# Institutional Determinants of Intergenerational Education Transmission - Comparing Alternative Mechanisms for Natives and Immigrants

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Abstract

We use census data on 26 Swiss cantons to determine the association of educational institutions with the intergenerational transmission of education. We test whether education transmission is higher when children enter kindergarten and school earlier and when tracking occurs at a later age. In contrast to the literature we consider the three institutions jointly. Our results generally confirm the expected correlation patterns. Among second generation immigrants, the age at enrollment in kindergarten is most closely associated with educational mobility. Among natives, late tracking is most strongly and positively associated with educational mobility. Our results are robust to various alternative specifications.

Keywords: educational mobility, kindergarten, age of school entry, age of tracking, immigrants
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## 1. Introduction

Typically, intergenerational transmission of education reflects inequality in access to education and, subsequently, to labor market opportunities (Black and Devereux 2011). While countries differ substantially in intergenerational education transmission (e.g., Hertz et al. 1997, OECD 2011), we know little about the reasons behind these differences. Intergenerational educational mobility appears to be determined by factors related to genetics (nature), to parental behavior (nurture), and to specific institutions of education systems. If patterns of genetic transmission and parental behavior are similar across countries international differences in educational mobility should be connected to institutional differences. We study the association of educational mobility with educational institutions in order to contribute to the explanation of cross-country heterogeneity in education mobility.

This paper takes advantage of the heterogeneity in the institutions of 26 Swiss cantons. For centuries, Swiss cantons have determined the specific institutional features of their regional education systems (Stadler 2011). Thus, we use the results of historic developments that much precede the outcomes studied here to describe the association between institutions and intergenerational mobility. Based on inter-cantonal heterogeneity, we study the correlation of age at (i) entry to kindergarten, (ii) entry to primary school, and (iii) secondary school tracking with intergenerational educational mobility, and investigate whether these patterns differ for natives and second generation immigrants.

Various mechanisms may be behind the association of educational institutions and intergenerational education mobility. Early entry to kindergarten or pre-school may improve subsequent educational outcomes particularly for youths from disadvantaged parental backgrounds for several reasons: early entry may stimulate cognitive capacities, transmit positive attitudes towards learning, improve self-esteem, and expose children to the language later spoken in school (Currie and Thomas 1999, Heckman 2006). Similarly, entering school early may improve the learning environment particularly for children of less educated parents.

If disadvantaged pupils receive additional support early on, the relevance of their parental background might diminish. Finally, tracking pupils in ability based school-types at a later age can affect educational mobility because more information on pupils' scholastic aptitude is available and reduces the probability of misallocating pupils. Also, if children are tracked early parents interfere and teachers may take parental background as a signal of pupils' ability (van Elk et al. 2011, Brunello and Checchi 2007, Jürges and Schneider 2011). Overall, it seems plausible that each of the three institutions is correlated with educational mobility. In addition, it is conceivable that these correlations are interdependent, e.g., that age of school entry yields a different correlation with mobility depending on whether kindergarten started early or late, or that the mobility correlation of the tracking regime differs in scenarios of early vs. late kindergarten enrollment. We test whether such interdependencies exist.

This study contributes to the literature on several counts: first, while already prior analyses studied the contribution of institutions to intergenerational education transmission these analyses typically focus on single characteristics of the educational system and evaluate their relevance in separation. For example, Currie (2001) looks at public preschool programs and argues that early schooling may equalize educational endowment differences; Hanushek and Woessmann (2006) study the impact of early school tracking and find that it reduces educational mobility. We go beyond these studies by evaluating the mobility correlation of different institutions jointly and in a comparative perspective.[1]

Second, since institutional frameworks may affect subgroups of the population differently we study the entire population as well as natives and second generation immigrants, separately.[2] Third, we solve a methodological problem that plagues the literature on the effects of age at kindergarten or primary school entry on educational attainment, i.e.

[1] This extends our earlier work (Bauer and Riphahn 2006, 2009, 2010) on single educational institutions. Here, we consider possible interactions between institutions, apply a different empirical approach, and evaluate the relative magnitude of institutional associations with educational mobility.

[2] Cobb-Clark et al. (2012) show that institutional arrangements can be associated with the educational attainment of immigrant relative to native students.

the separation of the effects of age and age at entry on educational attainment (Black et al., 2011). We address this problem by investigating educational outcomes that are not age-specific: we use attendance of the most academically oriented track as outcome of interest and study educational mobility as the correlation between parental education and child secondary school track enrollment.

Fourth and finally, we compare institutional features within a given country. This allows us to be confident that the measured correlations indeed reflect institutional differences. In contrast, in cross-national comparisons numerous institutions and culture in general differ between comparison groups and may affect the outcomes of interest.

Our results confirm the expected correlation patterns of the three institutional features with educational mobility: intergenerational educational mobility tends to be higher in situations where children enter kindergarten and school earlier and where tracking occurs at a later age. Among second generation immigrants, the age at enrollment in kindergarten is most closely associated with educational mobility. Only among immigrants we find a positive correlation between age at school enrollment and educational mobility. Among natives the grade of tracking is most strongly associated with educational mobility. We find highly significant interdependencies between institutional mobility correlations: for the full sample, natives, and immigrants all mobility correlations of one institution vary significantly depending on the other institutional regimes.

The next section describes the Swiss education system, reviews the relevant literature, and lays out our expectations regarding the correlation between institutions and educational mobility. Section 3 describes the data, presents first graphical evidence, and sketches our empirical approach. Results and robustness tests are presented in sections 4 and 5 before we conclude in section 6.

## 2. Background: institutions, literature, and expected patterns

## 2.1 Institutional background

In Switzerland, the responsibility for the education system is divided between the national government, cantons, and municipalities. While the national government only regulates the timing of the school year and general quality requirements, cantons administer the institutions of the educational system. Cantons can transfer competencies to the municipal level which typically is responsible for pre-school, primary, and lower secondary education.

Most children attend a public kindergarten for up to two years. They are usually enrolled at age 4 or 5; in rare cases they may start already at age 3 (Annen et al. 2010).[3] Entry to compulsory school education is governed at the cantonal level based on rules regarding the child's age at a given calendar date (Arnet 2000). Compulsory school lasts for 9 years, divided into a primary and lower secondary level (see **Figure 1** for a depiction of the Swiss educational system). Generally, children enter primary school between the ages of 5 and 7 and remain there between 4 and 6 years. Then, they are tracked into different types of secondary school which they complete after grade 9. Afterwards the majority takes up an apprenticeship lasting between 2 and 4 years. Alternatively, vocational or general schools offer training either for specific occupations or to prepare for other specialized schools. Individuals aiming at a university education attend advanced school for another 3 to 4 years after grade 9. After completing advanced school they can transfer to university.

**Table 1** summarizes institutional features of 26 cantonal education systems relevant for the birth cohort of 1983 which we analyze below. We study the age of enrollment in kindergarten, in primary school, and the timing of tracking. Column 1 of **Table 1** shows the heterogeneity of kindergarten enrollment regimes: it presents the share of 4-years-olds attending kindergarten between 1987 and 1989. While in some cantons no 4-years-olds are in

[3] In recent years, obligatory kindergarten attendance was discussed intensely in Switzerland. For the period of our data, i.e. the birth cohort of 1983, the vast majority of cantons offered public kindergarten on a voluntary basis, only. Wannack et al. (2006) show that even in 2006 there was no legal obligation to attend kindergarten in 18 out of 26 cantons. Even though we have no information on the cantonal legal obligation to attend kindergarten in the 1980s we assume that it existed at best for a small minority of cantons and should not affect our estimates.

kindergarten, in other cantons about 80 percent of all 4-years-olds are enrolled. In column 2 we use information from a survey of cantonal education departments on the average age at school entry in their canton for the early 1990s. The measure describes the absolute entry age that in a given canton affects all pupils. Column 3 of **Table 1** presents administrative education statistics on the cantonal grade of tracking as of 1995 (EDK 1995). Within Switzerland, tracking grades vary between grades 5 and 9. Most cantons use grade 6 as the first year of tracked instruction.

### 2.2 Prior literature and expected correlation patterns

Most of the empirical literature on educational mobility focuses on the causal effects of nature (genes) and nurture (parenting behavior).[4] The literature on institutional features of the education system typically studies single institutions in separation and focuses on educational attainment rather than on educational mobility as outcome variable. Therefore the extant evidence on the connection between educational institutions and mobility tends to be indirect. We briefly survey prior contributions on educational outcomes and age at kindergarten entry, school entry, and tracking. Then we discuss studies on educational mobility across population groups.

A number of contributions look at the age at kindergarten entry and its effects on educational attainment. Datar (2006) finds significant positive causal effects of delayed kindergarten entry on test score trajectories. The positive effects are larger for at-risk than for low-risk children in the U.S.. Elder and Lubotsky (2009) show that it is not the advanced age that makes those children more successful in school who went through kindergarten late, but instead their accumulated pre-kindergarten experience. These authors show that the association of age at kindergarten entry with educational achievement differs depending on the socioeconomic status of families; they conclude that raising the overall entrance age

[4] For important contributions to this literature see studies cited in Black et al. (2011), or Holmlund et al. (2011).

increases socioeconomic differences. Similarly, Deming and Dynarski (2008) suggest that postponing kindergarten and school entry increases inequality because unequal backgrounds predominate longer in a child's life. Currie (2001) surveys the evidence on preschool programs without attention to their timing. She concludes that preschool programs particularly benefit disadvantaged children and thus may contribute to balance differences in educational starting conditions prior to school entry. We expect that early enrollment in kindergarten enhances educational mobility and is of benefit to disadvantaged children.

A broad empirical literature studies the causal effect of age at school entry on educational attainment. The three contributions by Bedard and Dhuey (2006), Puhani and Weber (2007), and Fredriksson and Öckert (2005), show that later school entry improves educational outcomes. Bedard and Dhuey (2006) suggest that the correlation of relative age at school entry and high parental socioeconomic status in the U.S. increases inequality in educational outcomes: those with high socioeconomic status start school later and reap the double advantage of their parental background and advanced relative age. Puhani and Weber (2007) identify the causal effect of age at school entry in Germany based on the month of birth and Fredriksson and Öckert (2005) provide a similar analysis for Sweden. Both papers suggest that absolute age rather than being older than one's peers drives the positive age effect on attainment. Black et al. (2011) show for Norway that starting school relatively late has a long run negative earnings effect for men from disadvantaged backgrounds but not for others. The literature so far has rarely discussed the correlation of absolute age at school entry with educational mobility. As entering school early may reduce the variation in learning-relevant preschool experience, we expect that enrollment at primary school at an earlier age for all students is associated with higher educational mobility.[5]

[5] However, it is conceivable that the combination of late entry to school with a preschool or kindergarten experience that is more specifically targeted to balance child deficits increases mobility more strongly than early school entry.

Woessmann (2009) and Betts (2011) survey the literature on the effects of tracking on level and equity of educational attainment. Betts (2011) points out that tracking can take on various formats from within school tracking in the U.S. to between school tracking in Europe. He summarizes that early tracking exacerbates achievement differences correlated with family background. For example, Hanushek and Woessmann (2006) compare the inequality in pupils' attainment for educational systems with and without early tracking. They conclude that early tracking increases the inequality in student performance without positive attainment effects. Brunello and Checchi (2007) provide cross-country evidence showing that early tracking is detrimental to equality of opportunity in educational attainment. Schuetz et al. (2008) study the connection between early tracking and parental background effects on student performance. They find that the relevance of parental background for child attainment increases if pupils are tracked early. This is confirmed by Woessmann et al. (2009): the correlation of pupils' competence with parental background is larger in early tracking regimes. Using state-level tracking differences in Germany, Woessmann (2010) finds that attainment depends less on parental background in states that track later and have fewer tracks. Based on this evidence we expect that late tracking is correlated with higher educational mobility.

The literature discussed so far studies the overall correlation between institutions of the educational system and educational attainment and mobility. Another set of contributions addresses whether a given institutional framework affects natives and immigrants in the same way. Gang and Zimmermann (2000) compare intergenerational correlation patterns in educational attainment for natives and second generation immigrants in Germany and find that these patterns differ substantially. They confirm intergenerational correlation in education only for natives. Nielsen et al. (2003), Bauer and Riphahn (2007), and Aydemir et al. (2008) obtain similar evidence for Denmark, Switzerland, and Canada, respectively, where the association of educational attainment between parents and their children is much stronger among natives than among second generation immigrants. The authors hardly discuss

rationales to explain this heterogeneity in educational mobility. Aydemir et al. (2008) point out for Canada that immigrant educational mobility declines once third generation immigrants are considered. Bauer and Riphahn (2007) investigate to what extent observable characteristics can explain the intergenerational transmission patterns for native and immigrant subsamples. Their rich specification accounts for about one third of the unconditional intergenerational education correlation, with slightly different patterns for natives and immigrants. However, they neglect institutional heterogeneities, which we address here. We expect that institutional correlation patterns differ for natives and immigrants, where natives' mobility may be more closely related to educational institutions than immigrants'.

Several mechanisms might drive such differences; e.g., if educational institutions such as early tracking give parents a strong influence on child school choice, the mobility correlation of early tracking might be larger for those who know the system well and get involved than for those who are not accustomed to interfere in child educational careers. Alternatively, if educational institutions affect mobility by balancing the disadvantages of students from weaker backgrounds the impact of the institutions might be larger if the heterogeneity in student background is larger. If, e.g., language abilities or cultural backgrounds are more diverse among immigrants and if these differences are ameliorated by educational institutions then the relevance of institutions might be larger for immigrant educational mobility. The next section describes the data and our empirical approach.

## 3. Data and empirical approach

### 3.1 Data

Our analysis requires individual and cantonal data. For individual information we use the Swiss census of 2000 which covers the *entire* Swiss population as of December 5, 2000. The 2000 census was the last population survey that was answered in full by each resident of Switzerland; the subsequent census of 2010 combined information from administrative

records with surveys on population samples. Thus, the 2000 data provides the last full coverage of the Swiss population and is of particular relevance for research.[6]

In order to measure intergenerational correlation in educational attainment we code educational outcomes for Swiss born youths and their parents. We focus on the group of 17-years-olds, i.e. the birth cohort of 1983. At age 17, track choice is completed and indicates educational attainment. In addition, the 17-years-olds are most likely to still live in the parental household; this is important because the census data allow us to connect parent and child observations only if they reside in the same household. After dropping observations with missing information on parental characteristics and on regional identifiers our sample consists of 61,676 observations, which represents 89 percent of the population of Swiss-born 17-years-olds.[7] We consider individuals as natives if they have no parent who was born abroad (N=47,250). Those Swiss-born 17-years-olds with at least one parent who was born abroad are in our sample of second generation immigrants (N=14,426).[8]

Our dependent variable describes the educational choice of 17-years-olds. We focus on those who are in advanced secondary school (cf. **Figure 1**) or already pursuing university education at age 17. They are on the high education path which we code as a binary outcome.

Parental education can be coded using several outcomes: high, middle, low educational degrees, and missing information. Highly educated parents hold an advanced school or tertiary education degree, middle educated parents graduated with vocational

[6] About 7 percent of the population was covered by personal interviews, the remainder either mailed the completed survey questionnaire or provided the information via the internet. In principle, one might similarly analyze data from the 1980 or 1990 censuses. However, for the youths interviewed in these years we do not have information on the relevant cantonal institutions.

[7] Out of 70,598 Swiss born youths, we cannot match parental information in 7,781 cases, typically because the youth indicated not to be the child of the household head. In 282 cases information on the type of school attended is missing and in 859 cases municipal identification cannot be provided. Overall the distribution of educational attainment among youths and their parents in our data matches aggregate statistics.

[8] Immigrants in Switzerland are not uniformly distributed across the country. They attain higher population shares in cantons with a large urban population, in border cantons, and in the French and Italian speaking cantons. In our empirical approach, we control for the cantonal immigrant share and factors that are correlated with it. About 26 percent of our second generation immigrants have Italian origins, 10 and 7.6 percent have German and French roots. The next largest countries of origin are Spain (6.6 percent) and Turkey (5.9 percent).

degrees or hold degrees that do not permit university access, and low educated parents did not attain any degrees beyond mandatory secondary school. We consider the highest of paternal or maternal education as parental outcome.

**Table 2** describes the share of 17-years-olds on the high education track and its correlation with parental educational background. Overall, 24.8 percent of the youths in our sample pursue advanced education. This share varies by parental educational background, with 9, 21, and 60 percent shares among children of parents with low, medium, and high educational background, respectively. The heterogeneity across parental background is more pronounced among natives than immigrants: the probability to attend high education among children of low educated parents is one sixth of the probability for children of highly educated parents. This relative disadvantage is larger among natives (about one tenth) than among immigrants (about one fifth), which confirms the internationally observed pattern of higher mobility among immigrants discussed before.

We are interested in the correlation of intergenerational mobility with educational institutions. **Table 1** presented indicators of cantonal education regimes that were in place when the 1983 birth cohort attended kindergarten and secondary school. In **Figure 2** we plot the unconditional correlation of cantonal intergenerational mobility with the educational institutions of interest. As indicator of cantonal educational immobility we use the ratio of the propensity to attend advanced education for children of highly educated parents to the same propensity for children of parents with low education; under perfect mobility the ratio would take on a value of or close to one. The actually observed ratios vary between 17 in the German language canton of Uri and 2.4 in the French language canton of Geneva. **Figure 2.1** presents the correlation between educational immobility and the share of 4-years-olds in cantonal Kindergarten. We see the lowest educational immobility, i.e. the highest mobility where the share of 4-years-olds in kindergarten is high. **Figure 2.2** relates immobility to the cantonal age of school enrollment: educational immobility is low and mobility is high in

cantons with an early average age of school enrollment. **Figure 2.3** plots the correlation of educational immobility with the grade of tracking: in cantons where tracking takes place at higher grades we find the lowest level of immobility and the highest mobility.

### 3.2 Model and empirical approach

In order to measure the association of educational mobility with institutional features and to test whether this association is robust to controls for composition effects we estimate multivariate regression models. The dependent variable describes the educational track attended (*Y*) by a 17-years-old. Its correlation with parental education (*PE*) yields the extent of intergenerational education transmission. In addition to parental education we control for individual, household, and regional characteristics (*X*) as well as for institutional indicators (*Inst*). The latter describe the educational regime that the youth experienced when attending kindergarten and school. We assign the institutional features of the canton where the individual is observed to live in 2000 assuming that the person has not moved.[9] We consider interaction terms of parental education and the institutional indicators (*PE* · *Inst*) in the model. The estimated coefficients (d) show whether institutional regimes are correlated with intergenerational mobility. We use a linear probability model to estimate the parameters a-d of our empirical model (see equation 1). e represents a white noise error:

$$Y = a + b\,PE + c_0\,X + c_1\,Inst + d\,(PE \cdot Inst) + e\,. \qquad (1)$$

If the coefficient vector 'd' is statistically significant educational mobility, i.e. $\partial Y / \partial PE$, varies with institutional background.[10] We could only assign a causal interpretation to the

[9] The census data inform about whether an individual changed the canton of residence in the last five years. 98 percent of the observations in our sample indicate that five years ago they lived in the same canton. Based on the small sample share affected by mobility the effect of any measurement error related to changing the canton of residence should be minor. The propensity to move between cantons within the last five years is not significantly correlated with mobility. Also, there is no correlation between the decision to move and the educational characteristics of the destination canton. Finally, schooling is only free in the canton of residence. Therefore we do not expect parents to send their children to attend school in neighboring cantons.

[10] An alternative procedure to relate intergenerational mobility to cantonal characteristics

institutional effect if cantonal institutions *(Inst)* were exogenous in equation (1). Since we cannot exploit a natural experiment nor changes over time to identify causal effects and because we can neither exclude families sorting into cantons based on educational institutions nor the correlation of cantonal institutions with unobserved cantonal characteristics we do not claim to estimate causal effects. Instead, we study conditional correlation patterns at a descriptive level. As the literature on educational mobility has rarely looked at the broader institutional correlations of educational mobility this is still new and informative; in fact, in an extension we investigate whether institutional correlations with educational mobility are interdependent and vary depending on the other institutions characterizing a canton, which to our knowledge has not been looked at before.

We control for individual, household, and regional characteristics (*X*). We gathered individual and household level information from the census. Besides parental education we consider for parental age, child sex and religion, number of siblings, and immigrant status, which all are plausibly correlated with educational attainment. In addition, we consider cantonal indicators to control for potentially relevant regional heterogeneities. We measure, e.g., cantonal education expenditures, the number of advanced schools per 1,000 residents, the availability of teachers, average class sizes, the average education of the cantonal population, the language spoken in the region, the cantonal population share of immigrants, and the population density in the municipality.[11] **Table 3** shows summary statistics.

Our empirical analysis proceeds in three steps. First, we estimate separate models for each of the three institutional indicators.[12] In step two we consider the three institutional

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could follow the methods applied in Card and Krueger (1992a, 1992b). They relate returns to education and their differences to state level characteristics. We do not apply this procedure because we have far fewer cross-sectional units available and no panel dimension in our data.

[11] In addition, we control for cantonal female labor force participation, the share of left wing parties in cantonal parliaments, cantonal income inequality, population size, the share of residents living in cities, and the extent of municipal autonomy in a canton.

[12] These separate results are similar to institution-specific analyses that are presented in Bauer and Riphahn (2006, 2009, 2010). Here, however, we apply one empirical specification for all three institutions. This specification considers a much wider set of covariates to account for cantonal

features jointly. This allows for possible interactions of cantonal institutions and yields comparable indicators of their correlation with educational mobility. In step three we repeat step two separately for the native and immigrant samples.

## 4. Estimation results

### 4.1 Separate institutions

In step one of our analysis we determine the association of intergenerational education mobility with institutional features in separate estimations of equation (1), i.e., disregarding potential correlation patterns between the three institutions. We estimate linear probability models using high educational attainment of the 17-years-olds as dependent variable. In **Table 4** we present the coefficient estimates for parental education and the institutional indicators, i.e., the share of 4-years-olds attending kindergarten, age at school enrollment, or grade of tracking, and for interaction effects. We do not present the complete set of estimation results to save space. The first row in **Table 4** indicates that in all specifications children of highly educated parents ceteris paribus have a significantly higher propensity to attend advanced education than the children from middle and low parental backgrounds. The institutional main effects presented in row three yield that high educational outcomes are more likely in cantons with early entry to kindergarten and school. The correlation with the tracking regime appears to be ambiguous.

Our focus, however, is on these institutions' correlation with intergenerational educational mobility: mobility is high, if the educational advantage for the children of highly educated parents is small. We inspect the coefficient estimates of the interaction terms of institutions with high parental education. The significant negative coefficients in columns 1

heterogeneity than previously used models. In addition, the focus of this contribution is on the high education outcome for youth and on high parental education background. In prior studies we applied multinomial logit approaches, whereas we use linear models to study institutional effects here. In this study we compare the outcomes for immigrants and natives; we jointly consider the impact of three institutions, which is new to the literature. Finally, for the first time we study institutional interdependencies in correlations with educational attainment and educational mobility in this paper.

and 2 suggest that the advantage of highly educated families is smaller in cantons with high shares of 4-years-olds in kindergarten. Thus, early kindergarten admission is positively correlated with educational mobility.

The results in columns 3 and 4 yield contradictory results: without further control variables, we find that the educational benefit of children of highly educated parents is higher in scenarios where school enrollment takes place early, i.e. immobility is higher with early admission. Once we control for covariates in column 4 the coefficient changes sign; here early school enrollment coincides with increased mobility.

The coefficients of the interaction terms in columns 5 and 6 are small and imprecisely estimated. Their negative signs suggest that in a regime with late tracking the advantage of children of highly educated parents is smaller than in a regime of early tracking. Thus, mobility is higher where tracking occurs late. However, the estimated coefficients are only jointly significant in the specification with covariates.

While not all estimated interaction effects are statistically significant the evidence does not reject the expected correlation patterns that we saw already in **Figure 2**. The most precise correlation with educational mobility is found for age of kindergarten entry, where the interaction term coefficients are individually and jointly significant. To compare the magnitudes of the correlations we can evaluate the change in the benefit of high parental educational background that is associated with a change in each institution by two standard deviations (see **Table 3**) using, e.g., the estimates from the specifications with covariates in columns 2, 4, and 6: increasing the share of 4-years-olds in kindergarten by 44 percentage points is associated with a decline of the benefit of high parental background by ((0.44* 0.043)*100=) 1.9 points. Reducing age at school entry by 0.84 years is associated with a decline of the benefit of a high education parental background by 0.92 points, and postponing tracking by 1.6 years with a decline by 0.96 points. So the first correlation is the largest and most precisely estimated one.

### 4.2 Joint consideration of the three institutions

As step two of our analysis we consider the three institutions jointly in the estimation of equation (1). This more general estimation framework allows for institutional interaction and correlation patterns. **Table 5** presents the estimation results for the full set of interaction terms first without then with additional covariates. In columns 1 and 2 we show the results for the full sample, columns 3-6 present the results for the native and immigrant subsamples.

A comparison of the estimation results in **Tables 4** and **5** for the full sample yields rather similar results: with and without covariates (i.e., in columns 1 and 2 of **Table 5**) we find individually significant coefficients for the interaction terms of the share of 4-years-olds in kindergarten and high parental educational background. The estimates confirm a correlation pattern where early kindergarten entry goes along with high mobility. In **Table 4** we obtained a positive coefficient for the age at school entry interaction when considering control variables. Once the other institutions are considered in **Table 5** the coefficients of the relevant interaction terms are now negative. This suggests that school entry at high age is associated with a reduced advantage of children from high education backgrounds. While the coefficients are statistically insignificant, this result of the joint model now differs from the trend line in **Figure 2.2.** It suggests higher mobility in regimes of late school enrollment, which we discuss further in section 4.3. As in **Table 4**, the coefficients for the interaction of grade of tracking with high parental education are individually insignificant and negative: even when controlling for the other two institutions a late tracking regime is positively correlated with mobility.

Overall, the six estimated interaction terms in columns 1 and 2 are jointly significant, so educational mobility is significantly correlated with the institutional framework. We can use the estimates in column 2 to evaluate the magnitude of the correlation patterns implied by a two standard deviations change of the educational institution measures: the benefit of having

highly educated parents is lower by (0.05*0.44*100=) 2.2 points where the share of 4-years-olds is higher by 44 percentage points, the benefit is higher by 0.8 points where age at school entry is higher by 0.84 years, and is lower by 0.3 points where tracking is delayed by 1.6 years. The first correlation dominates in terms of statistical precision and magnitude.[13]

In additional estimations, which we do not show to save space, we evaluated whether the reported institutional mobility patterns are interdependent. Adding the set of three interacted institutional main effects to the model improves the model fit significantly.[14] When we then add cross-interaction terms where each institution-by-parent education interaction is interacted again with each of the two other institutions (yielding six additional coefficients) we obtain jointly significant estimates. This suggests that institutions are interdependent in their correlation with educational attainment and with educational mobility.

In sum, considering the full set of educational institutions jointly does not generally reverse prior findings on the correlation between institutions and educational mobility. However, the correlation of age at school enrollment with educational mobility switches sign in the specifications with control variables and the association of the tracking regime with educational mobility declines substantially in magnitude when the other institutions are controlled for. In addition, we find significant interdependencies of educational institutions in their correlation with educational attainment and mobility. Next, we study whether our results hold equally for the native and immigrant subsamples.

### 4.3 Joint consideration of the three institutions for native and immigrant subsamples

[13] One might suspect that any change between **Tables 4** and **5** could be associated with the correlation between the three institutional features. However, based on the 26 cantonal observations we obtain a correlation coefficient of -.42 for the correlation between the share of 4-years-olds in kindergarten and age at school entry, similarly of .45 for the correlation between the share of 4-years-olds in kindergarten and time of tracking, and of -.18 for the correlation between age at school entry and time of tracking. Therefore, the result does not seem to be driven by multicollinearity.

[14] We added the three interacted institution variables, share of 4-years-olds in kindergarten*age at school enrollment, age at school enrollment *grade of tracking, grade of tracking*share of 4-years-olds in kindergarten.

We saw in **Table 2** that educational outcomes and intergenerational correlation patterns differ for natives and second generation immigrants in Switzerland. Therefore, we study whether the relevance of institutions for both groups' intergenerational education transmission patterns differ, as well. To do so in the most flexible form we re-estimate our models separately for the native and immigrant subsamples. Columns 3-6 in **Table 5** present the results for the coefficients of interest (appendix **Table A.1** shows the full results).

With respect to the share of 4-years-olds in kindergarten, native and immigrant samples show the same correlation patterns. The patterns for the other two institutions differ between the two samples. The interaction coefficient of the share of 4-years-olds in kindergarten with high parental education background is more significant and substantially larger for immigrants than for natives. While early age of school enrollment is insignificantly associated with high educational mobility among natives, this correlation is reverse and statistically significant among immigrants: here, educational mobility is higher where school starts at a later age. This runs counter to our expectations and suggests that the benefit of those with highly educated parents is lower and/or the disadvantage of those with low educated parents is lower if school starts at a higher age. The latter pattern could be plausible, if institutions other than schools step in and use the years that immigrant children are not yet at school to, e.g., help them balance any educational deficits they may have. Possibly, the overly strong early kindergarten coefficient is a mechanism that works in this way.[15] Finally, with respect to the correlations of age at tracking, natives' educational mobility appears to be higher in cantons where tracking is postponed, the opposite holds for immigrants.

[15] To investigate such patterns, we re-estimated the model for immigrants adding three covariates: an interaction of the share of 4-years-olds in kindergarten and the age at school enrollment as a new main effect and the interaction of this main effect with the two parental education variables. The three additional coefficients are jointly significant but not individually. The total effect of either institution does not change signs when evaluated at sample means, i.e. early kindergarten entry remains positively associated with educational mobility and early school enrollment continues to be negatively associated with educational mobility. Therefore it seems unlikely that the interaction effects explain the particular institutional patterns for immigrants. We also compared the correlation patterns between educational institutions but did not find major differences for natives and immigrants.

For the three institutions and the native sample we now obtain changes in the benefit of having highly educated parents of 0.7, 0.8 and 1.1 points, respectively, if the three institutions change by the value of the two standard deviations considered before. Among natives, grade of tracking thus appears to be most strongly correlated with educational mobility. Based on the estimated correlations for the immigrant sample, the largest correlation with educational mobility derives from kindergarten entry age. We obtain absolute changes in the benefit from highly educated parents of 5.0, 4.4, and 1.9 points for the three correlations when calculated as before.

Thus, in all estimations and in all predictions early entry to kindergarten is correlated with high intergenerational educational mobility. This correlation is particularly large and significant for immigrants. Young age at school enrollment is correlated with higher intergenerational mobility in most separate estimations (see **Table 4**) and in the joint estimations for natives but not for immigrants. Once we control for the other institutions, the mobility enhancing effect of late tracking, which is well established in the literature and which was not rejected by the separate estimations in **Table 4**, is confirmed for the pooled and the native sample but not for immigrants. While the coefficient estimate is statistically insignificant, the economic magnitude of the tracking correlation is larger than those of the other institutions for natives. In contrast, immigrants' educational mobility is most strongly correlated with early kindergarten entry. This is plausible if early kindergarten enrollment contributes to balance specific disadvantages of immigrants such as language ability which are less relevant for natives (Currie and Thomas 1999, Magnuson et al. 2006).

## 5. Robustness tests

We tested a number of alternative specifications to investigate the robustness of our results: we (i) replaced the measure of highest parental education by paternal or maternal education, (ii) studied the heterogeneity between the main Swiss language regions, we (iii)

dropped observations of youths who had moved between cantons prior to the survey, (iv) we changed the definition of second generation immigrants, and (v) re-estimated the model after omitting observations with missing values on parental education.

When we replace our indicator of highest educational attainment between both parents by either paternal or maternal education our main conclusions from the above analyses are confirmed. Having a high share of 4-years-olds children in kindergarten is associated with an increase in intergenerational mobility, particularly among immigrants. The direction of the age at school enrollment correlation varies by subsample, and a higher grade of tracking enhances educational mobility for natives but not for immigrants.[16]

There is substantial cultural heterogeneity between the German and the romanic, i.e. French and Italian, language regions of Switzerland (see, e.g., Brugger et al. 2009 for a discussion). In order to evaluate whether cultural differences affect mobility beyond our broad set of control variables we reestimated our model and interacted the vector of institutional variables and their interaction terms with an indicator for the romanic language region[17] (see appendix **Table A.2**). The six additional interaction terms with high parental educational background are jointly significant at the 1 percent level for the full and native samples but not for immigrants; thus for Swiss natives there are indeed significant differences in the correlation patterns of educational mobility between the two regions. These differences, however, affect only the magnitudes of the correlations and not their directions. In fact, we find confirmation for the positive correlation of mobility with a high share of 4-years-olds in kindergarten for all subsamples in both regions of the country. Similarly, we find the positive correlation of mobility with early school enrollment among natives and the negative correlation for immigrants identically in both regions. Finally, we confirm that late tracking is not associated with higher mobility for immigrants, but for natives in romanic cantons.

[16] The estimation results are not presented to save space; they are available upon request.
[17] This includes the cantons Neuchatel, Vaud, Geneva, Jura, Fribourg, Valais, and Ticino.

Next, we addressed the concern that non-random mobility affects our estimates. We repeated our analysis after dropping youths who had changed their canton of residence in the last 5 years, separately for the different samples. The estimation results hardly changed compared to **Table 5** (results not presented to save space, available upon request).

So far we coded individuals to be a second generation immigrant if the person had at least one parent who was born abroad, yielding 14,426 observations. When we consider only those with both parents born abroad, the immigrant sample drops to 5,146 observations. We repeated the estimations of columns 5 and 6 of **Table 5** with this more restrictive subsample. Not surprisingly, now the coefficients of the parental education interactions are no longer significant. Except for the grade of tracking all correlation patterns with respect to educational mobility are confirmed: early kindergarten entry goes along with increased mobility and early school enrollment goes along with reduced mobility for the immigrant sample.

Finally, we re-run our analyses after dropping observations with missing values on parental education from the sample instead of considering control variables for this group. The sample size declined from 61.676 to 60.627 observations, however, the results stayed virtually identical.

## 6. Conclusions

We observe substantial heterogeneity in the extent of intergenerational education transmission across countries. While most of the literature on educational mobility is concerned with the causal effects of parental genes and behavior (for a recent survey see, e.g., Holmlund et al. 2011) these factors can hardly explain cross-national differences. Hence, we focus on the correlation of educational institutions with educational mobility to improve our understanding of possible mechanisms behind educational immobility.

This article takes advantage of (a) institutional heterogeneities between Swiss cantons and (b) a large administrative dataset on the entire Swiss population. We determine the

association of intergenerational educational mobility with three features of the education system: age at kindergarten entry, age at primary school enrollment, and the time of educational tracking. We describe unconditional correlations and estimate correlations conditional on a rich vector of covariates to account for heterogeneities at the individual and regional level. We test whether interdependencies between educational institutions are correlated with educational attainment and mobility, and we investigate whether these associations differ for natives and second generation immigrants.

Not conditioning on other educational institutions we find that early kindergarten enrollment, early primary school enrollment, and late tracking are positively correlated with intergenerational educational mobility. These results are similar to those of prior studies which typically looked at these three institutions in separation. We then go beyond institution-specific analyses and evaluate the robustness of these findings in joint estimations which consider all institutions simultaneously. This allows us to evaluate the relative magnitude of each of the three institutions' correlation with educational mobility.

Based on models that consider all three institutions jointly, we confirm the significant correlation of educational mobility with educational institutions. The correlation of early kindergarten enrollment with high educational mobility dominates the correlation of the other two institutions in magnitude and significance. Also, the correlation of each institution with educational attainment and mobility is significantly modified by the other institutions. We are not aware that such institutional interdependencies have been shown before.

We repeat the analyses separately for natives and immigrants; this shows that the mobility correlations of age of kindergarten enrollment and of age of school enrollment are substantially stronger for second generation immigrants than for natives. Surprisingly, the mobility correlation of age of school enrollment is positive among immigrants and negative among natives. Among natives the grade of tracking regime is most strongly correlated with educational mobility.

This heterogeneity of institutional correlation patterns and the interdependencies of different institutions within a given education system has not been discussed before. Our results are robust to various changes of the empirical setup and to modifications of key variables. Also, they hold up for culturally heterogeneous groups in Switzerland, i.e. the German and the romanic language groups. We conclude that the international heterogeneity in pre-school institutional arrangements is a likely candidate to contribute to cross-national differences in intergenerational educational mobility.

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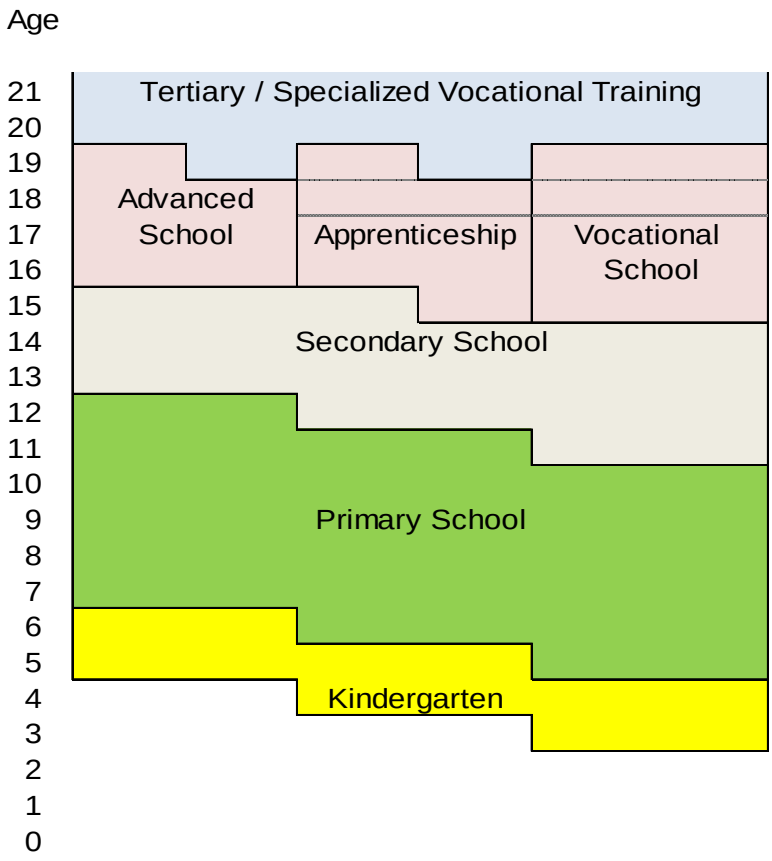
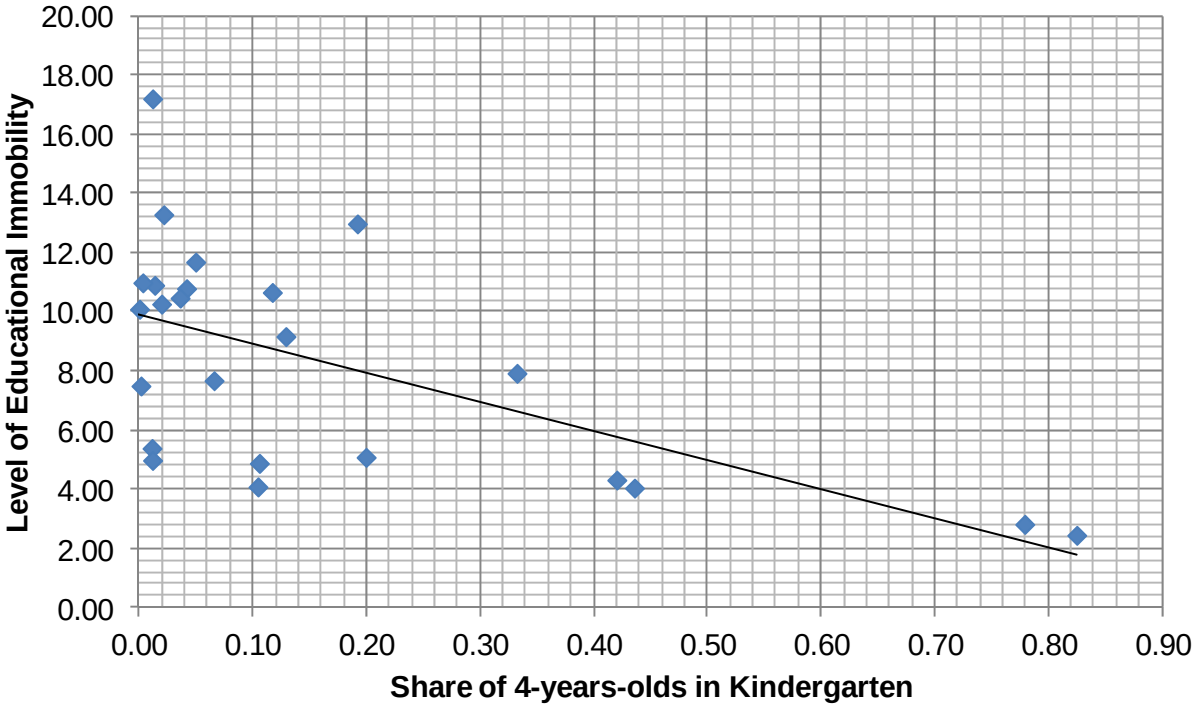
**Figure 1** Sketch of the Swiss educational system



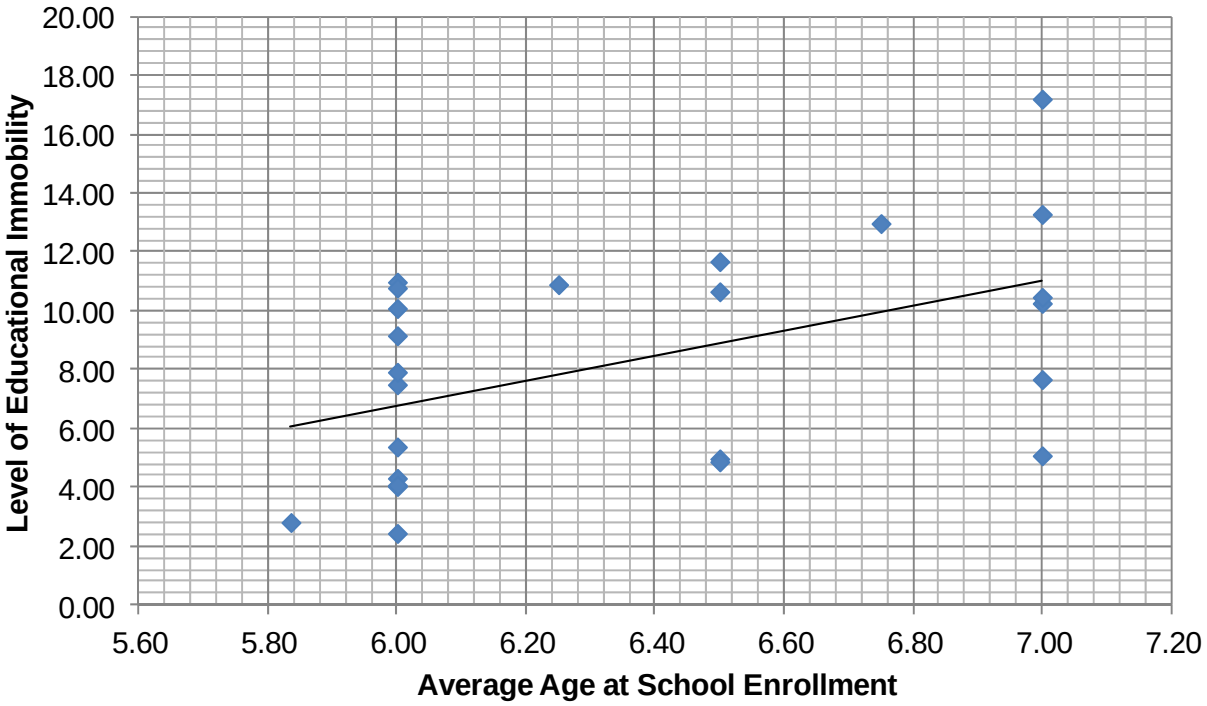

Source: Simplified description of general structures. The patterns in some of the 26 cantons differ from what is depicted.

**Figure 2** Correlation between cantonal educational immobility and educational institutions

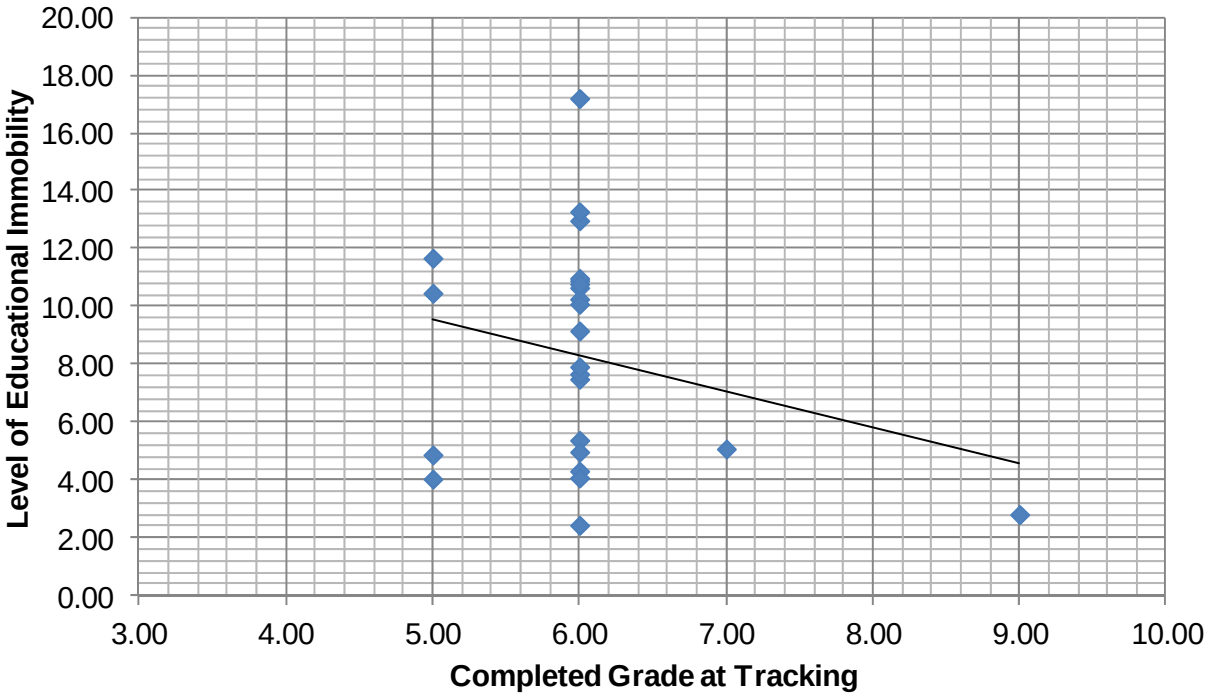
2.1 Average share of 4-years olds in Kindergarten




2.2 Average age at school enrollment



## 2.3 Average grade of tracking




Note: The cantonal level of educational immobility is calculated as Pr (child high | parent high) / Pr (child high | parent low).
Source: Census 2000 and own calculations.

**Table 1** Institutional regulation by canton

| Canton | Share of 4 years olds in kindergarten (1) | Average age at school enrollment (2) | Completed grade at tracking (3) | Number of obser-vations (4) |
|---|---|---|---|---|
| 1 Zuerich | 0.1 | 6.5 | 6.0 | 9291 |
| 2 Bern | 0.0 | 7.0 | 6.0 | 8668 |
| 3 Luzern | 0.0 | 6.3 | 6.0 | 3340 |
| 4 Uri | 0.0 | 7.0 | 6.0 | 388 |
| 5 Schwyz | 0.0 | 6.0 | 6.0 | 1315 |
| 6 Obwalden | 0.0 | 6.0 | 6.0 | 331 |
| 7 Nidwalden | 0.0 | 6.8 | 6.0 | 384 |
| 8 Glarus | 0.1 | 6.0 | 6.0 | 446 |
| 9 Zug | 0.0 | 6.0 | 6.0 | 800 |
| 10 Fribourg | 0.0 | 6.5 | 6.0 | 1944 |
| 11 Solothurn | 0.0 | 6.5 | 5.0 | 2352 |
| 12 Basel-Stadt | 0.2 | 7.0 | 7.0 | 1023 |
| 13 Basel-Landschaft | 0.1 | 6.5 | 5.0 | 2270 |
| 14 Schaffhausen | 0.2 | 6.8 | 6.0 | 679 |
| 15 Appenzell AR | 0.0 | 6.0 | 6.0 | 570 |
| 16 Appenzell IR | 0.0 | 7.0 | 6.0 | 199 |
| 17 St. Gallen | 0.0 | 6.0 | 6.0 | 4548 |
| 18 Graubünden | 0.1 | 7.0 | 6.0 | 1810 |
| 19 Aargau | 0.0 | 7.0 | 5.0 | 5347 |
| 20 Thurgau | 0.0 | 7.0 | 6.0 | 2407 |
| 21 Ticino | 0.8 | 5.8 | 9.0 | 1947 |
| 22 Vaud | 0.4 | 6.0 | 5.0 | 4658 |
| 23 Wallis | 0.4 | 6.0 | 6.0 | 2554 |
| 24 Neuenburg | 0.1 | 6.0 | 6.0 | 1292 |
| 25 Genf | 0.8 | 6.0 | 6.0 | 2399 |
| 26 Jura | 0.3 | 6.0 | 6.0 | 714 |
| Minimum | 0.0 | 5.8 | 5.0 | 199 |
| Maximum | 0.8 | 7.0 | 9.0 | 9291 |
| Mean | 0.2 | 6.4 | 6.0 | 2372 |
| Std. Dev. | 0.2 | 0.4 | 0.7 | 2399 |

Source: Column 1: Information on cantonal kindergarten regimes in the period 1987-1989, is provided by the Swiss Statistical Office, Section School and Vocational Education. Column 2: survey of cantonal education departments on typical age at school entry for the early 1990s. Column 3: administrative education statistics on the grade of tracking in 1995 (EDK 1995). Column 4: number of observations in our sample by canton.

**Table 2** Dependent variable: share of 17-years-olds on the high educational path by subsample and parental educational background

| | All | Natives | Immigrants |
|---|---|---|---|
| All parents | 24.82 | 23.23 | 30.02 |
| | | | |
| Parents education low | 9.21 | 6.13 | 12.85 |
| Parents education middle | 20.83 | 19.94 | 25.59 |
| Parents education high | 59.87 | 59.24 | 60.94 |

Note: In some cases parental education information is missing. While these cases are considered in the analyses, they are not presented here for brevity. The table uses 61,676 observations in total, 47,250 on natives and 14,426 on second generation immigrants.
Source: Census 2000, own calculations.

**Table 3** Descriptive statistics

| | All | | Natives | | Immigrants | |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD |
| **Individual indicators** | | | | | | |
| Highest parental education: Low or Middle (reference) | 0.836 | 0.370 | 0.867 | 0.339 | 0.735 | 0.441 |
| Highest parental education: High | 0.147 | 0.354 | 0.121 | 0.326 | 0.230 | 0.421 |
| Highest parental education: Missing | 0.017 | 0.129 | 0.012 | 0.107 | 0.035 | 0.183 |
| Female (0/1) | 0.483 | 0.500 | 0.483 | 0.500 | 0.481 | 0.500 |
| Father age | 38.96 | 19.56 | 38.21 | 19.90 | 41.43 | 18.19 |
| Mother age | 43.16 | 10.29 | 42.96 | 10.44 | 43.82 | 9.76 |
| Immigrant (0/1) | 0.234 | 0.423 | 0.000 | 0.000 | 1.000 | 0.000 |
| Religion: Christian (0/1) (reference) | 0.879 | 0.326 | 0.912 | 0.284 | 0.774 | 0.418 |
| Religion: Jewish (0/1) | 0.003 | 0.052 | 0.001 | 0.035 | 0.008 | 0.088 |
| Religion: Islamic (0/1) | 0.019 | 0.135 | 0.002 | 0.048 | 0.072 | 0.259 |
| Religion: other or no denomination (0/1) | 0.086 | 0.281 | 0.073 | 0.260 | 0.130 | 0.336 |
| Religion: no response (0/1) | 0.013 | 0.113 | 0.012 | 0.108 | 0.016 | 0.126 |
| No siblings (0/1) (reference) | 0.074 | 0.261 | 0.070 | 0.255 | 0.085 | 0.279 |
| One sibling (0/1) | 0.467 | 0.499 | 0.456 | 0.498 | 0.504 | 0.500 |
| Two siblings (0/1) | 0.305 | 0.460 | 0.311 | 0.463 | 0.285 | 0.451 |
| Three or more siblings (0/1) | 0.155 | 0.361 | 0.163 | 0.370 | 0.126 | 0.332 |
| **Cantonal institutions of interest** | | | | | | |
| Share of 4-years-olds in kindergarten | 0.156 | 0.221 | 0.131 | 0.194 | 0.236 | 0.276 |
| Age at school entry | 6.472 | 0.422 | 6.497 | 0.421 | 6.388 | 0.414 |
| School tracking | 5.909 | 0.796 | 5.894 | 0.745 | 5.958 | 0.944 |
| **Cantonal proxy variables** | | | | | | |
| Elementary school expenditures per capita | 0.861 | 0.329 | 0.843 | 0.322 | 0.920 | 0.342 |
| Total education expenditures per capita | 2645 | 320 | 2618 | 284 | 2734 | 406 |
| Teachers per 100 inhabitants | 1.205 | 0.269 | 1.187 | 0.247 | 1.262 | 0.326 |
| Class size: primary school | 19.90 | 0.757 | 19.89 | 0.770 | 19.94 | 0.713 |
| Class size: secondary school | 18.94 | 0.925 | 18.93 | 0.937 | 18.98 | 0.886 |
| Population share with higher degree | 0.099 | 0.035 | 0.095 | 0.032 | 0.113 | 0.038 |
| Population share with university degree | 0.051 | 0.023 | 0.049 | 0.020 | 0.060 | 0.028 |
| Population density (communal) | 0.011 | 0.017 | 0.009 | 0.014 | 0.018 | 0.024 |
| French speaking region (0/1) | 0.220 | 0.414 | 0.196 | 0.397 | 0.300 | 0.458 |
| Italian speaking region (0/1) | 0.032 | 0.175 | 0.024 | 0.153 | 0.056 | 0.231 |
| Share of left wing parties in cantonal parliament | 0.269 | 0.099 | 0.262 | 0.098 | 0.293 | 0.098 |
| Population share in urban areas | 0.385 | 0.197 | 0.371 | 0.189 | 0.429 | 0.217 |
| Population (in 1000) | 544.9 | 369.5 | 544.3 | 371.3 | 546.9 | 363.4 |
| Gini: equivalent incomes 2003 | 0.284 | 0.035 | 0.282 | 0.035 | 0.292 | 0.036 |
| Gini: equivalent incomes 1995 | 0.290 | 0.021 | 0.289 | 0.021 | 0.294 | 0.020 |
| Degree of local autonomy | 0.548 | 0.076 | 0.541 | 0.070 | 0.570 | 0.092 |
| No. adv. schools per 1000 inhabitants (communal) | 21.65 | 19.57 | 21.14 | 19.55 | 22.68 | 19.56 |
| No. adv. schools per 1000 inhabitants: missing (com.) | 0.704 | 0.456 | 0.742 | 0.437 | 0.581 | 0.493 |
| Female labor force part. (full and part-time) | 0.624 | 0.034 | 0.623 | 0.034 | 0.627 | 0.036 |
| Female labor force part. (full time) | 0.367 | 0.020 | 0.366 | 0.020 | 0.373 | 0.022 |
| Share of immigrants in population | 0.234 | 0.104 | 0.220 | 0.093 | 0.280 | 0.124 |
| Number of observations | 61676 | | 47250 | | 14426 | |

Source: Individual indicators: Swiss census 2000, first four cantonal indicators see information below Table 1, for remaining cantonal indicators see Müller Kucera and Stauffer (2003) and the Swiss Conference of Cantonal Ministers of Education (EDK 2000).

**Table 4** Estimation results of separate linear regression for each institution
Dependent variable: youth in advanced education track

| | Share of 4-years-olds | | Age at school enrollment | | Grade of tracking | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Parental education: high | 0.398 *** | 0.372 *** | 0.567 *** | 0.292 ** | 0.452 *** | 0.399 *** |
| | (0.008) | (0.007) | (0.118) | (0.123) | (0.068) | (0.055) |
| Parental education: missing | -0.117 *** | -0.088 *** | 0.049 | -0.044 | -0.124 ** | -0.174 *** |
| | (0.01) | (0.009) | (0.254) | (0.152) | (0.047) | (0.034) |
| Institutional main effect | 0.321 *** | 0.023 | -0.106 *** | -0.026 ** | 0.034 | -0.02 *** |
| | (0.027) | (0.06) | (0.036) | (0.012) | (0.025) | (0.004) |
| Institution*parental ed. high | -0.062 ** | -0.043 * | -0.026 | 0.011 | -0.007 | -0.006 |
| | (0.025) | (0.024) | (0.018) | (0.019) | (0.011) | (0.009) |
| Institution*parental ed. missing | 0.099 *** | 0.085 ** | -0.021 | -0.004 | 0.007 | 0.017 *** |
| | (0.033) | (0.034) | (0.038) | (0.022) | (0.009) | (0.006) |
| Additional controls | no | yes | no | yes | no | yes |
| **Joint significant tests (d.f.)** | | | | | | |
| interactions (2) | F=5.85 | F=3.43 | F=0.98 | F= 0.17 | F=1.91 | F=4.68 |
| | p= 0.008 *** | p=0.048 ** | p=0.389 | p=0.843 | p= 0.170 | p= 0.019 ** |
| interactions + level (3) | F=264.06 | F=2.31 | F=4.26 | F=2.06 | F=1.56 | F=10.28 |
| | p=0.000 *** | p=0.101 | p=0.015 ** | p=0.130 | p=0.223 | p=0.000 *** |

Note: ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively. Standard errors are clustered at the canton level. All estimations are with an intercept. Columns 2, 4, and 6 control for the full set of control variables described in **Table 3**. All estimations use the full sample with 61,676 observations. The joint significance tests consider first the coefficients of rows 4 and 5 and then they add the main effect of each of the institutions, as presented in row 3 to test for joint statistical significance.
Source: see Table 3.

**Table 5** Estimation results of joint linear regressions for all three institutions
Dependent variable: youth in advanced education track

| | All | | Natives | | Immigrants | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Parental education: high | 0.502 *** | 0.441 *** | 0.347 ** | 0.345 ** | 0.769 *** | 0.639 *** |
| | (0.145) | (0.141) | (0.146) | (0.147) | (0.191) | (0.18) |
| Parental education: missing | -0.500 *** | -0.410 ** | -0.625 ** | -0.539 * | -0.443 ** | -0.318 * |
| | (0.141) | (0.157) | (0.226) | (0.27) | (0.189) | (0.183) |
| Share of 4-years-olds | 0.287 *** | 0.158 *** | 0.268 *** | 0.184 *** | 0.332 *** | 0.104 *** |
| | (0.04) | (0.029) | (0.042) | (0.031) | (0.05) | (0.036) |
| Share * parental ed. high | -0.070 ** | -0.050 * | -0.037 | -0.016 | -0.145 *** | -0.114 *** |
| | (0.027) | (0.028) | (0.037) | (0.035) | (0.03) | (0.028) |
| Share * parental ed. missing | 0.142 *** | 0.115 *** | 0.014 | 0.015 | 0.131 *** | 0.092 *** |
| | (0.041) | (0.034) | (0.088) | (0.086) | (0.03) | (0.026) |
| Age at school enrollment | -0.028 | -0.023 *** | -0.026 | -0.026 *** | -0.038 | 0.008 |
| | (0.022) | (0.005) | (0.02) | (0.005) | (0.033) | (0.016) |
| Age * parental ed. high | -0.015 | -0.009 | 0.010 | 0.010 | -0.063 ** | -0.052 * |
| | (0.02) | (0.021) | (0.019) | (0.021) | (0.03) | (0.029) |
| Age * parental ed. missing | 0.046 ** | 0.037 * | 0.059 * | 0.049 | 0.029 | 0.013 |
| | (0.019) | (0.019) | (0.03) | (0.034) | (0.023) | (0.023) |
| Grade of tracking | 0.003 | -0.025 *** | 0.009 | -0.022 *** | -0.014 | -0.035 *** |
| | (0.008) | (0.002) | (0.008) | (0.002) | (0.009) | (0.004) |
| Grade * parental ed. high | -0.001 | -0.002 | -0.002 | -0.007 | 0.008 | 0.012 |
| | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.01) |
| Grade * parental ed. missing | 0.013 | 0.014 | 0.020 | 0.021 | 0.027 ** | 0.030 ** |
| | (0.008) | (0.009) | (0.015) | (0.017) | (0.011) | (0.012) |
| Additional controls | no | yes | no | yes | no | yes |
| **Joint significant tests (d.f.)** | | | | | | |
| all interactions (6) | F=7.35 | F=4.49 | F=2.97 | F=1.41 | F=9.45 | F=7.80 |
| | p=0.000 *** | p=0.003 *** | p=0.025 ** | p=0.250 | p=0.000 *** | p=0.000 *** |
| share: interactions (2) | F=7.28 | F=5.76 | F=0.54 | F=0.11 | F=22.63 | F=17.41 |
| | p=0.003 * | p=0.009 *** | p=0.591 | p=0.895 | p=0.000 *** | p=0.000 *** |
| share: interactions + level (3) | F=171.51 | F=13.52 | F=44.76 | F=12.42 | F=39.40 | F=15.87 |
| | p=0.000 *** | p=0.000 *** | p=0.000 *** | p=0.000 *** | p=0.000 *** | p=0.000 *** |
| age: interactions (2) | F=2.91 | F=1.88 | F=2.54 | F=1.08 | F=5.41 | F=2.20 |
| | p=0.073 * | p=0.174 | p=0.099 * | p=0.356 | p=0.011 ** | p=0.131 |
| age: interactions + level (3) | F=2.10 | F=14.97 | F=1.77 | F=13.40 | F=3.68 | F=1.49 |
| | p=0.126 | p=0.000 *** | p=0.178 | p=0.000 *** | p=0.026 ** | p=0.242 |
| grade: interactions (2) | F=1.34 | F=1.03 | F=0.86 | F=0.96 | F=3.28 | F=4.92 |
| | p=0.279 | p=0.370 | p=0.435 | p=0.398 | p=0.054 * | p=0.016 ** |
| grade: interactions + level (3) | F=1.68 | F=39.66 | F=3.53 | F=28.41 | F=3.41 | F=35.70 |
| | p=0.196 | p=0.000 *** | p=0.029 ** | p=0.000 *** | p=0.033 ** | p=0.000 *** |

Note: ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively. Standard errors are clustered at the canton level. All estimations are with intercept. Columns 2, 4, and 6 control for the full set of control variables described in **Table 3**. The estimations for the full sample use 61,676 observations, those for natives and immigrants 47,250 and 14,426 observations, respectively.
Source: see Table 3.

## Appendix

**Table A.1** Full estimation results of the regression model as presented in Table 5

| | All | | Natives | | Immigrants | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Parental education: high | 0.502 *** | 0.441 *** | 0.347 ** | 0.345 ** | 0.769 *** | 0.639 *** |
| | (0.118) | (0.118) | (0.144) | (0.144) | (0.212) | (0.211) |
| Parental education: missing | -0.500 ** | -0.410 ** | -0.625 *** | -0.539 ** | -0.443 | -0.318 |
| | (0.196) | (0.198) | (0.224) | (0.236) | (0.337) | (0.331) |
| Share of 4-years-olds | 0.287 *** | 0.158 *** | 0.268 *** | 0.184 *** | 0.332 *** | 0.104 |
| | (0.011) | (0.058) | (0.014) | (0.066) | (0.021) | (0.132) |
| Share * parental ed. high | -0.070 ** | -0.050 * | -0.037 | -0.016 | -0.145 *** | -0.114 ** |
| | (0.027) | (0.028) | (0.037) | (0.038) | (0.044) | (0.044) |
| Share * parental ed. missing | 0.142 ** | 0.115 * | 0.014 | 0.015 | 0.131 | 0.092 |
| | (0.059) | (0.06) | (0.088) | (0.089) | (0.081) | (0.081) |
| Age at school enrollment | -0.028 *** | -0.023 ** | -0.026 *** | -0.026 ** | -0.038 *** | 0.008 |
| | (0.005) | (0.01) | (0.005) | (0.011) | (0.011) | (0.025) |
| Age * parental ed. high | -0.015 | -0.009 | 0.010 | 0.010 | -0.063 ** | -0.052 * |
| | (0.017) | (0.017) | (0.02) | (0.02) | (0.031) | (0.031) |
| Age * parental ed. missing | 0.046 ** | 0.037 | 0.059 ** | 0.049 * | 0.029 | 0.013 |
| | (0.022) | (0.023) | (0.026) | (0.028) | (0.04) | (0.039) |
| Grade of tracking | 0.003 | -0.025 *** | 0.009 *** | -0.022 *** | -0.014 *** | -0.035 *** |
| | (0.003) | (0.005) | (0.003) | (0.006) | (0.005) | (0.012) |
| Grade * parental ed. high | -0.001 | -0.002 | -0.002 | -0.007 | 0.008 | 0.012 |
| | (0.007) | (0.007) | (0.009) | (0.009) | (0.01) | (0.01) |
| Grade * parental ed. missing | 0.013 | 0.014 | 0.020 | 0.021 | 0.027 | 0.030 |
| | (0.017) | (0.017) | (0.022) | (0.022) | (0.027) | (0.026) |
| **Individual control variables** | | | | | | |
| Father Age | - | 0.001 *** | - | 0.001 *** | - | 0.001 *** |
| | | (0.000) | | (0.000) | | (0.000) |
| Mother Age | - | 0.003 *** | - | 0.003 *** | - | 0.004 *** |
| | | (0.000) | | (0.000) | | (0.000) |
| Religion: Jewish (0/1) | - | 0.066 | - | 0.085 | - | 0.071 |
| | | (0.051) | | (0.059) | | (0.051) |
| Religion: Islamic (0/1) | - | -0.055 *** | - | -0.046 * | - | -0.047 *** |
| | | (0.008) | | (0.023) | | (0.009) |
| Religion: Other or no denomination (0/1) | - | 0.047 *** | - | 0.037 *** | - | 0.063 *** |
| | | (0.006) | | (0.006) | | (0.012) |
| Religion: No response (0/1) | - | -0.081 *** | - | -0.078 *** | - | -0.086 *** |
| | | (0.013) | | (0.016) | | (0.024) |
| One Sibling (0/1) | - | -0.02 *** | - | -0.018 ** | - | -0.026 ** |
| | | (0.006) | | (0.008) | | (0.012) |
| Two Siblings (0/1) | - | -0.03 *** | - | -0.025 *** | - | -0.041 *** |
| | | (0.005) | | (0.008) | | (0.011) |
| Three or more Siblings (0/1) | - | -0.047 *** | - | -0.042 *** | - | -0.059 *** |
| | | (0.008) | | (0.011) | | (0.01) |
| Female (0/1) | - | 0.085 *** | - | 0.082 *** | - | 0.094 *** |
| | | (0.008) | | (0.006) | | (0.013) |
| Second Generation Immigrant (0/1) | - | -0.015 ** | - | - | - | - |
| | | (0.007) | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Cantonal Proxy Variables** | | | | | | |
| Population share of foreigners | -0.266*** | | -0.329*** | | -0.35** | |
| | (0.057) | | (0.051) | | (0.135) | |
| Elementary school expenditure p.c. | - 0.013 | | - 0.029*** | | - -0.044*** | |
| | (0.008) | | (0.009) | | (0.013) | |
| Total education expenditure per capita | - 0.011 | | - 0.023** | | - -0.029* | |
| | (0.009) | | (0.011) | | (0.017) | |
| Teachers per 100 inhabitants | - 0.045*** | | - 0.04*** | | - 0.075*** | |
| | (0.01) | | (0.009) | | (0.013) | |
| Class size: primary school | - -0.028*** | | - -0.027*** | | - -0.03*** | |
| | (0.002) | | (0.002) | | (0.004) | |
| Class size: secondary school | - 0.012*** | | - 0.012*** | | - 0.019** | |
| | (0.002) | | (0.002) | | (0.007) | |
| Population share with higher degree | - 1.457*** | | - 2.124*** | | - 0.283 | |
| | (0.239) | | (0.322) | | (0.23) | |
| Population share with university degree | - -0.486 | | - -1.787*** | | - 3.139*** | |
| | (0.412) | | (0.482) | | (0.665) | |
| Population Density (communal) | - 0.564 | | - 0.971** | | - 0.155 | |
| | (0.364) | | (0.436) | | (0.22) | |
| French speaking region (0/1) | - 0.026 | | - 0.002 | | - 0.104*** | |
| | (0.017) | | (0.021) | | (0.028) | |
| Italian speaking region (0/1) | - 0.151*** | | - 0.125*** | | - 0.289*** | |
| | (0.034) | | (0.042) | | (0.053) | |
| Share left wing politicians in parliament | - 0.06 | | - 0.116** | | - -0.157** | |
| | (0.038) | | (0.044) | | (0.061) | |
| Population share in urban areas | - -0.022 | | - -0.009 | | - -0.086** | |
| | (0.016) | | (0.016) | | (0.034) | |
| Population | - -0.879*** | | - -1.039*** | | - -0.649*** | |
| | (0.114) | | (0.13) | | (0.149) | |
| Gini: equivalent incomes 2003 | - -0.484*** | | - -0.56*** | | - -0.012 | |
| | (0.067) | | (0.079) | | (0.126) | |
| Gini: equivalent incomes 1995 | - 0.793*** | | - 0.778*** | | - 0.514 | |
| | (0.157) | | (0.182) | | (0.303) | |
| Degree of local autonomy | - -0.135*** | | - -0.172*** | | - -0.071 | |
| | (0.032) | | (0.032) | | (0.058) | |
| No.adv.schools/1000 inhabitants (municip.) | - 0.101 | | - -0.027 | | - 0.881*** | |
| | (0.118) | | (0.148) | | (0.301) | |
| No.adv.schools/1000 inhabitants missing | - 0.316* | | - 0.588*** | | - -0.633** | |
| | (0.155) | | (0.169) | | (0.248) | |
| Female labor force partic.(full-&part-time) | - 0.000 | | - 0.000 | | - 0.000 | |
| | (0.000) | | (0.000) | | (0.000) | |
| Female labor force partic.(full-time) | - -0.27 | | - -0.402 | | - 0.035 | |
| | (0.285) | | (0.287) | | (0.448) | |
| Intercept | 0.313* | 0.301*** | 0.267* | 0.281*** | 0.461* | -0.091 |
| | (0.156) | (0.092) | (0.147) | (0.094) | (0.23) | (0.397) |
| Number of observations | 61676 | 61676 | 47250 | 47250 | 14426 | 14426 |
| R squared | 0.1394 | 0.1677 | 0.1208 | 0.1483 | 0.1791 | 0.2146 |

Notes: See Table 5.
Source: See Table 3.

**Table A.2** Estimation results of joint linear regression for all three institutions with interaction terms for romanic language region

| | All | Natives | Immigrants |
|---|---|---|---|
| Parental education: high | 0.222 | 0.140 | 0.491 ** |
| | (0.142) | (0.147) | (0.214) |
| Parental education: missing | -0.173 | -0.271 | -0.237 |
| | (0.112) | (0.219) | (0.29) |
| Share of 4-years-olds | -0.255 *** | -0.269 *** | -0.423 *** |
| | (0.038) | (0.04) | (0.095) |
| Share * parental ed. high | -0.079 | -0.083 | -0.013 |
| | (0.106) | (0.112) | (0.189) |
| Share * parental ed. missing | 0.084 | -0.321 * | 0.436 ** |
| | (0.092) | (0.172) | (0.171) |
| Age at school enrollment | -0.022 *** | -0.024 *** | 0.013 |
| | (0.003) | (0.003) | (0.019) |
| Age * parental ed. high | 0.002 | 0.021 | -0.057 * |
| | (0.017) | (0.018) | (0.029) |
| Age * parental ed. missing | 0.018 | 0.027 | 0.016 |
| | (0.016) | (0.024) | (0.023) |
| Grade of tracking | -0.006 ** | 0.003 | -0.025 *** |
| | (0.002) | (0.002) | (0.007) |
| Grade * parental ed. high | 0.023 * | 0.015 | 0.041 ** |
| | (0.013) | (0.01) | (0.019) |
| Grade * parental ed. missing | -0.004 | 0.004 | 0.008 |
| | (0.01) | (0.022) | (0.032) |
| Roman cantons (R) | -0.593 *** | -0.365 *** | -1.25 *** |
| | (0.042) | (0.052) | (0.319) |
| R * share of 4 year olds | 0.718 *** | 0.734 *** | 0.993 *** |
| | (0.035) | (0.039) | (0.138) |
| R * Share * parental ed. high | 0.012 | 0.050 | -0.085 |
| | (0.118) | (0.125) | (0.195) |
| R * Share * parental ed. missing | 0.116 | 0.514 ** | -0.400 ** |
| | (0.096) | (0.185) | (0.177) |
| R * age at school enrollment | 0.093 *** | 0.056 *** | 0.197 *** |
| | (0.006) | (0.008) | (0.055) |
| R * Age * parental ed. high | 0.032 ** | 0.031 *** | 0.035 * |
| | (0.013) | (0.011) | (0.018) |
| R * Age * parental ed. missing | -0.036 ** | -0.050 * | -0.019 |
| | (0.013) | (0.029) | (0.033) |
| R * grade of tracking | -0.016 *** | -0.020 *** | -0.006 |
| | (0.003) | (0.003) | (0.013) |
| R* Grade * parental ed. high | -0.029 * | -0.027 * | -0.037 * |
| | (0.015) | (0.014) | (0.021) |
| R* Grade * parental ed. missing | 0.024 | 0.027 | 0.031 |
| | (0.014) | (0.031) | (0.034) |
| Additional controls | yes | yes | yes |
| **Joint significant tests (d.f.)** | | | |
| R * all interactions (6) | F=7.12 | F=14.18 | F=1.97 |
| | p=0.000 *** | p=0.000 *** | p=0.108 |
| R * all interactions + level (9) | F=183.09 | F=191.41 | F=21.61 |
| | p=0.000 *** | p=0.000 *** | p=0.000 *** |
| R* share: interactions (2) | F=0.79 | F=4.02 | F=2.56 |
| | p=0.464 | p=0.031 ** | p=0.098 * |
| R * share: interactions + level (3) | F=207.47 | F=226.97 | F=22.35 |
| | p=0.000 *** | p=0.000 *** | p=0.000 *** |
| R * age: interactions (2) | F=14.30 | F=11.76 | F=1.90 |
| | p=0.000 *** | p=0.000 *** | p=0.170 |
| R * age: interactions + level (3) | F=130.87 | F=33.14 | F=5.68 |
| | p=0.000 *** | p=0.000 *** | p=0.004 *** |
| R * grade: interactions (2) | F=7.09 | F=4.42 | F=1.74 |
| | p=0.004 *** | p=0.023 ** | p=0.196 |
| R * grade: interactions + level (3) | F=51.84 | F=45.37 | F=1.57 |
| | p=0.000 *** | p=0.000 *** | p=0.223 |

Notes: See Table 5.
Source: See Table 3.