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## Erasmus Exchange Program – A Matter of (Relatively) Older Students

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**Abstract.** This study contributes to the literature on long-term effects of relative age (i.e. age differences between classmates in compulsory school) by examining tertiary education outcomes. We investigate whether there is evidence of relative age effects on university students enrolled in the Erasmus exchange program. We use administrative data on all exchange students who visited the Linnaeus University, in Sweden, in the four years since its founding. We find long-term evidence of RAEs—the youngest cohort students participate less often to the Erasmus exchange program than older cohort members.

**Keywords:** Educational Policy; Higher Education; International Education/Studies; Migration; Policy Analysis.

**JEL-Classification:** D04, I21, I23, I24

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## 1 Introduction

A key tenant of public education is its promise to equalize labor market opportunities regardless of one's ascriptive characteristics, such as race, class, and gender. One unique factor, often overlooked, is centered around birthdays—arbitrary age cutoff dates are created so that educational institutions can determine the age for which students enter school. For example, a cutoff date of September 1<sup>st</sup> would mean that students with a September 2<sup>nd</sup> birthday would need to wait a full calendar year before enrolling in school, making this student the oldest in their grade level. Conversely, students born just before the cutoff would be some of the youngest members of the class cohort. This age difference can matter. The relatively older students (born soon after the cutoff date) enjoy better performance, (non)cognitive abilities, and well-being than relatively younger students, who are born just before the cutoff (Fumarco & Baert, 2019, 2018; Navarro et al., 2015; Bernardi, 2014; Ponzio & Scoppa, 2014; Sprietsma, 2010; Dhuey & Lipscomb, 2010; Cobley et al., 2009; Dhuey & Lipscomb, 2008; Bedard & Dhuey, 2006; Thompson et al., 2004). These disparities are also known as relative age effects (RAEs) (see Barnsley & Thompson, 1988).

Despite a large literature on RAEs, it is unclear if there are long-term impacts. To date, there is little work focused on the long-term impact of relative age, especially for educational performance in college. Of existing research, some evidence in the education field suggests the relative age could have a negative impact on tertiary education access and performance. Bedard and Dhuey (2006) find that relatively older students are more likely to be accepted into top tertiary education institutes. Likewise, Peña (2017) and Plug (2001) find that relatively older students are more likely to attend university and suggest that this selectivity explains their better outcomes on the labor market. There could be at least one reason for this negative impact: better

students (who are often the oldest ones in the cohort) receive better learning opportunities (Cunha et al., 2006) and are more likely to proceed toward the highest education tiers (Allen & Barnsley, 1993).

Other work finds that relative age has a positive impact on tertiary education achievements—youngest students in their age group perform better in university settings (Roberts & Stott, 2015; Pellizzari & Billari, 2012). There could be at least two reasons why this might occur: (i) struggling students (who are often the youngest ones in the cohort) benefit from positive spillovers for receiving an education with better (and older) students, while developing resilience (Roberts & Stott, 2015), and (ii) struggling students may study harder to catch up with better students (Pellizzari & Billari, 2012). These patterns have been termed the relative age effects reversal (RAER) in other settings (Gibbs et al., 2012; Fumarco et al., 2017).

We examine whether there is evidence for RAEs or RAER when examining an important educational mobility program popular throughout Europe—Erasmus. Using data from Erasmus students who visited the Linnaeus University from January 2010 to December 2014, we examine if there is a disproportionate share of students who participate in the program born either shortly before or shortly after the primary and secondary institutional age cutoffs (by country of origin).

Students enrolled in the Erasmus spend anywhere from a few months to a full year in a foreign European university. Acceptance usually requires language proficiency in either the language of the host country or English (Souto-Otero et al 2013), and a good performance in the home institute.<sup>1</sup>

Why examine Erasmus for RAEs? First, Erasmus is the most successful geographic mobility program for tertiary education students in the world, with more than 3 million university

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<sup>1</sup> Students who apply to the Erasmus exchange program are ranked based on their performance and then the home institute offers the visiting opportunity to the best performing applicants.

student participants since 1987 (Ballatore & Ferede, 2013). Critically, participation to this program has been found to positively impact labor market outcomes. To date, international mobility programs are associated with improved cognitive and non-cognitive skills such as openness, adaptability, intercultural awareness, and proficiency in foreign languages (De Poli et al., 2017; Böttcher et al., 2016; European Commission, 2014; Salisbury et al., 2013; Raikauinen & Hakkarainen, 2012; Cisneros-Donahue et al., 2012; Williams, 2005). Moreover, program participation is linked to increased chances of working abroad (Ballatore & Ferede, 2013; Parey & Waldinger, 2011; Bracht et al., 2006), which widens options for labor market entry. Thus, any impact of RAEs and RAER would suggest wasted talent and opportunities for students whose birthdays simply fell on one side or the other of arbitrary school cutoff dates. Second, the Erasmus exchange program is an ideal research setting for the study of RAEs because of high internal validity. Given the range of school cutoff dates by country, we can identify the representativeness of any RAEs or RAER across diverse educational norms throughout Europe. And third, no known study has directly examined the impact of age cutoffs in primary and secondary school and subsequent participation in the Erasmus exchange program.

Based on the literature, we expect that:

**H1:** Erasmus students who, in early education, were among the youngest in their grade (i.e. relatively young Erasmus students) will be under-represented.

We will explore if this pattern differs by gender, and by educational settings.<sup>2</sup>

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<sup>2</sup> In an earlier version of this paper, we investigated the relationship between Erasmus students' relative age and their educational outcomes in the hosting university, namely the probability to pass an exam and the quantity of blocks (i.e. groups of courses) to which the student is registered. We found a limited relationship between the relative age and these two outcomes; this limited association is likely due to the home university's screening process of students selection into Erasmus, and, thus, to the presence of sample selection bias. For this reason, we decided not report these results in this final version of the study.

The remainder of the paper proceeds as follows. Section 2 describes the data. Section 3 conducts and illustrates the analyses on the effect of relative age on Erasmus students' representativeness. Section 4 concludes.

## **2 Data**

### **2.1 Data description and sample**

We collected information for all Erasmus students who arrived at Linnaeus University after January 2010 and left before January 2015,<sup>3</sup> except for: (i) students from Germany and the United Kingdom because these countries do not enforce a uniform cutoff date, and (ii) students who attended more than two semesters because we cannot precisely separate the period spent as an Erasmus student from that spent as a free-mover student. Our sample includes 1,470 students from 22 countries. We compile more sample information in the Appendix. Table A.1 presents the country-specific cutoff dates and Table A.2 lists the resources consulted to gain information on this data.

There are several reasons why we focus on data from the Linnaeus University. First, collection of detailed, although anonymized, data on students needs the authorization from their university and it requires substantial resources to approach several universities, since the authorization process differs to a large extent between universities. Moreover, the process for collecting the type of data required for this study is not standardized across universities. Thus, it is a challenge to collect information from different universities, where each data collection and preparation needs frequent interactions with the staff of the university. What made our data

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<sup>3</sup> This period corresponds to three complete academic years (2010-2011, 2011-2012, and 2012-2013) and two half academic years (the second semester of 2009-2010 and the first semester of 2013-2014). We do not have data prior to 2010 because Linnaeus University was founded in 2010, after the merger of Växjö University and Kalmar University.

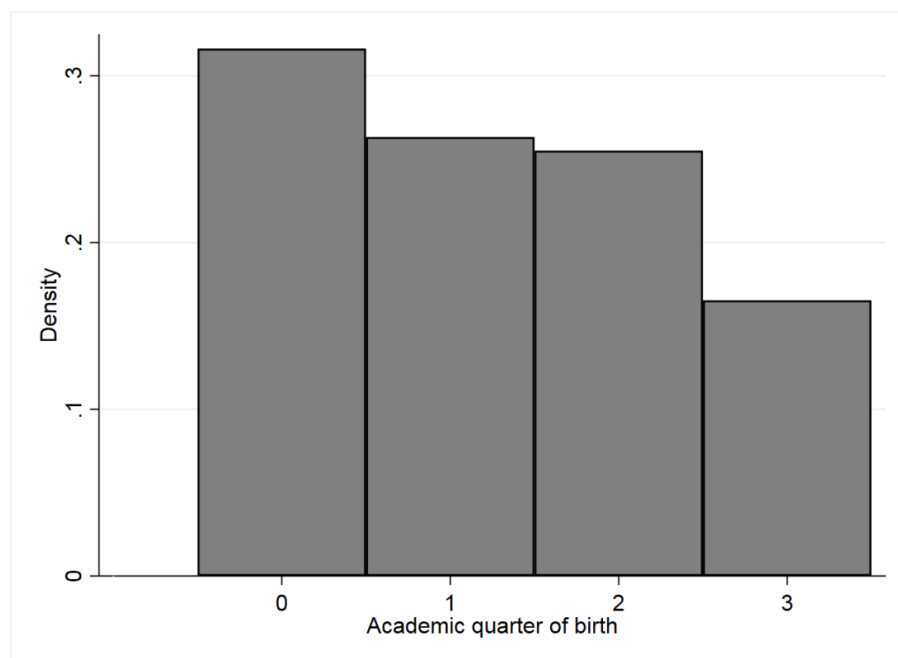
available at Linnaeus University was that at the moment of the data collection, two authors of this study were affiliated with, and physically located at, the Linnaeus University.

A relevant question is if these data are representative of Erasmus students in other universities. In other words, are the results of this study externally valid? We believe this could be the case. The main reason is that students in the Erasmus program at other universities went through a very similar process since entering school. They come from the same home countries in Europe, face the same cutoff dates when entering school and later face the same selection process into the Erasmus exchange program. Considering the latter, students select the host university in the country of destination two semesters before the students plan to take part of the Erasmus exchange program. Then it is their home university that selects the applicants who ultimately take part of the Erasmus; the relevant aspect of this selection process is that it is standardized (i.e. the selection process of students from university X who apply to visit university Z in country B is the same as the selection process of students from the same university X who apply to visit university K in country H) and thus it is the same regardless of the destination.

## **2.2 Academic Quarter of Birth**

We focus on the academic quarter of birth (AQB). This variable is a proxy for students' relative age in the pre-tertiary education, and its construction is based on the country cutoff date; from 0 (for the student born in the quarter that starts with the cutoff date) to 3 (for the student born in the quarter before the cutoff date). Figure 1 reports the histogram for Erasmus students' quarter of birth.

**Figure 1.** Erasmus students' academic quarters of birthrate frequency.



This figure provides *prima facie* evidence of negative RAEs on Erasmus students' representativeness. Relatively young students born toward the end of the admission year are under-represented, while relatively older students are over-represented. Moreover, there is a pattern: Erasmus students' quarter of birthrate decreases with the distance from the cutoff date; this trend is compatible with RAEs in other settings (e.g. professional soccer, Fumarco and Rossi (2018); professional hockey, Fumarco et al. (2017); politics, Muller and Page (2016) and Tukiainen et al. (2019); CEOs, Du et al. (2012)).<sup>4</sup>

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<sup>4</sup> Following the implementation of the General Data Protection Regulation in EU and EEA (2016), the authors have dropped from the dataset the variables on students' month of birth and home university, since they might allow students' identification. Thus, further heterogeneity analyses on these variables cannot be conducted.



### 3 The Relative Age Effect on Students' Representativeness

#### 3.1 Examining Evidence for RAEs

Is there evidence for RAEs among Erasmus students? Evidence of RAEs would mean that relatively older students will be over-represented, thus moving away from the cutoff date, the quantity of students being born in each quarter should monotonically decrease.<sup>5</sup> We examine evidence of RAEs using two statistical tests. First, we implement a chi-square goodness-of-fit test to compare the observed number of students per quarter of birth to the expected number based on a uniform distribution. Second, we compute the Spearman's rank correlation coefficient between the ranking of AQB based on the differences from the previous step and the ranking of AQB based on the distance from the cutoff.<sup>6</sup> Table 1 reports results for both tests.

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<sup>5</sup> Usually, one would compare the observed distribution of *AQB* with the reference distribution, from the general population. However, since our sample is composed of students from 22 countries, we choose as a reference a uniform distribution, as suggested in Delorme and Champely (2015).

<sup>6</sup> We cannot use the regression discontinuity design, as in Tukiainen et al. (2019), since it requires information on students' exact day of birth, whereas we have information on month and year of birth.

**Table 1.** RAEs in terms of representativeness, statistical tests.

Quarter	Quarters' representativeness				Academic quarter
	Observed counts (E)	Expected counts (O)	Difference (O)-(E)	Ranking (1)	Ranking (2)
AQB = 0	465	367.5	97.5	4	1
AQB = 1	387	367.5	19.5	3	2
AQB = 2	375	367.5	7.5	2	3
AQB = 3	243	367.5	-124.5	1	4
$\chi^2$ (3)	69.23 (0.000)				
Spearman	-1.000 (0.000)				

Note: "Ranking (1)" is the month ranking based on "Difference (O)-(E)." "Ranking (2)" is based on the position of the quarter of birth within the academic year (e.g.,  $AQB = 0$  and  $AQB = 3$  receive ranks 1 and 4 respectively).

The chi-square test results provide evidence that the observed quarter of birth distribution differs from the expected one, assuming the latter to be uniform. Moreover, the Spearman rank correlation coefficient provides evidence of a highly statistically significant and negative correlation between the gap in the number observed and expected students in a birth quarter and the distance to the cutoff. Students born in the first quarter are over-represented and this over-representation decreases for students born in the second and third quarter. Students in the fourth quarter are strongly under-represented: their observed counts are about 66% of their expected counts.

As a robustness check, we repeated the analyses by cutoff date groups and by year. Results on countries with a January 1<sup>st</sup> cutoff date have the same result as do countries with different cutoff dates. These results are shown in Tables A.3 and A.4. Cutoff dates per country are reported in Table A.1. Analyses by year of arrival at the Linnaeus University and by age group confirm that relatively young students are under-represented. We also conducted pairwise chi-square tests applying the Bonferroni adjustment to the p-values and we find that each pairwise difference is highly statistically significant. Results for these three last series of tests are available upon request.

### 3.2 Examining Evidence for RAEs by Gender

Female students tend to mature earlier than their male counterparts. Although there are good reasons to expect that RAEs vary during adolescences, as the timing for maturation varies by gender (Baxter-Jones et al., 1995; Vincent & Glamer, 2007), we can find no compelling reason to expect these differences to carry into young adulthood and for educational outcomes. Nonetheless, here we explore this possibility using the same tests as above. Table 2 reports results on these analyses by gender. We find evidence of RAEs for both female and male Erasmus students. However, the two-sample Kolmogorov-Smirnov test for equality of distributions reveals no statistically significant difference in RAEs patterns between female and male students.

**Table 2.** RAEs in terms of representativeness, statistical tests by gender.

Quarter	Male students				
	Quarters' representativeness				Academic quarter
	Observed counts (E)	Expected counts (O)	Difference (O)-(E)	Ranking (1)	Ranking (2)
AQB = 0	238	186.250	51.750	4	1
AQB = 1	194	186.250	7.750	3	2
AQB = 2	189	186.250	2.750	2	3
AQB = 3	124	186.250	-62.250	1	4
$\chi^2$ (3)	35.548 (0.000)				
Spearman	-1.000 (0.000)				
Quarter	Female students				
	Quarters' representativeness				Academic quarter
	Observed counts (E)	Expected counts (O)	Difference (O)-(E)	Ranking (1)	Ranking (2)
AQB = 0	227	181.250	45.750	4	1
AQB = 1	193	181.250	11.750	3	2
AQB = 2	186	181.250	4.750	2	3
AQB = 3	119	181.250	-62.250	1	4
$\chi^2$ (3)	33.814 (0.000)				
Spearman	-1.000 (0.000)				

Two-sample Kolmogorov-Smirnov test for equality of distribution functions  
0.006 (1.000)

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*Note:* “Ranking (1)” is the month ranking based on “Difference (O)-(E).” “Ranking (2)” is based on the position of the quarter of birth within the academic year (e.g.,  $AQB = 0$  and  $AQB = 3$  receive ranks 1 and 4 respectively).

### **3.3 Examining Evidence for RAEs by Educational Setting**

We also explore whether RAE patterns vary by home country. We know that some educational systems group students based on their perceived skills (see Table A.1), which could lead to maturity advantages of relatively old students (Fredriksson & Öckert, 2014; Mühlenweg & Puhani, 2010). In the long run, this might affect both the probability to start tertiary education and students’ self-esteem, which could be reflected into a stronger under-representation of Erasmus students from countries with pronounced ability grouping policies. Table 4 provides evidence that RAEs on representativeness characterize both countries where ability grouping is allowed and where it is not allowed. Moreover, there is no statistically significant difference between these two distributions of quarters of birth.

**Table 3.** RAEs in terms of representativeness, statistical tests by ability grouping.

Ability grouping allowed					
Quarter	Quarters' representativeness				Academic quarter
	Observed counts (E)	Expected counts (O)	Difference (O)-(E)	Ranking (1)	Ranking (2)
AQB = 0	363	283.000	80.000	4	1
AQB = 1	298	283.000	15.000	3	2
AQB = 2	283	283.000	0.000	2	3
AQB = 3	188	283.000	-95.000	1	4
$\chi^2$ (3)	55.300 (0.000)				
Spearman	-1.000 (0.000)				
Ability grouping not allowed					
Quarter	Quarters' representativeness				Academic quarter
	Observed counts (E)	Expected counts (O)	Difference (O)-(E)	Ranking (1)	Ranking (2)
AQB = 0	102	84.500	17.500	4	1
AQB = 1	89	84.500	4.500	3	2
AQB = 2	92	84.500	7.500	2	3
AQB = 3	55	84.500	-29.500	1	4
$\chi^2$ (3)	14.828 (0.002)				
Spearman	-1.000 (0.000)				
Two-sample Kolmogorov-Smirnov test for equality of distribution functions					
0.019 (1.000)					

*Note:* “Ranking (1)” is the month ranking based on “Difference (O)-(E).” “Ranking (2)” is based on the position of the quarter of birth within the academic year (e.g., AQB = 0 and AQB = 3 receive ranks 1 and 4 respectively).

## 4 Conclusion

The central contribution of this study is to demonstrate the lasting impact of RAEs on admissions into a critical educational program at the university-level. We investigate data on Erasmus students who visited the Linnaeus University between Spring 2010 and Winter 2014 and find that the amount of students born in the last academic quarter is two-thirds of the expected amount. The magnitude and direction of this result parallels findings in other competitive settings (e.g. professional soccer, Fumarco and Rossi (2018); professional hockey, Fumarco et al. (2017); politics, Muller and Page (2016) and Tukiainen et al. (2019)). We find equivalent results when we investigate RAEs by gender or educational settings in the country of origin.

In summary, we find that nearly 124 students born in the last quarter should have been admitted to the Erasmus exchange program but were not due to RAEs. This represents a significant loss of educational opportunities for simple administrative reasons carried out in primary and secondary schools across Europe.

Previous research suggests two possible reasons for this result. First, relatively young students perform poorly in their university, which reduces their chances to be selected to participate to the Erasmus. Second, because of low self-esteem, relatively young students might apply at lower rates; they could feel less prepared than their older peers to navigate the challenges associated with travelling and schooling outside of their home country.

Our study can be expanded upon in several ways. We think one important next step is to know more about the Erasmus selection process in the sending universities. While our study focuses on incoming Erasmus students, future studies could examine the policies and practices of selecting Erasmus exchange students by the home universities (e.g. compare applications of students accepted and rejected and levels of performance); in practical terms, what we envisage is that researchers from one university could study how their own university selects whom, among its students, are admitted to participate in the Erasmus program.

Overall, the long-term consequences of relative age start at the very beginning of a student's educational career. The results in this paper signal an effect of relative age that has been largely undetected in one of Europe's most important educational mobility programs. In the long-term, participation to this program has positive effects on cognitive and non-cognitive skills, increases employment prospects. In the short-term, Erasmus exchange students receive a (publicly funded) monthly scholarship of about 475€ on average,<sup>7</sup> which can significantly shape

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<sup>7</sup> At 2015 prices, <http://www.european-funding-guide.eu/articles/financing-tips/what-erasmus-internship-program> (November 11, 2019).

the university experience. Together, our findings suggest that both the long-term and short-term benefits of the Erasmus program is available to two-thirds of the potentially eligible fourth quarter students, while the excluded students have lost an educational benefit due to an unchangeable feature of their biography—their birthday. There is clearly a sizable share of student opportunities lost to RAE—a yet undemonstrated long-term impact of age cutoffs in primary and secondary schools across Europe.

We can draw a better picture of the importance of our results with two examples. Let us assume that there is a similar distribution of academic quarter of birth in all of the hosting universities, and that it is constant through time. Ballatore and Ferede (2013) suggest that 3 million students participated to the Erasmus exchange program from its very beginning, in 1987, to 2013. What does our result imply? Based on the above simplistic assumptions, our results suggest that, from 1987, only 480,000 students born in the fourth quarter of the academic year participated to the Erasmus, against expected 750,000 students (or 19,200 students versus expected 30,000 students per year). Unequal distribution of educational opportunities is reflected into an inefficient use of public money. Let us further assume that the average monthly scholarship has been assigned to these 3 million students, and that each of these students spent 5 months abroad (i.e. roughly one academic semester); in this example, the EU has allocated 3.1 billion euros over about 25 years. What does our result imply? Our results suggest that, from 1987 to 2013, Erasmus students born in the first quarter received about 980 million euros in total, students born in the second and third quarter received 816 and 791 million euros respectively, whereas students born in the fourth quarter received about 512 million euros, that is, almost 50% less than what has been allocated to students born in the first quarter of the academic year. Although these estimates are hypothetical, they should spur researchers to dig much further into this topic of RAEs on Erasmus students.

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