De Economist
https://doi.org/10.1007/s10645-025-09464-8

ORIGINAL PAPER

Does Month of Birth Affect Speed and Quality of Transition from School to Work?

Stijn Baert[1,2,3,4] · **Luca Fumarco**[4,5,6,7] · **Levi Halewyck**[1] · **Eline Moens**[1] · **Alessandro Vandromme**[1]

Received: 22 May 2025 / Accepted: 19 November 2025

Abstract

This study estimates the impact of relative age (i.e., the difference in classmates' ages) on both the speed and quality of individuals' transition from education to the labour market, and investigates whether and how this impact passes through characteristics of students' educational careers—topics that have been largely overlooked in prior work. We use rich data pertaining to schooling and to labour market outcomes one year after graduation to conduct instrumental variables analyses. We find that a one-year increase in relative age increases the likelihood of (i) being employed then by 3.5 percentage points (baseline 91.2%), (ii) having a permanent contract by 5.1 percentage points (baseline 42.6%), and (iii) having full-time employment by 6.5 percentage points (baseline 79.5%). These relative age effects are partly mediated by intermediate outcomes such as having had a schooling delay at the age of sixteen or taking on student jobs. The final mediator is particularly notable as no earlier studies examined relative age effects on student employment.

Keywords Relative age · School starting age · Labour market transition

JEL Classification I21 · J23 · J24 · J6

✉ Stijn Baert
Stijn.Baert@UGent.be

1 Ghent University, Ghent, Belgium

2 University of Antwerp, Antwerp, Belgium

3 Université catholique de Louvain, Louvain-la-Neuve, Belgium

4 IZA, Bonn, Germany

5 J-PAL, Cambridge, MA, USA

6 Masaryk University, Brno, Czech Republic

7 GLO, Essen, Germany

Published online: 15 December 2025

1 Introduction

Differences in maturity amongst classmates (henceforth 'relative age') correlate with gaps in the performances, cognitive abilities and noncognitive abilities of classmates (Bedard & Dhuey, 2006; Crawford et al., 2014; Fumarco & Baert, 2019; Fumarco et al., 2020; Oosterbeek et al., 2021; Peña, 2017, 2020; Ponzo & Scoppa, 2014). As shown in several articles, these gaps may continue throughout compulsory education (Bedard & Dhuey, 2006; Oosterbeek et al., 2021), and may even persist in tertiary education. More concretely, Crawford et al. (2013), Fredriksson and Öckert (2014), Peña (2017) and Zweimüller (2013), find that the oldest students in their school cohorts have better tertiary education outcomes, while Dobkin and Ferreira (2010) as well as Pellizzari and Billari (2012) find the opposite. Other researchers do not find any evidence of this relative age effect (RAE) on tertiary education outcomes (Oosterbeek et al., 2021; Pehkonen et al., 2015).

While the body of literature on RAEs in (compulsory) education has been growing rapidly, there is still relatively little research on the effects of RAEs on labour market outcomes. The limited evidence indicates that relatively older individuals (i.e., those born immediately after the cut-off date used to separate students into different school cohorts) mostly enjoy better outcomes, some of which tend to disappear in time. Specifically, Crawford et al. (2013) find that an increase in relative age decreases the likelihood of being unemployed as an adult in the UK, Fredriksson and Öckert (2014) find the same result in Sweden and Zweimüller (2013) finds an increase in the likelihood of having a white-collar job in Austria. Larsen and Solli (2017) also report positive RAEs with respect to earnings in Norway, but these effects appear to decrease over time and result in no economically significant difference in lifetime earnings. Differently, Dobkin and Ferreira (2010) do not find significant RAEs on labour market outcomes in the USA (California and Texas). Finally, Oosterbeek et al. (2021) report negative RAEs on earnings in the Netherlands, but these tend to disappear over time.

In this study, we estimate RAEs on the transition from school to successful employment; that is, on one's first labour market outcomes. This focus on the transition to the labour market is significant because being unemployed at the beginning of one's career increases the likelihood of being unemployed or of earning lower wages later (2024b; Arulampalam et al., 2001; D'hert et al., 2024a; Van Belle et al., 2018). Moreover, Clark et al. (2003) showed that this scarring effect decreases life satisfaction. Therefore, unsurprisingly, fostering the transition from school to work success is an essential component of the recommended OECD policy priorities (ILO, 2025; Schoon & Mann, 2020). However, in peer-reviewed international research, only Zweimüller (2013) has focused on first-job outcomes, finding that the youngest pupils in an academic cohort in Austria face a wage penalty of about 1.1% to 2.0% in their starting wages compared with their oldest counterparts. We innovate compared to their study by not only investigating quantitative aspects of first labour market outcomes but also investigating RAEs in qualitative aspects.[1]

[1] Zweimüller (2013) studies educational attainment, wage, and type of job (i.e., white- and blue-collar, civil servant, self-employed, farmer). One may argue that the latter is a qualitative aspect of labour market

In addition, we perform a mediation analysis to reveal to which extent RAEs on labour market outcomes pass through characteristics of students' educational careers. In fact, it is possible that these RAEs are simply the result of earlier RAEs on educational outcomes that persist over time, which would make them indirect RAEs (e.g., one may have lower educational attainments due to relative age, which in turn creates a more difficult transition to the labour market).

More concretely, we investigate RAEs on four different indicators of transition from school to work success. We investigate one quantitative aspect of the transition, i.e. the likelihood of employment one year after graduation, and we investigate three qualitative aspects of the transition, namely the likelihood that an individual will have an adequate job (that is, not be overeducated), obtain a permanent contract, and obtain a full-time contract one year after graduation. These transition measures are suggested in Fleming and Kler (2011) and in Kauhanen and Nätti (2015). To summarise, we investigate the following research questions:

R1. What is the impact of relative age at school start on the likelihood of employment one year after graduation?
R2. How do educational outcomes mediate the effect of relative age at school start on the likelihood of employment one year after graduation?
R3. What is the impact of relative age at school start on the quality of employment one year after graduation?
R4. How do educational outcomes mediate the effect of relative age at school start on the quality of employment one year after graduation?

Anticipating our results, we find that a one-year increase in relative age increases the likelihood of being employed one year after graduation by 3.5 percentage points (a 3.8% increase compared to the baseline of 91.2%) (R1). Furthermore, this older age within the cohort also improves the quality of the initial labour market position (R3): the likelihood of having a permanent contract rises by 5.1 percentage points (a 12.0% increase compared to the baseline of 42.6%), and the likelihood of working full-time by 6.5 percentage points (an 8.2% increase compared to the baseline of 79.5%). These effects are both partly mediated by educational outcomes such as schooling delay and student employment (R2 and R4).

The remainder of this article is structured as follows. Section 2 describes the data and variables. Section 3 outlines the empirical strategy and explains how we estimate the effects of relative age using ordinary least squares (OLS) and, more importantly, two-stage least squares (2SLS) to address potential endogeneity due to parental birthdate targeting or non-compliance with the cut-off date rule. Section 4 presents the results, and Sect. 5 concludes.

transition. However, Zweimüller explains that '[white-collar] jobs require more qualifications and pay higher wages' and show how wages vary broadly across these jobs. So, we interpret type of job as a proxy for wages, which is a quantitative aspect of the transition to the labour market.

2 Data

2.1 Sample

We use data from the Flemish survey SONAR ('Studie van de overgang van ONderwijs naar de ARbeidsmarkt'), which examines the transition from education to the labour market. Therefore, the institutional context of our study is Flanders, the northern part of Belgium. Figure 1 illustrates the local education system. Elementary education consists of (non-obligatory) kindergarten and six years of primary education. Parents can voluntarily enrol their children in kindergarten once they turn two and a half years of age. Compulsory (and free) education starts in the year in which children turn six, with a cut-off date of 1 January, and ends when they turn eighteen, regardless of whether a high-school degree is obtained (Baert & Cockx, 2013; Cockx et al., 2019; Nusche et al., 2015). When the academic year starts on 1 September, the oldest children are six years and eight months old (born on 1 January), while the youngest are five years and eight months old (born on 31 December), except for when children are withheld or advanced (see below). Ability tracking starts in secondary education. The different tracks in secondary education are general secondary education, technical secondary education, art secondary education and vocational secondary education—the lowest tier. The placement on a particular ability track depends on the students' and parents' choices, which are based on primary school teachers' advice, which in turn might be based on the recommendations of Student Guidance Centres (Cockx et al., 2019; Nusche et al., 2015; Tobback et al., 2024). In Belgium, every individual with a secondary education is allowed to enrol in tertiary education. The proportion of the population in Flanders with a tertiary degree (either college or

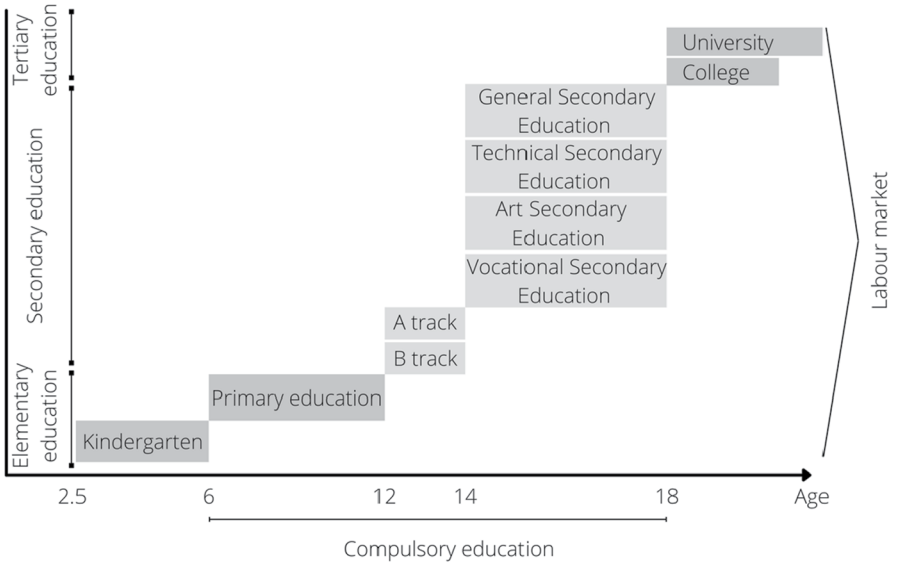

Fig. 1 Flemish education system

university) is higher than it is in many OECD countries, and is on the increase (Baert & Cockx, 2013; Cockx et al., 2019; Shewbridge et al., 2011).

SONAR is a longitudinal study in which birth cohorts of around 3,000 individuals were interviewed at the ages of 23, 26 or 29. Information about the sampling strategy, statistics and representativeness can be found in SONAR (2002). The survey includes a rich set of variables concerning the respondents' education, labour market outcomes and demographic characteristics. Therefore, these data allow us to measure both relative age and the speed (**R1** and **R2**) and quality (**R3** and **R4**) of labour market transition.

Our analysis is conducted on a sample of two birth cohorts, 1978 and 1980. We eliminate individuals who have not left school by the final interview or who have missing values for explanatory variables. There is a third, older cohort from 1976, but we do not use it as several variables are measured differently. Furthermore, as in Baert and Cockx (2013), we exclude individuals who are more than one year behind or ahead of their peers at the onset of compulsory education, because we suspect that these observations are affected by measurement error. The final sample size is 4882.

2.2 Variables

Table 1 presents the variables used in the analyses and provides basic descriptive statistics. Dependent variables are shown in Panel A, independent variables in Panel B, the instrumental variable in Panel C, control variables in Panel D and mediation variables in Panel E. Tables including the pairwise correlations can be found in the Appendix (Tables 9 and 10).

2.2.1 Dependent Variables

The dependent variable of interest for our first two research questions (**R1** and **R2**) concerning the speed of the transition is *Employment*. This is a binary variable indicating whether an individual is employed one year after graduation. Table 1 shows that 91% of the respondents are employed one year after graduation. This one-year threshold has been chosen because, according to OECD (2021), unemployed persons are considered to be long-term unemployed after one year of unemployment.

The third and fourth research questions (**R3** and **R4**) focus on the quality of the transition, measured by three binary variables. First, *Adequate employment* indicates whether individuals are employed at or above their education level after one year, meaning that the individual is not overeducated. Second, *Permanent contract* equals 1 if the individual has obtained a permanent contract one year after graduation. Third, *Full-time employment* indicates whether an individual is employed full-time after one year. Table 1 shows that around 43% of the respondents are adequately employed and have a permanent contract one year after graduation,[2] while 80% of the respondents are working full-time one year after graduation.

[2] We construct this outcome variable, *Adequate Employment*, following Baert et al. (2013), who also use SONAR data.

Table 1 Summary statistics

Variable	Definition	Mean	SD	Observations
A. Dependent variables				
Employment[a]	Equal to 1 if the respondent is employed one year after graduation, 0 otherwise	0.912	–	4,882
Adequate employment[a]	Equal to 1 if the respondent is adequately employed one year after graduation, 0 otherwise	0.426	–	4,882
Permanent contract	Equal to 1 if the respondent is employed under permanent contract one year after graduation, 0 otherwise	0.426	–	4,882
Full-time employment	Equal to 1 if the respondent is employed full-time one year after graduation, 0 otherwise	0.795	–	4,882
B. Independent variable				
Observed relative age	Age (in years, relative to the oldest regular student—regular meaning not withheld or advanced—based on day of birth and age when starting school)	−0.490	0.328	4,882
C. Instrumental variable				
Expected relative age	Age (in years, relative to the oldest regular student, based on day of birth)	−0.495	0.285	4,882
D. Control variables				
Female	Equal to 1 if the respondent is female, 0 otherwise	0.500	–	4,882
Migration background[a]	Equal to 1 if the respondent's maternal grandmother has a non-Belgian nationality, 0 otherwise	0.062	–	4,882
Father's tertiary education[a]	Equal to 1 if the respondent's father has obtained a tertiary degree, 0 otherwise	0.289	–	4,882
Mother's tertiary education[a]	Equal to 1 if the respondent's mother has obtained a tertiary degree, 0 otherwise	0.271	–	4,882
Cohort 1980	Equal to 1 if respondent was born in 1980, 0 otherwise	0.510	–	4,882
Youth unemployment rate	Youth unemployment rate (in %) at onset of job search	18.333	2.653	4,882
E. Mediation variables				
Schooling delay at 16[a]	Equal to 1 if respondent had a schooling delay at the age of sixteen, 0 otherwise	0.308	–	4,882
Vocational education at 16[a]	Equal to 1 if respondent was enrolled in vocational education at the age of sixteen, 0 otherwise	0.269	–	4,882
Tertiary degree[a]	Equal to 1 if respondent has obtained a tertiary education degree, 0 otherwise	0.427	–	4,882
Distinction degree[a]	Equal to 1 if the respondent has completed tertiary education with at least a distinction degree class, 0 otherwise	0.222	–	4,882
Student job[a]	Equal to 1 if the respondent held a student job during education, 0 otherwise	0.813	–	4,882

[a]Variables based on Baert et al. (2013). No standard deviations are reported for binary variables

2.2.2 Independent Variable

Observed relative age (*ORA*) is the explanatory variable of interest. As in the studies by Dobkin and Ferreira (2010), Peña and Duckworth (2018), Fumarco and Baert (2019), and Fumarco et al. (2020), it measures the difference between the age of stu-

dent i and the oldest regular student in cohort c. For regular students, *ORA* approaches −1 for individuals born on 31 December and 0 for individuals born on 1 January. This variable ranges between −2 and −1 for students who enter primary education one year earlier than expected. For students who enter primary education one year later, this variable can reach a maximum of 1. Thus, we compute *ORA* as in Eq. (1):

$$\mathrm{ORA_{ic}} = \mathrm{age_i} - \max_{\mathrm{I}=1,\ldots,\mathrm{n}} (\mathrm{age_{Ic}} \mid \mathrm{I} \in \mathrm{R_c}). \tag{1}$$

ORA is potentially endogenous, which is a well-documented problem in the RAE literature. A possible cause of endogeneity is parental birthdate targeting (Bedard & Dhuey, 2006), which refers to parents planning their children's birth dates to ensure that they are amongst the oldest in their classes. Another cause could be non-compliance with the cut-off date rule. Non-compliance with school entry rules can occur in two ways. That is, parents can either delay or advance their children's school entry by one year.[3]

Table 9 shows the correlations between *ORA* and the dependent variables. *Permanent contract* and *Full-time employment* are significantly and positively correlated with *ORA*. *ORA* is not significantly correlated with the other two outcome variables.

2.2.3 Instrumental Variable

We instrument *ORA* with *Expected relative age* (*ERA*) to account for possible endogeneity. This instrumental variable is similar to Black et al. (2011), Fumarco and Baert (2019), and Fumarco et al. (2020), except that we use the calendar date of birth in lieu of the month of birth. We use *ERA* as an instrument because it is exogenously determined (Black et al., 2011); below, we explain the tests used to assess its actual exogeneity.

Day of birth ranges from 1 for people born on 1 January to 365 or 366 (1980 was a leap year) for people born on 31 December. Equation (2) ensures that *ERA* ranges between −1 and 0 (for individuals born on the cut-off date), and thus increases as the individuals are relatively older.

$$ERA_i = -\frac{Day\ of\ birth_i - 1}{Number\ of\ days\ in\ year\ of\ birth_i - 1}. \tag{2}$$

Table 1 shows that *ORA* is somewhat larger than *ERA*. This indicates that there are more retained students than there are students who were advanced. This delay increases their relative age, and therefore indicates the possible endogeneity of *ORA*.

To verify whether the instrumental variable is consistent and balanced, we conducted tests to verify whether (i) *ORA* is highly correlated with *ERA*, and (ii) whether

[3] Delaying entry by one year is also called redshirting. Parents withhold their children voluntarily, thereby increasing their relative age and maturity in comparison to their classmates (Peña, 2020). While redshirting is common amongst families with high socio-economic status in the US, such families in most European countries tend to send their children to school one year earlier. Students who are older than their expected age in a given school class are more frequently students who have been retained. (Oosterbeek et al., 2021).

ERA is uncorrelated with respondents' observable demographic characteristics. The results are reassuring. Condition (i) is satisfied, as the correlation between *ERA* and *ORA* is 0.9 and is significant at the 1% significance level (see Table 9). Condition (i) is further tested and is satisfied in the first stage of the two-stage least square regression model (2SLS; see Sect. 4). Condition (ii) is also satisfied. More concretely, we conduct a nonparametric balance test; that is, an ordinary least square (OLS) regression of each control variable on *ERA* and a cohort dummy. We find no significant association of any control variable and *ERA* (see Table 11).

2.2.4 Control Variables

We use six control variables. *Female* indicates whether the respondent is female. *Migration background* shows whether the respondent's maternal grandmother has a non-Belgian nationality. *Father's tertiary education* and *Mother's tertiary education* specify whether an individual's parents have completed tertiary education. *Cohort 1980* indicates whether the respondent was born in 1980. The reference groups for these five variables are as follows: male respondent, no migration background, no tertiary education of the father, no tertiary education of the mother and being born in 1978. The sixth control variable is *Youth unemployment rate*, which reflects the youth unemployment rate at the start of an individual's job search.

Note that we are not controlling for absolute age because we do not have variation in this variable. Therefore, the measure of relative age we study includes the effect of absolute age. This is similar to recent studies (e.g., Oosterbeek et al., 2021) and does not represent a limitation; instead, it is something to consider when interpreting the results.

2.2.5 Mediator Variables

We focus on five educational mediators. The first mediator is *Schooling delay at 16,* which indicates whether a respondent had a schooling delay at the age of sixteen. *Vocational education at 16* indicates whether a respondent was enrolled in vocational education at sixteen.[4] *Tertiary degree* indicates whether an individual obtained a tertiary education degree. *Distinction degree* indicates whether an individual obtained a tertiary degree with distinction. *Student job* indicates whether the respondent had one or more student jobs during their education. These five mediator variables are binary.

Table 1 presents the summary statistics of the mediator variables. More than 40% of our sample obtained a tertiary degree, which is representative of the population born in 1978 and 1980 in Flanders (Statbel, 2021). Table 10 shows that *Schooling delay at 16* is significantly correlated with *ORA* (−0.029), which indicates that relatively older students are less likely to have a schooling delay.

The mediator variables *Schooling delay at 16*, *Vocational education at 16*, *Tertiary degree*, and *Distinction degree* are measures of educational attainment. The literature provides evidence of a relationship between these variables and our outcome variables. For instance, Saar et al. (2008) show that higher education increases the likeli-

[4] Vocational education is one of the available tracks in secondary education (see SubSect. 2.1).

hood of employment for almost all entrants into the labour market in the EU. Also, educational attainment and the likelihood of overeducation are linked (Baert et al., 2013). In addition, Baert and Cockx (2013) and Garrouste and Loi (2011) find that the level of educational attainment has a positive impact on the likelihood of obtaining permanent employment. Finally, individuals with less educational attainment are more likely to be employed part time (Ross & Wu, 1995).

Student job is not a measure of educational attainment in strict sense, but is included because several studies suggest a positive effect of working while studying on labour market outcomes such as the likelihood of employment, wages and job quality (Baert et al., 2016; Geel & Backes-Gellner, 2012; Häkkinen, 2006; Passaretta & Triventi, 2015; Tobback et al., 2024; Van Belle et al., 2020).

Thus, the literature shows the existence of an association between the mediators and our outcome variables of interest. In addition, relative age is generally proven to impact educational outcomes (Crawford et al., 2013; Dobkin & Ferreira, 2010; Fredriksson & Öckert, 2014; Peña, 2017; Zweimüller, 2013), although no study has investigated the effect of relative age on the probability of having a student's job yet. Therefore, we can assume a possible association between relative age and labour market outcomes via educational mediators.

3 Analytical Framework

To obtain an initial indication of RAEs on the outcome variables, we perform an OLS regression model with heteroscedasticity-robust standard errors. We regress our outcome variable of interest (speed and quality of transition) on relative age, a set of demographic characteristics and a control for birth cohort.

However, the main set of estimates addresses endogeneity of relative age and is conducted using a 2SLS regression model with *ERA* as the instrument.[5] The second-stage model specification of the 2SLS focuses on total RAEs; that is, there is no mediator variable. We control for a cohort dummy and all of the other control variables mentioned in Sect. 2.2.4. This basic specification is shown in Eq. (2):

$$Y_i = \gamma_0 + \gamma_1 \widehat{ORA}_i + \gamma_2 C_i + \gamma_3 D_i^{coh} + \varepsilon_i. \tag{3}$$

In this equation, Y_i is one of the independent variables from Sect. 2.2.1, $\widehat{ORA}_i$ is the predicted value of *ORA* from the first stage, C_i is the vector of control variables and D_i^{coh} is a cohort dummy. Estimating the coefficient of $\widehat{ORA}_i$, i.e. γ_1, will allow to answer **R1** and **R3**. The model specification of the naïve OLS estimates mirrors Eq. (3), except that it uses ORA_i.

In the first stage, *ORA* is regressed on *ERA*, the cohort dummy and the demographic controls, as shown in Eq. (4):

[5] To test the robustness of the main findings, we repeated the analyses with a probit 2SLS; the results are equivalent.

$$ORA_i = \beta_0 + \beta_1 ERA_i + \beta_2 C_i + \beta_3 D_i^{coh} + \varepsilon_i. \quad (4)$$

We exclude the youth unemployment rate from the set of control variables in the first stage because this variable is not expected to, and does not, significantly affect an individual's day of birth.

The final component of our main analysis comprises reduced form estimations in which we regress the mentioned outcome variables on *ERA* (our instrument) instead of *ORA*. This enables us to examine biological relative age instead of relative age in class. If no pupils are withheld or advanced, the results from this analysis equal our 2SLS estimates.

In addition, we conduct four mediation analyses to estimate indirect RAEs through educational outcomes. In these analyses, we insert one mediator variable (Sect. 2.2.5) at a time into Eq. (3). First, we insert *Schooling delay at 16* in the third specification model, and we then replace this mediator with *Vocational education at 16*, *Tertiary degree*, *Distinction degree*, and *Student job*. Focusing on one mediator at a time allows us to determine which mediator has the greatest explanatory power.

Figure 2 illustrates the ideas underpinning the mediation analysis and is based on Hayes (2013). The total effect (c'+a×b) is γ_1 from Eq. (3); that is, the second stage at which the mediator variable is not included. The direct association (c') is obtained from the second stage at which the mediator M_i is included; that is, $\gamma\prime_1$ in Eq. (5):

$$Y_i = \gamma_0 + \gamma_1' \widehat{ORA}_i + \gamma_2 M_i + \gamma_3 C_i + \gamma_4 D_i^{coh} + \varepsilon_i. \quad (5)$$

We obtain the indirect association (association a×b) in two steps. First, we regress the mediator variable on the basic model specification, as shown in Eq. (6):

$$M_i = \delta_0 + \delta_1 \widehat{ORA}_i + \delta_2 C_i + \delta_3 D_i^{coh} + \varepsilon_i. \quad (6)$$

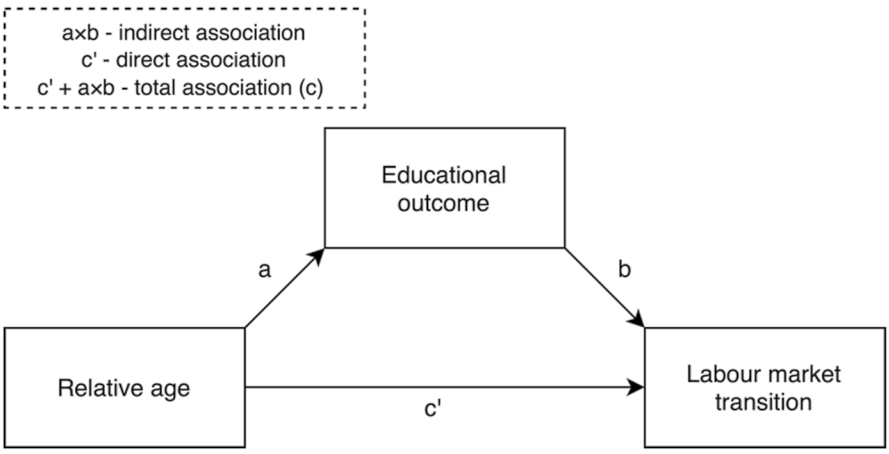

Fig. 2 Mediation model according to Hayes (2013)

$\widehat{ORA}_i$ is derived from the same first stage, i.e. Eq. (4). Second, Eq. (7) shows that we combine δ_1 from Eq. (6) with γ_2 from Eq. (5) to examine indirect associations:

$$a \times b = \gamma_2 \delta_1. \tag{7}$$

Within the context of this mediation analysis, we are mainly interested in direct RAEs (association c') and indirect RAEs through educational outcomes (association a × b), in view of answering **R2** and **R4**. The latter estimates cannot be given a causal interpretation because of the endogeneity of the educational outcomes, which arises from unobserved factors—such as ability, motivation, or parental background—that may influence both educational outcomes and later labour-market outcomes. However, we can give a causal interpretation to the effect of relative age on the mediators in Eq. (6) based on the assumption that our instrumental variable is exogenous.

4 Results

In SubSect. 4.1, we answer research questions **R1** and **R3** regarding RAEs on the speed and quality of the transition to the labour market. In Sect. 4.2, we answer **R2** and **R4** regarding mediation by relative effects in educational outcomes. Finally, in Sect. 4.3, we provide heterogeneity analyses in which we divide the sample based on the respondents' genders.

4.1 Main Analysis

4.1.1 Speed of Transition

Table 2 presents our analyses for **R1**. Column (1) shows the reduced form estimates, which suggest a positive relationship between relative age and employment one year after graduation; this association is statistically significant at a 5% significance level. Column (2) shows that a one-year increase in relative age (i.e., the maximum age difference between two individuals in the same school cohort) increases an individual's likelihood of being employed one year after graduation by 3.5 percentage points.

Table 2 Main analysis of RAE on the likelihood of employment one year after graduation

	Reduced form	Second-stage 2SLS	OLS
	(1)	(2)	(3)
Expected relative age	0.034**		
	(0.014)		
Observed relative age		0.035**	0.034**
		(0.015)	(0.014)
Control variables	X	X	X
Observations	4882	4882	4882

Control variables include a cohort dummy, female gender, migration background, father's tertiary education, mother's tertiary education, and the youth unemployment rate at the start of an individual's job search. These estimates correspond to total RAEs. Robust standard errors in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$

This estimate represents the total effect of relative age on our outcome variable. Note that these estimated RAEs are virtually the same as those from the reduced form, which is expected given the high proportion of regular students. In addition, the OLS estimate in Column (3) (3.4 percentage points) is almost identical to the 2SLS results.

Table 1 indicates that this effect is also economically significant. Of the respondents, 91.2% are employed, meaning that an increase in the likelihood of being employed by 3.5 percentage points translates as a decrease in one's non-employment (unemployment or inactivity; Baert, 2021) one year after graduation by 39.8% (from 8.8 to 5.3%).

Table 3 presents the first stage results. The coefficient of expected relative age on observed relative age is greater than 0.9 and is significant at the 1% significance level. Moreover, the results of the under- and weak-identification tests reject the null hypothesis that the instrument is not (or is weakly) correlated with the endogenous variable. These results further confirm the relevance of the instrument. Since the first stage is the same for all of the main analyses, we do not comment further on these results in the following subsections.

To conclude this subsection, we briefly discuss the results from analyses based on male-only and female-only subsamples. These analyses, similar to those of Black et al. (2011), Fredriksson and Öckert (2014), and Peña (2017), were conducted because there is evidence that relative age may affect females and males differently and shape their labour market outcomes in distinct ways (Johansen, 2021). The results, presented in Tables 12 and 13, show that the overall findings are driven by the male subsample, i.e. relative age has a positive and statistically significant total effect on the likelihood of being employed one year after graduation, whereas no such effects are observed for females.

Table 3 First stage of the two-stage least square

	Observed relative age
Expected relative age	0.961*** (0.011)
Control variables	X
Observations	4,882
2SLS tests	
Under-identification test, Lagrange-Multiplier (p-value)	3,409.858 (0.000)
Weak-identification test, F-statistic	11,000

The first stage includes demographic control variables (female gender, migration background, father's tertiary education, mother's tertiary education) and a cohort dummy. We exclude the youth unemployment rate from the set of control variables in the first stage; we have verified whether its inclusion changes the results; it does not, as expected and discussed in Sect. 3. Standard errors in parenthesis. ***$p<0.01$, **$p<0.05$, *$p<0.1$

4.1.2 Quality of Transition

Table 4 presents the results of our analyses for research question **R3**. Column (2) shows that a one-year increase in relative age does not affect the likelihood of obtaining adequate employment one year after graduation. Columns (5) and (8) show that a one-year increase in relative age statistically and significantly affects the likelihood of obtaining permanent or full-time employment one year after graduation; the likelihood increases by 5.1 and 6.5 percentage points, respectively. In this case, also note that the estimated RAEs are approximately the same as those from the reduced form. The same is true for the OLS estimates in Columns (3), (6) and (9).

These effects are economically significant in terms of full-time employment. Table 1 shows that 20.5% of the respondents are not working full-time one year after graduation; this means that an increase in the likelihood of being employed full-time by 6.5 percentage points translates as a 31.7% decrease in part-time employment (from 20.5 to 14.0%). The effect on obtaining permanent employment is somewhat smaller, as it translates as a decrease in non-permanent work of 9.1% (from 56.4 to 51.3%).

When analysing gender differences in the quality of the labour market transition (as shown in Tables 12 and 13), we find that among males, relative age positively and significantly affects the likelihood of full-time employment. Among females, by contrast, the only significant total RAE is observed for obtaining a permanent contract.

4.2 Mediation Analysis

4.2.1 Speed of Transition

Table 5 presents the complete results from the mediation analyses of employment one year after graduation to answer research question **R2**. If we compare the direct association (c') from Columns (1) to (5) in this table to the total association from Table 2 (c'+a×b), we can see that the estimates are similar; thus, not much of RAEs

Table 4 Main analysis of RAE on the quality of transition one year after graduation

	Adequate employment			Permanent contract			Full-time employment		
	Reduced form	Second-stage 2SLS	OLS	Reduced form	Second-stage 2SLS	OLS	Reduced form	Second-stage 2SLS	OLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Expected relative age	0.038 (0.025)			0.049** (0.025)			0.062*** (0.020)		
Observed relative age		0.040 (0.026)	0.038 (0.025)		0.051** (0.026)	0.049** (0.025)		0.065*** (0.021)	0.062*** (0.020)
Control variables	X	X	X	X	X	X	X	X	X
Observations	4882	4882	4882	4882	4882	4882	4882	4882	4882

Control variables include a cohort dummy, female gender, migration background, father's tertiary education, mother's tertiary education, and the youth unemployment rate at the start of an individual's job search. These estimates correspond to total RAEs. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 5 Mediation analyses of RAE on the likelihood of employment one year after graduation

	(1)	(2)	(3)	(4)	(5)
c'+a×b (total effect of relative age on employment)	0.035** (0.015)	0.035** (0.015)	0.035** (0.015)	0.035** (0.015)	0.035** (0.015)
c' (direct association between relative age and employment)	0.030** (0.015)	0.029** (0.015)	0.033** (0.014)	0.035** (0.015)	0.030** (0.015)
b (association between mediator below and employment)					
Schooling delay at 16	−0.038*** (0.010)				
Vocational education at 16		−0.089*** (0.011)			
Tertiary degree			0.116*** (0.009)		
Distinction degree				0.081*** (0.008)	
Student job					0.103*** (0.013)
a (association between relative age and mediator above)	−0.137*** (0.023)	−0.063*** (0.022)	0.016 (0.024)	0.001 (0.021)	0.048** (0.020)
a×b (indirect association)	0.006*** (0.002)	0.005*** (0.002)	0.002 (0.003)	0.001 (0.001)	0.005** (0.002)
Control variables	X	X	X	X	X
Observations	4,882	4,882	4,882	4,882	4,882

All of the analyses include both a cohort dummy and control variables female gender, migration background, father's tertiary education, mother's tertiary education, and the youth unemployment rate at the start of an individual's job search. Mediation analyses performed using Stata's sem command. Robust standard errors in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$

on the probability of obtaining employment one year after graduation passes through educational attainments. More concretely, Columns (1) to (5) show that 83 to 100% of the total effect of relative age on the likelihood of being employed one year after graduation can be attributed to direct association.[6] The results for this association are all significant at the 5% significance level.

Furthermore, Columns (1) and (2) show the negative association (association b) of *Schooling delay at 16* and *Vocational education at 16* and the likelihood of being employed one year after graduation, while Columns (3) to (5) indicate the positive association of *Tertiary degree*, *Distinction degree* and *Student job* and the outcome. These results are all highly statistically significant. However, as mentioned above, the latter associations cannot be interpreted causally.

We now interpret the RAEs on mediator variables (association a). These estimates are interesting per se, and are fundamental for the computation of the indirect associations (association a×b). Columns (1) and (2) show that a one-year increase in relative age significantly decreases the likelihood of having a schooling delay and being enrolled in vocational education at the age of sixteen by 13.7 and 6.3 percentage points, respectively. Similar results for RAEs on schooling delay (Bedard & Dhuey, 2006) and enrolment in vocational education (Ponzo & Scoppa, 2014) are documented in the literature. Columns (3) and (4) do not show significant RAEs on

[6] These percentages are obtained by dividing the direct association (c') by the total association (c'+a×b).

tertiary education outcomes. These results are similar to those in Oosterbeek et al. (2021). Lastly, Column (5) shows that a one-year increase in relative age increases the likelihood of having had one or more student jobs by 4.8 percentage points. This effect has not been investigated in the literature previously.

The results for the indirect association of relative age (association a × b) with being employed one year after graduation confirm the earlier insights. Column (1) shows that the mediating effect of having had a schooling delay at the age of sixteen accounts for about 17% of the total effect of relative age on the likelihood of employment one year after graduation. Column (2) shows that the mediating effect of being enrolled in vocational education accounts for about 14% of the total effect, while Columns (3) and (4) indicate no significant indirect associations through *Tertiary degree* or *Distinction degree.* Finally, the indirect association through taking up a student job accounts for around 14% of the total RAE.[7] Therefore, the indirect effects of relative age due to some educational attainments and student jobs are comparable.

Results of the RAEs on the speed of an individual's transition to the labour market have three implications. First, similar to Zweimüller (2013), we find that relative age has an impact on duration of unemployment before one's first job. Nevertheless, we can only partially confirm Zweimüller's hypothesis regarding the mechanism behind the RAE, which is that this effect is due to older individuals having a better education. We find no significant indirect association via the mediators that indicate a better education (*Tertiary degree* and *Distinction degree*), while we find evidence that the indirect association partially passes through compulsory schooling outcomes (*Schooling delay at 16* and *Vocational education at 16*) and *Student job*. However, this difference may of course be partly due to differences in educational institutions, e.g. to the extent to which pupils are remedied by repeating a year. A second implication is that, since relatively younger individuals are less likely to be employed one year after graduation, they miss important early work experiences. This may lead to further labour market scarring (2024b; Baert & Verhaest, 2019; D'hert et al., 2024a; Ghirelli, 2015; Van Belle et al., 2018). Moreover, these analyses suggest that the aspects of RAEs on labour market transition that pass through student jobs are as important as are the aspects that pass through educational attainments.

4.2.2 Quality of Transition

Tables 6, 7 and 8 present all the results on the mediation analyses of the likelihood of obtaining an adequate job, a permanent contract and full-time employment one year after graduation to answer research question **R4**. Note that, by design, association a is always the same as in Table 5; thus, we are not commenting on the effect of relative age on mediators in the tables.

If we compare the direct association (c') in Columns (1) to (5) in Table 6 to the total association in Table 5 (c'+a × b), we can see that the estimates are identical. Therefore, we can confirm that relative age does not affect the likelihood that one will obtain an adequate job within one year of graduation. Column (4) shows a posi-

[7] These percentages are obtained by dividing the indirect association (a × b) by the total association (c'+a × b).

Table 6 Mediation analyses of RAE on the likelihood of adequate employment one year after graduation

	(1)	(2)	(3)	(4)	(5)
c'+a × b (total effect of relative age on adequate employment)	0.040 (0.026)	0.040 (0.026)	0.040 (0.026)	0.040 (0.026)	0.040 (0.026)
c' (direct association between relative age and adequate employment)	0.040 (0.026)	0.040 (0.026)	0.040 (0.026)	0.040 (0.026)	0.040 (0.026)
b (association between mediator below and adequate employment)					
Schooling delay at 16	0.008 (0.016)				
Vocational education at 16		−0.002 (0.017)			
Tertiary degree			0.023 (0.015)		
Distinction degree				0.080*** (0.018)	
Student job					−0.009 (0.018)
a (association between relative age and mediator above)	−0.137*** (0.023)	−0.063*** (0.022)	0.016 (0.024)	0.001 (0.021)	0.048** (0.020)
a × b (indirect association)	−0.001 (0.002)	0.001 (0.001)	0.001 (0.001)	0.001 (0.002)	−0.001 (0.001)
Control variables	X	X	X	X	X
Observations	4882	4882	4882	4882	4882

All of the analyses include both a cohort dummy and control variables female gender, migration background, father's tertiary education, mother's tertiary education, and the youth unemployment rate. Mediation analyses performed using Stata's sem command. Robust standard errors in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$

tive association between *Distinction degree* and the likelihood that one will obtain an adequate job within one year of graduation (association b), while there is no evidence that the other mediators affect the outcome. Since the total and indirect associations are the same, the indirect association (association a × b) is nil. Also, with regard to the likelihood of obtaining permanent employment, Table 7 shows that the RAEs do not pass through educational attainments.

Finally, Table 8 shows that 86 to 100% of the total effect of relative age on the likelihood of being employed full-time one year after graduation can be attributed to direct association. The results regarding this association are all significant at the 1% significance level. The results regarding the indirect association of relative age (association a × b) with the likelihood of obtaining a full-time contract one year after graduation confirm the earlier insights regarding employment one year after graduation. In particular, Column (1) shows that the mediating effect of having had a schooling delay at the age of sixteen accounts for 14% of the total effect. Column (2) shows that the mediating effect of being enrolled in vocational education accounts for approximately 10% of the total effect, and Columns (3) and (4) indicate no significant indirect associations through *Tertiary degree* or *Distinction degree.* Column (5) shows that the mediating effect of having had a student job during education accounts for approximately 8% of the total effect.

In summary, the results of the mediation analyses concerning RAEs on the quality of the labour market transition mainly reveal that these RAEs are not substantially mediated by RAEs on educational outcomes. Mediation effects only exist with the likelihood of working full-time and experiencing a schooling delay at the age of sixteen, being enrolled in vocational education at sixteen, and having had student jobs during education.

5 Conclusion

In recent years, the interest in relative age effects (RAEs) has increased, resulting in a vast body of literature discussing the impact of one's day of birth in the calendar year on educational and labour market outcomes (Bedard & Dhuey, 2006; Crawford et al., 2013; Peña, 2017). Our study contributes to this literature by investigating RAEs on the transition from school to work. Our innovation is that we are the first to (i) focus on transition speed as well as on transition quality and (ii) divide these RAEs into direct and indirect associations through various educational attainments and students' job. A two-stage least square estimator was used to account for the endogeneity of relative age.

We found evidence that relatively older individuals are more likely to be employed one year after graduation. A one-year increase in relative age (i.e., the maximum age difference between two individuals born in the same calendar year) increases the likelihood of being employed by 3.5 percentage points. This relative age effect is partly mediated by intermediate outcomes such as having had a schooling delay at the age of sixteen or taking on student jobs. The final mediator is particularly notable as no earlier studies examined relative age effects on student employment.

Table 7 Mediation analyses of RAE on the likelihood of having a permanent contract one year after graduation

	(1)	(2)	(3)	(4)	(5)
c'+a × b (total effect of relative age on permanent contract)	0.051** (0.026)	0.051** (0.026)	0.051** (0.026)	0.051** (0.026)	0.051** (0.026)
c' (direct association between relative age and permanent contract)	0.048* (0.026)	0.051** (0.026)	0.051** (0.026)	0.051** (0.026)	0.050** (0.026)
b (association between mediator below and permanent contract)					
Schooling delay at 16	−0.022 (0.016)				
Vocational education at 16		0.001 (0.017)			
Tertiary degree			0.018 (0.015)		
Distinction degree				0.050*** (0.018)	
Student job					0.012 (0.018)
a (association between relative age and mediator above)	−0.137*** (0.023)	−0.063*** (0.022)	0.016 (0.024)	0.001 (0.021)	0.048** (0.020)
a × b (indirect association)	0.003 (0.002)	−0.001 (0.001)	0.001 (0.003)	0.001 (0.001)	0.001 (0.001)
Control variables	X	X	X	X	X
Observations	4,882	4,882	4,882	4,882	4,882

All of the analyses include both a cohort dummy and control variables female gender, migration background, father's tertiary education, mother's tertiary education, and the youth unemployment rate. Mediation analyses performed using Stata's sem command. Robust standard errors in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$

Table 8 Mediation analyses of RAE on the likelihood of full-time employment one year after graduation

	(1)	(2)	(3)	(4)	(5)
c'+a × b (total effect of relative age on permanent contract)	0.065*** (0.021)	0.065*** (0.021)	0.065*** (0.021)	0.065*** (0.021)	0.065*** (0.021)
c' (direct association between relative age and permanent contract)	0.056*** (0.021)	0.058*** (0.021)	0.062*** (0.020)	0.064*** (0.021)	0.059*** (0.021)
b (association between mediator below and permanent contract)					
Schooling delay at 16	−0.065*** (0.013)				
Vocational education at 16		−0.102*** (0.014)			
Tertiary degree			0.144*** (0.012)		
Distinction degree				0.099*** (0.013)	
Student job					0.112*** (0.016)
a (association between relative age and mediator above)	−0.137*** (0.023)	−0.063*** (0.022)	0.016 (0.024)	0.001 (0.021)	0.048** (0.020)
a × b (indirect association)	0.009*** (0.002)	0.006*** (0.002)	0.002 (0.003)	0.001 (0.001)	0.005** (0.002)
Control variables	X	X	X	X	X
Observations	4,882	4,882	4,882	4,882	4,882

All of the analyses include both a cohort dummy and control variables female gender, migration background, father's tertiary education, mother's tertiary education, and the youth unemployment rate. Mediation analyses performed using Stata's sem command. Robust standard errors in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$

With regard to transition quality, we found no evidence of RAEs on the likelihood of being employed according to one's educational level. However, we identified such effects on the likelihood of having permanent or full-time employment. A one-year increase in relative age increases the likelihood of obtaining permanent employment by 5.1 percentage points, and of working full-time by 6.5 percentage points. Only a small (or even negligible) fraction of total RAEs passes through educational outcomes or having a student job.

We end this study by discussing its main limitations and by providing recommendations for further research. First, since students who are born around the cut-off date are more likely to be withheld or advanced (Bedard & Dhuey, 2006), our instrumented variable for relative age might violate the monotonicity assumption (Barua & Lang, 2016). However, this should not be problematic, as we observe strong adherence to the cut-off rule (96.7%). Second, our mediation analyses only examined associations between relative age and labour market outcomes through certain educational mediators; other educational and non-educational mediators may also be important. Related to that, while the literature focuses on educational outcomes because of their impact on the labour market, the educational mediators we study mediate only a small fraction of relative age effects. Based on these results, we particularly recommend the further investigation of relative age effects on non-educational outcomes and of their roles as mediators. Previous studies showed that relative age affects soft skills, such as determination and leadership (Dhuey & Lipscomb, 2008; Peña & Duckworth, 2018), as well as cognitive abilities, ambition and life satisfaction (Black et al., 2011; Crawford et al., 2013; Fumarco et al., 2020; Peña, 2020).These might be essential factors in determining labour market transition outcomes, and it would be interesting to examine to which extent the RAEs pass through these other mediators. More in general, we are of the opinion that future studies should conduct further mediation analyses in order to understand the mechanisms behind RAEs.

Appendix

See Tables 9, 10, 11, 12, and 13

Table 9 Pairwise Spearman correlations including the outcome variables, control variables, instrumental variable and independent variable of interest

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Employment	1.000											
(2) Adequate employment	0.269***	1.000										
(3) Permanent contract	0.268***	0.061***	1.000									
(4) Full-time employment	0.613***	0.180***	0.211***	1.000								
(5) Female gender	−0.043***	−0.012	−0.097***	−0.156***	1.000							
(6) Migration background	−0.145***	−0.025*	−0.076***	−0.089***	0.013	1.000						
(7) Father's tertiary education	−0.008	0.017	−0.036**	−0.035**	−0.001	−0.083***	1.000					
(8) Mother's tertiary education	−0.005	0.015	−0.036**	−0.038***	−0.023	−0.095***	0.528***	1.000				
(9) Cohort 1980	0.050***	−0.011	−0.026*	0.037***	−0.011	0.067***	−0.032**	−0.019	1.000			
(10) Youth unemployment rate	−0.030**	−0.083***	−0.008	−0.046***	−0.058***	0.042***	−0.046***	−0.025*	0.069***	1.000		
(11) Expected relative age	0.033**	0.022	0.028*	0.041***	0.020	−0.007	−0.010	−0.016	−0.009	−0.003	1.000	
(12) Observed relative age	0.017	0.020	0.026*	0.026*	0.012	0.010	−0.024*	−0.028*	−0.002	−0.012	0.911***	1.000

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

Table 10 Pairwise Spearman correlations including the mediator variables, instrumental variable, and independent variable of interest

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Schooling delay at 16	1.000						
(2) Vocational education at 16	0.253***	1.000					
(3) Tertiary degree	−0.362***	−0.506***	1.000				
(4) Distinction degree	−0.253***	−0.301***	0.595***	1.000			
(5) Student job	−0.114***	−0.275***	0.216***	0.151***	1.000		
(6) Expected relative age	−0.083***	−0.037**	0.008	−0.001	0.033**	1.000	
(7) Observed relative age	−0.029**	−0.019	−0.008	−0.009	0.012	0.911***	1.000

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

Table 11 Nonparametric balance test of control variables: ordinary least square estimations of control variables on expected relative age and a cohort dummy

	Female gender	Migration background	Father's tertiary education	Mother's tertiary education
Expected relative age	0.035	−0.005	−0.016	−0.025
	(0.025)	(0.012)	(0.023)	(0.022)
Control variables	X	X	X	X
Observations	4882	4882	4882	4882

Standard errors in parenthesis.
***$p<0.01$, **$p<0.05$, *$p<0.1$

Table 12 Main and mediation analyses of the male subsample

	Main analysis, no mediator	Analysis with the following mediator:				
		Schooling delay at 16	Vocational education at 16	Tertiary degree	Distinction degree	Student jobs
	(1)	(2)	(3)	(4)	(5)	(6)
Outcome: Employment						
c'+a×b (total effect of relative age on permanent contract)	0.036*					
	(0.020)					
c' (direct association between relative age and permanent contract)		0.032	0.033*	0.034*	0.035*	0.036*
		(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
a×b (indirect association)		0.004**	0.003	0.002	0.000	0.000
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Outcome: Adequate employment						
c'+a×b (total effect of relative age on permanent contract)	0.058					
	(0.037)					
c' (direct association between relative age and permanent contract)		0.060	0.058	0.058	0.057	0.058
		(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
a×b (indirect association)		−0.002	−0.000	−0.001	0.000	−0.000
		(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Outcome: Permanent contract						
c'+a×b (total effect of relative age on permanent contract)	0.047					
	(0.038)					
c' (direct association between relative age and permanent contract)		0.045	0.047	0.047	0.047	0.047
		(0.038)	(0.037)	(0.037)	(0.037)	(0.037)
a×b (indirect association)		0.003	−0.000	0.001	0.000	−0.000
		(0.003)	(0.001)	(0.001)	(0.001)	(0.000)
Outcome: Full-time employment						
c'+a×b (total effect of relative age on permanent contract)	0.082***					
	(0.026)					
c' (direct association between relative age and permanent contract)		0.078***	0.080***	0.080***	0.081***	0.082***
		(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
a×b (indirect association)		0.004*	0.002	0.001	0.000	0.000
		(0.002)	(0.002)	(0.002)	(0.001)	(0.002)

Table 12 (continued)

	Main analysis, no mediator	Analysis with the following mediator:				
		Schooling delay at 16	Vocational education at 16	Tertiary degree	Distinction degree	Student jobs
	(1)	(2)	(3)	(4)	(5)	(6)
Control variables	X	X	X	X	X	X
Observations	2441	2441	2441	2441	2441	2441

All of the analyses include both a cohort dummy and control variables migration background, father's tertiary education, mother's tertiary education, and the youth unemployment rate. Mediation analyses performed using Stata's sem command. Robust standard errors in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$

Table 13 Main and mediation analyses for the female subsample

	Main analyses, no mediator	Analyses with the following mediator:				
		Schooling delay at 16	Vocational education at 16	Tertiary degree	Distinction degree	Student jobs
	(1)	(2)	(3)	(4)	(5)	(6)
Outcome: Employment						
c'+a×b (total effect of relative age on permanent contract)	0.033 (0.022)					
c' (direct association between relative age and permanent contract)		0.026 (0.022)	0.023 (0.021)	0.031 (0.021)	0.033 (0.021)	0.019 (0.021)
a×b (indirect association)		0.006*** (0.002)	0.009* (0.003)	0.001 (0.005)	−0.001 (0.003)	0.013*** (0.004)
Outcome: Adequate employment						
c'+a×b (total effect of relative age on permanent contract)	0.019 (0.036)					
c' (direct association between relative age and permanent contract)		0.019 (0.036)	0.018 (0.036)	0.019 (0.036)	0.020 (0.036)	0.018 (0.036)
a×b (indirect association)		0.000 (0.003)	0.001 (0.002)	0.001 (0.003)	−0.001 (0.003)	0.001 (0.003)
Outcome: Permanent contract						
c'+a×b (total effect of relative age on permanent contract)	0.059* (0.035)					
c' (direct association between relative age and permanent contract)		0.056 (0.035)	0.059* (0.035)	0.059* (0.035)	0.059* (0.035)	0.055 (0.035)
a×b (indirect association)		0.003 (0.003)	0.000 (0.002)	0.000 (0.000)	−0.001 (0.002)	0.004 (0.003)
Outcome: Full-time employment						
c'+a×b (total effect of relative age on permanent contract)	0.042 (0.032)					
c' (direct association between relative age and permanent contract)		0.028 (0.032)	0.027 (0.032)	0.040 (0.031)	0.043 (0.032)	0.026 (0.032)
a×b (indirect association)		0.014*** (0.004)	0.014*** (0.005)	0.002 (0.008)	−0.001 (0.005)	0.016*** (0.005)
Control variables	X	X	X	X	X	X
Observations	2441	2441	2441	2441	2441	2441

All of the analyses include both a cohort dummy and control variables migration background, father's tertiary education, mother's tertiary education, and the youth unemployment rate. Mediation analyses performed using Stata's sem command. Robust standard errors in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0$

Declarations

Conflict of interest No conflicts of interest.

References

Arulampalam, W., Gregg, P., & Gregory, M. (2001). Unemployment scarring. *Economic Journal, 111*(475), 577–584. https://doi.org/10.1111/1468-0297.00663

Baert, S. (2021). The iceberg decomposition: A parsimonious way to map the health of labour markets. *Economic Analysis and Policy, 69*, 350–365. https://doi.org/10.1016/j.eap.2020.12.012

Baert, S., & Cockx, B. (2013). Pure ethnic gaps in educational attainment and school to work transitions. When do they arise? *Economics of Education Review, 36*, 276–294. https://doi.org/10.1016/j.econedurev.2013.07.006

Baert, S., Cockx, B., & Verhaest, D. (2013). Overeducation at the start of the career: Stepping stone or trap? *Labour Economics, 25*(1), 123–140. https://doi.org/10.1016/j.labeco.2013.04.013

Baert, S., Rotsaert, O., Verhaest, D., & Omey, E. (2016). Student employment and later labour market success: No evidence for higher employment chances. *Kyklos, 69*(3), 401–425. https://doi.org/10.1111/kykl.12115

Baert, S., & Verhaest, D. (2019). Unemployment or overeducation: Which is a worse signal to employers? *De Economist, 167*, 1–21. https://doi.org/10.1007/s10645-018-9330-2

Barua, R., & Lang, K. (2016). School entry, educational attainment, and quarter of birth: A cautionary tale of a local average treatment effect. *Journal of Human Capital, 10*(3), 347–376. https://doi.org/10.1086/687599

Bedard, K., & Dhuey, E. (2006). The persistence of early childhood maturity: International evidence of long-run age effects. *Quarterly Journal of Economics, 212*(4), 1437–1472. https://doi.org/10.1093/qje/121.4.1437

Black, S., Devereux, P., Salvanes, K. (2011). Too young to leave the nest? The effects of school starting age. *Review of Economics and Statistics, 93*(2), 455–467. https://doi.org/10.1162/REST_a_00081

Clark, A., Georgellis, Y., & Sanfey, P. (2003). Scarring: The psychological impact of past unemployment. *Economica, 68*(270), 221–241. https://doi.org/10.1111/1468-0335.00243

Cockx, B., Picchio, M., & Baert, S. (2019). Modeling the effects of grade retention in high school. *Journal of Applied Econometrics, 34*, 403–424. https://doi.org/10.1002/jae.2670

Crawford, C., Dearden, L., Greaves, E. (2013). The impact of age within academic year on adult outcomes. IFS Working Paper, W13/07. *Institute for Fiscal Studies*. https://doi.org/10.1920/wp.ifs.2013.1307

Crawford, C., Dearden, L., & Greaves, E. (2014). The drivers of month-of-birth differences in children's cognitive and non-cognitive skills. *Journal of the Royal Statistical Society, 177*(4), 829–860. https://doi.org/10.1111/rssa.12071

D'hert, L., Baert, S., Lippens, L., Unemployment, Inactivity, and Hiring Chances: A Systematic Review and Meta-Analysis. *IZA Discussion Paper*, 17141.

D'hert, L., Lippens, L., Baert, S. (2024). *Not a lucky break? Why and when a career hiatus hijacks hiring chances*. *IZA Discussion Paper*, 17497.

Dhuey, E., & Lipscomb, S. (2008). What makes a leader? Relative age and high school leadership. *Economics of Education Review, 27*(2), 173–183. https://doi.org/10.1016/j.econedurev.2006.08.005

Dobkin, C., & Ferreira, F. (2010). Do school entry laws affect educational attainment and labor market outcomes? *Economics of Education Review, 29*(1), 40–54. https://doi.org/10.1016/j.econedurev.2009.04.003

Fleming, C., & Kler, P. (2011). I'm too clever for this job: A bivariate probit analysis on overeducation and job satisfaction in Australia. *Applied Economics, 40*(9), 1123–1138. https://doi.org/10.1080/00036840600771254

Fredriksson, P., & Öckert, B. (2014). Life-cycle effects of age at school start. *Economic Journal, 124*(579), 977–1004. https://doi.org/10.1111/ecoj.12047

Fumarco, L., & Baert, S. (2019). Relative age effect on European adolescents' social network. *Journal of Economic Behavior & Organization, 168*(1), 318–337. https://doi.org/10.1016/j.jebo.2019.10.014

Fumarco, L., Baert, S., Sarracino, F. (2020). Younger, dissatisfied, and unhealthy – Relative age in adolescence. *Economics & Human Biology, 37*(1). https://doi.org/10.1016/j.ehb.2020.100858

Garrouste, C., & Loi, M. (2011). School-to-work transitions in Europe: Paths towards a permanent contract. *JRC Scientific and Technical Reports, 67*(1), 1–52.

Geel, R., & Backes-Gellner, U. (2012). Earning while learning: When and how student employment is beneficial. *Review of Labour Economics and Industrial Relations, 26*(3), 313–340. https://doi.org/10.1111/j.1467-9914.2012.00548.x

Ghirelli, C. (2015). Scars of early non-employment for low educated youth: Evidence and policy lessons from Belgium. *IZA Journal of European Labor Studies*. https://doi.org/10.1186/s40174-015-0042-1

Hayes, A. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Press.

Häkkinen, I. (2006). Working while enrolled in a university: Does it pay? *Labour Economics, 13*(2), 167–189. https://doi.org/10.1016/j.labeco.2004.10.003

ILO (2025). Youth at Work in G20 countries: Progress and policy action in 2024. International Labour Organization, Geneva, Switzerland.

Johansen, E. (2021). Relative age for grade and adolescent risky health behavior: Evidence on abortions and alcohol poisonings. *Journal of Health Economics, 76*(1). https://doi.org/10.1016/j.jhealeco.2021.102438

Kauhanen, M., & Nätti, J. (2015). Involuntary temporary and part-time work, job quality and well-being at work. *Social Indicators Research, 120*(3), 783–199. https://doi.org/10.1007/s11205-014-0617-7

Larsen, E., & Solli, I. (2017). Born to run behind? Persisting birth month effects on earnings. *Labour Economics, 46*, 200–210. https://doi.org/10.1016/j.labeco.2016.10.005

Nusche, D., Miron, G., Santiago, P., & Teese, R. (2015). *OECD reviews of school resources: Flemish community of Belgium 2015*. OECD Publishing. https://doi.org/10.1787/9789264247598-en

OECD. (2021). Long-term unemployment rate. *OECD iLibrary*. https://doi.org/10.1787/76471ad5-en

Oosterbeek, H., ter Meulen, S., & van der Klaauw, B. (2021). Long-term effects of school-starting-age rules. *Economics of Education Review, 84*, 102144. https://doi.org/10.1016/j.econedurev.2021.102144

Passaretta, G., & Triventi, M. (2015). Work experience during higher education and post-graduation occupational outcomes: A comparative study on four European countries. *International Journal of Comparative Sociology, 56*(3–4), 232–253. https://doi.org/10.1177/0020715215587772

Peña, P. (2017). Creating winners and losers: Date of birth, relative age in school, and outcomes in childhood and adulthood. *Economics of Education Review, 56*(1), 152–176. https://doi.org/10.1016/j.econedurev.2016.12.001

Peña, P. (2020). Relative age and investment in human capital. *Economics of Education Review, 78*(1). https://doi.org/10.1016/j.econedurev.2020.102039

Peña, P., & Duckworth, A. (2018). The effects of relative and absolute age in the measurements of grit from 9th to 12th grade. *Economics of Education Review, 66*(1), 183–190. https://doi.org/10.1016/j.econedurev.2018.08.009

Pehkonen, J., Viinikainen, J., Böckerman, P., Pulkki-Råback, L., Keltikangas-Järvinen, L., & Raitakari, O. (2015). Relative age at school entry, school performance and long-term labour market outcomes. *Applied Economics Letters, 22*(16), 1345–1348. https://doi.org/10.1080/13504851.2015.1031864

Pellizzari, M., & Billari, F. C. (2012). The younger, the better? Age-related differences in academic performance at university. *Journal of Population Economics, 25*, 697–739. https://doi.org/10.1007/s00148-011-0379-3

Ponzo, M., & Scoppa, V. (2014). The long-lasting effects of school entry age: Evidence from Italian students. *Journal of Policy Modeling, 36*(3), 578–599. https://doi.org/10.1016/j.jpolmod.2014.04.001

Ross, C. E., & Wu, C. L. (1995). The links between education and health. *American sociological review*, 719-745. https://doi.org/10.2307/2096319

Saar, E., Unt, M., & Kogan, I. (2008). Transition from educational system to labour market in the European Union. *International Journal of Comparative Sociology, 49*(1), 31–59. https://doi.org/10.1177/0020715207088586

Schoon, I., Mann, A. (2020). School-to-work transitions during coronavirus: Lessons from the 2008 global financial crisis. *OECD Education and Skills Today*. Retrieved 13 November 2025 from https://oecdedutoday.com/school-work-during-coronavirus-2008-global-financial-crisis/

Shewbridge, C. Hulshof, M., Nusche, D., Stoll, L. (2011). School evaluation in the Flemish community of Belgium. *OECD Reviews of Evaluation and Assessment in Education*. OECD Publishing, Paris. https://doi.org/10.1787/9789264116726-en

SONAR (2002). Hoe maken Vlaamse jongeren de overgang van school naar werk? Basisrapportering COHORTE 1976 (Eerste Golf): eindrapport PB097. Steunpunt WAV, Leuven. Retrieved 13 November 2025 from https://lirias.kuleuven.be/1937881?limo=0

Statbel (2021). In 2020 heeft 47,8% van de 30−34-jarigen in België een diploma van het hoger onderwijs. Retrieved 13 November 2025 from https://statbel.fgov.be/nl/nieuws/2020-heeft-478-van-de-30-34-jarigen-belgie-een-diploma-van-het-hoger-onderwijs

Tobback, I., Verhaest, D., & Baert, S. (2024). Internships, hiring outcomes and underlying mechanisms: A stated preferences experiment. *De Economist, 172*, 25–48. https://doi.org/10.1007/s10645-023-09432-0

Van Belle, E., Caers, R., Cuypers, L., De Couck, M., Neyt, B., Van Borm, H., & Baert, S. (2020). What do student jobs on graduate CVs signal to employers? *Economics of Education Review, 75*, 101979. https://doi.org/10.1016/j.econedurev.2020.101979

Van Belle, E., Di Stasio, V., Caers, R., De Couck, M., & Baert, S. (2018). Why are employers put off by long spells of unemployment? *European Sociological Review, 34*, 694–710. https://doi.org/10.1093/esr/jcy039

Zweimüller, M. (2013). The effects of school entry laws on educational attainment and starting wages in an early tracking system. *Annals of Economics and Statistics, 111*(1), 141–169. https://doi.org/10.2307/23646329