# Higher education decisions and macroeconomic conditions at age eighteen

Jennifer Graves
Universidad Autónoma de Madrid

Zoe Kuehn
Universidad Autónoma de Madrid

Using individual data from PIAAC and aggregate data on GDP and unemployment for the US, Europe, and Spain, we test how macroeconomic conditions experienced at age eighteen affect the following decisions in post-secondary and tertiary education: i) enrollment ii) dropping-out, iii) type of degree completed, iv) area of specialization, and v) time-to-degree. We also analyze how the effects differ by gender and parental background. Our findings are different for each of these geographies, which shows that the impacts of macroeconomic conditions on higher education decisions depend on context, such as labor markets and education systems. By analyzing various components of higher education together, we are able to obtain a clearer picture of how potential mechanisms linked to lower opportunity costs of education and reduced ability to pay during economic downturns interact to determine student selection.

VERSION: April 2021

# Higher education decisions and macroeconomic conditions at age eighteen[*]

## Jennifer Graves[†] Zoë Kuehn[‡]

Using individual data from PIAAC and aggregate data on GDP and unemployment for the US, Europe, and Spain, we test how macroeconomic conditions experienced at age eighteen affect the following decisions in post-secondary and tertiary education: i) enrollment ii) dropping-out, iii) type of degree completed, iv) area of specialization, and v) time-to-degree. We also analyze how the effects differ by gender and parental background. Our findings are different for each of these geographies, which shows that the impacts of macroeconomic conditions on higher education decisions depend on context, such as labor markets and education systems. By analyzing various components of higher education together, we are able to obtain a clearer picture of how potential mechanisms linked to lower opportunity costs of education and reduced ability to pay during economic downturns interact to determine student selection.

*JEL classification*: I21, E32, I26

*Keywords*: higher education decisions, macroeconomic conditions, PIAAC,

# 1 Introduction

Business cycles impact individuals in profound ways.[1] Among the most widely studied effects of recessions are the ones on educational and labor market outcomes, because economic downturns alter the opportunity costs between education and labor market participation. However, while there exists a sizable literature that has studied the impact of macroeconomic conditions on college enrollment for the United States, there is a lack of evidence for other countries or regarding other higher education decisions.

The current paper tests how macroeconomic conditions experienced at age 18 affect a variety of decisions in post-secondary and tertiary education. To this end, we merge data from the Programme for the International Assessment of Adult Competencies (PIAAC) on individuals who turned 18 between 1980 and 2005 with information on GDP and unemployment for the US and six European countries (UK, Germany, France, Sweden, Finland, Spain). Our estimation compares individuals of similar family backgrounds and abilities, and we test how macroeconomic conditions experienced at age 18 affect the following higher education decisions: i) enrollment ii) dropping-out, iii) type of degree completed, iv) area of specialization, and v) time-to-degree. Given a natural path through high school determined largely by age, this "treatment" can be considered exogenous. Hence, conditional on various detailed controls, our estimates provide the causal impact of macroeconomic conditions on higher education decisions.

Our results suggest different mechanisms at work in the US and Europe. For the US, among those experiencing recessions at age 18, there is an increase in the rate of bachelor's and master's degree completion, paired with a decrease in enrollment and lower drop out rates. These findings could be due to the marginal student being deterred from pursuing higher degrees during economic downturns, potentially due to financial constraints. Student quality at higher education institutions could hence be increasing, leading to higher rates of degree attainment. Potentially related, we also find that students are more likely to specialize in so-called STEM fields (science, technology, engineering, mathematics) which are perceived as more challenging. In Europe, on the other hand, where tuition fees for higher education tend to be lower, we find results consistent with lower opportunity costs of studying

---

[1]Evidence finds that recessions affect health and mortality (Ruhm [2000]), fertility decisions (Currie and Schwandt [2014]), to the way in which people think and make decisions. For example, Malmendier and Nagel [2016] and [2011] show that economic conditions impact how one forms expectations and that they affect individual risk preferences respectively. Giuliano and Spilimbergo [2014] find that recessions affect individuals' beliefs about the role of luck in success.

during recessions and a reduced selectivity of students. For individuals experiencing economic downturns at age 18 we estimate a slight increase in completion of any post-secondary degree (including vocational degrees), shorter time-to degree, but an increase in non-completion of attempted degrees. Similarly for the case of Spain, those experiencing recessions or high rates of unemployment at age 18 are more likely to enroll in post-secondary programs, but they are also more likely to abandon them. Fewer individuals choose STEM fields. Overall, in Spain, economic downturns result in an increased probability to attain at least a bachelor's or master's degree, as some who are induced to enroll do succeed.

We also test for heterogeneity in our findings along gender and parental background. Female students in the US drive most of the impacts, in particular higher completion rates, lower drop-out rates, and shorter time-to-degree. In Spain, on the other hand, decisions of male students mainly explain higher enrollment and completion rates of bachelor's degrees. Regarding heterogeneity by parental background, in the US and Europe we only observe increased graduation rates from master's programs for students whose parents have tertiary education.

Our different results for the US and Europe highlight the importance of analyzing the effects of macroeconomic conditions on higher education decisions in the context of different education systems and labor markets. In addition, by looking at various components of higher education together, we are able to obtain a clearer picture of how potential mechanisms linked to lower opportunity costs of education and reduced ability to pay during economic downturns interact to determine student selection.

In economic downturns, the opportunity cost of continued schooling falls as labor market opportunities become less attractive. Everything else equal this should result in increased enrollment. Likewise, if higher education is viewed as a way to signal quality to potential employers, we would expect more individuals to enroll in higher education when labor markets are tighter. On the other hand, if individuals believe that recessions or high unemployment situations will outlast their time in higher education, then they may perceive a lower expected return from higher education and choose not to enroll. Additionally, economic downturns can also reduce one's ability to pay for higher education. Considering the large expenses associated with higher education, in particular in the US, this force would also predict lower enrollment during economic downturns.

However, ability to pay could not only affect enrollment but also the probability of college completion. Even without any effect on enrollment, as poor economic conditions persist,

2

individuals may find themselves no longer able to make payments toward their degree path. In addition, there could be interaction effects between completion and enrollment. If enrollment increases due to poor prospects in the labor market, then the marginal student who enrolls is most likely less prepared for college. We would therefore observe lower completion rates as some of these students dropout at greater rates. On the other hand, if enrollment falls during recessions, the remaining students may be those best prepared to obtain a degree and drop-out rates could be lower and degree completion rates higher following economic downturns.

Beyond enrollment and dropout behavior, students also make other higher education decisions which could be affected by macroeconomic conditions. For example, college major choice could be altered if students use their degree choice to signal employability in a tight labor market. Time-to-degree could also be affected as students may be able to remain in college to "wait out the storm" and to avoid any labor market penalty from experiencing unemployment. These decisions may be interconnected should the choice of major also impact time-to-degree.

The remainder of this paper is organized as follows. The next section provides a review of the existing literature. Section 3 describes our data, and in Section 4 we outline our empirical strategy. Section 5 presents and discusses our results including heterogeneity analyses. Finally Section 6 concludes.

## 2 Literature Review

While there is ample evidence that graduating during a recession has negative lasting impacts on wages and employment (e.g. Kahn [2010], Oreopoulos, von Wachter, and Heisz [2012], Oyer [2006], Raaum and Røed [2006]), literature on the recession effects on higher education decisions is less conclusive.

As mentioned before, most studies have focused on the impact of macroeconomic conditions on college enrollment in the United States. For instance, Long [2015] estimates that the Great Recession in the US resulted in overall higher college enrollment, but decreased full-time and increased part-time enrollment. For earlier time periods, Betts and McFarland [1995] find that as unemployment rose in the US during the 1970-80s, enrollment in community colleges increased. Dellas and Sakellaris [2003] and Dellas and Koubi [2003] also estimate enrollment

to be counter-cyclical for both 2-year and 4-year degrees. According to Kane [1994], on the other hand, family conditions and cost of education explain most changes in enrollment, with no notable impact of local economic conditions. Contrary to our findings, most studies point to increased enrollment in the US during economic downturns. However, our analysis covers a longer time period than most of these studies – 1980 to 2005– and we include enrollment in any post-secondary or tertiary program (vocational, bachelor's, master's and doctorate) which might explain the difference in results.[2]

Another reason that a clear impact of macroeconomic conditions on enrollment in higher education is elusive is that many studies find a great deal of heterogeneity. Results have been found to vary by race (e.g. Dellas and Sakellaris [2003] and Kane [1994]), as well as by gender and across degree levels. According to Johnson [2013] graduate school enrollment is counter-cyclical for women and acyclical for men. In contrast, Bedard and Herman [2008] find the effect for women to be acyclical, while the effect for men to vary by type of degree. The authors estimate male enrollment in PhD programs (master's programs) to be counter-cyclical (pro-cyclical). Similarly, our findings for the US show that completing a master's degree is counter-cyclical for women and acyclical for men. Considering family background, Christian [2007] finds that during US recessions college enrollment increases, but that this occurs more so among individuals from families with fewer liquidity constraints whose ability to pay is less affected. Our results on heterogeneity by parental background are in line with the author's findings.

Regarding other decisions in higher education, Charles, Hurst, and Notowidigdo [2015] find lower degree attainment after the Great Recession driven by reductions in enrollment during the previous housing boom. On the other hand and in line with our findings, Kahn [2010] provides evidence for small increases in college completion for US students linked to high unemployment rates experienced at age 18.[3] Additionally, Blom, Cadena and Keys [2015] show that exposure to higher unemployment rates during typical schooling years, results in US individuals studying college majors with better employment prospects and higher wages,

---

[2]In terms of time period studied, Méndez and Sépulveda [2012] is closest to our study. The authors consider US data for 1988 to 2006, and they also find schooling at any level (including primary schools) to be counter- cyclical but only for unskilled individuals.

[3]Bound, Lovenheim and Turner [2010] study trends of decreasing college completion rates for the US and find that while enrollment has increased, this is not matched in completion rates. One-third of lower completion is driven by lower ability of the marginal student and two-thirds are driven by a combination of tightened university budgets paired with the type of schools that marginal students attend (specifically, less selective universities and community colleges). While the authors do not consider business cycle impacts specifically, the suggested mechanism is consistent with decreased enrollments and increased completion rates induced by economic downturns

such as STEM fields. The authors argue that this type of "compensating behavior" aims to lessen the negative impacts of graduating in a recession, and they find women to be more likely to engage in it. We also find that in the US, economic downturns experienced at age 18 lead to more individuals specializing in STEM fields.

Only few studies have considered the effects of macroeconomic conditions on higher education decisions for countries other than the United States. For Europe, Ayllon and Nollenberger [2016] find that during the Great Recession higher unemployment rates coincide with higher enrollment and small increases in completion rates.[4] On the other hand, Clark [2011], who studies England, and Sievertsen [2016], who studies Denmark, estimate post-secondary enrollment to be countercyclical. For Canada, Alessandrini [2014] and King and Sweetman [2002] find results to differ by degree level. The former finds university enrollment to be counter-cyclical, college enrollment to be pro-cyclical and other non-university post-secondary education to be acyclical, while the latter observe returning to school to be pro-cyclical. Regrading cross-country evidence, Sakellaris and Spilimbergo [2000] state that "There should be no presumption that the relative importance of opportunity cost and ability to pay (or their cyclical components) should be the same across countries" (p. 222). Looking at foreign students at US universities, the authors find that those from OECD countries exhibited counter-cyclical enrollment, fitting the opportunity cost story, whereas students from non-OECD countries exhibited pro-cyclical enrollment, fitting the ability to pay mechanism. While their study motivates the importance of looking at different country contexts, its external validity is limited by the particularly selected set of students who choose to study abroad. Nonetheless, the study clearly highlights the two main theoretical mechanisms through which recessions may impact college enrollment: opportunity costs and ability to pay.

In the US, the cost of higher education has grown rapidly over the past few decades. This is an important consideration when comparing the US and Europe. First, because the proportion of the costs paid by students in the US is much larger than in Europe, and second, because even when faced with large cost increases, students in the US may be more likely to assure loans to fund their education compared to European students (Johnson, [2013]; OECD,

---

[4]The comparability of the results from this study are complicated by the way the authors define their dependent variable as student status for all educational levels, including high school, as opposed to the standard approach in the literature of only looking at high school graduates, and then measuring enrollment in higher education. The authors also find small positive effects on the graduation rate for high school and vocational education (defined as a combined category), as well as for university degrees. However, the magnitudes of the effects are quite small, and the positive coefficient for obtaining a bachelor's degree is even smaller than the one found for high school and vocational degrees.

[2011]).

A greater ease to pay for higher education might also be the reason why individuals in Europe seem to have more flexibility to adjust their time at university. Most studies on the effects of business cycles on time-to-degree have hence looked at European countries. For instance, Brunello and Winter-Ebmer [2003], in a survey of European countries, and Aina, Baici and Casalone [2011] focusing on students in Italy, both find that higher unemployment lengthens time-to-degree, as poor labor market prospects serve as a disincentive to graduate. However, the use of higher education as a "parking lot" is expected to vary by the cost of doing so and to be more likely in the context of low tuition fees (e.g. Becker, [2006] Garibaldi, Giavazzi, Ichino and Rettore, [2012]). For instance, for Swiss university students, Messer and Wolter [2010] observe that higher unemployment actually shortens time-to-degree by making it harder for students to find part-time jobs, which are commonly used to fund university attendance. In line with this last finding, our results indicate overall shorter time-to-degree in Europe, while in Spain, individuals of more advantaged parental backgrounds seem to be able to "wait out" recessions in higher education institutions.

# 3 Data

To test how macroeconomic conditions experienced at age 18 affect individuals' decisions in post-secondary or tertiary education, we combine PIAAC data on individuals who turned 18 between 1980 and 2005 with national statistics on GDP and unemployment.

## 3.1 PIAAC

The PIAAC survey was carried out by the OECD in 2011 and 2012 in 24 high-income countries. For our analysis we focus on a subset of seven countries: US, Finland, France, Germany, Spain, Sweden, and the UK.[5] PIAAC can be described as the adult version of the OECD's better-known "Programme for the International Assessment of Students" (PISA). While PISA assesses students' cognitive skills, PIAAC does so for a country's population aged 16-65. Apart from cognitive as well as non-cognitive ability scores, PIAAC provides

---

[5]For selecting the sub-set of countries for this study, we closely followed Graves and Kuehn [2019] selecting certain countries that represent different educational systems and labor marker institutions. Notably, the US is included as one of the seven countries in our sample as it serves as an important point of reference.

information about individual's schooling, continuous education, work experience, income, and other relevant labor market variables.

Given that our analysis focuses on the impacts of macroeconomic conditions on higher education decisions we limit our sample to high school graduates, eliminating high school drop outs, for whom there is no higher education decision to be made. We also limit our sample to those older than 25 because we want to ensure that individuals are old enough to have finished higher education.

For our study, we focus on the following key variables: First, we have information on individuals' highest educational degree (ISCED: 0 to 6) as well as their age at graduation.[6] PIAAC also provides information on the level of uncompleted education and the age at which individuals dropped out. Furthermore, the survey asks "What was the area of study, emphasis or major for your highest level of qualification?' Answers fall into the following categories: 1) general programmes; 2) teacher training and education science; 3) humanities, languages and arts; 4) social sciences, business and law; 5) science, mathematics and computing; 6) engineering, manufacturing and construction; 7) agriculture and veterinary; 8) health and welfare; 9) services.

We construct our outcome variables in the following way. First, we construct three indicator variables for educational attainment: obtaining any post-secondary degree or higher, obtaining a bachelor's degree or higher, and obtaining a master's degree or higher. The indicator for graduating with at least a post-secondary degree is recorded as 1 for a person having a vocational, bachelor's, master's or doctorate degree. As our sample is limited to high school graduates, the indicator takes on value 0 for individuals who have a high school degree recorded as their highest level of educational attainment. One the other hand, our indicator for bachelor's degree or higher includes those with a bachelor's, master's or doctorate degree relative to those with only a high school degree or a lower post-secondary degree. When defining our indicator for holding a master's degree or higher (PhD, doctorate) we have to exclude the UK from our sample of European countries because PIAAC data for the UK does not differentiate between individuals with bachelor's or master's degrees.

For enrollment, we define an indicator variable that takes on value 1 for those whose highest education obtained is recorded as any post-secondary degree, as they clearly would have

---

[6]ISCED stands for International Standard Classification of Education designed by the United Nations to be comparable across countries. For details see http://www.uis.unesco.org/Education/Pages/international-standard-classification-of-education.aspx.

enrolled, but we also include individuals with a high school degree who report to have attempted any type of higher education but who have not completed it. Together, this set of individuals comprises the group that at some point enrolled in higher education compared to high school graduates who never did. Degree non-completion or drop-out is defined among those ever enrolled. It is a dummy variable that takes on value 1 for individuals with at least a high school degree who have attempted any higher degrees but have not finished them. This results in a combined measure of non-completion at all levels, from attempted but not completed vocational degrees, bachelor's, to master's and including doctorate degrees. The variable therefore does not indicate whether individuals have ever obtained any post-secondary or tertiary degree or not. Note that the variable does not pick up high-school dropouts, as our sample is entirely comprised of high school graduates.

We also analyze the effect of economic conditions at age 18 on area of specialization and time-to-degree. For these outcomes, comparisons are only interesting among individuals who obtain at least a post-secondary degree, and hence we exclude individuals with only high-school education. For area of specialization we focus on so-called STEM fields. We define our dependent dummy variable such that individuals who report to have acquired a specialization in their highest level of education in the following two fields: "science, mathematics, and computing" or "engineering, manufacturing and construction," are assigned a value of 1, while everybody else is assigned value 0. Regarding the outcome variable "time-to-degree," PIAAC does not provide this information, but we know at what age individuals finished their highest degree. Assuming that most individuals start post-secondary or tertiary degrees at age 18, we hence proxy time-to-degree by taking the difference between age at graduation and age 18. For the US and Germany, age at graduation is only available in 5 year intervals, and we hence randomly assign individuals to years of graduation within each interval. While we refer to this measure as time-to-degree, it strictly measures time-to-degree from the "normal" starting time, at age 18. The variable therefore picks up any non-conventional timing track, including those who started at age 18 and took longer than most to finish, and –observationally equivalent – those who took the normal amount of time to complete their degree but for some reason delayed starting their higher education.

While PIAAC is a single cross-section, individuals of different ages allow us to make use of variation over time. In particular, for each observation we merge data from national statistics on GDP and unemployment in the year each individual turned 18. As an example, individuals of age 30 in our sample are assigned values for unemployment and GDP for the year 2000. For analyses of higher education decisions, age 18 is particularly relevant.

8

Among high school graduates, it serves as an important year for the path of higher education decisions across the various countries in our sample. Individuals who are 18 either remain at their highest level of educational attainment of high school graduate, enroll in a vocational degree or enroll in a bachelor's degree program. Even those with intentions to further continue in higher education, such as subsequently enrolling in a master's or PhD program, typically enroll in a bachelor's program at this time.

## 3.2   National Accounts

For creating our indicators of whether individuals experienced economic downturns at age 18 we rely on national statistics on GDP and unemployment from each country's national statistics office. In particular we construct a dummy variable for whether the individual experienced a recession at age 18, which takes on value one in years with two consecutive quarters of negative GDP growth. We also use the national unemployment rate at age 18 and the annual percentage point change in the unemployment rate in the year leading up to when individuals turn 18. We construct two additional macroeconomic controls for the year that individuals turn 18. First, we use the share of labor contracts covered by collective bargaining to capture changes in countries' labor market institutions which we obtain from Visser [2013]. Second, we include data from the World Bank on government expenditure to GDP to reflect changes in public employment opportunities. For the US, UK, Germany, Finland, and France our data starts in 1980. For Spain and Sweden it starts in 1982 and 1985 respectively.

## 3.3   Sample

Table 1 presents the summary statistics for our three samples. The first two samples include 15,162 individuals in Europe and 2,287 individuals in the US. We also highlight the case for Spain, using a sample of 1,547 individuals, which are also included in the European sample. Note that all our observations are weighted using personal weights supplied by PIAAC that have been adjusted such that individual weights are not influenced by a country's population size. In our European and US sample, around 16% of individuals experienced a recession at age 18, while this is only the case for 11% of individuals in the sample for Spain. On the other hand, the average unemployment rate of 17% in Spain by far exceeds those in the US (6%) or Europe (9%). The average change in unemployment experienced by individuals

9

in our Spanish sample is around 7-8 times larger compared to the variation in the US or Europe. As expected, union coverage of labor contracts is much more prevalent in Europe, and in particular in Spain, compared to the US. Numbers on government spending to GDP vary less across the three samples (15-21%).

Table 1: Summary statistics

| | US | | Europe | | Spain | |
|---|---|---|---|---|---|---|
| **Variable** | **Mean** | **Std. Dev.** | **Mean** | **Std. Dev.** | **Mean** | **Std. Dev.** |
| *Macroeconomic conditions at age 18* | | | | | | |
| $Recession_{18}$ | 0.158 | 0.365 | 0.162 | 0.369 | 0.108 | 0.31 |
| $U\text{-rate}_{18}$ | 6.244 | 1.497 | 8.634 | 4.111 | 16.737 | 3.863 |
| $\Delta\ u\text{-rate}_{18}$ | -0.071 | 0.882 | 0.066 | 1.184 | -0.526 | 1.609 |
| $Union\ coverage_{18}$ | 18.037 | 3.229 | 78.711 | 15.957 | 81.839 | 3.851 |
| $Government\ spending_{18}$ | 15.36 | 0.757 | 20.774 | 2.93 | 16.857 | 0.856 |
| *Countries* | | | | | | |
| Finland | – | – | 0.187 | 0.39 | – | – |
| France | – | – | 0.169 | 0.374 | – | – |
| Germany | – | – | 0.192 | 0.394 | – | – |
| Spain | – | – | 0.114 | 0.318 | 1 | 0 |
| Sweden | - | – | 0.166 | 0.372 | – | – |
| UK | – | – | 0.172 | 0.377 | – | – |
| US | 1 | 0 | – | – | – | – |
| *Individual characteristics* | | | | | | |
| Male | 0.476 | 0.5 | 0.497 | 0.5 | 0.479 | 0.5 |
| Foreign born | 0.146 | 0.353 | 0.128 | 0.334 | 0.164 | 0.371 |
| Second Generation Migrant | 0.092 | 0.289 | 0.111 | 0.314 | 0.026 | 0.159 |
| Parental education: secondary | 0.434 | 0.496 | 0.377 | 0.485 | 0.217 | 0.412 |
| Parental education: tertiary | 0.425 | 0.494 | 0.29 | 0.454 | 0.212 | 0.409 |
| *Number of books at home as a child* | | | | | | |
| 10 or less | 0.135 | 0.342 | 0.067 | 0.25 | 0.046 | 0.209 |
| 11 to 25 | 0.18 | 0.384 | 0.1111 | 0.315 | 0.142 | 0.349 |
| 26 to 100 | 0.339 | 0.473 | 0.329 | 0.47 | 0.391 | 0.488 |
| 101 to 200 | 0.173 | 0.379 | 0.198 | 0.398 | 0.194 | 0.395 |
| 201 to 500 | 0.109 | 0.312 | 0.185 | 0.388 | 0.145 | 0.353 |
| more than 500 | 0.064 | 0.245 | 0.109 | 0.312 | 0.082 | 0.275 |
| *Non-cognitive and cognitive abilities* | | | | | | |
| Readiness to learn 2 | 0.142 | 0.35 | 0.181 | 0.385 | 0.167 | 0.373 |
| Readiness to learn 3 | 0.172 | 0.377 | 0.226 | 0.418 | 0.218 | 0.413 |
| Readiness to learn 4 | 0.247 | 0.431 | 0.251 | 0.434 | 0.26 | 0.439 |
| Readiness to learn 5 | 0.366 | 0.482 | 0.259 | 0.438 | 0.302 | 0.459 |
| Numeracy: Proficiency level 2 | 0.333 | 0.471 | 0.288 | 0.453 | 0.372 | 0.483 |
| Numeracy: Proficiency level 3 | 0.312 | 0.463 | 0.398 | 0.49 | 0.433 | 0.496 |
| Numeracy: Proficiency levels 4 or 5 | 0.126 | 0.332 | 0.199 | 0.4 | 0.074 | 0.263 |
| *Decade turned 18* | | | | | | |
| 1980s | 0.397 | 0.489 | 0.373 | 0.484 | 0.191 | 0.393 |
| 1990s | 0.377 | 0.485 | 0.4 | 0.49 | 0.547 | 0.498 |
| 2000s | 0.226 | 0.418 | 0.227 | 0.419 | 0.262 | 0.44 |
| *Higher education decisions* | | | | | | |
| Bachelor's | 0.36 | 0.48 | 0.333 | 0.471 | 0.452 | 0.498 |
| Master's | 0.135 | 0.341 | 0.152 | 0.359 | 0.256 | 0.436 |
| Professional | 0.586 | 0.493 | 0.533 | 0.499 | 0.653 | 0.476 |
| Enrollment | 0.743 | 0.437 | 0.63 | 0.483 | 0.764 | 0.425 |
| Non-completion | 0.316 | 0.465 | 0.227 | 0.419 | 0.303 | 0.46 |
| Time to degree | 7.444 | 4.902 | 7.803 | 5.383 | 6.002 | 3.998 |
| STEM | 0.182 | 0.386 | 0.318 | 0.466 | 0.307 | 0.461 |

Number of observations: US: 2,287; Europe; 15,162 Spain:1,547; all observations are weighted.

Regarding individual characteristics, between 48-50% of individuals are male, and 13-16% are foreign born. The shares of individuals whose parents have secondary or tertiary education are highest in the US (43%), slightly lower in Europe (30-38%) and lowest in Spain (21-

22%). As a proxy for individuals' socio-economic status PIAAC provides information on the number of books that individuals recall to have had in the household when they were children. PIAAC data also includes measures for individuals' cognitive and non-cognitive abilities. This is relevant for our estimations because ability is an important determinant of higher education decisions and is often not included in datasets, posing a challenge for causal estimation. For non-cognitive skills, we use "readiness to learn" categories. This variable is intended to capture both motivation as well as learning strategies. For cognitive skills we use proficiency levels in numeracy as defined by PIAAC. It is worth noting that both cognitive and non-cognitive skills are measured in 2012. However, we expect both measures to be relatively stable over time, and therefore we treat them as non-time varying controls that are relevant to past educational choices. We make this assumption in part because cognitive skill categories are quite broad. While there will be variation across individuals in the sample, we do not expect large changes across these categories beyond high school completion, even with potential for improvements along the continuous measures due to higher education. Similarly, the non-cognitive skill measure of "readiness to learn" may evolve at young ages, but is likely to be fairly set after high school completion. The questions that go into the construction of this index bear some similarity to the Openness category of the Big Five personality traits which are commonly treated as relatively stable and latent. Ample evidence shows that non-cognitive skills of this type can predict educational and labor market outcomes beyond what is measured by typical cognitive skills (Almlund et al.[2011]).

Regarding higher education decisions, between 63% and 76% of individuals who completed a high school degree were ever enrolled in some form of post-secondary education (vocational, bachelor's, master's or PhD programs). However, 23-30% dropped out before obtaining the corresponding degree. Between 53-65% obtained some post-secondary degree, including vocational degrees, while around 33-45% obtained a bachelor's degree or higher, with 14-26% even obtaining at least a master's degree. Among those finishing, 18-32% specialized in STEM fields. Average time-to-degree is between 6 and 8 years.

From Table 1 we can also see that in our European sample, Spain has a slightly reduced weight compared to the other countries which may be influenced by the fact that in Spain there is a larger proportion of the population without a high school degree. Second, we can see that in the US and Europe a similar share of individuals turned 18 in the 1980s and 1990s, while in Spain the share in the 1990's is higher. This is due to the fact that we restrict observations to those with information on macroeconomic conditions, and for Spain, this data is only available from 1985 onward.

## 3.4 Descriptive evidence

To provide an idea of the macroeconomic conditions used in our identification, Figures A-1 and A-2 in the Appendix overlay our recession dummy with the evolution of the unemployment rate for each country. One can see that there is variation both across and within countries in timing of recessions. Also note that given our sample restriction of individuals age 25 or older, our data on economic conditions observed when individuals are 18 years old ends in 2005, and hence our sample does not include the Great Recession. While the unemployment rate tends to rise during recessionary periods, it exhibits considerable variation outside the recession bands. Depending on the country, we see that for some, unemployment rates fall back down relatively quickly, while for others, they remain high longer and even experience additional peaks between recessions.

# 4 Methodology

To estimate the effect of macroeconomic conditions on individuals' higher education decisions we estimate variants of the following regression

$$y_{i,j,d_18,y_18} = \beta_0 + \beta_1 MC(y_{18,j}) + \beta_2 X_i + \beta_3 Z(y_{18,j}) + \beta_4 D_j + \beta_5 D(d_{18}) + \epsilon_{i,j,d_{18}}$$

where $y_{i,j,d_18,y_18}$ indicates the higher education decision (enrollment, dropping out, completion, specialization, or time-to-degree) of individual $i$ in country $j$ who was of age 18 in decade $d_{18}$ and year $y_{18}$. Our main coefficient of interest is $\beta_1$ on the variable $MC(y_{18,j})$ which includes macroeconomic conditions such as unemployment rate, an indicator for a recession, and the change in unemployment rate in country $j$ in the year individuals were 18 years old. In our regression we also control for individual characteristics $X_i$, including gender, migrant status, parental background as well as cognitive and non-cognitive ability measures. $Z(y_{18,j})$ includes other macroeconomic variables such as union coverage of labor contracts and government spending relative to GDP, measured when individuals were 18 years old. Finally, we also control for decade fixed effects $D(d_{18})$, and in our European sample we also include country dummies $D_j$. $\epsilon_{i,j,d_{18}}$ is the residual which we cluster at the country-year-age-18 level. With the exception of time-to-degree, all other outcome variables – enrollment, dropping out, graduating, and specialization choice – are binary variables, and hence we estimate linear probability models such that values of estimated coefficients

indicate the probability that the particular outcome occurs, everything else equal.

Considering our data – a PIAAC cross-section of working age adults that has been merged with outside data – we obtain our identifying variation from the different years in which individuals turned 18 years old. We can compare similar individuals, some of whom happen to turn 18 during economic downturns and others who turned 18 during better macroeconomic times. Given a natural educational path through high school determined largely by age, this "treatment" can be considered exogenous. For this reason, conditional on our other controls in specification (1), $\beta_1$ provides the causal impact of economic conditions on various higher education decisions.

One concern when using various measures of macroeconomic conditions in the same specification could be multicolinearity (note that $MC$ includes unemployment rate, a recession dummy, and the change in the unemployment rate). To assure that this is not the case, we perform multicolinearity tests for the three variables for all countries in our sample. Table A1 in the Appendix shows the variance inflation factors. None is larger than 4, indicating that multicolinearity among the three measures is not a concern.

# 5    Results

## 5.1    Graduating with a least a bachelor's degree

Table 2 displays the results of the effect of macroeconomic conditions on the decision to finish higher education with at least a bachelor's degree for the US, Europe, and Spain. Regarding our main coefficients of interest, in the US and Spain, individuals who experienced recessions at age 18 are more likely to finish a bachelor's degree compared to individuals of similar characteristics who did not. In Spain the same holds true for those who experienced higher rates of unemployment when they were 18. In particular, for the US, recessions are associated with a 6.4% increase in the probability of obtaining a bachelor's degree, while in Spain this number is 10.5%. We do not find any significant effects for our European sample.

Regarding individual characteristics, results are as expected. In all three samples, male students are less likely to graduate with at least a bachelor's degree, while individuals whose parents have secondary or tertiary education are more likely to graduate compared to those whose parents have lower educational attainment. For the US and Europe, coefficients on

Table 2: The effect of macroeconomic conditions on completion of at least a bachelor's degree

| | US | Europe | Spain |
|---|---|---|---|
| | (1) | (2) | (3) |
| $\text{Recession}_{18}$ | 0.064 (0.025)*** | -.013 (0.017) | 0.105 (0.044)** |
| $\text{U-rate}_{18}$ | -.012 (0.012) | 0.003 (0.002) | 0.016 (0.005)*** |
| $\Delta\text{u-rate}_{18}$ | -.014 (0.009) | -.003 (0.005) | 0.0004 (0.01) |
| Male | -.100 (0.016)*** | -.089 (0.01)*** | -.134 (0.024)*** |
| Foreign born | 0.203 (0.026)*** | 0.12 (0.017)*** | -.104 (0.037)*** |
| Second Generation Migrant | 0.048 (0.032) | 0.058 (0.015)*** | -.004 (0.083) |
| Parental education: secondary | 0.117 (0.03)*** | 0.056 (0.01)*** | 0.121 (0.024)*** |
| Parental education: tertiary | 0.269 (0.033)*** | 0.226 (0.012)*** | 0.229 (0.033)*** |
| < 10 books | -.172 (0.045)*** | -.133 (0.021)*** | |
| 11-25 books | -.166 (0.042)*** | -.136 (0.019)*** | -.012 (0.065) |
| 26-100 books | -.092 (0.039)** | -.103 (0.017)*** | 0.079 (0.059) |
| 101-200 books | -.074 (0.032)** | -.073 (0.016)*** | 0.108 (0.066) |
| 201-500 books | -.009 (0.03) | -.045 (0.017)*** | 0.125 (0.064)* |
| Readiness to learn 2 | 0.007 (0.034) | 0.04 (0.013)*** | 0.077 (0.05) |
| Readiness to learn 3 | 0.07 (0.039)* | 0.076 (0.013)*** | 0.05 (0.042) |
| Readiness to learn 4 | 0.094 (0.035)*** | 0.105 (0.012)*** | 0.118 (0.048)** |
| Readiness to learn 5 | 0.113 (0.032)*** | 0.14 (0.013)*** | 0.198 (0.039)*** |
| Numeracy: Level 2 | 0.102 (0.027)*** | 0.068 (0.013)*** | 0.103 (0.046)** |
| Numeracy: Level 3 | 0.335 (0.023)*** | 0.206 (0.013)*** | 0.267 (0.044)*** |
| Numeracy: Level 4 or 5 | 0.535 (0.04)*** | 0.377 (0.015)*** | 0.403 (0.068)*** |
| $\text{Union coverage}_{18}$ | 0.015 (0.01) | -.001 (0.0009) | 0.0002 (0.002) |
| $\text{Government spending}_{18}$ | 0.024 (0.015) | 0.01 (0.006)* | -.083 (0.033)** |
| 1980s | -.064 (0.049) | 0.001 (0.016) | -.155 (0.071)** |
| 1990s | -.007 (0.023) | 0.028 (0.018) | -.031 (0.035) |
| Constant | -.514 (0.226)** | -.153 (0.142) | 1.230 (0.647)* |
| Number of observations | 2,287 | 15,162 | 1,547 |
| R-squared | 0.321 | 0.207 | 0.19 |

The dependent variable in all three columns is an indicator variable for graduating with a bachelor's degree or higher (master's or doctorate degree). The coefficients are marked with * if the level of significance is between 5% and 10%, ** if the level of significance is between 1% and 5% and *** if the level of significance is less than 1%. All columns are estimated by weighted OLS regressions. Standard errors are clustered at the country-year age 18 level. Heteroskedasticity robust standard

indicator variables for the number of books at home when growing up are as expected.

Individuals from more advantageous family backgrounds are more likely to graduate with a bachelor's degree or higher, in particular, those who report to have had more than 500 books at home as children (the omitted category). In all three samples, higher non-cognitive ability and higher proficiency values for numeracy are also associated with a higher probability to graduate with at least a bachelor's degree. Finally, regarding other macroeconomic controls, higher government spending at age 18 is related to a lower probability of graduating from university in Spain but a higher probability in Europe. The result for Spain could be due to relatively high government spending in the mid 1990's coinciding with Spain's construction boom, very low unemployment rates, and lower returns to education.

As previously discussed, less favorable macroeconomic conditions could induce individuals to pursue higher education or could deter them from it, depending on the mechanisms at play. Given different labor market contexts and education systems in the US and Europe, the workings of such mechanisms could differ quite a bit. For instance, regarding education systems, in Europe and especially in Germany and Finland, post-secondary non-tertiary degrees are much more important compared to the US. If such degrees provide a "safe" option for individuals in Europe, then instead of an increase in those finishing with at least a bachelor's degree we might observe an increase in individuals graduating from lower post-secondary degrees. Another explanation could be linked to master's degrees which have had a much longer tradition in the US compared to Europe.[7] If pursuing a master's degree is an option for US individuals - but less so for students in Europe - to "wait out recessions" then our result for the US could be due to more individuals graduating from master's degrees. To check if we observe such movements towards other degrees for those experiencing economic downturns at age 18, we run our regression with different outcome variables that includes: (i) any post-secondary degree or (ii) master's degree or higher.

## 5.2 Other degrees: Post-secondary and Master's degree

Table 3 displays the results for the effect of macroeconomic conditions on graduating from any post-secondary degree. We find slight evidence in support of the hypothesis stated before. In Europe, increases in unemployment rates at age 18 are associated with a higher probability of obtaining any post-secondary degree, including vocational degrees. Results for the US and Spain are not significant, suggesting that higher completion rates were driven

---

[7]Vocational degrees are recorded as a zero in the binary dependent variable in the specifications presented in Table 2, while master degrees are recorded as a 1

by bachelor's or higher degree levels.

Table 3: The effect of macroeconomic conditions on completion of any post-secondary degree

| | US | Europe | Spain |
|---|---|---|---|
| | (1) | (2) | (3) |
| $\text{Recession}_{18}$ | 0.021 | -.023 | 0.067 |
| | (0.031) | (0.018) | (0.064) |
| $\text{U-rate}_{18}$ | -.006 | -.002 | 0.009 |
| | (0.015) | (0.002) | (0.006) |
| $\Delta\text{u-rate}_{18}$ | -.002 | 0.01 | -.001 |
| | (0.01) | (0.006)* | (0.014) |
| Individual controls | x | x | x |
| Cognitive ability | x | x | x |
| Non-cognitive ability | x | x | x |
| Macroeconomic controls | x | x | x |
| Age 18 decade dummies | x | x | x |
| Number of observations | 2,287 | 15,162 | 1,547 |
| R-squared | 0.243 | 0.206 | 0.133 |

The dependent variable in all three columns is an indicator variable for graduating with any post-secondary degree or higher (vocational, bachelor's, master's or doctorate degree). The coefficients are marked with * if the level of significance is between 5% and 10%, ** if the level of significance is between 1% and 5% and *** if the level of significance is less than 1%. All columns are estimated by weighted OLS regressions. which include the same controls as those in Table 2; i.e. individual controls are male, foreign born, second generation migrant, parental education secondary, parental education tertiary, dummies for the number of books at home as a child, cognitive ability refers to PIAAC proficiency levels in numeracy, and non-cognitive ability to the readiness-to-learn index. Macroeconomic controls, measured at age 18 are % of contracts covered by collective bargaining and government spending to GDP. Standard errors are clustered at the country-year age 18 level. Heteroskedasticity robust standard errors.

Table 4 displays the results for obtaining at least a master's degree. For the US and Spain, experiencing more challenging macroeconomic environments at age 18 is associated with a higher probability to graduate with at least a master's degree. In particular, in the US, individuals who experienced a recession at age 18 are 8.6% more likely to graduate with at least a master's degree. For Europe, we do not find any significant results. Note that the sample for Europe is smaller because the UK is excluded, given that PIAAC data for the UK does not allow us to distinguish between individuals with a bachelor's or master's degree.

To better understand what might be driving these different results of macroeconomic conditions on obtaining post-secondary or tertiary degrees in the US (positive for at least bachelor's or master's degree) and Europe (only slightly significant when including vocational degrees), we now analyze whether the pool of students who access higher education changes. To this end, we estimate how macroeconomic conditions at age 18 affect enrollment and degree non-completion in higher education.

Table 4: The effect of macroeconomic conditions on completion of at least a master's degree

| | US | Europe | Spain |
|---|---|---|---|
| | (1) | (2) | (3) |
| Recession$_{18}$ | 0.086 | -.020 | 0.062 |
| | (0.039)** | (0.021) | (0.063) |
| U-rate$_{18}$ | -.015 | -.0005 | 0.014 |
| | (0.011) | (0.002) | (0.008)* |
| $\Delta$u-rate$_{18}$ | -.015 | 0.003 | 0.003 |
| | (0.012) | (0.005) | (0.013) |
| Individual controls | x | x | x |
| Cognitive ability | x | x | x |
| Non-cognitive ability | x | x | x |
| Macroeconomic controls | x | x | x |
| Age 18 decade dummies | x | x | x |
| Number of observations | 2,287 | 11,340 | 1,547 |
| R-squared | 0.183 | 0.163 | 0.155 |

The dependent variable in all three columns is an indicator variable for graduating with at least a master's degree or higher (doctorate degree). The coefficients are marked with * if the level of significance is between 5% and 10%, ** if the level of significance is between 1% and 5% and *** if the level of significance is less than 1%. All columns are estimated by weighted OLS regressions which include the same controls as those in Table 2; i.e. individual controls are male, foreign born, second generation migrant, parental education secondary, parental education tertiary, dummies for the number of books at home as a child, cognitive ability refers to PIAAC proficiency levels in numeracy, and non-cognitive ability to the readiness-to-learn index. Macroeconomic controls, measured at age 18 are % of contracts covered by collective bargaining and government spending to GDP. Standard errors are clustered at the country-year age 18 level. Heteroskedasticity robust standard errors. The sample for Europe does not include the UK.

## 5.3 Enrollment and Non-completion

Table 5 displays the results for the outcome variable enrollment in post-secondary education. In the US, having experienced a recession at age 18 reduces enrollment by 3.1%. For Europe, estimates are not significant at conventional levels. Effects for Spain are positive and much larger. The probability of enrolling in a post-secondary degree when having experienced a recession at age 18 in Spain increases by 19%. Regarding unemployment, with a standard deviation of 3.9% in our Spanish sample, individuals who experienced a one standard deviation higher unemployment rate are 9% more likely to enroll.[8]

Thus far, for the US we observe a lower probability of enrollment in post-secondary degrees, but an increased probability to graduate with at least a bachelor's or master's degree. For Europe, we find a small increase in completion of at least a vocational degree, but no notable shift in enrollment, and for the case of Spain we observe increases in enrollment and attainment of higher education. As previously discussed, changes in enrollment could affect degree attainment by altering the average students' preparedness, which could be reflected in changing drop-out rates.

[8]For Spain, the coefficient on change in unemployment when 18 years old mitigates these effects. For every percentage point increase in unemployment, the probability to enroll decreases by 2.7%. Overall, the positive recession effects on enrollment dominate in magnitude.

Table 5: The effect of macroeconomic conditions on enrollment in any post-secondary program

|  | US | Europe | Spain |
|---|---|---|---|
|  | (1) | (2) | (3) |
| Recession$_{18}$ | -.031 | -.015 | 0.188 |
|  | (0.012)** | (0.018) | (0.058)*** |
| U-rate$_{18}$ | -.011 | -.0007 | 0.023 |
|  | (0.009) | (0.002) | (0.007)*** |
| $\Delta$u-rate$_{18}$ | 0.01 | 0.006 | -.027 |
|  | (0.006) | (0.006) | (0.015)* |
| Individual controls | x | x | x |
| Cognitive ability | x | x | x |
| Non-cognitive ability | x | x | x |
| Macroeconomic controls | x | x | x |
| Age 18 decade dummies | x | x | x |
| Number of observations | 2,287 | 15,162 | 1,547 |
| R-squared | 0.192 | 0.19 | 0.086 |

The dependent variable in all three columns is an indicator variable for ever having been enrolled in any post-secondary program. The coefficients are marked with * if the level of significance is between 5% and 10%, ** if the level of significance is between 1% and 5% and *** if the level of significance is less than 1%. All columns are estimated by weighted OLS regressions which include the same controls as those in Table 2; i.e. individual controls are male, foreign born, second generation migrant, parental education secondary, parental education tertiary, dummies for the number of books at home as a child, cognitive ability refers to PIAAC proficiency levels in numeracy, and non-cognitive ability to the readiness-to-learn index. Macroeconomic controls, measured at age 18 are % of contracts covered by collective bargaining and government spending to GDP. Standard errors are clustered at the country-year age 18 level. Heteroskedasticity robust standard errors.

Table 6 displays the results for non-completion of any attempted post-secondary degree. Note that all samples for this estimation are smaller as they only include individuals that report to have ever been enrolled. For the US, estimates are negative, indicating lower dropout rates during economic downturns, while for Europe and Spain, we estimate positive effects on non-completion of a post-secondary degree.[9] Again, the effects for Spain are largest. The probability of dropping out of a post-secondary program when having experienced a recession at age 18 increases by almost 25%.[10] This might be due to the fact that our sample for Spain only includes the recession of 1992-93 followed by a construction boom that has been linked to increased dropout rates among high-school students (see Aparicio Fenoll, [2016]). Our results suggest that increased non-completion also occurred at higher levels of educational attainment. In line with this, Arce, Crespo and Míguez-Álvarez [2015] document that during the economic expansion of 2001-2007 more university students in Spain abandoned their studies than during the subsequent Great Recession.

---

[9]For the US and Spain, the coefficient on change in unemployment when 18 mitigates these effects, but the other estimates dominate in magnitude.

[10]The standard deviation in unemployment for Spain (age 18) is 3.8%. Looking at the estimated coefficient for unemployment, on average individuals who experienced a one standard deviation unit higher unemployment are 7% more likely to drop out. For every percentage point increase in unemployment, the probability of dropout decreases by 4.4%. For Europe the effects are much smaller in magnitude. With a standard deviation of 4.1 % in unemployment, individuals who experienced a one standard deviation higher unemployment rate at age 18 are 1-2% more likely to drop-out.

Table 6: The effect of macroeconomic conditions on non-completion of any post-secondary program

|  | US | Europe | Spain |
|---|---|---|---|
|  | (1) | (2) | (3) |
| Recession$_{18}$ | -.082 | 0.004 | 0.246 |
|  | (0.044)* | (0.012) | (0.058)*** |
| U-rate$_{18}$ | -.004 | 0.004 | 0.019 |
|  | (0.014) | (0.002)** | (0.007)*** |
| $\Delta$u-rate$_{18}$ | 0.027 | -.002 | -.044 |
|  | (0.013)** | (0.005) | (0.013)*** |
| Individual controls | x | x | x |
| Cognitive ability | x | x | x |
| Non-cognitive ability | x | x | x |
| Macroeconomic controls | x | x | x |
| Age 18 decade dummies | x | x | x |
| Number of observations | 1,973 | 13,497 | 1,312 |
| R-squared | 0.025 | 0.036 | 0.02 |

The dependent variable in all three columns is an indicator variable for ever having dropped out of any post-secondary program. The coefficients are marked with * if the level of significance is between 5% and 10%, ** if the level of significance is between 1% and 5% and *** if the level of significance is less than 1%. All columns are estimated by weighted OLS regressions which include the same controls as those in Table 2; i.e. individual controls are male, foreign born, second generation migrant, parental education secondary, parental education tertiary, dummies for the number of books at home as a child, cognitive ability refers to PIAAC proficiency levels in numeracy, and non-cognitive ability to the readiness-to-learn index. Macroeconomic controls, measured at age 18 are % of contracts covered by collective bargaining and government spending to GDP. Standard errors are clustered at the country-year age 18 level. Heteroskedasticity robust standard errors. All three samples only include individuals who ever started any post-secondary degree.

Considering our findings for attainment, enrollment and degree non-completion together, we can start to see a picture of the mechanisms at work. For the United States, among those experiencing recessions at age 18, there is an increase in the rate of bachelors and master's degree completion paired with a decrease in enrollment and drop-out rates. This could be driven by the marginal student being deterred from pursuing higher education, leading to higher average student quality and increasing rates of degree attainment. In Europe and Spain, on the other hand, our results point to a reduced selectivity of students. We estimate relatively small increases in completion of any post-secondary degree (including vocational degrees) as well as small increases in dropout rates for Europe. For Spain we observe a large positive enrollment response paired with a large increase in drop-out rates. However, the first effect seems to dominate given that for Spain we also estimate higher completion rates of bachelor's or master's degrees, indicating that at least some of that increased enrollment results in successful degree completion.

Thus far, we have explored the extensive margins of higher education decisions (enrollment, degree completion and drop-out rates) which are affected by changes in opportunity cost and ability to pay considerations during economic downturns. However, there are other intensive margins that students can use to adapt to unfavorable economic conditions, for instance specialization choice and time-to-degree.

## 5.4 Specialization choice and time-to-degree

Success in higher education might not only depend on average student quality but is also likely to vary by field of study. If as suggested by Blom, Cadenas and Keys [2015] macroeconomic conditions alter individuals' specialization decisions then these might also in part be driving our results. To test if this is the case we estimate the effect of macroeconomic conditions on completing a degree in a STEM field. Table 7 displays our results. Note that all samples for this estimation only include individuals who hold a post-secondary or tertiary degree. US individuals are roughly 9% more likely to choose a STEM specialization when having experienced a recession at age 18, in line with Blom, Cadenas and Keys [2015]. Our finding might also be connected to our previous results regarding a more selected student group, as indicated by lower enrollment and dropping out, along with higher degree completion rates. For Europe, we do not find any significant effect. Individuals in Spain who experienced a recession at age 18 on the other hand are 14% less likely to choose STEM fields.[11] This could be driven by our previous findings of higher enrollment rates and drop-out rates possibly indicating a group of students that is less prepared.

Table 7: The effect of macroeconomic conditions on completing a degree in STEM fields

|  | US | Europe | Spain |
|---|---|---|---|
|  | (1) | (2) | (3) |
| Recession$_{18}$ | 0.094 | -.001 | -.136 |
|  | (0.054)* | (0.015) | (0.045)*** |
| U-rate$_{18}$ | -.001 | -.0006 | -.006 |
|  | (0.019) | (0.002) | (0.003)* |
| $\Delta$u-rate$_{18}$ | -.001 | -.006 | 0.008 |
|  | (0.02) | (0.006) | (0.011) |
| Individual controls | x | x | x |
| Cognitive ability | x | x | x |
| Non-cognitive ability | x | x | x |
| Macroeconomic controls | x | x | x |
| Age 18 decade dummies | x | x | x |
| Bachelor's degree or higher | x | x | x |
| Number of observations | 1,380 | 8,591 | 1,060 |
| R-squared | 0.161 | 0.151 | 0.219 |

The dependent variable in all three columns is an indicator variable for having specialized in a STEM field. The coefficients are marked with * if the level of significance is between 5% and 10%, ** if the level of significance is between 1% and 5% and *** if the level of significance is less than 1%. All columns are estimated by weighted OLS regressions which include the same controls as those in Table 2; i.e. individual controls are male, foreign born, second generation migrant, parental education secondary, parental education tertiary, dummies for the number of books at home as a child, cognitive ability refers to PIAAC proficiency levels in numeracy, and non-cognitive ability to the readiness-to-learn index. Macroeconomic controls, measured at age 18 are % of contracts covered by collective bargaining and government spending to GDP. We also include a dummy variable indicating if individuals hold a bachelor's degree or higher. Standard errors are clustered at the country-year age 18 level. Heteroskedasticity robust standard errors. All three samples only include individuals who have at least completed a post-secondary degree.

As mentioned before, at least in Europe, students seem to have some flexibility of adjusting

---

[11]Individuals who experienced a one standard deviation higher unemployment rate (3.8% for our Spanish sample) are roughly 2% less likely to choose STEM specializations.

their time spent in higher education. A changing pool of students during economic downturns could hence also affect average time-to-degree. Changing fields of study could also have an effect. Table 8 displays the results for the impact of macroeconomic conditions experienced at age 18 on time-to-degree. For Spain, we do not find any significant effects. For the US, we find recessions experienced at age 18 to increase time-to-degree, while the opposite is true for unemployment rates and increases in unemployment rates. Comparing magnitudes and taking into account that for the US sample the average unemployment rate is 6.2, the negative effects dominate. In principle, shorter time-to-degree could be driven by a differential choice of degree. However, our finding for the US of more individuals choosing STEM fields, which are considered to be both more difficult and which typically take more time, stand in contrast to this hypothesis. Shorter time-to-degree in the US is hence most likely driven by a more selective student group as evidenced by lower enrollment, drop-out and higher completion rates. Similarly for Europe, more challenging economic environments experienced at age 18 are related to shorter time-to-degree. However, in this case, higher rates of completion of any post-secondary degrees, including vocational degrees, which tend to be shorter, are more likely to be the driving factor behind this result.

Table 8: The effect of macroeconomic conditions on time-to-degree

|  | US | Europe | Spain |
|---|---|---|---|
|  | (1) | (2) | (3) |
| Recession$_{18}$ | 1.819 | -.805 | 0.071 |
|  | (0.95)* | (0.338)** | (1.384) |
| U-rate$_{18}$ | -.848 | -.121 | 0.027 |
|  | (0.402)** | (0.044)*** | (0.137) |
| $\Delta$u-rate$_{18}$ | -.820 | 0.273 | 0.154 |
|  | (0.339)** | (0.095)*** | (0.248) |
| Number of observations. | 1,346 | 8,351 | 1,000 |
| Individual controls | x | x | x |
| Cognitive ability | x | x | x |
| Non-cognitive ability | x | x | x |
| Macroeconomic controls | x | x | x |
| Age 18 decade dummies | x | x | x |
| R-squared | 0.117 | 0.127 | 0.085 |

The dependent variable in all three columns is time to degree. The coefficients are marked with * if the level of significance is between 5% and 10%, ** if the level of significance is between 1% and 5% and *** if the level of significance is less than 1%. All columns are estimated by weighted OLS regressions which include the same controls as those in Table 2; i.e. individual controls are male, foreign born, second generation migrant, parental education secondary, parental education tertiary, dummies for the number of books at home as a child, cognitive ability refers to PIAAC proficiency levels in numeracy, and non-cognitive ability to the readiness-to-learn index. Macroeconomic controls, measured at age 18 are % of contracts covered by collective bargaining and government spending to GDP. Standard errors are clustered at the country-year age 18 level. Heteroskedasticity robust standard errors. All three samples only include individuals who have at least completed a post-secondary degree.

## 5.5 Heterogeneity

To further explore our findings, we test for heterogeneity by gender and parental background. Previous literature finds differential effects for men and women when analyzing the impact of macroeconomic conditions on higher education decisions. Our results for heterogeneity by gender are displayed in Tables A2 and A3 in the Appendix. For the US, we find women to drive higher rates of completion of bachelor's or master's degrees and possibly higher completion rates of degrees in STEM fields. We find no significant gendered effects for the US regarding enrollment, dropout rates, or time-to-degree. The fact that women seem to be driving most of the results regarding the impact of macroeconomic conditions experienced at age 18 on higher education decisions could potentially be due to differences in risk aversion. There exist experimental evidence that women tend to be more risk averse than men (Eckel and Grossman [2008]), and hence women could be less likely to "try their luck" in a more challenging labor market and more prone to choose higher education in order to signal quality to potential employers. Our result that women who have experienced higher unemployment at age 18 are more likely to choose STEM fields is in line with Blom, Cadena and Keys [2015].

For Europe, results on higher completion rates of any post-secondary degrees for those experiencing higher unemployment at age 18 are not gender specific, while higher drop-out rates are driven by men and shorter time-to-degree is primarily driven by women. Heterogeneity results by gender for Spain however are quite different. Men seem to driving higher completion rates of bachelor's degrees and to a larger extent the positive enrollment effects. We find no significant gender difference in degree non-completion. The significantly lower graduation in the area of STEM degrees found for Spain is driven by women. While our main results for Spain do not show any effects of macroeconomic condition on time-to-degree, when dis-aggregating by gender, we see longer time-to-degree for men.

We also analyze how our results depend on individuals' parental background. In particular, we differentiate between individuals with parents who have tertiary education and those whose parents have secondary education or lower educational attainment, see Tables A4 and A5. For the US, we find that higher completion rates of master's degrees for individuals having experienced recessions at age 18 are driven by those whose parents have tertiary education. Regarding other degrees and enrollment, individuals with parents who have tertiary education may be slightly less likely to enroll in or complete any post-secondary programs or bachelor's degree. We do not find any differential results by parental background

regarding drop-out rates, time-to-degree, or choice of STEM fields.[12] The result regarding higher master's degree completion could be linked to the ability-to pay mechanism which affects individuals from less advantageous family background more strongly during recessions. Hence, the option to "wait-out" a recession in a graduate program might not be available to them. These results are in line with findings in Christian [2007] who shows that in the US among individuals with fewer liquidity constraints college enrollment increases during recessions.

For Europe, we find no heterogeneity by parental education for degree completion, but increased dropout and shorter time-to-degree effects appear to be driven by those whose parents have lower educational achievement. While in our main estimation we did not find any significant results for Europe regarding completion of at least a master's degree, when differentiating by parental background, we see that for individuals who experienced recessions or high unemployment at age 18 among those with parents with lower levels of education fewer graduate with at least a master's degree. This is similar to our findings for the US. Not only does the ability-to pay mechanism clearly affect individuals from less advantageous family background more strongly during recessions, but compared to other degrees, tuition fees for master's programs are also relatively high in Europe.

In Spain, individuals whose parents have tertiary education and who experienced recessions at age 18 are more likely to drop out of any post-secondary program. However, they are also more likely to choose STEM fields and to take longer to finish their degree. These results could potentially be interconnected because more difficult STEM fields might explain the longer time-to degree as well as higher non-completion rates. Regarding enrollment, the positive results are driven by those whose parents have lower educational attainment. This might be due to the fact that while individuals with parents who have tertiary education would enroll in higher education anyway, there could be more students on the margin of enrolling among those whose parents have lower educational attainment. While our main results did not show any impact on completion of any post-secondary degree, when differentiating by parental background we see that those whose parents have lower educational attainment are more likely to complete any post-secondary degree. There are no differential results by parental background for the impact of macroeconomic conditions on the probability of completing at least a bachelor's degree

---

[12]Note that the effects for completing a STEM degree for those whose parents have tertiary education point in opposite directions, and taking into account average unemployment rates for our US sample of 6% they cancel out.

# 6    Conclusions

Different findings for the US, Europe and Spain show that labor markets and education systems matter for how macroeconomic conditions experienced at age 18 influence individuals' decisions in higher education. Looking at various higher education decisions together we are able to gain insight into how potential mechanisms related to opportunity costs and ability to pay determine student selection in these different contexts.

Taken together, our findings for the US indicate that after having experienced recessions or high unemployment at age 18, students in institution of post-secondary or tertiary education seem to become more positively selected. For Europe and Spain, on the other hand, our results point to a pool of students that is less selected. Notably, for both Europe and the US, we find evidence that coming from more advantageous family backgrounds allows individuals to wait out recessions in graduate programs.

One important driver behind the different results across the three geographies is likely differences in the costs of higher education. Especially in the US, during the last three decades tuition has increased considerably.[13] But also in Europe and Spain students have been subject to variation in tuition fees, as well as the availability of scholarships over time. We consider the joint impact of changes in net costs of higher education to students and macroeconomic conditions on higher education decisions to be an interesting avenue for future research. Likewise, our findings motivate further in-depth research for various countries that simultaneously considers the many components of higher education decisions and the influence of business cycles.

# References

**Aina, Carmen; Baici, Eliana and Giorgia Casalone** (2011): "Time to degree: students' abilities, university characteristics or something else? Evidence from Italy," *Education Economics,* 19(3), 311-325.

**Almlund, Mathilde; Duckworth, Angela L.; Heckman, James J. and Tim D. Kautz** (2011): "Personality Psychology and Economics," in E. Hanushek, S. Machin,

---

[13]According to a report by the College Board [2017] between 1987-88 and 2017-18, tuition fees in real terms increased by 125%, 129% and 213% at public two-year institutions, private non-profit four years institutions, and public four-year institutions respectively.

and L. Woessman, eds., *Handbook of the Economics of Education,* Amsterdam, Elsevier.

**Aparicio Fenoll, Ainhoa** (2016): "Returns to Education and Educational Outcomes: the Case of the Spanish Housing Boom," *Journal of Human Capital,* 10(2), 235-265.

**Arce, María Elena; Crespo, Barbara and Carla Míguez-Álvarez** (2015): "Higher Education Drop-Out in Spain – Particular Case of Universities in Galicia," *International Education Studies,* 8(5), 247-264.

**Ayllon, Sara and Natalia Nollenberger** (2016): "Are recessions good for human capital accumulation," NEGOTIATE working paper no. 5.1.

**Alessandrini, Diana** (2014): "On the Cyclicality of Schooling Decisions: Evidence from Canadian Data," Working Paper series 16-14, Rimini Centre for Economic Analysis.

**Becker Sasha O.** (2006): "Introducing Time-to-Educate in a Job-Search Model," *Bulletin of Economic Research,* 58(1), 61-72.

**Bedard, Kelly and Douglas A. Herman** (2008): "Who goes to graduate/professional school? The importance of economic fluctuations, undergraduate field, and ability," *Economics of Education Review,* 27(2), 197-210.

**Betts, Julian R and Laurel L McFarland** (1995): "Safe port in a storm: The impact of labor market conditions on community college enrollments," *Journal of Human Resources,* 741-765.

**Blom, Erica; Cadena, Brian C. and Benjamin J. Keys** (2015): "Investment over the Business Cycle: Insights from College Major Choice," IZA Discussion Paper No. 9167.

**Bound, John; Lovenheim, Michael F. and Sarah Turner** (2010): "Why have college completion rates declined? An analysis of changing student preparation and collegiate resource," *American Economic Journal: Applied Economics,* 2(3), 129-57.

**Brunello, Giorgio, and Rudolf Winter-Ebmer** (2003): "Why do students expect to stay longer in college? Evidence from Europe.," *Economics Letters,* 80(2): 247-253.

**Charles, Kerwin Kofi; Hurst, Erik and Matthew J Notowidigdo** (2015): "Housing Booms and Busts, Labor Market Opportunities, and College Attendance," NBER Working Paper No. 21587

**Christian, Michael S.** (2007): "Liquidity constraints and the cyclicality of college enrollment in the United States," *Oxford Economic Paper,* 59(1), 141-169.

**Clark, Damon** (2011): "Do Recessions Keep Students in School? The Impact of Youth Unemployment on Enrolment in Post-compulsory Education in England," *Economica,* 78, 523-545.

**College Board** (2017): "Trends in College Pricing 2017," Trends in Higher Education Series, The College Board.

**Currie, Janet and Hannes Schwandt** (2014): "Short-and long-term effects of unemployment on fertility," *Proceedings of the National Academy of Sciences,* 111(41), 14734-14739.

**Dellas, Harris and Vally Koubi** (2003): "Business cycles and schooling," *European Journal of Political Economy,* 19(4), 843-859.

**Dellas, Harris and Plutarchos Sakellaris** (2003): "On the cyclicality of schooling: theory and evidence," *Oxford Economic Papers,* 55 (1), 148-172.

**Eckel, Catherine C., and Philip J. Grossman** (2008): "Men, Women and Risk Aversion: Experimental Evidence" in Handbook of Experimental Economics Results, Vol. 1, 1061-1073, C. Plott, V. Smith, eds., New York, Elsevier.

**Garibaldi, Pietro; Giavazzi, Francesco; Ichino, Andrea and Enrico Rettore** (2012): "College cost and time to get a degree: evidence from tuition discontinuities," *Review of Economics and Statistics,* 94(3), 699-711.

**Giuliano, Paola and Antonio Spilimbergo** (2014): "Growing up in a Recession," *Review of Economic Studies,* 81(2), 787-817.

**Graves, Jennifer and Zoë Kuehn** (2019): "Specializing in growing sectors: Wage returns and gender difference," New York University Abu Dhabi, Division of Social Science, Working Paper No. 0030.

**Johnson, Matthew T** (2013): "The Impact of Business Cycle Fluctuations on Graduate School Enrollment," *Economics of Education Review,* 34, 122-134.

**Kahn, Lisa B.** (2010): "The Long-Term Labor Market Consequences of Graduating from College in a Bad Economy," *Labour Economics,* 17(2), 303-316.

**Kane, Thomas J.** (1994)): "College Entry by Blacks since 1970: The Role of College Costs, Family Background, and the Returns to Education," *Journal of Political Economy,* 102(5), 878-911.

**King, Ian and Arthur Sweetman** (2002): "Procyclical Skill Retooling and Equilibrium Search," *Review of Economic Dynamics,* 5(3), 704-717.

**Long, Bridget Terry** (2015): "The Financial Crisis and Declining College Affordability: How Have Students and their Families Responded?" in J. Brown and C. Hoxby, eds., How the Great Recession Affected Higher Education, University of Chicago Press, NBER Conference Report.

**Malmendier, Ulrike and Stefan Nagel** (2016): "Learning from Inflation Experiences'," *Quarterly Journal of Economics,* 131(1), 53-87.

**Malmendier, Ulrike and Stefan Nagel** (2011): "Depression Babies: Do Macroeconomic Experiences Affect Risk Taking,?" *Quarterly Journal of Economics,* 126(1), 373-416.

**Méndez, Fabio and Facundo Sepúlveda** (2012): "The Cyclicality of Skill Acquisition: Evidence from Panel Data," *American Economic Journal: Macroeconomics,* 4(3), 128-52.

**Messer, Dolores and Stefan Wolter** (2010): "Time-to-degree and the business cycle," *Education Economics,* 18(1), 111-123.

**OECD** (2011): "Education at a Glance. Chapter B: Financial and Human Resources Invested In Education. How Much Do Tertiary Students Pay and What Public Subsidies Do They Receive? Indicator B5," OECD Indicators. OECD Publishing, Paris.

**Oreopoulos, Philip; von Wachter, Till and Andrew Heisz** (2012): "The Short- and Long- Term Career Effects of Graduating in a Recession," *American Economic Journal: Applied Economics,* 4(1), 1-29.

**Oyer, Paul** (2006): "Initial Labor Market Conditions and Long-Term Outcomes for Economists," *Journal of Economic Perspectives,* 20(3), 143-160.

**Raaum, Oddbjørn and Knut Røed** (2006): "Do business cycle conditions at the time of labor market entry affect future employment prospects?," *Review of Economics and Statistics,* 88(2), 193-210.

**Ruhm, Christopher J.** (2000): "Are Recessions Good for Your Health?," *Quarterly Journal of Economics,* 115(2), 617-650.

**Sakellaris, Plutarchos and Antonio Spilimbergo** (2000): "Business cycles and investment in human capital: international evidence on higher education," in Carnegie-Rochester Conference Series on Public Policy," Vol. 52 North-Holland, pp. 221-256.

**Sievertsen, Hans Henrik** (2016): "Local unemployment and the timing of post-secondary schooling," *Economics of Education Review,* 50, 17-28.

**Visser, Jelle** (2013): "Data Base on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts, 1960-2011 (ICTWSS)," - Version 4.0.

# A    Appendix



(a) Spain

(b) Sweden

(c) United Kingdom

(d) United States
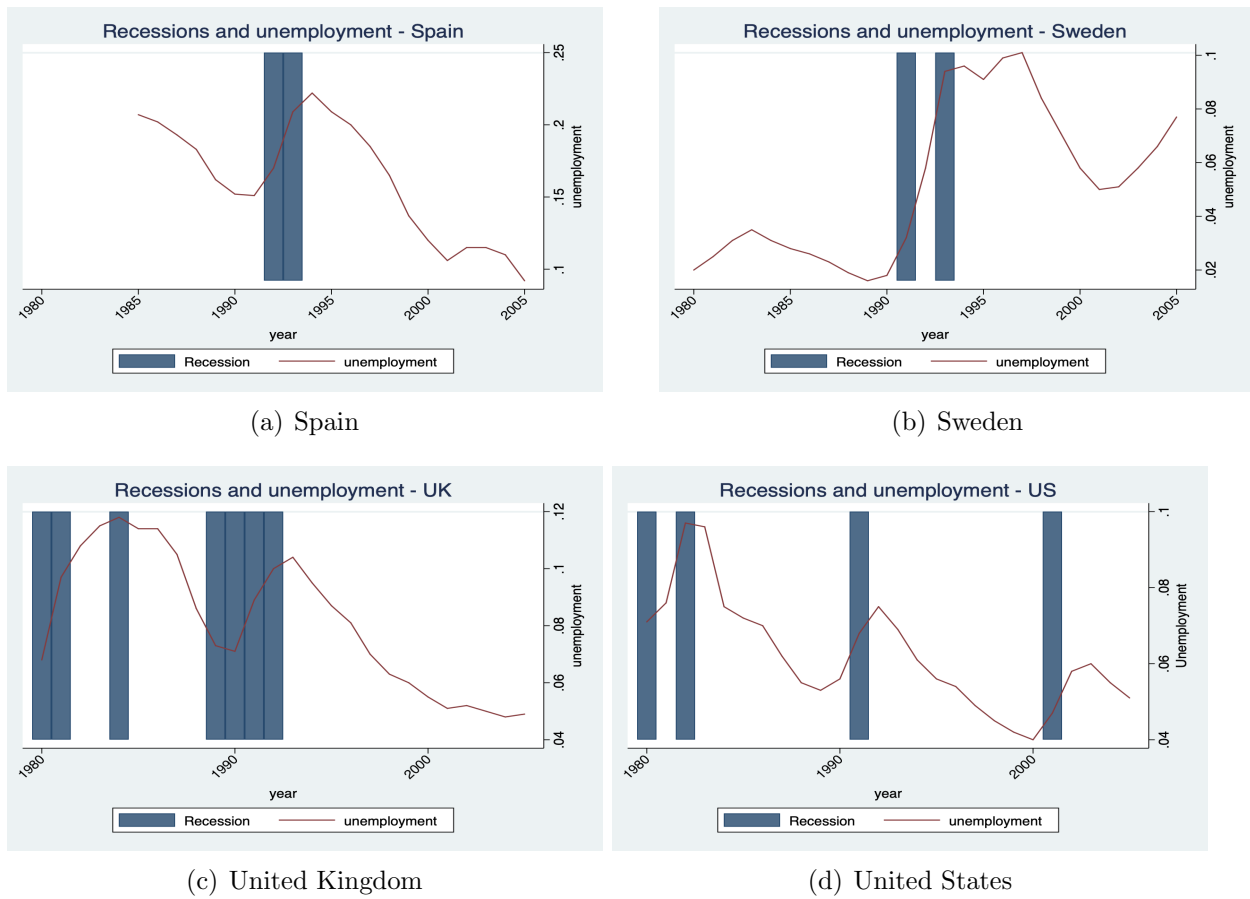
Figure A-1: Unemployment and recession indicators

Table A1: Multicolinearity Tests: Variance Inflation Factors

|         | Recession | Urate | Δurate | Mean VIF |
|---------|-----------|-------|--------|----------|
| US      | 2.34      | 1.14  | 2.50   | 1.99     |
| UK      | 1.21      | 1.03  | 1.23   | 1.16     |
| Sweden  | 1.37      | 1.04  | 1.37   | 1.26     |
| Spain   | 3.59      | 1.20  | 3.42   | 2.73     |
| Germany | 1.15      | 1.02  | 1.13   | 1.10     |
| France  | 1.22      | 1.01  | 1.23   | 1.15     |
| Finland | 1.77      | 1.03  | 1.80   | 1.53     |
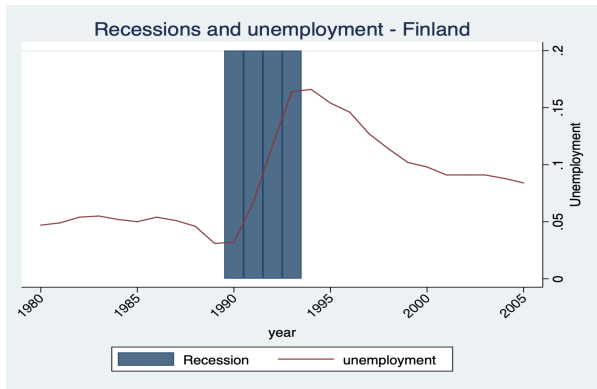
(a) Finland
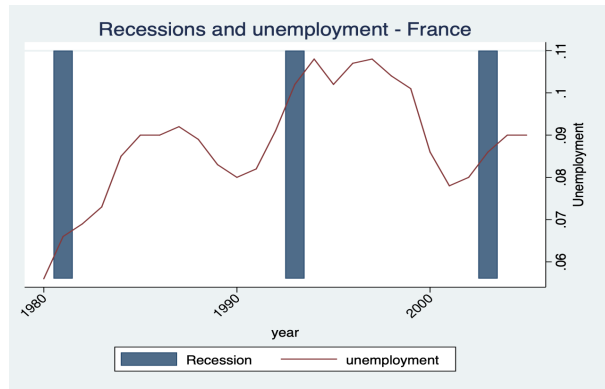


(b) France
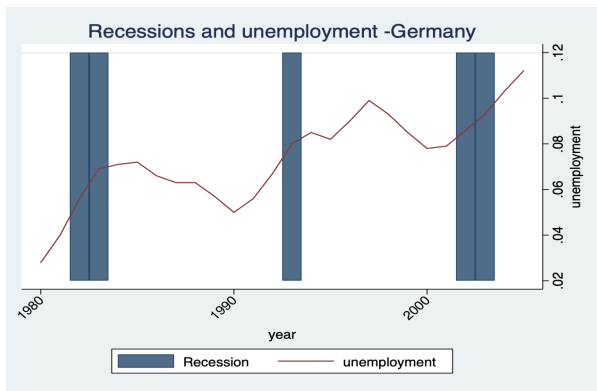


(c) Germany

Figure A-2: Unemployment and recession indicators

Table A2: Heterogeneity: The effect of macroeconomic conditions on higher education decisions - results by gender

| | US | Europe | Spain |
|---|---|---|---|
| **A: Completion of at least a bachelor's degree** | | | |
| $\text{Recession}_{18}$ | 0.139 (0.028)*** | -.022 (0.02) | -.020 (0.054) |
| $\text{U-rate}_{18}$ | -.013 (0.012) | 0.004 (0.002) | 0.013 (0.005)** |
| $\Delta\text{u-rate}_{18}$ | -.017 (0.01)* | -.007 (0.007) | 0.027 (0.013)** |
| Male | -.095 (0.058) | -.079 (0.022)*** | -.312 (0.081)*** |
| $\text{Recession}_{18}\times\text{male}$ | -.159 (0.05)*** | 0.018 (0.03) | 0.259 (0.063)*** |
| $\text{U-rate}_{18}\times\text{male}$ | 0.003 (0.009) | -.001 (0.002) | 0.007 (0.005) |
| $\Delta\text{u-rate}_{18}\times\text{male}$ | 0.007 (0.018) | 0.008 (0.01) | -.055 (0.019)*** |
| **B: Completion of any post-secondary degree** | | | |
| $\text{Recession}_{18}$ | 0.055 (0.069) | -.022 (0.026) | 0.024 (0.078) |
| $\text{U-rate}_{18}$ | -.005 (0.017) | -.001 (0.003) | 0.008 (0.007) |
| $\Delta\text{u-rate}_{18}$ | 0.003 (0.027) | 0.008 (0.007) | 0.008 (0.014) |
| Male | -.103 (0.091) | -.101 (0.018)*** | -.193 (0.08)** |
| $\text{Recession}_{18}\times\text{male}$ | -.072 (0.102) | -.003 (0.029) | 0.09 (0.087) |
| $\text{U-rate}_{18}\times\text{male}$ | -.003 (0.014) | -.001 (0.002) | 0.004 (0.005) |
| $\Delta\text{u-rate}_{18}\times\text{male}$ | -.012 (0.044) | 0.006 (0.007) | -.019 (0.018) |
| **C: Completion of at least a master's degree** | | | |
| $\text{Recession}_{18}$ | 0.144 (0.065)** | -.016 (0.027) | 0.026 (0.074) |
| $\text{U-rate}_{18}$ | -.027 (0.015)* | -.0008 (0.002) | 0.014 (0.009) |
| $\Delta\text{u-rate}_{18}$ | -.013 (0.018) | -.0004 (0.007) | 0.002 (0.017) |
| Male | -.205 (0.074)*** | -.050 (0.018)*** | -.092 (0.061) |
| $\text{Recession}_{18}\times\text{male}$ | -.120 (0.063)* | -.007 (0.03) | 0.072 (0.058) |
| $\text{U-rate}_{18}\times\text{male}$ | 0.027 (0.013)** | 0.0007 (0.002) | 0.002 (0.004) |
| $\Delta\text{u-rate}_{18}\times\text{male}$ | -.003 (0.02) | 0.008 (0.007) | 0.004 (0.014) |
| **D: Enrollment in any post-secondary program** | | | |
| $\text{Recession}_{18}$ | -.020 (0.041) | -.027 (0.023) | 0.109 (0.065)* |
| $\text{U-rate}_{18}$ | -.009 (0.011) | -.0008 (0.002) | 0.021 (0.008)*** |
| $\Delta\text{u-rate}_{18}$ | 0.018 (0.019) | 0.009 (0.007) | -.010 (0.014) |
| Male | -.093 (0.093) | -.095 (0.019)*** | -.170 (0.102)* |
| $\text{Recession}_{18}\times\text{male}$ | -.020 (0.092) | 0.023 (0.023) | 0.162 (0.092)* |
| $\text{U-rate}_{18}\times\text{male}$ | -.004 (0.013) | 0.0001 (0.002) | 0.004 (0.005) |
| $\Delta\text{u-rate}_{18}\times\text{male}$ | -.019 (0.035) | -.006 (0.007) | -.035 (0.021)* |

The dependent variable in panel A, B, C is an indicator for graduating with at least a bachelor's, any post-secondary degree, or at least a master's degree respectively, in panel D for ever enrolling in any post-secondary program. The coefficients are marked with * if the level of significance is between 5% and 10%, ** if the level of significance is between 1% and 5% and *** if the level of significance is less than 1%. All columns are estimated by weighted OLS regressions which include the same controls as those in Table 2; i.e. individual controls are foreign born, second generation migrant, parental education secondary, parental education tertiary, dummies for the number of books at home as a child, cognitive ability refers to PIAAC proficiency levels in numeracy, and non-cognitive ability to the readiness-to-learn index. Macroeconomic controls, measured at age 18 are % of contracts covered by collective bargaining and government spending to GDP. Standard errors are clustered at the country-year age 18 level. Heteroskedasticity robust standard errors. In panel C for Europe the sample does not include the UK as PIAAC data for the UK does not allow us to distinguish between individuals with a bachelor's or master's degree and higher.

Table A3: Heterogeneity: The effect of macroeconomic conditions on higher education decisions - results by gender continued

| | US | Europe | Spain |
|---|---|---|---|
| **A: Non-completion of any post-secondary degree** | | | |
| $\text{Recession}_{18}$ | -.117<br>(0.052)** | -.019<br>(0.017) | 0.192<br>(0.07)*** |
| $\text{U-rate}_{18}$ | -.008<br>(0.016) | 0.003<br>(0.002) | 0.022<br>(0.008)*** |
| $\Delta\text{u-rate}_{18}$ | 0.036<br>(0.018)** | 0.008<br>(0.006) | -.033<br>(0.014)** |
| Male | -.081<br>(0.083) | -.020<br>(0.018) | 0.088<br>(0.112) |
| $\text{Recession}_{18}\times\text{male}$ | 0.075<br>(0.064) | 0.045<br>(0.024)* | 0.108<br>(0.068) |
| $\text{U-rate}_{18}\times$ male | 0.009<br>(0.011) | 0.003<br>(0.002)* | -.004<br>(0.006) |
| $\Delta\text{u-rate}_{18}\times\text{male}$ | -.019<br>(0.026) | -.019<br>(0.009)** | -.024<br>(0.016) |
| **B: Completing a degree in STEM fields** | | | |
| $\text{Recession}_{18}$ | 0.053<br>(0.062) | 0.004<br>(0.021) | -.202<br>(0.06)*** |
| $\text{U-rate}_{18}$ | 0.005<br>(0.02) | -.001<br>(0.002) | -.011<br>(0.003)*** |
| $\Delta\text{u-rate}_{18}$ | 0.012<br>(0.02) | -.007<br>(0.007) | 0.033<br>(0.011)*** |
| Male | 0.355<br>(0.062)*** | 0.298<br>(0.026)*** | 0.007<br>(0.092) |
| $\text{Recession}_{18}\times\text{male}$ | 0.104<br>(0.066) | -.011<br>(0.034) | 0.166<br>(0.083)** |
| $\text{U-rate}_{18}\times$ male | -.017<br>(0.009)* | 0.002<br>(0.002) | 0.015<br>(0.006)** |
| $\Delta\text{u-rate}_{18}\times\text{male}$ | -.036<br>(0.022) | 0.002<br>(0.011) | -.061<br>(0.022)*** |
| **C: Time-to-degree** | | | |
| $\text{Recession}_{18}$ | 1.518<br>(1.090) | -.768<br>(0.489) | -.975<br>(1.356) |
| $\text{U-rate}_{18}$ | -.864<br>(0.405)** | -.173<br>(0.051)*** | 0.038<br>(0.138) |
| $\Delta\text{u-rate}_{18}$ | -.728<br>(0.37)** | 0.238<br>(0.112)** | 0.224<br>(0.261) |
| Male | -.520<br>(0.985) | -1.010<br>(0.439)** | 0.318<br>(0.844) |
| $\text{Recession}_{18}\times\text{male}$ | 0.758<br>(0.618) | -.091<br>(0.615) | 2.339<br>(0.873)*** |
| $\text{U-rate}_{18}\times$ male | 0.034<br>(0.151) | 0.113<br>(0.04)*** | -.013<br>(0.056) |
| $\Delta\text{u-rate}_{18}\times\text{male}$ | -.234<br>(0.273) | 0.071<br>(0.141) | -.175<br>(0.173) |

The dependent variable in panel A, B, C is an indicator for non-completion of any post-secondary program, for having completed any post-secondary degree in a STEM field and time-to-degree respectively. The coefficients are marked with * if the level of significance is between 5% and 10%, ** if the level of significance is between 1% and 5% and *** if the level of significance is less than 1%. All columns are estimated by weighted OLS regressions which include the same controls as those in Table 2; i.e. individual controls are foreign born, second generation migrant, parental education secondary, parental education tertiary, dummies for the number of books at home as a child, cognitive ability refers to PIAAC proficiency levels in numeracy, and non-cognitive ability to the readiness-to-learn index. Macroeconomic controls, measured at age 18 are % of contracts covered by collective bargaining and government spending to GDP. In panel C we also include a dummy variable indicating if individuals hold a bachelor's degree or higher. include. Standard errors are clustered at the country-year age 18 level. Heteroskedasticity robust standard errors.

Table A4: Heterogeneity: The effect of macroeconomic conditions on higher education decisions - results by parental background

| | US | Europe | Spain |
|---|---|---|---|
| **A: Completion of at least a bachelor's degree** | | | |
| $\text{Recession}_{18}$ | 0.037 (0.029) | -.010 (0.014) | 0.098 (0.054)* |
| $\text{U-rate}_{18}$ | -.011 (0.013) | 0.003 (0.002) | 0.014 (0.005)*** |
| $\Delta\text{u-rate}_{18}$ | 0.008 (0.011) | 0.001 (0.005) | 0.009 (0.013) |
| Parental education: tertiary | 0.243 (0.039)*** | 0.212 (0.024)*** | 0.064 (0.121) |
| $\text{Recession}_{18} \times$ parents tertiary | 0.065 (0.046) | -.010 (0.032) | 0.007 (0.11) |
| $\text{U-rate}_{18} \times$ parents tertiary | 0.002 (0.007) | 0.002 (0.003) | 0.009 (0.007) |
| $\Delta\text{u-rate}_{18} \times$ parents tertiary | -.061 (0.016)*** | -.015 (0.01) | -.033 (0.027) |
| **B: Completion of any post-secondary degree** | | | |
| $\text{Recession}_{18}$ | 0.039 (0.051) | -.020 (0.021) | 0.12 (0.067)* |
| $\text{U-rate}_{18}$ | -.011 (0.016) | -.001 (0.002) | 0.007 (0.006) |
| $\Delta\text{u-rate}_{18}$ | 0.013 (0.015) | 0.011 (0.006)* | -.006 (0.016) |
| Parental education: tertiary | 0.146 (0.08)* | 0.245 (0.025)*** | 0.021 (0.147) |
| $\text{Recession}_{18} \times$ parents tertiary | -.026 (0.056) | -.010 (0.036) | -.248 (0.1)** |
| $\text{U-rate}_{18} \times$ parents tertiary | 0.016 (0.012) | -.004 (0.003) | 0.01 (0.008) |
| $\Delta\text{u-rate}_{18} \times$ parents tertiary | -.052 (0.018)*** | -.004 (0.013) | 0.015 (0.021) |
| **C: Completion of at least a master's degree** | | | |
| $\text{Recession}_{18}$ | 0.031 (0.04) | -.019 (0.012)* | 0.113 (0.075) |
| $\text{U-rate}_{18}$ | -.012 (0.01) | -.002 (0.002) | 0.012 (0.008) |
| $\Delta\text{u-rate}_{18}$ | -.004 (0.01) | 0.005 (0.004) | -.005 (0.015) |
| Parental education: tertiary | 0.144 (0.051)*** | 0.101 (0.025)*** | 0.017 (0.103) |
| $\text{Recession}_{18} \times$ parents tertiary | 0.117 (0.045)*** | -.002 (0.048) | -.224 (0.101)** |
| $\text{U-rate}_{18} \times$ parents tertiary | -.008 (0.007) | 0.005 (0.003)** | 0.011 (0.006)* |
| $\Delta\text{u-rate}_{18} \times$ parents tertiary | -.022 (0.023) | -.005 (0.013) | 0.033 (0.022) |
| **D: Enrollment in any post-secondary program** | | | |
| $\text{Recession}_{18}$ | 0.011 (0.029) | -.015 (0.021) | 0.241 (0.069)*** |
| $\text{U-rate}_{18}$ | -.014 (0.01) | 0.001 (0.002) | 0.022 (0.007)*** |
| $\Delta\text{u-rate}_{18}$ | 0.017 (0.009)* | 0.005 (0.006) | -.033 (0.018)* |
| Parental education: tertiary | 0.107 (0.07) | 0.248 (0.024)*** | 0.073 (0.115) |
| $\text{Recession}_{18} \times$ parents tertiary | -.081 (0.053) | 0.001 (0.031) | -.240 (0.1)** |
| $\text{U-rate}_{18} \times$ parents tertiary | 0.01 (0.008) | -.008 (0.002)*** | 0.005 (0.006) |
| $\Delta\text{u-rate}_{18} \times$ parents tertiary | -.029 (0.017)* | 0.004 (0.011) | 0.021 (0.019) |

The dependent variable in panel A, B, C is an indicator for graduating with at least a bachelor's, any post-secondary degree, or at least a master's degree respectively, in panel D for ever enrolling in any post-secondary program. The coefficients are marked with * if the level of significance is between 5% and 10%, ** if the level of significance is between 1% and 5% and *** if the level of significance is less than 1%. All columns are estimated by weighted OLS regressions which include the same controls as those in Table 2; i.e. individual controls are male, foreign born, second generation migrant, parental education secondary, dummies for the number of books at home as a child, cognitive ability refers to PIAAC proficiency levels in numeracy, and non-cognitive ability to the readiness-to-learn index. Macroeconomic controls, measured at age 18 are % of contracts covered by collective bargaining and government spending to GDP. Standard errors are clustered at the country-year age 18 level. Heteroskedasticity robust standard errors. In panel C for Europe the sample does not include the UK as PIAAC data for the UK does not allow us to distinguish between individuals with a bachelor's or master's degree and higher.

Table A5: Heterogeneity: The effect of macroeconomic conditions on higher education decisions - results by parental background continued

| | US | Europe | Spain |
|---|---|---|---|
| **A: Non-completion of any post-secondary program** | | | |
| Recession$_{18}$ | -.112 (0.057)** | 0.002 (0.012) | 0.223 (0.063)*** |
| U-rate$_{18}$ | -.006 (0.013) | 0.005 (0.002)*** | 0.021 (0.007)*** |
| $\Delta$u-rate$_{18}$ | 0.04 (0.018)** | -.004 (0.005) | -.048 (0.013)*** |
| Parental education: tertiary | -.144 (0.124) | 0.051 (0.028)* | 0.201 (0.155) |
| Recession$_{18}$×parents tertiary | 0.073 (0.072) | 0.008 (0.03) | 0.132 (0.077)* |
| U-rate$_{18}$×parents tertiary | 0.009 (0.016) | -.005 (0.003)* | -.010 (0.009) |
| $\Delta$u-rate$_{18}$×parents tertiary | -.037 (0.042) | 0.008 (0.01) | 0.017 (0.018) |
| **B: Completing a degree in STEM fields** | | | |
| Recession$_{18}$ | 0.028 (0.055) | -.015 (0.019) | -.231 (0.035)*** |
| U-rate$_{18}$ | 0.014 (0.022) | -.0004 (0.002) | -.006 (0.004) |
| $\Delta$u-rate$_{18}$ | -.0006 (0.015) | -.002 (0.007) | 0.026 (0.011)** |
| Parental education: tertiary | 0.063 (0.078) | -.003 (0.026) | -.050 (0.128) |
| Recession$_{18}$×parents tertiary | 0.11 (0.059)* | 0.033 (0.032) | 0.344 (0.141)** |
| U-rate$_{18}$×parents tertiary | -.028 (0.014)** | -.0009 (0.002) | 0.0004 (0.007) |
| $\Delta$u-rate$_{18}$×parents tertiary | 0.004 (0.033) | -.010 (0.01) | -.060 (0.022)*** |
| **C: Time to degree** | | | |
| Recession$_{18}$ | 1.239 (1.120) | -.657 (0.345)* | -.347 (1.324) |
| U-rate$_{18}$ | -.726 (0.403)* | -.142 (0.044)*** | 0.011 (0.133) |
| $\Delta$u-rate$_{18}$ | -.822 (0.383)** | 0.255 (0.094)*** | 0.219 (0.231) |
| Parental education: tertiary | -.200 (0.776) | -.542 (0.264)** | -.651 (0.869) |
| Recession$_{18}$×parents tertiary | 0.971 (0.375)*** | -.344 (0.548) | 1.521 (0.623)** |
| U-rate$_{18}$×parents tertiary | -.217 (0.106)** | 0.065 (0.026)** | 0.054 (0.051) |
| $\Delta$u-rate$_{18}$×parents tertiary | 0.055 (0.217) | 0.042 (0.132) | -.184 (0.174) |

The dependent variable in panel A, B, C is an indicator for non-completion of any post-secondary program, for having completed any post-secondary degree in a STEM field and time-to-degree respectively. The coefficients are marked with * if the level of significance is between 5% and 10%, ** if the level of significance is between 1% and 5% and *** if the level of significance is less than 1%. All columns are estimated by weighted OLS regressions which include the same controls as those in Table 2; i.e. individual controls are male foreign born, second generation migrant, parental education secondary, dummies for the number of books at home as a child, cognitive ability refers to PIAAC proficiency levels in numeracy, and non-cognitive ability to the readiness-to-learn index. Macroeconomic controls, measured at age 18 are % of contracts covered by collective bargaining and government spending to GDP. In panel C we also include a dummy variable indicating if individuals hold a bachelor's degree or higher. include. Standard errors are clustered at the country-year age 18 level. Heteroskedasticity robust standard errors.