (0.45)	17

Notes: Number in brackets indicates students per 1,000 people (total Bavarian population in 1818, 1830, 1852, 1870, and 1890).

[a] Due to the lack of available data, this number lacks students in Eichstaett, Freising, Metten, and Zweibrücken. Moreover, population numbers are from 1818 and student numbers are from annual school reports issued between 1810 and 1820 (depending on the institution).

[b] Student numbers of 1833.

[c] Student numbers of 1851.

[d] Student numbers of 1892.

[e] Regensburg opened an additional Gymnasium in 1880. However, the annual report of the other Gymnasium in 1890 is not available; data of the new institution is used instead.

Source: Own calculations; see Table A2.2 for data details.

Table A2.4 – Number of students according to HISCLASS (employed sample)

HISCLASS	Class label	No. of students according to HISCLASS classes	
		Gymnasium	Gewerbeschule/Realschule
		1810-90	1850-90
1	Higher managers	1,032	575
2	Higher professionals	2,180	573
3	Lower managers	623	420
4	Lower professionals, and clerical and sales personnel	1,233	1,771
5	Lower clerical and sales personnel	302	173
6	Foreman	622	762
7	Medium skilled workers	873	859
8	Farmers and fishermen	865	167
9	Lower skilled workers	695	645
10	Lower skilled farm workers	57	19
11	Unskilled workers	211	227
12	Unskilled farm workers	60	56
13	Pensioners, retirees and independent gentlemen[a]	158	165
Total		8,911	6,412

Notes: Table lists student shares according to their social background coded into HISCLASS classes. Classes 13 and 14 are no official HISCLASS categories.

[a] Including cases where assignment into HISCO/HISCLASS not possible due to lack of occupational data or match (9 in Gymnasium, 19 in Gewerbeschule/Realschule).

Sources: van Leeuwen and Maas (2011, p. 57), *Jahresberichte*, various years. See Table A2.2 for data details.

Table A2.5 – Number of students according to BSKB categorization (employed sample)

BSKB code	Occupational category	No. of students according to BSKB sectors	
		Gymnasium	Gewerbeschule/Realschule
		1810-90	1850-90
A	Agriculture and forestry	1,226	421
B	Industry, crafts, and mining	2,075	2,517
C	Trade and transportation	1,144	1,961
D	Household services, servants, and day laborers	203	135
E	Civil services[a]	4,104	1,213
F	Pensioners, independent gentlemen, and unemployed[b]	159	165
Total		8,911	6,412

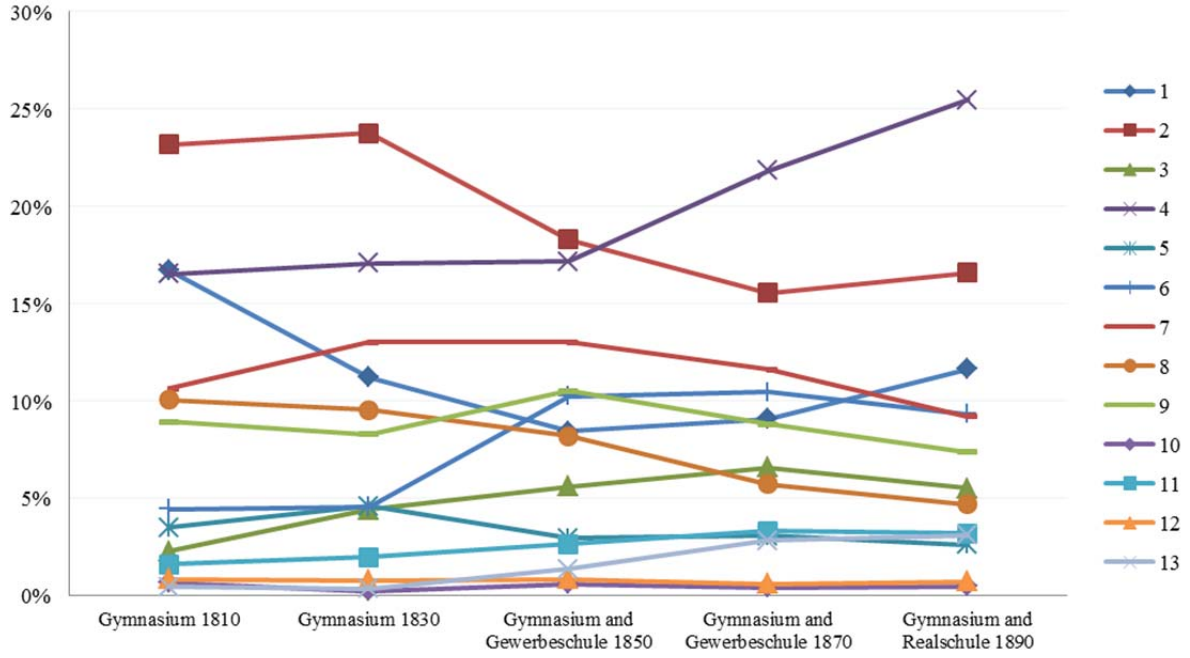
Notes: Table depicts secondary students according to BSKB categorization.
[a]Including military, church, school, medical, and court personnel as well as artists and freelancers.
[b]Including cases where assignment into BSKB categorization not possible due to lack of occupational data or match (9 in the Gymnasium, 19 in Gewerbeschule/Realschule).
Source: *Jahresberichte*, various years. See Table A2.2 for data details.

Table A2.6 – Development of secondary school and student numbers

Year	Secondary education		
	Students (per 1,000 people)	No. of schools	Students per school
1810	1,304 (0.35)[a]	25	52
1830	2,334 (0.56)[b]	26	90
1850	5,894 (1.29)[c]	54	109
1870	13,843 (2.85)[d]	68	204
1890	27,407 (4.89)[e]	89	308

Notes: Table depicts all secondary students per 1,000 people (total Bavarian population in 1818, 1830, 1852, 1870, and 1890. See Table A2.2 for data details
[a] Due to the lack of available data, this number lacks students in Eichstaett, Freising, Metten, and Zweibrücken. Moreover, population numbers are from 1818 and student numbers are from annual school reports issued between 1810 and 1820 (depending on the institution).
[b] Student numbers of 1833.
[c] Student numbers of the Gymnasium are from 1851.
[d] Including 364 students of six Realgymnasien.
[e] Including 496 students of four Realgymnasien. Student numbers of the Realgymnasium and Gymnasium are from 1892.
Source: Own calculations; see Table A2.2 for data details.

Figure A2.1 – Social composition of secondary schools, full HISCLASS range



Notes: Figure depicts students' social classes according to HISCLASS categorization of fathers' occupations as share of all secondary school students in the respective year.
Source: Own illustration; see Table A2.2 for data details.

Table A2.7 – Students with fathers employed as civil servants, shares

Father's occupation	% of students with fathers working as civil servants								HISCLASS codes
	Gymnasium					Gewerbeschule/Realschule			
	1810	1830	1850	1870	1890	1850	1870	1890	
Head teacher, principal	0.4	0.1	0.1	0.1	0.6	0.0	0.0	0.1	1
University professor	0.7	0.5	1.1	1.3	1.2	0.2	0.1	0.1	2
Teacher	3.5	5.4	7.4	8.4	9.4	3.8	2.9	3.2	2
Minister	5.1	2.9	3.2	3.6	2.3	1.6	0.4	0.2	2
Administrative officer	13.5	7.4	4.3	6.6	5.2	2.8	2.3	2.1	1, 2, 3, 4, 5
Forest officer	1.0	2.7	2.5	4.4	2.6	4.7	2.5	0.8	3
Customs officer	1.0	1.6	2.0	1.2	1.3	1.6	0.7	0.8	1, 2, 3, 4
Transport and communication officer	0.7	0.9	0.9	1.5	2.1	1.5	2.5	1.8	3, 4, 5
Fiscal officer	5.6	4.3	3.0	2.7	2.2	1.6	0.9	1.0	1, 2, 3, 4
Public medical officer	2.0	2.1	1.2	1.3	1.5	0.6	0.3	0.1	1, 2
Technician	1.0	0.9	0.9	0.7	1.2	1.1	0.5	0.8	1, 2, 3, 4
Military officer	2.2	1.9	1.5	2.4	3.8	2.1	1.1	0.7	1, 3
Physician	2.5	2.3	2.5	2.3	1.7	0.9	0.4	0.2	2
Judge	3.3	3.6	2.3	3.2	1.7	0.8	0.8	0.3	2
Notary	0.1	0.0	0.0	0.6	0.8	0.0	0.1	0.3	2
Lawyer	3.7	3.6	2.2	3.9	2.6	0.8	0.8	0.2	2
Total	46.3	40.4	35.0	44.2	40.1	23.8	16.4	12.9	

Notes: Table depicts students according to occupational background as share of total student number in respective school and year.
Source: Own calculations; see Table A2.2 for data details.

Table A2.8 – Participation of industrial and trade-related occupations in secondary education, shares

Father's occupation	% of students with fathers working in industrial or trade-related professions								HISCLASS codes
	Gymnasium					Gewerbeschule/Realschule			
	1810	1830	1850	1870	1890	1850	1870	1890	
Engineer	0.00	0.00	0.09	0.06	0.38	0.50	0.22	0.60	2, 4
Architect	0.10	0.19	0.13	0.06	0.43	0.50	0.39	1.59	2
Industrialist	2.09	1.50	1.46	1.45	3.92	3.57	4.87	6.89	1
Merchant	4.09	6.30	5.28	4.93	9.26	11.58	19.07	20.86	4
Travelling salesman or commissioner	0.00	0.00	0.09	0.00	0.43	0.00	0.13	0.68	4
Contractor or craftsman	18.16	21.33	24.94	17.37	14.85	31.98	32.23	26.31	6, 7, 9
whereof % master craftsman	24.61	20.76	35.46	45.82	47.13	35.23	34.37	42.21	6
Total	24.52	29.51	32.70	25.27	31.53	49.06	59.25	58.56	

Notes: Table depicts students according to occupational background as share of total student number in respective school and year.
Source: Own calculations; see Table A2.2 for data details.

Table A2.9 – Students with fathers of considerable wealth or working as farmers, shares

Father's occupation	% of students with fathers with fathers being/working as…								HISCLASS codes
	Gymnasium					Gewerbeschule/Realschule			
	1810	1830	1850	1870	1890	1850	1870	1890	
Private gentleman	0.00	0.19	0.73	1.39	1.79	0.94	2.30	1.55	/
Major landowner	0.38	0.50	0.64	1.07	0.94	1.44	0.87	0.80	1
General farmers	9.32	9.36	11.42	9.60	7.51	2.94	2.87	1.71	8
Total	9.70	10.04	12.79	12.07	10.24	5.32	6.04	4.06	

Notes: Table depicts students according to occupational background as share of total student number in respective school and year.
Source: Own calculations; see Table A2.2 for data details.

Chapter 3

Immigration and educational spillovers: evidence from Sudeten German expellees in post-war Bavaria

3.1 Introduction

Research repeatedly emphasizes the role of human capital for economic development.[1] In this context, it has been shown that external impulses from (high-) skilled immigrants can have various beneficial effects on the receiving economy.[2] Instead of focusing on economic outcomes of immigration directly, this paper explores the impact of skilled immigrants and – more importantly – their specific preferences toward education on the level of human capital in the native population. The mass exodus of ethnic Germans in the aftermath of World War II provides a unique natural experiment setting to study the impact of educational spillover effects.

The final months of WWII saw a tremendous movement of ethnic Germans from eastern to western territories of the German Reich fleeing from the advancing Red Army. By the time the Potsdam Agreement was signed on August 2nd 1945, roughly 4 million ethnic Germans from eastern territories had fled to areas which would form West Germany (Jaenicke 1950, p. 6). In 1949, the number of displaced ethnic Germans – so-called *Vertriebene*[3] – in West Germany who had fled or had

[1] The literature on the importance of human capital for economic development is vast. See for example, Barro (2001), Easterlin (1981), and Krueger and Lindhal (2001). These studies suggest that economic growth is positively associated with secondary and higher educational attainment (Barro 2001), schooling expansion (Easterlin 1981), and influenced through education policies (Krueger and Lindahl 2001).

[2] See for example Borjas (1999) and Kerr and Kerr (2011) for surveys.

[3] The Federal Expellee Law (BVFG, *Bundesvertriebenengesetz*) distinguishes between 'refugees' (*Flüchtlinge*) who fled from the Soviet occupation zone (SOZ)/German Democratic Republic (GDR) and 'displaced people' (*Vertriebene*) as German citizens or ethnic Germans who lived in former eastern German territories (lost during or after the war) or beyond the borders of the German Reich in 1937 and were displaced during or after the war. The latter are further differentiated into 'expellees' (*Heimatvertriebene*) who lived in former eastern German territories (inside 1914-37 borders) or former Austro-Hungarian territories in 31.12.1937, and into common 'displaced persons' (*Vertriebene*) who lived in would-be eastern territories or outside the German Reich on 31.12.1937. Children born to these displaced Germans inherit the displacement status of their parents (BVFG §§1-4). This suggests that 'natives' are people who had their place of residency in territories which later formed the Federal Republic of Germany (BRD) prior to the war. Sudeten Germans belong to the category *Heimatvertriebene* since Bohemia, Austrian/Moravian Silesia, and Moravia were part of the Austro-Hungarian Empire. In this paper, however, the terms expellees and displaced Germans will be used synonymously to refer

been expelled from east and central Europe amounted to approximately 8 million people – i.e. 17 percent of the total West German population (Nellner 1959, p. 97). While most refugees doubted in the beginning that their displacement would be permanent, by 1950 at the latest, it was clear that return was impossible (Jaenicke 1950, pp. 5-7).[4] Therefore, integration of these expellees became one of the highest and most urgent objectives in post-war Germany.

The southern German state of Bavaria received a great share of these displaced Germans: in 1950, about 2 million expellees had come to Bavaria, thereby accounting for more than 20 percent of the Bavarian population. The majority of expellees in Bavaria came from territories in Czechoslovakia known as the Sudetenland. Pre-war Sudetenland had been highly industrialized, demanding a profound level of education. In addition, Sudeten Germans assigned a high value to education since it also enabled them to preserve their cultural identity in Czechoslovakia (Lemberg 1959, pp. 370-2). Hence, displaced Sudeten Germans brought along specific preferences toward education, or more precisely, secondary education of a practical, business-oriented, and general type. Once arrived in Bavaria, Sudeten Germans successfully lobbied for the reintroduction of Realschulen which met all their educational demands but had been abolished in Nazi Germany. By increasing the provision of middle track education (i.e. Realschule and Fachschule) particularly in the Bavarian countryside, as well as by expressing their value for this kind of secondary education, Sudeten Germans might have enhanced educational participation of native Bavarians through educational spillover effects.

Thus, this paper analyzes the role of Sudeten Germans in Bavarian (higher) secondary education and studies their impact on educational development of post-war Bavaria. The latter is done by exploring county-level differences in student numbers and people with certain secondary school degrees through variation in the share of Sudeten Germans present after the war. Results indicate that a higher share of Sudeten Germans in 1950 is associated with higher educational participation – that is, a higher share of children in higher secondary education – as well as with higher educational attainment – that is, a higher share of the population holding secondary school degrees some 20 years after displacement. According to the results of a back-of-the-envelope-calculation, the increase in the stock of people with secondary school degrees can be traced back not only to more Sudeten Germans holding these degrees upon arrival in Bavaria but also to a higher number of native Bavarians with these degrees. Hence, Sudeten Germans induced a positive spillover effect on the Bavarian population. Results are especially pronounced for applied education, i.e. middle track institutions. Several robustness checks are employed and support the results.

to expelled or displaced ethnic Germans.

[4] These hopes of a fast return were fuelled in the immediate post-war years by various politicians such as Bavarian Prime Minister Högner (Oct. 1945), US Secretary of State Byrnes (Sept. 1946) and his successor Marshall (Apr. 1947) (Habel 2002, p. 106).

By focusing on the impact of ethnic German expellees on the educational development of post-war Bavaria, this paper contributes to the economic literature on the impact of both forced and high-skilled migration.

The economic integration of ethnic German expellees has recently started to receive attention by economists. These studies can be sorted into two categories: (1) effects on displaced Germans as forced migrants and (2) effects on post-war Germany as the receiving country and its communities.[5] Research belonging to the first category focuses on the economic impact on displaced ethnic Germans after WWII. For example, Bauer et al. (2013) find that the long-term effects on economic outcomes of displaced Germans were significantly negative compared to native Germans: expellees experienced lower incomes and higher unemployment risks even 25 years after resettlement. This economic disadvantage seems to have been inherited by their children who as second-generation migrants[6] were also economically worse off than their native peers. However, migrants who had worked in agriculture before the war profited economically from displacement since their long-term incomes exceeded those of non-displaced peers. The authors explain this finding as a result of faster tranisition of expellees into other – potentially better paid – sectors of the economy. Falck et al. (2012) study the integration of displaced Germans into the labor market and thereby evaluate the 1953 Federal Expellee Law (*Bundesvertriebenengesetz*) which intended to improve the econmomic situation of expellees.[7] Although expellees experienced a considerable increase in their economic well-being during the post-war years, Falck et al. argue that this improvement cannot be attributed to the law but rather to the general economic boom of the 1950s and 60s. Studies belonging to the second category focus on economic effects induced by immigration of displaced Germans. For example, Braun and Mahmoud (2014) find that expellees considerably reduced native employment rates in the short-run[8] since both groups were considered close substitutes by employers. Braun and Kvasnicka (2014) find that the inflow of displaced ethnic Germans substantially contributed to structural change by speeding up the transition from low-productivity agriculture to high-productivity sectors. One reason is that displaced farmers had to find work in other sectors due to the non-availability of free arable land.

[5] See Ruiz and Vargas-Silva (2013) for an extensive literature overview on the economics of forced migration.
[6] Bauer et al. (2013, p. 20) define second-generation migrants as children born to displaced Germans between 1944 and 1949.
[7] The Federal Expellee Law (BVFG, *Bundesvertriebenengesetz*) was introduced in 1953 and defined who was to be considered as an expellee. The aim of the BVFG was to improve the economic well-being of expellees who had to struggle not only with the loss of their homes, belongings, occupations, farms, etc. but also with other consequences of flight such as emotional distress, health problems, or the loss of loved ones. According to contemporary newspaper reports, only about a quarter of them were working in positions similar to their pre-displacement status in 1952 (Strobel 1953). See also also Stein (1952). The BVFG contained several mechanisms/instruments including official legitimation of occupational certificates, preferred placement of expellees into vacant positions by public employment services, integration of former farmers into the agricultural sector, and provision of subsidized credits to self-employed and entrepreneurs.
[8] Braun and Mahmoud (2014) use 1950 census data.

Forced migration after WWII affected other European countries as well. For example, Sarvimäki et al. (2009) focus on the displacement of Finns which resulted after Finland had to cede part of their territory to the Soviet Union after WWII. Their results suggest positive long-term economic outcomes for displaced men. The authors ascribe this finding to the increased regional mobility of displaced.

All studies discussed so far focus on the economic effects of forced migration by exploiting the fact that there are no large differences between natives and displaced persons according to their labor market opportunities. This may have been the case for the average expellee[9] in Germany, but in Bavaria this was certainly not. The overwhelming majority of expellees in Bavaria came from Czechoslovakia and was known as Sudeten Germans.[10] Sudeten Germans, differed in several aspects from the receiving Bavarian population. While pre-war Bavaria was predominantly characterized by agriculture, the Sudetenland had a highly developed industrial sector employing most of the population.[11] The industrial orientation of the Sudetenland clearly demanded a profound level of education. Furthermore, being an ethnic minority might itself have influenced educational outcomes. According to Lemberg (1959, pp. 370-2), Sudeten Germans saw education as a means to preserve their linguistic identity and to dissociate themselves from the Czechoslovakian population. In addition, Keil (1967b, p. 13) maintains that Sudeten Germans were especially enthusiastic about education. This is in line with Handl and Herrmann (1994, p. 40) who conclude that the presence of Sudeten Germans led to huge educational gaps between natives and immigrants in the affected counties.

Migration of (high-) skilled individuals has been shown to have various effects on the receiving economy. For example, Hornung (2014) studies the expulsion of Huguenots from France to Prussia at the end of the 17th century. The Huguenots were a Protestant group characterized by a high level of human capital and self-selection into skilled occupations. Hornung finds that Huguenots substantially increased productivity in the textile sector in the long-run by transferring their superior knowledge to the native population. Focusing on immigration of German-Jewish scientists from Nazi-Germany to the U.S., Moser et al. (2014) find that these high-skilled immigrants increased patenting by U.S. inventors by a third. However, this is not a result of higher productivity of incumbents but rather of the entrance of new U.S. researchers into immigrants' research fields. Hunt and Gauthier-Loiselle (2010) also look at patenting in the U.S. and show that skilled immigrants led to a boost in patenting activity.

[9] In 1950, 57 percent of all displaced Germans in West Germany (incl. West Berlin) came from former eastern provinces (e.g. Pomerania and East-Prussia) and 24 percent from Czechoslovakia (SBBRD 1953).
[10] The term 'Sudetendeutsch' emerged during the 1920s after formation of Czechoslovakia and refers to those territories inside Czechoslovakia that were mainly populated by ethnic Germans (Preissler 1967, p. 134).
[11] The difference in the share of people employed in industry and crafts is especially pronounced between the Sudetenland and Bavaria: while only 17 percent of the pre-war Bavarian population worked in the industrial sector, the share in the Sudetenland exceeded 43 percent. Section 3.3.1 provides a more detailed discussion of socio-economic differences between Bavarians and Sudeten Germans.

According to the authors, this increase is due to immigrants patenting at higher rates than natives as well as to positive spillovers from immigrants on incumbent scientists.

Hence, this paper combines two strands of the literature by complementing the research on forced as well as skilled migration. First, it shifts the focus from economic outcomes to educational impacts induced by forced migrants. Second, it exploits the difference in educational behavior between natives and displaced to study the effect on educational outcomes.

Bavaria is an interesting case to study the impact of skilled immigration on educational development: as a predominantly agrarian state it received an enormous number of expellees coming from highly industrialized Sudetenland. This stark contrast between host and sending region in economic terms combined with the fact that Sudeten Germans bore specific preferences concerning education provides a unique opportunity to study educational spillover effects.

The remainder of the paper is structured as follows. Section 3.2 provides a brief background on the history of the Sudetenland and post-war migratory movements of Germans. Section 3.3 discusses the role of Sudeten Germans in post-war Bavaria. Section 3.4 describes the data. Section 3.5 introduces the empirical strategies to identify Sudeten German influence on the educational development of Bavaria and presents regression results. Section 3.6 discusses potential channels of Sudeten German influence on educational development. Finally, section 3.7 concludes.

3.2 Historical background

3.2.1 A brief history of the Sudetenland

Earliest ethnic German settlements in Bohemia and Moravia are documented for the 11th and 12th century (Schieder et al. 1984a, p. 3). In the following 800 years, ethnic Germans and Czechs lived more or less peacefully side by side. With the upcoming idea of the national state during the 19th century, tensions started rising between the Czech and German population (Aschenbrenner 1959, pp. 127-9). After the downfall of the Habsburg monarchy in 1918, the first Czechoslovakian Republic was founded. Although this republic was initially conceptualized as a federal state,[12] the Czech population pursued the ideal of a Czech national state. As a result, the ethnic German population – henceforth called Sudeten Germans – became a tolerated minority instead of an equal partner. In the following years, Sudeten Germans first fought for recognition inside the Czechoslovakian state, then for a transformation of Czechoslovakia into a multinational state, and – as both failed – demanded full autonomy of the Sudetenland or, alternatively, integration into the German Reich (Habel 2002, pp. 20-4; Schieder et al. 1984a, pp. 3-4). This conflict culminated in the so-called 'Sudeten crisis' of 1938, provoked by Nazi Germany by demanding the annexation of those parts of Czechoslovakia inhabited predominantly by ethnic Germans, known as the Sudetenland. Czechoslovakia finally yielded to the

[12] Example was the Swiss model as a multinational federal state (Habel 2002, pp. 35-6).

pressure imposed also by the Great European Powers (i.e. England, France, and Italy) and ceded the Sudetenland to the German Reich at the Munich Agreement in September 1938 (Aschenbrenner 1959, pp. 98-9; Gebel 2000, pp. 1-2).[13] The main part of the Sudetenland was then transformed into the *Reichsgau Sudetenland* with capital Reichenberg and incorporated into the German Reich. Smaller Sudeten German settlements in the south went to Bavaria and Austria – since March 1938 also part of the German Reich. Although most German settlements were now part of the German Reich, several cities with German minorities – including for example Prague and Brünn – remained Czechoslovakian. This changed in spring 1939, when Hitler's forces marched into the Czech parts of Czechoslovakia resulting in the establishment of the Protectorate of Bohemia and Moravia. This breach of the Munich agreement, as well as the injustices against the Czechoslovakian population perpetrated in the following period, ultimately contributed to the Beneš[14] decrees leading to the disempowerment, expropriation, and expulsion of ethnic Germans after the war (Aschenbrenner 1959, pp. 100-6).

The Sudetenland was characterized by a highly developed industrial sector – especially in comparison to predominantly agrarian Bavaria. It was rich in natural and mineral resources like coal, fossil oil, iron ore, graphite, and timber, which formed the basis for light and heavy industry. Furthermore, trade, commerce, and industry flourished in Sudeten cities. The Sudetenland was famous for its sophisticated textile, porcelain, glazing, and food industries (Aschenbrenner 1959, pp. 120-6; Maier and Tullio 1996, pp. 28-9).

This high level of industrialization was complemented by the educational system of the Sudetenland: while an industrial society requires a sort of education meeting economic and industrial demands, it is also this kind of education which contributes to the development of this specific economic environment. In comparison to the rest of the German Reich, modern secondary education in form of the Realschule and Realgymnasium enjoyed high popularity. Especially the latter school type was very popular since it was conceived as the industrial response to the humanist Gymnasium. Furthermore, Fachschulen and Gewerbeschulen provided relevant education for industrial, commercial, and trade-related occupations, and entitled to university studies (Prinz 1970).[15]

[13] In fact, the cession of the Sudetenland to the German Reich was supposed to sustain peace in Europe and hence greatly welcomed – especially by the British Prime Minister Chamberlain and the British public (Gebel 2000, p. 1; Slapnicka 1970a, p. 96).

[14] Eduard Beneš was president of Czechoslovakia from 1935 to 1938, head of the Czechoslovakian exile government from 1940 to 1945, and afterwards president of the re-founded Czechoslovakian Republic (until 1948) (Slapnicka 1970a, pp. 134-9). Decrees concerning the expulsion of ethnic Germans were issued between May and October 1945 (Bohmann 1959, pp. 198-9).

[15] In fact, Bavaria had introduced modern secondary education in form of the Gewerbeschule in 1829 which was later replaced by the Bavarian Realschule. The Realschule was also extremely popular as an alternative to the humanist Gymnasium (Semrad 2015).

3.2.2 Flight and expulsion 1945-50

Approximately 3,000,000 people lived in the Sudetenland in 1939 (RSG). Until 1945, the Sudetenland had been mainly unaffected by the war, with only few bombings of industrial locations. This changed in early 1945 when Soviet forces entered the Sudetenland and the Protectorate, thereby triggering mass evacuation and flight of the German population (Schieder et al. 1984a, pp. 19-32). To deal with the mass exodus of ethnic Germans not only from Czechoslovakia but from all eastern provinces of the collapsed German Reich, official redistribution policies were initiated by the Allied Control Council. Reference to the problem of displaced Germans was also made in the Potsdam Agreement.[16] One point concerned the 'Orderly Transfer of German Populations': remaining ethnic Germans in Poland, Czechoslovakia, Hungary, and Austria were to be transferred into post-war German territories (Jaenicke 1950, pp. 6-7). The Potsdam Agreement determined that the transfer should be undertaken in "*an orderly and humane manner*".[17] Although several contemporary testimonies report injustices or in some instances atrocities against expellees by the Czechoslovakian public and official personnel,[18] Schechtman (1953) concludes that all in all the operation met the standards stipulated by the Potsdam Agreement.

The majority of Sudeten Germans fled to Germany: ca. 1,900,000 to West and ca. 900,000 to East Germany (Nellner 1959, p. 120; Pietsch and Pleticha 2012, p. 83). The remainder went to Austria (ca. 140,000), Scandinavia (ca. 4,300), Italy (ca. 3,000), and Switzerland (ca. 2,000). Small numbers of Sudeten German refugees are also documented for almost all European countries as well as for Israel, South and North America, New Zealand, and Australia (Bohmann 1959, pp. 231-6). The number of Sudeten Germans deceased on the run or in prisons and detention camps associated with post-war expulsion is estimated at ca. 240,000 (Schieder et al. 1984a, p. 134; Slapnicka 1970b, p. 320), while the number of Sudeten Germans remaining in Czechoslovakia amounts to ca. 150.000 to 250.000 people (Aschenbrenner 1959, p. 105).[19]

As a result of geographical proximity, most Sudeten Germans fled to nearby Bavaria. More than half of the roughly 2 million Sudeten Germans in West Germany had settled in Bavaria by 1950.[20] In

[16] The Potsdam Agreement was signed on August 2nd 1945 by the leaders of the Allies of World War II – Soviet General Secretary Stalin, US President Truman, and British Prime Minister Attlee – and laid the foundation for the allied occupation and reconstruction of post-war Germany (Jaenicke 1950, p. 6).

[17] Paragraph XII of the Potsdam Agreement regulates the 'Orderly Transfer of German Populations'. The Potsdam Agreement is available online: http://usa.usembassy.de/etexts/ga4-450801.pdf.

[18] See Schieder et al. (1984b) and Harasko (1995) for a compilation of Sudeten German expellees' testimonies.

[19] Ethnic Germans were allowed to stay as full-fledged citizens in post-war Czechoslovakia if they had been involved in resistance or opposition to German National Socialism (this mostly applied to members of the Social Democrats and/or Communists). However, these Germans did not enjoy any minority rights which might explain why the majority of them, i.e. 86,176, opted for voluntary transfer to East and West Germany in the following years while 55,017 remained in Czechoslovakia. Furthermore, certain skilled workers were also excluded from expulsion (Schechtmann 1953, pp. 156-7; Slapnicka 1970b, pp. 321-2).

[20] The distribution of Sudeten German expellees across other states of West Germany (in 1950) is as follows: 394,51 in Hesse, 322,681 in Baden-Wuerttemberg, 74,607 in North Rhine-Westphalia, 57,790 in Lower Saxony,

Bavaria, Sudeten Germans also formed the biggest expellee group. With a total of 1,986,195 people, Bavaria had one of the highest shares of expellees in total population (20 percent) in post-war Germany, surpassed only by Schleswig-Holstein (33 percent) and Lower Saxony (27 percent) (Müller and Simon 1959, p. 360).[21] Table 3.1 provides information about the country of origin of displaced Germans in Bavaria in 1950.

Table 3.1 – Displaced people in Bavaria in 1950 according to pre-war place of residence

Place of residence in 1939	Total number 1950	% of total population 1950	% of all displaced people 1950
Sudetenland	1,031,468	11.23	51.93
Silesia	461,158	5.02	23.22
Other former German territories in 1937[a]	137,264	1.49	6.91
Yugoslavia	71,073	0.77	3.58
Poland	67,115	0.73	3.38
Hungary	57,511	0.63	2.90
Romania	48,024	0.52	2.42
Other foreign countries[b]	44,812	0.49	2.26
Austria	42,952	0.47	2.16
Former Baltic States	13,378	0.15	0.67
Danzig	11,440	0.12	0.58
Total	**1,986,195**	**21.63**	**100**

Notes: Table depicts total and relative numbers of displaced people in Bavaria according to pre-war place of residence.

[a] Territories east of Oder/Neisse line (East Prussia, East Pomerania, East Brandenburg).

[b] Including people without information on place of residence in 1939.

Source: Own calculations based on BSB, 171 (1952).

According to Table 3.1, Sudeten Germans in Bavaria amounted to 1,031,468 people in 1950 – i.e. 11 percent of the total Bavarian population. Silesians were the second largest group, followed by people from territories east of the Oder/Neisse line. Thus, Sudeten Germans constituted a large part of the Bavarian post-war population and it can therefore be supposed that they played a significant role in the formation of post-war Bavaria.

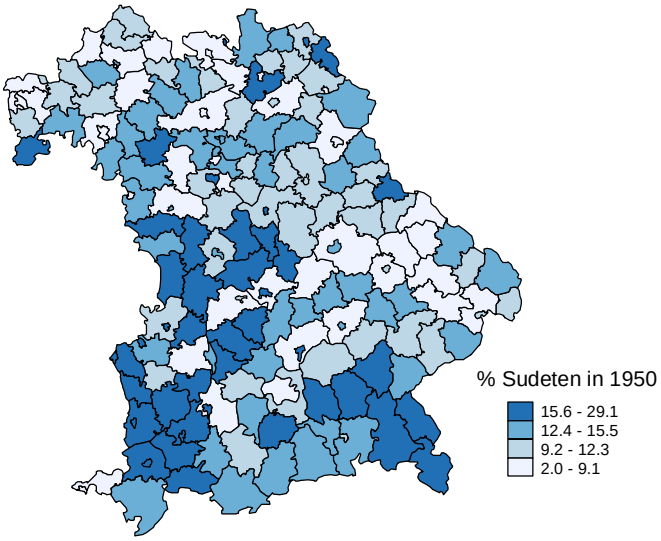
The first flow of refugees into Bavaria started in early 1945 when Germans living in the eastern territories had to flee from the advancing Red Army. Once arrived in Bavaria, they – i.e. people from Silesia, East Prussia, East Pomerania, and East Brandenburg – settled in areas most closely to the border for obvious reasons: first, these were the first accessible safe regions and second, in case of return – which many refugees were in the beginning quite sure of – these regions were closest to their homes (Maier and Tullio 1996, pp. 131-2). Hence, when Sudeten Germans arrived during 1946, the Bavarian refugee offices (*Flüchtlingsämter*) placed them in the southern and western areas of Bavaria

29,645 in West Berlin, 15,771 Rhineland-Palatinate, 12,684 in Schleswig-Holstein, 5,818 in Hamburg, and 2,289 in Bremen (Bohmann 1959, p. 226).

[21] In absolute terms, Bavaria received the highest numbers of expellees across all German states, followed by Lower Saxony (ca. 1,850,000), and Schleswig-Holstein (ca. 857,000) (Bauer 1995, p. 201).

which had been largely unaffected by the inflow of previous expellee groups. The aim was to equalize the distribution of displaced people in Bavaria and thereby lower the average financial burden in counties (Jaenicke 1950, pp. 8-10). As a result, Sudeten Germans were primarily sent to Swabia and Upper Bavaria. In Swabia, they accounted for 68 percent of all displaced Germans and constituted 17 percent of the total Swabian population in 1950 – the highest share of all Bavarian administrative regions. In several Swabian counties, more than every fourth inhabitant was from the Sudetenland.[22] Figures 3.1 and 3.2 present the distribution of Sudeten Germans across Bavarian counties and administrative regions in 1950, respectively.

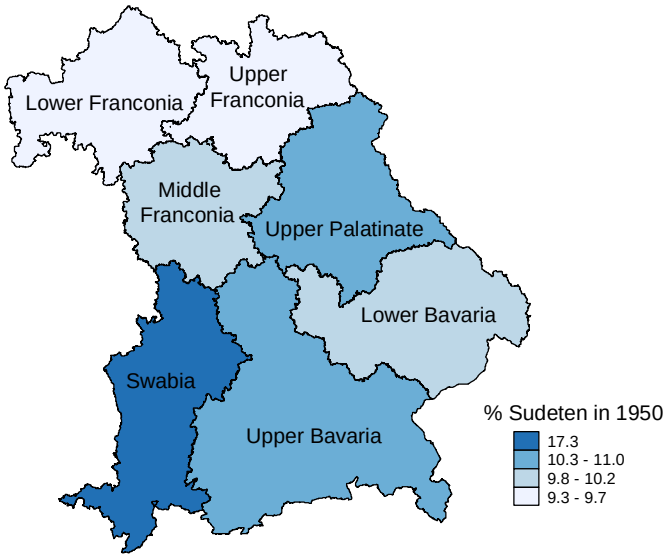
Figure 3.1 – Sudeten Germans across Bavarian counties 1950



Notes: Figure depicts county-level population shares of Sudeten Germans across Bavarian urban and rural counties in 1950.
Source: Own illustration; see Bibliography and Table A3.2 in Appendix 3 for data details.

[22] Out of the 15 Bavarian counties with population shares of Sudeten Germans exceeding 20 percent, 12 were located in Swabia. In five of them (i.e. the Swabian rural counties of Wertingen, Illertissen, Marktoberdorf, Neu-Ulm and the urban county of Kaufbeuren), Sudeten Germans accounted for more than a fourth of the total population in 1950.

Figure 3.2 – Sudeten Germans across Bavarian administrative regions 1950



Notes: Figure depicts population shares of Sudeten Germans across Bavarian administrative regions in 1950.
Source: Own illustration; see Bibliography and Table A3.2 in Appendix 3 for data details.

In general, expellees were placed in small municipalities with less than 5,000 inhabitants.[23] This is especially true for Sudeten Germans: 54 percent of them lived in municipalities with less than 2,000 inhabitants, whereas this was only the case for every third non-Sudeten German displaced person (BSB 151, p. 8). The placement in small villages is a direct consequence of the war: while in most of the larger German cities the housing stock had been substantially destroyed, smaller counties had mainly been spared from the Allies' bombs (BSB 142, p. 7). Therefore, Bavarian – and especially Swabian – counties might have benefitted the most from potential spillover effects by Sudeten Germans.

Hence, expulsion and resettlement taking place in this particular historical setting ensures that this study does not suffer from selection problems commonly encountered in migration analyzes. First, Sudeten Germans were not able to self-select into migration. This would be problematic if only those Sudeten Germans migrated to Bavaria that were especially keen on education and inference is to be drawn on all Sudeten Germans (migrated and not migrated). Since expulsion affected all Sudeten Germans (with only very few exceptions) this study does not suffer from self-selection of migrants. Second, the specific historical conditions provide that placement of Sudeten Germans across Bavarian counties is relatively random[24] and, more importantly, not associated with provision of secondary schools or other education-related factors in the placement county: a simple linear regression of the

[23] 75 percent of all displaced Germans lived in small municipalities with less than 5,000 inhabitants in 1950 (BSB 151, p. 8).
[24] Placement was arguably random since it occurred irrespective of considerations regarding the economic receptiveness or development potential of the county (Bauer 1995, pp. 200-1). However, since war bombings affected in most cases economic center there might exist a negative relationship between economic development before or during the war and post-war expellee placement in counties.

share of Sudeten Germans in 1950 on the existence of applied secondary schools in 1938 (i.e. Realschule, Realgymnasium, and Oberrealschule) – the last year before the school reform – reveals a significant negative relationship.[25] Hence, post-war placement of Sudeten Germans across Bavarian counties was not positively associated with pre-war provision of applied secondary schools. In addition, expellees (and also Bavarians) were not free to move to other counties until 1949 (Ziemer 1973, pp. 130-3). Since the empirical analysis employs 1950 data on Sudeten Germans, one remaining threat concerns migration of Sudeten Germans after 1950 which might occur due to educational purposes. The robustness section will address this problem.

3.3 Sudeten Germans in post-war Bavaria

3.3.1 Descriptive statistics

To assess the role Sudeten Germans played in the formation and development of post-war Bavaria, precise information about the socio-economic background of Sudeten German immigrants is necessary. In absence of this information, descriptive statistics on the Sudetenland before the war are employed and compared to respective Bavarian numbers. Since expulsion affected the whole population of the Sudetenland – with only very few exceptions – available pre-war information provides a reliable source on the characteristics of the average Sudeten German expellee.

As outlined in section 3.2.2, most Sudeten Germans settled in the Bavarian countryside – mainly in Swabia – and not in cities. Therefore, any spillover effects Sudeten Germans might induce should be more pronounced in Bavarian rural counties. Taking this historical settlement pattern into account, Table 3.2 compares Bavarian urban with rural counties.

[25] The coefficient of an applied school dummy in 1938 on the share of Sudeten Germans in 1950 is -2.57, with a p-value of 0.001. This correlation becomes insignificant once a dummy for rural county is added. Table A3.1 in Appendix 3 reports regression results. Moreover, according to the results of a two-sided t-test, counties without applied secondary schools in 1938 had on average 2.5 percentage points higher shares of Sudeten Germans in 1950 than counties with an applied school before the war.

Table 3.2 – Pre- and post-war differences between Bavarian urban and rural counties

Variables	Urban county		Rural county		Difference in means
	Mean	Std. Dev.	Mean	Std. Dev.	
	(1)	(2)	(3)	(4)	(5)
Students in secondary education 1939					
% of total population	3.69	1.83	0.27	0.44	3.43***
% of respective age cohort[a]	23.52	10.03	1.56	2.59	21.96***
Secondary schools per school-aged[a] child	0.04	0.03	0.01	0.01	0.03***
Sudeten Germans (% of total population)					
1950	8.93	5.14	13.68	4.66	-4.75***
Observations	48		143		

Notes: Table depicts sample means and differences in sample means of pre-war (1939) variables. Difference in means is statistically significant at *** 1%, **5% and *10% level.

[a] 10-20 year olds.

Source: Own calculations; see Table A3.2 in Appendix 3 for data details.

According to Table 3.2 there are substantial differences between rural and urban counties. First, educational participation is significantly lower in the countryside: while less than 2 percent of school-aged children continued to secondary education, the corresponding rate was more than 10 times higher in urban counties. In cities, almost 24 percent of children between 10 and 20 years were enrolled in secondary education in 1939. Thus, before the war, urban counties had a strikingly higher share of children in secondary education. Clearly, this might have also been the result of a lower provision of secondary schools in rural counties, as indicated by the table. The aforementioned concentration of Sudeten Germans in small and rural municipalities is confirmed: whereas urban counties housed on average 9 percent of Sudeten Germans in 1950, rural counties had shares of 14 percent.

Hence, Bavarian rural counties can be supposed to have been more affected by potential spillovers of Sudeten Germans since they were more 'treated' than Bavarian cities. Table 3.3 acknowledges this supposedly stronger spillover effect by reporting pre-war characteristics of the Sudetenland and Bavaria, thereby differentiating between Bavaria as a whole and Bavarian rural counties only.

Table 3.3 – Pre-war characteristics of Bavarians and Sudeten Germans

Pre-war variables	Bavaria, all		Bavaria, rural counties		Sudetenland		Difference in means (5)-(1)	Difference in means (5)-(3)
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Population 1939	36,405	65,783	31,057	10,609	50,328	20,682	13,922	19,271***
Age structure (% of total population)								
> 6 years	11.39	1.69	12.05	1.25	8.08	1.42	-3.31***	-3.97***
6 - 14 years	13.77	2.23	14.62	1.74	12.62	1.98	-1.16***	-2.00***
65 years <	7.52	1.01	7.46	0.94	9.20	1.40	1.68***	1.74***
Children in secondary school age[a]	18.82	1.74	19.42	1.34	17.39	1.28	-1.43***	-2.03***
Religion (% of total population)								
Catholics	74.03	30.78	77.80	30.07	89.73	9.58	15.70***	11.94***
Protestants	24.85	30.46	21.49	29.99	5.12	7.49	-19.73***	-16.37***
Students in secondary education								
% of total population	1.13	1.79	0.27	0.44	0.78	0.68	-0.35	0.51***
% of respective age cohort[a]	7.08	11.01	1.56	2.59	4.90	4.27	-2.18	3.34***
Secondary schools per school-aged[a] child	0.01	0.02	0.01	0.01	0.02	0.02	0.01	0.01***
Employment								
I. Status (% of total population)								
Self-employed	10.44	3.37	11.88	2.51	17.06	5.32	6.62***	5.17***
Civil servants & white collar workers	6.75	4.81	4.27	1.91	12.48	5.83	5.73***	8.21***
Blue collar workers	21.23	5.49	19.96	5.15	46.57	7.82	25.33***	26.60***
Helping family member	16.27	9.06	20.72	5.47	9.69	5.26	-6.59***	-11.04***
Living of rents[b]	8.31	2.98	7.14	1.47	14.25	2.30	5.94***	7.11***
II. Sector (% of total population)								
Agriculture	25.26	15.31	32.81	9.16	22.29	14.36	-2.97	-10.52***
Industry & crafts	17.10	7.03	15.40	6.05	43.31	11.83	26.22***	27.91***
Trade & Transport	6.10	4.05	4.30	1.87	11.98	5.39	5.88***	7.68***
Public & private services	4.66	3.48	3.16	1.81	6.93	3.44	2.27***	3.77***
Observations	191		143		58			

Notes: Table depicts sample means and differences in sample means of pre-war (1939) variables, rounded to two decimal places. Difference in means is statistically significant at *** 1%, **5% and *10% level.

[a] 10-20 year olds.

[b] Including unemployed, pensioners, and students living outside family.

Source: Own calculations; see Table A3.2 in Appendix 3 for data details.

Columns 1, 3, and 5 of Table 3.3 report means of pre-war characteristics, columns 2, 4, and 6 respective standard deviations, and columns 7 and 8 the difference in means between Sudetenland and Bavaria as a whole and Bavarian rural counties, respectively. As both columns 7 and 8 indicate, Sudeten Germans and Bavarians differ significantly in almost all variables. Differences are especially pronounced for religious affiliations, blue collar workers, and industry and crafts. Hence, the Sudetenland had a higher share of Catholics, blue collar workers, and people employed in industry and crafts than Bavaria. Further, it is important to note that Sudeten Germans and Bavarians do not differ significantly in the population shares of students in higher education shown in column 7. This changes once Bavarian urban counties are excluded in column 8: Sudeten German counties exhibit a

significantly higher share of students in secondary education than the Bavarian countryside. Student shares – referring either to total population or respective age cohort – are more than twice the value of the Bavarian ones. Consequently, Bavarian rural counties as being the main receiver of Sudeten Germans – who sent proportionally more of their children to secondary education – should therefore also be the main profiteers from potential spillover effects.[26]

3.3.2 Sudeten German influence on Bavarian secondary education

Indeed, historical evidence suggests that Sudeten Germans played a decisive role in the development of the Bavarian education sector. According to Keil (1967a, p. 481), Sudeten Germans in post-war Bavaria actively sought a form of school which they would have preferred for their children in the Sudetenland. So when former Sudeten German teachers arrived in post-war Bavaria, these teachers started to become actively engaged in the founding of new schools, partly due to economic self-interest, but also due to their inherent educational spirit and beliefs (Arnold 1967; Keil 1967a, pp. 485-7). One prime representative of the Sudeten German teachers was Viktor Karell, also named 'Father of the Bavarian Realschule' (Schmitzer 2002, p. 215). Karell, who had been teacher at several commercial schools and academies in the Sudetenland, became a prominent advocate for the establishment of a Bavarian school focusing on practical, commercial as well as general education. He and his pedagogical colleagues teamed up with forces from business, industry, commerce, and crafts, which were also demanding this kind of education, and successfully lobbied for the reintroduction of the Realschule in post-war Bavaria. In 1949 the first Realschule in post-war Bavaria was opened in Landau a.d.Isar and Karell became its principal (Schmitzer 2002). The importance of former Sudeten German teachers for the Bavarian Realschule is also stressed by Trapp (2003). According to his figures, the overwhelming majority of teachers at the newly established Realschulen in post-war Bavaria were Sudeten German expellees. This overrepresentation of Sudeten Germans among Realschulen teachers is a result of the former Sudeten German school system which focused more on practical education compared to other regions of the German Reich. Hence, displaced Sudeten Germans which were additionally also in need of new jobs, constituted the optimal choice for the Realschulen teaching staff (Trapp 2003, p. 13).

As a school providing general secondary education combined with practical knowledge, the post-war Bavarian Realschule was especially popular among Sudeten Germans. One reason for this preference might be the highly developed industrial sector of former Sudetenland (see Table 3.3). This strong technical as well as business-oriented background brought up several kinds of artisanal and trade schools. These sorts of professional schools were especially scarce or even nonexistent in Bavaria. Therefore, Sudeten Germans started to set up schools meeting their specific demands in their

[26] The difference in student numbers (percentage of respective age cohort) remains substantial if Bavarian rural counties are compared with rural counties in the Sudetenland: 1.56 percent (Bavaria) vs. 3.93 percent (Sudetenland) (significantly different from 0 at the 1 percent level).

new hometowns. For instance, Sudeten German expellees founded a professional school for glass and jewelry making in Kaufbeuren[27] and a school for violin production in Erlangen (Keil 1967a, p. 483). Furthermore, Sudeten Germans set up commercial schools such Handelsschulen, Wirschaftsrealschulen, and Wirtschaftsgymnasien (Arnold 1967). These newly founded institutions were also highly valued by Bavarians who started to demand more of these modern school types as well (Keil 1967a, p. 484). Another example of a school opening initiated by Sudeten Germans is the Realschule Waldkraiburg.[28] Being provided with only primary schooling, the Sudeten Germans of Waldkraiburg actively lobbied for secondary education in form of a Realschule and even founded their own association to support their demands. In their opinion, only the Realschule resembled the type of secondary school they had in the Sudetenland for the education of future entrepreneurs and skilled workers. In 1955 they succeeded and the Realschule Waldkraiburg was established. However, students of this Realschule were not exclusively children of Sudeten Germans or other displaced people although the majority of inhabitants in Waldkraiburg were; as the years passed, more and more Bavarian students joined this school. In 1967, students' backgrounds were equally divided between displaced and native (Palme 1967).[29]

Hence, Sudeten Germans played an important role in the development of the post-war Bavarian school system. Sudeten Germans founded several professional and commercial schools, and were especially active in the formation of the Bavarian Realschule. Since these institutions became also increasingly popular among native Bavarians, it can be supposed that Sudeten Germans had a positive impact on the educational participation of Bavarians.

3.4 Data

To analyze whether the inflow of Sudeten Germans into Bavarian counties generated educational spillovers on the Bavarian population, data on 191 Bavarian counties are employed. The empirical estimation thereby considers three points in time: pre-war (1939), immediate post-war (1950), and outcome period (1970). Since several administrative and territorial reforms occurred between 1939 and 1970, this paper chooses 1950 as the main reference year; therefore, counties of 1939 and 1970

[27] The school was set up in the district Neugablonz, which was itself founded by expellees from Gablonz in the Sudetenland (Keil 1967a, p. 483). Gablonz had been famous for its glass and jewelry industry and so became Neugablonz in the post-war years.

[28] Waldkraiburg in Upper Bavaria had been a displacement camp for displaced Germans – most of them Sudeten Germans – immediately after the war and emerged into a town during the late 1940s (Maier and Tullio 1996, pp. 160-3).

[29] The Realgymnasium in Rohr in Lower Bavaria provides an additional example of a school founding motivated by Sudeten Germans. In this case, however, it was Benedictine monks who had run a Gymnasium in the Sudetenland. In 1947, these teachers were able to re-establish their old institution as a boarding school in their new hometown Roth. By 1961, the Realgymnasium had well over 300 students coming from all over Bavaria (Menzel 1967).

are converted into 1950 territorial and administrative units.[30] Description and sources of the data used are given in Table A3.2 in Appendix 3.

Pre-war characteristics of Bavarian counties stem from publications of the Bavarian statistical office in *Beiträge zur Statistik Bayerns* (BSB). The last census before the war was conducted in 1939 and published between 1942 and 1943 (BSB 132). Besides general information on the population structure, this census also reports sector and status of employment on a county basis. After the annexation of the Sudetenland by the German Reich, analogous information was gathered for the Sudetenland in 1939 and published in 1941 (RSG). Number of students in secondary education before the war comes from the Ministry of Science, Education, and National Culture in Berlin (RS) which reported information on schools and student numbers for all German states and Reich districts (*Reichsgaue*) on an annual basis.

Post-war census data on the number of Sudeten Germans and other displaced ethnic Germans in Bavarian counties is available for 1946 (BSB 142) and 1950 (BSB 171).[31] The mass arrival of Sudeten Germans started immediately after the war and surged during 1946 with official redistribution of expellees (Slapnicka 1970b, pp. 320-2). This official redistribution lasted until the end of 1946, and was followed by voluntary and illegal migration until early 1950 (Schechtman 1953, pp. 156-7). After 1950, only a few hundred Sudeten Germans arrived in Bavaria. Therefore, the empirical specification focuses on data on Sudeten Germans in 1950 (September) rather than 1946.[32] 1950 marks also the last year Sudeten Germans were explicitly reported on a county basis in censuses (afterwards only the total number of expellees per county was documented).[33] Hence, the main part of the empirical estimation will use Sudeten Germans in 1950; however, several robustness checks will be employed to deal with potential migration issues.

[30] Volkert (1983) provides extensive information on the administrative organization of Bavaria during the 19th and most of the 20th century. In combination with data on municipalities, it is possible to also account for territorial losses due to the war and hence construct a database on the administrative and territorial basis of 1950.

[31] These publications only report German expellees from Czechoslovakian territories according to 1937 borders. Besides Sudeten Germans, another ethnic German group – i.e. Carpathian Germans – had lived in Czechoslovakia before the war. Hence, the employed measure of Sudeten Germans actually also includes Carpathian Germans. However, the latter were a very small group consisting of only 200,000 people in 1939 – compared to 3,000,000 Sudeten Germans (SBBRD 1953). The majority of Carpathians was also expelled after the war; although ca. 12,000 to 15,000 of them remained in post war Czechoslovakia (Bohmann 1959, p. 120). Hence, taking also the loss of lives during the war into account, approximately far less than 200,000 Carpathians were affected by expulsion. Considering in addition the fact that not all of these expellees ended up in Bavaria, the role of Carpathians in post-war Bavaria is most likely negligible – at least compared to that of Sudeten Germans. Thus, in this paper, the term 'Sudeten Germans' is be used for all ethnic Germans expelled from Czechoslovakia.

[32] Sudeten Germans amounted to 871,863 people in 1946; their number rose steadily to 1,031,468 people in 1950. During 1946 alone, ca. 786,000 Sudeten Germans arrived in Bavaria (SFW, p. 7).

[33] Data on the arrival of Sudeten Germans after 1950 is only available for Bavaria as a whole (500 in 1951 and 596 in 1952) and for total West Germany (123 in 1953) (Bohmann 1959, p. 209).

Information on self-employed expellees in 1950 is provided by data on displaced Germans in West Germany gathered in 1950 (SBBRD).[34]

Since educational spillover effects can be supposed to take some amount of time to build a noticeable impact on overall educational development, an outcome period several years after the mass arrival of *Heimatvertriebene* is chosen. This paper focuses thereby on the impact of Sudeten Germans on educational attainment at the (higher) secondary school level.[35] Bavarian secondary schools in 1971 are the *Realschule*, *Gymnasium*, and *Fachschule*. Gymnasien and Realschulen take children in after four years (or also six years in case of the Realschule) of elementary schooling (around age 11). Fachschulen are professional schools accepting students either after elementary school (e.g. Handels- and Wirtschaftschulen) or after completed vocational training (i.e. apprenticeship). Therefore, students at this institution are on average older than in the Realschule/Gymnasium. Data on student numbers of the Realschule and Gymnasium in 1971 originate from school registers published by the Ministry of Education (SBSUK). Data on students in the Fachschule stem from the 1970 census. Additional information on the number of people with degrees of secondary education per county is provided by 1970 census data. Hence, educational attainment is captured by students in secondary schools in 1971 as well as by people with secondary education degrees in 1970. The 1970 census provides a wide range of socio-economic variables (BSB 253, 327a, 328a). These censuses include occupational, demographic, and religious data. However, it does not include the number of unemployed at the county level. Therefore, county level data on unemployment in 1968 are used (KSLB).

This rich set of data does not only allow to run cross-sectional OLS regressions but also to compile a panel dataset spanning two points of time: 1939 as the 'pre-treatment' period and 1970/71 as the 'post-treatment' period. This dataset includes pre- and post-war population shares of students in higher education (i.e. students in *Realschule* and *Gymnasium* for 1939 and 1971, as well as *Oberschule* and *Aufbauschule* for 1939) and population shares of employees in industry and crafts, public and private services, and civil servants and white collar workers. The variable of interest is the share of Sudeten Germans in total population 1950 interacted with a 1970 dummy. Hence, the share of Sudeten Germans in Bavaria is set to zero in 1939.

Except in case of the Fachschule,[36] employed student numbers originate from school registries implying that students are counted at the school instead of county level. This is due to the 1939 data which only reports school-based student numbers, while the 1970 census also reports county-based numbers. Using school-based student numbers suggests that students might have lived outside the school county, which might impose problems for the estimation of spillover effects if intensity of

[34] Note that this data relates to all expellees, not only Sudeten Germans.
[35] The German school system of 1970 is divided into three secondary school tracks. The highest is the Gymnasium, followed by the Realschule and Fachschule, and finally the Hauptschule. This paper focuses on the highest and middle track schools.
[36] Due to data availability, employed student numbers of the Fachschule are county-based.

exposure to Sudeten Germans differed between school and home county. However, since most counties had secondary schools by 1970 (96 of 191 in 1939 and 179 of 191 in 1971) and it can be supposed that children visit schools close to their homes, this problem should be negligible.[37]

3.5 Empirical strategy

This section introduces empirical models to assess whether the influx of Sudeten Germans into Bavarian counties increased educational development. The main hypothesis is that a higher share of Sudeten Germans in 1950 is associated with higher educational attainment reflected by student numbers, i.e. a flow variable, and people with secondary school degrees, i.e. a stock variable, some 20 years later. Since Sudeten Germans were especially enthusiastic about applied secondary education in form of the Realschule and Fachschule, the empirical analysis will acknowledge this fact by differentiating between an extensive and intensive margin. While the extensive margin focuses on all students and graduates of secondary education, the intensive margin concentrates on that fraction of secondary students and graduates who are enrolled in or graduated from applied schools. Hence, the hypothesis of the extensive margin is that Sudeten Germans increased overall educational development captured by students and people with degrees of all secondary schools (i.e. Gymnasium, Realschule, and Fachschule). In contrast, the hypothesis of the intensive margin is that Sudeten Germans increased applied educational outcomes measured by students and the share of people with degrees from the Realschule and Fachschule (conditional on having a secondary school degree).

As outlined in section 3.2.2 and 3.3.1, it can be supposed that any Sudeten German effect should be more pronounced in rural counties since these received higher expellee shares and additionally had lower pre-war educational development than urban Bavarian counties. Therefore, the following regressions are based on rural counties (Appendix 3 includes results based on all – urban and rural – Bavarian counties for each of the empirical specifications).

A potential threat to identification stems from migration: if a large fraction of Sudeten Germans moved to other counties between 1950 and 1970, identification of any Sudeten German spillover effect would clearly be hampered. Due to the lack of available data there is no possibility to account for specific movements of Sudeten Germans or expellees in general. However, Falck et al. (2012, p. 5) show that for West Germany as a whole, overall mobility of expellees was rather low. In Bavaria, the correlation coefficient of the share of displaced Germans across counties between 1950 and 1970 is

[37] An exception is of course boarding schools. In fact, in 1971, 29 of 144 Realschulen and 55 of 139 Gymnasien were boarding schools, although in most cases not exclusively since they were also open to community children living outside the school building (SB 283, 293, 203). The available data does, however, not differentiate between boarders and community children. The 1939 data does not provide explicit information on boarding schools.

0.39 and highly significant. Hence, it seems that also in Bavaria, mobility of expellees was rather limited.[38] However, two methods are applied in the robustness section to deal with migration.

3.5.1 Basic model

To test whether the share of Sudeten Germans in a county in 1950 is positively associated with higher educational outcomes of the respective county in 1970/71, the following relationship is estimated using OLS regression analysis:

$$EDU_{i,1970/71} = \alpha_1 + \beta_1 * Sudeten_{i,1950} + \gamma_1 X_{i,1970,\,1950,1939} + u_i \qquad (3.1)$$

where EDU is a measure of educational outcomes in county i in 1970/71 and X is a set of control variables including a dummy for rural county, shares of Protestants, employment structure, and educational factors, measured in 1970, 1950, and 1939. Educational outcomes in 1970/71 refer either to the share of school-aged children in all higher secondary education (Gymnasium, Realschule, and Fachschule) or applied schools (Realschule and Fachschule) and to the share of population with secondary school degree in general (Gymnasium, Realschule, and Fachschule) or of applied schools.

The variable of interest is $Sudeten_{i,1950}$, i.e. the share of Sudeten Germans in county population in 1950. Hence, β_1 captures the increase in educational outcomes in 1970/71 that can be ascribed to the presence of Sudeten Germans in 1950. If Sudeten Germans imposed any educational spillover effects, $\hat{\beta}_1$ should be positive and significantly different from zero.

Did the arrival of Sudeten Germans increase long-term educational participation and attainment? The following two tables address this question by presenting results obtained by the basic model (3.1). Tables 3.4 and 3.5 thereby focus on the extensive and intensive margin, respectively. The structure of these tables is as follows: columns 1 and 5 control for the share of Protestants in 1970 and include a dummy for the existence of the respective school type in the county; columns 2 and 6 add employment structure in 1970 (i.e. population shares of unemployed, people working in industry, crafts, public and private services, as self-employed or civil-servants and white collar workers); columns 3 and 7 add the share of self-employed expellees in 1950; and finally, columns 4 and 8 further account for students in higher secondary education and employment structure in 1939 (equivalent to 1970).[39]

Results in Table 3.4 indicate that a higher share of Sudeten Germans is positively and significantly associated with both the share of children in secondary education and people with secondary school degrees, even when accounting for the widest set of control variables. Hence, an

[38] Falck et al. (2012, p. 5) obtain a correlation coefficient of 0.82 for the share of expellees between 1950 and 1961 in all West-Germany. In comparison to 0.82, the computed value of 0.39 for Bavaria might seem rather low. However, taking the extended time period (i.e. 1950 and 1970) into account, 0.39 is still a relatively high value.

[39] Tables A3.3 and A3.4 in Appendix 3 report full regression results.

increase in the share of Sudeten Germans in 1950 of 1 percentage point is associated with an around 0.4 percentage point higher share of school-aged children in secondary schools and with a 0.1 percentage point higher share of the population holding secondary school degrees (above 20 years). According to the estimates presented by Table 3.5 for the intensive margin, i.e. the share of secondary school students enrolled in applied schools, the specific relationship between Sudeten Germans and applied schools is confirmed: counties with higher shares of Sudeten Germans in 1950 have significantly higher shares of students and graduates of the Realschule and Fachschule. Corresponding estimates suggest that a 1 percentage point higher share of Sudeten Germans is associated with an at least 0.9 percentage point higher share of applied students in all secondary students. Since the average share of children in the Realschule across all counties is 36.75 percent, counties with a 1 percentage point higher share of Sudeten Germans would be associated with 37.65 percent of their secondary school children in applied schools. This is in line in line with historical evidence as outlined in section 3.3 (that is, the opening of Realschulen and professional schools initiated by Sudeten Germans). Furthermore, an increase in the share of Sudeten Germany by 1 percentage point is associated with around 0.1 percentage point higher share of people with applied school degrees in all secondary school graduates. Whether this finding constitutes a spillover effect or might rather be the result of an increase in the number of Sudeten Germans holding these degrees upon arrival in Bavaria, will be discussed in the subsequent chapter.

Tables A3.5 and A3.6 present results based on all – rural and urban – Bavarian counties. Except for the results on student flows in the extensive margin, estimates based on all counties confirm the finding that Sudeten Germans are in general positively and significantly correlated with higher secondary student shares and people with secondary school degrees.

Table 3.4 – Sudeten Germans and long-term educational attainment, extensive margin

Dependent variable	Flow: Share of secondary school students in school-aged[a] population 1971 (in %)				Stock: Share of people with secondary school degree in population>20 years 1970 (in %)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Sudeten Germans 1950	0.441***	0.425**	0.330*	0.338**	0.204***	0.108***	0.130***	0.131***
	[0.144]	[0.170]	[0.180]	[0.158]	[0.058]	[0.031]	[0.030]	[0.030]
Mean dependent variable	18.65				14.36			
Additional controls								
Protestants (1970), school dummy[b]	yes	yes	yes	yes	yes	yes	yes	yes
Employment structure 1970	no	yes	yes	yes	no	yes	yes	yes
Self-employed expellees 1950	no	no	yes	yes	no	no	yes	yes
Secondary students and employment structure 1939	no	no	no	yes	no	no	no	yes
Observations	143	143	143	143	143	143	143	143

Notes: Table reports OLS estimates based on 143 rural Bavarian counties. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. Secondary schools are Fachschule, Gymnasium, and Realschule, applied schools are Fachschule and Realschule.
[a] Relevant school age is 10-20.
[b] Columns 5-8 include a dummy for the existence of a secondary school in 1970.

Table 3.5 – Sudeten Germans and long-term educational attainment, intensive margin

Dependent variable	Flow: Share of students in applied schools in all secondary school students 1971 (in %)				Stock: Share of people with applied school degree in population with sec. school degree >20 years 1970 (in %)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Sudeten Germans 1950	1.136***	0.848**	0.912*	0.871*	0.082**	0.100***	0.097***	0.108***
	[0.380]	[0.428]	[0.473]	[0.481]	[0.032]	[0.022]	[0.023]	[0.022]
Mean dependent variable	36.75				93.94			
Additional controls								
Protestants (1970), school dummy[a]	yes	yes	yes	yes	yes	yes	yes	yes
Employment structure 1970	no	yes	yes	yes	no	yes	yes	yes
Self-employed expellees 1950	no	no	yes	yes	no	no	yes	yes
Secondary students and employment structure 1939	no	no	no	yes	no	no	no	yes
Observations	143	143	143	143	143	143	143	143

Notes: Table reports OLS estimates based on 143 rural Bavarian counties. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. Secondary schools are Fachschule, Gymnasium, and Realschule, applied schools are Fachschule and Realschule.

[a] Columns 5-8 include a dummy for the existence of an applied school in 1970.

Hence, results obtained by this basic model provide first support for the hypothesis that Sudeten Germans are associated with higher educational development in post-war Bavaria.

3.5.2 Quantifying the spillover effect

As above results illustrate, a higher share of Sudeten Germans in 1950 is positively and significantly correlated both with the flow of students and stock of people holding degrees. The latter, however, might just reflect a mechanical effect: if expellees from the Sudetenland had already obtained their secondary degrees before displacement, an increase in the share of Sudeten Germans would mechanically lead to a larger stock of people with degrees. As outlined in section 3.3.1, a higher fraction of Sudeten German children visited secondary schools compared to their Bavarian peers. Hence, also the share of people with secondary school degrees obtained before 1945 should be larger in the Sudetenland than in Bavaria. Consequently, an increase in the stock of people with secondary school degrees induced by Sudeten German expellees could just be the result of a mechanical and not of a spillover effect on native Bavarians.

To disentangle mechanical from potential spillover effects, precise information about the scholastic achievement of Sudeten German immigrants at the moment of their exodus would be required. However, to the best of my knowledge there exists neither county nor aggregate data on school-leaving degrees of Sudeten Germans before or after displacement. Given available data on educational attainment of all expellees in Germany (not just Sudeten Germans) provided by the MZU-71[40] and analyzed by Handl and Herrmann (1994), it is possible to conduct a back-of-the-envelope-calculation, presented in the following.

[40] The *Mikrozensus-Zusatzerhebung* (MZU-71) is a supplement to the 1971 census based on individual level

According to Handl and Herrmann (1994, pp. 28-36.) about 30 percent of all displaced Germans born between 1890-99 and 1910-19 held secondary school degrees, whereof ca. 5 percent from the Gymnasium and ca. 22 percent from an applied school (Realschule and Fachschule). Taking into account that Sudeten Germans were not only more enthusiastic about higher education compared to native Bavarians but also to other displaced groups (Lemberg 1959, pp. 370-2), I will assume that the respective degree shares are 35 percent for all secondary schools, 5 percent for Gymnasium, and 30 percent for applied schools. The implied magnitude of the educational spillover will not only depend on the level of education of migrating Sudeten Germans, but also on the characteristics of the receiving economy. In what follows, a back-of-the-envelope-calculation based on observed county averages is conducted.

In 1970, the average rural county has a population of 47,893. The average share of Sudeten Germans in 1950 across counties is 13.7 percent. So if this share increases by 1 percentage point, then the total number of Sudeten Germans in 1950 per county increases by 446 people.[41] However, only Sudeten Germans above age 45 in 1970 are relevant for the analysis since these are old enough to have received their entire education in the Sudetenland before 1945. The average fraction of people aged 45 and older across counties in 1970 is 34.5 percent. Under the condition that this age distribution also holds for Sudeten Germans, 154 of the 446 additional Sudeten Germans are older than 45. Of these 154 Sudeten Germans, 35 percent are supposed to hold secondary school degrees, i.e. 54 people, whereof 85.7 percent hold applied degrees, i.e. 46 people. Hence, the contribution of Sudeten Germans to secondary schooling degrees in 1970 amounts to 54 in case of all secondary degrees and to 46 in case of applied degrees. This is a purely mechanical effect induced by a higher share of Sudeten Germans.

But did this also lead to educational spillovers on Bavarians? First, the average population size increases by 446 Sudeten Germans to 48,339 in 1970 (provided that these Sudeten Germans are still in the county in 1970). However, only people older than 20 years are relevant since these should have completed any secondary education by 1970. Based on the share of the population above 20 in 1970, i.e. 66 percent, this translates into 31,904 people. According to the estimates in Table 3.4, an increase in the share of Sudeten Germans by 1 percentage point is associated with an increase in the stock of people with secondary school degrees by around 0.13 percentage points. Thus, the average share of the relevant population with secondary school degree increases to 14.49 percent, i.e. 4,623 people. Prior to inflow of additional 446 Sudeten Germans, this number had been 4,539 (14.36 percent of 31,609

data. By providing retrospective data on the occupational history and educational attainment of natives and displaced Germans it was supposed to provide insights into the economic and social integration of expellees (Handl and Herrmann 1994, pp. 19-20).

[41] The calculation is as follows: the average county population in 1950 is 44,627. While a share of Sudeten German of 13.7 percent translates into a total number of 6,114 Sudeten Germans, an increase of 1 percentage point in this share leads to a total number of 6,560 Sudeten Germans. Hence, the group of Sudeten Germans increases by 446 people in 1950.

people older than 20 years). This suggests a surplus of 84 people with secondary school degrees in the relevant age cohort, whereof 54 are Sudeten Germans. Hence, 30 more native Bavarians hold secondary schooling degrees (in the relevant age cohort).

Given the estimates in Table 3.5, that is, a Sudeten German effect of 0.1 percentage points more applied graduates in all secondary school graduates, the corresponding share increases to 94.04 percent. Hence, 94.04 percent of 4,623 people, i.e. 4,347, hold applied secondary school degrees after an increase in the share of Sudeten Germans – a plus of 83 people.[42] Subtracting the number of Sudeten German applied degree holders, i.e. 46, yields a final number of 37 people. These 37 (Bavarian) people constitute the spillover effect. Thus, an increase in the share of Sudeten Germans in 1950 is on average associated with 37 more Bavarians holding applied secondary school degrees (conditional on having a secondary school degree).

3.5.3 Differences-in-differences estimation

A potential drawback of model (3.1) is that it is unable to deal with the influence of unobservables that might be correlated with model regressors. For example, it could well be that Sudeten Germans settled in counties in which the population was also enthusiastic about education. Educational performance in these counties in the 70s might then be higher irrespective of the presence of Sudeten Germans. Panel data models provide a possible solution: rather than comparing outcomes across counties, these models enable comparisons in the change in outcomes between a pre-treatment and a post-treatment period. Any observed and unobserved time-invariant heterogeneity between receiving counties is then irrelevant and will no longer bias the estimates. This paper thereby adopts a differences-in-differences approach. Note that due to data availability it is only possible to implement this approach in case of student numbers. To the best of my knowledge, there exists no pre-war county level data on people with secondary school degrees.

Hence, a difference-in-differences model is constructed of the following form:

$$EDU_{it} = \alpha_i + \partial_1 d1970_t + \beta_2 * Sudeten_{i,1950} * d1970_t + \gamma_2 X_{it} + u_{it} \qquad (3.2)$$

where EDU_{it} is a measure of educational outcomes in county i in year t, X_{it} is a set of control variables reflecting the employment structure of county i in year t, α_i reflects county fixed effects, and $d1970_t$ a dummy that takes the value 1 in 1970, i.e. post treatment. The inclusion of county fixed effects enables controlling for unobserved heterogeneity between counties that is constant over time and related to explanatory variables, whereas the introduction of $d1970_t$, i.e. a time fixed effect, captures the influence of changes over time affecting all counties homogenously. Once again, 1950 marks the latest point in time Sudeten Germans were reported on a county basis in the census data.

[42] Prior to the increase in Sudeten Germans by 1 percentage point, 93.94 percent of 4,539 people (i.e. population older than 20 with secondary school degree) held applied school degrees. This amounts to 4,264 people.

Therefore, the interaction term between $d1970_t$ and the share of Sudeten Germans per county in 1950 constitutes the variable of interest.[43] The coefficient $\hat{\beta}_2$ then captures the difference in educational participation per county between 1939 and 1970 associated with the presence of Sudeten Germans in 1950.

Table 3.6 provides estimates on the share of secondary school students in school-aged population. Columns 1 reports estimates of the pooled model, column 2 and 3 add county fixed effects.

Table 3.6 – Differences-in-differences estimation, extensive margin

Dependent variable	Flow: Share of students in secondary education[a] in school-aged[b] population (in %)		
	Pooled	County fixed effects	
	(1)	(2)	(3)
% Sudeten Germans 1950 *x d*1970	0.420***	0.374**	0.415***
	[0.146]	[0.145]	[0.153]
% Industry and crafts			-0.323
			[0.288]
% Services			0.457
			[0.442]
% Self-employed			-0.655
			[0.534]
% Civil servants & white collar workers			-0.45
			[0.420]
*d*1970	7.971***	8.600***	7.324**
	[2.189]	[2.061]	[3.615]
Constant	1.558***	1.558***	14.8
	[0.217]	[0.329]	[11.02]
County fixed effects	no	yes	yes
Observations	286	286	286
Number of counties		143	143
R-squared	0.534	0.757	0.766

Notes: Table reports regression DID estimates based on panel data for 143 rural Bavarian counties for two time periods (1939 and 1970/1). Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level.

[a] Secondary schools are Gymnasium, Oberschule, and Realschule in 1939 and Gymnasium and Realschule in 1971.

[b] Relevant school-aged population is 10-20.

According to the estimates, a higher share of Sudeten Germans in 1950 is positively and highly significantly associated with a higher share of students in secondary education. Results obtained for all Bavarian counties in Table A3.7 show a quite reversed picture: estimates suggest a negative or insignificant impact of Sudeten Germans on educational participation. This once again highlights the educational impact of Sudeten Germans particularly in the Bavarian countryside.

[43] Note that use of this interaction term implicitly sets the share of Sudeten Germans in 1939 to zero and in 1970 equal to 1950 numbers.

Once again, the underlying assumption is that the share of Sudeten Germans remains constant between 1950 and 1970 – an arguably strong assumption. The next section will try to approach the problem of Sudeten German migration.

3.5.4 Accounting for Sudeten German migration between 1950 and 1970

The implicit assumption underlying model (3.1) is that the share of Sudeten Germans in the county population remains constant (or at least relatively constant) over time. If, however, Sudeten Germans decided to move to other counties between 1950 and 1970, model (3.1) would not be able to capture any Sudeten German spillover effect. Migration is especially harmful if it occurred due to educational purposes. Suppose, for example, that Sudeten Germans found the availability or quality of schools in their county insufficient and therefore moved to other – presumably better equipped – counties. In this case, model (3.1) would suffer from an endogeneity problem resulting from reverse causality.

Unfortunately, as outlined above, 1950 marks the last point in time Sudeten Germans were reported on a county basis. However, the total number of expellees (*Vertriebene*) per county is available for later years. Since more than every second displaced person in 1950 was of Sudeten German origin (see Table 3.1), Sudeten Germans should also account for most of the expellees in 1970 – provided that Sudeten German fertility was at least as high as fertility of the other expellee groups.[44] Hence, the number of *Vertriebene* is quite a good – albeit not perfect – proxy for Sudeten Germans in 1970. To further improve this proxy variable, an instrumental variable approach is adopted to deal with potential measurement error in the explanatory variable.

First, the share of expellees in 1970 is regressed on the share of Sudeten Germans in 1950 and control variables:

$$Expellees_{i,1970} = \alpha_3 + \beta_3 * Sudeten_{i,1950} + \gamma_3 X_{i,1970,1950,1939} + u_i \quad (3.3)$$

where the variable $Expellees_{i,1970}$ captures that part of the variation in the share of displaced people that can be explained by variation in the share of Sudeten Germans in 1950. Hence, $\widehat{Expellees}_{i,1970}$ predicts the share of Sudeten Germans in 1970, based on their share in 1950.[45] This predicted share of Sudeten Germans is then used in the second stage:

$$EDU_{i,1970/71} = \alpha_4 + \beta_4 * \widehat{Expellees}_{i,1970} + \gamma_4 X_{i,1970,1950,1939} + u_i \quad (3.4)$$

Thus, this specification might be better able to measure a Sudeten German spillover effect in case of Sudeten German migration between 1950 and 1970. An additional approach to deal with

[44] Children of displaced people were also considered as expellees still in the 1970 census (BSB 327b, p. xii).
[45] In theory, it is also possible that the presence of Sudeten Germans in 1950 attracted other expellee groups. If this was the case, then $\widehat{Expellees}_{1970}$ would not exclusively predict Sudeten Germans in 1970. To the best of my knowledge there exists no historical account supporting this Sudeten German induced migratory pattern.

migration is to account for the overall level of mobility in counties by running model (3.1) weighted by the share of the population which is not a net immigrant (BSB 253).[46] According to the results provided by Table A3.8 in Appendix 3, the positive Sudeten German effect on educational performance found in section 3.5.1 is confirmed even when accounting for overall migration.

Table 3.7 provides second-stage instrumental variable estimates and first-stage *F*-statistics for the extensive and intensive margin. In all cases, the *F*-statistics exceed the critical value of 10 indicating that the share of Sudeten Germans in 1950 is sufficiently correlated with the share of displaced people in 1970. Second-stage estimates confirm previous results obtained by the basic model in section 3.5.1: expellees, instrumented by the share of Sudeten Germans in 1950, are correlated positively and significantly with students and graduate both in the extensive and intensive margin. In comparison to the estimates in columns 3 and 7 of Tables 3.4 and 3.5 (same set of control variables), instrumental-variables estimates are larger in size suggesting that previous estimates might have been biased downwards as a result of Sudeten German migration. Results for all Bavarian counties presented by Table A3.9 are also positive and significant for most outcomes in the extensive and intensive margin.

Table 3.7 – Instrumenting the share of expellees with the share of Sudeten Germans, 2nd stage results

	Extensive margin		Intensive margin	
Dependent variable	Flow: Students	Stock: Degrees	Flow: Students	Stock: Degrees
	(1)	(2)	(3)	(4)
% Sudeten Germans 1950	0.506*	0.200***	1.398*	0.149***
	[0.290]	[0.051]	[0.742]	[0.039]
Mean dependent variable	18.65	14.36	36.75	93.94
1st stage *F*-statistic[a]	88.84	87.21	88.84	88.47
Additional controls				
Protestants (1970), school dummy[b], employment structure 1970, self-employed expellees 1950				
Observations	143	143	143	143

Notes: Table reports 2nd stage instrumental-variable estimates for rural and urban Bavarian counties. The share of Sudeten Germans in 1950 serves as an instrument of the share of displaced people in 1970. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. The extensive margin refers to % secondary school students or graduates in school-aged population and population older than 20 years, respectively. The intensive margin refers to % applied students or graduates in all secondary school students and population with secondary school degree, respectively. Secondary schools are Fachschule, Gymnasium, and Realschule, applied schools are Fachschule and Realschule.

[a] 1st stage *F*-statistics in columns 2 and 4 include dummies for existing secondary and applied schools in 1970, respectively.

[b] Columns 5-8 include a dummy for the existence of a secondary school in 1970.

[46] Using these weights ensures that counties with positive net migration (that is, the difference between immigrants and emigrants) receive lower weights in the estimation of a Sudeten German effect. An obvious shortcoming of this data is that it is unable to provide thorough information on the mobility pattern of a county. For example, zero net immigration does not necessarily imply zero mobility as it could well be that immigrants counterbalance emigrants. In absence of more reliable data, data on net immigration is used in an additional robustness check.

Thus, the instrumental variable approach applied to improve the measurement of Sudeten Germans actually present in 1970 further strengthens the role of Sudeten Germans in secondary education.

3.6 Discussion of channels

According to the empirical results of sections 3.5.1-3.5.4, a higher share of Sudeten Germans after the war is associated with higher educational development in the 1970s. However, it is not clear what causes this Sudeten German effect. Three channels seem possible: (1) lobbying, (2) skilled labor demand, and (3) preferences.

As outlined in section 3.3.2, Sudeten German expellees actively lobbied for the reintroduction of Bavarian Realschulen. In addition, several applied school foundings can be traced back to Sudeten German involvement. This historical evidence is confirmed by Table 3.8: the share of Sudeten Germans is positively and significantly associated with the number of Realschulen per 1,000 people in 1971.

Table 3.8 – Sudeten Germans and the provision of Realschulen in 1971

Dependent variable	No. of Realschulen per 1,000 people 1971	
	Rural counties	All counties
	(1)	(2)
Share of Sudeten Germans 1950	0.076*	0.071*
	[0.043]	[0.042]
Mean dependent variable	2.88	3.57
Additional controls		
Protestants (1970), rural county dummy[a], employment structure 1970, self-employed expellees 1950		
Observations	143	191

Notes: Table reports OLS estimates based on Bavarian counties. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level.

[a] In column 2.

Hence, it seems plausible that a higher provision of applied schools led to higher secondary school participation in Bavaria.

Prior to expulsion, at least every second Sudeten German had worked in industry- or trade-related sectors – incl. crafts and transportation, and almost every fifth had been self-employed (see Table 3.3). Once they had been resettled in Bavaria, many Sudeten Germans used their expertise and re-established their former businesses. Between 1945 and 1950 alone, Sudeten Germans opened 10,347 businesses (Bohmann 1959, p. 215).[47] This might have increased the demand for skilled labor –

[47] These were set up as surrogate businesses (*Ersatzarbeitsstätten*) founded to replace businesses lost as a result of war destruction or expulsion (Bohmann 1959, p. 215).

especially in form of applied education – as well. Furthermore, since many re-founded Sudeten businesses involved crafts which had been rather rare in pre-war Bavaria or underdeveloped in comparison to the Sudetenland (e.g. glass-processing or small musical instrument production), specific occupational knowledge or education was in need. Thus, Sudeten Germans might have increased Bavarian student numbers in middle track education through their skilled labor demand.

Finally, it is also possible that Sudeten German preferences for higher secondary education in form of applied schools spread in the Bavarian population (as outlined in section 3.3.2). Given the pronounced differences in secondary school participation between Sudeten Germans and the rural Bavarian population prior to the war, it could also be that higher educational attainment in form of people with secondary school degrees in 1970 is only a result of Sudeten German migrants holding respective degrees. However, the results of a back-of-the-envelope-calculation in section 3.5.2 suggest that there were indeed positive spillover effects at work: secondary school degrees increased with the share of Sudeten Germans present in the county not only because Sudeten Germans brought along these degrees but also due to an increase in the number of Bavarians holding these degrees.

3.7 Conclusion

This paper analyzes long-term educational effects of the mass inflow of displaced Germans into Bavaria after WWII, thereby focusing on expellees from the Sudetenland. Sudeten Germans formed the biggest expellee group in Bavaria and constituted a large part of its post-war population: in 1950, 1 out of 10 people in Bavaria was of Sudeten German descent. In contrast to other studies on displaced Germans after WWII focusing on similarity and thus substitutability of natives and displaced, this paper exploits differences existing between these groups. Coming from highly industrialized Sudetenland, Sudeten Germans found themselves in war-ridden Bavaria, which was still mainly an agrarian state. The majority of these migrants were placed in small municipalities in the Bavarian countryside. Compared to their new neighbors, Sudeten Germans were more likely to have worked as civil servants, white or blue collar workers or as self-employed before displacement. Moreover, Sudeten Germans who had been of school-age in 1939 were also more likely to have visited a secondary school than their Bavarian peers. Historical evidence reveals that Sudeten Germans were enthusiastic about education (Keil 1967b, p. 13), perceived it as part of their cultural identity (Lemberg 1959, pp. 370-2), and were especially fond of the Bavarian Realschule. Correspondingly, empirical results show that counties with a higher share of Sudeten Germans in 1950 are associated with a higher share of children in secondary schools as well as with a higher share of the population holding a degree of these schools. The latter is not only due to a mechanical effect (i.e. more Sudeten Germans with secondary school degrees upon arrival in Bavaria) but also to a spillover effect on (native) Bavarians. The connection between Sudeten Germans and higher secondary education remains robust across several alternative specifications (incl. differences-in-differences and

instrumental variable estimations). Even though there is no possibility to determine the exact channel through which Sudeten Germans increased educational outcomes given the available data, empirical results indicate that there is a strong association between educational development and the presence of Sudeten Germans. Since human capital has been shown to be an important determinant of economic growth, it can be supposed that Sudeten Germans indirectly contributed to the economic development of post-war Bavaria as well.

In the beginning, fast integration of Sudeten Germans into the Bavarian population seemed rather unlikely since both Sudeten Germans and Bavarians did not believe in the definitive nature of their displacement. In addition, discrimination against Sudeten Germans and other expellee groups by the Bavarian population was not uncommon (Habel 2002, p. 116).[48] However, these obstacles to integration started to fade in the following years manifesting itself through a higher rate of marriages between expellees and natives (Handl and Herrmann 1994, pp. 105-30) as well as through disappearance of expellees' political parties (Weiß 1995, pp. 249-53).[49] This is in line with Handl and Herrmann (1994, pp. 138-9) who conclude that by 1970 full integration of expellees has more or less been achieved. This suggests that Sudeten Germans became an integral part of the Bavarian society and with them also their perceptions towards secondary education. Hence, the 1.03 million Sudeten Germans might have permanently altered overall educational behavior in Bavaria.

[48] Social rejection of Sudeten Germans or other expellees might in most cases be explained by the austerities of the post-war years since arriving expellees implied sharing already scarce resources with a higher number of people.

[49] Displaced Germans founded the political party BHE (*Bund der Heimatvertriebenen und Entrechteten*) which later merged with the DP (*Deutsche Partei*) into the GDP (*Gesamtdeutsche Partei*). Although quite successful in the beginning (for example, they achieved election results well over 40 percent in some Bavarian counties), they diminished into political insignificance during the early 1960s (Gutjahr-Löser and Singbartl 1975, pp. 86-7; Slapnicka 1970b, pp. 330-1; Weiß 1995, pp. 249-53).

Appendix 3

Table A3.1 – Provision of applied schools in 1938 and placement of Sudeten Germans

Dependent Variable	Share of Sudeten Germans in 1950 in total population (in %)		
	(1)	(2)	(3)
Applied school in 1938[a]	-2.576***	0.002	-0.466
	[0.763]	[0.848]	[0.907]
Rural county dummy		4.750***	2.720*
		[1.005]	[1.381]
Additional controls			
Employment structure 1939	no	no	yes
Observations	191	191	191

Notes: Table reports OLS estimates based on 191 Bavarian counties. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level.
[a] Applied schools in 1938 are Oberrealschule, Realschule, Realgymnasium, and Realprogymnasium.

Table A3.2 – Data description and source

Variable	Description	Source
County	Binary, 1 if unit of observation is a rural county; 0 if urban (basis: 1950)	Census 1950 (BSB: 171)
Pre-war characteristics Bavaria		
Share of students in secondary education 1939	Students in secondary schools divided by total population	Guide to higher education 1939 (RS), Census 1939 (BSB: 132)
Share of secondary school students in school-aged population 1939	Students in secondary schools divided by total population (aged 10-20)	Guide to higher education 1939 (RS), Census 1939 (BSB: 132)
Secondary schools per school-aged child 1939	Number of secondary schools divided by total population (age 10-20)	Guide to higher education 1939 (RS), Census 1939 (BSB: 132)
Applied secondary school in 1938	Binary, 1 if county has a Oberrealschule, Realschule, Realgymnasium, and/or Realprogymnasium	Guide to higher education 1939 (RS)
Share of self-employed 1939	Self-employed divided by total population	Census 1939 (BSB: 132)
Share of civil servants and white collar workers 1939	Civil servants and white collar workers divided by total population	Census 1939 (BSB: 132)
Share of blue collar workers 1939	Blue collar workers divided by total population	Census 1939 (BSB: 132)
Share of helping family members 1939	Family helpers divided by total population	Census 1939 (BSB: 132)
Share of population living of rents 1939	People living of rents (incl. unemployed, pensioners, and students outside family) divided by total population	Census 1939 (BSB: 132)
Share of population employed in agriculture 1939	Employees in agriculture divided by total population	Census 1939 (BSB: 132)
Share of people employed in industry and crafts 1939	Employees in industry and crafts divided by total population	Census 1939 (BSB: 132)
Share of people employed trade and transport 1939	Employees in trade and transport divided by total population	Census 1939 (BSB: 132)
Share of people employed in public and private services	Employees in public and private services divided by total population	Census 1939 (BSB: 132)
Pre-war characteristics Sudetenland		
Share of students in secondary education 1939	Students in secondary schools divided by total population	Guide to higher education 1939 (RS), Census 1939 (RSG)
Share of self-employed 1939	Self-employed divided by total population	Census 1939 (RSG)
Share of civil servants and white collar workers 1939	Civil servants and white collar workers divided by total population	Census 1939 (RSG)
Share of blue collar workers 1939	Blue collar workers divided by total population	Census 1939 (RSG)
Share of helping family members 1939	Family helpers divided by total population	Census 1939 (RSG)
Share of population living of rents 1939	People living of rents (incl. unemployed, pensioners, and students outside family) divided by total population	Census 1939 (RSG)
Share of population employed in agriculture 1939	Employees in agriculture divided by total population	Census 1939 (RSG)
Share of people employed in industry and crafts 1939	Employees in industry and crafts divided by total population	Census 1939 (RSG)
Share of people employed trade and transport 1939	Employees in trade and transport divided by total population	Census 1939 (RSG)
Share of people employed in public and private services	Employees in public and private services divided by total population	Census 1939 (RSG)
Post-war characteristics Bavaria		
Share of Sudeten Germans 1946	Number of Sudeten Germans divided by total population	Census supplement 1946 (BSB: 142), Census 1946 (BSB: 145)
Share of Sudeten Germans 1950	Number of Sudeten Germans divided by total population	Census 1950 (BSB 171)
Share of self-employed expellees 1950	Number of self-employed expellees divided by total number of expellees	SBBRD
Share of non net immigrants (1950-1961)	Number of immigrants minus emigrants divided by total population 1950	Census 1961 (BSB 253)
Share of secondary school students in school-aged population 1971	Students in Gymnasium, Realschule, and Fachschule divided by total population (aged 10-20)	School register (SBSUK: B/2), Census 1970 (BSB: 327a)
Share of students in applied schools in all secondary school students 1971	Students in Realschule and Fachschule divided by all secondary school students (Gymnasium, Realschule, Fachschule)	School register (SBSUK: B/2), Census 1970 (BSB: 327a)
Share of population with secondary school degree in population > 20 years 1970	People with highest school-leaving degree from Gymnasium, Realschule, or Fachschule divided by total population	Census 1970 (BSB: 327a)
Share of population with applied school degree in population with secondary school degree 1970	People with applied school-leaving degree from Realschule or Fachschule divided by population with secondary school degree	Census 1970 (BSB: 327a)
Gymnasium 1970	Binary, 1 if city/county has a Gymnasium	General education in Bavaria (SB: 293, 303)
Realschule 1970	Binary, 1 if city/county has a Realschule	General education in Bavaria (SB: 283)
Fachschule 1969	Binary, 1 if city/county has a Fachschule	Register of Fachschulen (SB)
Realschulen 1971 per 1,000 people	Number of Realschulen divided by total population (in 1,000)	School register (SBSUK: B/2)
Share of self-employed 1970	Self-employed divided by total population	Census 1970 (BSB: 328a)
Share of civil servants and white collar workers 1970	Civil servants and white collar workers divided by total population	Census 1970 (BSB: 328a)
Share of people employed in industry and crafts 1970	Employees in industry and crafts divided by total population	Census 1970 (BSB: 328a)
Share of people employed in public and private services	Employees in public and private services divided by total population	Census 1970 (BSB: 328a)
Share of unemployed 1968	Unemployed divided by total population	City and county data 1969 (KSLB)
Share of Protestants 1970	Protestants divided by total population	Census 1970 (BSB: 327a)

Table A3.3 – Sudeten Germans and educational attainment, full regression results, extensive margin

Dependent variable	Flow: Share of secondary school students in school-aged[a] population 1971 (in %)				Stock: Share of people with secondary school degree in population>20 years 1970 (in %)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Sudeten Germans 1950	0.441***	0.425**	0.330*	0.338**	0.204***	0.108***	0.130***	0.131***
	[0.144]	[0.170]	[0.180]	[0.158]	[0.058]	[0.031]	[0.030]	[0.030]
School dummy[b]					1.055	0.852**	0.903**	0.828
					[1.381]	[0.344]	[0.379]	[0.508]
% Protestants 1970	-0.013	0.004	0.011	-0.000	-0.003	-0.012*	-0.013**	-0.011*
	[0.034]	[0.035]	[0.035]	[0.032]	[0.010]	[0.006]	[0.006]	[0.006]
% Industry and crafts 1970		-0.083	-0.046	0.172		-0.143***	-0.152***	-0.114*
		[0.358]	[0.357]	[0.435]		[0.048]	[0.049]	[0.068]
% Services 1970		0.974*	0.918*	0.677		0.157*	0.169**	0.137
		[0.532]	[0.526]	[0.554]		[0.081]	[0.080]	[0.098]
% Self-employed 1970		0.109	0.0143	-1.339		0.292*	0.314**	0.517***
		[0.796]	[0.800]	[0.860]		[0.153]	[0.152]	[0.176]
% Civil servants & white collar workers 1970		0.441	0.751	-0.270		1.181***	1.110***	1.030***
		[0.466]	[0.482]	[0.516]		[0.092]	[0.094]	[0.116]
% Unemployed 1968		0.188	0.281	2.476		-0.971**	-0.990**	-1.601***
		[2.210]	[2.164]	[1.894]		[0.438]	[0.442]	[0.477]
% Self-employed expellees 1950			0.683	-0.0902			-0.160**	-0.109
			[0.442]	[0.462]			[0.077]	[0.078]
% Industry and crafts 1939				-0.329				-0.077
				[0.309]				[0.053]
% Services 1939				-3.088***				-0.086
				[1.031]				[0.208]
% Self-employed 1939				1.399**				-0.389***
				[0.586]				[0.129]
% Civil servants & white collar workers 1939				4.855***				0.116
				[1.208]				[0.242]
% Secondary students 1939				7.523***				0.390
				[1.860]				[0.380]
Constant	12.90***	0.945	-12.58	-7.782	10.64***	0.195	3.307	7.212**
	[2.265]	[14.01]	[17.13]	[14.92]	[1.447]	[2.429]	[2.724]	[2.941]
Observations	143	143	143	143	143	143	143	143

Notes: Table reports OLS estimates based on 143 rural Bavarian counties. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. Secondary schools are Fachschule, Gymnasium, and Realschule, applied schools are Fachschule and Realschule.

[a] Relevant school age is 10-20.

[b] Columns 5-8 include a dummy for the existence of a secondary school in 1970.

Table A3.4 – Sudeten Germans and educational attainment, full regression results, intensive margin

Dependent variable	Flow: Share of students in applied schools in all secondary school students 1971 (in %)				Stock: Share of people with applied school degree in population with sec. school degree 1970 (in %)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Sudeten Germans 1950	1.136***	0.848**	0.912*	0.871*	0.082**	0.100***	0.097***	0.108***
	[0.380]	[0.428]	[0.473]	[0.481]	[0.032]	[0.022]	[0.023]	[0.022]
School dummy[a]					-0.219	0.007	-0.007	-0.074
					[0.666]	[0.446]	[0.442]	[0.401]
% Protestants 1970	-0.079	-0.140	-0.144	-0.090	0.002	0.002	0.002	-0.001
	[0.090]	[0.099]	[0.100]	[0.098]	[0.005]	[0.003]	[0.003]	[0.004]
% Industry and crafts 1970		0.248	0.223	1.806		0.107**	0.108**	-0.043
		[0.863]	[0.863]	[1.237]		[0.046]	[0.046]	[0.074]
% Services 1970		-0.415	-0.377	1.447		-0.066	-0.067	-0.259***
		[1.102]	[1.110]	[1.444]		[0.085]	[0.084]	[0.093]
% Self-employed 1970		-1.915	-1.850	-4.894**		-0.022	-0.026	-0.135
		[2.110]	[2.134]	[2.243]		[0.116]	[0.116]	[0.122]
% Civil servants & white collar workers 1970		-2.827***	-3.039***	-5.659***		-0.533***	-0.522***	-0.593***
		[1.057]	[1.147]	[1.438]		[0.083]	[0.085]	[0.089]
% Unemployed 1968		-15.11**	-15.17**	-10.49		0.017	0.018	0.0181
		[5.888]	[5.898]	[6.772]		[0.270]	[0.271]	[0.264]
% Self-employed expellees 1950			-0.466	-1.430			0.026	0.054
			[1.247]	[1.314]			[0.073]	[0.078]
% Industry and crafts 1939				-1.851*				0.141***
				[0.948]				[0.050]
% Services 1939				-7.889***				0.230
				[2.619]				[0.150]
% Self-employed 1939				2.462				0.128
				[1.725]				[0.100]
% Civil servants & white collar workers 1939				11.89***				0.164
				[3.134]				[0.181]
% Secondary students 1939				-3.436				-0.125
				[5.049]				[0.274]
Constant	23.05***	78.19**	87.42**	73.51*	92.96***	96.53***	96.04***	96.85***
	[6.582]	[32.94]	[38.37]	[40.02]	[0.657]	[2.128]	[2.664]	[2.268]
Observations	143	143	143	143	143	143	143	143

Notes: Table reports OLS estimates based on 143 rural Bavarian counties. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. Secondary schools are Fachschule, Gymnasium, and Realschule, applied schools are Fachschule and Realschule.

[a] Columns 5-8 include a dummy for the existence of an applied school in 1970.

Table A3.5 – Sudeten Germans and educational attainment, rural and urban counties, extensive margin

Dependent variable	Flow: Share of secondary school students in school-aged[a] population 1971 (in %)				Stock: Share of people with secondary school degree in population>20 years 1970 (in %)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Sudeten Germans 1950	0.400**	0.241	0.226	0.263	0.140***	0.102***	0.106***	0.105***
	[0.173]	[0.207]	[0.215]	[0.203]	[0.052]	[0.032]	[0.036]	[0.035]
Mean dependent variable	32.17				16.75			
Additional controls								
Protestants (1970), rural county dummy, school dummy[b]	yes	yes	yes	yes	yes	yes	yes	yes
Employment structure 1970	no	yes	yes	yes	no	yes	yes	yes
Self-employed expellees 1950	no	no	yes	yes	no	no	yes	yes
Secondary students and employment structure 1939	no	no	no	yes	no	no	no	yes
Observations	191	191	191	191	191	191	191	191

Notes: Table reports OLS estimates based on 191 rural and urban Bavarian counties. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. Secondary schools are Fachschule, Gymnasium, and Realschule, applied schools are Fachschule and Realschule.

[a] Relevant school age is 10-20.

[b] Columns 5-8 include a dummy for the existence of a secondary school in 1970.

Table A3.6 – Sudeten Germans and educational attainment, rural and urban counties, intensive margin

Dependent variable	Flow: Share of students in applied schools in all secondary school students 1971 (in %)				Stock: Share of people with applied school degree in population with sec. school degree >20 years 1970 (in %)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Sudeten Germans 1950	0.937***	0.680**	0.778**	0.590*	0.135***	0.154***	0.211***	0.205***
	[0.283]	[0.310]	[0.341]	[0.344]	[0.037]	[0.034]	[0.049]	[0.046]
Mean dependent variable	34.39				92.91			
Additional controls								
Protestants (1970), rural county dummy, school dummy[a]	yes	yes	yes	yes	yes	yes	yes	yes
Employment structure 1970	no	yes	yes	yes	no	yes	yes	yes
Self-employed expellees 1950	no	no	yes	yes	no	no	yes	yes
Secondary students and employment structure 1939	no	no	no	yes	no	no	no	yes
Observations	191	191	191	191	191	191	191	191

Notes: Table reports OLS estimates based on 191 rural and urban Bavarian counties. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. Secondary schools are Fachschule, Gymnasium, and Realschule, applied schools are Fachschule and Realschule.

[a] Columns 5-8 include a dummy for the existence of an applied school in 1970.

Table A3.7 – Differences-in-differences estimation, rural and urban counties, extensive margin

Dependent variable	Flow: Share of students in secondary education[a] in school-aged[b] population (in %)		
	Pooled	County fixed effects	
	(1)	(2)	(3)
% Sudeten Germans 1950 *x d*1970	-1.319***	-0.757***	0.0781
	[0.348]	[0.238]	[0.228]
% Industry and crafts			-1.933***
			[0.429]
% Services			-0.0879
			[0.845]
% Self-employed			-0.0752
			[0.788]
% Civil servants & white collar workers			-1.041*
			[0.626]
*d*1970	37.31***	30.29***	35.11***
	[5.236]	[3.645]	[4.728]
Constant	7.078***	7.078***	48.34***
	[0.797]	[0.625]	[15.81]
County fixed effects	no	yes	yes
Observations	382	382	382
Number of counties		191	191
R-squared	0.265	0.603	0.708

Notes: Table reports regression DID estimates based on panel data for 191 rural and urban Bavarian counties for two time periods (1939 and 1970/1). Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level.

[a] Secondary schools are Gymnasium, Oberschule, and Realschule in 1939 and Gymnasium and Realschule in 1971.

[b] Relevant school-aged population is 10-20.

Table A3.8 – Accounting for net immigration (1950-61)

Dependent variable	Extensive margin		Intensive margin	
	Flow: Students	Stock: Degrees	Flow: Students	Stock: Degrees
	(1)	(2)	(3)	(4)
% Sudeten Germans 1950	0.329*	0.131***	0.891*	0.097***
	[0.180]	[0.029]	[0.484]	[0.023]
Mean dependent variable	18.65	14.36	36.75	93.94
Additional controls				
Protestants (1970), school dummy[a], employment structure 1970, self-employed expellees 1950				
Observations	143	143	143	143

Notes: Table reports OLS estimates based on 143 rural Bavarian counties, weighted by the share of non net immigrants. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. Secondary schools are Fachschule, Gymnasium, and Realschule, applied schools are Fachschule and Realschule. The extensive margin refers to % secondary school students or graduates in school-aged (10-20 years) population and population older than 20 years, respectively. The intensive margin refers to % applied students or graduates in all secondary school students and population with secondary school degree, respectively. Secondary schools are Fachschule, Gymnasium, and Realschule, applied schools are Fachschule and Realschule.

[a] Columns 5-8 include a dummy for the existence of a secondary school in 1970.

Table A3.9 – 2nd stage results, rural and urban counties

Dependent variable	Extensive margin		Intensive margin	
	Flow: Students	Stock: Degrees	Flow: Students	Stock: Degrees
	(1)	(2)	(3)	(4)
% Sudeten Germans 1950	0.273	0.129***	0.939**	0.255***
	[0.273]	[0.042]	[0.457]	[0.066]
Mean dependent variable	32.17	16.75	34.39	92.91
1st stage *F*-statistic[a]	48.16	47.68	48.16	47.63
Additional controls				
Protestants (1970), rural county dummy, school dummy[b], employment structure 1970, self-employed expellees 1950				
Observations	191	191	191	191

Notes: Table reports 2nd stage instrumental-variable estimates for rural and urban Bavarian counties. The share of Sudeten Germans in 1950 serves as an instrument of the share of displaced people in 1970. Robust standard errors are in parentheses: significantly different from 0 at *** 1%, **5% and *10% level. The extensive margin refers to % secondary school students or graduates in school-aged (10-20 years) population and population older than 20 years, respectively. The intensive margin refers to % applied students or graduates in all secondary school students and population with secondary school degree, respectively. Secondary schools are Fachschule, Gymnasium, and Realschule, applied schools are Fachschule and Realschule.

[a] 1st stage *F*-statistics in columns 2 and 4 include dummies for existing secondary and applied schools in 1970, respectively.

[b] Columns 5-8 include a dummy for the existence of a secondary school in 1970.

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