Too few university graduates. Inclusiveness and effectiveness of the Italian higher education system

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Abstract
A large body of research has shown that human capital is a key factor in individual wellbeing and national economic growth. In this perspective, supranational institutions like the OECD and the EU emphasize the role of higher education in their policy agendas. Despite the absence of formal access barriers, Italy is lagging behind the majority of the developed countries in the share young individuals with tertiary education. Exploiting the administrative data of a large public Italian institution, we analyse student academic careers across recent matriculation cohorts, estimating the paths for different student profiles and analysing recent time trends. We propose a flexible discrete-time competing risks estimation that allows to overcome some major limitations of conventional competing risks models. We find extremely large differentials in student academic careers across prior schooling backgrounds. We observe moderate improvements over time in retention and time-to-degree: by decomposing time changes into components related to the composition of the enrolled population, the pattern of choice of the field of study and ‘individual behaviour’, we find that compositional effects play a minor role. All student profiles have witnessed improvements, with the exception of those from the vocational high-school track. Despite the observed progress, altogether our results call for great concern over the inclusiveness and effectiveness of the Italian university system.

Keywords: educational economics, school choice, student academic careers, dropout, time to degree, longitudinal modelling

JEL codes: I2, I23, I24
1. Introduction

A large empirical body of research has shown that human capital is a key factor in individual wellbeing and national economic growth (Blundell et al. 1999). Acknowledging this evidence, supranational institutions emphasize the role of education in their policy promotion agendas. Higher education is receiving a special attention. The OECD highlights the growing importance of higher education in modern societies and strictly monitors its expansion across member countries (OECD 2017); in the perspective of promoting economies based on knowledge and innovation, the EU2020 strategy defined in 2010 set the goal of 40% individuals of age 25-34 with tertiary education by 2020. Although it is now widely recognized that the cognitive skills rather than mere school attainment are drivers of economic growth (Barro 2001, Hanushek and Woessmann 2008), it is also clear that formal education plays a fundamental role in developing skills (OECD 2017).

To attain a large share of young people with tertiary education, higher education systems need to be both inclusive and effective. Inclusiveness can be defined in terms of the capability of providing wide opportunities along race, ethnicity, gender, income and social class lines to attain higher education degrees, and also responds to the aim of promoting equity and social cohesion. Yet, although related to equity (entailing balanced participation), the concept of inclusiveness also implies the broad participation of all social groups. Inclusiveness can be defined in terms of access, if the enrolment probability is high for all social groups, or completion, if the completion (or timely completion) probability given enrolment is high for all social groups. We define a system effective if the majority of the students who enrol eventually attain the degree and within a reasonable amount of time. In this sense, inclusiveness in completion can be conceived as ‘effectiveness for all’.

These are not independent dimensions. In a synchronic perspective, inclusiveness at access and effectiveness may be negatively related: dealing with a less selected student body, more inclusive systems are likely to display poorer outcomes in terms of retention and time to degree. Instead, inclusiveness at access and in completion may be positively intertwined. Incentives to university enrolment differ across social groups because students from more advantaged backgrounds have more economic resources and higher aspirations, and being on average better performing, they have a higher probability of succeeding in degree completion (Breen and Goldthorpe 1997). If individuals’ educational decisions are influenced by the experience of the older cohorts and in particular of those considered as ‘peers’, the presence of de-facto or perceived barriers to the successful progression could discourage prospective students of the less disadvantaged groups from entering higher education. Instead, a system that appears to work well for all is likely to foster the development of positive attitudes, favouring enrolment and active engagement in the university life.

Despite the educational expansion that has interested all advanced economies in the past decades and that has translated in the large growth of the share of young individuals with tertiary education, variability across

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2 Inclusiveness at access can be evaluated in terms of norms, according to whether there are entry barriers based on ability, prior school performance or type of upper secondary education. However, actual barriers to participation may exist even if no formal restrictions to enrolment are in place, as shown by the low participation rates of students from disadvantaged backgrounds in many countries with formally open systems.
countries is wide. At the OECD level, the average share for year 2018 is 44% (OECD 2018). At the top of the ranking there is Korea (70%) followed by Canada (61%) and Japan (60%), and among European countries, Ireland (53%), Luxembourg (51%) and Switzerland (50%). Italy (27%) is placed at the bottom of EU and OECD’s rankings, and displays a much lower proportion even when compared to Mediterranean countries with similar educational systems like France (44%), Spain (43%) and Portugal (34%). This critical situation results not only from a low share of young individuals entering higher education (De Santis et al. 2019), but also to high non-completion rates (Schne pf 2014, ANVUR, 2016). Dropout is a severe problem in Italian higher education; moreover, time to degree attainment is on average far above the institutional length of the degree courses (Almalaurea, 2016). This raises an issue of system effectiveness.

There is also an issue of equity. The Italian upper secondary education system channels students into school-types with different learning targets; however, all individuals with a 5-year diploma have access to university and no ability-based restrictions are in place. Despite this formal openness, transition rates to university are much higher for individuals coming from the academic track than for students from more vocationally oriented high-schools. Given the different educational content of the various school-types, this evidence is hardly surprising and could be considered an inevitable and perhaps even intended consequence of the student tracking policy. However, as demonstrated by an extensive literature, high-school choices in Italy are persistently characterized by an extremely strong social stratification, even in comparison to other tracked systems (Jackson, 2013). In this scenario, large differences in the participation and completion of higher education across tracks cannot be interpreted only in terms of different preparedness, but must be considered also in the perspective of inequality of opportunity in educational attainment.

Against this background, in this work we analyze student academic careers in Italy, a country that despite having an open educational system in terms of access barriers to higher education, is still lagging behind most other developed countries in the share of the population with higher education, even in the most recent cohorts.

When looking at national-level aggregate data on the higher education incoming student population, we may unambiguously conclude that the Italian university system is not becoming more inclusive at access. The overall transition rates from upper secondary to tertiary education were rather stable around 56% at the national level between 2004 and 2010, then fell to 53% in 2015 and only slightly increased since then.³ The decline has interested all school types, but the technical and vocational tracks to a larger extent. As a result, the composition of the newly matriculated population has changed markedly over time, being increasingly represented by students coming from the academic track (see Figure 1).

While there are no signs of increasing inclusiveness at access, there is evidence of increasing effectiveness: in the past decade, aggregate dropout rates have been steadily decreasing and time to graduation seems to be reducing (ANVUR 2016). These improvements might be entailed by organizational changes, better teaching practices, widened tutoring, or simply by lowered educational targets. In principle, the observed changes in educational outcomes could also be due to changes in student attitudes, related to cultural factors or perception of the labour market needs. However, there is also a competing mechanism, related to the (self-) selection

³ Official reports of the National University Evaluation System (ANVUR 2016 and 2018).
process into university. Since students have become more positively selected, at the aggregate level we expect more favourable outcomes in terms of retention and time to degree, even in the absence of behavioural changes on part of any of the actors involved, students or university institutions. To understand how academic careers are shaped across students’ background and to analyse recent changes over time, in-depth analyses of student trajectories in higher education are needed.

Our empirical analysis is based on the case-study of the University of Torino, a large public institution delivering degree courses in most fields of study in the North West of the Italy. We exploit the administrative longitudinal data released by the national university student registry. Our data archive contains the entire careers of all students first enrolled at the University of Torino between years 2004 and 2015, recording degree attainments, system dropout, degree changes and transfers to other institutions. We analyse the careers of students enrolled in bachelor (BA) programs up to either BA completion or dropout, with flexible discrete-time competing risks models, in order to evaluate the determinants of successful vs. less successful trajectories and assess the extent to which trajectories differ across previous schooling backgrounds. We then analyse trends over time. Consistently with national-level aggregate evidence, we find a moderate increase in both retention and timely degree probabilities. To shed some light on the drivers of this improvement, we decompose the observed changes into three distinct components, related to the composition of the student body, the choice of the field of study and a residual component that we may interpret in terms of ‘individual behaviour’ after enrolment.

The contribution of this paper to the existing literature is twofold. From a substantive perspective, it aims at contributing to a deeper understanding of the ongoing processes underlying student academic careers in a European country that despite a recent substantial increase, still displays a very low share of young individuals with tertiary education. From a methodological point of view, we relate to a small literature analysing academic trajectories in their entirety with administrative data, and within the framework of survival modelling, propose a flexible competing risks model that overcomes some of the limitations of conventional competing risks models. The main advantage of our approach is the possibility to distinguish between events of interest determining an exit from the state of interest (dropout and graduation) and events of interest that we wish to model, but not consider as exit states (change of degree program).

The paper is organized as follows. In section 2 we describe the Italian educational system and the evidence on student academic careers. In section 3 we describe the data and illustrate the methods used to model trajectories and analyse their trends over time. Results are illustrated in section 4. In section 5 we speculate on potential drivers of the observed trends, related to labour market and university institutional changes. Finally, in section 6 we draw the conclusions.

2. The Italian context

2.1 Educational system

In Italy, children enter formal schooling at 6 and must attend school up to age 16. Compulsory education is comprehensive up to eight grade, with five years of primary school and three years of lower secondary school.
Upper secondary school offers a variety of educational programs, differing in content and learning targets, and broadly grouped into lyceums (academic track), technical schools and vocational schools. Lyceums may be further divided into traditional lyceums (the classical lyceum, with a focus on humanities, and the scientific lyceum, with more emphasis on math and sciences) and other lyceums considered less prestigious (linguistic, socio-pedagogical, artistic). Technical schools provide academic education together with some job-oriented instruction. Vocational schools are academically less demanding, and put more emphasis on the training for low qualification technical jobs. There are no ability-based access restrictions to the different school types. At the end of high school, students take a high-stakes national (non-standardized) examination that determines their exit mark.

Despite the strongly stratified character of upper secondary education, higher education is formally open: all students with a 5-year high school diploma have access to university (although for few majors, enrolment is limited and regulated by admission tests), regardless of prior performance. However, transition rates vary markedly across tracks. Excluding the law and medical schools and few other degree-programs still lasting 5-6 years, since the implementation of the EU Bologna Process in 2001 the system has been organized into a 3-year bachelor program followed by a 2-year master program. Students choose a degree program focusing on a field of study (e.g. physics, philosophy or economics) and have limited leeway in choosing courses and exams. Provided that they respect possible prerequisites in the order of the exams, they are not subject to an evaluation at the end of each academic year, as occurs in many countries; instead, if students fail an exam or get a poor grade, they are allowed to repeat it until they obtain a result that they consider satisfactory. There are generally no limits to time-to-degree. As a consequence, many students largely exceed the institutional length of the degrees.4

In the Italian higher educational system there is no formal divide between universities and polytechnic institutions. Higher education is mainly composed by public institutions but there are also few very prestigious private ones. University qualifications have all the same “legal value”. Hence, although different studies show that the reputation of a university is relevant in attracting students (Agasisti 2009, Cattaneo et al. 2016), the role played by reputation is less important in Italy than in other countries with more differentiated university systems.

Tuition costs in public universities have limited variation across institutions and fields of study. University fees are relatively low and depend on household income, therefore it is unlikely that low-income students will not enrol because of the direct costs of education. Financial aid in the form of grants is limited.5 Some scholarships are provided by regional authorities to low-income students obtaining a minimum amount of credits and grade point average.

2.2 Evidence on schooling choices and student academic careers

There is a huge sociological and economic literature on educational choices focusing on the role of social class (Boudon 1974, Collins 1979, Bourdieu and Passeron, 1990; Breen and Goldthorpe 1997, Barone et al. 2018),

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4 Average time to completion for 3-years programs was 4.6 years in 2014 (Almalaurea 2016)
5 In Italy 19% of the students benefitted of public financial aid in 2010-11 (OECD, 2013).
family income (Carneiro and Heckman 2002) and income constraints (Dynarsky 2003), risk aversion (Checchi et al. 2014). These studies provide theoretical explanations of the overwhelming evidence that more prestigious educational choices including university enrolment are strongly influenced by family background.

The literature on student academic careers upon enrolment mainly focuses on the study of the determinants of university dropout and timely degree completion. A systematic review of the personal and institutional factors affecting dropout is in Larsen et al (2103). Tinto (1975) focuses on the role of academic and social integration. Smith and Naylor (2001) and Arulampalam et al. (2005) highlight the role of individual’s prior performance as an indicator of preparedness. Due to their better academic preparation, students from advantaged backgrounds experience higher retention and completion probabilities, although they often display better outcomes also net of prior schooling (Ishitani 2006, Vignoles and Powdthavee 2009, Bowen et al. 2009). Manski (1989) explained university dropout as a rational behavior: due to incomplete knowledge of learning targets and their actual chances to attain the degree, individuals may first enroll and then reevaluate their choices once they have acquired more information. In this perspective, Stinebrickner and Stinebrickner (2013), show that students update their beliefs about their own ability over time and that this process plays a decisive role in dropout decisions. Other push factors may be related to intervening financial constraints (Stinebrickner and Stinebrickner 2008). In this perspective, financial aid plays a role in favouring study progression (Dynarski 2003, Gloker 2011). In favourable labour market conditions pull factors may also operate, as students might be induced to accept good job offers and leave university. Some scholars focus on system selection. For example, analysing data for Belgium Flanders, a country where higher education has low admission standards and strong ex-post selection, Declerq and Verboven (2018) argue that moderate admission standards may reduce unsuccessful careers without decreasing degree completion. Instead, Denning et al. (2019) argue that the recent increase in college completion rates in the US is due to reducing standards to degree receipt. Time to degree is the object of another line of research: studies on the United States show that time to degree has increased markedly over time outside the most selective universities and that this is due to a rising share of students in employment (Bound et al. 2012).

Within this scenario, Italy stands as a country with particularly large inequalities in upper secondary school choices and access to tertiary education (Jackson, 2013). Despite the absence on formal barriers to track choice and access to university, the Italian educational system is flawed by strong socioeconomic inequalities (Cobalti and Schizzerotto 1993; Contini and Triventi 2016). Social background critically influences students’ high school choices (Gambetta 1987; Schizzerotto and Barone 2006). Even if inequalities in access to upper secondary education have witnessed a consistent reduction and a moderate increase in the share of students enrolling to the academic track, inequalities in track choices have not changed much over time (Panichella and Triventi 2014).

Horizontal segregation in high-school has strong consequences on inequalities on university enrolment, as

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There is also a recent literature aimed at early prediction of student dropout with machine learning techniques (eg. Delen 2010), but this is out of the scope of the present work and will not be mentioned further.

ANVUR (2016)
the transition rate to tertiary education varies largely across tracks (see Figure 1). Overall, there is evidence of increasing participation to higher education and slightly decreasing inequalities up to the 2000s (Argentin and Triventi 2011, Guetto and Vergolini 2017), but in the most recent decade, probably due to the economic crisis, transition rates have been declining and differences across high school tracks have raised, determining a change in the composition of the enrolled population.

Research on student academic careers has been limited by the lack of appropriate longitudinal data at the national level. For this reason, the existing literature on university dropout – conceived as system-level dropout – is largely based on survey data, and in particular on a retrospective survey data on high school graduates (e.g. Di Pietro and Cutillo 2008; Cingano and Cipollone 2007, Contini et al. 2018)\(^8\). This literature reports substantial differentials related to family background and prior schooling. Other studies (Cappellari and Lucifora 2009) focus on the Bologna Process and show that it contributed to a small reduction of the dropout probability. Only a few studies are based on micro-level administrative data, because the Ministry of Education has released the data only in recent years; moreover, the archives on schooling and university careers are not linked (so the enrolment choice cannot be studied) and universities have access only to the data of their own institution. Among these papers, Clerici et al. (2014) highlight that determinants of academic careers differ across the fields of study, whereas Carrieri et al (2015) find that a stronger selection at entrance considerably reduces dropout risks. Indirect evidence of the role of financial constraints is provided by a small literature analysing the impact of various forms of scholarships and financial aid for low-income students, showing that income support favours study progression and degree completion (Mealli and Rampichini 2012, Azzolini et al 2018, Vergolini and Zanini 2015). Only few contributions focus on time to degree. Aina et al. (2011) highlight the role of individual and family factors and find that weak labour market conditions tend to delay degree completion. Garibaldi et al. (2012) find that time to degree is negatively related to tuition costs. Contini et al. (2018) show that timely completion is a more stringent outcome than retention and depends heavily on prior scholastic performance.

**Figure 1. Transition rates from upper secondary to tertiary education**

![Figure 1. Transition rates from upper secondary to tertiary education](image)

Source: Own elaboration from data reported by ANVUR (2016)

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3. Data and methods

3.1 Data

In this work we exploit administrative data provided by the Ministry of Education on the entire careers – degree programs, exams and grades, number of credits – of the cohorts of students first enrolled at the University of Torino in a bachelor’s program (BA) in the academic years 2004/05-2013/14 (approximately 90,000 individuals) up to 2015. This is the largest of the two universities in Torino\(^9\) – a large city in the North-West of Italy with a longstanding industrial tradition, partially reconverted to the tertiary sector from the 1980s – offering degree courses at the BA, MA and PhD level in most disciplines. This institution occupies a middle-high position in national university rankings\(^10\) and has aggregate level dropout probabilities similar to that at the national level\(^11\).

As mentioned above, each institution has access only to its own micro-data. Hence, if the aim is to study student academic careers from a system-level perspective one major limitation is that it is generally not possible to distinguish between change of institution and withdrawal from higher education altogether. To overcome this problem and identify dropout correctly, we obtained a special data release including the career segments occurred after transfers to any other national higher education institution. The administrative data provides full information on the students’ progression (including exam transcripts and credits earned), degree changes, change of institution, timing of degree attainment or withdrawal, as well as demographic information on individuals (gender, age at first enrolment, place of birth) and information on previous schooling (type of high school and final examination marks).

By “drop out” we mean that the student, after having formalized enrolment for a number \(t\) of subsequent academic years (not ended with degree completion), does not re-enrol (at the University of Torino or at any other national higher education institution) in year \(t+1\). In this case we will say that she has dropped out after \(t\) years. Similarly, we say that a student has graduated at year \(t\) if she attains the degree after \(t\) enrolment years. Examples of student trajectories, time in the university system \(T\) and destination states are shown in Figure 2.

Enrolment spells following a first dropout are not analysed in this paper. However, the share of dropout students eventually re-enrolling is low (around 10\%) and only a minority of them eventually attain the degree.

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\(^9\) The other university is the Polytechnic, delivering degrees in Engineering and Architecture. There are no major private higher education institutions in the region.

\(^{10}\) 37\(^{rd}\) percentile according to the ranking of the “Il Sole 24 Ore”, 2016.

\(^{11}\) From a comparison of national figures and our own estimates.
Figure 2. Time in the system and exit states

Figure 3 shows the probabilities that a newly enrolled student in a BA program – institutional length 3 years – will dropout or graduate within 1-6-years. Take matriculation cohort 2008 as an example: the probability of dropping out after the first year is 14% and that of withdrawing within 6 years 32%, whereas the probability of graduating within 6 years from enrolment is 56%. Focalizing on time trends, we observe declining dropout probabilities at all durations (although not monotonically across cohorts) and steadily increasing graduation probabilities.

Figure 3. Cumulative dropout and graduation rates within 6 years from enrolment, by matriculation cohort, BA degrees (3-year programs)
3.2 Modelling trajectories

Event history is a longitudinal analytic technique that is particularly well suited to study the temporal nature of student academic careers (DesJardins 2006). We investigate the educational outcomes of the different cohorts of BA degree entrants using a flexible step-by-step longitudinal approach that mimics the estimation of discrete-time hazard functions within a competing risk (CR) framework.

Event history analysis builds on survival analysis. Survival analysis aims at modelling time elapsed in a given state of a discrete-state process. When the event “exit” can occur only at isolated time points (say, at times $T = 1, 2, 3$…), we refer to discrete time models. In this context, the functions of main interest are the survival function $S(j) = P(T > j)$, the probability that exit will not occur up to time $T = j$, and the hazard function $h(j) = P(T = j | T > j - 1)$, the probability of exiting the state at time $T = j$ given survival up to time $j - 1$. Common specifications including explanatory variables are the discrete-time version of the proportional hazard model or, within the logit modelling framework, the proportional odds model (Jenkins, 2005).

Competing risks (CR) models are extensions of survival models when exit from the state of interest may occur towards different destination states, and we are interested in considering the destination along with the timing of the exit event. Our case study fits this situation. Students remain in the university system until they either drop out (one possible destination) or attain the degree (alternative possible destination). Individuals are censored if they are still enrolled at the end of the observation window. More specifically, while survival analysis typically models the hazard function, CR models focus on the so-called transition intensities (as named in the econometric literature, Lancaster 1990) or cause-specific hazards (in the bio-statistical literature, Collett 2015)\textsuperscript{12}, defined as:

$$h_v(j) = P(T = j, D = v | T > j - 1)$$

the probability of exiting at time $T = j$ towards destination $D = v$ given survival up to time $j - 1$. The unconditional probability that a given individual exits the system at time $T = j$ towards destination $D = v$ is related to the transition intensities by:

$$P(T = j, D = v) = h_v(j) \prod_{k=1}^{j-1} (1 - h_v(k))$$

and equals the probability of not exiting the system at time 1 times the probability of not exiting the system at time 2 given survival up to time 1, etc. …times the probability of exiting the system towards a given destination (dropout or graduation) at time $j$ given survival up to time $j-1$.

The literature on CR models has been largely developed within the framework of continuous time models. Discrete time models can be specified with multinomial logit modelling (Jenkins 2005). As described in Figure 2, time is measured as the number of subsequent enrolments (students are required to enrol at the beginning of each academic year) before the occurrence of one of the two possible events defining the exit from the system:

\textsuperscript{12} The competing risks literature often refers to (1) as hazard rates of the latent variables $T^{(v)}$ (failure time until event $v$), under the assumption that latent variables are independent (Cox and Oakes, 1990; Collett 2015). This interpretation is not of interest in the present context is not needed for identifiability of (1).
dropout or graduation. Considering matriculation cohorts separately, at each year, we use multinomial logit models to estimate the probability of all possible options (Table 1). At year 1, we estimate the probability of continuing in the chosen degree program, versus switching to another degree, versus dropping out. Transfers to other institutions (rare) are included in the degree change option, and we distinguish between changes to 3 year programs and to 5/6 year programs. If the student drops out, she falls out of the risk set. At year 2, we consider only students still in the risk set and model choices within the same set of options. From year 3 graduation is also possible (instead, since degree changes are infrequent after the first years, we collapse them with the ‘continue’ option). Graduation is an exit state, like dropout.

Table 1. Options and exit states by academic year after enrolment

<table>
<thead>
<tr>
<th>Academic year</th>
<th>Options</th>
<th>Exit states</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CONTINUE, DROPOUT, CHANGE TO OTHER 3Y, CHANGE TO 5/6Y</td>
<td>DROPOUT</td>
</tr>
<tr>
<td>2</td>
<td>CONTINUE, DROPOUT, CHANGE TO OTHER 3Y, CHANGE TO 5/6Y</td>
<td>DROPOUT</td>
</tr>
<tr>
<td>3-6</td>
<td>CONTINUE, DROPOUT, GRADUATE</td>
<td>GRADUATE</td>
</tr>
</tbody>
</table>

At each step, we include the following time-invariant explanatory variables: gender, age at first matriculation, high school track (traditional lyceums, other lyceums, technical schools, vocational schools) and high-school final examination mark, as well as the field of study at first enrolment. We also insert a time-varying indicator of whether the student has previously changed degree program. Unfortunately, family background indicators are not collected by the Ministry of Education, so this information cannot be included in the models.

Formally, the CR model, defined as a multinomial step-by-step model, may be written as:

\[
P(T = j, D = v|T > j - 1) = \frac{\exp(\beta_v X_{j-1})}{1 + \sum_v \exp(\beta_v X_{j-1})} \quad \forall v \in \text{set of options } \neq \text{'continue'}
\]

\[
P(T > j|T > j - 1) = \frac{1}{1 + \sum_v \exp(\beta_v X_{j-1})}
\]

(3)

where \(T > j\) means that at time \(j\) the students continues in the original degree course and \(T = j, D = v\) represents exit at time \(j\) towards one the other possible options \(v\). If the destination belongs to the set of exit states, the student falls out of the risk set thereafter.

For each matriculation cohort we then estimate the Cumulative Incidence Functions (CIF), describing the probability that a newly enrolled student with a specific profile of explanatory variables will exit the university system by dropping out or graduating within 1-6-years:

\[
CIF_D(j) = P(T \leq j, D = d)
\]

\[
CIF_G(j) = P(T \leq j, D = g)
\]

(4)

13 Fields of study are grouped into the following categories: health, economics, social sciences, scientific, humanities. Due to institutional changes occurred within the period under study, law is excluded from the analyses.
The destination state can be either \( D = \text{dropout} \) (d) or \( G = \text{graduation} \) (g). The complementary function:

\[
P(T > j) = 1 - P(T \leq j, D = d) - P(T \leq j, D = g)
\]

is the probability of being still enrolled after \( j \) years.

Estimation of the CIF could be done by multiplying the step-by-step predicted probabilities of the single outcomes giving rise to each specific sequence compatible with the outcome of interest, and then adding up the probabilities of all compatible sequences\(^{14}\). However, a simpler and straightforward way to evaluate the joint probabilities of interest consists in performing Monte Carlo simulations of a large number of educational careers using the predicted probabilities of occupying a specific state at each step, and then computing the share of simulated cases experiencing the desired outcomes. For large \( N \), this approach is equivalent to the analytic computation of probabilities. We compute the CIF for specific profiles of explanatory variables and for the entire observed populations, with their actual population composition in terms of all the relevant individual characteristics. More specifically, when we analyse specific profiles we use \( N=20000 \), when we focus on the overall population we expand the observed samples by a multiplier factor \( N=1000 \).\(^{15}\)

(Notice that, differently from conventional CR models, with this strategy we can easily estimate the probability of any specific trajectory or any complex outcome of interest. For example, the probability that an individual with given characteristics will change degree after year 1, continue in the same degree program after year 2 and then drop out after year 3; or instead the probability of graduating after 5 years after having experienced a degree change at some point in time. These probabilities can be easily computed by the share of simulated trajectories giving rise to the desired outcome over the total number of simulated trajectories.)

The advantages of our step-by-step estimation approach over conventional competing-risk (CR) models are related to its greater flexibility.\(^{16}\) The main reason for adopting it in this particular context is the possibility to distinguish between events of interest determining an exit from the state of interest (final destinations) and events of interest that we want to model, but not consider as exit states. In conventional CR modelling, once individuals are assigned a destination, they fall out of the risk set. Consider the event “change of degree program”. This event is not rare: approximately 10% of the students make a change during the first two years after matriculation. We are interested in modelling degree changes, because they are informative on individuals’ attitudes and help predicting future outcomes. Vertical moves (change to another BA program) usually come along with dissatisfaction over the current degree program or insufficient academic skills to continue, while upward moves (degree changes from BA to 5- or 6- year programs) usually demonstrate high aspirations and/or high ability\(^{17}\). Yet, we want to model their occurrence without defining them as exit states.

\(^{14}\) For instance, \( P(T \leq 3, \text{Dest} = D) = P(T = 1, \text{Dest} = D) + P(T > 1)P(T = 2, \text{Dest} = D|T > 1) + P(T > 2)P(T = 3, \text{Dest} = D|T > 2) \)

\(^{15}\) These values were determined after different trials, in order to reach substantial stability of the estimates.

\(^{16}\) Flexibility in the shape of the hazard functions also has the advantage of helping to adjust for unobserved heterogeneity, that leads to a systematic bias of the shape of the hazard function towards negative duration dependence (Lancaster 1990).

\(^{17}\) The majority of these upward moves are from 3-year scientific degrees like biology or chemistry to the 6-year medical school degree program. The reason is that entrance to medical school is subject to a national level entrance examination and regulated by a strict \textit{numerus clausus} policy. Some students not admitted in year 1, matriculate into a BA degree program and try the examination again after one year.
However, this is not possible within the conventional CR framework. Instead, with step-by-step analysis we are able to make degree changes endogenous, by including them as possible transitory outcomes within the process under study, and as explanatory variables upon occurrence. Once individuals experience the change, we do not force them out of the risk set, so we are still able to analyse their trajectories up to dropout or graduation (or censoring).

Step-by-step modelling also allows to relax the usual assumption in CR models that explanatory variables have the same effect at all times. This assumption is often not corroborated by empirical evidence: DesJardins (2003) finds that the independent variables have effects that are different over the course of a student’s academic careers. We find ourselves that some explanatory variables are empirically relevant in first year, while have no effect or a larger effect in subsequent years. Another minor point is that although graduation is possible only after the institutional length of the degree has elapsed, conventional CR analyses do not allow to include an exit state only at a certain point. Imposing this condition is straightforward with our approach.

Although in this paper we focus on single spells, the step-by-step technique can easily handle more complex event history data including multiple spells, for example by considering re-enrolment after a drop out or enrolment into master programs. Similarly, in appropriate contexts, we could easily simulate the effects of policy changes.

A limitation of our step-by-step procedure is the large number of parameters, that might yield to inefficiency of the estimates. However, our samples should be large enough (approximately 9,000 individuals per matriculation cohort) to ensure the delivery of reliable estimates of the probabilities of the outcomes of interest.

3.2 Analysing time trends

To analyse time trends we focus on 4-year outcomes. Starting from the estimates of the step-by-step multinomial logit models for, we apply a Blinder-Oaxaca-like decomposition of the observed changes in the population-level CIF estimates at time 4, i.e. on the probability of dropping out within 4 years and the probability of graduating within 4 years. We choose this threshold, because 4 years is a reasonable amount of time for graduating in a 3-year program, given that the share of students graduating within the institutional time is actually quite low. The aim is to evaluate the extent to which the differences in selected outcomes for two cohorts are related to the different composition of the populations of students enrolled (i.e. are explained by the different composition) or instead to different “behaviour” (i.e. to changing model parameters), possibly entailed by organizational changes or different teaching practices or by changes in student attitudes.

More specifically, we assume that the decision process of the individual who attained a high-school diploma first consists in choosing whether to enrol in university and then the field of study: this defines the composition of the enrolled population in each field of study. What happens next – university careers – is expression of the

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18 Desjardins et al. (2002) propose a more flexible version of conventional CR models that allows for time-varying coefficients of the explanatory variables. Our step-by-step model is similar in spirit, although we use a multinomial logit framework.

19 A version of the Blinder-Oaxaca decomposition adapted for a binary outcome has been proposed by Fairlie (1999). Our decomposition follows the same logic, but it is applied to a 3-stages process, and is performed via simulations.
behaviour of the actors involved: students in first place, and the university institutions. Since data on all students eligible for university enrolment are not available, we cannot study the enrolment process, but only account for the distribution of the characteristics of the higher education student population at matriculation \( f(X|\text{enrolled}) \). We may then analyse the probability of choosing a specific field of study given enrolment \( P(F|X, \text{enrolled}) \), and the probability of different academic careers’ outcomes \( P(Y|F, X, \text{enrolled}) \) given the field of study\(^{20}\).

In the end, the outcome’s \( Y \) distribution for each matriculation cohort may be expressed as follows:

\[
P_C(Y) = \sum_r \sum_X \sum_{\text{track}} P_C(Y|F, X, \text{track}) P_C(F|X, \text{track}) P_C(X, \text{track})
\]

\[
P_C(Y|\text{track}) = \sum_r \sum_X P_C(Y|F, X, \text{track}) P_C(F|X, \text{track}) P_C(X|\text{track})
\]

where \( X \) are time invariant explanatory variables, \( F \) the field of study at matriculation and \( c \) the cohort of matriculation. Expression (6a) refers to the entire student population, expression (6b) to each track separately.

In this framework, we may study how university careers change over time across cohorts by decomposing the observed change into three parts: a first one related to changes in the composition of the student body, a second related to changes in the choice of the field of study and a third one related to changes in “behaviour”. Since this component is defined residually, rigorously speaking it can be interpreted as truly behavioural only conditional on all the relevant determinants being accounted for.

We apply this decomposition to the change between the outcomes of the two extreme cohorts for which we observe 4 years after matriculation, i.e. cohorts 2004 and 2010:

\[
P_{222} - P_{111} = (P_{222} - P_{122}) + (P_{122} - P_{112}) + (P_{112} - P_{111})
\]

Subscript 2 represents cohort 2010 and subscript 1 represents cohort 2004, the first subscript refers to the composition of the enrolled, the second to the choice of the field and the third to behaviour. In practice, this decomposition is performed by means of simulations. Each “counterfactual” probability is estimated by combining probabilities relative to different cohorts. For example, we estimate \( P_{122} \) by applying to the population of the first cohort (2004) the estimated parameters of the model for the choice of the field of study of the second cohort (2010), and then the parameters of the academic careers’ models of the second cohort. Since what varies is only the student body composition, the first term in parenthesis refers to compositional changes; similarly, the second term refers to changes in the pattern of choice of the field and the third to changes in student trajectories given individual characteristics and field of study\(^{21}\).

\(^{20}\) We consider here the choice of the field of study at matriculation. As described above, students may change degree course; the occurrence of this event is modeled within the CR modeling of students’ academic careers.

\(^{21}\) In principle, 6 decompositions are possible. We report only results relative to (7), as it seems to be the most meaningful one. The others are less salient because do not follow the hypothesized time ordering of the decision process.
4. Results

The empirical analyses are organized as follows. Firstly, we examine the academic careers of students matriculated in 2008, the latest cohort for which we can observe up to 6 academic years after enrolment. After estimating the multinomial logit models at each step and created the simulated data set as described above, we derive the Cumulative Incidence Functions for students with different profiles. Then, to gain understanding of the process underlying the differences across profiles, we concentrate on the first year after matriculation and examine the number of credits earned in this year. Focusing on the poor performing students, defined as those attaining at most one third of the planned credits, we analyse the choices undertaken after the first year – continuation, dropout from university, change of degree program – as well as the probabilities to eventually graduate within six years from enrolment. Secondly, we examine time trends in the dropout risk and graduation probabilities and analyse the extent to which these changes can be ascribed to behavioural changes, or instead if they depend on variations in the composition of the enrolled student population.

4.1 Students’ academic careers

Selected results of the step-by-step modelling of student trajectories are shown in the Appendix (Figure A1). At each step, we find the effects usually reported in the literature: less dropout and higher graduation probabilities for students enrolled at younger age, for students coming from traditional lyceums (followed by other lyceums, technical schools and vocational schools) and with good prior scholastic performance. Gender differences exist and are substantial (girls do better than boys), but reduce and often disappear once we control for prior schooling and fields of study. Different outcomes are observed also by field of study.

As regards degree changes, we observe that the risk of experiencing a horizontal degree change (towards another 3-year program) relative to continuing in the original one is larger for students from non-academic tracks and students with low high school marks, whereas the probability of changing towards a 5/6-year program (mainly medical and law schools) is higher for students from more advantaged schooling backgrounds. Instead, older students have a lower probability to make a degree change of whatever type. Students who have experienced a horizontal degree change are more likely to drop out in subsequent years and also to make another change and, not surprisingly, take more time to attain the degree.

The estimates of the Cumulative Incidence Functions for females of selected profiles defined by age at matriculation, school track and final high-school examination grade of the students matriculated in 2008 and enrolled in 3-year degree courses (BA) are depicted in Figure 4. On the left side we consider individuals who first matriculated at age ≤19 (the regular age of end of high-school), on the right side individuals matriculated at age 22-25. Blue lines depict graduation probabilities and red lines dropout probabilities. The solid line refers...
to students with a median high school mark, the dashed line to students at the 75th percentile (“high mark”) and the point line to students at the 25th percentile (“low mark”). As mentioned above, females do better than males, but when adding controls, the differences largely fade away, so the outcomes corresponding to males are very similar to those shown in Figure 4.

Both dropout probabilities and graduation probabilities vary markedly along these dimensions. Consider younger students from traditional lyceums (upper left panel) as an example. Students with high marks in high school perform quite well: their probability of attaining the degree within 3 years is 54% and within 6 years is 82%. Their withdrawal probability within 6 years is 10%. The remaining 8% is the quota of students still enrolled after 6 years: in general, this is an indicator of system ineffectiveness (note however that this share also includes students who switched degree course from a 3- to a 5/6-year program, a group largely composed by well performing high school students from lyceums). As we move towards lower high school marks, the picture deteriorates. Within 3- and 6-year graduation probabilities are 41% and 73% for median mark students, 29% and 62% for low mark students. The within 6-year dropout probability is 15% for the former and 23% for the latter. Academic careers of students of school types different from traditional lyceums are substantially poorer. Students from other lyceums and technical schools display similar patterns, and high mark students from these tracks behave similarly to medium mark students from traditional lyceums. Outcomes further deteriorate for students with low marks (the 6-years graduation probability ranges between 45% and 67%) and for students coming from the vocational track (the 6-years graduation probability ranges between 30% and 55% depending on high school performance). Among those delaying entrance to 22-25 years old (right panel), the large majority leaves the system before degree completion. An intermediate pattern (not shown) applies to students enrolling at age 20-21.

Altogether, it seems that only the outcomes of very well performers from lyceums, enrolling with no delay after high school, may be considered “good” outcomes. Our estimates show that the issue of effectiveness involves students from all schooling backgrounds, including those exiting from academic oriented high schools with average prior performance levels.
Figure 4. CIF estimates for individuals enrolled in 3-year degree programs, by age at enrolment, school type and final examination mark (matriculation cohort 2008)

Graduation:  
Dropout:  

Final examination mark:  
- 75th percentile
- 50th percentile
- 25th percentile

Age at matriculation <= 19
Age at matriculation 22-25

Traditional Lyceum

Other Lyceum

Technical

Vocational
4.2 First year performance and future outcomes

We now analyse the credits earned in the first year after matriculation. The entire BA degree course requires the attainment of 60 credits per year (in total 180): we examine the probability of attaining zero credits, ≤20 credits (poor result) or ≥40 credits (satisfactory result) with logit modelling, controlling for gender, age at enrolment, high-school track, final high-school examination mark and field of study. Results are reported in Table 2. In the first two columns we show the raw probability value for each high-school track and the difference from traditional lyceums, in the last column the average marginal effect (AME) with all controls. We find a clear hierarchy, with traditional lyceums ranking at the top, other lyceums and technical schools in the middle (with similar results), and the vocational track at the bottom. Among the latter, more than one third earn zero credits, against nearly 12% of students from traditional lyceums; after taking under control the available explanatory variables, these two groups differ on average by almost 17 percentage points. The ≤20 credits picture is qualitatively similar: one fourth to more than half of the students earn at most 20 credits, depending on the high-school track.

### Table 2. Credit attainment in the first academic year after enrolment (probabilities in percentage points)

<table>
<thead>
<tr>
<th></th>
<th>Raw probability</th>
<th>Raw difference (from Trad. Lyceum)</th>
<th>AME (from Trad. Lyceum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P(n° credits=0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional Lyceum</td>
<td>11.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other lyceum</td>
<td>20.28</td>
<td>8.52</td>
<td>7.39</td>
</tr>
<tr>
<td>Technical</td>
<td>25.23</td>
<td>13.47</td>
<td>9.52</td>
</tr>
<tr>
<td>Vocational</td>
<td>34.17</td>
<td>22.41</td>
<td>16.81</td>
</tr>
<tr>
<td>TOTAL</td>
<td>18.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P(n° credits &lt;=20)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional Lyceum</td>
<td>25.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other lyceum</td>
<td>38.44</td>
<td>12.98</td>
<td>12.98</td>
</tr>
<tr>
<td>Technical</td>
<td>42.12</td>
<td>16.66</td>
<td>12.21</td>
</tr>
<tr>
<td>Vocational</td>
<td>56.35</td>
<td>30.89</td>
<td>25.35</td>
</tr>
<tr>
<td>TOTAL</td>
<td>34.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P(n° credits &gt;=40)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional Lyceum</td>
<td>53.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other lyceum</td>
<td>39.42</td>
<td>-13.72</td>
<td>-15.14</td>
</tr>
<tr>
<td>Technical</td>
<td>35.67</td>
<td>-17.47</td>
<td>-14.52</td>
</tr>
<tr>
<td>Vocational</td>
<td>26.47</td>
<td>-26.67</td>
<td>-22.23</td>
</tr>
<tr>
<td>TOTAL</td>
<td>44.48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AME from logit model with gender, age at enrolment, high-school track, final high-school examination mark and field of study as controls.

The final examination high-school mark is also relevant: the AME (not reported in Table 2) is 0.3 in the 0 credits model (since marks vary between 60 and 100, roughly speaking, there is a 12 p.p. difference between the lowest and the highest), and 0.9 in the ≤20 credits one model. These results show that the number of credits earned in the first year depends heavily on previous preparedness. However, the much smaller effect of marks when focusing on the dichotomy 0/>0 instead of ≤20/>20 credits suggests that few-credits earned should be more safely considered as a “failure” than no-credits earned. In fact, students realizing that “they are not in the right place” might withdraw at the very beginning of the year and not even attempt to give exams. Hence, for some students 0 credits could be the consequence rather than the cause of dropout or degree change.
What happens after a poor first academic year? With the above caveat in mind, we examine the choices for students who earned ≤20 credits in the first year. In the upper panel we report the raw probabilities to: ‘continue’ in the chosen degree course, ‘drop out’ of the higher education system, ‘change’ degree course (distinguishing between a move to 3-year and 5/6-year courses). Students from lyceums are much more likely to switch course rather than dropping out relative to the others; the differential across high-school tracks is large, even after controlling for individual characteristics and the number of earned credits (see AME in the lower panel of Table 3, estimated with multinomial logit modelling). Qualitative research (Pilutti et al. 2019) provides an explanation to this evidence. Students from more privileged backgrounds tend to choose traditional lyceums as the natural route to university entry, that is often taken for granted since childhood: when confronted with a failure, these students will adjust their choices in order to achieve this goal. Instead, students with less favourable backgrounds, whose educational plans take shape later on, are more inclined to give up. Interestingly, other things being equal, the higher the final high-school examination mark, the higher the probabilities to both drop out and (in particular) change degree program rather than continuing in the same program. This result suggests that students who are used to performing well are more likely to perceive a small number of earned credits as a failure, and react to this failure with an action: the most resilient ones change degree course, the more fragile withdraw.

Table 3. Dropout, change course and continuation probabilities after the first academic, students who earned <=20 credits, by high school track (probabilities in percentage points)

<table>
<thead>
<tr>
<th>Raw probabilities</th>
<th>Dropout</th>
<th>Change 3Y</th>
<th>Change 5/6Y</th>
<th>Continue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Lyceum</td>
<td>28.89</td>
<td>28.11</td>
<td>3.81</td>
<td>39.19</td>
</tr>
<tr>
<td>Other lyceum</td>
<td>48.62</td>
<td>18.89</td>
<td>0.69</td>
<td>31.80</td>
</tr>
<tr>
<td>Technical</td>
<td>53.93</td>
<td>13.96</td>
<td>0.27</td>
<td>31.84</td>
</tr>
<tr>
<td>Vocational</td>
<td>59.40</td>
<td>12.23</td>
<td>0.18</td>
<td>28.19</td>
</tr>
<tr>
<td>TOT</td>
<td>44.19</td>
<td>20.02</td>
<td>1.73</td>
<td>34.06</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Controls: gender, age at matriculation, high school mark, field of study and n° credits earned the first year. AME computed on students who earned &lt;=20 credits</th>
</tr>
</thead>
</table>

Almost half of the students earning at most 20 credits in the first year do not re-enrol the following year. What happens to those who do not drop out? Excluding the small group who transferred to a long degree course, we apply step-by-step modelling with the inclusion of the number of earned credits in the first year as an explanatory variable, to estimate the probability of eventually attaining the BA degree within 3-6 years after enrolment. Notice that the reverse causation caveat does not apply to this case, because we are considering
only students who, despite their poor performance in the first year, decided not to leave university. We estimate that only 1 out of 4 complete the degree course within 6 years, with differences across high school tracks.\textsuperscript{24}

\textbf{Table 4. Graduation probabilities within 3-6 years for students who attained <=20 credits in the first year and did not drop out after the first year, by high-school track (in percentage points)}

<table>
<thead>
<tr>
<th></th>
<th>3 academic years</th>
<th>4 academic years</th>
<th>5 academic years</th>
<th>6 academic years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Lyceum</td>
<td>1.4</td>
<td>13.2</td>
<td>22.5</td>
<td>28.5</td>
</tr>
<tr>
<td>Other Lyceum</td>
<td>0.6</td>
<td>8.7</td>
<td>17.3</td>
<td>22.5</td>
</tr>
<tr>
<td>Technical</td>
<td>0.8</td>
<td>8.7</td>
<td>16.6</td>
<td>20.9</td>
</tr>
<tr>
<td>Vocational</td>
<td>0.5</td>
<td>5.8</td>
<td>12.4</td>
<td>16.5</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1.1</td>
<td>10.8</td>
<td>19.4</td>
<td>24.7</td>
</tr>
</tbody>
</table>

\textbf{NOTE. Step-by-step models estimated on all students. Models for all academic years include all previous covariates, the number of earned credits in the first year and indicators of previous degree change.}

The estimation of the graduation probabilities for students who earned at least 40 credits in the first year confirms the importance of first year outcomes as predictors of subsequent trajectories. Overall, these students perform well: 56% attain the degree on time and 86% attain the degree within 6 years from enrolment. Once again, differences across tracks are relevant, in particular on the timing of degree completion.

\textbf{Table 5. Graduation probabilities within 3-6 years for students who attained >=40 credits in the first year, by high-school track (in percentage points)}

<table>
<thead>
<tr>
<th></th>
<th>3 academic years</th>
<th>4 academic years</th>
<th>5 academic years</th>
<th>6 academic years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Lyceum</td>
<td>62.0</td>
<td>81.8</td>
<td>87.8</td>
<td>89.9</td>
</tr>
<tr>
<td>Other Lyceum</td>
<td>44.2</td>
<td>68.2</td>
<td>77.9</td>
<td>81.1</td>
</tr>
<tr>
<td>Technical</td>
<td>51.9</td>
<td>72.5</td>
<td>80.1</td>
<td>82.7</td>
</tr>
<tr>
<td>Vocational</td>
<td>33.2</td>
<td>54.6</td>
<td>65.1</td>
<td>68.9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>56.0</td>
<td>76.6</td>
<td>83.7</td>
<td>86.1</td>
</tr>
</tbody>
</table>

\textbf{NOTE. Step-by-step models estimated on all students. Models for all academic years include all previous covariates, the number of earned credits in the first year and indicators of previous degree change.}

\textbf{4.2 Trends over time}

We now focus on the dropout and graduation probabilities within 4 years across the matriculation cohorts for which this information is available (2004-2010). At the aggregate level, we observe substantial improvements over time. However, these changes are not homogeneous across high school types. Students from the vocational track do not benefit as the other subgroups. Their dropout rates – already very high in earlier cohorts (43%) – increase by more than 6 percentage points between matriculation cohorts 2004 and 2010, and the share of degree completion is stable around 25%. Instead, all other groups improve substantially in dropout and particularly in graduation probabilities (Figure 5). Recalling that they have become increasingly fewer in number, altogether these results suggest that students from the vocational track are being progressively marginalized from the higher education system.

\textsuperscript{24} Students eventually re-enrolling after a dropout are not included in these estimates. We estimate that the probability that a dropout will re-enrol is around 10% and the probability that she will also attain the degree is around 3%.
4.3 Compositional or behavioural changes?

Is this descriptive picture driven by behavioural changes, or is it due to changes in the composition of the high-school subgroups enrolling at university, or to the pattern of choice of the field of study?

The student composition has changed markedly over the observed time span (Tables A.1 and A.2 in the Appendix). The share of students coming from lyceums has increased from 57% to 73% between matriculation cohorts and 2010, and that of students first enrolled within age 21 increased from 87% to 93%. This tendency also holds when we look at data by field of study, although the changes are marked for some fields (economics, scientific and health) and mild for others (humanities and socio-politics). Thus, we expect compositional changes to have contributed to the reduction of overall dropout rates and time to degree. However, the share of older students has increased substantially among students from the vocational track, and the mean final high-school examination mark has decreased for all school types.

Figure 6 shows the decomposition of the total difference in the 4-year dropout and graduation probabilities between matriculation cohorts 2010 and 2004. Since the share of younger students and from lyceums has been increasing, on the whole the university student-body population has become more positively selected. The reduction of the dropout probability can be partly ascribed to these compositional changes and partly to changes in individual behaviour. No role is played instead by changes in the pattern of choice of the field of study. Instead, the improvement in the graduation probability is almost entirely due to changes in behaviour.

Inspection of the changes observed within high school tracks provides additional insights (Figure 7). The improvements observed for students from traditional lyceums, other lyceums and technical schools are largely due to behavioural effects. Compositional effects are small: they contribute to a dropout increase for the first group and to a small reduction for the other two, and to a graduation probability decrease for all. Instead, the

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25 In more recent cohorts the composition is similar to that of 2013.
role played by changes in the choice of the field of study is negligible. A completely different picture is observed for the students coming from the vocational track. As mentioned above, this is the only subgroup exhibiting a (large) aggregate deterioration of dropout probabilities. This change is entirely due to compositional effects (probably because the average age at enrolment increases substantially over time for this group). Instead, stability observed at the aggregate level in the graduation probability results from the sum of a negative compositional and a positive behavioural component. We may conclude that, other things being equal, students from the vocational track do not experience a reduction in their chances to dropout, while they share with the other students an improvement in the within 4-year graduation probability.

Figure 6. Decomposition of the changes between matriculation cohorts 2010 and 2004 in the probability of dropping out and completing the degree within 4 years (population)

Figure 7. Decomposition of the changes between cohorts 2010 and 2004 in the probability of dropping out and completing the degree within 4 years, within high school tracks
5. Explaining the improvement (still an open issue)

Our findings unambiguously point to an improvement in the system effectiveness. Although addressing the causes of the observed changes is out of the scope of the present paper, we briefly sketch out some possible reasons of these changes. There are at least two major macro-level factors occurred in the past 15 years that might have triggered substantial changes in individual educational decisions and outcomes at the tertiary level: the changes in the labour market structure and the economic crisis started at the end of 2008 on the one side, and the institutional changes in the university system enforced after 2004 in the other.

Labour market changes and the economic crisis

Theoretical predictions on the effects of the economic downturn on tertiary education outcomes are not clear-cut. Firstly, individuals may react differently to adverse conditions of the labour market, according to preferences, risk aversion and other psychological traits. Secondly, individuals are subject to different constraints, due to diverse economic and cultural endowments. Thus, the effects of economic crisis on educational choices may operate at two levels. A downturn affects the conditions of the macroeconomic context and labour market opportunities, thereby changing the prospective students’ evaluation of costs and benefits of tertiary education and/or the choice of the field of study. However, a downturn also directly affects the conditions of individuals, constraining the educational options of prospective students experiencing financial hardship. In this perspective, we now briefly review the potential mechanisms related to the economic crisis operating on university enrolment (affecting the composition of the student body) and on student trajectories given specific profiles (affecting behaviour). In principle, another possible driver of change is the increasing job insecurity and importance of atypical and fixed-term jobs, ongoing since the mid-nineties but predictions on academic careers are difficult to make.26

Enrolment: By reducing the opportunity costs of studying, poor labour market prospects should increase participation to higher education – this is the evidence from recent experience of community colleges in the USA (Hillmann and Lee Orians 2013). Yet, poor labour market prospects might also affect motivation and yield to discouragement, contributing to reduce participation. The balance between these opposite forces should depend on the (perceived) returns to tertiary education. However, bad economic conditions might also have a direct negative influence on enrolment: individuals living in families experiencing severe financial hardship might have an urgent need of income and may not be able to attend university. In this scenario, even if the crisis increases the share of individuals in poor economic conditions in the population, the effects on the composition of university students is not clear-cut.

Dropout: Poor labour market prospects may contribute to lower dropout rates because the opportunity costs of attending university decline. Moreover, a decline in employment opportunities should reduce the number of withdrawals related to labour market pull out factors. On the contrary, students lacking economic resources might be pushed out of the educational systems due to an immediate need to earn income.

26 In addition, returns to higher education in Italy have been steadily lower than in most other OECD countries (OECD, 2018). This might be responsible of low enrolment rates while it is difficult to predict whether it should also have an influence on completion.
Time to degree: On the one side, if the labour market prospects of university graduates are poor, opportunity costs decline and individuals should take longer time to complete their majors. However, the increasing competition over scarce job positions may also induce students to attain the degree in time, because this would be a good signal for prospective employers. Focusing on current resources, students living in households with financial problems might feel urged to graduate, in order to reduce university costs and start earning income, or, on the contrary they might choose to work while studying, contributing to lengthen time to degree.

Institutional changes in the university system

In the past decade, the Italian university underwent various institutional rearrangements that followed the implementation of the Bologna process in 2001. The two major reforms where enacted in 2004 and in 2010 enforcing changes in the structure of Italian university system – increasing autonomy in the educational curricula, reorganizing BA and MA degrees, moving teaching management responsibilities to departments, previously devoted only to research, enhancing accountability and introducing a performance-based research funding system. Several other minor normative changes have been introduced over these years. Overall, this reorganization process could have contributed to the rise of retention and timely completion rates.

Summing up, since institutional changes have invested the entire Italian university system simultaneously, identification of their effects is difficult, and it is difficult also to disentangling their effects from those of the labour market changes entailed by economic crisis. Further research exploiting differences across territories, institutions or within organizational units (schools or departments) is needed. Still, based on our current findings, we may trace the following (very) preliminary conclusions.

(i) The observed changes in students’ academic careers have started well before the onset of the economic downturn, so the crisis cannot be the only explanation for the sustained changes observed from 2004. Still, the downturn might have played a role since 2008. Via effects on the composition of the student body, that has become progressively more “positively” selected (more students coming from lyceums, and on average younger), or via effects on students’ behaviour. With this caveat in mind, improvements in higher education trajectories might be due to changing attitudes on part of the students entailed by the economic crisis and the ongoing structural changes of labour demand. Our results on dropout are consistent with the hypothesis that the lower opportunity costs of studying and the reduced labour market pull-out factors might have played a role in reducing withdrawal from university. The improvement in timely degree, instead, support the hypothesis that the crisis has led to a greater urge to complete university studies. Due to the increasingly large share of families in need, many students may have needed to become economically independent as quickly as possible. A concurring explanation is related to the increasing competition over scarce job opportunities on the graduates’ labour market, if students perceive that prospective employers consider timely degree as a relevant positive signal that increases their chances of being hired.

(ii) The improvements in the student trajectories could also be ascribed to positive effects of institutional changes that may have fostered better management practices, better teaching, or widened tutoring of the students in need. Additional evidence of substantial differences across fields of study within the university of
Torino support the idea that institutional changes and the way they have been implemented have played a role. Less optimistically, better student outcomes might be the result of lowered educational targets, that reduce the effort required to attain the degree. This assumption would be consistent with the evidence that, other things being equal, all students experience lower dropout and higher timely graduation probabilities. The fact that vocational track students have not witnessed any reduction of their dropout probabilities might disconfirm this explanation or instead, since they represent the most disadvantaged segment of the student population whose chances of being in need of income are highest, be due to their stronger exposure to the effects of the economic crises.

6. Conclusions

In this paper we have analysed the university trajectories of ten cohorts of students matriculated in BA courses at the University of Torino between 2004 and 2013 using a flexible discrete-time competing risks model that allows studying academic careers without defining all states of the process as final destination (exit) states. This method can be easily applied to analyse academic careers in other institutions with similar data and may be adapted to incorporate different explanatory variables and answer different research questions in different contexts and applications.

At first we have focused on cohort 2008, the most recent cohort for which we observe 6 full academic years after enrolment, with the aim of highlighting the determinants of successful vs. less successful academic careers and estimating relevant outcomes for different student profiles. Dropout probabilities – larger after the first academic year, but substantial also in later years – are high for most profiles, and the chances to attain the BA degree in a reasonable amount of time are generally low. At the aggregate level only 28% of the students attains the degree within the 3-year institutional length of time and 56% reach the goal within 6 years. The remaining 44% either drop out (two thirds) or are still enrolled after 6 years (one third). These figures point to a severe lack of effectiveness of the system, entailing a huge waste of public and individual resources.

Student trajectories largely differ across high school tracks and prior performance. Given the strong social stratification of high school choices in Italy, these differences must be interpreted not only in terms of different preparedness, but also in the perspective of social inequalities. Age at matriculation is also a powerful predictor of success: the large majority of the students delaying higher education entrance a few years after the regular age of high school completion drops out at a certain point. This adds on to the gaps across high-school tracks, because delayed entrance is much more frequent among students from technical and vocational schools. Indeed, the direction of these results is not surprising, but the magnitude of the differentials across student profiles is impressive. Although defining what can be considered satisfactory is arbitrary, we believe we may speak of “good” outcomes only for the small group of students enrolling immediately after high school and coming from traditional lyceums with high marks. Degree completion is a hard to reach goal for those with less successful prior schooling and in particular for more mature students. These findings are in explicit conflict with the goal of the EU agenda to increase the inclusiveness of higher education and to provide opportunities to individuals from more disadvantaged backgrounds to enter and complete higher education.
Examination of the credits earning in the first academic year and subsequent outcomes allows shading some light on the processes at work. One third of the students earn at most 20 credits and only less than 50% reach 40 credits out of the planned 60. Indeed, differences across tracks are large. Moreover, when experiencing a poor result (≤20 credits) – a much more likely event for non-academic high school students – individuals react differently. Students from lyceums and good high school marks tend to remain in the university system and change degree course, whereas students from less advantaged backgrounds are more likely to drop out. Among those who do not leave the system, only a minority attains the degree within 6 years from enrolment, with persisting differences across school types. Hence, in each step of the “chain” of events – credit earning, resilience to a “failure” and subsequent outcomes – inequalities across high school tracks cumulate, giving rise to the impressive large differentials observed in the Cumulative Incidence Functions represented in Figure 5.27

When we examine changes over time we may take a more optimistic view: what we observe is an overall reduction of dropout rates and a progressive increase in the timely graduation probabilities across matriculation cohorts. The observed improvements in student trajectories are not mainly due to compositional effects, but instead, to changes in the behaviour of the actors involved.

Notwithstanding this positive result, the outlook for students from the vocational track is grimmer. At the aggregate level, these students have experienced an increase in the dropout probability over time and stability of the probability of timely graduation. Changes in student characteristics are largely responsible for these outcomes (contrary to the general trend, vocational track students have become older in recent matriculation cohorts, and age at enrolment has a large negative effect on academic careers). However, while students from the vocational track have witnessed an improvement in the graduation probability, they have not shared with the others a reduction in their chances to drop out. This could be due to their greater exposure to income constraints and the effects of the economic crisis.

Let us go back to the question raised in the introduction of this paper: is there evidence that the Italian university system is becoming more inclusive and effective? We already pointed out that, according to aggregate national data on enrolment, the system is not becoming more inclusiveness at access, as the transition rates from high-school to university are not increasing (and the share of students with an upper secondary degree is rather stable). We have also argued that, instead, there are visible signs of an improvement in effectiveness, as the share of students who attain the degree has been rising steadily in the observed time span. To address the issue of inclusiveness at completion, conceived as effectiveness “for all”, we rely on our analyses of the changes occurred in student trajectories focusing on the case-study of the University of Torino. Our findings point to a blurred picture in this respect. We might speak of increasing effectiveness “for the majority”, but not for all, because students from the vocational track have not witnessed a reduction in the probability to leave university before attaining the degree.

Leaving considerations on equity aside, we might pragmatically make some back-of-the-envelope calculations aimed at showing how our results could translate into an estimate of the share of young individuals

27 Further work not presented in this paper shows that the probability to continue with an MA degree after the BA attainment is also highly dependent on previous schooling, reinforcing inequalities across students’ backgrounds.
with a higher education degree. Assuming that the share of students attaining an upper secondary degree remains stable at 80% and the transition rate from upper secondary to tertiary education goes back up to 56%, the share of young individual entering university would reach 45%. Considering as degree attainment probability the average within-6-years graduation probability (56%) observed for our 2008 cohort, we would obtain a 25% share of youngsters with tertiary degree. (This figure is slightly lower than the current official share of 27%: this is reasonably a small underestimate, because the graduation probability has increased a little in recent cohorts, some students take even longer than 6 years to complete the degree and few students re-enrol after dropout). Even if we assumed a substantial improvement – that on average students reach the graduation probability of median mark students from traditional lyceums enrolled at age 19 (73%) – at equilibrium the share of graduates would not exceed 33%.

We may conclude that, in addition to making further large improvements in the system effectiveness there is also the need to sharply increase the share of students entering higher education. Even under the optimistic scenario of a 73% degree-attainment probability, to reach the share of 40% graduates – just below the EU and OECD average levels – the transition rate from high school to university needs to increase from 56% to 69%. In the current system, this is possible only if participation rates of the students from all school types increase substantially. We may conclude that unless institutional reforms or powerful policy interventions aimed at fostering study progression of disadvantaged students are put in place, there seems to be little chance to raise the share of young people with tertiary education to the level of most other developed countries within the next future.

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Appendix

Appendix A. DESCRIPTIVE STATISTICS

Table A1. Student characteristics at enrolment (BA degrees), by matriculation cohort.

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<thead>
<tr>
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<th></th>
<th></th>
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</tr>
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<tbody>
<tr>
<td>Age 18-19</td>
<td>66%</td>
<td>68%</td>
<td>70%</td>
<td>71%</td>
<td>71%</td>
<td>70%</td>
<td>70%</td>
<td>69%</td>
<td>69%</td>
<td>68%</td>
</tr>
<tr>
<td>Age 20-21</td>
<td>19%</td>
<td>19%</td>
<td>18%</td>
<td>18%</td>
<td>19%</td>
<td>21%</td>
<td>21%</td>
<td>24%</td>
<td>24%</td>
<td>25%</td>
</tr>
<tr>
<td>Age &gt; 21</td>
<td>15%</td>
<td>13%</td>
<td>12%</td>
<td>10%</td>
<td>10%</td>
<td>9%</td>
<td>8%</td>
<td>8%</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>Female</td>
<td>60%</td>
<td>62%</td>
<td>62%</td>
<td>60%</td>
<td>63%</td>
<td>62%</td>
<td>62%</td>
<td>62%</td>
<td>62%</td>
<td>61%</td>
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<tr>
<td>Traditional Lyceum</td>
<td>45%</td>
<td>46%</td>
<td>49%</td>
<td>51%</td>
<td>53%</td>
<td>54%</td>
<td>56%</td>
<td>57%</td>
<td>58%</td>
<td>57%</td>
</tr>
<tr>
<td>Other Lyceum</td>
<td>10%</td>
<td>11%</td>
<td>12%</td>
<td>14%</td>
<td>14%</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
<td>17%</td>
<td>16%</td>
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<tr>
<td>Technical</td>
<td>26%</td>
<td>23%</td>
<td>22%</td>
<td>22%</td>
<td>20%</td>
<td>21%</td>
<td>21%</td>
<td>24%</td>
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<td>25%</td>
</tr>
<tr>
<td>Vocational</td>
<td>20%</td>
<td>20%</td>
<td>18%</td>
<td>14%</td>
<td>12%</td>
<td>11%</td>
<td>11%</td>
<td>10%</td>
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<td>Average mark</td>
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<td>78.4</td>
<td>77.2</td>
<td>77.1</td>
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<td>20%</td>
<td>20%</td>
<td>23%</td>
<td>22%</td>
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<tr>
<td>Economics</td>
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<td>17%</td>
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<td>17%</td>
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<td>20%</td>
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Table A2. Student characteristics at enrolment (BA degrees), by school type (cohorts 2004 and 2010)

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<th>2006</th>
<th>2007</th>
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<th>2013</th>
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<tbody>
<tr>
<td>Traditional Lyceum</td>
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<td>14</td>
<td>4</td>
<td>61</td>
<td>78.47</td>
<td>58.3</td>
<td></td>
<td></td>
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<tr>
<td>Other Lyceum</td>
<td>62</td>
<td>20</td>
<td>18</td>
<td>87</td>
<td>78.69</td>
<td>9.8</td>
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<td>25</td>
<td>44</td>
<td>77.42</td>
<td>23.4</td>
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<tr>
<td>Vocational</td>
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<td>24</td>
<td>15</td>
<td>73</td>
<td>79.48</td>
<td>19.1</td>
<td></td>
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<tr>
<td>TOTAL</td>
<td>69</td>
<td>18</td>
<td>13</td>
<td>62</td>
<td>78.44</td>
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<table>
<thead>
<tr>
<th>School Type</th>
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<tr>
<td>Traditional Lyceum</td>
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<td>76.16</td>
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<td>Vocational</td>
<td>47</td>
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<td>20</td>
<td>61</td>
<td>76.27</td>
<td>9.7</td>
<td></td>
<td></td>
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<tr>
<td>TOTAL</td>
<td>73</td>
<td>20</td>
<td>7</td>
<td>63</td>
<td>76.45</td>
<td>100</td>
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NOTE. 3-years law students excluded from this table and from the analysis because institutional changes limit the comparability over time.
Appendix B. STEP-BY-STEP MODEL ESTIMATES

Figure A1 displays selected step-by-step model estimates for the 2008 matriculation cohort. We present the coefficients of the multinomial logit model for gender, age, high school track and field of study for dropout and graduation, by year after enrolment (years 1-6 for dropout, years 3-6 for graduation).

**Figure A1. Selected step-by-step model estimates**

<table>
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<tr>
<th>GENDER (REF CAT MALE)</th>
<th>AGE (REF CAT 18-19)</th>
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<tr>
<td>Dropout</td>
<td>Graduation</td>
</tr>
<tr>
<td>Dropout</td>
<td>Graduation</td>
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<td>Dropout</td>
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<tr>
<td>Dropout</td>
<td>Graduation</td>
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</table>

Appendix C. GOODNESS OF FIT

**Table A3. Cumulative observed and predicted dropout/graduation probabilities (CIF), by academic year (cohort 2008)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Dropout</th>
<th>Graduation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Observed</td>
<td>15.34%</td>
<td>21.95%</td>
</tr>
<tr>
<td>Predicted</td>
<td>15.65%</td>
<td>22.3%</td>
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