Three Essays on the Economics of Education:

Equal Opportunities for All?

Inequalities in the German Education System

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Abstract

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The importance of tracking and educational reforms over the last decades in Germany, and their consequences in terms of inequalities, connects the three papers of this dissertation. In my first paper, I examine causal effects of relative school-starting age on children's math, science, and reading competencies in primary school, as well as on teacher track recommendation at the end of grade four and actual track choice in grade five. I employ a fuzzy regression discontinuity design to account for the endogeneity of school-starting age. I find substantial positive effects on math, science, and reading competencies; my results also provide evidence that students who are the oldest in their cohort are more likely to receive a high-track teacher recommendation or attend a high-track school, compared to students who are among the youngest. I do not find differential effects depending on the student's gender or socioeconomic background.

In my second paper, I analyze the interacting influences of school type attended and school certificate earned on students' transition chances to fully qualifying vocational training in

Germany. More specifically, employing linear probability models, I explore whether those chances are different for intermediate (*Realschule)* certificate graduates depending on the type of school at which the certificate was obtained, and whether students attending the lowest-track *Hauptschule* who graduated with an intermediate certificate have better transition chances compared to their peers who earned lower school certificates. I find that intermediate certificate graduates who attended a *Hauptschule* have lower transition chances than intermediate certificate graduates who attended a *Realschule* or comprehensive school. I also find that students who attended a *Hauptschule* and graduated with an intermediate certificate have better transition chances compared to their *Hauptschule* peers who graduated with lower credentials. There is no evidence that students who earned an intermediate certificate enter vocational training positions of differing socioeconomic status or prestige depending on type of school attended.

In my third paper, using school-fixed effects regression models, I investigate socioeconomic status gaps in students' cognitive achievement in grade nine within different school types in Germany. I also explore the association between socioeconomic background and attainment of the intermediate secondary certificate and transition to upper secondary education in multi-track schools. My results provide suggestive evidence that socioeconomic status gaps in cognitive achievement exist within all school types. I also find that more privileged students are significantly more likely to earn an intermediate certificate or transition into upper secondary education. The decomposition of primary and secondary effects reveals that secondary effects are stronger at this transition in the German school system.

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Chapter 1: Introduction

The quality of an individual's education strongly influences their life outcomes. The analysis of educational inequality is of relevance because the positions that individuals attain in society, as well as their future life chances and well-being, are strongly associated with educational attainment. Higher educational achievement is often connected with higher earnings and better career opportunities (Psacharopoulos, 1994; Card, 1999; Psacharopoulos & Patrinos, 2002), lower risks of unemployment and precarious work (Hausner et al., 2015; Schmillen & Stüber, 2014), and better health (Sander, 1995; Wolfe & Zuvekas, 1997). A high-quality education system also contributes to a country's economic growth and social development, ensuring its capacity to produce, grow and innovate. Educational failure, on the other hand, imposes high costs on society and damages social cohesion and mobility.

The first PISA results of the early 2000s exposed that German students' scores in reading, mathematics, and science were lower than the OECD average, and that Germany belonged to the group of countries where the association between family socioeconomic background and student achievement was the strongest (OECD, 2001; OECD, 2004). This came as quite a shock to policymakers and the general public alike, and triggered an intense political and public debate about education policy in Germany's three-tier schooling system, which tracks students into different school types as early as age 10. It also led to the implementation of several reforms with the goal of increasing effectiveness and equality of educational opportunity. However, none of these changes challenged the fundamental structure of the traditional German school system: the highest-track school *Gymnasium*, which exists in all states, remains unchanged; and, with it, so does early tracking (after grade four, as it happens in most states, or after grade six, in some cases). The importance of tracking and educational reforms over the last

decades in Germany, and their consequences in terms of inequalities, connects the three papers of this dissertation.

In theory, tracking should be based solely on assessments of students' ability and academic interest. However, in school systems where the first tracking occurs very early, as is the case in Germany, track choice is strongly influenced by factors other than students' ability and academic interest. One factor, as numerous studies have documented for the German context and tracking after primary school, is students' parental background (e.g., Dustmann, 2004; Stocké, 2007; Tamm, 2008; Dumont et al., 2014; Falk et al., 2020). In my first paper, Chapter 2, I examine whether relative age at school entry is another such factor. I study the causal effects of relative school-starting age on children's math, science, and reading competencies in primary school, as well as on teacher track recommendation at the end of grade four and actual track choice in grade five. Legally defined cutoff dates for enrollment determine the age at which children may legally begin school in many countries, which leads to considerable variation among children in the school-starting age within each class. Numerous prior studies have documented that children who are among the oldest in their cohort perform better on school-based achievement tests than their younger peers within the same grade (Bedard & Dhuey, 2006; McEwan & Shapiro, 2008; Elder & Lubotsky, 2009; Fredriksson & Ockert, 2014; Dhuey et al., 2019). Research on countries where tracking happens in higher grades or where students are not tracked into different schools at all suggests that this effect fades as the duration of schooling grows longer (Elder & Lubotsky, 2009; Black et al., 2011).

If students are separated into different educational tracks very early, differences in age-related achievement might translate into age-related differences in track choice. I employ a fuzzy regression discontinuity design to account for the endogeneity of school-starting age. I find

substantial effects on math, science, and reading competencies, and my results provide evidence that students who are among the oldest in their cohort are more likely to receive a high-track teacher recommendation and attend the highest-track school, compared to students who are the youngest in their cohort. I do not find differential effects depending on the student's gender or socioeconomic background as measured by highest level of parental education.

My second paper, Chapter 3, is inspired by the observed trend in the decoupling of school type attended and school certificate earned over the past decades, after educational reforms made it possible to earn the intermediate (*Realschule*) certificate at all school types. In 2017, only 44 percent of secondary-school graduates who finished with *Realschule* certificates earned them at a standalone *Realschule*. In the same year, 10 percent of *Realschule* certificate graduates received theirs at a *Hauptschule* (German Federal Statistical Office, 2019). Today, every third *Hauptschule* student graduates with an intermediate certificate (Authoring Group, 2020). Despite these developments, however, little research has been undertaken to analyze whether the transition from school to vocational training for intermediate certificate graduates is influenced by the school type attended, or how transition chances change for *Hauptschule* students depending on the certificate earned.

In this paper, I analyze the interacting influences of school type attended and school certificate earned on students' transition chances to fully qualifying vocational training in Germany. Specifically, I explore whether transition chances differ for *Realschule* certificate graduates depending on what kind of school the certificate was obtained at, and whether *Hauptschule* students who graduated with an intermediate certificate have better transition chances compared to their peers who earned lower certificates. Additionally, I investigate whether intermediate certificate graduates gain access to vocational training positions of

differing socioeconomic status and prestige depending on the school type attended. I find that intermediate certificate graduates who attended a *Hauptschule* have lower transition chances than intermediate certificate graduates who attended a *Realschule* or comprehensive school. I also find that students who attended a *Hauptschule* and graduated with an intermediate certificate have better transition chances compared to their *Hauptschule* peers who graduated with lower certificates. There is no evidence, though, that intermediate certificate recipients secure vocational training positions of differing socioeconomic status or prestige depending on type of school attended.

My third paper, Chapter 4, is inspired by another set of educational reforms that led to considerable adjustments in the structure of school systems across German states. In the majority of states, the traditional coexistence of up to six school types has been abandoned in favor of differently accentuated two-pillar models over the past 20 years (Authoring Group, 2020). In the two-pillar system, states only offer two types of secondary school: the highest-track *Gymnasium*, and schools that combine multiple tracks under one roof. These are either campuses that have merged the two lower-track schools (*Hauptschule* and *Realschule*), offering the *Hauptschule* and *Realschule* certificates, or comprehensive schools (*Gesamtschule*), which offer all tracks and access to the upper-secondary certificate (*Abitur*). Currently, in some states multi-track schools coexist with the *Gymnasium*, the *Realschule*, and the *Hauptschule*. The goal of these school-structure reforms was to reduce the effects of socioeconomic background at the transition from primary to secondary education, to create greater permeability in terms of earning the different secondary certificates, and to decrease inequality of educational opportunity in Germany overall.

Despite these developments, relatively few studies have analyzed the consequences of these structural reforms on either the development of students' competencies or on social

inequalities. Thus, in my third paper, Chapter 4, I investigate socioeconomic status gaps in students' cognitive achievement in grade nine within different school types as well as the association between socioeconomic background and the attainment of the intermediate-secondary certificate and the transition to upper secondary education in multi-track schools in Germany. My results provide descriptive evidence that socioeconomic disparities in cognitive achievement exist within all school types. I also find that students from high socioeconomic backgrounds are significantly more likely to earn an intermediate certificate or transition into upper secondary education than their less-privileged peers. The decomposition of primary and secondary effects shows that secondary effects are stronger at this transition in the school system.

My dissertation highlights evidence regarding the existence of inequalities on several levels in the German education system. Considering the long-term implications of track choice and the unintended consequences of tracking, this paper contributes to a much broader set of conversations about the fundamental structure of the German school system: Should Germany eliminate the early tracking system entirely, or at least postpone tracking to a later point in students' lives? Could social disparities possibly be reduced this way? Knowing that relative age effects usually fade away over the duration of schooling, the identified relative age effect on teachers' track recommendation and actual track choice reveals an avoidable inequality of access in the German school system. Eliminating or postponing tracking could be a strategy to eliminate this avoidable inequality. In view of the results of my second paper, eliminating tracking altogether could possibly also reduce school-type effects for holders of the same school certificate in the transition to vocational training. Abandoning tracking in its current form at such

an early age would likely reduce educational inequalities overall and make the education system more efficient.

The fact remains, however, that the introduction of one comprehensive school for all students is not politically palatable in Germany at the moment. It remains to be seen if the two-pillar systems, which have been implemented in many states, can reduce some of the inequalities associated with the traditional three-tier system. In this regard, further research on the effects of structural reforms that have led states to shift from three-tier systems to two-tier systems is needed. The effects of the reforms on social inequalities in the acquisition of secondary certificates and transitions to upper secondary education are particularly relevant. Large-scale studies should be conducted at the state level, since substantial differences in the implementation of the reforms exist. In order to address inequalities in the transition from school to vocational training, it is crucial to conduct further research to gain insights into the interaction effects of school type attended and school certificate earned on transition chances to vocational training, including whether there are discrediting or discriminatory processes at work with employers in terms of school type attended. The use of experiments is especially promising in this regard. Furthermore, longer-term results need be examined to understand how the type of school attended affects long-term labor-market outcomes.

Inequality of educational opportunity is a major problem not only for the individual, but also for society and the economy. Reducing educational disparities is essential for reasons of social cohesion and social mobility. Making the system more efficient is also an economic necessity. A continued concerted effort by both the research community and policymakers towards that goal is, therefore, unquestionably essential.

Chapter 2: School-Entry Age Effects in an Early-Tracking School System: Does a Student's Secondary-School Track Choice in Germany Depend on the Month in Which He or She was Born?

2.1 Introduction

Legally defined cutoff dates for enrollment determine the age at which children may begin school in many countries. All children born before the cutoff are supposed to enter school in a given year, while those born after it are supposed to wait until the start of the next academic year. This leads to considerable variation between children in the school-starting age within a class. Numerous prior studies have documented that children who are among the oldest in their cohort perform better on school-based achievement tests than their younger peers within the same grade (Bedard & Dhuey, 2006; McEwan & Shapiro, 2008; Elder & Lubotsky, 2009; Fredriksson & Ockert, 2014; Dhuey et al., 2019). Research on countries where tracking happens in higher grades, or where students are not tracked into different schools at all, suggests that this effect fades as the duration of schooling grows longer (Elder & Lubotsky, 2009; Black et al., 2011). If in such education systems the performance gap tends to dissolve over the course of the educational career, as research suggests, the relative age assignment within a grade is not problematic.

However, if students are separated into different educational tracks very early, differences in age-related achievement might translate into age-related differences in track choice, and this raises concerns. Germany's tracking system separates students into different schools at the early age of 10, when students are moving into grade five. Teacher recommendations given in grade four whether a student should attend a low-, middle- or high-

track school are to a large degree based on students' grades in the last year of primary school. Previous studies in countries with early tracking systems have shown that relatively younger students are disproportionately less likely to attend a high-track school, suggesting that this might aggravate the relative age effect by limiting the scope for convergence through less challenging curricula and peers for disadvantaged students (Mühlenweg & Puhani, 2010, and Dustmann et al., 2017, for certain states in Germany; Schneeweis & Zweimüller, 2014, for Austria). Specifically, for Germany, research has also shown that it is mainly students from more privileged socioeconomic backgrounds who are able to benefit from the opportunity to revise their initial track choice later on (Biewen & Tapalaga, 2017; Blossfeld, 2018). An early school-entry age could therefore be viewed "as a randomly allocated disadvantage concerning track choice" (Mühlenweg & Puhani, 2010, p. 409) leading to inequality of access based on a random event. This begs the question of whether, in cohorts that have recently started school in Germany, the type of secondary school a student attends partly depends on the month in which he or she was born. From an individual student's point of view and a policy perspective, this would be very problematic. Further, it is important to examine whether teachers take age differences into account when making their recommendations at the end of grade four, which should be based on their assessment of future academic performance.

In this paper, I examine how school enrollment at a relatively younger versus older age due to age-based cutoff dates for school entry affects the track recommendations that students' teachers make for them at the end of grade four, their actual track choice and competencies in primary school. My starting point is that, because of the school-entry cutoff rules in the German education system, children whose birthdays fall just before the cutoff begin school almost one year younger than students born just after it. Therefore, even though not all children's parents

comply with this law, those born just after the cutoff date are on average considerably older when they start school.

Employing two datasets, which include information on students from all states in Germany and which cover the cohorts that started school in 2001/2002 and 2012, this paper makes two main contributions. First, I examine causal effects of relative school starting age on children's math, science and reading competencies in primary school to shed light on the possible existence and persistence of relative age effects across primary education in Germany for students who started school as recently as 2012. Specifically, I examine whether students who are among the oldest in their cohort perform better than their younger peers in the same cohort. This is, to my knowledge, the first study to examine relative school starting age effects on test scores at different points in primary schooling for one cohort of students in Germany.

Second, I examine the causal effects of relative school starting age on teacher track recommendation at the end of grade four and actual track choice in grade five for cohorts that relatively recently began school. In my analyses, I investigate whether students who start school at a younger age are less likely to receive a high-track teacher recommendation and attend a high-track school than their peers who start school at an older age. I employ a fuzzy regression discontinuity design to account for the endogeneity of school starting age because some parents time their children's school enrollment with respect to (unobserved) child characteristics, such as health and perceived school readiness. Like previous literature, I use assigned school-entry age based on legal cutoff dates for enrollment as an instrument for actual (observed) school-entry age.

This paper is structured as follows: Section 2.2 gives a brief overview of the German education system. Section 2.3 reviews previous research, while Section 2.4 lays out the research

design, and Section 2.5 describes the data, samples, and outcomes. Section 2.6 presents the results. Finally, Section 2.7 includes discussion and conclusion.

2.2. The German General Education System and Tracking

Education in Germany is overwhelmingly public. Although education is a domain governed by the states, it is highly standardized at the federal level, with degrees and certificates being equivalent across states. The German education system has also traditionally been highly stratified; it is divided into elementary, secondary, tertiary, vocational and continuing education. From ages three to six, children can attend *Kindergarten,* which are mainly run by non-public bodies. Children typically enter into primary school at the age of six or seven, and for the next four years, they are all taught together in these schools. After their fourth year (in some states after the sixth year) students are tracked into four different types of schools (or tracks) according to their perceived abilities: (1) *Hauptschule*, (2) *Realschule*, (3) *Gymnasium*, and (4) multi-track schools.

The secondary-school system in Germany has undergone major reforms in the last two decades, though the structural changes have taken different forms in the different states. Over the past 20 years, school structures were made more permeable by setting up additional transitions points; the goal in doing so was to make upgrading to higher school types easier, and to make it possible to earn the intermediate (*Realschule*) certificate at all school types. On the other hand, there were considerable structural adjustments on the supply side. In the majority of states, the traditional coexistence of up to six school types has been abandoned in favor of differently accentuated two-pillar models (Authoring Group, 2020). In the two-pillar system, states only offer two types of secondary school: the highest-track *Gymnasium* and those that combine multiple tracks under one roof. These are either schools that have merged the two lower track

schools (*Hauptschule* and *Realschule*), offering the lower *(Hauptschule)* and intermediate *(Realschule)* certificates, or comprehensive schools (*Gesamtschule*), which offer all tracks and preparation for all three types of certificates, including the upper-secondary certificate *(Abitur)*. Currently, in some states multi-track schools co-exist with the *Gymnasium*, the *Realschule*, and the *Hauptschule*. The *Hauptschule* and *Realschule* certificate can be earned at a *Hauptschule*, *Realschule*, multi-track school, or the *Gymnasium*; the *Abitur* can be earned at a comprehensive school or the *Gymnasium*. The *Hauptschule* and *Realschule* certificates entitle graduates to take up work, to pursue vocational studies or training, or to continue at the *Gymnasium* or, in some states, a comprehensive multi-track school with higher secondary studies. Two or three more years at the *Gymnasium* or a comprehensive multi-track school will lead to the *Abitur*, which grants access to tertiary studies, after grade 12 or 13 depending on the state. Tertiary studies include universities and other educational institutions that offer higher degree programs (bachelor, master, and Ph.D.).

However, all described educational reforms and resultant changes did not challenge the fundamental structure of the traditional German school system: the highest track school *Gymnasium*, which exists in all states, remains unchanged and with it the early tracking. Therefore, teacher recommendations and actual track choice decisions still have major effects on the entire life course. Indeed, students experience very different learning environments in each of the tracks. First, the tracks differ with respect to teaching intensity and learning goals. A second important difference is that high-track students are surrounded by academically stronger peers than those attending lower-track schools. Third, teachers in high-track schools are likely to be of higher quality than teachers in medium- or low-track schools (for details, see Dustmann et al., 2017).

In terms of long-term implications, track allocation and inequalities in secondary track placement in the German system are problematic because the certificates earned at lower-track schools qualify their recipients for very different forms of further education (vocational education training versus tertiary education), and subsequently their future earnings, compared to the *Abitur* certificate typically earned at the *Gymnasium*. In 2018, 85 percent of *Gymnasium* students graduated with an *Abitur* (Authoring Group, 2020), which grants access to higher education. Similarly, in 2017, of all secondary-school graduates leaving school with an *Abitur*, 87 percent earned theirs at the *Gymnasium* (German Federal Statistical Office, 2019). Overall, attendance of the different tracks during secondary schooling is usually associated with varying levels of educational quality and are predictive of later life outcomes, with students attending the higher track schools usually achieving higher levels of educational achievement overall (e.g., Dustmann, 2004).

Teachers give individual track recommendations in the fourth grade based on each student's grades, mainly math and German, and on their subjective evaluation of the children's overall academic abilities and potential. In most states, these teacher recommendations are not binding; parents may decide to deviate from the teacher's recommendation and send their child to a higher (or lower) school track. In the states where teacher track recommendations are binding, children can still attend a higher track than the one recommended if they pass an entrance examination. Mobility between tracks is in principle possible at any grade throughout secondary schooling. In practice, however, typically only about two to three percent of students change school tracks during lower secondary schooling (Schnepf, 2003; Dustmann et al., 2017), with the majority of those school changes constituting downgrades from the *Gymnasium* to a lower track school (Authoring Group, 2020). Hence, once students are allocated, they are

essentially locked into their chosen track for at least four or five years. After finishing secondary school after grade nine or 10 with the *Hauptschule* or *Realschule* certificate, it is possible for students to upgrade their certificates at upper secondary or vocational schools. Yet, research has also shown that it is mainly students from higher socio-economic backgrounds who are able to benefit from the opportunity to revise their initial track choice in these later stages (Biewen & Tapalaga, 2017; Blossfeld, 2018).

2.3. Previous Literature and Theoretical Considerations

Numerous prior studies have documented that children who are among the oldest in their cohort perform better on school-based achievement tests than their younger peers (e.g., Bedard & Dhuey, 2006; McEwan & Shapiro, 2008; Elder & Lubotsky, 2009; Fredriksson & Ockert, 2014; Attar & Cohen-Zada, 2018; Dhuey et al., 2019). This difference has been attributed to the hard-to-disentangle effects of school starting age, relative age in class, and age-at-test.

Studies that examined school-entry age effects acknowledge that entrance age is an endogenous variable. To deal with this concern, researchers used school entry cutoffs as an exogenous source of variation in entrance age, using assigned school-entry age as an instrument for actual (observed) school-entry age. The German school entry rule, for example, has been used to study the effects of relative school starting age on the likelihood of receiving a higher track recommendation and attending higher track schools (Jürges & Schneider, 2007; Mühlenweg & Puhani, 2010); on test scores at the end of primary school, in secondary school and several years after (Puhani & Weber, 2007); on non-cognitive skills (Mühlenweg et al., 2012); on long-term labor-market outcomes (Dustmann et al., 2017); on competencies in adulthood (Görlitz et al., 2019); and on smoking behavior and health in adulthood (Bahrs et al., 2020). Bedard and Dhuey (2006) first used this identification strategy, defining birth month

relative to the school cutoff date as the instrument "assigned age," in their study of relative age effects on test scores in 17 OECD countries. There is consensus in the previous literature that assigned age based on cutoff dates for enrollment constitutes a valid instrument.

In this approach, as required, the employed instrument is strongly associated with the actual entrance age because the majority of parents comply with the school entry rules. However, the causal interpretation of the estimates in these studies relies on two assumptions that may not hold in practice: monotonicity and randomness of dates of birth (i.e., the independence assumption). While the independence assumption has received attention in all previous papers, with authors discussing it in detail and providing some suggestive evidence that it is satisfied, monotonicity has not received equal attention, it was simply assumed to hold.

Monotonicity requires that all children affected by the instrument must be affected in the same direction. The monotonicity assumption is particularly crucial when the gain from the treatment is heterogeneous across the population and individuals sort themselves into treatment based on this gain (Heckman et al., 2006). This applies when estimating the effect of school-entry age on outcomes. The gain from beginning school older is heterogeneous across the student population; being older could benefit some students and harm others. When parents decide when to enroll their children in school, they take this gain into consideration. Barua and Lang (2016) and Fiorini and Stevens (2014) show that, due to redshirting (i.e., voluntarily postponing school entry), the monotonicity assumption may be violated when relying on an instrumental variable approach alone. Potential violations originate from the fact that, for compliers, (counterfactually) shifting a child's date of birth after the cutoff increases the school-entry age, while for non-compliers, it reduces it (Attar & Cohen-Zada, 2018). As a consequence, the instrumental variable, which indicates whether the child's date of birth is before or after the cutoff, is not

monotonically related to the actual school-entry age. Therefore, more recent studies have discussed the potential violation of monotonicity when using this identification strategy (Attar & Cohen-Zada, 2017; Page et al., 2019; Dhuey et al., 2019; Bahrs & Schumann, 2020). Fiorini and Stevens (2014) suggest that potential monotonicity violations may be decreased by employing a fuzzy regression discontinuity (RD) design and by shrinking the RD sample to only including children born very close to the cutoff date or, alternatively, by including a trend in date of birth.

In this study, I examine how school enrollment at a relatively younger versus an older age due to age-based cutoff dates for school entry affect students' track recommendations from teachers at the end of grade four, actual track choice in grade five and competencies throughout the different grades in primary school. I do not distinguish between absolute and relative age effects. Due to the shifting of cutoff dates throughout Germany over the past decades, different states have different cutoff dates for the cohort starting school in 2012. Therefore, students living in different states may begin school at different (absolute) ages. However, the changing of cutoff dates shifts the age distribution of the entire cohort in a given state and the relative age difference between the youngest and oldest remains at 11 months in all states for students who enrolled according to the rule. Thus, for compliers, I compare the youngest and the oldest students across states, with students in some states entering relatively earlier in terms of absolute age than those in others. This does not affect my analyses though. In my analyses on relative age effects on track recommendation and track choice, my focus is on examining whether relatively younger students are less likely to receive a high track recommendation or are less likely to transition to a higher track school compared to their relatively older peers. The legal terms of the NEPS data use agreement do not allow me to conduct analyses comparing individual states where students start school at different absolute ages. In terms of my analyses of relative age effects on test

scores, my focus is on examining whether relative age effects exist during primary school and persist until the end of grade four, offering insights into potential mechanisms of relative age effects on track recommendation and choice. Thus, for the purpose of this study, I do not need to disentangle effects of school starting age, relative age in class and age-at-test.

The key question for systems with early tracking is whether it aggravates the relative age effect when it comes to longer-term implications. Studies in the Austrian and Dutch contexts, all systems that track early, have found effects of relative age on track choice, as well as differential effects in terms of persistence of relative age effects depending on the student's socioeconomic background (Schneeweis & Zweimüller, 2014, for Austria; Misheva, 2016, for the Netherlands). In the German context, Jürges and Schneider (2007), Mühlenweg and Puhani (2010), and Dustmann et al. (2017) find that students who are relatively younger at the start of primary school are less likely to receive a high-track teacher recommendation and attend higher secondary-school tracks. Mühlenweg and Puhani and Dustmann et al. focused on the German states of Bavaria and Hesse only, while Jürges and Schneider used data from the extension of the German PISA 2000 study.

Mühlenweg and Puhani (2010) examine relative age effects on track choice for all cohorts that began school from 1993 to 1998 in the state of Hesse. In order to estimate the causal effect of school-entry age on track attendance, the authors apply a two-stage least squares estimator, where assigned school-entry age acts as an instrument for the observed actual entry age and a binary indicator for higher track is the outcome variable. Employing a fuzzy RD design, the authors restrict the estimation sample to the population of students born in a narrow window around the enrollment cutoff; specifically, in June or July. Their results show that entering school at age seven rather than six raises the probability to attend a highest track

secondary school by about 13 percentage points. Dustmann et al. (2017) estimate reduced form estimates for birth cohorts from 1961 to 1976 and 1988 to 1994. For the different samples and specifications, they find that students who are relatively older at school entry are between 3.8 to 9.2 percent more likely to attend a high-track school, with results being stronger for recent cohorts. In a third study, Jürges and Schneider (2007) use data from the German PISA 2000 extension study and find that relatively younger students are less likely to be recommended to the highest track school and to actually attend the highest track school. Their results, however, are based on student data from two decades ago; the students in their sample started school in the early 1990s. In none of these studies researchers conduct subgroup analysis by family's socioeconomic background.

In a related study, Görlitz et al. (2019) analyze data from the adult cohort of the National Educational Panel Study (NEPS), which includes individuals born between 1944 and 1986, and find that being one year older at school entry increases an individual's probability of attaining the highest school certificate. However, students can correct their track choice within secondary schooling or upgrade their school-leaving certificates through multiple channels even when they are older. Therefore, the analysis is different from an analysis of school-entry age effects on track choice in grade five.

Employing an instrumental variable approach, Schneeweis and Zweimüller (2014) estimate the causal relative age effect on track choice in Austria, a country where students are tracked first in grade five (at the age of 10) and again in grade nine. They find a strong positive relative age effect on track choice in grades five through eight. The age effect persists beyond grade eight for students from lower socioeconomic backgrounds and those in urban areas. Also employing an instrumental variable approach and using the assigned school-entry age as an

instrument for the observed entry age, Misheva (2016) finds that relatively younger students in the Netherlands are less likely to go to a school in a higher track, and that their teachers expect them to continue in a high-track school less frequently than older students. She also detects relative age effects on language and math test scores for students in grades two, four, and six.

Puhani and Weber (2007) estimate the effect of age of school entry on standardized test scores in grade four at the end of primary schooling in Germany using PIRLS data. Results based on instrumental variable estimation exploiting the exogenous variation in month of birth show that test scores of students who enter school at seven instead of six years of age are 0.42 standard deviations higher than those of their younger peers.

I am not aware of any study that explicitly examines relative school starting age effects on test scores at several different points in primary schooling for one starting cohort in Germany. In the context of the NEPS panel study, standardized test score data on competencies has been collected simultaneously in all different states for one representative sample of a school-starting cohort at three different measurement points during primary schooling. This new data for students who started school in 2012 makes it possible to study the (possible) existence and persistence of relative age effects on competencies throughout primary school.

2.4 Research Design

2.4.1 School Enrollment Regulations and Compliance with the Enrollment Cutoff

In this paper, I examine how school enrollment at a relatively younger versus older age due to age-based cutoff dates for school entry affect students' track recommendation from teachers, actual track choice, and competencies. My starting point is that, because of the school-entry cutoff rules in German states, for compliers, children whose birthdays fall just before the cutoff begin school a year younger than students born just after it. Therefore, even though not all

children's parents comply with this law, children born just after the cutoff date are on average considerably older when they start school.

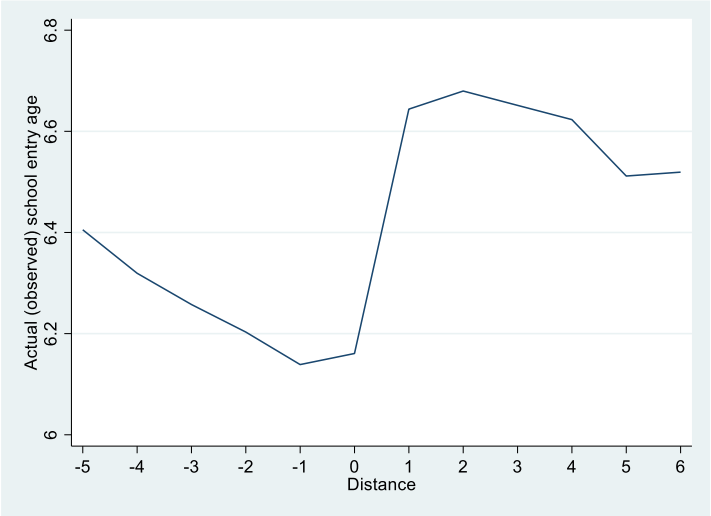
In all German states, the academic school year is from August 1 to July 31. Throughout the country, the school-entry age is effectively assigned by an enrollment cutoff date, which is legally determined at the state level. Until 2003, the rule in all states was that children who turned six by June 30 in year *t* were supposed to start primary school on August 1 in year *t*, while those turning six on July 1 or after in year *t* should start primary school on August 1 in year $t + 1$. Over the next several years, however, the states of Bavaria, North Rhine-Westphalia, Baden-Wurttemberg, Lower Saxony, Berlin, Brandenburg, Rhineland-Palatinate and Thuringia decided to change their cutoff dates in monthly steps over several years to August 31, September 30, October 30, and December 31 (Authoring Group, 2012). This change in policy becomes relevant for the analysis of NEPS Starting Cohort 2 data, in which the majority of children started school in 2012. For this sample, multiple cutoff dates had to be considered for the coding of the instrument. Children in NEPS Starting Cohort 4, who started school in 2001 or 2002, were not affected by the policy change because they enrolled before the changes were put into effect. The table in Appendix A gives an overview over the cutoff dates in different states.

Interestingly, the states of Bavaria and North Rhine-Westphalia, which had intended to change their cutoff dates to October 31 and December 31 respectively, have since switched back to September 30. It was argued that the regulations should not force parents to enroll their children in school at the age of five, which was considered to be too early after all, though no large-scale studies had been conducted, and there was no empirical evidence to support this view. In this study, though, I focus on the effects of relative age, not on the effects of absolute age. The shifting of cutoff dates shifts the age distribution of the entire cohort in a given state

and the relative age difference between the youngest and oldest remains at 11 months in all states for students who enrolled according to the rule. Thus, for compliers, I compare the youngest and the oldest students across states, with students in some states entering relatively earlier in terms of absolute age than those in other states. In 2012, due to the shifting of cutoff dates in some states, the official school-entry age ranges from 5.7 years in Berlin with the earliest cutoff date to 6.2 years in the states with the original cutoff date of June 30. In 2010, 7.5 percent of children were enrolled late and 4.5 percent of children were enrolled early. For example, in Bavaria, one of the states with the earliest cutoff dates, 21.5 percent of children were enrolled late; as a consequence, the early cutoff was shifted back to a later point (Authoring Group, 2012). For the 2012 starting cohort, even though there was weaker compliance with the school entry rule, there is still substantial discontinuity in school starting age of about six months at the school entry cutoff, as can be observed in Figure 2.1. Figure 2.1 displays the actual (observed) school-entry ages by distance from the cutoff for school starting cohort 2012 (kindergarteners in 2010).

Figure 2.1

Actual (Observed) School-Entry Ages by Distance from Cutoff: 2012 Starting Cohort (Kindergarteners in 2010)[1]



[1] Source: NEPS SC2 8.0.0., author's calculations and graphic.

2.4.2 Identification Strategy

The general relationship between students' outcomes and school starting age (SSA) can be expressed by the following equation:

$$Y_{ig} = \alpha_0 + \alpha_1 SSA_{ig} + \alpha_2 X_{ig} + \epsilon_{ig} \quad (1)$$

where Y_{ig} is one of the outcome variables for child *i* in grade *g* (track choice, teacher track recommendation or competency score), SSA_{ig} is the actual (observed) school starting age of student *i* in grade *g* (measured in months), and X_{ig} is a set of covariates predetermined with respect to birth, including student's gender, parents' highest level of school education, and migration background, as well as dummies for the states of enrollment in primary school. ϵ_{ig} is an error term. The coefficient of interest α_1 would capture the effect of school starting age on students' outcomes if there was no selection bias. The possibility of non-compliance with the cutoff rules, however, suggests that the actual school-entry age is endogenous, implying that even if birth month and thus assigned school-entry age were randomly assigned across children, the actual school-entry age might correlate with the child's proficiency (with less proficient students entering later).

Variation in observed school starting age arises from the following sources: the distribution of births over the calendar year and the non-compliance of some students with the school enrollment cutoff date rules. Since I cannot assume that non-compliance with the cutoff rule is exogenous with respect to students' outcomes, a simple ordinary least squares model would provide a biased estimate of the relative age effect. The estimate is expected to be downward biased if children who defer enrollment tend to be negatively selected with respect to cognitive and non-cognitive skills, while children starting school early might be of particular high ability.

For the reasons described in Section 2.3, I employ a fuzzy regression discontinuity (RD) design. To circumvent the problem of school starting age not being randomly allocated, I instrument school starting age with a dummy variable indicator *post* for being born after the cutoff date (1 = born in the six months following the cutoff date, 0 = born in the six months before the cutoff date). For the 2012 starting cohort, multiple cutoff dates were incorporated for the coding of the instrument.

Analytically, the estimation of the treatment effect in a fuzzy RD design can be carried out by the two-stage least squares (2SLS) method. The following models illustrate how 2SLS analysis can be carried out in this study's setting.

First-stage equation:

$$SSA_i = \beta_0 + \beta_1\, post_i + f\,(birthday_i) + \beta_2\, X_i + \epsilon_i \qquad (2)$$

In the first stage, actual (observed) school starting age SSA_{ig} (measured in months) is regressed on the instrument $post_i$, where subscript *i* denotes individual *i*. $f\,(birthday)_i$ is a function of birthday.

Second-stage equation:

$$Y_i = \gamma_0 + \gamma_1\, \widehat{SSA}_i + f\,(birthday_i) + \gamma_2\, X_i + \epsilon_i \qquad (3)$$

In the second stage, the outcome of interest Y_i is regressed on predicted school starting age in months $\widehat{SSA}_i$.

The reduced-form or intention-to-treat effect is:

$$Y_i = \delta_0 + \delta_1\, post_i + f\,(birthday_i) + \delta_2\, X_i + \epsilon_i \qquad (4)$$

In the fuzzy RD design, I can either use the parametric or the non-parametric approach. In the parametric approach, one can use the entire sample and model polynomial trends of the running variable around the cutoff (Lee & Lemieux, 2010). The non-parametric approach

involves restricting the sample to a narrow bandwidth within which the functional form between rating and the outcome of interest can be approximated with a linear function. In my analyses, I use both approaches.

In my first approach, I restrict my sample to the children born within +/- one month of the cutoff (a two-months window); for example, students born in June and July if the cutoff date is June 30. One limitation is that, for each child, I only have information on year and month of birth; therefore, I cannot perform the more standard RD analysis with daily-level running variable. Therefore, my estimate comparing individuals born in the month before and in the month after the cutoff may be seen as a regression discontinuity estimate in which the sample is restricted to students born within one month of the school-entry cutoff date (+/- one month) and the birthday effect $f(birthday_i)$ is assumed to be constant (compare Dustmann et al., 2017).

For my second approach, I use the entire sample and include separate linear trends on each side of the cutoff in the estimation. The running variable $dist_i$ is the distance between a child's month of birth and the school-entry cutoff date. It is measured in months and takes on integer values between -5 and 6. Modeling higher degree polynomials of the running variable is infeasible in this application, because the running variable is discrete rather than continuous (compare Bahrs & Schumann, 2020). The advantage of implementing the second approach is the gain in precision due to the larger number of observations. The first-stage equation with separate linear trends in the running variable and covariates is:

$$SSA_i = \beta_0 + \beta_1\, post_i + \beta_2\, dist_i + \beta_3\, dist_i * post_i + \beta_4\, X_i + \epsilon_i \qquad (5)$$

The corresponding second-stage equation is:

$$Y_i = \gamma_0 + \gamma_1\, \widehat{SSA}_i + \gamma_2\, dist_i + \gamma_3\, dist_i * post_i + \gamma_4\, X_i + \epsilon_i \qquad (6)$$

I will also analyze whether relative school starting age affects students of different socioeconomic backgrounds and gender differently.

2.4.3 Identifying Assumptions

Identification is based on the following assumptions. First, in order to have a valid instrument, it must be correlated with the endogenous variable. Table 2.9 in the results section presents the first-stage estimates, separated for the three samples used. These results confirm that the expected school-starting age is well suited to serve as an instrument for actual school starting age.

Second, the independence assumption requires that a student's birth month may ideally be random. The independence assumption could be violated if parents timed the birth of their children to take advantage of a later school starting age. If, for example, in states with a June 30 cutoff date parents with higher socioeconomic backgrounds are more likely to have children in July than in June, the estimated relative age effect would be upward biased. That is unlikely in this case, though, as the school entry rule was not rigidly enforced and parents could deviate from it. One way suggested to test whether the independence assumption holds is to show that predetermined variables, such as gender and parental education, are not correlated with the instrument. Tables 2.1, 2.2, and 2.3 present coefficients of separate regressions of observed student characteristics for the 2001/2002 and 2012 school starting cohort samples. Results are shown for the discontinuity population (+/- one month around the cutoff date; a two-month window). The results of regressions that use the predetermined covariates as outcome variables confirm the absence of systematic differences around the cutoff, except for migration background in the 2001/2002 starting cohort track recommendation and track choice samples and

the 2012 starting cohort competencies sample. Due to this, I will include the covariates in my analyses.

Table 2.1

Regression of Covariates on Instrument (Post): Track-Recommendation Samples (Two-Month Window)

	2001/2002 Starting Cohorts	2012 Starting Cohort
Male	-0.023	-0.004
	(0.035)	(0.035)
Migration background	0.046*	0.030
	(0.027)	(0.028)
Parental highest level of education (*Abitur* certificate)	-0.021	-0.013
	(0.035)	(0.032)
Further covariates	Yes	Yes
Observations	892	820

Note: Robust standard errors are in parentheses. Additional covariates include gender, migration background, highest parental level of school education, and the state of primary-school enrollment.
Source: NEPS SC4 10.0.0 and SC2 8.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

Table 2.2

Regression of Covariates on Instrument (Post): Track-Choice Samples (Two-Month Window)

	2001/2002 Starting Cohorts	2012 Starting Cohort
Male	-0.023	0.010
	(0.035)	(0.037)
Migration background	0.046*	0.042
	(0.025)	(0.029)
Parental highest level of education (*Abitur* certificate)	-0.021	0.002
	(0.035)	(0.034)
Further covariates	Yes	Yes
Observations	892	744

Note: Robust standard errors are in parentheses. Additional covariates include gender, migration background, highest parental level of education, and the state of primary-school enrollment.
Source: NEPS SC4 10.0.0 and SC2 8.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

Table 2.3

Regression of Covariates on Instrument (Post): Competencies Sample, 2012 Starting Cohort (Two-Month Window)

	2012 Starting Cohort
Male	-0.011
	(0.039)
Migration background	0.054*
	(0.031)
Parental highest level of school education (*Abitur* certificate)	0.015
	(0.036)
Further covariates	Yes
Observations	677

Note: Robust standard errors are in parentheses. Additional covariates include gender, migration background, highest parental education level, and the state of primary-school enrollment.
Source: NEPS SC2 8.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

Overall, the results tentatively indicate that parents do not strategically plan to deliver children before or after the school cutoff date in Germany, which is also confirmed for the German context by using different data sets by Mühlenweg and Puhani (2010, state of Hessen), Bahrs and Schuhmann (2020) using the German Socio-Economic Panel (SOEP) and Dustmann et al. (2017) using the German Microcensus, and Görlitz et al. (2019), using the NEPS adult cohort data.

Third is the exclusion restriction. The instrument should affect the outcomes only through school-starting age; the instrument has no direct effect on the outcomes analyzed. In Germany, since students must complete at least nine years of secondary schooling before they are allowed to leave school, there is no interaction between school entry age and compulsory school attendance laws, as it is the case in the United States for example. Fourth, monotonicity is assumed.

2.5. Data

2.5.1 Overview

I use individual-level data from the so-called second and fourth starting cohorts (SC2 and SC4), students who started school in 2001/2002 (SC4), and 2012 (SC2), from the National Educational Panel Study (NEPS). The main aim of the NEPS is to collect and provide data on the development of skills and educational trajectories throughout the whole lifespan. To meet these aims as quickly as possible, a multi cohort sequence design was chosen, following six parallel starting cohorts at different ages and stages in the educational career (Blossfeld et al., 2011). The NEPS data contains data for all German states.

SC2 covers educational processes during kindergarten and elementary school age in two stages: "kindergarten and transition to elementary school" and "elementary school and transition to lower secondary school." Data collection started in winter 2010/2011 with a cluster sample of 3,000 target children aged four to five years attending kindergarten, who were eligible to start primary school in 2012. The cohort was more than doubled in size when most of these children began school, by integrating their classmates and a further subsample of first-grade students into the survey (Berendes K. et al., 2019).

Table 2.4

Number of Students Surveyed Across Waves (SC2)

Wave	Year	Number of Students Surveyed
Wave 1	2011	2,949
Wave 2	2012	2,727
Wave 3	2013	6,734
Wave 4	2014	6,827
Wave 5	2015	5,800
Wave 6	2016	6,954
Wave 7	2017	4,22
Wave 8	2018	4,164

For students in the starting cohort of ninth graders (SC4), most of whom began school in 2001 and 2002, the first survey was carried out in fall/winter 2010. Upon entering the vocational track, students left the institutional school context in which they were originally sampled and surveyed. They were then individually surveyed.

Table 2.5

Number of Students Surveyed Across Waves (SC4)

Wave	Year	Number of Students Surveyed
Wave 1	2010	16,425
Wave 2	2011	15,088
Wave 3	2011/2012	14,011
Wave 4	2012	1,551 (only school-leavers)
Wave 5	2012/2013	12,982
Wave 6	2013	5,392 (only school-leavers)
Wave 7	2013/2014	11,829
Wave 8	2014/2015	9,871
Wave 9	2015/2016	9,553
Wave 10	2016/2017	7,984

For both starting cohorts, in addition to the students, their parents were interviewed and teachers and principals filled out self-administered questionnaires. The NEPS data for both cohorts contains student information on: month and year of birth, month and year of school entry, whether students were enrolled on time, early or late, grade level and school type, teachers' track recommendations in grade four, competency scores from tests administered in different grades, school grades, and rich background information (socioeconomic background, parental education, gender, migrant status, etc.).

2.5.2 Samples and Variables

For the NEPS SC 2, the goal was to sample four-year-olds in kindergarten in 2010 who were eligible to start primary school in 2012. Therefore, my analysis of this sample focuses on the 2012 school starting cohort; i.e., students who actually started school in that year. The

advantage of the 2012 cohort is, that it enables me to analyze relative age effects on competencies at different points during primary schooling; this data is not available for the SC 4 cohort.

For the NEPS SC 4, students were sampled in grade 9 during the 2010-2011 academic year, when schooling was still compulsory for them. Since students were sampled in grade nine, the NEPS Starting Cohort 4 includes children from different school starting cohorts. My analysis focuses on children who were born between July 1994 and June 1996. Because I observe these children in grade nine in the 2010-2011 academic year, children born between July 1994 and June 1995 had either repeated a grade or delayed their school entry. Children born between July 1995 and June 1996, by contrast, represent the regular school cohort.

For my analyses of relative age effects on teacher track recommendation in grade four and actual track choice, I conduct my analyses separately for starting cohorts 2001/2002 and 2012. For both starting cohorts, the parents reported the year and month their children first began primary school, as well as whether they had enrolled their children according to the rule, or whether their children were enrolled earlier or later than they were supposed to. I exclude from my sample children for whom parents did not report a school starting year, or for whom they did not report the information on whether they were enrolled early or late. For all analyses, I only included in my sample students on whom there was reasonable information. Students who, based on information provided, would have been clearly too young (e.g., two years old) or too old (e.g., 11 years old) at school entry were deleted. When parent responses for covariates were missing, I used information collected from students directly. Students' year and month of birth were taken from school records. Lastly, the two samples only include children for whom I have complete

information regarding the analytical outcomes and covariates as well as information on month and year of birth. This leaves me with the following samples:

Table 2.6

Teacher Track Recommendation Samples

	2001/2002 Starting Cohorts	2012 Starting Cohort
Two-month window (+/- month around the cutoff)	892	820
All months, entire sample	5,595	4,602

Table 2.7

Track Choice Samples

	2001/2002 Starting Cohorts	2012 Starting Cohort
Two-month window (+/- month around the cutoff)	892	744
All months, entire sample	5,595	4,310

As described in the previous section, for my non-parametric approach analysis I restrict my sample to the children born within one month before or after the cutoff date ("two-months window"); for example, students born in June and July if the cutoff date is June 30. In the parametric approach, I use the entire sample ("all months").

Due to sampling design as well as survey non-response for the 2012 starting cohort, there are disproportionately more students enrolled in the *Gymnasium* and fewer in the *Hauptschule*. For starting cohort 2001/2002 *Hauptschule* students were oversampled. Also, data is missing not at random. Thus, as a limitation to this study, it has to be kept in mind that results from analyses are not based on a representative sample.

For my analyses of relative age effects on competencies, I include all children sampled as part of the 2012 starting cohort, who participated in all three math tests in primary school, in both sciences tests in primary school and in the reading test in grade four; and for whom I have

no missing data on month and year of birth, month and year of school entry, gender, migration background and parental education. This leaves me with a sample of 677 students for the two-months window and 3,754 students for the all-months sample for the analyses of relative age effects on competencies in primary school.

Table 2.8

Competencies Sample, 2012 Starting Cohort

	2012 Starting Cohort
2-months window (+/- month around the cutoff)	677
All-months, entire sample	3,754

Outcome variable: teacher track recommendation and track choice. My first and second outcome of interest, binary indicators, are the teacher track recommendation in grade four and actual track choice in grade five. I distinguish between the most prestigious school type (*Gymnasium*) and all other tracks. For teacher recommendation, I use teacher information when available, and otherwise rely on what parents supplied. For track choice for SC 2, I use information from parents where available, and from students in all other cases. For track choice for SC 4, I use information on sampling school in grade nine as a proxy for track choice in grade five.

Outcome variable: competencies. For my analyses of relative age effects on competencies throughout primary school, I operationalize my first outcome of interest using math competency test scores on standardized tests that contained between 22 and 24 items. The tests took place on three occasions: in 2013, when children were enrolled in the first grade; then again in 2014, when children were in the second grade; and finally, in 2016, when children had reached the fourth grade. I chose math because it is the only competency measured in the NEPS

three times throughout primary school; and thus, I can study changes over time. I also selected science competency, because it was measured twice during primary school, in grades one and three. Finally, I also chose reading competency, which was only measured in grade four, as an outcome. Teacher recommendations to attend a low-, middle- or high-track school are to a large degree based on students' grades, mainly on math and German, in the last year of primary school. Therefore, math and reading competencies work well as outcomes for my analyses of relative age effects on test scores, possibly illuminating the mechanisms behind the results from analyses of relative age effects on teacher track recommendation and track choice. To derive an estimate of the unobserved competencies of the children from the test results, I used the weighted maximum likelihood estimates (WLE) provided by NEPS. I standardized WLEs for the analysis sample to have a mean of zero and a standard deviation of one to measure relative test score differences rather than absolute test score differences. Differences on the z-score scale are easy to interpret and, in relative terms, comparable across different domains and over time.

Covariates. The following analyses use predetermined covariates; that is, children's characteristics that are determined before school enrollment. I include students' gender, migration background, and parents' highest level of education as well as indicators for the state of enrollment in primary school. Because I observe two school entrance cohorts of children in grade nine in the NEPS starting cohort 4 sample (2001 and 2001), I include a control for year of school enrollment for the analyses with the 2001/2002 starting cohort sample.

2.6 Results

Since the competency test scores are only available for the 2012 starting cohort, for clarity, I will only present results for the 2012 cohort in this section. Results for the 2001/02 starting cohorts can be found in Appendix B.

2.6.1 The Validity of Expected Age as Instrument

Table 2.9 presents the first stage results for the 2012 starting cohort together with the F-statistics for the two-months window samples. Actual school starting age is measured in months. If there was perfect compliance with the school entry rule, there would be an 11-month difference in expected age between children born in the month before the cutoff date and those born in the month after the cutoff date. For the track recommendation sample, increasing the expected age at school entry by 11 months is associated with an average increase of actual age at school entry by 5.86 months for the 2012 starting cohort. Similarly, for the track choice sample, increasing the expected age at school entry by 11 months is associated with an average increase of actual age at school entry by 6.00 months. For the competencies sample, increasing the expected age at school entry by 11 months is associated with an average increase of actual age at school entry by 5.69 months. Since the F-test for the significance of the instruments is always above 10, there is no problem of a weak instrument (Stock, Wright, & Yogo, 2002[2]).

Table 2.9

Effect of Instrument on Actual School-Starting Age (First-Stage Estimates): Two-Month Window

	2012 Starting Cohort		
	Track Recommendation Sample	Track Choice Sample	Competencies Sample
Assigned school-starting age	5.86***	6.00***	5.69***
	(0.332)	(0.342)	(0.371)
Covariates	Yes	Yes	Yes
R-squared	0.337	0.360	0.319
F-Statistic	30.99	38.09	25.45
Observations	820	744	677

Note: Robust standard errors are in parentheses. Covariates in all regressions include gender, migration background, highest parental level of school education, and state of primary-school enrollment.
Source: NEPS SC2 8.0.0, author's calculations.

*$p < 0.1$, **$p < 0.05$, ***$p < 0.0$

[2] Stock, Wright, and Yogo (2002) suggest that F-statistics above 10 are necessary to rule out weak instruments.

Since I will also analyze whether relative age affects students differently based on socioeconomic background and gender when it comes to track recommendation received and actual track choice, I examine potential heterogeneities in the first-stage relationship. For this, I run a fully interacted model of the first stage including the interaction terms with the instrument for the two-months window specification. In Table 2.10 and Table 2.11, the estimates in the column (Ref.) report the first stage estimate for the reference group, and the estimates in the column (Int.) report the coefficient for the interaction of the instrument and the other subgroup indicator variable. The interaction term for gender is not statistically significant for either the track recommendation or the track choice sample (column 5 in both Table 2.10 and Table 2.11), which indicates that the instrument affects these two subgroups in a similar way.

Table 2.10

Effect of Instrument on Actual School-Starting Age (First-Stage Estimates): Track Recommendation Sample Subgroups (Two-Month Window)

	2012 Starting Cohort			
	Parents' highest education level		Student's gender	
	Low/ Medium	High	Female	Male
	(Ref.)	(Int.)	(Ref.)	(Int.)
Assigned school starting age	6.95***	-1.59**	5.80***	0.21
	(0.562)	(0.696)	(0.468)	(0.664)
Covariates	Yes	Yes	Yes	Yes
F-Statistic	396.78	23.33	19.31	13.60
Observations	275	545	432	388

Note: Specifications as in Column 2 of Table 2.10, and fully interacted with the respective subgroup indicator variable. The estimates in the column (Ref.) report the first-stage estimate for the reference group. The estimates in the column (Int.) report the coefficient for the interaction of the instrument and the other subgroup indicator variable (fully interacted model). The sample sizes indicate the number of students in each subgroup. The first-stage F-Statistic refers to the first-stage F-statistic for each subgroup and is obtained from a separate regression. Robust standard errors are in parentheses.
Source: NEPS SC2 8.0.0, author's calculations.
*$p < 0.1$, **$p < 0.05$, ***$p < 0.0$

The interaction term for highest level of parental education is statistically significant for both the track-recommendation and track-choice sample (column 3 in both Table 2.10 and Table

2.11), indicating that the students with higher educated parents are less compliant in terms of adhering to the school enrollment regulations.

Table 2.11

Effect of Instrument on Actual School-Starting Age (First-Stage Estimates): Track-Choice Sample, Subgroups (Two-Month Window)

	2012 starting cohort			
	Parent's highest education level		Student's gender	
	Low/ Medium	High	Female	Male
	(Ref.)	(Int.)	(Ref.)	(Int.)
Assigned school-starting age	7.35**	-1.88**	5.98***	-0.17
	(0.590)	(0.719)	(0.483)	(0.684)
Covariates	Yes	Yes	Yes	Yes
F-Statistic	53.59	16.92	63.42	21.76
Observations	225	519	385	359

Note: Specifications as in Column 3 of Table 2.10, and fully interacted with the respective subgroup indicator variable. The estimates in the column (Ref.) report the first stage estimate for the reference group. The estimates in the column (Int.) report the coefficient for the interaction of the instrument and the other subgroup indicator variable (fully interacted model). The sample sizes indicate the number of students in each subgroup. The first-stage F-Statistic refers to the first-stage F-Statistic for each subgroup and is obtained from a separate regression. Robust standard errors are in parentheses.
Source: NEPS SC2 8.0.0, author's calculations.
*$p < 0.1$, **$p < 0.05$, ***$p < 0.0$

2.6.2 Effects of Relative Age on Track Recommendation and Track Choice

Table 2.12 presents the IV and the reduced form estimates for the analyses of relative age effects on teacher track recommendation in grade four and actual track choice in grade five for the 2012 samples. The reduced-form captures the net effect of assigned age on the outcome of interest (intention-to-treat effect; i.e., the impact of being born in the month after the cutoff date compared to being born in the month before the cutoff). The IV coefficient captures the effect of relative age for the sample of students that comply with the assignment rule.

The positive IV estimates are all statistically significant, suggesting that students who are among the oldest at school entry are more likely to receive a high track teacher recommendation at the end of grade four and are also more likely to attend a high track school in grade five.

Looking at the results for teacher track recommendation, for the two-months window specification, the IV estimate in Table 2.12, row 2, column 2 is 0.014. Thus, a 1-month increase in school starting age increases the likelihood of receiving a high-track teacher recommendation by about 1.4 percent. For the all-months specification, the IV estimate in Table 2.12, row 2, column 3 is with 0.010 very similar in magnitude. For the compliers, these results suggest that students who are 11 months older at school entry, i.e., comparing students born in the month before and after the cutoff and compliant with the school entry rule, are about 11 to 15 percent more likely to receive a high track recommendation.[3]

Table 2.12

Effect of Relative Age and Birth Month on Teacher Track Recommendation and Track Choice

	2012 Starting Cohort		**2012 Starting Cohort**	
	Two-month window	All months	Two-month window	All months
	Track recommendation		Track choice	
A. Reduced form				
Assigned school-starting age	0.085**	0.074**	0.076**	0.065**
	(0.034)	(0.028)	(0.036)	(0.029)
Observations	820	4,602	744	4,310
B. IV coefficients				
Observed school-starting age	0.014**	0.010**	0.013**	0.009**
	(0.006)	(0.004)	(0.006)	(0.004)
Further covariates	yes	yes	yes	yes
Observations	820	4,602	744	4,310

Note: Robust standard errors are in parentheses. Additional covariates include gender, migration background, highest parental education level, and the state of primary-school enrollment.
Source: NEPS SC2 8.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

The IV estimates for actual track choice in grade five are very similar. The IV estimates in Table 2.12, row 1, column 4 and 5, are 0.013 (two-months specification) and 0.009 (all months specification). Thus, a 1-month increase in school starting age increases the likelihood of

[3] Results are similar for the 2001/2002 starting cohort, presented in table B.2 in Appendix B.

attending the high-track by about 1 to 1.3 percentage points. All of the reduced form estimates are statistically significant as well. Students born in the month after the cutoff date are 8.5 percentage points more likely to receive a high track recommendation (Table 2.12, row 21, column 2) and 7.6 percentage points more likely to attend a high track school in grade five (Table 2.12, row 1, column 4) than students born in the month before the cutoff.

The magnitudes of the track choice estimates are in line with previous research conducted in the German context (Mühlenweg & Puhani, 2010; Dustman et al., 2017). And so are the magnitudes of the teacher track recommendation estimates (Jürges & Schneider, 2007). The track recommendation estimates provide suggestive evidence for a recent school starting cohort that teachers do not seem to take age differences into account when making their recommendations. The results of the subgroup analyses, employing the parametric approach due to sample size, are presented in Table 2.13 and Table 2.14.

Table 2.13

Effect of Relative Age and Birth Month on Teacher Track Recommendation and Track Choice (All-Months Specification), Parental Education Subgroup Analysis

	2012 Starting Cohort			
	Low/medium parental education	High parental education	Low/medium parental education	High parental education
	Track recommendation		Track choice	
A. Reduced form				
Assigned school-starting age	0.057	0.078**	0.078	0.060*
	(0.049)	(0.035)	(0.055)	(0.034)
Observations	1,557	3,045	1,330	2,980
B. IV Coefficients				
Observed school-starting age	0.007	0.012**	0.009	0.009*
	(0.006)	(0.005)	(0.006)	(0.005)
Further covariates	Yes	Yes	Yes	Yes
Observations	1,557	3,045	1,330	2,980

Note: Robust standard errors are in parentheses. Additional covariates include migration background, highest level of parental education, and state of primary-school enrollment.
Source: NEPS SC2 8.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

Coefficients are very similar across the parental-education and gender subgroups for both track recommendation and actual track choice, slightly bigger for families with high levels of parental education for track recommendation. While the differences are not statistically distinguishable, this result also appears consistent with high-status families having a somewhat bigger starting-age effect, which might perhaps explain their lower rates of compliance.

Table 2.14

Effect of Relative Age and Birth Month on Teacher Track Recommendation and Track Choice (All-Months Specification), Gender Subgroup Analysis

	2012 Starting Cohort			
	Male	Female	Male	Female
	Track recommendation		Track choice	
A. Reduced form				
Assigned school-starting age	0.074*	0.071*	0.081*	0.045
	(0.041)	(0.039)	(0.042)	(0.041)
Observations	2,229	2,373	2,098	2,212
B. IV Coefficients				
Observed school-starting age	0.010*	0.010*	0.011*	0.006
	(0.006)	(0.006)	(0.006)	(0.006)
Further covariates	Yes	Yes	Yes	Yes
Observations	2,229	2,373	2,098	2,212

Note: Robust standard errors are in parentheses. Additional covariates include migration background, highest parental school education, and state of primary-school enrollment.
Source: NEPS SC2 8.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

2.6.3 Effects of Relative Age on Math, Science, and Reading Competencies During Primary School

Table 2.15 presents the IV and the reduced-form estimates for the analyses of relative age effects on math competencies in grades one, two and four for the 2012 starting cohort. The IV estimates are statistically significant for math competencies for all specifications across all grades. For the grades one, two and four math competencies, the IV estimates range from 0.032 to 0.065 SD (Table 2.15, row 2, columns 2-7); indicating that an increase of school entry age by

one month relates to a three to six percent of a standard deviation increase in test score results. These are substantial effects. Even though the estimates are imprecisely estimated, these results indicate differences in achievement between the older and younger students in my sample. For compliers, these results suggest that students who are 11 months older at school entry, i.e., comparing students born in the month before and after the cutoff, math test score outcomes in primary school increase by about 0.40 to 0.60 standard deviations compared to the youngest student in a class. These constitute substantial positive relative age effects.

The intention-to-treat effect estimates (i.e., the impact of being born in the month after the cutoff date compared to being born in the month before the cutoff) are all statistically significant and range from 0.23 to 0.38 SD (Table 2.15, row 1).

Table 2.15

Effect of Relative Age and Birth Month on Math Competency

	2012 Starting Cohort Competencies Sample					
	Two-month window	All months	Two-month window	All months	Two-month window	All months
	Math competency, grade 1		Math competency, grade 2		Math competency, grade 4	
A. Reduced form						
Assigned school-starting age	0.372***	0.382***	0.284***	0.367***	0.304***	0.226***
	(0.072)	(0.062)	(0.072)	(0.061)	(0.071)	(0.060)
Observations	677	3,754	677	3,754	677	3,754
R-squared	0.152	0.106	0.168	0.122	0.129	0.101
B. IV coefficients						
Observed school-starting age	0.065***	0.055***	0.050***	0.054***	0.053**	0.032***
	(0.027)	(0.009)	(0.013)	(0.009)	(0.013)	(0.009)
Further covariates	Yes	Yes	Yes	Yes	Yes	Yes
Observations	677	3,754	677	3,754	677	3,754
R-squared	0.124	0.087	0.139	0.096	0.039	0.083

Note: Robust standard errors are in parentheses. Additional covariates include gender, migration background, highest parental education level, and the state of primary-school enrollment.
Source: NEPS SC2 8.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

Table 2.16 presents the IV and the reduced-form estimates for the analyses of relative age effects on science competencies in grades one and three for the 2012 starting cohort. The reduced-form and IV estimates are statistically significant for science competencies for all specifications across all grades. For the IV estimates, for both grades one and three, the point estimates for an increase of school entry age by one month correspond to a four to six percent of a standard deviation increase in test score results (Table 2.16, row 2, columns 2-5). The reduced-form effects range from 0.21 to 0.39 SD (Table 2.16, row 1, columns 2-7).

Table 2.16

Effect of Relative Age and Birth Month on Science Competency

	2012 Starting Cohort Competency Sample			
	Two-month window	All months	Two-month window	All months
	Science competency, grade 1		Science competency, grade 3	
A. Reduced form				
Assigned school-starting age	0.295***	0.386**	0.213**	0.303***
	(0.071)	(0.061)	(0.072)	(0.061)
Observations	677	3,754	677	3,754
R-squared	0.174	0.128	0.159	0.127
B. IV coefficients				
Observed school starting age	0.052***	0.055***	0.037**	0.043***
	(0.012)	(0.009)	(0.013)	(0.009)
Further covariates	Yes	Yes	Yes	Yes
Observations	677	3,754	677	3,754
R-squared	0.177	0.116	0.143	0.106

Note: Robust standard errors are in parentheses. Additional covariates include gender, migration background, highest level of parental school education, and the state of primary school enrollment.
Source: NEPS SC2 8.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

Table 2.17 presents the reduced-form and IV estimates for the analyses of relative age effects on reading competencies in grade four for the 2012 starting cohort. All of the estimates are statistically significant. Though smaller in size compared to the relative age effects on math and science competencies, the results provide evidence that relative age effects on reading

competencies exist at the end of primary schooling. For the IV estimates, the point estimates for an increase of school entry age by one month correspond to about three percent of a standard deviation (Table 2.17, row 2, columns 2 and 4). The reduced-form effects range from 0.15 to 0.18 SD (Table 2.17, row 1, columns 2 and 4).

Table 2.17

Effect of Relative Age and Birth Month on Reading Competency

	2012 Starting Cohort Competency Sample	
	Two-month window	All months
	Reading competencies, grade 4	
A. Reduced form		
Assigned school-starting age	0.150**	0.181**
	(0.073)	(0.061)
Observations	677	3,754
R-squared	0.122	0.101
B. IV Coefficients		
Observed school-starting age	0.026**	0.026**
	(0.013)	(0.009)
Further covariates	Yes	Yes
Observations	677	3,754
R-squared	0.117	0.093

Note: Robust standard errors are in parentheses. Additional covariates include gender, migration background, highest level of parental education, and the state of primary-school enrollment.
Source: NEPS SC2 8.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

Overall, the direction and magnitude of the described effects are in line with expectations based on previous research results in the international context. I find that students who are among the oldest in their class show higher performances on math, science and reading competency tests in grades one, two, three, and four compared to younger students. With substantial positive effects, my results provide evidence that relative age effects on test scores exist in a substantially meaningful way in the early years of primary schooling and at the end of grade four, when track recommendations are given by teachers, in terms of math, science and

reading competencies. These findings provide some insights into why I find statistically significant effects of relative age on track recommendation and track choice for the 2012 starting cohort, as described in the previous section.

2.7. Discussion and Conclusion

In this paper, I examined how school enrollment at a relatively younger versus older age due to age-based cutoff dates for school entry affects students' track recommendation from teachers; actual track choice; and math, science, and reading competencies, employing a fuzzy regression discontinuity design. All children born before a specific cutoff are supposed to enter school in a given year, while those born after it are expected to wait until the start of the next academic year. This leads to considerable variation between children in the school starting age within a class: For compliers, there will be an 11-month difference in school entry age between children born in the month before the cutoff date and those born in the month after the cutoff date. My results provide evidence of substantial relative age effects across all outcomes analyzed.

In terms of the limitations of this paper, it has to be kept in mind that my samples are small and the estimates are not very precise. Further, due to missing data issues, the sample is also by no means representative.

In terms of the track recommendation and track choice analyses, the fuzzy regression discontinuity design results show that a one-month increase in school starting age significantly increases the likelihood of receiving a high track teacher recommendation and actually attending a high track school by about 1 to 1.4 percentage points. These estimates imply that an increase in school starting age by 11 months, i.e., comparing children born in the month directly before and after the cutoff and compliant with the school entry rule, increases the likelihood of receiving a

high track recommendation and actually attending a high track school by about 11 to 15 percentage points. I do not find differential effects depending on the student's gender or socioeconomic background as measured by highest parental education. Therefore, in the context of my study, I cannot conclude that relative school starting age effects reinforce existing socioeconomic inequalities. It is important to note at this point, though, that I find negative effects for compliers, and that families of higher economic status are less likely to comply with the school-entry rules. Overall, in line with previous research, I can also conclude that for a relatively recent school-starting cohort, an early school-entry age can be viewed "as a randomly allocated disadvantage concerning track choice" (Mühlenweg & Puhani, 2010, p. 409).

I also find substantial positive relative age effects on math, science and reading competencies in grades one, two and four. My results provide evidence that relative age effects on test scores persist until the end of grade four in Germany, when teachers give track recommendations, in substantially meaningful ways, though they decrease slightly towards the end of primary schooling (as documented by research conducted in other countries as well). These findings, to my knowledge the first of its kind in the German context, provide some insights into why I find statistically significant effects of relative age on track recommendation and track choice for the 2012 starting cohort.

School entry age effects may be related to many factors. Even though the school entry literature has documented substantial differences in educational outcomes between the oldest and youngest in class across different countries, "policy recommendations are generally hard to come by" (Dhuey et al., 2019, p. 567). In terms of relevant policy implications of my research findings, most importantly, my results provide evidence, for a recent school starting cohort, that teachers do not seem to take age differences into account when making their recommendations. Track

recommendations should be based on teachers' assessment of future academic performance. Knowing that relative age effects usually fade away as the duration of schooling grows longer, the identified relative age effects on teachers' track recommendation at the end of grade four and actual track choice reveal an avoidable inequality of access in the German school system. Abandoning or postponing tracking could be a strategy to eliminate this avoidable inequality.

As long as school enrollment only happens once per year, there will always be substantial age differences between the youngest and the oldest student in a class. This would also not change if the school entry age was shifted up or down. Could all teachers be trained to take age effects into account when making their recommendations? Or would it be feasible to group children into more age-homogenous classrooms? The answer is probably no. Considering the long-term implications of track choice, this paper contributes to a much broader set of conversations about the fundamental structure of the German school system: Should Germany eliminate the early tracking system entirely or at least postpone tracking to a much later point in students' lives? My results provide another reason for policymakers to be concerned about the status quo. Abandoning tracking could be a strategy to reduce educational inequalities overall. At the same time, in view of the Germany's need for well-qualified, skilled workers in the future, making the education system more efficient is also crucial from an economic point of view.

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carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in cooperation with a nationwide network.

Chapter 3: The Relevance of Type of School Attended for Transition to Vocational Educational Training—How Do Students' Transition Chances Differ Depending on School Certificate Earned and School Type Attended?

3.1 Introduction

Traditionally, vocational training in Germany has been regarded as an important factor of social integration. Internationally, the German system has been praised as a successful model of smooth school-to-work transition (e.g., European Commission, 2013). However, in recent years this traditional strength has been increasingly called into question. In 2016, 14.6 percent of German 25- to 34-year-olds—constituting a substantial 1.54 million young people—had no formal vocational or higher-education certificate, and were no longer pursuing further education. Individuals without such a degree (referred to in Germany as "low-qualified") are at a much higher risk for unemployment than their better-educated peers. In 2016, for example, 19.1 percent of "low-qualified" individuals in Germany were unemployed, compared to 4.2 percent with a fully qualifying vocational-training degree and 2.3 percent of those with a higher-education diploma (Röttger, Weber, & Weber, 2020). Failure to enter the labor market and joblessness at a young age are extremely problematic; there is a substantial body of literature documenting that youth unemployment predicts limited professional opportunities for affected individuals over their entire lifecycles (e.g., Gregg, 2001).

Many studies have found a strong correlation between social background and the acquisition of different school-leaving certificates in Germany's general school system, which tracks students very early (e.g., Dustmann, 2004; Krause & Schüller, 2014). Researchers have

therefore examined differences in transition chances to vocational training between the holders of different school leaving certificates, since their attainment shows strong background-specific variation. These studies consistently document that students with higher school certificates have better transition chances and that opportunities of lower secondary (*Hauptschule)* certificate holders have decreased significantly over time, and that they face immense difficulties with the transition process today (e.g., Beicht et al, 2008; Kleinert & Jacob, 2012; Solga & Menze, 2013; Protsch, 2014; Beicht & Walden, 2015; Hillmert, Hartung, & Weßling, 2017). There has been limited study, however, of how the *interaction* of the type of school attended and the certificate earned affects transition chances to vocational training.

Since research has shown that tracking reinforces the effects of family background on educational achievement (e.g., Dustmann et al., 2004; Ferreira & Gignoux, 2012), there have been several recent policy changes in Germany aimed at increasing equality of opportunity in the general school system. Over the past decades, school structures have become more permeable, making upgrading to higher-track schools easier, and making it possible to earn the intermediate certificate at the *Hauptschule* as well. The intermediate leaving certificate can now be obtained at all school types. On the other hand, there have been considerable structural adjustments on the supply side. In many states, the traditional coexistence of up to six school types has been abandoned in favor of differently accentuated two-pillar models (Authoring Group, 2020). These changes in the school systems across states have led to a decoupling of the type of school attended and the resulting educational qualification. In 2017, for example, only 44 percent of graduates from secondary schools who finished with a *Realschule* certificate earned those at a standalone *Realschule*. That same year, 10 percent of *Realschule* certificate graduates received

their diploma at a *Hauptschule* (German Federal Statistical Office, 2019); and, in 2018, every third *Hauptschule* student graduated with a *Realschule* certificate (Authoring Group, 2020).

Despite these developments, there has been little research undertaken to specifically analyze whether the type of school attended influences the transition from school to vocational training for *Realschule* certificate students. From a policy perspective, it is important to understand whether the decision to enroll in a *Hauptschule* (heavily influenced by the student's family background), and the difficulties *Hauptschule* students experience when transitioning to vocational training, could be made easier by the option to earn the *Realschule* certificate at the *Hauptschule*. It is possible that *Hauptschule* attendance alone might lead employers to perceive this as a signal for lower capability and productivity.

Thus, the first issue: If students with a *Realschule* certificate from the *Hauptschule* have lower transition chances than graduates of the *Realschule* and the other existing types of schools, despite having the same formal certificate, it raises the question of whether the measures that decoupled school type and educational qualification can really be seen as significantly contributing to opening up the traditionally highly differentiated German school system. Secondly, it is important to understand whether, for individual *Hauptschule* students, the effort of upgrading to a *Realschule* certificate is rewarded in the vocational-training market.

In this paper, I set out to analyze the interacting influences of school type attended and school certificate earned on the chances of transitioning to vocational training in Germany. To my knowledge, mine is the first study of this kind, and my paper contributes to filling this research gap. Specifically, I will explore the following research questions:

(1) Do transition chances of intermediate (*Realschule)* certificate students differ by the type of school attended? Do students who earned an intermediate certificate

at the *Hauptschule* have lower transition chances than students who received their intermediate certificate at other secondary schools? Do students who earned an intermediate certificate at the *Hauptschule* gain access to vocational training positions of lower socioeconomic status and prestige than students who received their intermediate certificate at other secondary schools?

(2) Do *Hauptschule* students who earned an intermediate certificate at the *Hauptschule* have better transition chances compared to their peers who graduated from *Hauptschule* with a qualified *Hauptschule* certificate, or a simple *Hauptschule* certificate? Does upgrading to an intermediate certificate at the *Hauptschule* improve their transition chances?

This paper is structured as follows: Section 3.2 gives a brief overview of the German school system, as well as the system of vocational education and training. Section 3.3 reviews previous research and theoretical considerations, and Section 3.4 describes the data and methods. While Section 3.5 presents the results, Section 3.6 includes the discussion and conclusion.

3.2 The German School System and Vocational Education and Training System

Early tracking (as described in Chapter 2), along with a system of vocational education and training (VET) with well-defined occupations, are key features of the education system in Germany. At the end of compulsory lower-secondary education, students decide whether they want to continue schooling; or whether to leave school with no certificate, with a lower-secondary (*Hauptschule)* certificate, or with an intermediate (*Realschule*) certificate after grade 10 to start vocational training. Since schooling and vocational education are compulsory until at least the age of 18 in most German states, seeking full-time employment directly after leaving secondary school after grade nine or 10 is not an alternative option for most students. Students

get tracked into different schools after grade five, but the *Hauptschule* and *Realschule* certificates can be earned at all types of schools. The trend of decoupling school type and resulting educational qualification can be observed in Table 3.1, which shows the distribution of certificates earned across all types of secondary school in Germany in the years 2006, 2012, and 2018.

Table 3.1

Distribution of Certificates Earned Across School Types: 2006, 2012, and 2018 (Percent)[4]

Type of Certificate Earned	2006	2012	2018
		Hauptschule	
Without certificate	9.5	7.8	9.8
Hauptschule certificate	69.5	64.6	56.8
Realschule certificate	21.0	27.6	33.5
		Realschule	
Without certificate	1.4	1.2	1.8
Hauptschule certificate	4.4	4.3	4.5
Realschule certificate	94.1	94.6	93.6
		Two-track school	
Without certificate	6.8	5.3	7.5
Hauptschule certificate	23.3	25.4	23.2
Realschule certificate	69.9	69.3	69.3
		Comprehensive multi-track school	
Without certificate	5.1	3.5	6.6
Hauptschule certificate	28.2	20.6	23.5
Realschule certificate	41.8	42.8	44.2
Abitur/Fachhochschulreife	24.8	33.1	25.8
		Gymnasium	
Without certificate	0.3	0.3	0.7
Hauptschule certificate	0.9	2.0	1.8
Realschule certificate	9.9	8.1	12.3
Abitur/Fachhochschulreife	88.9	89.6	85.2

In some states, *Hauptschule* enrollees can earn a qualified (extended) *Hauptschule* certificate, usually by staying in school for an additional year or by passing specific academic

[4] Data source: Germany's National Education Report 2020.

requirements depending on the state. This certificate can increase chances in the apprenticeship market, as it signals to employers that the holder has a qualification beyond just the simple *Hauptschule* certificate. The prominent role of vocational educational training is associated with a differentiation of clear occupational profiles in the German labor market. Therefore, for students leaving secondary school with no certificate, or with a lower or intermediate certificate, the transition from school to vocational training is crucial; it has strong implications for their professional lives and later life outcomes. Most importantly, individuals without a formal vocational or higher-education degree are at a much higher risk of unemployment in Germany. Table 3.2 presents unemployment rates by educational certificate and vocational certificates for the years 2010 through 2019.

Table 3.2

Unemployment Rates in Germany by Educational Attainment, 2010-2019 (Percent)[5]

	Overall	Without educational degree	With vocational training degree	With higher education degree
2010	7.6	20.7	5.8	2.4
2011	7.0	19.8	5.1	2.4
2012	6.9	19.7	5.0	2.5
2013	7.0	20.0	5.1	2.5
2014	6.8	19.9	4.9	2.6
2015	6.6	20.3	4.6	2.4
2016	6.2	19.1	4.2	2.3
2017	5.8	17.9	3.9	2.3
2018	5.3	17.4	3.4	2.0
2019	5.2	17.0	3.3	2.0

The German vocational-training system consists of three sectors: the well-known dual system of company-based training combined with school-based education (apprenticeships),

[5] Data source: Research Institute of the Federal Employment Agency in Germany (IAB): Röttger, Weber, & Weber, 2020.

fully qualifying school-based vocational programs (mainly for intermediate-level white-collar, female-dominated occupations in sectors such as health, social work, and media; for example, nurses, kindergarten teachers, and medical assistants), and the sector of prevocational training measures, called the "transitional system." The regular dual and school-based vocational-training programs are both occupation-specific and fully qualifying; both lead to nationally recognized, occupation-specific vocational certificates, though the two sectors provide training for different occupations. The occupation the student is being trained for determines the sector in which the training takes place. In contrast to the fully qualifying company-based and school-based sectors, the different prevocational programs do not award occupational credentials. These programs usually last for up to a year; some are shorter, though, and a few can last up to two years. While a few offer practice trainings at companies, most are entirely school based. Vocational programs usually start in September; therefore, applications and recruitment are completed throughout the spring and summer, and are the student's responsibility. As of October 2019, there are 325 vocational-training occupations (BIBB, 2020). Companies bear the costs of training in the dual system, and pay wages to their apprentices. These wages are the result of collective-bargaining negotiations applying to 87 percent of apprentices today; apprenticeship wages account for roughly 46 percent of the firms' total training costs (BIBB, 2013). State governments bear the costs of the school-based trainings.

By law, there are no entry requirements for company-based vocational training; even a person without any kind of secondary certificate can enter into vocational training. For full-time school-based vocational training, on the other hand, a *Realschule* certificate often represents the minimum requirement. However, in recent years, the clear trend among companies has been to choose graduates with higher-secondary certificates. This is because more students have been

earning *Abitur* certificates (the general higher-education entrance qualification) due to educational expansion; an increasing number of those students are pursuing vocational training, with many occupations becoming more complex due to technological advances (e.g., Protsch, 2014). Higher-ranked vocational opportunities—for example, for bank clerks or information technology clerks—now *de facto* require an *Abitur* to receive an apprenticeship contract.

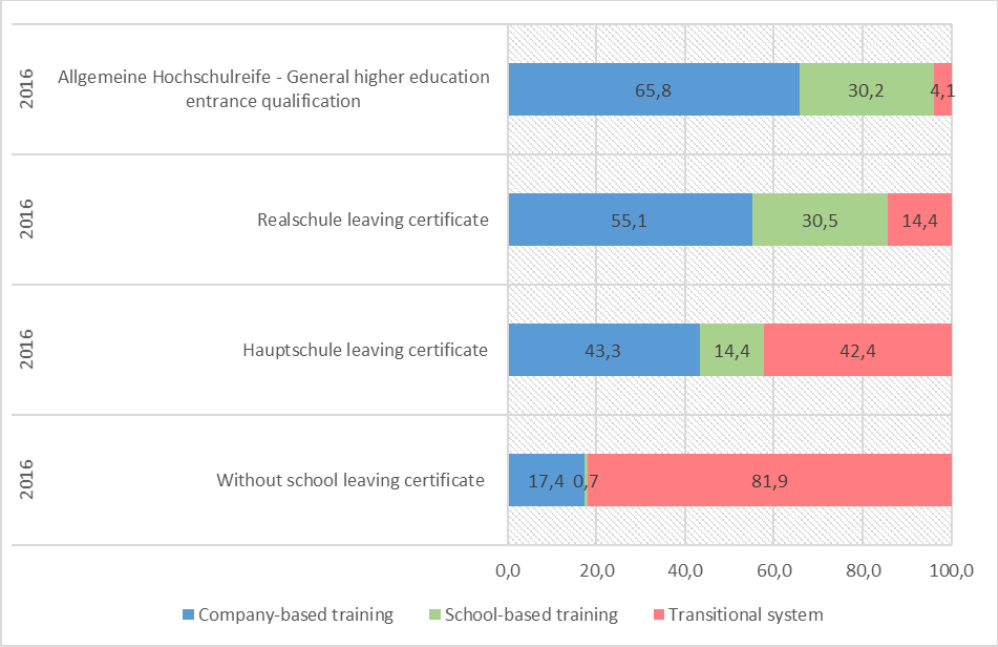
In 2016, 49 percent of the new enrollments in the VET system were in apprenticeship programs, 22 percent in fully qualifying school-based VET programs, and 29 percent in prevocational measures. This translates into 292,000 young people who did not enter regular vocational-training programs, but rather the "transitional system" of prevocational measures (Authoring Group, 2018). Enrollment in the three sectors differs strongly by school-leaving certificate (Figure 3.1). In 2016, 42 percent of *Hauptschule* certificate holders and 82 percent of school leavers without a certificate enrolled in prevocational training after leaving secondary school. Only 14 percent of graduates with a *Realschule* certificate and four percent of those with a *Gymnasium* certificate, by contrast, joined prevocational measures after secondary school that same year.

Currently, the German VET system is characterized by matching problems. The training market figures for the end of 2018 were extraordinary, as they contained numerous "peak values" compared to the past 10 years. There were 574,200 company-based training places available—the highest level since 2009. At the same time, the number of unfilled company-based training spots increased from 3.6 percent in 2010 to 9.9 percent in 2018 (BIBB, 2018). In 2018, 57,000 of the 574,200 available company-based slots remained unfilled (BIBB, 2018); in some areas, there were more positions than applicants, while in other regions there were many

more applicants than open training spots (BIBB, 2018). There are also substantial differences among different occupational segments (BIBB, 2018).

Figure 3.1

Enrollment in the Three Sectors by School-Leaving Certificate, 2016 (%)[6]



3.3 Previous Literature and Theoretical Considerations

In the case of dual-system vocational training, the transition to training is a two-sided process depending not only on school-leavers' educational decisions, but also on companies' demand for trainees and their recruitment practices for training positions. The mechanisms at play here are comparable to those at work in the labor market. Thus, the dominant labor-market theories explain the selectivity in access to different vocational positions.

The human capital model provides a basic theoretical grounding for a student's decision to invest in education; e.g., earning a *Realschule* certificate versus a *Hauptschule* certificate. A classical approach to education investments and the returns on education builds on Becker's

[6] Data source: Germany's National Education Report 2018. Author's calculations and figure.

human capital theory (1962), and the idea that human capital can be accumulated by devoting time and resources to education; in doing so, raising productivity and, consequently, translating into higher wages. The human capital model hypothesizes that individuals will invest in certain levels of schooling to maximize their net present discounted value (expected gains minus expected cost) within their budget constraints. Though differing slightly, several versions of the model agree that human capital is valued in the labor market (Becker, 1962; Nelson & Phelps, 1966; Bowles & Gintis, 2002). The views suggest that human capital increases a firm's profit through increased productivity, dimensions of skills, adaptability, and capacity to work in organizations respectively.

Signaling theories (Spence, 1973) argue that employers use educational certificates—observable human capital—as an indicator of an individual's innate ability and trainability. On the basis of previous experience, the employer makes conditional probability assessments of productive capacity of job applicants given various combinations of signals the applicants display. Since employers' information on the applicants' productivity is imperfect, they use statistical information on the group they belong to, to infer productivity and then rank different applicants accordingly (Arrow, 1972). In the case of vocational training, school-leaving certificates serve as signals for employers. Thurow's job competition model (1975) further argues that there is no absolute relationship between educational qualifications and returns; rather, it is the relative position of the applicant in the "labor queue" that is key.

In line with human capital theory and signaling theories, numerous prior studies have documented how, in Germany, students with higher school-leaving certificates have better transition chances and get access to better-paid and more prestigious vocational-training programs (e.g., Beicht et al, 2008; Kleinert & Jacob, 2012; Solga & Menze, 2013; Protsch, 2014;

Beicht & Walden, 2015; Hillmert, Hartung, & Weßling, 2017). By the same token, with the decoupling of school leaving certificates earned and school type attended in Germany, it can be theorized that attending a standalone *Hauptschule* serves as a "bad" signal when a student earned their *Realschule* certificate at a standalone *Hauptschule*. Consequently, with school leaving certificates and school type being used as accepted selection criteria, youth with *Realschule* certificates earned at a *Hauptschule* would get ranked lower in the companies' recruitment process due to their lower-track school, as compared with students who earned their *Realschule* certificates at other types of schools.

These theories are helpful for supporting the hypothesis that where the school-leaving certificate was earned makes a difference in terms of transition chances: Just like higher leaving certificates might indicate higher skill levels, better learning aptitude, and lower anticipated costs for on-the-job training, it is possible to conceive that companies and vocational schools interpret attendance of higher-track schools as a sign of candidates' stronger skills and aptitude. Secondly, at the individual level, the different composition of peer groups at the different schools—along with exposure to varying performance levels, teachers and access to different network resources—add another layer that might be relevant.

Empirical studies on the decoupling of school-leaving certificates and school type in Germany have mainly focused on the differences in academic performance among students who have obtained an *Abitur* at various types of schools (e.g., Köller at al., 1999; Trautwein et al., 2007). However, research on *Abitur* certificate holders from different institutions has so far scarcely focused on the question of whether receiving the credential from these different types of schools has an effect on transition chances to vocational training.

Two descriptive studies have analyzed how transition chances differ for students who received a *Realschule* certificate at a *Hauptschule* and those who earned lower *Hauptschule* certificates at a *Hauptschule*. In the first, Schuchart (2007) finds, from her research on the states of North Rhine-Westphalia and Bavaria, that students who earned a *Realschule* certificate at a *Hauptschule* were able to access more attractive company-based vocational training than those who had received a *Hauptschule* certificate at a *Hauptschule*. In the second study, Baas (2017) analyzes whether students who earned a *Realschule* certificate at the *Hauptschule* school had better transition chances than graduates who earned their *Hauptschule* certificate at the *Hauptschule* in the state of Lower-Saxony for the 1997-2001 and 2002-2004 school-leaving cohorts, using panel data from the Sociological Research Institute (SOFI) at the University of Göttingen. The author applies logistic regressions and finds no significant differences in transition chances between these two groups. However, since the data sample is small and only includes students from the state of Lower-Saxony, the informative value of the study's results should be interpreted with caution.

In a third related study, Holtmann et al. (2017) analyzed the chances of transitioning to vocational training for students who left the general school system without a certificate, or with only a lower or extended *Hauptschule* certificate, with a special focus on application efforts. The authors control for school type at the time of graduation, differentiating between (1) *Hauptschule*, (2) special-needs schools, and (3) others (*Realschule*, *Gymnasium*, and all multiple-track schools). They find that transition chances are worse for students graduating from special-needs schools; however, they do not conclude that there are differential transition chances between *Hauptschule* students and those who attended a *Realschule*, a *Gymnasium*, or a multiple-track school.

To my knowledge, this study is the first to analyze how the type of school attended and the certificate earned influence the chances of transition into vocational training for students who earned a *Realschule* certificate at different kinds of schools. As a second contribution, I will provide new evidence on the returns of the *Realschule* certificates earned by *Hauptschule* students relative to their peers who graduated with a simple or qualified (extended) *Hauptschule* certificate in states with standalone *Hauptschule* schools. I expect graduates who received their *Realschule* certificate from a standalone *Hauptschule* to have lower chances overall of transitioning successfully into vocational training after graduating from secondary school, compared to *Realschule* certificate graduates from other institutions. Second, I expect students who earned a *Realschule* certificate at the *Hauptschule* to experience more successful transitions compared to their peers who finish *Hauptschule* with a lower *Hauptschule* certificate.

3.4 Data and Methods

3.4.1 Overview

The individual-level data is from the so-called Starting Cohort 4 (SC4) of the National Educational Panel Study (NEPS) (Blossfeld et al., 2011). In this cohort, all respondents attended grade nine at German secondary schools in the fall of 2010 (Leuze et al., 2011). The sample design employed a stratified two-stage sampling strategy; first sampling schools, and then classes within schools (Steinhauer & Zinn, 2016). The first survey was carried out in fall/winter 2010. For all starting cohorts, in addition to the students, context persons such as parents, teachers, and principals were regularly surveyed, too.

3.4.2 Samples, Variables, and Descriptive Statistics

For my study, I included in my sample students who graduated from a secondary school after grade nine or 10 with a lower-secondary (*Hauptschule)* or intermediate (*Realschule)*

leaving certificate in 2011 or 2012. I excluded students from special-needs schools, and only include students who graduated from secondary schools. There is also a smaller group of students who graduated from special vocational schools in 2011 and 2012; however, for the purposes of my analysis, I am specifically interested in graduates of secondary schools and their direct transitions into vocational training.

As a second step, I restricted my sample to students who said they had applied for vocational training when they were surveyed directly after leaving school (in wave 3 or wave 5). I also include those who did not indicate that they applied, but who actually started vocational training by the end of the year in which they graduated from secondary school. Finally, I only include graduates of schools in states in which students were able to graduate from *Hauptschule* schools. For SC4, NEPS researchers sampled students in *Hauptschule* schools in seven states. Due to legal restrictions on the use of NEPS data, I am not allowed to report individual state results. For easier interpretability, I will conduct subgroup analysis for the sample of *Realschule* certificate graduates and the sample of *Hauptschule* students. The described strategy leaves me with the following samples.

Table 3.3

Subsample 1: Students Graduating With a Realschule Certificate

	Type of School Attended					
	Hauptschule	*Realschule*	Merged *Haupt-/ Realschule*	Comprehensive/ multiple tracks	*Gymnasium*	Total
Realschule certificate	434	1,317	244	226	39	2,260
	19%	58%	11%	10%	2%	100%

Table 3.4

Subsample 2: Students Graduating From Hauptschule School

	Type of School Certificate Earned			
	Simple *Hauptschule* certificate	Qualified *Hauptschule* certificate	*Realschule* certificate	Total
Hauptschule school	761	454	434	1,649
	46%	28%	26%	100%

Outcome variable. For my first binary outcome variable, I code as follows: 1 = successful transition into fully qualifying training until the end of December 2011 for 2011 graduates, and until the end of December 2012 for 2012 graduates; 0 = transition into prevocational programs, unqualified employment/unemployment, further schooling, not officially recognized vocational training, military or volunteering services, parental leave, or gap time.

Legally, it is possible to start dual vocational training at any point during the calendar year. In practice, though, apprenticeships tend to start at the beginning of the new vocational school year, since it is more difficult for students to start their school-based theoretical education at mid-year, and companies orient themselves at this starting date. The same usually applies for the start of fully school-based vocational training (e.g., often health-related occupations). The start of the vocational school year depends on the state, but typically it is between August and September. The reporting year for the German federal employment agency (*Agentur für Arbeit*) also runs from the beginning of October in a given year until the end of the next September for monitoring and governing purposes (e.g., in terms of number of apprenticeships and applicants registered with the agency, apprenticeships that could not be filled, etc.). Vocational-training

positions filled after September 30 in a given year are considered late placements (*Nachvermittlung*). In October 2019, for example, only 10 percent (50,000) of apprenticeships advertised in the 2018/2019 year remained unfilled. By January 2020, this number had dropped to 6,600 (Federal Employment Agency, 2020).

If students have not started vocational training by the end of a given year, their chances of finding an apprenticeship before the next summer are very slim. This is relevant for the time frame for which I observe "direct" transitions into vocational training. Due to the nature of the yearly vocational-training cycle, I observe transitions until the end of the year in which students graduated from secondary school, in the same way that other recent studies have defined their outcome variable as "successful transition into vocational training" (Hoenig, 2017; Roth, 2018). In my sample, that is the end of 2011 and the end of 2012. The starting month is not indicative of a higher or lower rate of search success; it merely echoes the externally predefined nature of the yearly vocational-training cycle.

Since my analyses are focused on the transition into vocational training, whether the activity is still being carried out at the end of the year is not relevant, nor is whether the training started will actually be completed. It is solely relevant whether a graduating student ever started a fully qualifying training program between graduating from school and the end of the same year. I also do not differentiate between pursuing dual vocational training and school-based vocational training. In my sample, the majority of students pursued dual vocational training. 64 percent of students in my sample experienced successful transitions until the end of the year they graduated from secondary school, 36 percent did not. While 71 percent of the sample's *Realschule* certificate graduates started apprenticeships right after school, 60 percent of qualified

Hauptschule certificate earners also did, compared with only 48 percent of simple *Hauptschule* certificate recipients.

For my *Realschule* subsample, due to the bigger sample size, I will also analyze two outcomes related to socioeconomic status and prestige. My second outcome variable is the socioeconomic status of the vocational-training profession. I measure this using the ISEI-08 score developed by Ganzeboom (2010) and Ganzeboom, Graaf, et al. (1992), which maps occupations in a range of 11.56 to 88.96 using a combination of education level and income. My third outcome variable is the prestige of the vocational-training occupation, which is measured with the Standard International Occupational Prestige Scale (SIOPS-08) score developed by Ganzeboom and Treiman (1996, 2003) and Treiman (1977). With scores ranging from 12 to 72, this prestige ranking is based on surveys from 55 countries.

Control variables. Below, I provide information on the control variables I included in my analyses. Distributions and descriptive statistics on these variables and the outcome variables are presented in Tables 3.6 and 3.7.

Student characteristics. As measures of students' social background, I include the number of books in the household, parents' highest level of educational attainment, and parents' highest occupational status (ISEI-08); this data was gathered from the parent and student questionnaires. I give priority to data form the parent survey (about half of parents participated). If no information from the parents is available, I also rely on information from the students. If there is only information on one parent available, I use this information. I also include child's gender, year of birth, and migration background. Students are defined as having a migration background if they themselves, at least one of their parents, or at least two of their grandparents were born abroad.

Looking at academic achievement, I include the final grades for mathematics and German and grade point average (GPA) on students' leaving certificates, which were reported by students. To control for cognitive competencies, I include scores from performance tests administered in grade nine (mathematics, information and communication technologies [ICT], science, and reading comprehension). The NEPS consortium has developed competence tests for different domains, scaled by using models of item response theory (IRT) (Pohl & Carstensen, 2012); NEPS provides the weighted maximum likelihood estimator (WLE).

In order to control for non-cognitive skills, I include a measurement of conscientiousness, which is one dimension of the common five-factor model of personality; this also includes extraversion, agreeableness, neuroticism, and openness. The NEPS used a 10-item short version (called BFI-10) of the well-known Big Five Inventory (NEO-FFI), developed by Rammstedt and John (2007). Like previous researchers, I decided to only include conscientiousness. This choice is guided by the idea that this dimension is "closest" to what is needed for students in terms of application behavior to lead a successful job search (De Raad & Schouwenburg, 1996; Holtmann et al., 2017).

Furthermore, network resources and social contacts are known to play a central role in ensuring individuals' labor-market success (Bourdieu, 1977; Granovetter, 1995; Lin, 2001) and transitions to vocational training (Roth, 2018). Therefore, I include an indicator variable for social capital. In the context of vocational training, *Hauptschule* and *Realschule* certificate students are very young (15-17 years old), and their networks can provide valuable information on vacant apprenticeship positions and application procedures. The measure of professional networks I employ is based on students' evaluation of how likely they think it is that persons in their lives, whether they know them or not, will provide them with information on interesting

open vocational-training positions. This information was collected when students were still in school.

School exit year. I do not control for school exit year; this heavily corresponds with type of school certificate earned, since a higher certificate usually means one more year of schooling (e.g., almost all *Realschule* certificate graduates left school in 2012).

State dummies. I also included dummies for the German states in which a student attended secondary school to account for differences between states. Due to NEPS regulations, however, I am not allowed to report the estimates of the states' dummies.

Local vocational-training market. I modulate constraints by using a typology of local vocational-training markets developed by the Institute for Employment Research (IAB) (Kleinert, Vosseler, & Blien, 2018). Kleinert et al. describe 11 different market types, which I include as dummy variables in my analyses. This typology is based on six indicators that have been shown to influence transitions into dual vocational training: the share of large companies with more than 250 employees, the share of school leavers in the residential population, the share of companies that take on trainees, the unemployment rate, the share of large companies within all companies that take on trainees, and finally the share of high-school leavers. This data was merged with the NEPS data at the municipality level (*Kreiskennziffer*) based on students' school attended in grade nine. Since this index was constructed with six indicators, I choose this control variable over single indicators like the local youth unemployment rate. While the data used for the typology stem from 2009/2010, the "great recession" of the late 2000s had only a short and relatively weak impact on the German youth labor market. From 2009 on, conditions in the vocational-training market improved, driven by economic and demographic factors; as the time

between 2011 and 2013 was a stable phase, I feel confident in using this indicator. Table 3.4 provides an overview of the different market types.

Table 3.5

Typology of Training Market Types, 2010, According to Kleinert, Vosseler, and Blien (2018)

I: Eastern German districts with very few school leavers and high unemployment
Ia: Rural districts with large secondary sector
Ib: Rural districts with average training market conditions
Ic: Differing districts with favorable training market conditions
II: Dynamic metropolitan areas in the West
IIa: Metropolitan districts with favorable training market conditions and low competition
IIb: Urban districts with strong large-establishment neighborhoods
III: Western districts with large-establishment neighborhoods
IIIa: Urban districts with average conditions
IIIb: Rather urban districts with very low unemployment and high competition
IIIc: Metropolitan districts with high unemployment
IV: Western districts with no large-establishment neighborhoods and low unemployment
IVa: Rather urban districts; favorable training market conditions and medium competition
IVb: Rural districts with large secondary sector and high competition
IVc: Rural districts with very weak large-establishment neighborhoods and high competition

Missing data. I dealt with missing data in the following way: For unordered categorical predictors, I added an extra category for the variable indicating missingness. For continuous predictors, I replaced the missing by the mean (Gelman & Hill, 2006).

Table 3.6

Descriptive Statistics, Subsample 1: Students Graduating With a Realschule Certificate

Variables	Average or Percent
Status at end of year: Vocational training	71.30
Status at end of year: Other	28.70
Socioeconomic status of the vocational-training occupation (ISEI-08)	39.46
Prestige of the vocational-training occupation (SIOPS-08)	42.51
School type	

Hauptschule	19.23
Realschule	58.27
Merged *Haupt-/Realschule*	10.79
Comprehensive multi-track school	9.99
Gymnasium	1.72
Male	54.69
Year of birth	1995.23
Migration background (% yes)	21.44
Migration background (% missing)	4.20
Highest occupational status of parents (ISEI-08)	46.91
Books in household*	3.80
Highest qualification of parents	
Lower-secondary certificate with VET or less	20.38
Intermediate-secondary degree (with apprenticeship)	36.38
At least *Abitur*	24.18
% missing	19.05
Social capital (% access to information through network)	87.98
Social capital (% missing)	1.95
GPA on school-leaving certificate (1 = highest, 6 = lowest)	2.59
Grade, German (1 = highest, 6 = lowest)	2.86
Grade, math (1 = highest, 6 = lowest)	3.02
Test score, math	-0.20
Test score, reading	-0.24
Test score, science	-0.13
Test score, ICT	-0.12
Conscientiousness	3.27
Sample size	2,260

Source: National Educational Panel Study (NEPS): Starting Cohort 4, author's calculations.
*1 = 0-10, 2 = 11-25, 3 = 26-100, 4 = 101-200, 5 = 201-500, 6 = more than 500 books.

Table 3.7

Descriptive Statistics, Subsample 2: Students Graduating From Hauptschule School

Variables	Average or Percent
Status at end of year: Vocational training	56.02
Status at end of year: Other	43.98
School-leaving certificate	
Simple *Hauptschule* certificate	46.22
Extended *Hauptschule* certificate	27.47

Realschule	26.32
Male	59.61
Year of birth	
Migration background (% yes)	32.30
Migration background (% missing)	5.69
Highest occupational status of parents (ISEI-08)	39.41
Books in household	3.32
Highest qualification of parents	
Lower-secondary certificate with VET or less	33.15
Intermediate-secondary degree (with apprenticeship)	27.47
At least *Abitur*	13.79
% missing	25.59
Social capital (% access to information through network)	71.87
Social capital (% missing)	6.78
GPA on school-leaving certificate (1 = highest, 6 = lowest)	2.72
Grade, German (1 = highest, 6 = lowest)	2.91
Grade, math (1 = highest, 6 = lowest)	3.02
Test score, math	-0.72
Test score, reading	-0.92
Test score, science	-0.65
Test score, ICT	-0.68
Conscientiousness	3.40
Sample size	1,649

Source: National Educational Panel Study (NEPS): Starting Cohort 4, author's calculations.
*1 = 0-10, 2 = 11-25, 3 = 26-100, 4 = 101-200, 5 = 201-500, 6 = more than 500 books.

3.5 Empirical Strategy

In this paper, I set out to examine how the type of school attended *and* the school certificate earned influence a student's chances of transitioning to fully qualifying vocational training. The present observational study is among the first to examine the interacting influences of certificate earned and school type attended on transition chances, while also attempting to isolate the two. Selection into the different school and certificate types is not random. While my

research questions certainly are causal in nature, the data available do not allow me to employ causal methods. Theoretically, in a selection-on-observables approach, the causal effects of type of school/certificate earned could be identified when all variables that influence both the selection of the school types/certificates and the transition to vocational training were included in the model. Even though comprehensive data is available through NEPS, this cannot be fulfilled. Due to the lack of randomized treatment assignment, the observational associations reported cannot be given a causal interpretation. The results from my analyses thus need to be considered descriptive in nature, and it has to be kept in mind that unobserved third variables might lead to spurious effects. However, contrary to many previous studies analyzing school-to-vocational-training transitions in Germany, using the NEPS data makes it possible to account for differences in cognitive skills, independently of school grades, non-cognitive skills, and application effort, as well as regional labor-market effects.

To test my hypotheses, I employ a linear probability model when analyzing the binary outcomes, and OLS when analyzing the continuous outcomes. The general relationship between outcomes and type of school attended and certificate earned can be expressed by the following equation:

$$Y_i = \beta_0 + \beta_1\, stype_i + \beta_2\, scert_i + \beta_3\, (stype_i * scert_i) + \beta_2 X_i + \epsilon_i \quad (1.1.)$$

Or with subsample analysis by subgroups:

$$Y_i = \beta_0 + \beta_1\, scert_i + \beta_2 X_i + \epsilon_i \quad (1.2.)$$

$$Y_i = \beta_0 + \beta_1\, stype_i + \beta_2 X_i + \epsilon_i \quad (1.3.)$$

Where Y_i is a binary indicator where one indicates for student *i* that the student has successfully transitioned into a fully qualifying vocational-training program (first outcome); or a continuous variable indicating the socioeconomic status or prestige of the training position (second and third

outcome), with the most important independent variables being school type ($stype_i$) and school certificate ($scert_i$). $X_i$is a set of variables described in the previous section—e.g., context factor variables or student's GPA on their school leaving certificate—and ϵ_i is an error term.

It has been argued that, when using a dummy dependent variable, logistic regression models might have more merits than linear probability models. Two of the major difficulties with a linear probability model include the unboundedness of the predicted probabilities and heteroskedasticity; the major advantage of the model, however, is the straightforward interpretation that it enables. Therefore, I employ a linear probability model when analyzing the binary outcomes. In a second step, I also estimate logistic regressions and compare results to check result robustness to model specification. In order to take the clustered sampling design into account, I cluster standard errors by school attended in wave 1 of the NEPS study.

Abundant prior research has shown consistently that students graduating secondary school with higher school certificates have better transition chances than *Hauptschule* certificate holders (e.g., Beicht et al, 2008; Kleinert & Jacob, 2012; Solga & Menze, 2013; Protsch, 2014; Beicht & Walden, 2015; Hillmert, Hartung, & Weßling, 2017). No previous study has shown that a *Hauptschule* certificate, on average, is more valuable in the apprenticeship market than a *Realschule* certificate. From a theoretical perspective and based on prior research, employers and vocational schools will therefore value a *Realschule* certificate more highly than a *Hauptschule* certificate. My first research question focuses on the population of students graduating with a *Realschule* certificate.

My second analysis is inspired by the question of whether the change in policy that permitted a *Realschule* leaving certificate to be earned at a *Hauptschule* has contributed to opening the highly differentiated German school system; i.e., whether students who attended a

Hauptschule and upgraded to a *Realschule* certificate benefit from their effort relative to their *Hauptschule* peers who graduated with a simple or qualified *Hauptschule* certificate. My second research question, therefore, focuses on the very specific sub-population of secondary-school students in Germany who attended a *Hauptschule*. The composition of the student body at a *Hauptschule* tends to be very different from all other school types. Consequently, going from theory to empirical-model specification, the arguments brought forth do not imply an interaction model to analyze the influence of school type on transition chances for students who graduated with a *Realschule* certificate and the influence of certificate earned for *Hauptschule* students. Therefore, for the sake of easier readability and understanding, I will proceed to conduct subsample analysis to explore my research questions.

Subsample 1—Realschule Certificate Students: Model Specifications

In order to investigate the relationship between type of school attended and transition chances, and school type attended and socioeconomic status and prestige of training positions for *Realschule* certificate graduates, I use the subsample of *Realschule* certificate students and employ a linear probability model/OLS:

$$Y_i = \beta_0 + \beta_1\, stype_i + \beta_2 X_i + \beta_3 Ability + \epsilon_i \qquad (1.4)$$

Where Y_i is a binary indicator, where one indicates for student *i* that the student has successfully transitioned into fully qualifying vocational training (first outcome); or a continuous variable indicating the socioeconomic status or prestige of the training position (second and third outcome). β_1, the variable of interest, is the difference in transition chances/socioeconomic status or prestige of the training position attributable to type of school attended. $X_i$is a set of variables described in the previous section. *Ability* includes effects attributable to high-school grades, final GPA, and competency scores. ϵ_i is an error term.

Subsample 2—Hauptschule Students: Model Specification

In order to investigate the relationship between school certificate earned and transition chances for students attending a standalone *Hauptschule*, I use the subsample of students who graduated from *Hauptschule* and employ a linear probability model:

$$Y_i = \beta_0 + \beta_1 scert_i + \beta_2 X_i + \beta_3 Ability + \epsilon_i \qquad (1.5.)$$

Where Y_i is a binary indicator, where one indicates for student *i* that the student has successfully transitioned into fully qualifying vocational training. β_1, the variable of interest, is here the difference in transition chances attributable to certificate earned. $X_i$is a set of variables described in the previous section. *Ability* includes effects attributable to high-school grades, final GPA, and competency scores. ϵ_i is an error term.

3.6. Results

3.6.1 Relationship Between Type of School Attended and Transition Chances for Realschule Certificate Graduates

In order to investigate the relationship between type of school attended and transition chances for *Realschule* certificate graduates, I used the subsample of *Realschule* students and employed a linear probability model. Table 3.8 reports the results of linear probability model regressions, with the binary outcome variable "transition into vocational training." In order to examine how the control variables affect the relationship between the type of school attended and transition chances, I added covariates stepwise.

The *Hauptschule* type serves as the reference group for all other school types. Overall, the estimated association between type of school attended and transition chances remains quite stable over the stepwise addition of covariates. The coefficients for *Realschule* and

comprehensive school remain significant after adding in family socioeconomic background variables (Table 3.8, column 7).

Table 3.8

Transition Into Fully Qualifying Vocational Training (LPM) for Realschule Certificate Graduates

	(1)	(2)	(3)	(4)	(5)	(6)
School type, reference: *Hauptschule* school						
Realschule	0.100**	0.083**	0.083**	0.085**	0.077**	0.072**
	(0.029)	(0.029)	(0.029)	(0.039)	(0.029)	(0.030)
Merged *Haupt-/Realschule*	0.087**	0.039	0.036	0.039	0.035	0.032
	(0.043)	(0.040)	(0.040)	(0.039)	(0.039)	(0.040)
Comprehensive school	0.101**	0.105**	0.102**	0.102**	0.101**	0.096**
	(0.040)	(0.046)	(0.045)	(0.045)	(0.044)	(0.044)
Gymnasium	0.110	0.108	0.127	0.127	0.114	0.095
	(0.079)	(0.084)	(0.086)	(0.086)	(0.085)	(0.084)
GPA on final certificate/Grades in school	No	No	Yes	Yes	Yes	Yes
Cognitive and non-cognitive skills	No	No	No	Yes	Yes	Yes
Gender, migration background, and year of birth	No	No	No	No	Yes	Yes
Family background and social capital	No	No	No	No	No	Yes
Local labor market	No	Yes	Yes	Yes	Yes	Yes
States	No	Yes	Yes	Yes	Yes	Yes
Observations	2,260	2,260	2,260	2,260	2,260	2,260

Note: This table reports results from estimating equation 1.4 on the data. Standard errors in parentheses clustered by school attended in grade nine. Source: NEPS SC4 10.0.0, author's calculations.

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

In line with my hypothesis, my results show that students who graduated with a *Realschule* certificate from a standalone *Hauptschule* had statistically significantly lower transition chances than those who graduated from other types of schools. The probability of moving successfully into vocational training directly after school is significantly higher for students graduating from *Realschule* and comprehensive schools than for those who attended *Hauptschule* (seven percent and 10 percent, respectively; Table 3.8, column 7). With relatively

large standard errors, the estimates are very imprecise; however, the direction of the coefficients is in line with my hypothesis.

In order to put these results into perspective in terms of their magnitude, I combined the two subsamples and examined the association between school certificate earned and transition to vocational training, controlling for school type and including an interaction term between school type and school certificate. As reported in Table B.3 in Appendix B, results show that school leavers who earned a *Realschule* certificate were 19 percent more likely to start vocational-training programs than students who received lower certificates. The statistically significant interaction term confirms the results from subgroup analysis: Students who earned a *Realschule* certificate at a *Hauptschule* were about 10 percent less likely to enter into vocational training than *Realschule* certificate graduates who earned their certificate at another type of school. Considering that *Realschule* certificate graduates were overall 19 percent more likely to transition successfully compared to students with lower certificates, it constitutes a substantial effect that *Hauptschule* students who earned the same certificate are 10 percent less likely to transition directly into vocational training than students who earned the *Realschule* certificate at other types of institutions.

Students who graduated with a *Realschule* certificate from the merged *Haupt-/Realschule* did not have statistically significantly different transition chances compared to students who graduated from a *Hauptschule*. Due to the very small number of students in the sample who attended a *Gymnasium*, the coefficients for *Gymnasium* are very imprecisely estimated. They are insignificantly different from zero.

Logistic regressions, employed for robustness checks, confirmed all of the results. Average marginal effects are reported in Table B.4 in Appendix B.

Other results, though with large standard errors imprecisely measured, match existing research on the transition to vocational training after secondary school in Germany. The results, presented in Table B.5 in Appendix B, show statistically significant coefficients for a student's socioeconomic background, gender, migration background, and social capital. Male students are five percentage points more likely, and students with a migration background 10 percent less likely, to transition into vocational training until the end of the year. Students whose parents earned a *Realschule* certificate and a vocational-training certificate were six percent more likely to directly transition than those whose parents achieved lower levels of education. Further, youth with access to information about available vocational-training positions through their networks were eight percent more likely to enter regular vocational training than those without such contacts. Even though this is a simpler measure of social capital compared to other recent studies, my results are in line with their findings (Hoenig, 2017; Roth, 2018).

Since we are dealing with small sample size and large confidence intervals, it is appropriate to be cautious regarding the magnitude of the coefficients. However, these results do indicate that students who graduate with a *Realschule* certificate from a standalone *Hauptschule* experience substantially lower transition chances than those who attend a *Realschule* or comprehensive school.

3.6.2 Relationship Between Type of School Attended and Socioeconomic Status and Prestige of Vocational Training Position for Realschule Certificate Graduates

Table 3.9 presents the results of OLS regressions, with the outcome variables for socioeconomic status and prestige of vocational training, using the subsample of students who

successfully transitioned into training[7]. For prestige, for both models (columns 2 and 3), none of the estimates are significantly different from zero.

Table 3.9

Socioeconomic Status (SES) and Prestige of Vocational Training Position (OLS) for Realschule Certificate Graduates

	Prestige of the Training Position		SES of the Training Position	
	(1)	(2)	(1)	(2)
School type, reference: *Hauptschule* school				
Realschule	0.85 (0.60)	0.66 (0.611)	2.03** (1.03)	1.32 (1.02)
Merged Haupt-/*Realschule*	0.23 (0.82)	0.063 (0.837)	1.52 (1.27)	1.09 (1.28)
Comprehensive school	0.78 (0.98)	0.57 (0.975)	2.73* (1.53)	1.67 (1.54)
GPA on final certificate/Grades in school	Yes	Yes	Yes	Yes
Cognitive and non-cognitive skills	Yes	Yes	Yes	Yes
Gender, migration background, and year of birth	Yes	Yes	Yes	Yes
Family background and social capital	No	Yes	No	Yes
Local labor market	Yes	Yes	Yes	Yes
States	Yes	Yes	Yes	Yes
Observations	1,459	1,459	1,459	1,459

Note: This table reports results from estimating equation 1.4 on the data. Standard errors in parentheses clustered by school attended in grade nine.
Source: NEPS SC4 10.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

In terms of results for the socioeconomic status of the training position, the point estimates for *Realschule* and for comprehensive school using model 1 (column 4) are statistically significant at the five percent level before adding in controls for socioeconomic background and social capital; these relate to 0.15 SD and 0.20 SD, respectively. Once controls for family

[7] Due to a very small number of observations, students who graduated from a *Gymnasium* are excluded from this analysis.

socioeconomic background and social capital are added, the estimates for *Realschule* and for comprehensive school are still positive, but not statistically significant anymore.

Due to the small sample size, I will not conduct this analysis with the second subsample (*Hauptschule* students). Conducting the same analysis on the sample of students who successfully transitioned into vocational training, combining both samples 1 and 2, the results (Table B.6 in Appendix B) show that students with a *Realschule* certificate start vocational-training positions of higher socioeconomic status (+6.1 points) and prestige (+3.0 points) than those who earned a lower-secondary or lower extended-secondary (*Hauptschule*) certificate, providing evidence for variability between school certificates earned, controlling for school type. These estimates relate to 0.5 SD and 0.4 SD, respectively.

3.6.3 Relationship Between School Certificate Earned and Transition Chances for Hauptschule Students

While a *Realschule* certificate earned at a *Hauptschule* may not be as valuable in the vocational training market as a *Realschule* certificate earned at another type of school, it may still be a better option for individual students than earning only a lower or extended *Hauptschule* certificate. Therefore, it is worthwhile to examine whether *Hauptschule* students who earned a *Realschule* certificate are more likely to successfully enter vocational training than their peers who earned lower certificates. In order to investigate the relationship between school certificate received and transition chances for students attending a standalone *Hauptschule*, I use the subsample of students who graduated from a *Hauptschule*, employing a linear probability model. Results are shown in Table 3.10. In order to examine how the control variables affect the relationship between the type of school certificate earned and transition chances, I add covariates stepwise, with the *Realschule* certificate serving as the reference group for the other certificate

types. The estimates change the most when controls for local labor-market conditions and states are added, suggesting substantial regional differences.

Table 3.10

Transition Into Fully Qualifying Vocational Training (Hauptschule Subsample Analysis, LPM)

	(1)	(2)	(3)	(4)	(5)	(6)
School certificate,						
reference: *Realschule* certificate						
Hauptschule simple certificate	-0.146***	-0.104**	-0.094**	-0.097**	-0.101**	-0.093**
	(0.033)	(0.035)	(0.039)	(0.041)	(0.041)	(0.041)
Hauptschule qualified certificate	-0.021	-0.038	-0.044	-0.044	-0.053	-0.048
	(0.034)	(0.036)	(0.037)	(0.037)	(0.038)	(0.039)
GPA on final certificate/Grades in school	No	No	Yes	Yes	Yes	Yes
Cognitive and non-cognitive skills	No	No	No	Yes	Yes	Yes
Gender, migration background, and year of birth	No	No	No	No	Yes	Yes
Family background and social capital	No	No	No	No	No	Yes
Local labor market	No	Yes	Yes	Yes	Yes	Yes
States	No	Yes	Yes	Yes	Yes	Yes
Observations	1,649	1,649	1,649	1,649	1,649	1,649

Note: This table reports results from estimating equation 1.5 on the data. Standard errors in parentheses clustered by school attended in grade nine.
Source: NEPS SC4 10.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

These results show, in line with my hypothesis, that students who graduated with a *Realschule* certificate from a standalone *Hauptschule* had better transition chances than their peers who graduated from a *Hauptschule* school with a simple *Hauptschule* certificate; simple *Hauptschule* certificate holders are nine percent less likely to enter vocational training after graduating from secondary school. The coefficient for the qualified *Hauptschule* certificate is positive, but not statistically significant. This means that, in my sample, I cannot observe

statistically significant differences in transition chances between the qualified *Hauptschule* certificate holders and the *Realschule* holders. Due to the small sample size, I observe an overall level of imprecision in the estimates, but the direction of the coefficients for both the simple *Hauptschule* certificate and qualified *Hauptschule* certificate is in line with my hypothesis. The results provide tentative descriptive evidence that students attending a *Hauptschule* are likely to benefit from upgrading to a *Realschule* certificate when it comes to improving their transition chances.

These estimations are repeated with logistic regressions, which confirmed the results. Average marginal effects are reported in Table B.7 in Appendix B.

Other results, though with large standard errors imprecisely measured, match the current state of research on the transition to vocational training after secondary school in Germany. The results, presented in Table B.8 in Appendix B, display statistically significant effects for gender, migration background, and social capital. Male students are more likely, and students with a migration background less likely, to transition into vocational training by the end of the year in which they graduated from secondary school (statistically significant at the five percent level). Students whose parents earned a *Realschule* certificate and a vocational-training certificate were more likely to directly transition than students whose parents achieved lower levels of education (statistically significant at the 10 percent level). Interestingly, social capital is not statistically relevant. This could be an indication of the overall demographics of *Hauptschule* students, who are on average from less privileged backgrounds compared to the sample of students from other schools; thus, this might be reflected in the lower quality of their networks.

3.7 Discussion and Conclusion

Several recent policy reforms in Germany have been aimed at increasing equality of opportunity in the general school system, including several that made it possible to obtain the *Realschule* certificate at all types of schools. These changes, among others, in the school systems across states have led to a decoupling of the type of school attended and the resulting educational qualification. Little research, though, has been undertaken to examine whether these measures have succeeded in significantly opening up the highly differentiated German school system with respect to transitions to vocational training.

In this paper, I therefore examined the relationship between type of school attended *and* school certificate earned and transition chances to fully qualifying vocational training, exploring how the transition chances of *Hauptschule* students who graduated with a *Realschule* certificate differed compared to their *Hauptschule* peers with lower certificates, as well as whether the odds of successful vocational transition are different for *Realschule* certificate students depending on school type attended. Additionally, I analyzed whether *Realschule* certificate graduates gain access to vocational training positions of varying socioeconomic status and prestige depending on the type of school attended. Because there has been very little research with this focus undertaken so far, my analyses are therefore explorative and descriptive in nature.

In line with my hypothesis and in accordance with the theoretical considerations for my first research question, my empirical analyses show that students who graduated with a *Realschule* certificate from a standalone *Hauptschule* had lower transition chances than those who graduated from a *Realschule* or a comprehensive school. *Hauptschule* alumni were seven and 10 percentage points less likely to enter regular vocational training before the end of the year in which they graduated from secondary school than those graduating from a *Realschule* or

comprehensive school, respectively. Students who graduated with a *Realschule* certificate from other types of schools did not have statistically significantly different transition chances compared to those who attended a *Hauptschule.* There is no evidence that students who earned a *Realschule* certificate started vocational training positions of differing socioeconomic status or prestige depending on type of school attended.

In line with my hypothesis and in accordance with the theoretical considerations, the results from my second analysis show that students who graduated with a *Realschule* certificate from a standalone *Hauptschule* had better transition chances than those who graduated from a *Hauptschule* with a simple or qualified *Hauptschule* certificate. These findings provide empirical support that students attending a *Hauptschule* benefit from upgrading to a *Realschule* certificate, relative to obtaining a simple or qualified *Hauptschule* certificate.

For both analyses, my results further showed that, after controlling for both school type and school certificate, social background still had a noticeable influence on transitions into the vocational-training market for *Realschule* certificate graduates and *Hauptschule* students. In line with previous research, my findings illustrate how these odds of moving smoothly into vocational training differ by gender, migration background, and social-capital resources. In that sense, my study replicated previous research results.

Despite the advances I made, several limitations of this study have to be noted. First, due to the methodology employed, the observational associations reported cannot be given a causal interpretation. Even though I was able to include several important control variables, unobserved third variables may have led to spurious effects. Second, it has to be kept in mind that the sample size is relatively small, which has led to an overall level of imprecision in the estimates. The

research questions require panel data information, and panel attrition has been an issue with the NEPS data. There are several ways in which future research should extend the literature.

First, this paper cannot assess whether individuals who transition directly after graduating from secondary school into vocational training benefit in the long-term from their earlier start at accumulating company- and occupation-specific human capital compared to their peers who take a longer time to transition to vocational training, or who decide to first upgrade their school certificates (compare Hillerich-Sigg, 2020). Though these short-term outcome findings are helpful, longer-term outcomes should be studied to understand how the type of school attended affects long-term labor-market outcomes.

Furthermore, the transition to vocational training in the dual system is a twofold process involving both applicants' and employers' decisions. For this study, the transition process was analyzed from the students' perspective. Due to data limitations, there have been fewer studies analyzing companies' recruitment and decision-making processes in the German apprenticeship market. The use of experiments is an especially promising strategy for gaining insights into the interaction effects of school type attended and school certificate earned on transition chances, as well as whether there are discrediting or discriminatory processes at work with employers in terms of school type attended. One such example is the correspondence experiment conducted by Penny and Nüß (2019), which examined ethnic discrimination in the hiring market for apprenticeships in Germany.

Recent research findings also indicate the need to study the contextual radius that impacts young adults' vocational-training chances in more detail. The author of one study, for example, showed that regional unemployment on several levels of aggregation—district and neighboring

districts—had an impact on students' chances of entering dual vocational training (Hartung, 2017). Thus, future studies should address these, issues too.

Despite these limitations, the results of my empirical analyses provide valuable descriptive insights in terms of how the type of school attended *and* school certificate earned interactively influence chances of transitioning to fully qualifying vocational training. My findings suggest that the type of certificate a student earned, *and* the school a student attended, matter. Further, they imply that students attending a *Hauptschule* benefit in terms of their transition chances from upgrading to a *Realschule* certificate compared to their *Hauptschule* peers. In light of the results from my first analysis, however, it is problematic that the same students have lower transition chances compared to those who graduated with a *Realschule* certificate from a *Realschule* or a comprehensive school. My findings indicate two things: (1) Relative to their *Hauptschule* peers with lower certificates, upgrading to a *Realschule* certificate seems to be beneficial for *Hauptschule* students at a personal level. (2) However, in terms of answering the question of whether the policy change has contributed to decreasing longstanding inequalities in the education system, the answer is not so straightforward.

If we look at trends in the graduation and dropout rates over time, we can observe a growth in the number of students seeking higher school-leaving certificates. Between 2006 and 2016, the proportion of young people with an intermediate qualification rose from 46 percent to 54 percent, and those with an upper-secondary certificate (*Abitur*) from 30 percent to 41 percent. In contrast, the number and proportion of young people with a *Hauptschule* certificate and those leaving without a secondary leaving certificate decreased over that same period; in 2016, 21 percent of graduates earned a *Hauptschule* certificate, compared to 27 percent in 2006 (Authoring Group, 2018). Furthermore, the percentage of *Hauptschule* students who earned a

Realschule certificate increased from 21 percent in 2016 to 33.5 percent in 2018 (Authoring Group, 2020). More students earning a *Realschule* certificate can be considered a good outcome overall.

Based on these numbers, it is likely that some students who upgraded to a *Realschule* certificate at a *Hauptschule* might not have done so if they had not had the option to earn the higher credential at the *Hauptschule* they attended. However, if a *Realschule* certificate earned at a *Hauptschule* does not have the same value as the certificate from the *Realschule*, this could mean two things. One possibility is that, because of peer composition and exposure to a different overall schooling environment, teachers and curriculum, students from a *Hauptschule* who earned a *Realschule* certificate might actually be less qualified compared to students who earned the same certificate at other types of schools, and potential employers might be able to observe this (and I cannot in my data). It might be possible though, that stigmatization of *Hauptschule* students is at play here. From a systematic level, this would be problematic. If stigmatization and discrediting of *Hauptschule* and *Hauptschule* certificate students really occurs, one could conclude that the decoupling of school type and resulting educational qualifications is not enough to alleviate longstanding inequalities.

Another key unaddressed question for future research is what the appropriate counterfactual for a student who earns a *Realschule* certificate at a *Hauptschule* is. Would the student have gone to a *Realschule* instead, if the option to earn a *Realschule* certificate at a *Hauptschule* did not exist? Or would the student have earned a lower certificate at the *Hauptschule*? In light of the trend towards two-pillar systems in many German states, what role will multi-track schools play in the future in terms of the attainment of school certificates by students from different socioeconomic backgrounds? Many states have closed their standalone

Hauptschule schools, opting for multi-track schools besides the *Gymnasium*. Further research is needed to understand what happened in those states—namely, whether systems without a standalone *Hauptschule* have done a better job at equipping lower-achieving students for success in the vocational-training market. Because, even if the *Hauptschule* is gone, the population of students who attended them is certainly not; what's more, there is no indication that the *Hauptschule* certificate will be abolished anytime soon, either. Since the transition period from school to working life is of utmost importance for young people's future labor-market outcomes and overall life opportunities, it is essential to examine these processes. Both in terms of policy innovations and research, much remains to be done.

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Chapter 4: Socioeconomic Status Gaps in Students' Educational Achievement at the End of Lower Secondary Education in Germany

4.1 Introduction

The quality of an individual's education strongly influences their life chances. Educational attainments in the form of certificates and degrees are prerequisites for access to opportunities, resources, and goods in the labor market, which assign a social status to individuals. If a person's life chances are based on performance-related characteristics, a society can be considered meritocratic: inequalities do not disappear, but are legitimized through merits. By the same token, scholars agree that it is morally objectionable for outcome inequalities to be explained by pre-determined circumstances, which individuals simply inherit beyond their control, and which do not reflect their choices or actions (e.g., Roemer, 1998). The analysis of educational inequality is relevant because the position that individuals attain in society, as well as their life chances and well-being, are strongly associated with educational achievement: Higher education is often connected with higher earnings and better career opportunities (e.g., Psacharopoulos, 1994; Card, 1999; Psacharopoulos & Patrinos, 2002), lower risks of unemployment and precarious work (Hausner et al., 2015; Schmillen & Stüber, 2014), and better health (Sander, 1995; Wolfe & Zuvekas, 1997). A high-quality education system also contributes to a country's economic growth and social development, ensuring its capacity to produce, grow, and innovate. Educational failure, on the other hand, imposes high costs on society and damages social cohesion and mobility.

The association between social background and academic achievement is an essential measure of inequality of educational opportunity (Coleman, 1966; Schütz et al., 2008). Another indicator relevant to equity in secondary education is the connection between family background

and secondary certificate attained. More than half a century of research has established profound associations between children's academic achievement and the socioeconomic background of their family. Especially since the release of the first results of the OECD's assessment of student learning outcomes (PISA) in 2000, there has been a new interest in studying educational inequality in many countries. Looking specifically at Germany, numerous studies have documented that student achievement there is strongly associated with family background, and that it belongs to the group of countries where this influence is highest in international comparisons (e.g., Ferreira & Gignoux, 2012; Krause & Schüller, 2014).

Early tracking is a key feature of Germany's education system, with students being sorted into secondary schools of differing prestige and quality at the age of 10. Since extensive research has shown that social inequality exists in German secondary education, policy reforms over the past decades have aimed at increasing equality of opportunity. For example, there were considerable adjustments in the structure of school systems; in many states, the traditional coexistence of up to six school types has been abandoned in favor of differently accentuated two-pillar models over the past 20 years (Authoring Group, 2020). In the two-pillar system, states only offer two types of secondary school: the highest-track school (*Gymnasium*) and schools combining multiple tracks under one roof. The latter are either schools that have merged the two lower-track schools (*Hauptschule* and *Realschule*), offering the lower *(Hauptschule)* certificate and intermediate *(Realschule)* certificate; or comprehensive schools (*Gesamtschule*), which offer all tracks and access to the upper-secondary certificate *(Abitur)*. Currently, in some states multi-track schools coexist with the *Gymnasium*, the *Realschule*, and the *Hauptschule.*

The *Gymnasium* remains unchanged, and it is the only type of school that exists in all German states. While the introduction of one comprehensive school for all students would

politically not be palatable in Germany, the goal of these structural reforms was to reduce the effects of socioeconomic background at the transition from primary to secondary education, to create greater permeability in terms of earning the different secondary certificates at different schools, and to increase overall equality of educational. The trend towards the two-pillar system has led to a substantial increase in the number of multi-track schools and the number of students attending them.

Despite these developments, relatively few studies have analyzed the consequences of these structural reforms on either students' competency development or social inequalities. Besides the PISA evaluations, recent research documents strong associations between German children's achievement, as measured by test scores, and the social background of their family (Linberg et al., 2019; Skopek & Giampiero, 2020). Extensive research has also shown a strong correlation between a student's socioeconomic background and secondary-school track choice at the central transition from primary to secondary education in Germany (e.g., Dustmann, 2004; Stocké, 2007; Tamm, 2008; Dumont et al., 2014; Falk et al., 2020). Previous studies also show that decisions about upward mobility at school and upgrading to higher certificates correlate with a student's socioeconomic background (e.g., Biewen & Tapalaga, 2017; Blossfeld, 2018).

For the most part, in the German context, the research focus has been on analyzing inequalities in terms of accessing the *Gymnasium* and attaining the highest secondary certificate, the *Abitur*. However, socioeconomic status (SES) gaps in the attainment of the intermediate certificate have received less attention. Besides the PISA evaluations, the extent to which SES disparities in children's achievement exist at multi-track schools has not recently been studied, either, nor have they been compared to SES-related gaps within other school types in Germany. With 60 to 65 percent of all graduates each year leaving secondary school with a lower or

intermediate certificate, or with no certificate (Authoring Group, 2018), it is also important to investigate social inequalities in the attainment of the intermediate certificate. Students who leave secondary school to start vocational training have better transition chances if they have earned a higher school certificates, compared to those with a lower certificate or none at all (e.g., Beicht et al, 2008; Kleinert & Jacob, 2012; Solga & Menze, 2013; Protsch, 2014; Beicht & Walden, 2015; Hillmert, Hartung, & Weßling, 2017). If they transition into grade 11 at a comprehensive school or the *Gymnasium*, students are automatically awarded the *Realschule* certificate, and offered entry to upper-secondary schooling.

Multi-track schools were created with the explicit goal of reducing socioeconomic background effects on educational outcomes. The question is: How far do SES gaps in cognitive achievement and in the attainment of different certificates persist at multi-track schools—which are, at least in theory, pedagogically set up to serve students with diverse backgrounds and to decrease social inequalities—in terms of earning the different secondary certificates? With the majority of states nowadays relying on two-pillar models and others moving towards them, it is essential to study multi-track schools, and to understand the consequences of the structural reforms in terms of educational inequalities in the German secondary-school system overall.

This paper makes the following two contributions: First, it documents socioeconomic-status gaps in students' cognitive achievement within all school types for students in grade nine as one way to study primary effects. Second, it documents the extent of social inequality in the attainment of the intermediate school-leaving certificate and the transition to upper secondary education at multi-track schools in Germany, and decomposes differentials in these educational decisions into primary and secondary effects, as proposed by Boudon (1974). Specifically, I will explore the following research questions:

(1) How large are the socioeconomic status gaps in students' cognitive achievement within the different school types in Germany in grade nine? Are these disparities substantially bigger or smaller at multi-track schools compared to the other school types?

(2) What is the association between socioeconomic background and the attainment of the intermediate school-leaving certificate, and the transition to upper secondary education, at multi-track schools in Germany? Are primary or secondary effects larger?

This paper is structured as follows: Section 4.2 gives a brief overview of the German education system and tracking. Section 4.3 reviews previous research and theoretical considerations. While Sections 4.4 and 4.5 describe the data and methods employed, Section 4.6 presents the results. Finally, Section 4.7 includes the discussion and conclusion.

4.2 The German General Education System and Tracking

Early tracking (as described in Section 2.3 of Chapter 2) and a vocational education and training system with well-defined occupations (as described in Section 3.2 of Chapter 3) are key features of the German education system. In this chapter, I emphasize the aspects of German schooling that are most pertinent for understanding the relevance of multi-track schools within the system.

Most children in Germany enter into primary school at the age of six or seven. For the next four years, all youth are taught together in these schools. After the fourth year (in some states, after the sixth), students are tracked into four different types of schools according to their perceived abilities: (1) *Hauptschule*, (2) *Realschule*, (3) *Gymnasium*, and (4) multi-track schools. Teachers give individual track recommendations towards the end of the fourth grade based on

the student's grades, mainly math and German, and the teacher's subjective evaluation of the children's academic abilities and potential. In most states, this advice is not binding, and parents may decide to deviate from the teacher's suggestion by sending their child to a higher-track (or lower-track) school. In the states where teacher recommendations are binding, children can still attend a higher-track institution than the one recommended if they pass an entrance examination.

Mobility between school tracks is, in principle, possible at any grade throughout secondary schooling. In practice, however, only two to three percent of students change tracks during the lower-secondary years (Schnepf, 2003; Dustmann et al., 2017). Hence, once students are sorted into the different types of schools, they are essentially locked into their chosen track for at least four or five years. Presently, about 42 percent of students transition to the *Gymnasium* after primary school (Authoring Group, 2020).

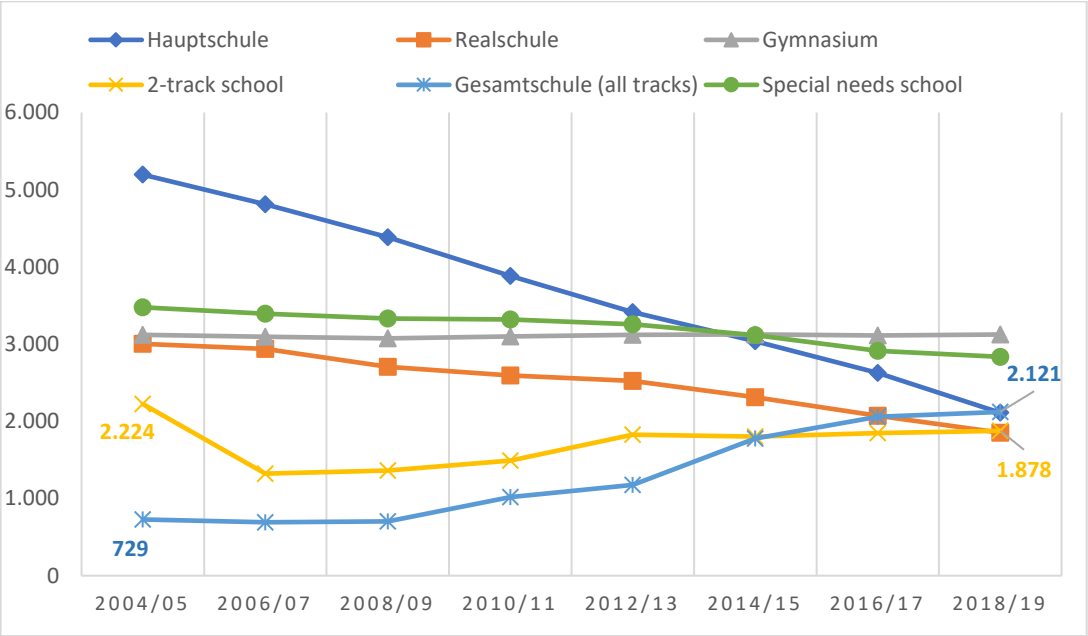
The secondary-school system in Germany has undergone major reforms in the last two decades; although the structural changes have taken different forms in the different states. At this point, the majority have implemented the reformed two-pillar models (Authoring Group, 2020). In those states, only two types of secondary school exist: the highest-track school, *Gymnasium*, and those that combine multiple tracks under one roof. The two-track campuses merge the two lower-track schools (*Hauptschule* and *Realschule*), while comprehensive schools offer all three tracks and access to the highest secondary certificate, *Abitur*.

As more states moved towards the two-pillar structure, the number of multi-track schools and students attending them has increased substantially over the years. Indeed, the number of youth at schools with two tracks rose by 39 percent between 2004 and 2018, from 379,000 to 526,000. Over the same period, the number of youth enrolled in schools with three tracks grew by 89 percent, from 451,000 to 834,000 (Authoring Group, 2020). Currently, in some states

multi-track schools coexist with the *Gymnasium*, the *Realschule*, and the *Hauptschule*. Figure 4.1 shows how the number of secondary schools changed between 2004 and 2018.

Figure 4.1

Secondary Schools by School Type and Year, 2004-2018[8]



The aforementioned changes in the school systems across states have also led to a decoupling of school type and resulting educational certificate (as described in more detail in Section 3.2 of Chapter 3). At the two-track schools, students can earn the *Hauptschule* certificate and intermediate certificate; at comprehensive schools, students can earn all types of credential, including the *Abitur*. Table 4.2 presents the distribution of certificates earned across the two-track and comprehensive schools in Germany in 2006, 2012, and 2018. The *Hauptschule* certificate can be earned after grade nine or 10, and the *Realschule* certificate after grade 10. These credentials entitle graduates to take up work or vocational studies/training. In 2018, about

[8] Data source: Germany's National Education Report 2020. Author's graphic.

30 percent of two-track and comprehensive-school students earned less than a *Realschule* certificate (Authoring Group, 2020).

Table 4.1

Distribution of Certificates Earned at Multi-Track Schools: 2006, 2012, and 2018 (Percent)[9]

Type of Certificate Earned	2006	2012	2018
		Two-track school	
Without certificate	6.8	5.3	7.5
Hauptschule certificate	23.3	25.4	23.2
Realschule certificate	69.9	69.3	69.3
		Comprehensive multi-track school	
Without certificate	5.1	3.5	6.6
Hauptschule certificate	28.2	20.6	23.5
Realschule certificate	41.8	42.8	44.2
Abitur/Fachhochschulreife	24.8	33.1	25.8

At comprehensive schools, in 2018, 44 percent of students earned the *Realschule* certificate, which entitles recipients to continue upper secondary education at the *Gymnasium* or a comprehensive school. Two or three more years at the *Gymnasium* or *Gesamtschule* will lead to a certificate that grants access to tertiary studies (*Abitur)*, after grade 12 or 13 depending on the state.

4.3 Previous Literature and Theoretical Considerations

Despite the increasing numbers of comprehensive and two-track schools, and their theoretical relevance for questions of social equality in Germany, there are so far surprisingly few studies that explicitly address such inequalities in these types of institutions (e.g.; Köller, Baumert, & Schnabel, 1999; Fend, 1982, 2009; Lorenz, 2017). This research gap can be traced back to a rather infrequent overall consideration of comprehensive schools in empirical

[9] Data source: Germany's National Education Report 2020.

educational research over the past decades. Previously, this was justified by a limited comparability with the schools of the traditional multi-tier school system, which in turn resulted from the unique composition of the student body at most comprehensive schools (Müller-Benedict, 2007). Another reason for the dearth of research has been the limited availability of good data sources.

While some researchers have focused on the differences in achievement between comprehensive (*Gesamtschule)* and *Gymnasium* students in upper-secondary education (e.g., Schleithoff, 2016), there are only a few descriptive studies that specifically examine German comprehensive schools and their significance for inequality of opportunity. Köller, Baumert, and Schnabel (1999) investigate the question of whether the alternative access route to the *Abitur*, which the comprehensive school offers, contributes to opening up the education system and reducing social inequality. Using data from the BIJU study, the analyses are carried out with a partial sample of students enrolled in the 12th grade at a comprehensive school or *Gymnasium* in the state of North Rhine-Westphalia in 1997. The authors' comparison of these upper secondary students found that the social composition of neither the *Gymnasium* nor the comprehensive schools changed between grade 10 and 11. They interpret this as an indication that there is no longer any social selection at the transition to the upper-secondary level.

Fend (1982, 2009) analyzes data on comprehensive school students who attended upper-secondary grades in the 1970s and 1980s. He finds that the comprehensive schools exhibit higher levels of equality of opportunity during secondary education, but later labor market success is associated with students' socioeconomic background. Lorenz (2017) looks in particular at the transition to upper-secondary education—i.e., into grade 11—at *Gymnasium*, comprehensive schools, and the *Realschule*, identifying socioeconomic background effects for students at the

Gymnasium and the *Realschule*, but not at the comprehensive schools. Baumert at al. (2018) looked at teachers' placement decisions at the transition to the upper-secondary level in non-academic multi-track schools in Berlin after the city-state shifted to a two-track system; i.e., now only the *Gymnasium* and one other type of secondary school exist there. They conclude that the probability of transition to upper-secondary education is still linked with sociocultural background at the non-academic multi-track schools in the new two-pillar system; in addition, these differences are not smaller than the ones found in the previous system of multiple non-academic-track schools. Scharf et al. (2020) are the first to investigate the relative importance of primary and secondary effects at the transition to upper-secondary education for a cohort of students in Hamburg, another German city-state. However, they do not report results by school type. So far, to my knowledge, no study has investigated socioeconomic status gaps in the attainment of the intermediate certificate at multi-track schools in Germany.

While the empirical literature on comprehensive schools in Germany is scarce, we can draw on the literature on de-tracking to provide some insights into how student academic performance is affected when they are taught comprehensively for longer or shorter periods during secondary school. Many studies have exploited changes in the tracking system within a country, or within-country variation in tracking ages, to examine the impact of tracking on students' achievement and educational paths (e.g., Malamud & Pop-Eleches, 2011, for Romania; Meghir & Palme, 2005, and Hall, 2012, for Sweden; Pekkarinen et al., 2009, for Finland). Many studies show that de-tracking especially benefits disadvantaged students. For example, In the German context, several researchers have analyzed school reforms that have either delayed tracking by two years or shifted it to earlier grades. Piopiunik (2014), for example, finds that moving the timing of tracking in low- and middle-track schools from grade six to grade four in

the state of Bavaria reduced the performance of 15-year-old students in both low- and middle-track schools. Matthewes (2020) studied the effects of early between-school ability tracking on student achievement, exploring institutional differences among German states. He finds evidence that prolonged comprehensive schooling—i.e., tracking after grade six versus after grade four—has positive effects on mathematics and reading scores in grade seven, especially for disadvantaged youth.

In terms of research on SES gaps in children's academic achievement, numerous studies have documented that these disparities in cognitive and academic achievement are already profound before children even start school, and remain constant or slightly increase during secondary school. However, most of the longitudinal evidence on achievement gaps comes from Anglophone countries that have institutional settings very different from Germany's. Linberg et al. (2019) are the first to study SES gaps in young children's cognitive skills in Germany in the beginning of grade one, finding large disparities based on socioeconomic background. Skopek and Giampiero (2020) explore the development of SES gaps in cognitive achievement from the age of seven months to 16 years in Germany, finding large differences before students start school that remain relatively stable throughout secondary schooling. The authors did not, however, analyze how SES gaps differ depending on school type and track.

Primary and Secondary Effects

When analyzing inequality of educational opportunity, it is important to differentiate between *primary* and *secondary effects*, as Boudon (1974) has outlined. According to Boudon (1974), the total effect of the families' social status on children's educational attainment can be divided into primary and secondary effects. *Primary effects* are all those that are expressed via the association between children's socioeconomic backgrounds and their actual levels of

academic performance, due to parents of different status being differently endowed with resources beneficial for children's learning. *Secondary effects* refer to variations in educational choices, including exit, made by families from different social backgrounds, even if children exhibit similar academic performance.

Relevance of Intermediate Certificate (Grade 10) for Transitions to Vocational Training

Students who decide to leave school after grade nine or 10 to start vocational training instead of continuing in upper secondary education to earn the *Abitur* face competition in the vocational-training market. The mechanisms at play here are comparable to those at work in the labor market. Thus, the dominant labor-market theories explain the selectivity in access to different dual vocational training positions. The human capital model provides a basic theoretical grounding for a student's decision to invest in education; e.g., earning a *Realschule* certificate versus a *Hauptschule* certificate. Though differing slightly, several versions of the model agree that human capital is valued in the labor market (Becker, 1962; Nelson & Phelps, 1966; Bowles & Gintis, 2002).

They all suggest that human capital increases the firm's profit through increased productivity, dimensions of skills, adaptability, and capacity to work in organizations. Signaling theories (Spence, 1973) hold that employers use educational certificates as an indicator of an individual's trainability. Previous research has shown that students who leave secondary school to start vocational training have much better transition chances if they have earned higher school certificates, compared to the lower certificate or no certificate at all, and that *Hauptschule* certificate holders face immense difficulties in the transition process (e.g., Beicht et al., 2008; Solga & Menze, 2013; Beicht & Walden, 2015). *Realschule* certificate graduates are at a clear advantage, compared to students with no or a lower school certificate.

Social Inequality in the Transition to Upper-Secondary Education (Grades 11-13)

Children who grow up in families of higher economic status have advantages in terms of cognitive development before they even begin schooling (Linberg et al. 2019), which are then accumulated throughout the life course (Hillmert & Jacob, 2005). At the end of compulsory lower-secondary education, students decide whether they want to continue schooling; or to leave with no certificate, a lower-secondary certificate (after grade nine or 10), or an intermediate certificate (after grade 10) to start vocational training. Since schooling and vocational education are compulsory until at least the age of 18 in most German states, seeking full-time employment directly after exiting secondary school after grade nine or 10 is not an alternative option for most students.

Research has shown that students tend to make educational choices that maximize their chances to maintain the social status of the family and to minimize the risk of downward mobility; theories that explain social inequality in educational transitions generally treat the transition as the result of a rational decision process taking into account the probability of success and the expected costs and benefits (Erikson & Jonsson, 1996; Jackson et al., 2007). The underlying assumption is that choice among several educational alternatives is mainly restricted by individual resources and prior achievement. For students who have to maintain a high parental status, upper secondary education will be a "necessary choice" in order to earn the *Abitur* and then take up high-status vocational training or go to university. For children of less-educated parents, upper secondary education is not necessary for status maintenance. Vocational training that is achievable without the *Abitur* may thus be more attractive for lower-status children with scarce financial resources, who might want to avoid the opportunity costs associated with upper-secondary education and instead start earning money through vocational

training. The same argument can be made for earning a *Hauptschule* certificate instead of an intermediate certificate. Institutional factors—i.e., the type of school a student attends and the associated teachers, peers, and resources to which they are exposed—should influence transition decisions as well.

Hypotheses

I base my hypotheses on the overall overwhelming literature documenting the existence of socioeconomic-background effects at all levels in the German education system. At multi-track schools, I expect children from high-status parents overall to be more likely to attain an intermediate certificate or transition to upper-secondary education for two reasons: First, they are more likely to be eligible for entry to upper secondary education due to higher academic performance (primary effects). Second, within the group of eligible students, they have stronger incentives to make this transition than do those from lower socioeconomic backgrounds (secondary effects). In terms of primary and secondary effects, I expect secondary effects to remain. In terms of SES gaps in cognitive achievement, I expect to detect SES-related differences within all school types.

4.4 Data and Methods

4.4.1 Overview

The individual-level data is from the Starting Cohort 4 (SC4) of the National Educational Panel Study (NEPS) (Blossfeld et al, 2011). In this cohort, all respondents attended grade nine at German secondary schools in fall 2010 (Leuze et al., 2011). The sampling design employed is a stratified two-stage sampling strategy, sampling first schools and then classes within schools (Steinhauer & Zinn, 2016). The first survey was carried out in fall/winter 2010. For all starting

cohorts, in addition to the students, context persons such as parents, teachers, and principals were regularly surveyed, too.

4.4.2 Samples, Variables, and Descriptive Statistics

For my first analysis of socioeconomic status gaps in students' cognitive achievement within all school types in grade nine, I include in my sample all students from the Starting Cohort 4 (ninth graders in 2010) for whom I have information on test score data in grade nine for math, reading, science and ICT competencies, parental education, and the type of school in which they were enrolled in grade nine in the fall of 2010.

Students for whom this data was missing were dropped. This leaves me with the sample size described in Table 4.2.

Table 4.2

Number of Students by School Type

Sample school type in grade 9	Freq.	Percent
Hauptschule	2,097	20.75
Realschule	2,215	21.92
Two-track school	660	6.53
Comprehensive school	1,084	10.37
Gymnasium	4,049	40.07
Total	10,105	100.00

For my second analysis, the examination of socioeconomic gaps in the attainment of the intermediate certificate and the transition to upper-secondary education in grade 11, I conduct subgroup analysis of only the students attending either a two-track or comprehensive multi-track school in grade nine. In my sample, therefore, I include all youth from SC4 who attended a multi-track school in grade nine in the fall of 2010. Students for whom data is missing on parental education were dropped.

In this subgroup analysis, I examine the influence of socioeconomic background on the attainment of intermediate certificates and transitions to upper-secondary education for the population of students enrolled in multi-track schools. Student compositions at the other school types are very different; further, I am also not interested in comparing socioeconomic background effects across all types of secondary schools. Therefore, it makes sense to conduct this specific subgroup analysis. This leaves me with a sample size of 1,952 students: 745 at two-track schools, and 1,207 at comprehensive schools[10]. The NEPS study started with a multi-track sample size of 2,993 students in grade nine; however, since non-response and panel attrition in later waves was an issue, this leaves me with only a small sample. At the same time, though, there are few datasets available to study socioeconomic effects in multi-track schools, so this sample provides a good basis for some exploratory, descriptive analyses.

Outcome 1: Attainment of intermediate certificate/transition to upper-secondary education. For my binary outcome variable for my first analysis, I code as follows: 1= attainment of intermediate secondary-school certificate or enrolled in upper-secondary education in grade 11 in the fall of 2013, 0=left school without certificate earned or attainment of the lower certificate (*Hauptschule*). Missings (seven percent) were set to 0 as well.

Outcome 2: competencies. For my analyses of SES gaps in cognitive achievement, I use scores from performance tests administered in grade nine (mathematics, reading, science, and ICT). The NEPS consortium has developed competence tests for different domains, scaled by using models of Item Response Theory (Pohl & Carstensen, 2012), with the NEPS providing the weighted maximum likelihood estimator (WLE). I standardized WLEs for the analysis to have a mean of zero and a standard deviation of one to measure relative test-score differences rather

[10] Sample size is slightly bigger for this sample than for the multi-track school samples used for the first analysis. This is due to the fact that not all students participated in all the competency tests administered in grade nine.

than absolute score differences. Differences on the z-score scale are easy to interpret and, in relative terms, comparable across different domains and over time. This outcome makes it possible for me to compare SES gaps in cognitive achievement across all school types, unlike my first outcome. I use the same test scores to control for cognitive competencies in my second analysis of socioeconomic gaps in the attainment of the intermediate certificate and the transition to upper-secondary education in grade 11. Table 4.3 shows that average student achievement, as well as school composition in terms of student socioeconomic background, differs substantially among school types.

Table 4.3

Competencies and Student Background by School Type (Average or Percent)[11]

	Hauptschule	*Realschule*	Two-track school	Comprehensive multi-track school	*Gymnasium*
High SES	20.27	37.38	24.70	44.74	68.83
Std. test score, math	-0.70	-0.20	-0.56	-0.37	0.66
Std. test score, reading	-0.78	-0.12	-0.38	-0.15	0.57
Std. test score, science	-0.75	-0.11	-0.35	-0.27	0.58
Std. test score, ICT	-0.82	-0.06	-0.46	-0.28	0.61
Sample size	2,097	2,215	660	1,084	4,049

Indicator for socioeconomic status. Concerning the social background of the students, I include parents' highest educational attainment. I generated a dummy variable, which equals one if at least one of the parents earned the *Abitur*. I decided to use parental education as a key indicator of family socioeconomic background for various theoretical reasons, as has been done in recent previous studies (e.g., Bradbury et al., Linberg et al., 2019; Skopek & Giampiero, 2020). One reason is that educational attainment is relatively stable over the life course, and

[11] Source: NEPS SC4 10.0.0., author's calculations.

typically precedes childbirth. An additional reason for choosing this indicator is that, compared to other socioeconomic background indicators, such as earnings and occupational attainment, parental education is less prone to fluctuations and measurement error. Parental education also serves as a good overall indicator for family resources, values, and beliefs (Bradbury et al., 2015). I use data from the student and the parent questionnaires, giving priority to the parent data (about half of parents participated). If no information from the parents is available, I also use information from the students. If there is only information on one parent available, I use this data. Students for whom neither parent nor student information was available were dropped.

Control variables. Below, I provide information on the variables I include as control variables in my second analysis, where I examine the influence of socioeconomic background on the attainment of intermediate certificates and transitions to upper-secondary education for students enrolled in multi-track schools. Distributions and descriptive statistics on these variables are presented in Table 4.4.

Student characteristics. Gender data was taken from school records in grade nine. I defined students as having a migration background if they themselves or at least one of their parents were born abroad.

Teacher school-track recommendation at the end of grade four. All parents receive a teacher recommendation regarding the most suitable track type for their child for secondary schooling. Based on parents' reports, I generate a dummy variable which equals one if a child received a recommendation for the high track, and zero otherwise.

Students' grades, cognitive skills, and non-cognitive skills. Based on students' self-reports, I include math and German grades on the final report cards from grade eight to control for academic performance. In the German grading system, marks range from one to six, where

lower grades indicate better performance. To control for cognitive skills, I use scores from performance tests administered in grade nine for mathematics, reading, science, and ICT competencies (WLEs), as described previously. In order to control for non-cognitive abilities, I include a measurement of conscientiousness, which is one dimension of the common five-factor model of personality. The NEPS used a 10-item short version (called BFI-10), developed by Rammstedt and John (2007).

Table 4.4

Distribution of Independent and Control Variables (Average or Percent): Subsample of Students Enrolled at Multi-Track Schools[12]

	Two-track school	Comprehensive school
Intermediate certificate attained/enrolled in upper-secondary education in grade 11	63.62	78.71
High SES	24.16	44.32
Male	52.08	49.13
Migration background	10.87	26.18
Missing	5.10	4.14
Test score, math	-0.52	-0.29
Test score, reading	-0.34	-0.07
Test score, science	-0.23	-0.14
Test score, ICT	-0.33	-0.16
Math grade (1 = highest, 6 = lowest)	2.97	2.84
German grade (1 = highest, 6 = lowest)	2.92	2.81
Conscientiousness	3.12	3.13
Observations	745	1,207

Missing data. I dealt with missing data for control variables in the following way: For migration background and track recommedation, I added an extra category for the variable indicating missingness. For continuous predictors, I replaced the missing by the mean (Gelman & Hill, 2006).

[12] Source: NEPS SC4 10.0.0, author's calculations.

4.5 Empirical Strategy

In this paper, I first examine raw SES gaps in children's cognitive achievement that occur within each school type. I will analyze SES gaps in students' math, reading, science, and ICT competencies, not controlling for mediating factors besides school type, since my focus is on examining the overall association between parental education and children's achievement.

In order to answer my research questions, it is essential to control for school characteristics and regional variations. I can take advantage of the fact that, due to the stratified sampling design, students are clustered within schools in the NEPS data. By running fixed-effects regressions using the school identifier as a panel variable, I can control for all school characteristics and compare youth who attended the same school in grade nine. Therefore, in order to estimate the raw difference in average scores for students from families with low/medium versus high levels of parental education, I am employing a school-fixed effects regression model that does not include variables that are expected to mediate the relationship between socioeconomic status and outcome. I will run the regressions separately for the different school-type samples and for the four outcomes. I use standardized test scores as outcomes, which measure relative test-score differences.

In my second analysis, I conduct subgroup analysis with the sample of students who attended multi-track schools in grade nine. Here, I examine the relationship between socioeconomic background, the attainment of the intermediate secondary certificate, and the transition to upper secondary education in multi-track schools in Germany, as well as whether there are differential associations at two-track versus comprehensive schools. My analyses are purely descriptive in nature. The general relationship can be expressed by the following equation:

$$Y_i = \beta_0 + \beta_1\, schooltype_i + \beta_2\, SES_i + \beta_3\, (schooltype_i * SES_i) + \beta_4 X_i + \epsilon_i \quad (2)$$

Where Y_i is a binary indicator, where one indicates for student *i* that the student has successfully earned an intermediate school-leaving certificate/passed grade 10 and enrolled in upper secondary education in grade 11, with the most important independent variables being school type ($stype_i$), a student's socioeconomic background operationalized by parental education (SES_i) and the interaction terms ($stype_i * SES_i$); X_{ig} is a set of covariates including student's gender and migration background, student's competency test scores and grades received in grade eight, teacher track recommendation at the end of grade four, and an indicator for student's non-cognitive skills in grade nine. ϵ_i is an error term.

Corresponding to my first analysis, I take advantage of the stratified sampling design of the NEPS study, which clusters students within schools, and I employ a school-fixed effects linear probability regression model, controlling for the variables mentioned above. I will run the regressions separately for the two-track and comprehensive school samples. Besides estimating the raw SES gaps, I will also examine the relative importance of primary and secondary effects of parental education by describing socioeconomic background differences conditional on indicators for children's cognitive competencies and academic performance, which can capture the strength of primary effects.

4.6 Results

4.6.1 Socioeconomic Status Gaps in Students' Cognitive Achievement

For my first analysis, I examined SES gaps in children's cognitive achievement. Table 4.7 presents coefficients from school-fixed effects regressions of test scores on parental education for the four outcomes: math, reading, science, and ICT. I ran the regressions separately for the different school-types samples and for the four outcomes. I find statistically significant

coefficients across all outcomes and school types, except for the coefficients for reading and science for the two-track student sample (Table 4.5, row 4). Students with at least one parent with an *Abitur* perform significantly better across all outcomes within all school types.

The socioeconomic status gaps are mostly relatively moderate, with 0.06 to 0.18 SD for the *Hauptschule*, *Realschule*, and two-track school samples (Table 4.5, rows 2-4). In terms of the results for the two-track schools, even if the coefficients for reading and science are not statistically significant, the gaps observed in the very important competencies of math and ICT are not smaller compared to other institution types. With a range of 0.20 to 0.30 SD, some of the estimates are larger at the *Gymnasium* and comprehensive schools (Table 4.5, rows 5 and 6). There is no evidence of comprehensive schools reducing the socioeconomic status gap compared to other school types; if anything, the disparity is slightly bigger at these institutions.

Table 4.5

Socioeconomic Status Gaps in Cognitive Achievement: Regression Results by Outcome and School Type (FE Models)

	Hauptschule	*Realschule*	Two-track school	Comprehensive school	*Gymnasium*
Std. test score, math	0.113**	0.089**	0.175**	0.293***	0.200***
	(0.037)	(0.031)	(0.067)	(0.049)	(0.031)
Std. test score, reading	0.110**	0.073**	0.043	0.188**	0.179***
	(0.051)	(0.037)	(0.082)	(0.061)	(0.027)
Std. test score, science	0.149**	0.168**	0.077	0.277***	0.153***
	(0.056)	(0.040)	(0.074)	(0.055)	(0.028)
Std. test score, ICT	0.099**	0.066**	0.153**	0.173**	0.111***
	(0.045)	(0.037)	(0.093)	(0.062)	(0.029)
Observations	2,097	2,215	660	1,084	4,049
Number of groups	177	101	55	55	148

Note: Regression coefficients for parental education from school fixed-effects regressions. Robust standard errors in parentheses.
Source: NEPS SC4 10.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

For the interpretation of these results, however, it is important to note that the range of variation in test scores is higher at comprehensive schools than at other school types, due to the diverse student populations these campuses tend to have. This may be one explanation for the larger effect of parental education. At the *Hauptschule* and the *Realschule,* students are more homogenous and thus already selected on the outcomes, leaving less room for socioeconomic background to matter.

Therefore, while conducting a comparison is problematic, the results provide evidence that SES gaps remain at multi-track schools. There are also substantial differences in student achievement by school type, as presented in Table 4.3 in the previous section.

4.6.2 Socioeconomic Status Gaps in the Attainment of the Intermediate Certificate and the Transition to Upper Secondary Education at Multi-Track Schools

The estimates in column 2 of Table 4.6 stem from school fixed-effects linear probability regressions of the described outcome variable on a dummy variable for high socioeconomic status (model 1). The raw SES gap stands at 0.10 for students at two-track schools (Table 4.6, row 1, model 1), and at 0.16 for students at comprehensive schools (Table 4.6, row 1, model 1); in other words, students with at least one parent who has an *Abitur* are 10 percentage points more likely to earn the intermediate certificate or transition to upper-secondary education at two-track schools, and 16 percent more likely at comprehensive schools. This reveals that youth from more privileged backgrounds are significantly more likely to earn an intermediate certificate or transition into upper-secondary education. In the next step, the decomposition of primary and secondary effects reveals that secondary effects are bigger.

Table 4.6

Relationship Between Parental Education and Attainment of Intermediate Certificate/ Transition to Upper Secondary Education (FE Model)

	Two-track school			Comprehensive school		
	(1)	(2)	(3)	(1)	(2)	(3)
High SES	0.099**	0.106**	0.085**	0.157***	0.159***	0.114***
	(0.037)	(0.039)	(0.039)	(0.022)	(0.023)	(0.017)
Conscientiousness	No	No	Yes	No	No	Yes
Teacher recommendation, grade 4	No	No	Yes	No	No	Yes
German grade	No	No	Yes	No	No	Yes
Math grade	No	No	Yes	No	No	Yes
Reading test score	No	No	Yes	No	No	Yes
Math test score	No	No	Yes	No	No	Yes
Science test score	No	No	Yes	No	No	Yes
ICT test score	No	No	Yes	No	No	Yes
Migration background	No	Yes	Yes	No	Yes	Yes
Male	No	Yes	Yes	No	Yes	Yes
Observations	745	745	745	1,207	1,207	1,207
Number of groups	55	55	55	55	55	55

Note: Regression coefficients for parental education from school fixed-effects linear probability regressions. Robust standard errors in parentheses.
Source: NEPS SC4 10.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

In addition to looking at raw socioeconomic status gaps in transition probabilities, I also investigate SES gaps net of school and academic performance, as measured by differences in grades and test scores. This conditional gap expresses any differences that originate from socioeconomic status differences after controlling for academic performance, and can thus be interpreted as secondary effects; i.e., effects that refer to differences in educational choices made by families from varying social backgrounds, even if children exhibit similar academic achievement. The results presented in columns 4 and 7 of Table 4.6 reveal that gender and migration background do not affect the estimated high SES coefficients (model 2), while grades and test scores reduce it (model 3).

Performance differences account for about one third of the socioeconomic status gap at comprehensive schools, and for about one sixth at two-track schools. This indicates that secondary effects are substantially larger than primary effects at multi-track schools and comprehensive schools. Even conditional on grades, test scores, gender, and migration background, children with at least one parent who has an *Abitur* are significantly more likely to earn an intermediate certificate or transition into upper-secondary education at two-track schools and comprehensive schools (8.5 and 11 percentage points, respectively; Table 4.6, row 1, columns 4 and 7).

It has to be kept in mind that confidence intervals are fairly large for the two-track school estimates; for the comprehensive school estimates, however, they are much smaller. Since we are dealing with small sample sizes and imprecise estimates, it is appropriate to be cautious regarding the magnitude of the identified socioeconomic status effects. However, these results do suggest that SES gaps persist at secondary multi-track schools in Germany when it comes to the attainment of the *Realschule* certificate and the transition to upper secondary school.

4.7 Discussion and Conclusion

In this paper, I examined the association between socioeconomic background and the attainment of the intermediate-secondary certificate and the transition to upper secondary education in multi-track schools in Germany, and whether there are differential effects at the two-track schools versus comprehensive schools. My results indicate that socioeconomic status gaps certainly exist at secondary multi-track schools; children from less-privileged backgrounds are significantly less likely to earn an intermediate certificate or transition into upper secondary education. I also examined socioeconomic status gaps in children's cognitive achievement as measured by math, reading, science, and ICT test scores. Here, my findings provide evidence

that such disparities in cognitive achievement, as measured by math, reading, science, and ICT test scores, exist within all school types, including multi-track and comprehensive schools.

Several limitations have to be noted. First, the results are purely descriptive in nature. Second, it has to be kept in mind that the sample size is relatively small for some subgroups; thus, some estimates are imprecise. The research questions require information from panel data to answer them, and panel attrition has been an issue with the NEPS data. Despite these limitations, though, the results of my empirical analyses provide descriptive insights in terms of socioeconomic gaps in the attainment of the intermediate-secondary certificate and the transition to upper secondary education in multi-track schools in Germany, as well as disparities in students' cognitive achievement in grade nine within all school types.

My results are yet another reminder that it is important to examine both primary and secondary effects when studying the association between socioeconomic background and educational attainment, in order to tailor policy interventions accordingly. Results of my second analysis demonstrated that, even conditional on grades, test scores, gender, and migration background, children of lower socioeconomic background are significantly less likely to earn an intermediate certificate or transition into upper-secondary education. In terms of policy conclusions, a reduction of educational inequalities could therefore possibly be achieved if schools provided more information and targeted resources to students and parents. For example, through a recent evaluation of the *Balu und Du* mentoring program offered in primary schools (similar to Big Brothers Big Sisters in the U.S., university students act as mentors), Falk et al. (2020) provide causal evidence that students from disadvantaged socioeconomic backgrounds who were randomly assigned to a mentor for one year were 20 percent more likely to enter a high-track program in grade five.

Overall, we can only speculate about what effects would be expected if comprehensive schools did not coexist with other institutions, but rather were the only type of school for all students in Germany. As more states have moved towards two-pillar systems, large-scale studies should be implemented to understand the consequences of these structural reforms on social inequalities, as information about the two-pillar systems is still anecdotal (Becker at al., 2016). This research should be conducted at the state level, since substantial differences in the implementation of the reforms exist. It remains to be seen if the two-pillar models can reduce some of the inequalities present in the traditional three-tier system.

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Chapter 5: Conclusion

After the 2018 PISA results were announced in December of 2019, the Federal President of Germany Frank-Walter Steinmeier demanded a greater commitment and effort from politicians and policymakers to finally create greater educational equality in Germany. As he said: “In Germany, it is still often…the social background that determines the educational opportunities of children, more than in other industrial nations. The latest PISA study proves this again.” Steinmeier added, “There is hardly a field of politics in which speaking and acting diverge so much. (...) We have to reduce these inequalities, and that is a task that schools cannot do alone” (Office of the Federal President, 2019). In 2008, the then-Federal President of Germany Horst Köhler made similar remarks in reaction to another round of PISA results: “It is shameful, how often the background of a person burdens his or her future in the German education system” (Office of the Federal President, 2008). Tellingly, nearly the same words were spoken 11 years apart. There has certainly been a good deal of “talk” about reducing inequalities in the German education system, and the secondary-school system in Germany has indeed undergone major changes in the last two decades. Many of the reforms described in Chapters 3 and 4 were implemented with the communicated goal of reducing social disparities.

All of the described educational reforms and resultant changes, however, did not challenge the fundamental structure of the traditional German school system: the existence of a highest-track school (*Gymnasium*) in all states remains unchanged, as does early tracking (after grade four in most states, or after grade six, in some cases). The two-pillar system is one in which the *Gymnasium* coexists with another type of school for the remaining students who did not transition to a *Gymnasium*. Currently, several states still have multi-tier systems in place. The

first transition in the German secondary-school system, therefore, remains very important for students' educational trajectories.

In my first paper, I examined whether an early school-entry age can be viewed "as a randomly allocated disadvantage concerning track choice" (Mühlenweg & Puhani, 2010, p. 409), and whether there are differential effects based on students' gender and socioeconomic background. I find that children who comply with the school-entry rule and are among the oldest in their class are 10 to 15 percentage points more likely to receive a high track recommendation from their teachers, and to actually attend a high-track school, than the students who comply with the rule and are among the youngest in their class. In terms of relevant policy implications of my research findings, most importantly, my results for a recent school-starting cohort provide evidence that teachers do not seem to take age differences into account when making their recommendations.

Track recommendations should be based on teachers' assessment of future academic performance and potential. Knowing that relative age effects usually fade away over the duration of schooling, the identified relative age effect on teachers' recommendations at the end of grade four and actual track choice in grade five reveals an avoidable inequality of access in the German school system. Considering the long-term implications of track choice, this paper therefore contributes to a much broader set of conversations about the fundamental structure of the German school system: Should Germany abandon the early-tracking system entirely, or at least postpone tracking until a much later point in students' lives? Could social disparities possibly be reduced this way? Extensive research has documented the strong correlation between a student's socioeconomic background and their secondary-school track choice at the central transition from primary to secondary education (e.g., Dustmann, 2004; Stocké, 2007; Tamm, 2008; Dumont et

al., 2014; Falk et al., 2020). My results provide another reason for policymakers to be concerned about the status quo. Eliminating or postponing tracking could be a strategy to reduce educational inequalities due to relative age effects, and make the education system more efficient.

In view of the results of my second paper, eliminating tracking altogether could also reduce the possibility of school-type effects for holders of the same school certificate in the transition to vocational training. As long as tracking remains, though, it will be crucial to conduct further studies to gain insights into the interaction effects of school type and certificate earned on transition chances, including whether there are discrediting or discriminatory processes at work with employers in terms of the type of school attended. The use of experiments is especially promising in this regard. One such example is the correspondence experiment conducted by Penny and Nüß (2019), which was used to study ethnic discrimination in the hiring market for apprenticeships in Germany. Furthermore, though short-term outcome findings, as presented in my paper, are helpful, longer-term outcomes should be studied to understand how the type of school a person attends affects their long-term labor-market outcomes.

The results of my third paper provide further descriptive evidence of social inequalities in the German school system; socioeconomic status gaps in cognitive achievement exist within each of the different school types, and students from privileged backgrounds are significantly more likely to earn an intermediate certificate or transition into upper-secondary education at multi-track schools. While the introduction of one comprehensive school for all students is not politically palatable in Germany at the moment, many states have moved to the two-pillar model; it remains to be seen if that model can reduce some of the inequalities that were present in the traditional three-tier system. In this regard, further research on the effects of structural reforms,

which led states to shift from three-tier systems to two-tier systems, needs to be conducted. It would be particularly relevant to conduct research on how the reforms are affecting social selectivity in the acquisition of secondary certificates and transition to upper secondary education. The results of my third paper suggest that it is important to analyze and differentiate between primary and secondary effects, in order to be able to tailor policy responses accordingly. Large-scale studies should be conducted at the state level, since there are substantial differences among states in the implementation of the structural reforms.

Finally, in view of Germany's future need for well-qualified skilled workers, reducing educational inequalities is also an economic necessity. This is not only important in terms of retaining talent, but it is also critical for reasons of social cohesion and social mobility—in working towards a society where citizens feel fairly treated. In worrying developments over the past years, the far-right populist Alternative for Germany (AfD) party has gained in popularity, even winning seats in state parliaments and the national parliament (*Bundestag*). The COVID-19 pandemic has also made social inequalities more apparent. Children growing up in less-privileged families are experiencing the most disadvantages from school closures and the shift towards online learning, for which many are not sufficiently equipped. While social inequalities in education may never be completely eliminated, there are school systems around the world in which the association between family socioeconomic background and student achievement is considerably weaker than in Germany. Unfortunately, with respect to attitudes in Germany regarding fundamentally changing the existing secondary-education system in favor of comprehensive schools, "The difficulty lies, not in the new ideas, but in escaping from the old ones" (in the words of John Maynard Keynes, 1936, p. vii).

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Appendix A: Cutoff Dates for School Entry by State

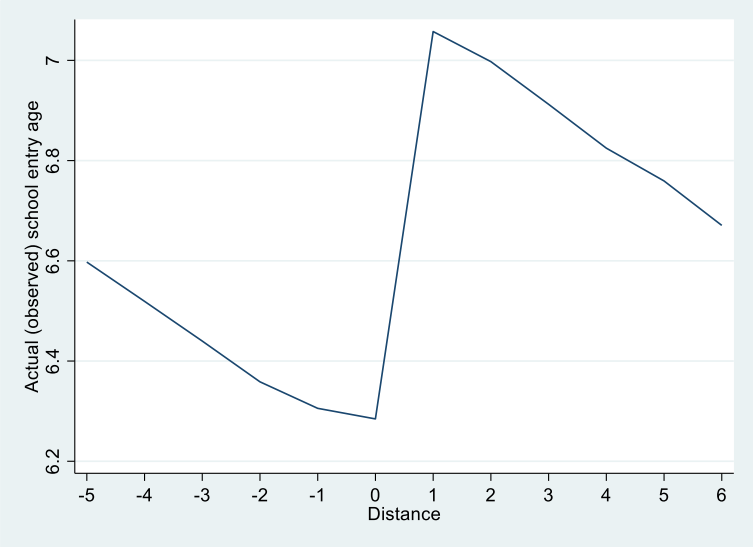
	Legally determined cutoff dates relevant for Starting Cohort 4 of NEPS data (entered school in 2001 and 2002)	Legally determined cutoff dates relevant for Starting Cohort 2 of NEPS data (entered school in 2012)
Baden-Württemberg	June 30	September 30
Bavaria	June 30	September 30
Berlin	June 30	December 31
Brandenburg	June 30	September 30
Bremen	June 30	June 30
Hamburg	June 30	June 30
Hesse	June 30	June 30
Lower Saxony	June 30	September 30
Mecklenburg-Vorpommern	June 30	June 30
North Rhine-Westphalia	June 30	September 30
Rhineland-Palatinate	June 30	August 31
Saarland	June 30	June 30
Saxony	June 30	June 30
Saxony-Anhalt	June 30	June 30
Schleswig-Holstein	June 30	June 30
Thuringia	June 30	July 31

Source: Germany's National Education Report 2012.

Appendix B: Additional Tables and Figures

Figure B.1

Actual (observed) school-entry ages by distance from cutoff for 2001/2002 starting cohorts (ninth graders in 2010)



Note: Data from NEPS SC4 10.0.0, author's calculations and graphic.

Table B.1

The effect of the instrument on actual school starting age (first-stage estimates) - track recommendation and track choice sample (2-months window)

	2001/2002 Starting Cohorts
	Track recommendation/Track choice Sample
Assigned school starting age	9.24***
	(0.251)
Covariates	Yes
R-squared	0.59
F-Statistic	104.93
Observations	892

Note: Robust standard errors are in parentheses. Covariates include gender, migration background, highest level of parental school education, state of primary school enrollment.
Source: NEPS SC4 10.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.0

Table B.2

The effect of relative age and birth month on teacher track recommendation and track choice in grade nine, 2001/2002 starting cohorts

	Starting cohorts 2001/2002			
	2-months window	All months	2-months window	All months
	Track recommendation		Track choice grade 9	
A. Reduced form				
Assigned school starting age	0.069**	0.058**	0.039	0.018
	(0.033)	(0.026)	(0.032)	(0.026)
Observations	892	5,595	892	5,595
B. IV Coefficients				
Observed school starting age	0.008**	0.006**	0.004	0.002
	(0.004)	(0.003)	(0.004)	(0.003)
Further covariates	yes	yes	yes	yes
Observations	892	5,595	892	5,595

Note: Robust standard errors are in parentheses. Additional covariates include gender, migration background, highest parental school education, the state of primary school enrollment, and year of enrollment.
Source: NEPS SC4 10.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

Table B.3

Transition into fully qualifying vocational training (LPM), Subsample 1 and 2 combined

	Transition into vocational training
School certificate reference: lower secondary (*Hauptschule)* certificates	
Intermediate (*Realschule*) certificate	0.192***
	(0.032)
Interaction school certificate x school type (Ref. not H*auptschule)*	
Realschule certificate x *Hauptschule* school	-0.101**
	(0.043)
School type	yes
GPA on final certificate/Grades in school	yes
Cognitive and non-cognitive skills	yes
Gender, Migration background and year of birth	yes
Family background and social capital	yes
Local labor market	yes
States	yes
R-squared	0.094
Observations	3,767

Note: Linear probability model estimations. Standard errors in parentheses clustered by school attended in grade 9.
Source: NEPS SC4 10.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

Table B.4

Transition into Fully Qualifying Vocational Training (Logistic Regressions, Average Marginal Effects) for Realschule Certificate Graduates

	(1)	(2)	(6)
School type, reference: *Hauptschule* school			
Realschule	0.100**	0.080**	0.071**
	(0.029)	(0.029)	(0.029)
Merged *Haupt-/Realschule*	0.087**	0.033	0.028
	(0.043)	(0.042)	(0.041)
Comprehensive school	0.101**	0.099**	0.091**
	(0.040)	(0.044)	(0.042)
Gymnasium	0.111	0.104	0.091
	(0.079)	(0.080)	(0.079)
GPA on final certificate/Grades in school	no	no	yes
Cognitive and non-cognitive skills	no	no	yes
Gender, Migration background and year of birth	no	no	yes
Family background and social capital	no	no	Yes
Local labor market	no	yes	yes
States	no	yes	yes
Observations	2,260	2,260	2,260

Note: Average marginal effects of logistic regressions. Standard errors in parentheses clustered by school attended in grade 9.
Source: NEPS SC4 10.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

Table B.5

Transition into Fully Qualifying Vocational Training (LPM), Subsample 1: Realschule Certificate Students

	Transition into vocational training
School type, reference: *Hauptschule* school	
Realschule	0.074**
	(0.030)
Merged *Haupt-/Realschule*	0.032
	(0.040)
Comprehensive school	0.096**
	(0.044)
Gymnasium	0.096
	(0.084)
Male	0.044**
	(0.021)
Migration background	-0.096***
	(0.024)
Highest ISEI, parents	0.001
	(0.001)
Parental highest level of education (Ref.: *Hauptschule* certificate [with VET] or less)	
Realschule certificate (with VET)	0.059**
	(0.021)
Abitur certificate (with VET)	0.029
	(0.030)
Books in household	0.014
	(0.008)
Social capital—access to information about VET through network	0.081**
	(0.032)
GPA on final certificate/Grades in school	Yes
Cognitive and non-cognitive skills	Yes
Year of birth	Yes
Local labor market	Yes
States	Yes
Observations	2,260

Note: Linear probability model estimations. This table reports results from estimating equation 1.4 on the data. Standard errors in parentheses clustered by school attended in grade nine.
Source: NEPS SC4 10.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

Table B.6

Socioeconomic Status and Prestige of Vocational-Training Position (OLS): Subsample 1 and 2 Combined

	Prestige of the training position	SES of the training position
School certificate reference: lower-secondary (*Hauptschule)* certificates		
Intermediate (*Realschule*) certificate	2.96*** (0.765)	6.19*** (1.035)
School type	yes	yes
GPA on final certificate/Grades in school	yes	yes
Cognitive and non-cognitive skills	yes	yes
Gender, migration background, and year of birth	yes	yes
Family background and social capital	yes	yes
Local labor market	yes	yes
States	yes	yes
R-squared	0.12	0.22
Observations	2,185	2,185

Note: OLS estimations. Standard errors in parentheses clustered by school attended in grade nine.
Source: NEPS SC4 10.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

Table B.7

Transition into Fully Qualifying Vocational Training (Hauptschule Subsample Analysis, Logistic Regression, Average Marginal Effects)

	(1)	(2)	(6)
School certificate, reference: *Realschule* certificate			
Hauptschule simple certificate	-0.146***	-0.103**	-0.093**
	(0.033)	(0.035)	(0.040)
Hauptschule qualified certificate	-0.021	-0.037	0.047
	(0.034)	(0.036)	(0.038)
GPA on final certificate/Grades in school	No	No	Yes
Cognitive and non-cognitive skills	No	No	Yes
Gender, migration background, and year of birth	No	No	Yes
Family background and social capital	No	No	Yes
Local labor market	No	Yes	Yes
States	No	Yes	Yes
Observations	1,649	1,649	1,649

Note: Average marginal effects of logistic regressions. Standard errors in parentheses clustered by school attended in grade nine.
Source: NEPS SC4 10.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01

Table B.8

Transition into Fully Qualifying Vocational Training (LPM), Subsample 2: Hauptschule Students

	Transition into vocational training
School certificate, reference: *Realschule* certificate	
Hauptschule simple certificate	-0.093**
	(0.041)
Hauptschule qualified certificate	0.048
	(0.039)
Male	0.087**
	(0.028)
Migration background	-0.131***
	(0.024)
Highest ISEI, parents	0.001
	(0.001)
Parental highest education level (Ref.: *Hauptschule* certificate with VET or less)	
Realschule certificate (with VET)	0.057*
	(0.033)
Abitur certificate (with VET)	-0.004
	(0.041)
Books in household	0.012
	(0.010)
Social capital—access to information about VET through network	0.043
	(0.029)
GPA on final certificate/Grades in school	Yes
Cognitive and non-cognitive skills	Yes
Year of birth	Yes
Local labor market	Yes
States	Yes
Observations	1,649

Note: Linear probability model estimations. This table reports results from estimating equation 1.5 on the data. Standard errors in parentheses clustered by school attended in grade nine.
Source: NEPS SC4 10.0.0, author's calculations.
*p < 0.1, **p < 0.05, ***p < 0.01