

# The long-term effect of school entry laws on educational attainment and earnings in an early tracking system

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## Abstract

Empirical evidence suggests that relative age, which is determined by date of birth and the school entry cutoff date, has a causal effect on track choice. Using a sample of male labor market entrants drawn from Austrian register data, I analyze whether the initial assignment to different school tracks has long-term effects on educational attainment and earnings in the first years of the career. I estimate the reduced-form effect of the school entry law on starting wages and find a wage penalty of 1.4-1.9 percentage points for students born in August (the *youngest*) compared to students born in September (the *oldest*). The analysis of educational attainment suggests that significant differences in the type of education exist. Younger students are more likely to pursue an apprenticeship and less likely to have a higher education. The analysis of short-run wage profiles shows that wages converge after three years of experience. Additional evidence suggests that this convergence is in line with human capital theory.

*JEL Classification:* I21, J24, J31

*Keywords:* School entry law, early tracking, educational attainment, earnings, labor market entrants

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# 1 Introduction

The growing public interest in international comparisons of student achievement (e.g. PISA, TIMSS) has fueled the academic debate on the impact of organizational aspects of the education system. One of these organizational aspects is the timing and extent of tracking, i.e. the allocation of students into differing-ability schools or classes. The economic literature on tracking has focused on equality of opportunity and efficiency aspects. While there is clear evidence that early tracking reinforces the role of parental background and limits intergenerational mobility in education and earnings, there is no consensus on whether early tracking is efficient or not.<sup>1</sup> One of the main arguments in favor of early tracking is that teachers are more effective in teaching homogenous classrooms. On the other hand, less gifted students may benefit from the presence of more gifted peers. In that case, delaying the separation into tracks could be more efficient.

Recently, economists have emphasized that early tracking may be inefficient because track choice is influenced by factors other than innate ability, for instance the age of a student. Brunello, Giannini, and Ariga (2007) argue that the allocation of students to tracks is based on a noisy signal and that the size of the noise is decreasing with the age at first selection. Allen and Barnsley (1993) and Bedard and Dhuey (2006) stress that the long-run cost of the misallocation rise with the difference in the rates of human capital accumulation between tracks.

In Austria and Germany, students are allocated to academic and vocational schools at the age of ten.<sup>2</sup> Recent empirical studies for these countries show that the

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<sup>1</sup>See for instance, Bauer and Riphahn (2006), Ammermüller (2005), Pekkarinen et al. (2009b), Brunello and Checchi (2007), Dustmann (2004), Malamud and Pop-Eleches (2011) and Hanushek and Wößmann (2006) for evidence on equality of opportunity aspects, and Duflo, Dupas, and Kremer (2011), Galindo-Rueda and Vignoles (2004), Pischke and Manning (2006), Meghir and Palme (2005), Guyon, Maurin, and McNally (2010), Hall (2012), Malamud and Pop-Eleches (2010) and Pekkarinen, Uusitalo, and Kerr (2009a) for evidence on efficiency aspects.

<sup>2</sup>In some German states students are tracked at the age of 12. Within OECD countries, the age at first tracking varies considerably: Hungary, the Czech Republic, Slovakia and Turkey track their students at the age of 11, Belgium and Mexico at the age of 12 and Chile, Luxembourg and the Netherlands at the age of 13. All other OECD countries track their students at the age of 14 to 18 (Brunello and Checchi, 2007).

youngest students within a school cohort (grade) are significantly less likely to attend the academic track compared to their older peers (Jürges and Schneider, 2011; Mühlenweg and Puhani, 2010; Schneeweis and Zweimüller, 2009).

This paper focuses on the long-term effects of the school entry law on educational attainment and earnings in an early tracking system. The school entry law assigns students to different school entry cohorts based on their date of birth and generates an age difference of 11 months between children born in August and children born in September. This age difference leads to a difference in the probability of choosing the academic track at the age of 10 (Schneeweis and Zweimüller, 2009). August-born children are less likely than September-born children to attend the academic track in grades 5-8. Since the academic track offers a more advanced curriculum, a higher peer quality and teachers with higher qualifications (and salaries), the school entry law implies that younger and older students are exposed to schools of different quality for at least four years of their school career. Furthermore, younger students are less likely to choose a higher secondary school at the age of 14.

In this paper, I analyze whether the initial assignment to different school tracks has long-term effects on educational attainment and earnings in the first years of the career. The analysis is based on a sample of male labor market entrants drawn from the *Austrian Social Security Database* and followed over time. I estimate the reduced-form effect of the school entry law on starting wages and short-run wage profiles and find a wage penalty of 1.4-1.9 percentage points for students born in August (the *youngest*) compared to students born in September (the *oldest*). I estimate a reduced-form approach without specifying any channel through which wages could be affected, but — to a certain degree — the data allows me to analyze differences in the quantity and quality of education directly. The estimation results suggest that there are significant differences in the type of education but not in the years of education. Younger individuals are significantly more likely to pursue an apprenticeship and are less likely to have at least higher general/vocational education

and to hold a degree. The analysis of short-run wage profiles shows that wages converge after three years of labor market experience.

Although the school entry law entails differences in school quality and educational attainment between children born before the cutoff date and children born after the cutoff date, the impact on labor market outcomes is only minor. It seems likely that the dual education system which combines professional training at a firm with vocational and general education at a part-time vocational school is partly responsible for the results in this study. The results are also in line with Malamud and Pop-Eleches (2010), who find that a reform that shifted students from vocational to general education had no effect on labor market outcomes such as unemployment and wages although the affected cohort was less likely to work in a manual or craft-related occupation.

## 2 Related literature

An increasing body of empirical research documents that the position of a student in the age distribution within a grade or class has a causal effect on school performance (e.g. Bedard and Dhuey, 2006; Datar, 2006; Fredriksson and Öckert, 2006; McEwan and Shapiro, 2008). Since part of the variation in age is due to parental discretion in the timing of school entry, the causal effect is identified by using only the exogenous variation in age that stems from the distribution of births over the calendar year and the school entry cutoff date. The birth month of a student determines his or her relative age within a grade because school entry is based on a specific cutoff date. If the entry rule is strictly followed, students born after the cutoff date are almost one year older than students born before the cutoff date. Using birth month relative to the cutoff date as an instrument for a student's age in a given grade, these studies identify the causal effect of relative age<sup>3</sup> on school performance for

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<sup>3</sup>The concept of "relative age" was first introduced by Allen and Barnsley (1993) and refers to age differences between individuals that are grouped by cohort (based on a specific cutoff date).

compliers.<sup>4</sup> Compliers are students who are among the oldest within grade only because they are born after the cutoff date and would be among the youngest if they were born before the cutoff date.

One key criticism in this literature is that this identification strategy does not allow to discriminate between the age-at-school-entry effect and the age-at-test effect as long as students' performance is measured when they are still in school.<sup>5</sup> A notable exception are Black, Devereux, and Salvanes (2011), who disentangle these effects by using IQ scores of 18-year-old Norwegian students measured outside of school. They provide compelling evidence for a positive age-at-test effect, whereas starting school one year later has a small negative effect on IQ scores. Elder and Lubotsky (2009) find that the relative age effect fades with the duration of schooling, which is interpreted as evidence that the age-at-test effect dominates. They also find higher effects for children with more favorable parental background, suggesting that the relative age effect partly reflects differences in skill accumulation prior to kindergarten enrollment.

Irrespective of their actual origin, relative age effects may be perpetuated by the education system, if, for example, students are separated into different educational tracks very early. In Austria and Germany, lower secondary students are physically segregated into academic (high track) schools or vocational (low track) schools at the age of 10 (in grade 5). Schneeweis and Zweimüller (2009) show that older students are 13-17 percentage points more likely to attend a high track school in grade 8 than their younger peers of the same grade. Mühlenweg and Puhani (2010) and Jürges and Schneider (2011) find similar results for Germany, where lower secondary education lasts until grade 9 (or grade 10 in some states). Although students may revise their

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<sup>4</sup>See Angrist et al. (1996) for the interpretation of causal effects in a heterogenous treatment effects framework.

<sup>5</sup>The age-at-school-entry effect is the causal effect of starting school at an older age on school performance. The age-at-test effect is due to the fact that some children are older when educational achievement is measured. The age-at-school-entry effect is perfectly collinear with the age-at-test effect because students who start school later are also older when their educational achievement is measured.

track choice in any grade, upward mobility is limited because of differences in the curricula between high track and low track schools. After graduating from a low track school, a considerable number of students does revise the initially chosen track by upgrading to a general or vocational high track school. While Mühlenweg and Puhani (2010) show that the relative age effect disappears because students have the possibility to revise their track choice, Schneeweis and Zweimüller (2009) still find an age penalty for the youngest Austrian students.<sup>6</sup>

The evidence on age-related differences in long-term outcomes such as educational attainment or earnings is mixed. Using German survey data on the school entry cohorts 1966–1980, Fertig and Kluge (2005) find no significant relationship between school starting age and educational attainment, neither for West Germany where students were tracked at the age of ten, nor for East Germany where education was comprehensive until the age of 16. Likewise, Black, Devereux, and Salvanes (2011) find no evidence that starting school later has a positive effect on educational attainment in a sample of Norwegian students born 1962–1980. In contrast, Fredriksson and Öckert (2006) find a positive effect on years of schooling and the probability of attending college for the Swedish population born 1935–1974. Their results suggest that the effect is higher for cohorts that attended a selective school system than for cohorts that were in the comprehensive school system that was introduced gradually between 1950 and 1967.

The latter two studies also look at the long-run impact on earnings. Fredriksson and Öckert (2006) show that the age effect on earnings is negative for younger cohorts and positive for older ones. This finding is consistent with a concave experience-earnings profile. Although starting school later may have a positive effect on educational attainment, it definitely reduces labor market experience at a given age. The opposing results for younger and older cohorts may reflect that small differences in labor market experience are more important in earlier stages of the working life.

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<sup>6</sup>Note that the elimination of the age effect is only due to students upgrading to vocational high track schools and not to general high track schools (Mühlenweg and Puhani, 2010).

Alternatively, it may be that the age effect is stronger for older cohorts because they attended the selective school system.<sup>7</sup> Black, Devereux, and Salvanes (2011) track different cohorts from age 24 to age 35 and estimate separate regressions for each age group. They find a negative effect on earnings at younger ages and no effect at older ages, supporting the hypothesis that the cohort difference is due to the concave experience-earnings profile. However, their sample does not include individuals who were separated into different educational tracks early in the school career.

Dustmann, Puhani, and Schönberg (2012) analyze the long-term effects of the type of middle school attended in grade 5 to grade 9/10 on labor market outcomes in Germany. They distinguish between a direct effect that is due to differences in middle school quality and an indirect effect via completed education and show that the type of middle school affects neither educational attainment nor labor market outcomes of men aged 30 and above.<sup>8</sup> These results are in line with Mühlenweg and Puhani (2010) who find that relative age effect disappears after the second tracking because students have the possibility to revise their track choice. In contrast, Schneeweis and Zweimüller (2009) provide evidence that the relative age effect does not fully disappear after the second tracking in Austria.

In this paper, I estimate the reduced-form effect of the school entry law on educational attainment and earnings based on a sample of male labor market entrants in Austria, a country where first tracking occurs very early by international comparison. By focusing on the outcomes of labor market entrants the study avoids confounding the estimated effect with differences in labor market experience and shows how the effect evolves as these workers gain labor market experience.

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<sup>7</sup>Fredriksson and Öckert (2006) are not able to discriminate between these two explanations because cohort effects cannot be distinguished from experience effects in cross-sectional data.

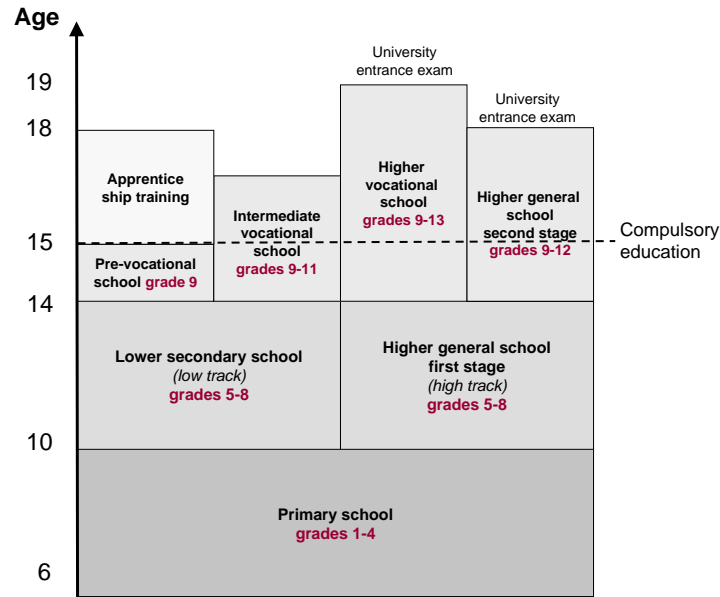
<sup>8</sup>Grenet (2009) provides evidence for France where first tracking occurs at the age of 14. He finds that younger students (born in December) are more likely to be held back in school, are more likely to choose a vocational qualification, are more likely to be unemployed and have somewhat lower wages than their older peers (born in January). For the US, Dobkins and Ferreira (2010) find no effect of birth month on labor market outcomes (employment and wages) and other long run outcomes (home ownership and house prices) although there is evidence that the youngest students obtain more education than their older peers which is due to the interaction of school entry laws with compulsory schooling laws (Angrist and Krueger, 1991).

This study is also related to the literature on the effects of postponing or reducing tracking on educational achievement and labor market outcomes. Recent research by Malamud and Pop-Eleches (2010) and Hall (2012) show that the adoption of a more comprehensive schooling system had no discernible impact on university enrollment, wages, family income and the incidence of unemployment (and non-employment). However, in both countries (Romania and Sweden) students attended a comprehensive school system until the age of 14 (or 16) already before the respective reform.

### 3 Institutional background

Figure 1 shows the structure of the Austrian education system which is characterized by early tracking, a multitude of different educational tracks and a strong vocational orientation.

Figure 1: The Austrian education system



Austrian children enter primary school in a given year if they turn six before September 1 of that year. Children who turn six thereafter have to delay enrollment by one year. Accordingly, being born in August implies being among the youngest students within a cohort whereas being born in September implies being among the



oldest students. Since children may differ in maturity, these entry rules are not strictly enforced. For instance, children born between September 1 and December 31 may enroll early under certain circumstances.<sup>9</sup> On the other hand, children who are not mature enough have to attend the pre-primary class instead of the first grade of primary school. Furthermore, if a student's achievement is insufficient in more than two subjects he or she has to repeat the grade. Since late enrollment (and grade retention) is much more common among students born before the cutoff date, the average age difference between September-born and August-born students is about 5 months (instead of 11 months under strict enforcement and without grade retention).<sup>10</sup>

Compulsory education lasts nine years. After four years of primary school, students are physically separated into academically-oriented higher general schools and vocationally-oriented lower secondary schools. The admission to a higher general school depends on primary school grades in the core subjects (Mathematics, German writing and reading) or an entrance exam. Furthermore, primary school teachers give recommendations but these are not binding.<sup>11</sup> Both types of education last four years but differ in many aspects, such as the curricula, and the qualifications and salaries of teachers. Formally, students have the possibility to switch between tracks, however, the more advanced curriculum in the academic track inhibits upward mobility from the vocational to the academic track.

In grade 9, the Austrian education system offers a variety of educational tracks: pre-vocational schools, a range of intermediate and higher vocational schools<sup>12</sup> and the second stage of higher general schools. Most students who attend a higher general school in grade 8 stay there for another four years or change to a higher

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<sup>9</sup>The parents have to apply for early enrollment, the health officer of the school has to confirm that the child is mature enough and the primary school principal has to agree.

<sup>10</sup>See Schneeweis and Zweimüller (2009).

<sup>11</sup>The majority of Austrian students attends a lower secondary school, e.g. in the school year 2006/07 about 67 percent of Austrian students attended a lower secondary school in grade 8 (Statistik Austria, 2008).

<sup>12</sup>There are several types of intermediate and higher vocational schools with different professional orientations, e.g. business, technical, tourism, teacher training, agricultural.

vocational school. Both school types provide university entrance qualifications upon completion. Higher vocational schools intend to prepare students for a profession in addition to providing higher general education. In contrast, the majority of lower secondary school students attends either a pre-vocational school or an intermediate vocational school. While intermediate vocational schools last three years and provide professional education, pre-vocational schools are one-year-schools that provide the last year of compulsory education and prepare students for apprenticeship training.

Apprenticeships last between two and four years and consist of professional training at a firm combined with vocational and general education at a part-time vocational school. Apprenticeship training is required for a multitude of occupations ranging from traditional crafts professions to sales, administrative and technical professions.<sup>13</sup> The acquired skill level strongly depends on the type of occupation. While part of these occupations can be considered as low-skilled, other — more forward-looking and medium-skill — occupations offer fairly good labor market and advancement opportunities.

## 4 Empirical framework

This section explains the estimation model (section 4.1), the data (section 4.2) and the estimation sample (section 4.3), and provides descriptive statistics (section 4.4). In contrast to previous studies the reduced-form effect of the school entry rule (birth month) on earnings and educational attainment is estimated for a sample of male workers who enter the labor market for the first time. The advantage of this strategy is that earnings differences between the youngest (i.e. August-born) and the oldest (i.e. September-born) individuals of a labor market entry cohort do not reflect differences in labor market experience but rather differences in the quantity and quality of education or skills acquired before entering the labor market.

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<sup>13</sup>There are about 260 apprenticeship occupations.

## 4.1 Econometric model

The estimation model is based on the reduced-form approach suggested in Bedard and Dhuey (2006):<sup>14</sup>

$$Y_i = \alpha_0 + \alpha_1 \text{Assigned age}_i + \alpha_2 X_i + \alpha_3 t_i + \epsilon_i \quad (1)$$

where  $Y_i$  is the outcome of individual  $i$  (e.g. the starting wage),  $X_i$  is a vector of exogenous variables,  $t_i$  is the year in which individual  $i$  entered the labor market and  $\epsilon_i$  is the error term. The variable of interest, *assigned age* <sub>$i$</sub> , is a discrete variable ranging from 0 for individuals born in August to 1 for individuals born in September. The difference in assigned age between August-born and September-born individuals corresponds to 11 months. Assigned age is obtained through a simple transformation of birth month:

$$\text{Assigned age}_i = \begin{cases} \frac{8-b_i}{11} & \text{if } 1 \leq b_i \leq 8 \\ \frac{20-b_i}{11} & \text{if } 9 \leq b_i \leq 12 \end{cases}$$

where  $b_i$  is the birth month of individual  $i$ .

The main outcomes in this analysis are the starting wage and the wage in each of the five years after labor market entry. The model estimates the reduced-form effect of assigned age according to the school entry law on the (starting) wage of an individual without specifying any channel through which the (starting) wage could be affected. Since the school entry rule states that August-born kids have to enroll one year earlier than September-born kids, they are less mature at school entry and less mature when they have to decide which track to attend at age 10 (first tracking) and at age 14 (second tracking). As discussed in section 2, this difference in maturity potentially entails differences in school quality in grades 5-8 (direct effect) and differences in educational attainment (indirect effect). I try to assess

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<sup>14</sup>Bedard and Dhuey (2006) use assigned age as an instrument for observed age to estimate relative age effects on test scores for a number of OECD countries.

the importance of the indirect effect by analyzing different measures of educational attainment.

The administrative data does not contain information on the actual age at school entry or track choice. Hence, there is no possibility to estimate a two-stage least squares regression with assigned age as an instrument for the observed age at school entry (or track choice).<sup>15</sup> Fortunately, the reduced-form effect is also informative and policy-relevant as it shows whether the combination of early tracking and the school entry rule leads to inferior long-term outcomes for relatively younger students. Since the mapping from assigned age to observed age (the first stage) is not one (due to late enrollment, early enrollment and grade retention), the estimated effect may encompass compensating effects. For instance, the age effect may be offset for students who do not comply with the school entry law and enroll one year later or earlier than they should according to the law.<sup>16</sup>

Another channels through which the (starting) wage could be affected are non-cognitive skills. Dhuey and Lipscomb (2008) and Thompson et al. (2004) provide evidence that older students have more leadership experience and self-esteem, which could have a positive effect on labor market outcomes. In contrast, Pellizzari and Billari (2012) argue that these psychological effects could decrease the amount of time that relatively younger students devote to social activities because they have a lower return to these activities. Using Italian data, they find that relatively younger students have less active social lives, devote more time to studying and perform better at university.

The estimated effect does not reflect ability differences if the birth month of an individual is randomly assigned and therefore, not related to unobserved characteristics that are correlated with wages (e.g. ability, parental background). Buckles and

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<sup>15</sup>Based on the estimates obtained in Schneeweis and Zweimüller (2009) I could estimate a two-sample two-stage least squares regressions. However, if both effects — the direct and the indirect one — exist, two instrumental variables would be needed to separately identify both effects.

<sup>16</sup>As expected, late enrollment is much more frequently observed among the youngest students and early enrollment is almost exclusively observed among students born between September and December. See Schneeweis and Zweimüller (2009).

Hungerman (2008) show that children born in spring outperform children born in winter and have a better family background, suggesting that quarter of birth is not a valid instrument. In the Austrian case children born just below and just above the cutoff date are born within the same season, hence, these objections are less evident. Since the administrative data does not include any measure of parental background or ability I can not formally test the identification assumption, but I can show the sensitivity of the estimated coefficient with respect to the inclusion of quarter of birth indicators as control variables. Furthermore, I provide some graphical evidence based on data from PISA (Programme for International Student Assessment, waves 2003 and 2006) and the Austrian birth register. Figures A.1 and A.2 in the appendix do not indicate a clear pattern of seasonality or birth timing.<sup>17</sup>

Estimation model (1) imposes a linear relationship between the assigned age and the starting wage of an individual. As a robustness check, I follow Dobkins and Ferreira (2010) and estimate a regression discontinuity model, controlling for a linear trend that is allowed to have different slopes before and after the cutoff date:

$$Y_i = \beta_0 + \beta_1 Old_i + \beta_2 Dist_i + \beta_3 Old_i * Dist_i + \beta_4 X_i + \beta_5 t_i + \eta_i \quad (2)$$

where *Old* is a binary variable that is one for individuals who are born in the six months after the cutoff date (i.e. between September 1 and February 28) and zero otherwise, and *Dist* is the distance between an individual's birth month and the cutoff date. Due to the interaction between *Old* and *Dist*, the trend may differ before and after the cutoff date.

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<sup>17</sup>In a related paper, Schneeweis and Zweimüller (2009) show that the inclusion of an index of parental socioeconomic status and parental education has no impact on the reduced form effect of assigned age on track choice.

## 4.2 Data

The empirical analysis is based on administrative employment records from the *Austrian Social Security Database* (ASSD). The ASSD is a matched firm-worker database which combines detailed longitudinal information on employment (including basic employer information) and earnings for all private sector workers in Austria since 1972 (Zweimüller et al., 2009). Since these data are administrative records to verify pension claims it contains complete and precise information about employment histories and earnings. The longitudinal dimension of the data allows me to identify labor market entrants and to track the labor market histories of these individuals over time. The main drawbacks of these data are that earnings are top-coded and there is no information on the number of working hours and no comprehensive measure of educational attainment.<sup>18</sup> However, the database includes information on whether an individual has pursued an apprenticeship training or holds a degree (MA/MSc or PhD). For a subsample (about 65 percent of the total sample), more detailed information on educational attainment is available in the *Austrian unemployment register* and can be linked to the ASSD. The combination of different databases allows me to show whether school entry laws lead to differences in educational attainment.

The data on wages is provided by employer and year. Wages for self-employed workers and farmers are only continuously available since 1997 and wages of civil servants are not recorded at all in the ASSD. Wages of civil servants are obtained from the *Austrian Tax Register* which covers gross wages for all dependent employees in the private and the public sector and is available from 1994 to 2005.<sup>19</sup> Due to these data restrictions, the estimation sample consists only of individuals who entered the labor market between 1997 and 2000, and their wages up are observed until five

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<sup>18</sup>Earnings are top-coded because there is a maximum level for contributions to the old-age pension system and a maximum level for old-age pension benefits for private sector workers.

<sup>19</sup>Wages are top-coded in the ASSD but not in the tax register. To make the earnings data comparable I apply the same (yearly) thresholds to the gross wages of civil servants from the tax register data.

years after their labor market entry. The starting wage refers to the first regular employment spell, whereas subsequent wages are measured as average earnings over all employment spells in a given year.

### 4.3 Definition of job starters

The labor market entry spell is defined as the first regular employment spell of an individual that is not a marginal employment spell and lasts for at least 60 days in a row<sup>20</sup> or 180 days with the same employer but periods of non-employment in between.<sup>21</sup> Apprenticeship spells are not considered as entry spells, but rather as part of the education of an individual. The entry spell of an apprentice is the first employment spell — according to the criteria above — that is not an apprenticeship spell.

Due to the lack of information on working hours, labor supply changes are only observed at the extensive margin and not at the intensive margin. Since female workers are more likely than male workers to work part-time due to family responsibilities, the analysis focuses on male labor market entrants. Furthermore, females are also more likely to temporarily leave the labor market when they have a child which complicates the analysis of their wage profiles.

I consider only individuals who are Austrian citizens because the definition of the entry spell is hardly possible for immigrants. The first spell observed in the data could either be the entry spell or the first employment spell of that individual in the Austrian labor market. Moreover, the estimation sample is restricted to individuals entering the labor market before they turn 31. A labor market entry above the age of 30 may indicate that the individual has already worked abroad, is still in education or is unable to find stable employment. Since I cannot distinguish between those

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<sup>20</sup>An employment spell during the summer (June-September) that last 60 days or longer is not considered as first regular employment spell if this is the only employment spell in that year because this spell is most likely only a summer job of an individual that is still in education.

<sup>21</sup>The definition of the entry spell is somewhat arbitrary. Therefore, I also use other thresholds to test the sensitivity of the results with respect to this definition (30 days/150 days and 90 days/180 days). Results do not change and are available upon request.

explanations I drop these individuals from the estimation sample.<sup>22</sup> Figure 2 shows the distribution of the entry age for males labor market entrants. The majority of individuals enters the labor market between the age of 18 to 20, i.e. when they have finished secondary education or an apprenticeship training (and the compulsory military service).

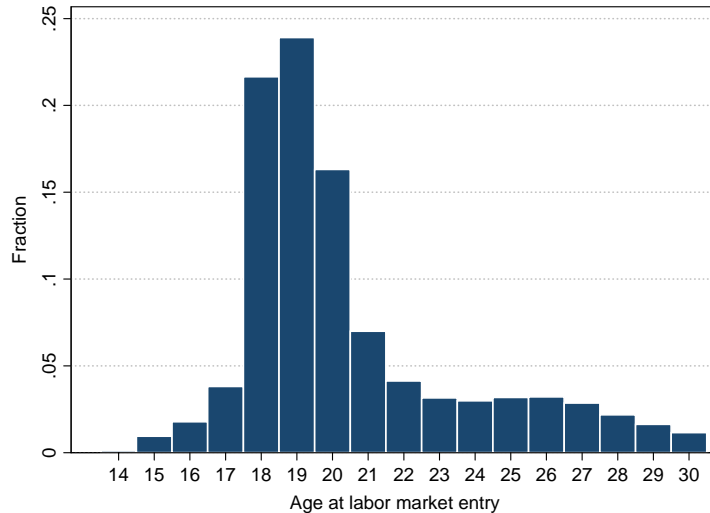


Figure 2: Distribution of age at labor market entry

#### 4.4 Descriptive statistics

The estimation sample consists of 169,987 male labor market entrants. Summary statistics are provided in table 1. The average labor market entrant is almost 21 years old and holds his first job for less than two years. Male workers earn a starting wages of 56.45 Euros on average. The starting wage refers to the first regular employment spell and is measured as the real daily wage in prices of 2008, i.e. the real wage per day actually worked. Wages are measured in the first year after labor market entry for apprentices who stay at the same firm after finishing their apprenticeship training. For this group, measuring the starting wage in the year of labor market entry would lead to an underestimation of starting wages because wages are

<sup>22</sup>Only about four percent of the sample is older than 30 years. The results do not change substantially when these workers are included in the estimation sample.



measured per employer and year and the remuneration during the apprenticeship is lower than the starting wage.<sup>23</sup>

Table 1: Summary statistics

Variable	Mean	SD
Real daily starting wage	56.45	21.86
Age at job entry	20.90	3.16
Duration of entry job (years)	1.71	2.58
Academic degree <sup>a</sup>	0.09	
Skilled worker	0.44	
Unskilled worker	0.10	
Apprenticeship training (at least 2.5 years)	0.46	
Any apprenticeship training	0.51	
Length of apprenticeship period (years) <sup>b</sup>	3.11	0.73
Higher general/vocational school or more <sup>c</sup>	0.26	

NOTES: N=169,987. <sup>a</sup>The degree refers to the year 2008 because the ASSD only includes the current degree of an individual. <sup>b</sup>All individuals who had any apprenticeship training. <sup>c</sup>This information is only available for 109,963 individuals (65 percent of the sample).

The table also provides summary statistics for different measures of educational attainment. 51 percent of male workers have some apprenticeship training and 9 percent hold an academic degree (MA/MSc or PhD). Based on the age at labor market entry and the information about apprenticeship training in the administrative data, a rough measure of a worker's skill level can be computed. The medium-skilled group includes all workers who have an apprenticeship training that lasted at least 2.5 years. This restriction ensures that these workers most likely have completed their apprenticeship training. The skilled group consists of workers who entered the labor market at age 19 or above and have no apprenticeship training. Workers are considered unskilled if they entered the labor market before the age of 19 and have not completed an apprenticeship. According to this definition, 44 percent of male labor market entrants are skilled workers, 46 percent have completed an apprenticeship and 10 percent are unskilled workers. The last measure of educational

<sup>23</sup>In the estimations below, I control for a dummy variable that indicates whether the starting wage is measured one year after labor market entry. However, the results are not sensitive to the exclusion of this variable.

attainment is derived from detailed categories of completed education (ranging from compulsory schooling to the type of tertiary education) and shows whether the labor market entrant has at least finished a higher general/vocational school. However, this information is only available for a subsample of 109,963 individuals (65 percent) who have registered at the public employment office after finishing education.<sup>24</sup>

Table 2 shows the distribution of the type of the first job spell and the average starting wage for each type. The majority of male individuals starts in a blue-collar job (56.5 percent) or a white-collar job (38.5 percent). About 1.5 percent directly enter a public sector job and 2.4 percent and 1.1 percent start as self-employed or farmer, respectively. Individuals in public sector, white-collar and blue-collar jobs earn higher starting wages than self-employed workers or farmers.

Table 2: Real daily starting wage by type of entry job

	Obs.	%	Mean	SD
White-collar	65,475	38.5	57.6	24.9
Blue-collar	96,094	56.5	56.5	17.5
Civil servant	2,580	1.5	69.7	20.3
Self-employed	4,053	2.4	39.1	38.9
Farmer	1,785	1.1	29.2	21.0
Total	169,987	100.0	56.5	21.9

## 5 Results

The first part of the analysis focuses on the reduced-form effect of the school entry law (assigned age) on starting wages (section 5.1) and educational attainment (section 5.2). In the second part, I show how the effect evolves as workers gain

<sup>24</sup>Since workers have to register at the public employment office to be observed in the subsample, this sample may be negatively selected. However, selection may not be such a problem because all individuals who do not start working immediately after finishing education have to register at the public employment office in order to be covered by the health insurance of their parents unless they pay for their own health insurance.

labor market experience and try to assess the reasons for the observed development (section 5.3).

## 5.1 Starting wages

Table 3 presents regression results for estimation models 1 and 2. The base specification in the first column suggests that being born in August instead of September results in a wage penalty of 1.6 percentage points (model 1). Controlling for season of birth effects (column (2)) does not significantly change the estimated coefficient and the estimates from the regression discontinuity model are also very similar. Figure A.3 in the appendix give a graphical representation of the results of estimation model 2. The figure shows that here is a clear discontinuity at the cutoff date.

Table 3: The effect of the school entry law (assigned age) on the starting wage

	(1)	(2)	(3)
<i>Model 1:</i>			
Assigned age	0.016*** (0.004)	0.014*** (0.005)	0.018*** (0.004)
Adjusted $R^2$	0.023	0.023	0.159
<i>Model 2:</i>			
Old	0.019*** (0.005)	0.015** (0.006)	0.021*** (0.005)
Distance	0.001 (0.001)	-0.002 (0.002)	0.002* (0.001)
Distance X Old	-0.004** (0.001)	-0.004** (0.002)	-0.004*** (0.001)
Adjusted $R^2$	0.023	0.023	0.159
Year of labor market entry	x	x	x
Quarter of birth		x	
Type of entry job			x
Observations	169,987	169,987	169,987

NOTES: Robust standard errors in parentheses. \*\*\*, \*\* and \* indicate significance at the 1-percent, 5-percent and 10-percent level. All regressions include a dummy variable that indicates whether wages are measured one year after labor market entry. See section 4.3 for further details.

Table 4 shows whether the type of entry job is related to the assigned age of a labor market entrant. The estimated marginal effects are obtained from a multinomial

logit regression with the type of entry job as dependent variable. September-born males are significantly less likely to work in a blue-collar job and significantly more likely to work in a white collar-job than August-born males. This difference in the type of entry job may explain the observed wage penalty for August-born males. Blue-collar workers typically perform manual labor and are directly involved in the production process. In contrast, white-collar workers are non-manual workers in supervising, administrative, sales or service jobs. On average, white-collar jobs require more qualifications and pay higher wages. Column (3) of table 3 shows the estimated effect of the school entry rule conditional on the type of entry job. Since the conditional effect is very similar to the unconditional effect, the difference in the type of entry job does not seem to be responsible for the observed wage difference between August-born and September-born workers.

Table 4: The effect of the school entry law (assigned age) on the type of entry job<sup>a</sup>

	<i>Model 1: Assigned age</i>	
White collar	0.009** (0.004)	0.013** (0.005)
Blue collar	-0.013*** (0.004)	-0.017*** (0.005)
Civil servant	0.002* (0.001)	0.001 (0.001)
Self-employed	0.001 (0.001)	0.001 (0.002)
Farmer	0.001 (0.001)	0.002 (0.001)
Year of labor market entry	x	x
Quarter of birth		x
Observations	169,987	169,987

NOTES: This table shows the estimated marginal effects of assigned age on the type of entry job from a multinomial logit model. Robust standard errors in parentheses. \*\*\*, \*\* and \* indicate significance at the 1-percent, 5-percent and 10-percent level.

## 5.2 Educational attainment

Are these age-related differences in starting wages accompanied by differences in the quantity or quality of education? Table 5 shows results for different measures of educational attainment (as explained in section 4.4). Each row presents the estimated coefficients from four different regressions with either *assigned age* (model 1) or *old* (model 2) as the variable of interest. The first row shows how the age at labor market entry — a proxy for years of education — is affected by the school entry rule (birth month). Differences in the entry age reflect differences in the school entry age, the grade retention rate and educational attainment. September-born labor market entrants are only about 0.6 years older than August-born entrants. Due to a higher probability of August-born students to defer enrollment or to repeat a grade, the observed age difference is less than a year on average (Schneeweis and Zweimüller, 2009). Therefore, an age difference of 0.6 years does not suggest that September-born individuals attain significantly more years of education. The reason may be that very different types of education have the same duration in Austria. For example, students who attend a higher general/vocational school and students who pursue an apprenticeship both finish their education at the age of 18/19.<sup>25</sup>

The remainder of table 5 shows regression estimates of the impact of the school entry law on the type of education. Each cell reflects results from a separate regression of a binary variable indicating that the worker has obtained a certain education level on either *assigned age* or *old*. The estimates suggest that being born in September instead of August decreases the probability of having some apprenticeship training by 2.7-3.7 percentage points (depending on the specification). The effect is even higher when only completed apprenticeships, i.e. apprenticeship that lasted at least 2.5 years are considered. Moreover, September-born individuals are more likely skilled workers (4.9-6.1 percentage points) and less likely unskilled workers (1.8-2.2

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<sup>25</sup>Alternatively, it could also be that the age at labor market entry is simply a biased measure of years of education, for instance if education is correlated with job search duration.

percentage points), and — in three out of four specifications — are significantly more likely to hold a degree (0.5-0.8 percentage points). Results from a multinomial logit model (presented in table A.1 in the appendix) confirm the monotonic relationship between assigned age and the worker’s skill level.

Table 5: The effect of the school entry law on educational attainment

	<i>Model 1: Assigned age</i>		<i>Model 2: Old</i>	
	(1)	(2)	(3)	(4)
Age at labor market entry	0.611*** (0.024)	0.592*** (0.032)	0.661*** (0.031)	0.654*** (0.037)
Any apprenticeship training <sup>a</sup>	-0.027*** (0.004)	-0.031*** (0.005)	-0.034*** (0.005)	-0.037*** (0.006)
Skilled worker <sup>b</sup>	0.049*** (0.004)	0.051*** (0.005)	0.059*** (0.005)	0.061*** (0.006)
Apprenticeship training ( $\geq 2.5$ years) <sup>c</sup>	-0.031*** (0.004)	-0.033*** (0.005)	-0.037*** (0.005)	-0.039*** (0.006)
Unskilled worker <sup>d</sup>	-0.018*** (0.002)	-0.018*** (0.003)	-0.021*** (0.003)	-0.022*** (0.004)
Academic degree <sup>e</sup>	0.003 (0.002)	0.007** (0.003)	0.005* (0.003)	0.008** (0.004)
Higher general/vocational school or more <sup>e</sup>	0.023*** (0.004)	0.026*** (0.006)	0.029*** (0.005)	0.031*** (0.006)
Education missing	0.003 (0.004)	0.008 (0.005)	0.009* (0.005)	0.011* (0.006)
Year of labor market entry	x	x	x	x
Quarter of birth		x		x
Distance & Old*Distance			x	x
Observations	169,987	169,987	169,987	169,987

NOTES: Each cell represents a separate regression of the dependent variable (see first column) on assigned age/old and control variables as indicated in the bottom of the table. Robust standard errors in parentheses. \*\*\*, \*\* and \* indicate significance at the 1-percent, 5-percent and 10-percent level. <sup>a</sup>Reference group: workers without apprenticeship training. <sup>b</sup>Reference group: unskilled workers and workers with apprenticeship training (at least 2.5 years). <sup>c</sup>Reference group: skilled and unskilled workers. <sup>d</sup>Reference group: skilled workers and workers with apprenticeship training (at least 2.5 years). <sup>e</sup>The degree refers to the year 2008 because the ASSD only includes the current degree of an individual. <sup>f</sup>N=109,963, reference group: less than high school.

The analysis of the subsample for which a more detailed measure of educational attainment is available complements the results described above.<sup>26</sup> September-born individuals are significantly more likely than August-born individuals to have completed at least a higher general or a higher vocational school. The estimated effects

<sup>26</sup>Table A.2 shows that the effect on the starting wage in the subsample is similar to the estimated effect for the total sample presented in table 3.

on educational attainment are in line with Schneeweis and Zweimüller (2009), who show that August-born individuals are considerably more likely to attend a pre-vocational or an intermediate vocational school than September-born individuals.

### 5.3 Short-run wage profile

How does the effect of the school entry law evolve as workers gain labor market experience? Table 6 presents results for up to five years after labor market entry. Again, both models described in section 4.1 are estimated. After the first year of labor market experience the wage penalty for August-born male workers has decreased to 1.1-1.4 percentage points, after the second year to 0.8-1.3 percentage points. In the third year, wages for August-born and September-born males are not significantly different in three out of four specifications.

Table 6: The effect of the school entry law on subsequent wages

	<i>Model 1: Assigned age</i>		<i>Model 2: Old</i>	
	(1)	(2)	(3)	(4)
1 <sup>st</sup> year after job entry	0.011*** (0.004)	0.013*** (0.004)	0.011** (0.005)	0.014*** (0.004)
2 <sup>nd</sup> year after job entry	0.008** (0.004)	0.010*** (0.004)	0.010** (0.005)	0.013*** (0.005)
3 <sup>rd</sup> year after job entry	0.004 (0.004)	0.006 (0.004)	0.008 (0.005)	0.010** (0.005)
4 <sup>th</sup> year after job entry	-0.000 (0.004)	0.003 (0.004)	-0.000 (0.005)	0.002 (0.005)
5 <sup>th</sup> year after job entry	0.002 (0.004)	0.005 (0.004)	0.003 (0.006)	0.006 (0.005)
Year of labor market entry	x	x	x	x
Type of entry job		x		x
Distance & Distance*Old			x	x

NOTES: Each cell represents a separate estimation of the wage after  $x$  years of potential labor market experience (see first column) on assigned age/old and control variables as indicated in the bottom of the table. Each estimation includes only employed individuals. Therefore, the number of observations varies between the years. Wages are measured as average real daily wages over all employment spells in a given year conditional on being employed. Robust standard errors in parentheses. \*\*\*, \*\* and \* indicate significance at the 1-percent, 5-percent and 10-percent level.

What are the reasons for the almost immediate convergence in wage profiles despite differences in education levels? Human capital theory suggests that experience-earnings profiles converge for individuals with different education levels (Mincer, 1974). Since the differences in education levels between August-born and September-born individuals are only minor, human capital theory could provide an explanation for the convergence. However, there may also be other explanations.

Since the analysis of wage effects is based on the subsample of employed individuals, differences in the labor supply response at the extensive margin could be partly responsible for the convergence. Table A.3 in the appendix shows whether such differences exist or not. The results suggest that the probability to have any employment spell in a given year is not significantly related to month of birth (except for year 5). However, September-born males have more employment days than August-born males in the first and second year after labor market entry. These findings do not point to a selection-based explanation. Rather, the results suggest that September-born males are more attached to the labor force in the first years after labor market entry. This could imply that they had a better job match in the first place and therefore, are less likely to change their employer. Since Topel and Ward (1992) show that job mobility is an important element of early career development and wage growth, a higher job mobility among August-born workers could explain the convergence of wage profiles. Table A.4 in the appendix shows that this is not the case. On the contrary, September-born workers are 1.7-1.8 percentage points more likely to change their employer in the first year after labor market entry. Therefore, a better job match in the first place may not explain why September-born workers earn higher wages in the first years of their professional career.

Table A.5 in the appendix looks at the employment history of the labor market entrants. The employment history includes all employment spells prior to the first regular employment spell. According to the definition of labor market entrants in section 4.3, the history should predominantly include short-term employment spells



and summer jobs. The results suggest that there is no difference in the probability of employment between August-born and September-born workers but August-born workers have spent more days in employment before their first regular employment spell. Two explanations are consistent with this observation: (i) August-born workers had more short-term employment spells before they finally found a good job match. This difficulties may have decreased their reservation wage and led to a lower starting wage compared to September-born workers. This explanation is also consistent with a lower probability to change the employer in the first two years after job entry. (ii) August-born workers have gained more working experience (labor market skills) while in education. The starting wage is lower because of a lower education level, but the additional skills act as a substitute for education after some years in the labor market.

Overall, the analysis suggests that although the school entry law entails differences in school quality and educational attainment between children born before the cutoff date and children born after the cutoff date, the impact on labor market outcomes is only minor.

## 6 Conclusions

Empirical studies have shown that the allocation of students to educational tracks is influenced by the position of a student in the age distribution within a cohort. The reason is that the track choice is based on a noisy signal of ability, the size of which is correlated with age. Therefore, early tracking is considered as particularly harmful and could have long-run effects on educational attainment and earnings. By international standards, first tracking occurs very early in Austria and Germany. Recent empirical studies for these countries show that the youngest students within a school cohort (grade) are significantly less likely to attend the academic track

compared to their older peers (Jürges and Schneider, 2011; Mühlenweg and Puhani, 2010; Schneeweis and Zweimüller, 2009).

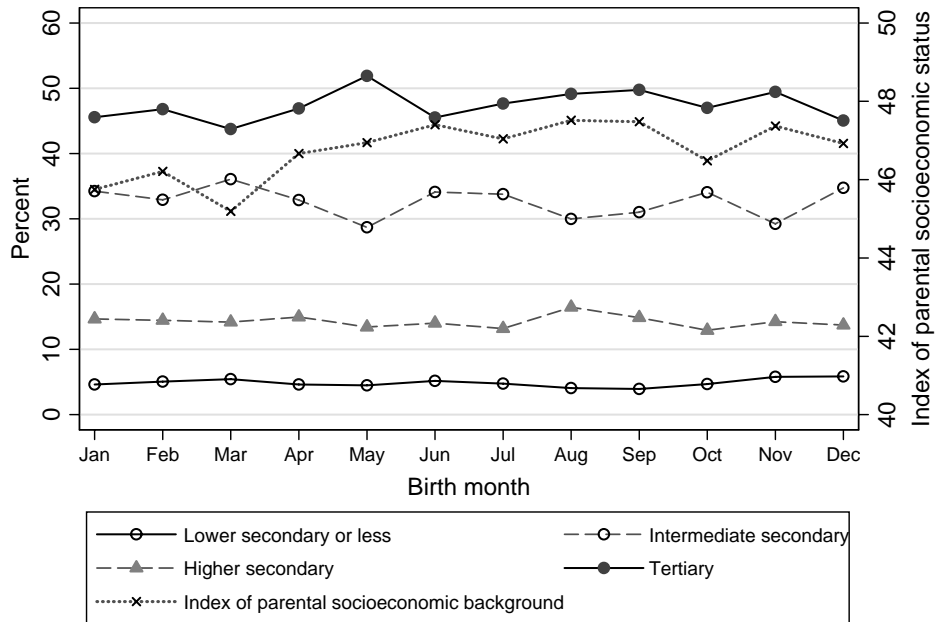
In this paper, I estimate the reduced-form effect of the school entry rule, which assigns students to different school types based on their date of birth, on earnings and educational attainment for a sample of individuals entering the Austrian labor market between 1997 and 2000. The advantage of this strategy is that earnings differences between the youngest (i.e. August-born) and the oldest (i.e. September-born) individuals of a labor market entry cohort do not reflect differences in labor market experience but rather differences in the quantity and quality of education or skills acquired before entering the labor market.

The main findings are that September-born males earn significantly higher wages in the year of labor market entry and in the two years thereafter. The wage premium amounts to 1.4-1.9 percentage points in the entry year, 1.1-1.4 percentage point in the first year and 0.8-1.3 percentage points in the second year after labor market entry. The analysis of differences in the quantity and quality of education reveals that September-born males are less likely to have apprenticeship training, and consequently are less likely to work in a blue-collar job and more likely to work in a white-collar job. Furthermore, they are more likely to have at least higher general/vocational education and to hold a degree. Altogether, September-born individuals seem to have obtained a slightly higher education level than August-born individuals.

The convergence in wage profiles of individuals with different education levels is in line with human capital theory. Since convergence is already obtained after three years of labor market experience, I also investigate alternative explanations for this development. I find no evidence for a better initial job match of September-born individuals, but some evidence that they had more continuous employment spells in the first years after labor market entry. August-born individuals have spent more days in employment before their first regular employment spell, suggesting that

labor market experience may be a substitute to education after some years in the labor market. It also seems likely that the dual education system which combines professional training at a firm with vocational and general education at a part-time vocational school is partly responsible for the surprising result, which, however is in line with recent evidence that the difference between the returns of general and vocational education is largely explained by selection (Malamud and Pop-Eleches, 2010).

# Appendix



Data source: PISA waves 2003 and 2006

Figure A.1: Distribution of parental socioeconomic status across birth months

NOTES: This figure is based on data from PISA (Programme for International Student Assessment) waves 2003 and 2006 and shows the distribution of parental education and the index of parental socioeconomic status across birth months. See Schneeweis and Zweimüller (2009) for further details.

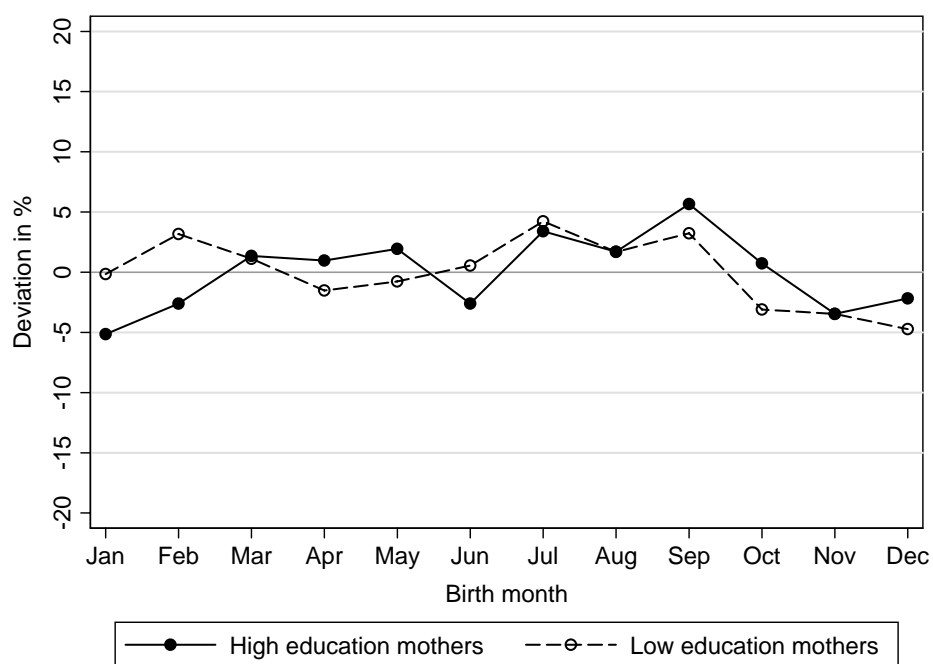


Figure A.2: Distribution of mother's education across birth months

NOTES: This figure is based on data from the Austrian birth register and shows the monthly deviation (in percent) in the number of births with respect to a uniform distribution over the year for all Austrian births over the period 1984-1991.

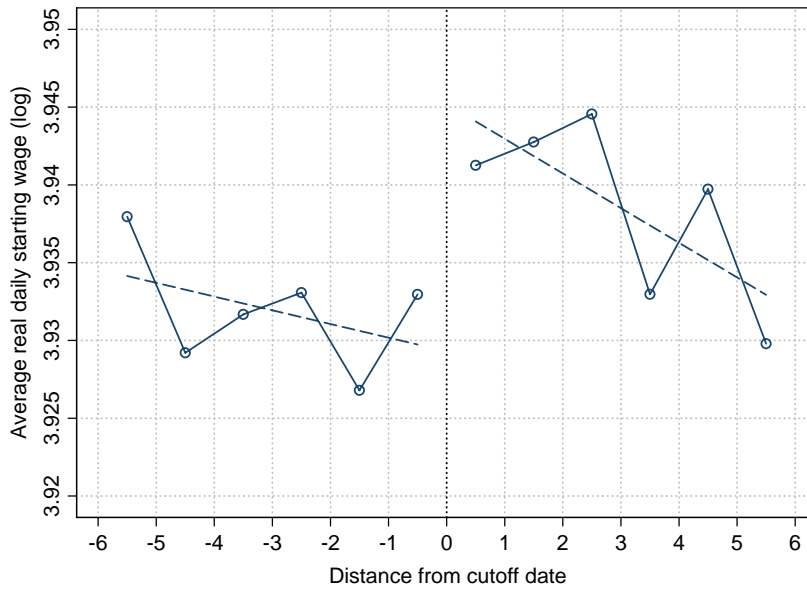


Figure A.3: Starting wage by distance from cutoff date

NOTES: Figure A.3 shows the unconditional log real daily starting wage by the distance between an individual's birth month and the cutoff date. Individuals born in August have a distance of -0.5, individuals born in September have a distance of +0.5. The dashed line represents a linear trend estimated separately before and after the cutoff date.

Table A.1: The effect of the school entry law on the skill level

	<i>Model 1: Assigned age</i>	
	(1)	(2)
Skilled worker	-0.018*** (0.002)	-0.018*** (0.004)
Apprenticeship training ( $\geq 2.5$ years)	-0.031** (0.004)	-0.034*** (0.005)
Unskilled worker	0.049*** (0.004)	0.052*** (0.005)
Year of labor market entry	x	x
Quarter of birth		x
Observations	169,987	169,987

NOTES: This table shows the estimated marginal effects of assigned age on the worker's skill level from a multinomial logit model. Robust standard errors in parentheses. \*\*\*, \*\* and \* indicate significance at the 1-percent, 5-percent and 10-percent level.

Table A.2: The effect of the school entry law on the starting wage — subsample<sup>a</sup>

	(1)	(2)	(3)
<i>Model 1</i>			
Assigned age	0.014*** (0.004)	0.013** (0.006)	0.017*** (0.004)
Adjusted $R^2$	0.026	0.026	0.142
<i>Model 2</i>			
Old	0.017*** (0.005)	0.014** (0.006)	0.019*** (0.005)
Distance	0.000 (0.001)	-0.000 (0.002)	0.001 (0.001)
Distance X Old	-0.003** (0.002)	-0.003* (0.002)	-0.003** (0.001)
Adjusted $R^2$	0.026	0.026	0.142
Year of labor market entry	x	x	x
Quarter of birth		x	
Type of entry job			x
Observations	109,963	109,963	109,963

NOTES: Robust standard errors in parentheses. \*\*\*, \*\* and \* indicate significance at the 1-percent, 5-percent and 10-percent level. All regressions include a dummy variable that indicates whether wages are measured one year after labor market entry. See section 4.3 for further details. <sup>a</sup> Results are based on a subsample for which information on educational attainment is available. See notes in table 5 for further details.



Table A.3: Labor supply

	<i>Model 1: Assigned age</i>		<i>Model 2: Old</i>	
	Pr(Work) <sup>a</sup>	Days emp. <sup>b</sup>	Pr(Work) <sup>a</sup>	Days emp. <sup>b</sup>
1 <sup>st</sup> year after job entry	-0.001 (0.002)	7.050*** (0.928)	-0.002 (0.002)	8.479*** (1.176)
2 <sup>nd</sup> year after job entry	-0.002 (0.002)	5.757*** (0.829)	-0.003 (0.003)	6.303*** (1.051)
3 <sup>rd</sup> year after job entry	-0.000 (0.002)	1.297* (0.778)	-0.002 (0.003)	1.534 (0.986)
4 <sup>th</sup> year after job entry	-0.003 (0.002)	1.333* (0.753)	-0.004 (0.003)	1.290 (0.954)
5 <sup>th</sup> year after job entry	-0.004* (0.002)	2.320*** (0.731)	-0.005* (0.003)	2.318** (0.928)
Year of labor market entry	x	x	x	x
Distance & Distance*Old			x	x
Observations	169,987	169,987	169,987	169,987

NOTES: Robust standard errors in parentheses. \*\*\*, \*\* and \* indicate significance at the 1-percent, 5-percent and 10-percent level. <sup>a</sup> The dependent variable measures the probability to have any (non-marginal) employment spell in a given year. <sup>b</sup> The dependent variable measures the days of employment for employed individuals in a given year.

Table A.4: Job mobility

	<i>Model 1: Assigned age</i>	<i>Model 2: Old</i>
1 <sup>st</sup> year after job entry	0.018*** (0.004)	0.017*** (0.005)
2 <sup>nd</sup> year after job entry	0.008* (0.004)	0.007 (0.005)
3 <sup>rd</sup> year after job entry	0.005 (0.004)	0.002 (0.005)
4 <sup>th</sup> year after job entry	0.005 (0.004)	0.004 (0.005)
5 <sup>th</sup> year after job entry	0.002 (0.004)	-0.000 (0.004)
Year of labor market entry	x	x
Distance & Distance*Old		x

NOTES: Each cell represents a separate estimation of a binary variable indicating whether an individual works for another employer than in the entry job after  $x$  years of potential labor market experience (see first column) on assigned age/old and control variables as indicated in the bottom of the table. Each estimation includes only employed individuals. Therefore, the number of observations varies between the years. Robust standard errors in parentheses. \*\*\*, \*\* and \* indicate significance at the 1-percent, 5-percent and 10-percent level.

Table A.5: Employment history

	<i>Model 1: Assigned age</i>		<i>Model 2: Old</i>	
	(1)	(2)	(3)	(4)
Any employment	0.003 (0.002)	0.001 (0.003)	0.003 (0.003)	0.002 (0.003)
Duration of employment (days)	-28.357*** (4.378)	-29.015*** (5.859)	-34.170*** (5.552)	-34.205*** (6.617)
Any self-employment	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Duration of self-employment (days)	0.000 (0.012)	-0.008 (0.012)	0.004 (0.014)	-0.011 (0.014)
Year of labor market entry	x	x	x	x
Quarter of birth		x		x
Distance & Distance*Old			x	x
Observations	169,987	169,987	169,987	169,987

NOTES: This table presents an analysis of the employment history prior to an individual's first regular employment spell (as defined in section 4.3). Each cell represents a separate regression of the dependent variable (see first column) on assigned age/old and control variables as indicated in the bottom of the table. Robust standard errors in parentheses. \*\*\*, \*\* and \* indicate significance at the 1-percent, 5-percent and 10-percent level.

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