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# The role of school composition in educational attainment: evidence from Austrian register data

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## ABSTRACT

This study investigates how the socioeconomic composition of lower secondary schools in Austria's highly tracked education system is associated with students' subsequent educational attainment. Drawing on comprehensive register data, we examine whether students with comparable starting conditions follow different trajectories depending on school context. We find strong and persistent composition effects: attending a socially disadvantaged school is linked to a lower likelihood of Matura attainment (university entrance qualification) and a higher likelihood of early school leaving, even after accounting for prior achievement, school type, and family background. These effects are more pronounced for positive outcomes and for lower-SES students. Analyses further reveal that students from privileged backgrounds retain high educational success probabilities across contexts, while disadvantaged students are doubly burdened – by selection into less favourable schools and by heightened sensitivity to composition. Our findings highlight the lasting influence of school context and call for policies that reduce social segregation in education.

## ARTICLE HISTORY

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## KEYWORDS


School composition; educational attainment; tracking; register data; Austria

## 1. Introduction

The relationship between individual background and educational attainment is well established, with extensive literature demonstrating that student performance is strongly influenced by socioeconomic status (SES). Additionally, disparities are amplified by differences in school-level student composition. Austria stands out with particularly high socioeconomic segregation among OECD countries (Gruber 2019). For example, Gutiérrez, Jerrim, and Torres (2020) found that approximately 41% of lower secondary students would need to change schools to achieve an equal distribution of advantaged and disadvantaged peers, suggesting that many Austrian students are effectively segregated by social background – an issue compounded by Austria's early tracking system.

While previous studies demonstrate clear correlations between school composition and academic performance (Biedermann et al. 2016; Schnell 2022; Wroblewski 2012), evidence

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on how socioeconomic school context affects subsequent educational trajectories in Austria remains limited. Notable exceptions typically rely on cross-sectional surveys or standardised tests, focusing only on outcomes at a single time point. Similar gaps exist internationally, as evidence on how early school environments shape later educational attainment remains comparatively scarce. By analysing the Austrian case – characterised by early tracking and social stratification – this study contributes to comparative research on how institutional contexts shape the link between school composition and life-course inequalities. It thus offers insights relevant beyond Austria into how stratified education systems reproduce social disparities and influence long-term educational trajectories.

This paper expands the literature in three ways. First, we adopt a dynamic perspective covering the entire lower secondary period. Second, we move beyond immediate learning outcomes to examine school SES effects on longer-term educational attainment. Third, we address how composition effects vary across socioeconomic backgrounds.

To achieve these aims, we use a novel longitudinal register dataset that links students' educational records with rich information on family background and school contexts. Our primary objective is to analyse whether students with comparable socioeconomic backgrounds and school performance histories experience different educational trajectories depending on the socioeconomic composition of the lower-secondary schools they attended. Using multivariate logistic regression models with individual-level contextual exposure measures and selected individual and school-level controls, we examine how socioeconomic composition influences two key outcomes: early school leaving and Matura attainment (Austria's university entrance qualification). In addition to presenting average marginal effects, we illustrate how combinations of family and individual characteristics translate into school placement and outcomes through four student prototypes. These profiles represent contrasting levels of social (dis)advantage and reflect enduring patterns of educational inequality.

Beyond its academic contribution, this study informs public discourse on educational equity. Schools characterised by concentrated disadvantages occupy a prominent position in media and policy debates. Given that student composition is closely linked to equal opportunity, our findings guide targeted policy interventions to promote greater educational equity.

The remainder of the paper is structured as follows. [Section 2](#) reviews the extant empirical findings, the mechanisms underlying composition effects, and the Austrian education system. [Section 3](#) details the data and methodology employed in our study. [Section 4](#) presents descriptive statistics and regression results, and [Section 5](#) concludes with a discussion of limitations and implications.

## **2. Background**

### ***2.1. Previous research***

The role of school composition in shaping educational outcomes has been a long-standing topic in educational research (Coleman et al. 1966; Mayer and Jencks 1989). Numerous studies show that attending schools with more socioeconomically advantaged peers is linked to better academic outcomes, independent of students' own background (Tan et al. 2025; van Ewijk and Slegers 2010). Large-scale assessments like PISA, TIMSS, and PIRLS provide

robust comparative evidence (Caro and Mirazchiyski 2012; OECD 2010, 2023; Sciffer, Perry, and McConney 2022; Willms 2010).

While the relationship between school composition and learning outcomes is well documented, fewer studies examine its role for attainment, such as school completion or academic track access. Emerging evidence suggests that peer composition shapes not just achievement, but aspirations and decisions (Glauser, Busse, and Scharenberg 2026; Palardy 2020; Rosenqvist and Brandén 2025; Smith 2023). For example, Rosenqvist and Brandén (2025) demonstrate that students in Sweden are more likely to pursue an academic path when surrounded by peers with highly educated parents.

Evidence from Austria is limited. Existing studies mostly use cross-sectional data, focusing on learning outcomes. Biedermann et al. (2016), for example, found substantial but weak effects of classroom composition on Math performance. A recent contribution by Schnell (2022) identified a pronounced impact of school composition in socially deprived primary schools. Additionally, national analyses of Austrian PISA and PIRLS data largely confirmed international findings on effects of social and/or ethnic compositions (Bacher 2010; Eder and Dämon 2012; Schneeweis and Winter-Ebmer 2007; Wroblewski 2012). To our knowledge, however, no empirical work exists on the study of SES composition effects during lower secondary education on later attainment – likely due to limited data availability, which until recently made such longitudinal studies impossible.

Research on heterogeneity in composition effects is also limited and often context-specific, yielding mixed findings. Some studies suggest high-SES students benefit most from attending high-SES schools (Crosnoe and Muller 2014; Klugman and Lee 2019), while others indicate stronger gains for low-SES students (Rosenqvist and Brandén 2025; Strømme 2020). These divergent results highlight the importance of moving beyond average effects to examine how composition affects students differently – particularly within stratified education systems.

Finally, some scholars have questioned the robustness of composition effects, citing methodological issues such as measurement error and model misspecification (Marks 2015; Zhou and Ma 2023). We acknowledge these debates and address limitations transparently in our study.

## **2.2. Mechanisms explaining the link between peer composition and educational attainment**

The pathways linking peer composition and educational outcomes are multifaceted, operating at both individual and institutional levels. This study focuses on direct effects arising from the social environment created by schoolmates, and how these may vary across socioeconomic groups. While our analysis is observational and does not allow for causal inference, this section outlines key conceptual mechanisms to interpret the observed associations.

The most direct mechanisms are peer effects – how peers' attitudes, behaviours, and academic orientations influence individual students (Sacerdote 2011). High-SES schools often foster achievement-oriented climates through shared norms, supportive home environments, and high parental expectations. On the contrary, schools with concentrated disadvantage may lack such reinforcement, potentially reducing academic engagement

(Gröhlich, Scharenberg, and Bos 2009; Wilkinson 2002). Recent studies also emphasise the heterogeneity of peer effects (Patacchini, Rainone, and Zenou 2017).

Two specific mechanisms help conceptualise how peer effects may operate. First, *contagion* suggests that students adopt aspirations and behaviours shaped by peer norms. In high-SES schools, these norms often promote ambition (Legewie and DiPrete 2012). However, their influence may not be evenly distributed across student groups (Rosenqvist and Brandén 2025). Disadvantaged students, lacking similar support at home, may benefit more from exposure to such environments. On the other hand, such compensatory effects may be limited, as low-SES students may struggle to access or integrate into academically advantaged peer networks due to segregated social interactions (Cherng, Calarco, and Kao 2013; Malacarne 2017).

Second, *social comparison* suggests students assess their standing relative to peers, shaping aspirations and confidence. While students who are expected to be high-achievers – often those from high-SES families – may experience discouragement in competitive settings (Murphy and Weinhardt 2020), lower-SES students may be less affected or even motivated by their relative standing, resulting in potential compensatory outcomes (Rosenqvist and Brandén 2025).

Beyond peer effects, institutional mechanisms also matter. School composition shapes not only social climates but also the institutional resources, expectations, and opportunities available to students. More advantaged schools tend to attract better-qualified teachers, experience lower staff turnover, and maintain more positive learning climates (Muijs et al. 2014; Tan et al. 2025). They also benefit from greater parental involvement and stronger linkages to academic upper-secondary or higher-education pathways (Park, Stone, and Holloway 2017). Conversely, schools in socially disadvantaged areas often face teacher shortages and higher turnover (Klusmann and Richter 2014; Treptow and Rothland 2005), as well as resource constraints, reduced curricular breadth, and lower expectations, which may narrow students' later opportunities even when individual ability or motivation is high (Reynolds et al. 2014). These institutional advantages and disadvantages can compound over time through tracking decisions, teacher recommendations, and differential access to information about educational options.

Together, peer and institutional mechanisms operate jointly to produce durable inequalities, with early school composition shaping both immediate learning contexts and the longer-term educational trajectories that follow.

### **2.3. Austrian context and school system**

Austria's education system is characterised by early selection and strong institutional tracking (Herzog-Punzenberger and Schnell 2019; OECD 2025). After four years of primary education, students are sorted into one of two lower secondary school types: the *Allgemeinbildende Höhere Schule (AHS)*, an academically selective track preparing for university, and the *Mittelschule* (formerly *Hauptschule* or *Neue Mittelschule*), a generalist track attended by about two-thirds of students. Placement largely depends on teacher recommendations and parental preferences, though regional norms and school availability also influence choices (BMBWF 2024; Statistics Austria 2025).

The *AHS* is structurally and symbolically more prestigious, admitting higher-performing students, employing better-qualified teachers, and offering a more academic curriculum. On

the contrary, the *Mittelschule* serves a more socioeconomically diverse population. Although intended to reduce stratification – since all educational pathways technically remain open – inequalities persist into upper secondary education. Most AHS students progress to the upper level of AHS or to five-year vocational schools (*BHS*), both of which lead to the Matura, Austria's university entrance qualification. On the contrary, only 40% of students from the general track transition to upper secondary schools that lead to the Matura. The majority instead attend shorter VET programs or enter the dual system, combining apprenticeships with part-time schooling (Statistics Austria 2025). While this system is well-regarded for labour market integration, it does not provide direct university access, and second-chance routes like the *Berufsreifeprüfung* remain rare and socially selective (Graf 2016; Lassnigg 2011).

Austria's system features not only vertical but also horizontal stratification within the VET sector. Upper secondary VET schools vary widely in curriculum, duration, specialisation, and qualifications, significantly shaping students' long-term prospects. Pathways are often complex and rigid, with limited permeability across tracks. Social background remains a key determinant: students from lower-SES families and those with immigrant backgrounds are overrepresented in lower-track schools or exit education early (OECD 2025; Schnell and Gruber 2023). Austria ranks among the OECD countries with the highest levels of social and ethnic segregation in schooling. Existing literature shows that roughly 40% of lower-secondary students would need to change schools to achieve an even social mix – a level of segregation well above the European average (Biedermann et al. 2016; Gutiérrez, Jerrim, and Torres 2020). These divides are particularly pronounced in urban areas, where *Mittelschulen* increasingly concentrate students from low-income and immigrant families (Herzog-Punzenberger and Schnell 2019; Schnell and Gruber 2023). Unlike many countries, private schools play a minor role in Austria, accounting for only about 8% of schools (BMBWF 2024; Statistics Austria 2025).

### 3. Data and methods

#### 3.1. Data

Our analyses draw on comprehensive Austrian register data, including school statistics, higher education data, and employment histories, to map the educational careers of all students in the 2006/07 school entry cohort over 16 years (2006/07 to 2021/22). These data are enriched with contextual and background information from social insurance, unemployment statistics, and census-based data.

The initial sample comprises all individuals enrolled in Austrian schools during the 2013/14 academic year who were 13 years<sup>1</sup> old on September 1, 2013 ( $N = 83,457$ ). This reference point was chosen because it marks the first availability of full background data and includes students who entered the Austrian school system after first grade (i.e. first generation immigrants). Using age rather than grade allows us to account for early selection effects such as early/late enrolment or grade repetition.

To refine the sample and ensure analytic validity, we exclude:

- Students with special educational needs (3+ years in special schools), as most exit education after compulsory schooling ( $N = 2,776$ ).
- Individuals with conflicting school entries in at least four years, suggesting misassigned personal identifiers ( $N = 156$ ).

- Students whose maximum age in the school statistics is 14 who never appear in labour market registers, likely due to out-migration ( $N = 339$ ).
- Students who spent most of lower secondary education in statutory schools<sup>2</sup>, whose heterogeneity in structure and pedagogy hampers interpretation ( $N = 238$ ).

This yields a final sample of  $N = 79,852$ .

The dataset also contains rich background variables: main language spoken at home, country of birth, district of residence (as of 1 September 2013), parental education, parental country of birth, parental income (2013), and daily labour market status (2011–2021). From 2011/12 onward, school-level data on student composition are available. Frequency tables and descriptive statistics for all variables are provided in the ([Online Appendix Table A1](#)). All analyses were conducted with data from the Austrian Micro Data Center (AMDC). The AMDC is a research data infrastructure facility of Statistics Austria that enables research on micro data processed in compliance with data protection regulations (Fuchs et al. 2024).

### 3.2. Methods

We define two key outcome variables:

- I. Matura attainment (university entrance qualification), including *Berufsreifeprüfungen* (which grant full access to higher education), but excluding *Studienberechtigung sprüfungen* (which only allow access to specific programs).
- II. Maximum compulsory education (ISCED 2, ISCED 3c), including graduation from polytechnic schools, transitional/orientation levels, and vocational orientation programs; excluding graduation from one-year vocational secondary schools and individuals still in education at the end of observation. This outcome corresponds to early school leaving and is referred to as such throughout the paper.

These outcomes allow us to capture both lower and upper ends of attainment, reflecting short- and medium-term effects of school composition. While longer-term outcomes (e.g. tertiary graduation, labour market success) would be valuable, most students in our sample are still in education or have only recently transitioned to work.

To assess the role of socioeconomic composition, we use the ‘Chancenindex’ [opportunity Index] developed by Schnell and Schüchner (2019). Based on earlier work (Bacher 2015; Kuschej and Schönpflug 2014), it captures school-level (dis)advantage using two key variables: parental education and the share of students with a non-German everyday language – both well-established predictors of educational inequality in Austria (Herzog-Punzenberger and Schnell 2019; Schnell and Rothmüllner 2021).

The Chancenindex is calculated annually as<sup>3</sup>:

$$100 * (1 + (1.0 * \text{Share of students with parents with only compulsory schooling} + 0.6 * \text{Share of students with parents with VET} + 0.3 * \text{Share of students with parents with Matura} + 0.0 * \text{Share of students with parents with a university degree} + 0.6 * \text{Share of students with non-German everyday language})/2)$$

The weights reflect observed performance differences between student groups in national educational assessments<sup>4</sup>. The index can assume values between 100 and 180, with higher values being indicative of greater disadvantage. A value of 100 corresponds to schools where all parents have university degrees and all students speak German in everyday life; 180 indicates all parents have no more than compulsory education and no student speaks German.

Following Schnell and Schüchner (2019), the calculated index is then divided into seven levels, based on which – following the idea of the Chancenindex, additional resources should be allocated to support students. The higher the index level, the greater the socioeconomic disadvantage, and thus also the degree of stress experienced by the school location. Schools from index level 5 onwards, but particularly those with level 6 and 7, are considered to be in a ‘socially deprived situation’, as they educate a significant proportion of students from socially disadvantaged backgrounds.

Although the Chancenindex is tailored to the Austrian context and thus limits international comparability, it is firmly grounded in extensive administrative data and aligns closely with established indicators of school disadvantage (Geweke and Edelstein 2025). This ensures both conceptual validity and practical relevance for analysing compositional effects (Radinger, Ernst, and Mayerweck 2018; Schnell and Schüchner 2019). Notably, the index has also received increasing policy attention in Austria, where it now serves as a basis for allocating additional support to a selected number of disadvantaged schools – an important first step towards its broader official adoption. To test robustness, we replicated all analyses using alternative composition indicators, such as parental education, migration background, and parental employment. Results are presented in [Online Appendix Tables A2 and A3](#).

We estimate logistic regression models with binary outcomes to examine associations between the Chancenindex and attainment. Separate models are estimated for the two outcomes – Matura attainment and early school leaving – with the Chancenindex level as the main explanatory variable. To capture students’ full lower secondary experience, we calculate an individual-level Chancenindex by averaging the index values of all schools attended between grades 5 and 8, then translating this value to the corresponding Chancenindex level used in the regression models. This measure summarises each student’s cumulative exposure to more or less advantaged school contexts rather than year-specific variation, making an individual-level approach most appropriate for our research question.

While multilevel modelling is a common strategy for analysing school effects, we rely on an individual-level approach that better fits our data structure and analytical focus. Because many students change schools between grades 5 and 8 and school identifiers are therefore not stable over time, hierarchical models would add little analytical value. The aggregated Chancenindex summarises cumulative exposure to different school contexts, allowing us to capture students’ overall lower-secondary experience while preserving the full sample size and individual-level detail. We acknowledge, however, that the absence of a multilevel specification limits our ability to decompose within- and between-school variance components. Future research with stable school or classroom identifiers could extend our approach by explicitly modelling cross-level dependencies and contextual heterogeneity.

To further isolate these associations, we include in the full model a comprehensive set of individual and contextual characteristics capturing family background and school performance: gender, main language spoken at home, place of residence, migration background, parental education, parental labour force status, parental income, pre-school enrolment, school type (academic/general track), school provider (public/private), number of school

years with excellent or good success during lower secondary education, and grade repetition. Including these variables helps account for pre-existing differences in socioeconomic background and relevant circumstances during lower secondary education that may otherwise confound associations between school composition and attainment. Descriptive statistics and detailed definitions of all control variables are provided in [Online Appendix Table A1](#).

To complement these regression analyses with an illustrative, case-centred perspective, we additionally apply a prototype approach that translates the statistical results into predicted trajectories for typical student profiles. These prototypes represent stylised combinations of individual and family characteristics reflecting common constellations of social advantage and disadvantage discussed in the sociological literature. Four prototypes were constructed by fixing key background characteristics (gender, migration background, parental education, parental employment status, and place of residence) to predefined values representing different social contexts (see [Section 4.2.3](#)). The prototypes are hypothetical profiles and therefore do not correspond to specific numbers of students in the sample.

The prototype approach follows a two-step analytical procedure. First, we estimate an ordinal logistic regression model in which the dependent variable is the ordered Chancenindex level of the school attended during lower secondary education. The independent variables include the characteristics defining the prototypes. Based on this model, we calculate the predicted probability that each prototype attends schools at each Chancenindex level. These predictions correspond to the red arrows in [Figures 7–10](#).

Second, we estimate binary logistic regression models predicting the probability of (a) attaining the Matura and (b) leaving education after compulsory schooling. These models include the Chancenindex level as the key predictor while holding the profile characteristics constant. From these models, we compute predicted probabilities of educational outcomes for each Chancenindex level and prototype. These predictions correspond to the green arrows in [Figures 7–10](#).

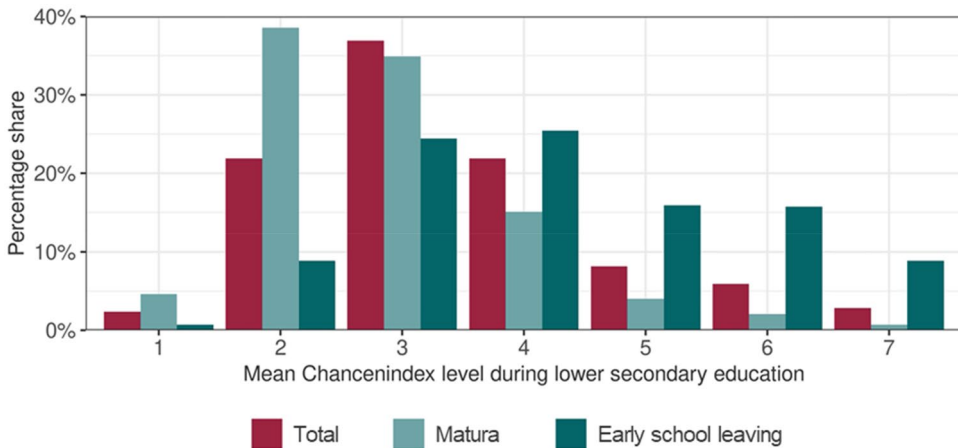
Indicators of school performance during lower secondary education (grade repetition and the number of school years with excellent or success) are included in the models but held constant at their modal values (one year with excellent/ success and no grade repetition) for all prototypes. Apart from these indicators, the models include only the characteristics defining the prototypes; all other control variables are excluded. Predicted probabilities are calculated by fixing the characteristics defining each prototype.

Finally, a key methodological challenge concerns selection bias, as students are not randomly assigned to schools and unobserved factors may influence both school composition and student outcomes. While school- or sibling-fixed effects could mitigate this, our single-cohort dataset without sibling identifiers precludes such methods. We therefore acknowledge that our findings can only identify associations, while we cannot assume a causal relationship. Still, the rich administrative data enable us to control for a wide range of background characteristics, considerably reducing the risk of omitted variable bias.

## 4. Results

### 4.1. Descriptive results

[Figure 1](#) shows the distribution of students across Chancenindex levels for the total sample (dark red), Matura graduates (seafoam green), and early school leavers (deep cyan). Over



**Figure 1.** Proportion of students per Chancenindex level (by educational outcome).

Notes: Chancenindex level is based on the average of all lower secondary schools and school years attended; N (Total) = 79,852; N (Matura) = 37,071; N (Early school leaving) = 8,117.

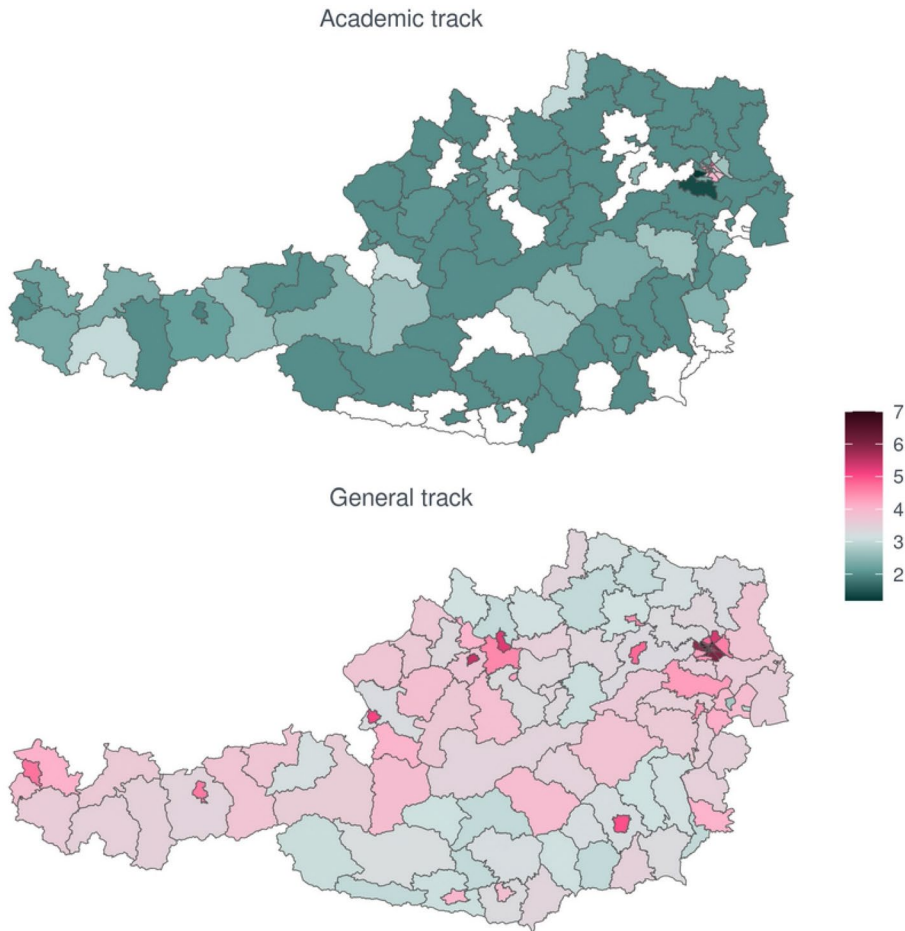
one-third (37%) of all students attended a school with Chancenindex level 3 during lower secondary education. Levels 2 and 4 were each attended by 22%, while levels 1 and 7 were the least common (2% and 3%, respectively). Levels 5 and 6 accounted for 8% and 6% of students.

Clear differences emerge by educational outcome. Among Matura graduates, 43% attended schools with Chancenindex levels 1 or 2 (low support needs), compared to just 10% of early school leavers. Conversely, 41% of early school leavers attended schools at level 5 or higher, versus only 7% of Matura graduates. This underscores a strong link between school composition and educational attainment.

Figure 2 displays the mean Chancenindex by school type and district. It reveals substantial regional variation and sharp differences between general and academic tracks. Nationwide, academic-track schools average a Chancenindex of 2.3, compared to 4.0 for general-track schools. Among academic-track schools, the lowest index levels are found in Vienna's 13<sup>th</sup> district (1.2), Mödling (1.4), and Innsbruck (1.9). The highest values – between 4.4 and 5 – are seen in Vienna's 20<sup>th</sup>, 5<sup>th</sup>, and 16<sup>th</sup> districts. Outside Vienna, the most disadvantaged academic-track schools are in Gmünd, Hallein, and Landeck. General-track schools have consistently higher Chancenindex levels across almost all districts. The lowest values are found in Eisenstadt (2.7), while districts such as Wels, Linz, Salzburg, and most of Vienna exceed 5. This highlights the strong association between school type and student composition.

#### 4.2. Regression results

Figure 3 shows predicted probabilities for the two outcomes based on the Chancenindex level, using logistic regression with no additional controls. A clear gradient emerges: the probability of Matura attainment declines sharply as the Chancenindex increases, whereas the likelihood of early school leaving rises accordingly. At index level 1, just 3% of students are predicted to leave school early, compared to 31% at level 7. In contrast, the probability of Matura drops from 90% at level 1 to 11% at level 7. The steep decline between levels 2 (82%) and 3 (44%) is especially striking, highlighting the benefits of highly favourable peer composition.



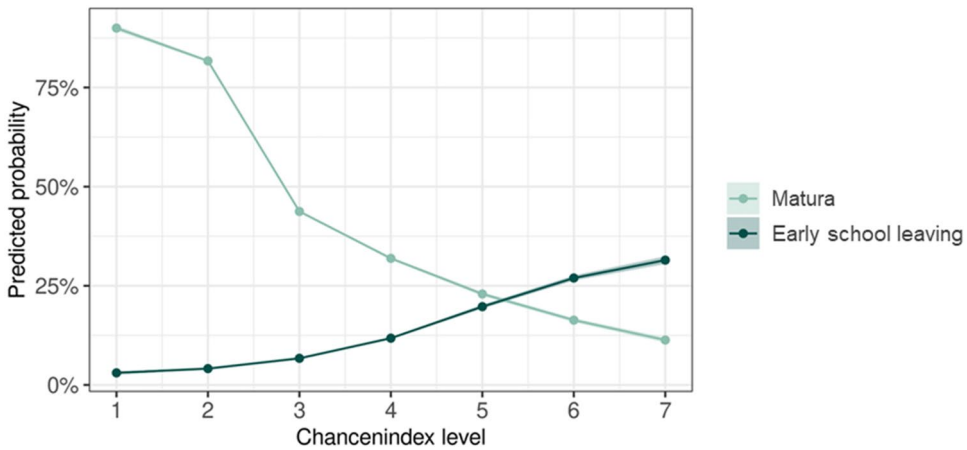
**Figure 2.** Mean Chancenindex level by school type and district.

Notes: Chancenindex level based on mean values for all lower secondary schools and school years attended by students in the sample; N (Academic track) = 102; N (General track) = 119.

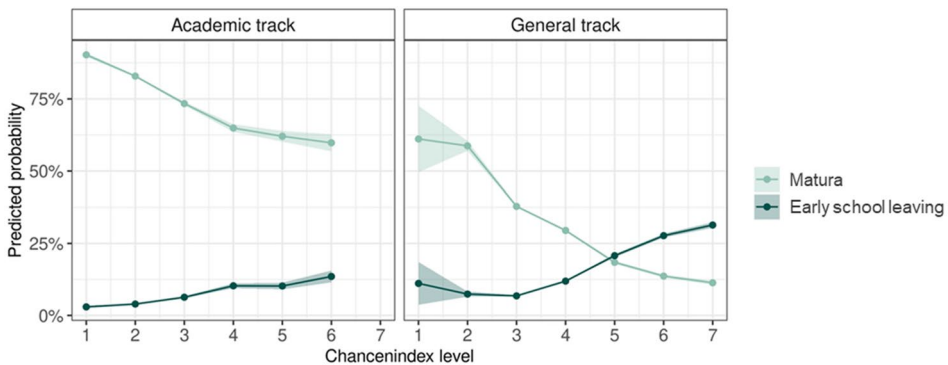
Figure 4 further breaks down the results by school type. Although the overall pattern remains – the probability of Matura declines and early school leaving increases with rising Chancenindex levels – there are notable differences between tracks. Students from academic-track schools consistently have higher probabilities of Matura attainment than those from general-track schools, regardless of index level. At level 6, for example, 59% of students from academic-track schools are predicted to attain Matura, compared to only 14% from general-track schools. Conversely, early school leaving is more prevalent in the general track, especially at higher index levels, where it exceeds the Matura probability. These results underscore the cumulative effects of school composition and early tracking on educational outcomes.

#### 4.2.1. Matura

Table 1 presents the average marginal effects of Chancenindex levels on the probability of Matura attainment across three logistic regression models. Model 1 includes only the Chancenindex (mirroring Figure 3), Model 2 adds school type, and Model 3 includes all



**Figure 3.** Predicted probabilities of attaining a Matura or of early school leaving, by Chancenindex level. Notes: Chancenindex level calculated as the average of all schools and school years attended during lower secondary education. Shaded areas indicate standard errors; N = 79,850.



**Figure 4.** Predicted probabilities of attaining a Matura or of early school leaving, by Chancenindex level and school type.

Notes: Results are based on separate models by school type. School type refers to the most frequently attended track during grades 5 to 8. The Chancenindex level is based on mean values for all lower secondary schools and school years attended. Shaded areas indicate standard errors. Due to small sample sizes, no values are shown for academic-track students at index level 7. N (Academic track) = 25,847; N (General track) = 53,908.

individual and school-level controls. For robustness, [Online Appendix Table A4](#) reports equivalent models treating the Chancenindex as a continuous variable rather than categorical.

In all models, Chancenindex levels show significant effects. However, controlling for additional variables reduces effect sizes. For instance, attending a school with index level 1 (vs. level 3) increases the Matura probability by 46 percentage points in Model 1, 25 percentage points in Model 2, and 6 percentage points in Model 3. This decline reflects the strong correlation between students' socioeconomic background and both school placement and academic success. Model 3 exhibits the best fit. Some residual variance likely stems from unmeasured factors like student competencies.

**Table 1.** Average marginal effects for Matura attainment.

	Model 1	Model 2	Model 3
<b>Chancenindex level</b>			
Level 1	0.4645*** (0.0077)	0.2526*** (0.0156)	0.0635*** (0.0144)
Level 2	0.3808*** (0.0043)	0.1252*** (0.0073)	0.0588*** (0.0060)
Level 3	<i>Reference category</i>		
Level 4	-0.1161*** (0.0048)	-0.0802*** (0.0047)	-0.0142*** (0.0037)
Level 5	-0.2072*** (0.0064)	-0.1907*** (0.0067)	-0.0653*** (0.0061)
Level 6	-0.2732*** (0.0066)	-0.2509*** (0.0077)	-0.0784*** (0.0080)
Level 7	-0.3274*** (0.0079)	-0.2989*** (0.0109)	-0.0921*** (0.0119)
<b>School type</b>			
General track	<i>Reference category</i>		
Academic track		0.3436*** (0.0060)	0.2567*** (0.0060)
Additional controls	No	No	Yes
McFadden Pseudo R <sup>2</sup>	0.1559	0.1909	0.4012
AIC	83,266.63	79,810.36	59,115.05
BIC	83,330.85	79,883.76	59,390.29
N	71,320	71,320	71,320

Notes: The table shows average marginal effects (and standard errors) of Chancenindex levels and types of school(s) attended during lower secondary education on the probability of Matura attainment. Additional controls include gender, main language spoken at home, place of residence (large city), migration background, parents' education, parents' labour force status, parents' income, pre-school enrolment, school provider (private/public), number of school years with excellent/good success during lower secondary education, and grade repetition in lower secondary education; multicollinearity was checked.

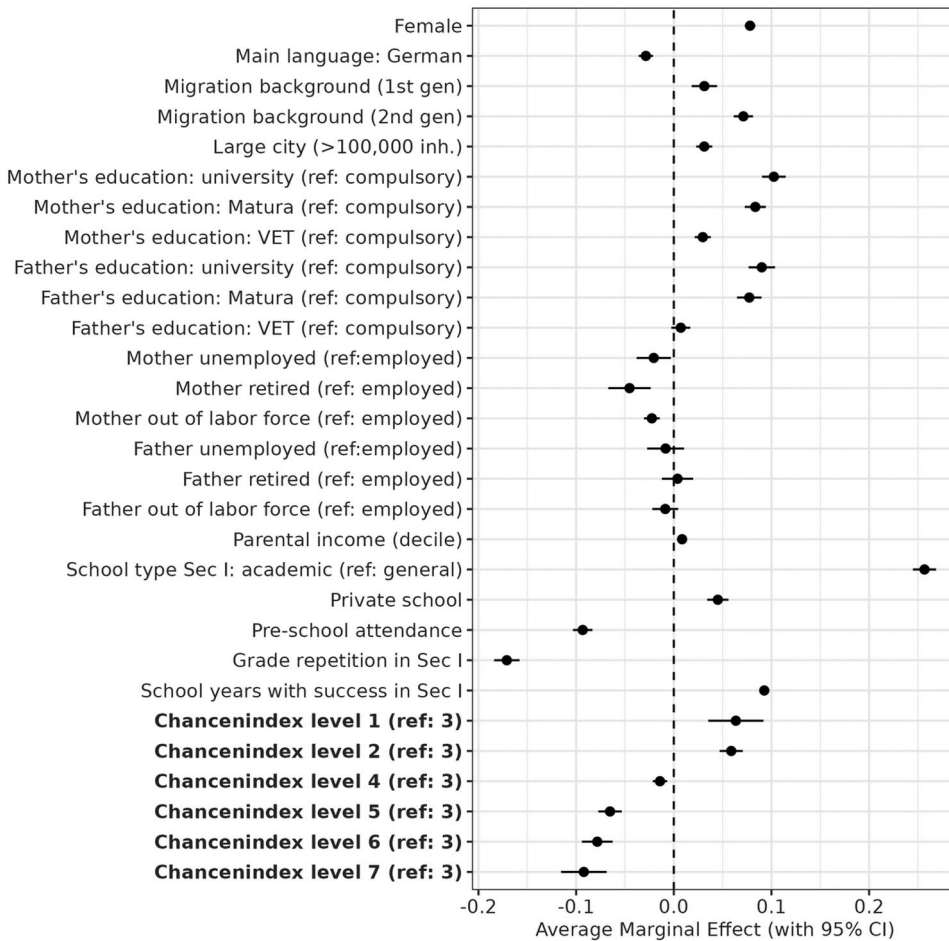
\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .

To assess the robustness of these findings, we replicated all models using alternative indicators of school composition – namely the shares of students with low-educated parents, non-German everyday language, migration background, and parental unemployment ([Online Appendix Table A2](#)). The results are highly consistent with those obtained using the Chancenindex: all indicators show significant and directionally similar effects, though effect sizes are somewhat smaller as these variables capture only single dimensions of disadvantage. Model fit statistics (Pseudo R<sup>2</sup>, AIC, BIC) are comparable across specifications, confirming that the Chancenindex provides a reliable composite measure of socioeconomic school composition.

The results also underscore the strong impact of school type: attending an academic-track school increases the probability of Matura attainment by 34 percentage points in Model 2 and 26 percentage points in Model 3. [Online Appendix Table A6](#) shows Model 3 results separately by school type.

[Figure 5](#) details the marginal effects of all control variables. In addition to school composition and early tracking, school performance during lower secondary education is particularly predictive: repeating a grade reduces the Matura probability by 17 percentage points, while each year with excellent/good success increases it by 9 percentage points. Furthermore, an early setback resulting from pre-school enrolment<sup>5</sup>, correlates with a 9 percentage point decrease.

Among individual characteristics, maternal education is especially influential. Notably – and contrary to public discourse – students with migration background and non-German home language are more likely to attain Matura when other factors are held constant, indicating ‘positive ethnic choice effects’, where migrant students pursue more ambitious educational paths than native peers with similar backgrounds ([Glaser and Becker 2023](#); [Salikutluk 2016](#); [Tjaden and Hunkler 2017](#)).



**Figure 5.** Average marginal effects for Matura attainment.

Note: The figure shows average marginal effects (with 95% CI) of individual and school-specific variables on the probability of Matura attainment;  $N = 71,320$ .

Supplementary interaction models (Online Appendix Table A8; Figures A1–A3) reveal only limited heterogeneity in how school composition relates to Matura attainment. The overall pattern is remarkably consistent across social groups: students in more advantaged schools have higher probabilities of attaining a Matura, regardless of their background. However, some subtle differences emerge. The association appears slightly weaker for first-generation migrants (Figure A1) and for students living in large cities (Figure A3), suggesting that contextual advantages at the school level may matter somewhat less when other opportunity structures or resources are present. Differences by parental education are also modest. Students with less-educated parents benefit marginally more from attending socially advantaged schools, but the overlapping confidence intervals indicate that these contrasts are small and should be interpreted with caution (Figure A2).

#### 4.2.2. Early school leaving

Table 2 shows regression results for early school leaving<sup>6</sup>. While composition effects are smaller than for Matura attainment, they remain substantial at higher Chancenindex levels. In Model 1, attending a school with level 6 increases the probability of early school leaving by 20 percentage points compared to level 3. This effect drops to 19 percentage points in Model 2 (controlling for school type) and to 4 points in Model 3 (with full controls). In this final model, only higher index levels ( $\geq 4$ ) show significant effects. The results of Model 3 are presented separately for students in the academic vs. general track in Online Appendix Table A7.

The type of school attended during lower secondary education shows less association with early school leaving than with Matura attainment. Students from academic-track schools are 3 (Model 2) to 5 (Model 3) percentage points less likely to leave school after compulsory education, suggesting that early school leaving is more strongly shaped by individual factors – some of which are likely unobserved in our data.

We further tested the robustness of these results using alternative indicators of school composition (Online Appendix Table A3). The direction and significance of effects remain stable across all measures, with disadvantaged school contexts consistently associated with a higher risk of early school leaving. As in the Matura models, the Chancenindex yields the strongest and most consistent gradients, reflecting its broader coverage of socioeconomic disadvantage at the school level. These results confirm that our findings are not sensitive to the operationalisation of school composition.

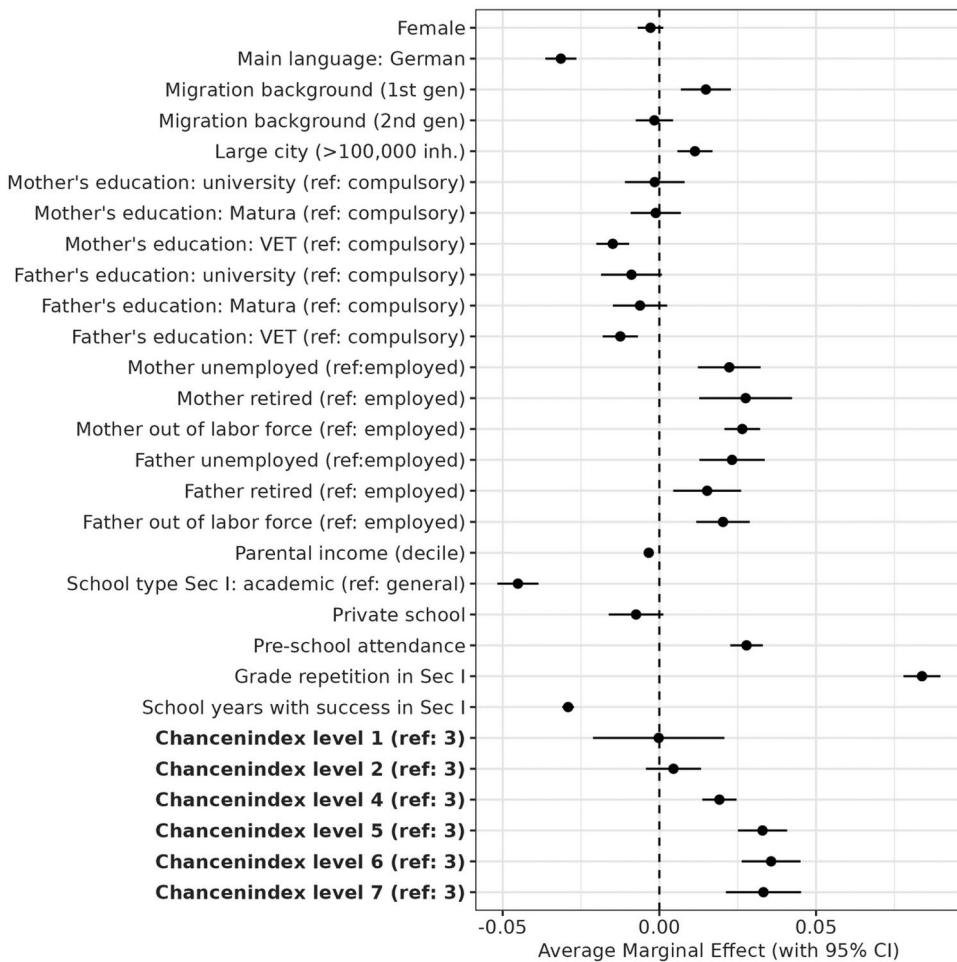
Figure 6 presents the average marginal effects of control variables. As with the Matura, academic performance is key: grade repetition raises the risk of early school leaving by 8 percentage points, while each year with good or excellent success lowers it by 3 points. Pre-school enrolment is linked to a 3-point increase in early school leaving. Unlike our

**Table 2.** Average marginal effects for early school leaving.

	Model 1s	Model 2	Model 3
<b>Chancenindex level</b>			
Level 1	-0.0367*** (0.0042)	-0.0273*** (0.0053)	-0.0002 (0.0107)
Level 2	-0.0255*** (0.0021)	-0.0142*** (0.0030)	0.0045 (0.0045)
Level 3		<i>Reference category</i>	
Level 4	0.0473*** (0.0029)	0.0428*** (0.0028)	0.0192*** (0.0028)
Level 5	0.1221*** (0.0054)	0.1150*** (0.0052)	0.0329*** (0.0040)
Level 6	0.1945*** (0.0070)	0.1821*** (0.0069)	0.0357*** (0.0048)
Level 7	0.2436*** (0.0107)	0.2253*** (0.0105)	0.0332*** (0.0061)
<b>School type</b>			
General track		<i>Reference category</i>	
Academic track		-0.0261*** (0.0034)	-0.0451*** (0.0033)
<b>Additional controls</b>			
	No	No	Yes
McFadden Pseudo R <sup>2</sup>	0.0738	0.0745	0.1681
AIC	48,633.22	48,395.76	37,212.75
BIC	48,698.24	48,470.06	37,488.00
N	71,320	71,320	71,320

Notes: The table shows average marginal effects (and standard errors) of Chancenindex levels and school types of school(s) attended during lower secondary education on the probability of early school leaving. Additional controls include gender, main language spoken at home, place of residence (large city), migration background, parents' education, parents' labour force status, parents' income, pre-school enrolment, school provider (private/public), number of school years with excellent/ success during lower secondary education, and grade repetition in lower secondary education; multicollinearity was checked.

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .



**Figure 6.** Average marginal effects for early school leaving.

Note: The figure shows average marginal effects (with 95% CI) of individual and school-specific variables on the probability of early school leaving;  $N = 71,320$ .

findings for Matura attainment, a non-German home language and migration background are associated with poorer educational outcomes.

Overall, effect sizes are generally smaller than in the Matura model, indicating that unobserved factors likely play a greater role in early school leaving. Supplementary interaction analyses ([Online Appendix Table A9](#); [Figures A4–A6](#)) examine whether the association between school composition and early school leaving differs across student groups. The results reveal a broadly consistent pattern across social backgrounds: attending schools with a more disadvantaged composition increases the likelihood of early school leaving for all students. Differences between groups are small, though the association appears somewhat stronger among students without migration background ([Figure A4](#)), those whose parents have lower levels of education ([Figure A5](#)), and those from non-urban areas ([Figure A6](#)). In these groups, disadvantaged school environments seem to exacerbate dropout risks more strongly, whereas migrant and urban youth may benefit from alternative support structures

or educational aspirations. However, the overlapping confidence intervals across all subgroups indicate that these contrasts are modest and statistically imprecise, confirming that school composition effects are similar across diverse student populations.

#### 4.2.3. Predictions based on prototypes

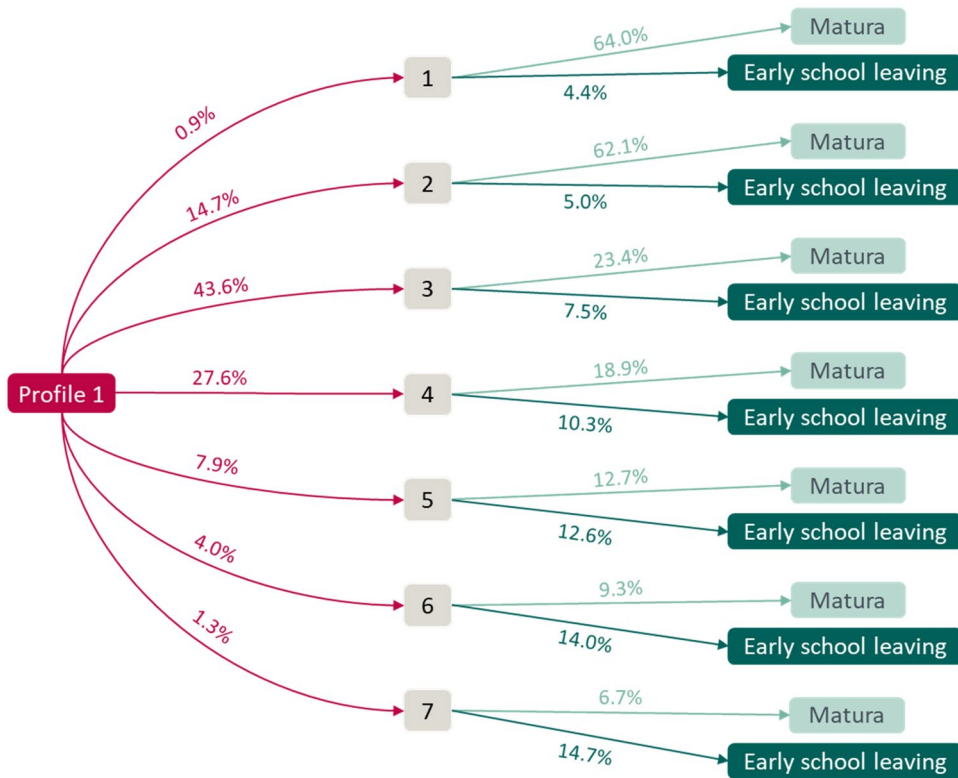
To illustrate how family background is associated with school placement and outcomes, we developed four student prototypes. These profiles capture typical constellations of advantage and disadvantage and serve to translate the regression-based results into concrete, relatable examples of how social background shapes educational trajectories.

The following four prototypes were defined:

- **Profile 1 ‘Working-class girl from the countryside’:**  
A female student living in a rural area with no migration background. Her parents have vocational education; her father is employed, and her mother is out of the labour force. This profile draws on Dahrendorf’s (1965) description of cumulative educational disadvantage in the 1960s, shaped by overlapping structural barriers.
- **Profile 2 ‘Immigrant son in the city’:**  
A male student in an urban area, second-generation immigrant. His parents have no more than compulsory education; his father is unemployed, and his mother is out of the labour force. Reflecting the evolving nature of disadvantage, this profile corresponds to discussions of educational inequality around the turn of the millennium (Geißler 2005).
- **Profile 3 ‘Cosmopolitan expat daughter’:**  
A female student in an urban area, first-generation immigrant. Both parents hold university degrees and are employed. This profile represents a particularly privileged immigrant background, with high cultural and economic capital.
- **Profile 4 ‘Suburbanite from the educated bourgeoisie’:**  
A male student living in the suburbs with no migration background. His mother holds a Matura, and his father has a university degree; both are employed. This profile contrasts sharply with Profile 1 and reflects a prototypical upper-middle-class Austrian background.

The following figures illustrate the predicted trajectories for each prototype: red arrows indicate the probability of attending schools at different Chancenindex levels, while green arrows show the corresponding probabilities of Matura attainment (light green) or early school leaving (dark green) conditional on those levels.

Figure 7 illustrates the predicted probabilities for profile 1 (‘working-class girl from the countryside’). This student is most likely to attend a school with Chancenindex level 3 (44%), followed by level 4 (28%) and level 2 (15%). The likelihood of attending schools with levels 1, 5, 6, or 7 is relatively low, totalling just 14%. While students with this profile have a higher probability of Matura attainment than of leaving school early, these probabilities vary substantially by school composition. For example, attending a school with Chancenindex level 1 is associated with a 64% chance of Matura attainment and only a 4% chance of early school leaving. At level 7, the patterns are reversed, with only a 7% probability of Matura and a 15% chance of early school leaving. For the most likely scenario – attending a level 3 school – the predicted probability is 23% for Matura, compared to 8% for early school leaving.

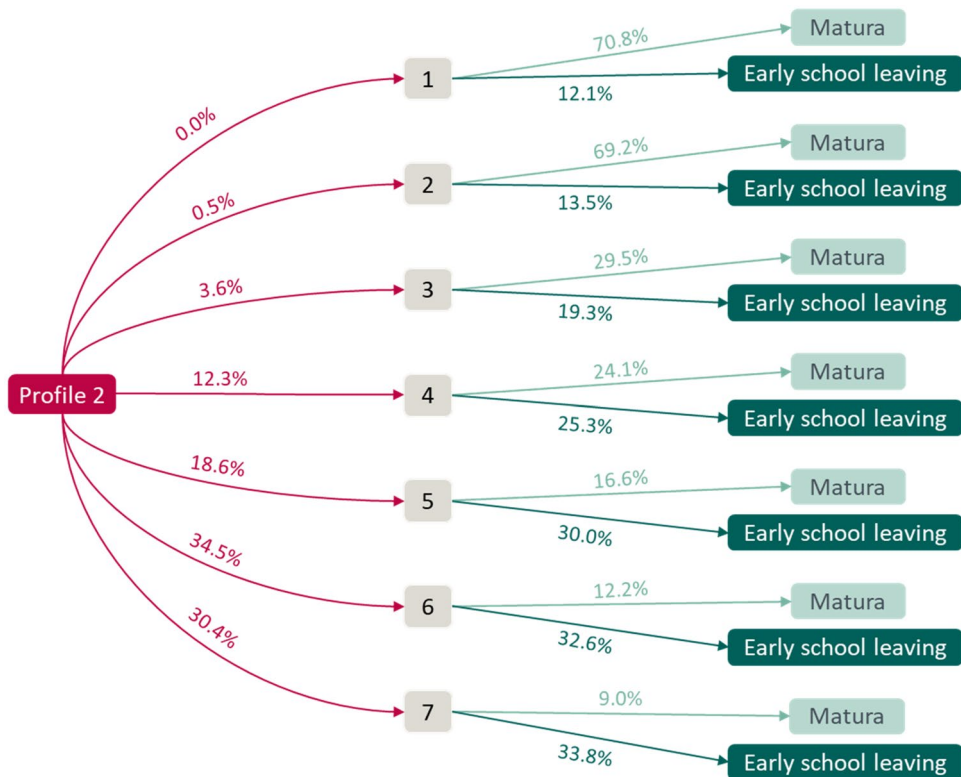


**Figure 7.** Predicted probabilities for the Chancenindex level and resulting educational outcomes, profile 1.

Notes: Predicted probabilities for profile 1 of attending schools at different Chancenindex levels (red arrows) are based on ordinal logistic regression. Green arrows indicate predicted probabilities of Matura attainment (light green) and early school leaving (dark green) conditional on Chancenindex level, estimated using logistic regression. Predictions are calculated for the specified prototype characteristics while holding educational performance indicators constant ( $N = 72,677$ ).

The predicted probabilities for profile 2 ('immigrant son in the city') differ significantly from those for typology 1 (see Figure 8). This student is most likely to attend a school with Chancenindex level 6 (35%) or 7 (30%), indicating a high likelihood of enrolment in socially disadvantaged schools. Contrary, attending a school with level 1 or 2 is highly unlikely – less than 1%. Interestingly, this student has higher predicted probabilities for both early school leaving and Matura attainment across all levels, compared to profile 1. This reflects the dual role of migration background: increasing risks at the lower end of the educational spectrum while also being linked to higher aspirations and attainment at the upper end. However, the only Chancenindex levels where Matura attainment exceeds the risk of early school leaving are levels 1 to 3 – the very schools this profile is least likely to attend. At level 1, the predicted probability is 71% for Matura and 12% for early school leaving; at level 7, these shift to 9% and 34%, respectively, revealing how school composition significantly shapes outcomes for students from disadvantaged backgrounds.

Figure 9 presents predicted probabilities for profile 3 ('cosmopolitan expat daughter'). This student is most likely to attend a school with Chancenindex level 3 (47%) or 2 (27%),

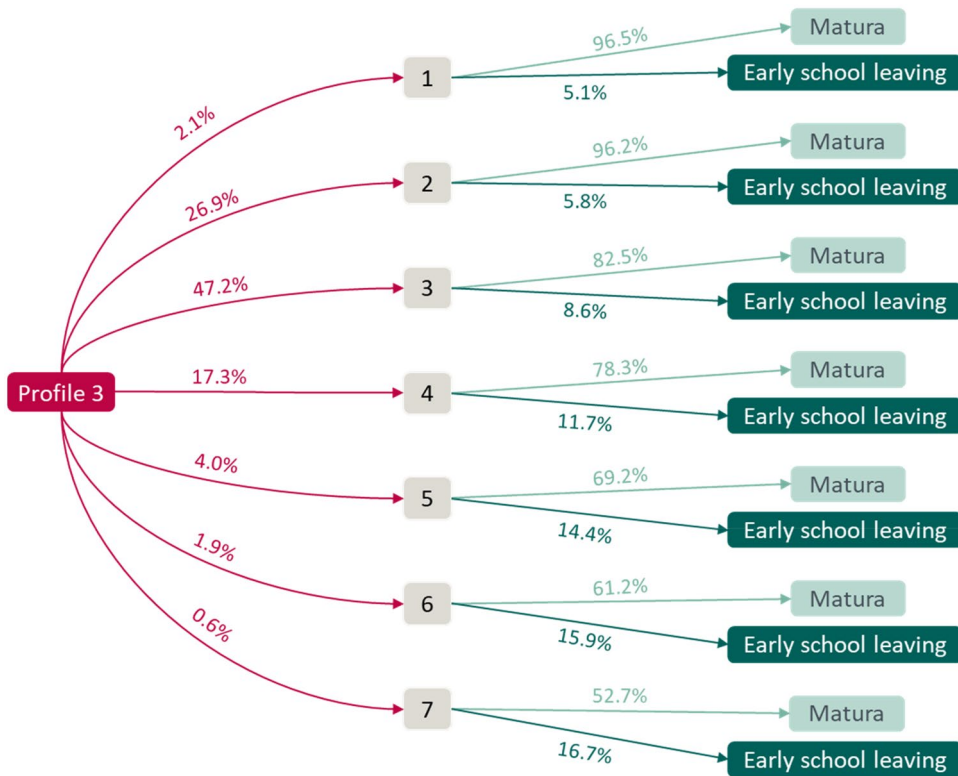


**Figure 8.** Predicted probabilities for the Chancenindex level and resulting educational outcomes, profile 2.

Notes: Predicted probabilities for profile 2 of attending schools at different Chancenindex levels (red arrows) are based on ordinal logistic regression. Green arrows indicate predicted probabilities of Matura attainment (light green) and early school leaving (dark green) conditional on Chancenindex level, estimated using logistic regression. Predictions are calculated for the specified prototype characteristics while holding educational performance indicators constant ( $N = 72,677$ ).

giving a combined probability of 74%. In contrast, attending a school with high support needs (level 6 or 7) is highly improbable – less than 3%. The figure also shows that school composition has comparatively limited effects on educational outcomes for high-SES students. Across all Chancenindex levels, the probability of Matura attainment exceeds 50%, while the probability of early school leaving remains below 17%. These results suggest that for highly privileged students, the social background may buffer against the disadvantages of school context.

Finally, **Figure 10** presents predicted probabilities for profile 4 (‘suburbanite from the educated bourgeoisie’). This student is most likely to attend a school with moderate support needs – Chancenindex level 3 (41%) or 4 (30%) – resulting in a combined probability of 71%. Enrolment in highly privileged (levels 1–2) or highly disadvantaged schools (levels 6–7) is relatively rare. School composition has relatively modest effects on early school leaving for this group: probabilities range from just 4% at level 1 to 12% at level 7. However, differences in Matura attainment are more pronounced. While the likelihood of Matura

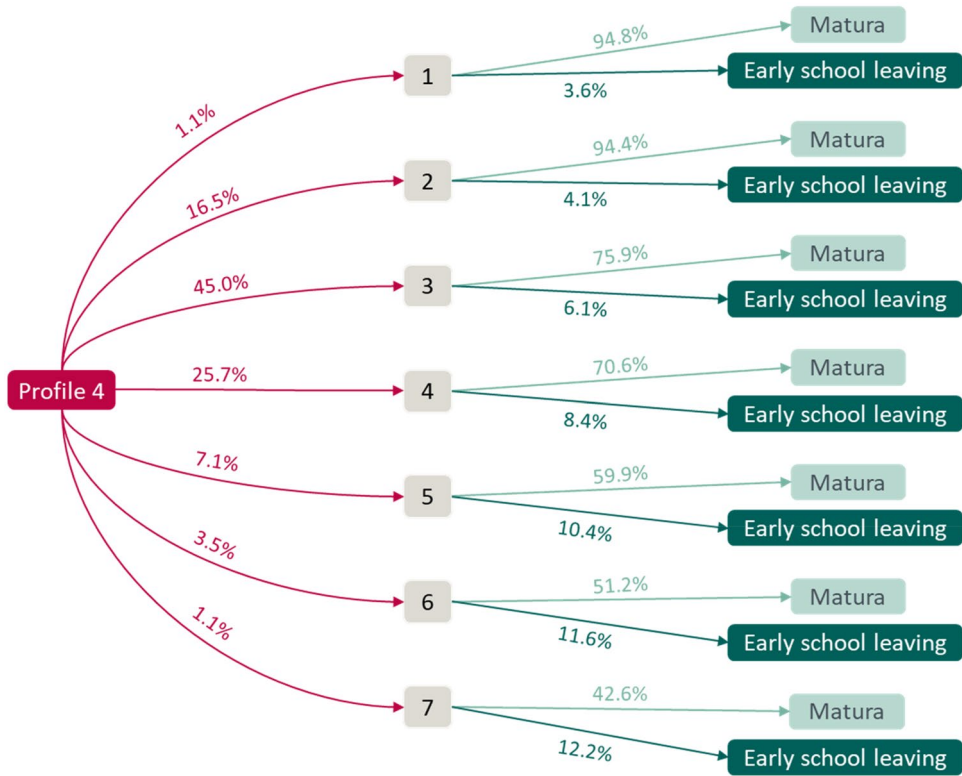


**Figure 9.** Predicted probabilities for the Chancenindex level and resulting educational outcomes, profile 3.

Notes: Predicted probabilities for profile 3 of attending schools at different Chancenindex levels (red arrows) are based on ordinal logistic regression. Green arrows indicate predicted probabilities of Matura attainment (light green) and early school leaving (dark green) conditional on Chancenindex level, estimated using logistic regression. Predictions are calculated for the specified prototype characteristics while holding educational performance indicators constant ( $N = 72,677$ ).

attainment is 95% in level 1 schools, it declines to 43% in level 7 schools – highlighting that even for advantaged students, school composition can shape longer-term outcomes.

A comparison of the four profiles reveals stark contrasts in educational opportunity. Profile 3 ('cosmopolitan expat daughter') emerges as the most privileged, while profile 2 ('immigrant son in the city') faces the greatest disadvantage. Notably, both profiles have a migration background, consistent with our earlier findings that this characteristic is linked to both elevated Matura attainment and increased risk of early school leaving. Comparing profile 1 ('working-class girl from the countryside') and profile 4 ('suburbanite from the educated bourgeoisie') – both without a migration background – highlights the persistent disadvantages faced by rural, working-class students, particularly in achieving higher levels of education, compared to their peers from highly educated households. Yet, our results also suggest a shift in the archetype of disadvantage: whereas educational inequality in the 1960s was often embodied by rural working-class girls, today it appears more strongly associated with urban immigrant boys.



**Figure 10.** Predicted probabilities for the Chancenindex level and resulting educational outcomes, profile 4.

Notes: Predicted probabilities for profile 4 of attending schools at different Chancenindex levels (red arrows) are based on ordinal logistic regression. Green arrows indicate predicted probabilities of Matura attainment (light green) and early school leaving (dark green) conditional on Chancenindex level, estimated using logistic regression. Predictions are calculated for the specified prototype characteristics while holding educational performance indicators constant (N = 72,677).

## 5. Conclusion and discussion

This study examined how the socioeconomic composition of lower secondary schools in Austria shapes students’ educational trajectories. Using a novel longitudinal register dataset, we assessed whether students with similar starting conditions experience different outcomes depending on the (dis)advantage of the schools they attended.

Our findings underscore the enduring influence of school composition on attainment. The steep decline in Matura attainment across the Chancenindex gradient – even after controlling for background, school type, and prior achievement – indicates that structural inequalities are embedded in the schooling environment. These results support sociological theories of cumulative (dis)advantage and peer-based transmission of aspirations and opportunity, highlighting how structural inequality is reproduced through everyday schooling contexts (DiPrete and Eirich 2006; Harris 2010; van Ewijk and Slegers 2010). They also align with international evidence showing that compositional inequality amplifies social stratification, particularly in early-tracking systems (Blossfeld et al. 2016; Van de

Werfhorst 2019). At the same time, our longitudinal perspective extends this literature by demonstrating that composition effects persist well beyond immediate performance, shaping students' longer-term educational trajectories.

We also find asymmetries in how school composition operates. Effects are more pronounced for high-stakes outcomes like Matura attainment and weaker for early school leaving. This suggests that contextual advantage fosters achievement, while negative outcomes may relate more to individual risk factors.

Our prototype analysis further illustrates how institutional sorting interacts with family background. Disadvantaged students are more likely to attend deprived schools and are more vulnerable to their effects. Conversely, students with high socioeconomic status often succeed regardless of school context – highlighting unequal capacities to buffer against disadvantage.

These insights advance debates in the sociology of education in two ways. First, we move beyond short-term performance to highlight the long-term consequences of compositional inequality, using nationally representative data that follow students through key educational transitions. Second, we provide empirical clarity on how early tracking and peer composition jointly shape outcomes – linking institutional structures to cumulative disadvantage. This contribution reinforces theoretical arguments about institutional path dependency in educational systems (Blossfeld et al. 2016) and situates Austria within the broader comparative literature on inequality of educational opportunity.

Yet our findings also point to research gaps. Register data enable precise, longitudinal measurement but lacks qualitative dimensions such as school climate, teacher expectations, or student belonging. Nor can we fully address selection bias without natural experiments or fixed-effects designs. Future research could address these limitations by integrating administrative and survey data, collecting school-level information on pedagogical climate and teacher practices, and employing quasi-experimental or multi-cohort designs to distinguish selection effects from causal impacts of school composition. In addition, more detailed data on classroom-level segregation and peer networks would allow a finer-grained understanding of how contextual effects operate within schools.

Despite these limitations, policy implications are clear. Reducing socioeconomic segregation must be central to any equity-focused education reform. Targeted resource allocation based on contextual disadvantage, needs-based school funding formulas, and professional support for teachers in socially disadvantaged settings can help mitigate cumulative disadvantage. Comparative evidence from other countries shows that delaying early tracking and strengthening permeability between educational pathways can promote both equity and overall performance (Mittal, Nilsen, and Björnsson 2020; OECD 2012). Tailored interventions for at-risk groups can further reduce inequality. Ultimately, promoting educational equity requires moving beyond equal access to ensure that learning conditions and outcomes become genuinely equal across schools.

### **Declaration of generative AI tools**

The authors used ChatGPT-4o and DeepL Write for language editing purposes. All content was subsequently reviewed and revised, and the authors take full responsibility for the final publication.

## Notes

1. This corresponds to one year before the formal end of compulsory schooling.
2. Statutory schools are institutions that do not conform to a standard, legally regulated school type. Public recognition depends on compliance with an approved organizational statute covering structure, curriculum, and staff qualifications. These schools must define their own educational concept and represent only a marginal share of the education system.
3. A derivation and more detailed explanation of this formula can be found in Schnell and Schüchner (2019).
4. The weights used in the Chancenindex are based on average performance gaps from Austria's national educational standard tests, expressed in equivalent school months. Students whose parents completed only compulsory education perform 27 months behind those from academic households and are assigned the highest disadvantage value (1.0). Tertiary-educated parents serve as the reference group (0). Intermediate weights reflect smaller disadvantages: 0.6 for apprenticeship or medium-level education (−63%) and 0.3 for Matura (−30%). Language background is weighted similarly: non-German speakers face a 59% disadvantage (0.6), while German speakers are assigned 0.
5. The term pre-school here refers to the Austrian concept of “Vorschule”, which is distinct from the concept of kindergarden or other early childhood education facilities. Children who have reached the age of compulsory school attendance but are not yet ready to attend formal schooling are admitted to a one-year pre-school program. This decision is typically made by parents and/or the respective school's head teacher based on their assessment of the child's readiness.
6. Table A5 in the Appendix presents the results of the same models but using the Chancenindex level as a continuous variable instead of a categorical variable.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Data statement

This study uses sensitive individual-level administrative data, accessible only upon request and exclusively for scientific research. All data are stored at the Austrian Micro Data Centre under strict data protection regulations and are not publicly available. Aggregated data, models, code, and output-controlled findings can be shared upon request. All analyses were conducted in R.

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