ORIGINAL RESEARCH

Delayed Graduation and Overeducation in Italy: A Test of the Human Capital Model Versus the Screening Hypothesis

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Abstract

Exploiting the human capital versus screening hypothesis frameworks, this paper studies the link between delayed graduation and overeducation, and their effect on wages, by using the ISFOL-Plus data. The evidence lines towards predictions based on the signalling model. However, as to the determinants of overeducation the coefficient of delayed graduation is significant only for delays of 3 years or more and also controlling for the entire set of covariates. This suggests that delay conveys a signal of low skill.

Keywords Delayed graduation · Overeducation · Human capital theory · Screening hypothesis · Earnings equations

JEL Classification C25 · C26 · C33 · I2 · J13 · J24

1 Introduction

Delayed graduation is spreading worldwide, from the United States to Europe, especially Germany, France, Denmark and Sweden (Häkkinen and Uusitalo 2003; Van Ours and Ridder 2003; Brunello and Winter-Ebmer 2003; Bowen et al. 2009; Bound et al. 2010). It is hence a cause of concern for academicians, policy makers and practitioners at all levels, as it may generate important consequences on the individual, such as psychological distress as well as negative effects on several labor market outcomes, such as employment

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and wages (see, among others, Brodaty et al. 2008; and Gary-Bobo et al. 2016; Witteveen and Attewell 2019). It may also lead to later start of career trajectories and foregone tax revenues for the State. In the long run, it may lead to decreasing enrolment rates, especially during economic crisis, when the expected net return of investment in higher education may shrink. Overall, the causes are similar across countries, except for some country specific factors.

Italy, the country on which this contribution is focused, is indeed an interesting case study due to its large and persistent share of students that spend more years than the curricular number prescribed to attain their degree. According to data provided by the Italian Ministry of Education, about 40% of students experience some sort of delay. In this respect, a neologism has been introduced for this phenomenon: "fuoricorsismo".

Following the amended human capital model (HCM; e.g. Altonji 1993; for a survey, see Aina et al. 2019; for a discussion on Italy, see Pastore 2019), delayed graduation is a consequence of low ex ante returns to education net of the (direct, indirect and opportunity) costs. It means that any factor affecting the expected returns to education, including a lower share of graduates, might cause further delay or dropout. For instance, excess time to graduation recently increased where the cost of education has steeply risen, forcing not well-off students to engage in paid work to support their own studies (above all US and UK). In the North European countries, graduation over 30 accounts for about a quarter of the total, as students can leave the education system relatively easily and re-enter it later (OECD 2010).

The lack of admission tests may also be a factor. Carrieri et al. (2015) show that admission tests have reduced the dropout rate of first-year students by about 14%, increasing their grade average by 0.78 points. Not being forced to pass all the exams scheduled during an academic year to enrol to a subsequent year of study along with uncapped completion period also discourages graduation on time. Providing scholarships to not well-off students regardless of their talent, even if enrolled beyond the minimum period may be factors (Garibaldi et al. 2012).

From the demand side, poor labour market prospects contribute particularly to the length of time to degree by reducing the opportunity cost of education (Aina et al. 2011).

The relevance of this topic arises in consideration of the greater expenditure on educational investment, lower starting salary, later launch of their career trajectory and foregone tax revenues for the State. Moreover, as noted by an increasing strand of recent literature, delayed graduation and overeducation contribute to slow down the transition from school-to-work, with dramatic consequences for young people (see Pastore 2019; and Pastore et al. 2020).

By following the identification strategy adopted by Groot and Oosterbeek (1994) (see Sect. 2 for further details), this paper aims to contribute to the soaring literature on the consequences of delayed graduation, by testing whether it can affect the risk of overeducation and the returns to education. In our empirical exercise, we look at the vertical overeducation that is when a graduate worker does a job for which a university degree is not required. Still in line with the specification of Groot and Oosterbeek (1994), we test how the educational path of each graduate influences his/her labour market performance, by looking at the total number of years spent in education or its decomposition in legal years, repeated years accumulated up to high school diploma and delayed years (see Table 1). We define the legal years of schooling as the number of years nominally required to complete a certain degree; while the repeated years are the number of years of schooling that an individual has spent in the same grade before enrolling to the subsequent one; finally, the delayed years represent the number of additional years beyond the legal duration that a person spent at university before achieving the degree. Besides

Table 1 Human capital versus screening model, expected sign in Groot and Oosterbeek (1994)

	Human capital model	Screening hypothesis
Repeated years	$S_R \geq 0$	$S_R < 0$
Skipped years	$S_S \leq 0$	$S_R > 0$
Inefficient routing years	$S_I \geq 0$	$S_I < 0$
Dropout years	$S_{DO} > 0$	$S_{DO} < 0$

Table 2 Expected signs in PROBIT equations of the determinants of overeducation

	Human capital model	Screening hypothesis
Actual years	$\varphi = n.a.$	$\varphi = n.a.$
Legal years	$\gamma < 0$	$\gamma < 0$
Repeated years	$\delta \leq 0$	$\delta > 0$
Delayed years	$\theta \leq 0$	$\theta > 0$
1–2 years of delay	$\theta^{1-2} \leq 0$	$\theta^{1-2} > 0$
3 years or more of delay	$\theta^{3plus} \leq 0$	$\theta^{3plus} > 0$

Coefficients are as presented in Eqs. (1)–(4) in the main text

Table 3 Expected signs in earnings equations

	Human capital model	Screening hypothesis
Actual years	$\varphi = n.a.$	$\varphi = n.a.$
Legal years	$\gamma' \geq 0$	$\gamma' \geq 0$
Repeated years	$\delta' \geq 0$	$\delta' < 0$
Delayed years	$\theta' \geq 0$	$\theta' < 0$
Delayed graduation	$\theta' \geq 0$	$\theta' < 0$
Overeducation	$\omega < 0$	$\omega < 0$

Coefficients are as presented in Eqs. (7) to (9) in the main text

to the educational career, we then gradually add further control variables (i.e. gender, formal human capital, parental education, labour market conditions and job tenure) to the baseline specification to detect which mechanism mostly explains the role played by each type of year of schooling considered. The effects of the quality of the year of schooling on the selected outcome, either overeducation or earnings, are discussed within two theoretical frameworks: a) HCM and b) screening hypothesis, by looking at the expected sign of the variables of interest. In fact, delayed graduation reduces the risk of overeducation within the human capital model, but increases it according to the screening hypothesis (see Table 2). Accordingly, delayed graduation provides greater (smaller) returns to education if the human capital framework (screening hypothesis) holds (see Table 3). In short, within the HCM additional years of schooling, regardless of the type, should be rated positively in the labour market as spending more time in education individuals may have acquired more competences and skills. Instead, within the screening framework repeated years and graduation with delay are signal of lower skills, which penalise graduates (See Sect. 2 for additional details).

Our empirical exercise is based on a sample of graduates drawn from the ISFOL-Plus survey. Over the time span 2005–2008, we include in our estimates only the first record in which a graduate is observed working as employee. The cross-section nature of the data is a limitation as it reduces our chance to control for omitted heterogeneity in a fully satisfactory way, giving to our study the characteristics of multivariate correlation. Nevertheless, this is the only data source available in the country which provides detailed information about overeducation, educational path followed (i.e. information on delayed graduation, repeated years) along with a series of other indicators of the quality of education (e.g. grades achieved at each step of the educational path) on a representative sample of the country's population.

To sum up, this paper extends and develops the setting laid down in Groot and Oosterbeek (1994) in two main directions. Firstly, we include overeducation in the econometric testing of the human capital versus the signalling model. Secondly, we compare our econometric findings across a number of Probit and OLS specifications extended with a number of control variables, which allow us controlling for several fixed effects at the individual, regional and time level.

The rest of the paper is structured as follows. Section 2 motivates the research by showing the links of delayed graduation and overeducation. Section 3 shortly reviews the relevant literature, highlighting theoretical framework of the analysis and empirical testing. Section 4 discusses our identification strategy. Section 5 presents the main findings of the analysis. Some concluding remarks follow.

2 Motivation

The Italian education system, before the 2001 Bologna reform, which introduced a two-tier structure of the university degree (i.e. 3 year course degree—Bachelor degree—plus an optional 2 years course degree—Master degree), was characterised by a one tier system, namely Laurea degree. Within the former scheme the average curricular number of years varied between 4 and 6 depending on the field of study. Graduation was expected at the age of 23–25 years, but in standard 4-year programs, students were observed to graduate, on average, at 27.5 years. According to AlmaLaurea (2012), this tendency has not changed after the 2001 reform since the average time required to achieve a Bachelor degree is 4.5 years instead of 3 years.

Delayed graduation is a long-lasting feature in Italy. Figure 1 shows that the number of enrolled students has been growing since the early 1970s up until the late-1990s, when there was a lull. The trend restarted only after the 2001 reform. Therefore, also the number of students enrolled beyond the legal duration has increased over time.

Even the Bologna reform, meant also as a remedy against delayed graduation, only marginally increased the number of students graduating on time (Fig. 2). This result was achieved mainly via the reduction in the length of first-degree courses and by giving the opportunity to students enrolled under the old regime to switch to the new one and complete their studies with fewer exams to pass. However, only a small number of students completed their studies.

The reasons of the failure to improve the Italian university system lie in the fact that this reform did not change its specific traits, namely lack of admission tests, no constraints in enrolling in the subsequent academic years, in sitting exams and in setting a cap on the length of the degree programmes.
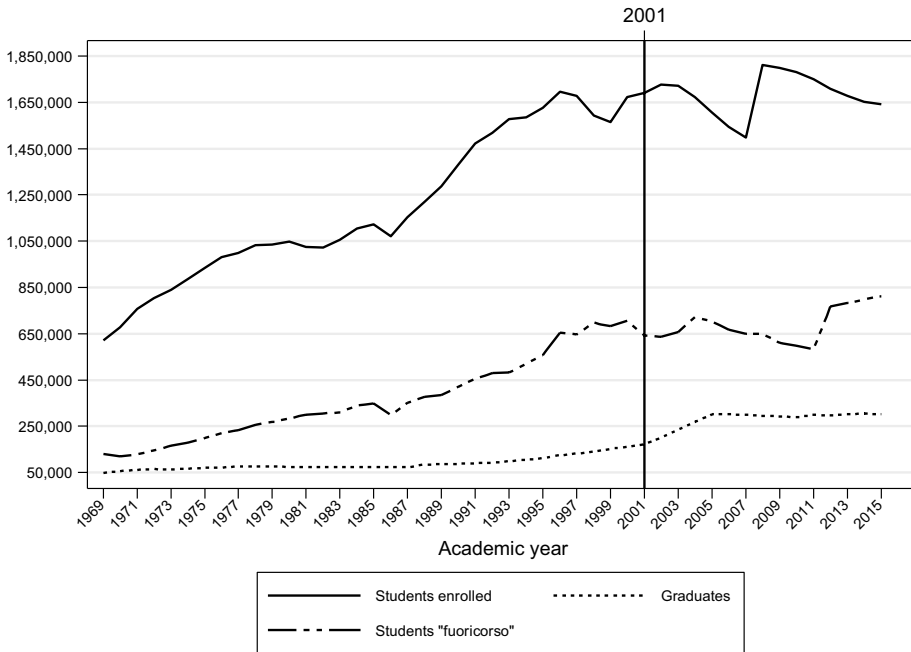
Fig. 1 Enrolled students, fuoricorso and graduates in Italy (1969–2015). Note: The vertical line highlights the year when "3+2" university reform has been introduced. *Source* Own elaboration of Istat and MIUR data (1969–2009)
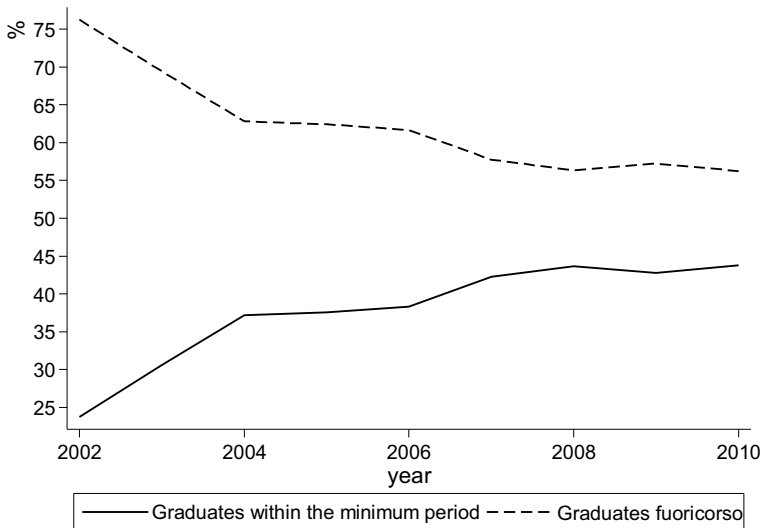

Fig. 2 Trends of graduates within the minimum period and fuoricorso (2002–2010). *Source* Own elaboration of MIUR data (2002–2010)

Despite the importance of this phenomenon, except for some recent research (Monks 1997; Becker 2006; Aina et al. 2011; Francesconi et al. 2011; Bound et al. 2012; Garibaldi et al. 2012), contributions addressing the analysis of the causes and consequences of delayed graduation are still not many, and, to the best of our knowledge, only one contribution (Ordine and Rose 2009) formally investigates the link with overeducation. The purpose of this paper is then to contribute to filling this gap.

In this empirical exercise we ask: Does delayed graduation affect overeducation and through which mechanisms? How does it influence earnings in turn? First, graduating with a delay might increase the chances of overeducation; second, it might also affect earnings either directly or through overeducation. We build on and develop the empirical framework devised in Groot and Oosterbeek (1994) by adding overeducation and controlling for several mechanisms. In their exercise they disentangle the effects of the quality of the years of schooling by exploiting the HCM and the signalling framework to discriminate between these models, Groot and Oosterbeek (1994) apply Mincerian earnings equations and divide the actual years of schooling into effective, repeated, skipped, inefficient and dropout years. Their expectations are summarised in Table 1. Repeated years should bear a wage gain or no gain in the HCM if they lead to some deeper understanding of the subject studied. They lead to a negative effect in the screening theory, since employers might perceive them as a signal of low skills. The wage effect of skipped years is the opposite of repeated years. The wage effect of inefficient years and dropout years is the same as repeated years. Inefficient routing years are those that an individual spends in a program that he/she decides to leave or to change at a later stage because it is not consistent with his/her aspirations. Dropout years are those spent in education without gaining the expected final certificate.

They essentially find confirmation of the HCM and argue that a model including controls only for the actual and effective years is statistically inferior to one where each component is clearly specified. In addition, class skipping generates a wage penalty, classfailing is wage neutral, and dropout years bear a wage premium. Within their theoretical and empirical framework, the delay in one' studies, and therefore at the university, can be rationalised as being conceptually opposite to skipped years and similar to repeated years. Repeated years will have a non-negative effect on earnings in the HCM and a negative one in the screening model.

Finally, in the HCM, delayed years may (or may not) lead to a thorough understanding of the intellectual content of the schooling program attended. If they do so, they might increase the human capital and productivity (earnings) of students. According to the screening hypothesis, instead, delayed years signal low skills (motivation and effort) to prospective employers, hence, yielding a wage penalty.

In line with this identification strategy, we provide evidence for Italy, by decomposing the educational career of graduates drawn from ISFOL-Plus data. In particular, we control for the total years spent in education and their components: legal years,[1] repeated years up to high school and years spent at university beyond the minimum period. Despite the wealth of information of our database, we can neither define "inefficient years", i.e. years spent to find the best field of study, nor "dropout years", i.e. years spent at school/university before dropping out.[2]

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[1] For the sake of clarity, we rename effective years as legal years.

[2] Even if available, this information cannot be used as our analysis focuses on graduates.

In addition, to further analysing the consequences of delayed graduation once in the labour market, besides the returns to graduation, we investigate the relationship between delayed graduation and overeducation, since both may entail poor labour market outcomes, especially we test whether the two phenomena correlate with each other and generate a cumulative effect on wages.

All in all, our modelling strategy consists, firstly, of testing the extent to which delayed graduation is positively correlated to overeducation and, secondly, whether the wage penalty associated to each of these two characteristics are related. By decomposing the schooling years obtained by each graduate in our sample, we have then the opportunity to test the human capital theory against the screening hypothesis, hence investigating whether schooling enhances or uncovers individual's productivity.

3 The State of the Art

3.1 Causes and Consequences of Delayed Graduation

Delayed graduation has recently attracted much attention (see, among others, Garibaldi et al. 2012; Gary-Bobo et al. 2016; and Witteveen and Attewell 2019 and, for a detailed survey of the literature, Aina et al. 2019).

Altonji (1993) proposed a revised version of the classical HCM to take into account the sequential (rather than simultaneous) nature of the decision to invest in education and suggests that delayed graduation is the consequence of the interaction of demand side, supply side and institutional constraints. The country's specialisation in traditional manufacturing explains the low demand for higher education, the ensuing low ex post returns to higher education and the tendency of young people to reduce their effort to attain a degree in the shortest possible time. This behaviour is called "parking lot hypothesis". Moreover, the low expected net returns to tertiary education crucially depend on the high costs of tertiary education itself, not so much university fees, but also high dropout rate, which reduces ex ante returns.

Sasha Becker (2006) sees delayed graduation within the context of a job-search theoretical model where time-to-educate matters. In this model, unemployment rates affect the choice whether continuing to study or start looking for a job: when unemployment rates are high, job search is generally less intense. However, if the unemployment rate reduces and enrolled students find a job, then they dropout of university.

In principle, it is hard to say whether the delay is increasing the human capital of university students, or not. On the one hand, delayed graduates made some progress to pass the exams they initially failed. On the other hand, it is questionable whether this process is increasing their human capital and labour market opportunities after graduation. It is hence a matter of empirical analysis to ascertain which of these two alternative outcomes prevails.

Moreover, in line with the screening hypothesis, delayed graduation might hint unobserved characteristics with a negative productivity value. Monks (1997) finds a negative correlation between age at graduation and entry-level wages, also controlling for work experience, job tenure, hours of work, ability measures and individual fixed effects. Taniguchi (2005), still for the US, estimates that the penalisation for late graduation already begins from 25 years and above. Contributions for Sweden, instead, analyse the issue of late graduation by focusing on the effect of gap years between high school and university,

as it has become common to enrol at university not immediately after high school diploma.[3] Holmlund et al. (2008) find that gap years have a significant and negative effect on earnings at ages 30 and 40, which is persistent over the work career. Similarly, for the UK, Egerton (2001) finds that, for students graduating after age of 25, 15 years are required to fully catch up.

For the Italian context, without controlling for the field of study, Aina et al. (2019) examine the association between age at tertiary graduation and labour outcomes during the first phase of graduates' working careers in Italy. Findings suggest that older age at graduation slightly reduces the probability of being employed in the private sector but does not penalise weekly wages, annual earnings, or employment/unemployment spells either in the first working year, or in the following ones. Aina and Casalone (2020), still for Italian graduates, find that once employed they are penalised in their net monthly earnings, even after 5 years of graduation.

3.2 Overeducation

Education-job mismatch has been widely analysed as it has effect in a number of labour market outcomes. Several studies contributed to identify the most relevant determinants that promote overeducation. In particular, the probability of being overeducated is explained looking at ability and institution quality measures (Robst 1995); heterogeneity of skills endowment (Chevalier 2003), workers' geographical mobility (Büchel and van Ham 2003; Jauhiainen 2011; Devillanova 2013; Croce and Ghignoni 2015). About labour market consequences, instead, significance evidence reported that overeducation is associated with labour turnover (Hersch 1991; Tsang et al. 1991), and job satisfaction (Tsang and Levin 1985; Battu et al. 2000; Di Pietro and Urwin 2006). Nevertheless, the major line of research has analysed the effects on wages. A well-established result is that graduates employed in non-graduate jobs earn less than those who are correctly matched in the labour market, but more than individuals working in an equivalent job with the level of education actually required (Duncan and Hoffman 1981; Hartog and Oosterbeek 1988; Dolton and Vignoles 2000; Hartog 2000; Rubb 2003).

Although the share of Italian graduates is low in the EU countries, evidence suggests that the proportion of overeducated workers with a university degree is significant (OECD 2016),[4] indeed because firms have strong incentives to hire university graduates rather than high school graduates (Schivardi and Torrini 2010).

In line with this evidence, using the ISFOL-Plus data, Mandrone et al. (2017) estimated that in 2014 the share of undereducated was only 5.7%, whereas that of vertical overeducated amounted to 18%. In general, wage penalty of overeducation is found to be lower in Italy than elsewhere. Caroleo and Pastore (2018) focus their analysis on jobs held 5 years after graduation among AlmaLaurea pre-reform graduates. They estimate a conditional wage penalty of about 12.2% of the median wage for overeducation and of about 6.9% for overskilling. Controlling for sample selection bias, the authors find that the wage penalty associated to overeducation/overskilling goes up to 13.6 and 7.6 percent, respectively. They

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[3] About 25% of individuals enrol at university between two to four years after high school diploma, while about 40% more than five years later (OECD, 2015).

[4] The average percentage of graduates in the age group 25-34 is 44.5% in the OECD countries and 26.8% in Italy, whereas the portion of overeducated is 16.8% and 18.2% in the OECD countries and Italy, respectively.

take this finding as supporting the human capital, the job competition and the job assignment models versus the search theoretical model, suggesting that the non-employed would be more likely overeducated/overskilled if they found a job. Finally, Ordine and Rose (2009) report that the completion of the degree on time is completely irrelevant in determining overeducation in the South of Italy while it appears to be strongly significant in the Northern area, arguing that this may reflect signalling mechanisms working differently in geographical sub-markets.

4 Empirical Strategy

We investigate, on the one hand, whether the total number of years of schooling attended is a relevant factor in explaining the risk of experiencing overeducation and of receiving a wage penalty; or, on the other hand, whether other specific individual characteristics count more.[5] In attempting to understand the role of specific aspects of the educational career, we divide the total number of years spent in education between legal duration of the degree chosen, repeated years and delayed years (i.e. years spent at university beyond the legal duration). We aim to verify whether, in line with the human capital theory, staying longer in education is rated positively in the labour market, which would prove that individuals have acquired more competences and skills and, hence, increased their productivity, regardless the quality of the years of schooling. On the contrary, if delayed years are penalised in the labour market, suggesting that firms consider this trait as a signal of lower skills, then the screening framework holds. In analytical terms, the following probit models have been estimated to study the determinants of the probability of overeducation:

$$Pr(O = 1|X) = \Phi\big(\varphi S_A + X'\beta\big) \tag{1}$$

$$Pr(O = 1|X) = \Phi\big(\gamma S_L + X'\beta\big) \tag{2}$$

$$Pr(O = 1|X) = \Phi\big(\gamma S_L + \delta S_R + \theta S_D + X\prime\beta\big) \tag{3}$$

$$Pr(O = 1|X) = \Phi\big(\gamma S_L + \delta S_R + \theta_1 S_D^{1-2} + \theta_2 S_D^{3plus} + X'\beta\big) \tag{4}$$

where O is a binary variable with outcome 1 in case of overeducation and 0 otherwise; X is a common vector of regressors including the constant term and □ is a vector of parameters; Pr denotes probability and □ is the cumulative distribution function of the standard normal distribution. We consider a number of components of the schooling variable: actual years of schooling (S_A), to mean the algebraic sum of all the type of years spent in education:

$$S_A = S_L + S_R + S_D \tag{5}$$

where S_L represents the legal duration of the educational career taken, namely the official curricular number of years that are necessary to achieve a university degree in the field of study chosen. S_R represents the number of years that an individual has repeated during his/

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[5] See Data Section in the online Appendix for further details.

her pre-university educational path. S_D represents the number of years of delay added during the undergraduate degree beyond the legal duration prescribed. In the fourth specification, S_D is collapsed in two components:

$$S_D = S_D^{1-2} + S_D^{3plus} \qquad (6)$$

where S_D^{1-2} represents a delay of up to 2 years and S_D^{3plus} represents a delay of 3 years or more. Considering that no cap is set to the overall number of years necessary to attain a degree, it is quite frequent to complete with some delay. This last specification can help to capture whether employers penalise only students with longer delay.

The expected signs associated to our coefficients of interest are summarised in Table 2. Legal years are expected to reduce the probability of overeducation in both theoretical contexts. In particular, in the HCM it happens because of the greater productivity acquired with more years of schooling, whereas according to the screening hypothesis, more years are preferred by prospective employers as a signal of superior skills.

Repeated years are expected to reduce the probability of overeducation according to the human capital model, since they increase individual's productivity. According to the screening hypothesis, instead, they should increase the probability of overeducation, since they signal lower skill endowment.

Finally, delayed years at graduation increase the probability of overeducation according to the screening hypothesis and reduce it according to the HCM. In the latter framework, delayed graduation means the possibility of students to be exposed to educational course programmes and other university activities for a longer period of time; while, according to the screening hypothesis delayed graduation signals to potential employers lower skills.

We compute the average marginal effects of each component of schooling years on the probability of overeducation without additional controls (column 1 of Table 4) and then adding variables observed at the time of graduation: gender (column 2); formal human capital (i.e. final score obtained in each educational grade, field of study grouped and whether a graduate attained a short degree course programme) (column 3); parental education (column 4); labour market conditions (column 5); and all the aforementioned variables together (column 6). Adding covariates to the baseline estimation will help us underlining which is the main mechanism that contributes to explain the role played by each component of the educational career on overeducation.

The chore specification of step two of the analysis is a standard Mincerian earnings equation, estimated by OLS and augmented of several terms to catch the effect of the overall years of schooling spent in education and of its decomposition along with the dummy variable of being overeducated:

$$Lnw = \alpha + \varphi' S_A + \omega' O + X' \beta \qquad (7)$$

$$Lnw = \alpha + \gamma' S_L + \omega' O + X' \beta \qquad (8)$$

$$Lnw = \alpha + \gamma' S_L + \delta' S_R + \theta' S_D + \omega' O + X' \beta \qquad (9)$$

where the dependent variable (Lnw) represents the natural logarithm of monthly wages net of taxes. The independent variables include different components of the actual years of schooling (S_A) as reported in Eq. (5). In each specification, we also include a dummy variable for overeducation (O).

Table 4 Probability of being (vertically) overeducated: probit model estimates. *Source*: own elaboration with ISFOL–Plus data

Variable	Average marginal effect controlling for					
	Nothing	Gender	Formal human capital	Parental education	Labour market conditions	All
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A						
Actual years	0.001	0.002	0.006	0.001	−0.001	0.003
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Panel B						
Legal years	−0.072***	−0.073***	−0.037*	−0.075***	−0.069***	−0.034**
	(0.017)	(0.017)	(0.021)	(0.017)	(0.017)	(0.024)
Panel C						
Legal years	−0.076***	−0.077***	−0.037*	−0.078***	−0.072***	−0.035**
	(0.017)	(0.017)	(0.021)	(0.017)	(0.017)	(0.021)
Repeated years	−0.028	−0.028	−0.039	−0.026	−0.020	−0.032
	(0.028)	(0.028)	(0.027)	(0.028)	(0.028)	(0.027)
Delayed years	0.018**	0.018**	0.014*	0.018**	0.014*	0.009
	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)	(0.008)
Panel D						
Legal years	−0.076***	−0.077***	−0.038*	−0.079***	−0.073***	−0.035*
	(0.017)	(0.017)	(0.021)	(0.017)	(0.017)	(0.021)
Repeated years	−0.032	−0.033	−0.042	−0.030	−0.024	−0.034
	(0.028)	(0.029)	(0.028)	(0.028)	(0.028)	(0.027)
Delayed up to 2 years	0.036	0.036	0.023	0.034	0.025	0.011
	(0.025)	(0.025)	(0.026)	(0.025)	(0.025)	(0.025)
Delayed of 3 or more years	0.142***	0.142***	0.110**	0.144***	0.114**	0.080
	(0.050)	(0.049)	(0.051)	(0.050)	(0.048)	(0.049)

Table 4 (continued)

Variable	Average marginal effect controlling for					
	Nothing	Gender	Formal human capital	Parental education	Labour market conditions	All
	(1)	(2)	(3)	(4)	(5)	(6)
N. of observations	1026	1026	1026	1026	1024°	1024°

*Significant at 10%; **significant at 5%; *** significant at 1%. Standard errors are reported in parenthesis. Reference category: (2) males, (3) fair/passing middle school grade, high school final grade between 90 and 100, university top marks, social science area, 4 to 6 years degree programme, (4) father with compulsory education or less, mother with compulsory education or less, (5) Piedmont and Valle d'Aosta regions, graduation in 1969–1971. In each specification, we also control for year of interview (ref. cat. 2005). ° The sample size is reduced because in these specifications a dummy for the timing of graduation perfectly predicts the outcome. The set of covariates included in each column is detailed in Table A1 in the online Appendix

The Huber/White/sandwich estimator of variance is used to correct for heteroscedasticity

Table 5 Mincerian earnings equation estimates (marginal effects). *Source*: own elaboration with ISFOL-Plus data

Variable	Earnings estimates controlling for						
	Nothing	Gender	Formal human capital	Parental education	Labour market conditions	Actual work experience	All
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A							
Overeducation	−0.163***	−0.158***	−0.126***	−0.163***	−0.104***	−0.098***	−0.063*
	(0.035)	(0.034)	(0.036)	(0.036)	(0.036)	(0.035)	(0.034)
Actual years	0.001	−0.009	−0.013*	−0.000	0.005	0.004	−0.010
	(0.008)	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)
Panel B							
Overeducation	−0.146***	−0.149***	−0.127***	−0.145***	−0.086**	−0.080**	−0.061*
	(0.036)	(0.034)	(0.037)	(0.036)	(0.036)	(0.035)	(0.035)
Legal years	0.070***	0.037*	0.014	0.072***	0.079***	0.073***	0.019
	(0.022)	(0.021)	(0.025)	(0.022)	(0.022)	(0.021)	(0.023)
Panel C							
Overeducation	−0.138***	−0.141***	−0.118***	−0.138***	−0.081**	−0.077**	−0.058*
	(0.036)	(0.035)	(0.037)	(0.036)	(0.037)	(0.035)	(0.035)
Legal years	0.074***	0.041*	0.016	0.076***	0.082***	0.075***	0.019
	(0.022)	(0.021)	(0.025)	(0.022)	(0.022)	(0.021)	(0.023)
Repeated years	0.063**	0.040	0.062**	0.061**	0.047*	0.028	0.017
	(0.028)	(0.027)	(0.031)	(0.028)	(0.026)	(0.028)	(0.029)
Delayed years	−0.020**	−0.022***	−0.024***	−0.021**	−0.014*	−0.012	−0.016**
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
N. of observations	1026	1026	1026	1026	1026	1026	1026

*Significant at 10%; **significant at 5%; ***significant at 1%. Figures reported in the table represent marginal effects. Standard errors are reported in parenthesis. Reference category: (2) males, (3) fair/passing middle school grade, high school final grade between 90 and 100, university top marks, social science area, 4 to 6 years degree programme, (4) father with compulsory education or less, mother with compulsory education or less, (5) Piedmont and Valle d'Aosta regions, graduation in 1969–1971. In each specification, we also control for year of interview (ref. cat. 2005). The set of covariates included in each column is detailed in Table A1 in the online Appendix

The Huber/White/sandwich estimator of variance is used to correct for heteroscedasticity

Similarly to the specifications of being overeducated, we estimate returns to education adding to the baseline specification (column 1 of Table 5) the following covariates: gender (column 2); formal human capital variables (i.e. final score obtained in each educational grade, field of study grouped and whether a graduate attained a short degree course programme) (column 3); parental education (column 4); labour market conditions (column 5); actual work experience[6] (column 6) and all the variables together (column 7).

Table 3 provides the expected signs of the coefficients of interest in the earnings Eq. (9) as based on the HCM and the signalling framework. The sign of the coefficient for actual years of schooling is hard to predict a priori, as it is the algebraic sum of coefficients of individual components. The legal years should bear a positive sign in earnings equations according to both the theoretical frameworks considered as, on the one hand, increasing the curricular number of years of education due to move from a three to a 6-year programme is likely to increase the human capital (and productivity) of individuals. On the other hand, additional years of education signal higher skills to prospective employers. Like in Groot and Oosterbeek (1994), repeated years bear a non-negative effect on earnings according to the human capital model, since they enable better understanding of the content of programs attended, but a wage penalty in the screening model, by signalling a lower skill level in individuals. In this framework, delayed years are similar to repeated years. Finally, based on a large empirical literature, overeducation is expected to determine a wage penalty in both theoretical frameworks, although for different reasons. In the HCM, the wage penalty depends on the fact that regardless of the schooling level achieved, overeducated individuals are still missing some important components of human capital, such as work-related competences, which make them less easily employed in jobs that are in line with their educational path (Leuven and Oosterbeek 2011; Cappelli 2015). In the screening model, vertical overeducation is a signal of low skill on graduate's side.

5 Results

5.1 Determinants of Overeducation

Panel A of Table 4 provides the average marginal effects with reference to Eq. (1). When looking at the probability of overeducation, the average marginal effect of the total number of years spent in education (i.e. actual years of education) is zero. This result is also confirmed when we add to this baseline specification the control variables, namely gender, formal human capital, parental education, and labour market characteristics. This evidence suggests that firms are more interested in the quality of education rather than in the years of schooling.

Panel B of Table 4 shows the estimation results of Eq. (2), in which we test the effect of the legal duration of studies without controls (column 1) and, then, gradually adding our explanatory variables (following columns). In column 1, the coefficient is negative and statistically significant. The probability of overeducation decreases by 7 percentage points for each additional year of university achieved. This result is not unexpected as a higher number of legal years is associated to a specific degree programme and field of study, hence

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[6] In this estimate we also take into account job tenure.

it is likely that this variable is catching the specific return of the choice made. Gender, parental education and labour market conditions (i.e. proxied by the timing of graduation and region of residence) do not affect the risk of overeducation once the legal duration is accounted. Conversely, formal human capital (Panel B- column 3) explains about 47% of the effect of the legal years of schooling with regard to Panel B—column 1.

Disentangling the components of the schooling years in legal duration, repeated years and delayed years (see Panel C in Table 4), the unconditional average marginal effect of the legal duration is negative and statistically significant, reducing the risk of overeducation by about 7.6% as one would expect based on the human capital and the screening models (see Table 2), while each year of delay increases this probability by 1.8% as the screening hypothesis would predict. This is in line with the finding of Ordine and Rose (2009) that graduation on time reduces the probability to experience overeducation. We find no statistically significant effect for repeated years, suggesting that in the case of people holding a university degree, employers tend to merely look at the last degree attained, not at the entire educational performance. Again, controlling for gender (Panel C—column2), parental background (Panel C—column 4) and labour market characteristics (Panel C—column 6) is irrelevant in explaining overeducation, whereas formal human capital (Panel C—column 3) affects the risk of overeducation. Overall, the formal human capital lessens the effect of legal duration and of delayed graduation by about 50%. In particular, a degree in a Scientific field decreases the risk of overeducation by about 11%. In other words, the risk of overeducation depends more on the field of study rather than the level of abilities as measured by the final mark at each educational grade. Once controlling for all the explanatory variables together, the average marginal effect of legal duration is equal to 3.5%, instead the years of delay are not statistically significant. Considering that we analyse a sample of graduates in a large cohort bracket, this latter result reveals that over time the stigma associated to delayed graduation is mediated by all the covariates together. In other words, the heterogeneity of the individuals who experience the delay might explain the probability to be overeducated beyond the delay itself. In turn, it suggests that the measures of the quality of human capital and other observed characteristics available in our data are important predictors of delayed graduation and therefore explain the penalty associated to delayed years, which, in fact, disappears.[7]

Finally, in the last specification (see Panel D in Table 4), we control for the number of years of delay by using two dummies—one up to 2 years and another one with three or more years, since existing research suggests that the effect of delayed graduation on labour market outcomes is not linear (see Aina et al. 2011). Panel D—column 1 confirms this, as for delays greater than 2 years the exposure to overeducation increases of about 14%, whereas there is no statistically significant effect for a delay of up to 2 years. This effect is not affected by controlling for gender and parental background, but by labour market conditions and formal human capital. Especially, once formal human capital is controlled for (Panel D—column 3), the average marginal effects of legal duration and delayed graduation above 2 years reduce by 50% and 22%, respectively. Finally, when we include in this specification all the controls, the average marginal effect of legal duration on the probability of overeducation is still negative but now equals to 3.5% for each additional year of schooling, whereas the negative effect of the delay again disappears.

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[7] Previous studies (e.g. Kleibrink, 2016) have found the same result for the wage penalty associated to overeducation, which disappears when controlling for measures of the skills of individuals in the sample..

To sum up, the probability of overeducation is lower for graduates in degree programmes that have a longer legal duration (i.e. graduates under the old regime or in the master's degrees under the new regime) and a small number of delayed years. The estimated results confirm the importance of decomposing the total years of schooling spent in education. Looking at separate probit estimates by set of covariates, the most important mechanism is the formal human capital, especially in terms of the field of study chosen rather than the final grade, while gender and parental background are insignificant. This is an important result as it denotes that employers pay considerable attention to graduates in Science, Technology, Engineering and Mathematics (STEM) (e.g. Ordine and Rose 2009; Franzini and Raitano 2012). Overall, estimates on effective and repeated years seem to confirm expectations based on the human capital model; instead, the evidence on delayed years, although not always statistically significant, is in line with the screening hypothesis.

5.2 Determinants of Earnings

Following the specification of (7) (see Panel A in Table 5), the total number of years spent in education is not informative, whatever the set of controls added. While the effect of overeducation—a wage penalty of about 16% (Panel A—column 1)—is in line with the existing evidence. Once controlling for gender, the wage penalty associated to overeducation reduces of about 3%, while the female dummy shows a penalty of about 29 percentage points. Parental background does not affect earnings, while the wage penalty associated to overeducation is mitigated once controlling for formal human capital, regional conditions and job tenure, decreasing of about 23%, 36% and 40%, respectively. Once all the covariates are jointly considered, the overeducation disadvantage goes down to 6.3 percentage points. Again, overeducation is a consequence of a number of specific characteristics of the overeducated.

Looking at the estimates in which we replace the actual years with the legal duration of the study (Panel B in Table 5), we notice that without additional controls the penalty for overeducation is equal to 14.60 percentage points (Panel B—column 1); adding as controls gender and parental background their effects are negligible (Panel B—columns 2 and 4). Controlling for field of study and final scores at each grade reduces the penalty by 13 percentage points (Panel B—column 3), while regional characteristics and actual work experience reduce this risk of about 41 percentage points (Panel B—column 5) and 45 percentage points (Panel B—column 6), respectively. These mechanisms are significant in explaining the returns, and the risk of overeducation is lower when an individual graduate in the Scientific fields and enters the labour market during a period with favourable economic conditions. While the premium associated to each additional year of formal education is equal to about 7 percentage points, which confirms that a larger human capital endowment increases the returns to the labour market. Once we add information on parental education (Panel B—column 4), regional characteristics (Panel B—column 5) and actual work experience (Panel B—column 6), these mechanisms seem not to affect the premium associated to each year of education acquired, whereas controlling for gender and formal human capital reduce this effect. In particular, Panel B—column 2 denotes that the dummy for females reduces of about 47 percentage points the premium for each year of schooling, suggesting that the female dummy captures their average poor labour market opportunities and their

tendency of not choosing STEM fields.[8] The positive effect associated to each additional year of schooling vanishes once formal human capital is controlled for (Panel B—column 3). Finally, including all the covariates (Panel B—column 7), overeducation decreases (i.e. 6.1 percentage points) while legal duration becomes statistically insignificant.

Estimates of Eq. (9) (see Panel C in Table 5), which provides a decomposition of the years of schooling, suggest that overeducation reduces wages of about 14 percentage points and each year of delay of about 2 percentage points, in line with the screening hypothesis. Legal years of education correlate with a premium of about 7.4 percentage points per year, while repeated years up to high school diploma confirm the expectation within the human capital framework, that is remedial years have a positive effect on wages, increasing them of about 6 percentage points per year. However, once we control for all covariates this effect disappears. Similarly, the penalty associated to overeducation is not affected by gender (Panel C—column 2) and parental education (Panel C -column 4). Controlling for formal human capital (Panel C—column 3), labour market characteristics (Panel C—column 5) and actual work experience (Panel C—column 6), instead, reduces its effect of about 14%, 41% and 45%, respectively. It means that the wage penalty of being overeducated is attenuated by the quality of schooling years, better economic conditions as well as the acquisition of job related competences. With regard to legal duration, we notice that each additional year of education is associated with higher wages of about 7.4 percentage points, and this effect is not affected by neither parental background (Panel C—column 4) nor actual work experiences (Panel C—column 6). Gender, instead, reduces this effect of about 46% (Panel C—column 2), while labour market characteristics entail an additional premium of 10% (Panel C—column 5). Conversely, once controlling for the formal human capital, this premium vanishes, suggesting that the field of study is the most relevant mechanism at play in explaining returns to education. Regarding the years of delay, in the baseline estimate, the coefficient suggests a wage penalty of 2 percentage points for each year of delay. The effect becomes slightly larger when we control for gender, formal human capital, and parental background (i.e. 10%, 16% and 5%, respectively). The wage penalty decreases when labour market conditions are accounted (Panel C—column 5), but disappears once tenure (Panel C—column 6) is considered. Panel C—Column 7 confirms for delayed years, once all covariates are considered, a wage penalty of 1.6 percentage points.

To sum up, Mincerian equation estimates suggest that it is important to disentangle the characteristics of the total years of schooling. According to the existing literature, a graduate with a job not in line with the university degree achieved and with graduation not on time faces a wage penalty, while the effect is attenuated if the legal length of the degree chosen is longer. However, controlling for several mechanisms, the penalty associated to these specific individual traits is lower if the field of study chosen is in STEM subjects or the labour market conditions at the time of graduation were favourable. The negative sign associated to delayed graduation confirms the screening hypothesis framework.

Due to the characteristics of our dataset, a repeated cross-section with a relatively small number of relevant observations (graduates) and the nature of some of our core

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[8] According to OECD statistics (2016), women are still under-represented in STEM fields and over-represented in certain fields such as education and health. On average, in 2014, there were three times more men than women who graduated with a degree in engineering; and four times more women than men who graduated with a degree in the field of education.

Table 6 Heckman's estimates on overeducation and returns to education. *Source*: own elaboration with ISFOL-Plus data

Variable	Average marginal effect of the probability of being overeducated	
	Probit	Heckprobit
Legal years	− 0.035**	− 0.029
	(0.021)	(0.022)
Repeated years	− 0.032	− 0.037
	(0.027)	(0.024)
Delayed years	0.009	0.004
	(0.008)	(0.008)
Wald test of Independent equations		0.39
	Earnings estimates	
	OLS	Heckit
Overeducation	− 0.058*	− 0.071*
	(0.035)	(0.036)
Legal years	0.019	0.010
	(0.023)	(0.023)
Repeated years	0.017	0.035
	(0.029)	(0.034)
Delayed years	− 0.016**	− 0.006
	(0.008)	(0.010)
Wald test of Independent equations		2.84*
N. of observations	1026	1430

The probit estimate reproduces Table 4, Panel C, Column 6, while the OLS reproduces Table 5, Panel C, Column 7. The estimates include the same set of explanatory variables as in the Tables 4 and 5, except for the selection equation which includes also the instrumental variables. These variables have been omitted from the table for shortness' sake. The Heckit includes dummies for the year of graduation covering 4 years, instead of 3, to allow convergence of the ML estimate

*Significant at 10%; **significant at 5%; *** significant at 1%. Standard errors are reported in parenthesis

variables (i.e. educational career is a time-invariant variable), to control for possible omitted heterogeneity of the non-employed, we implement the Heckman selection model, namely the Heckprobit for the overeducation estimates and the Heckit model for the earnings equation (see Heckman 1976, 1979). Omitted estimates confirm that our analysis is robust to the hypothesis of omitted heterogeneity of the graduates who are employed (see Table 6).

6 Concluding Remarks

This paper builds on the statistical test devised in Groot and Oosterbeek (1994) to discriminate between human capital and signalling model by looking at the effect of different indicators of human capital on earnings, by adding analysis of the effect of delayed graduation

both on earnings and on the risk of overeducation, which are aspects not considered in their contribution.

We use slightly different measures of the quality of human capital from Groot and Oosterbeek (1994), namely actual, legal and repeated years, since we focus on graduates. We assume that attendance of more years of schooling, regardless of their quality, increases human capital if the effect of more years (actual, legal, repeated and delayed) is reducing the risk of overeducation and increasing wages; vice versa, the screening hypothesis is confirmed if shorter degrees, and larger repeated and delayed years increase the risk of overeducation and lower wages. The analysis is carried out using the ISFOL-Plus data, specifically a pool of graduates observed for the first time as employees in three separate samples (2005, 2006 and 2008). In our estimates, we find support for the HCM for legal and repeated years, but in favour of the screening hypothesis in case of delayed years. The latter are perceived by prospective employers as a sign of lower skills.

We also consider the possibility that some underlying individual characteristics and/or local labour market conditions where graduates were searching for a job may partly explain both the effects on overeducation and on wages due to endogeneity bias. We resort to use different fixed effects to catch the role of gender, formal human capital, parental background, and local labour market conditions at the time of graduation in increasing the risk of overeducation. When controlling for all these mechanisms together, the coefficient of legal years is still statistically significant, while the coefficient of delayed years is not anymore, suggesting that delay might be a proxy conveying a number of information regarding the specific characteristics of individuals and the market where graduates search for a job. Nevertheless, the dummy for a long delay is still statistically significant.

Mincerian earnings equations suggest that, with reference to legal years, the most important mechanism is formal human capital, while the wage gap associated to overeducation is lower if a graduate enters the labour market in favourable economic conditions. With reference to delayed graduation, the penalty is not statistically significant once job tenure is taken into account. In the full specification, penalisation for each year of delay, and overeducation persists.

Overall, our analysis prefigures new tests for the human capital versus screening hypothesis in the case of delayed graduation. Delayed graduation is a consequence of individual, institutional and labour market characteristics, except for the case when the delay is very long, in which case, it is actually contributing to increase the chance of overeducation and reducing wages, therefore signalling a low skill level, which is not caught by other observable and unobservable sources of heterogeneity.

Future research should deepen the consequences of delayed graduation on several labour market outcomes, including overeducation. The model by Ordine and Rose (2009) is an important reference in this direction, while availability of new longitudinal data banks with the same wealth of information as the ISFOL Plus data bank, but with more observations, should allow further developing treatment of endogeneity issues.

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