Is there still a wage penalty for being overeducated but well-matched in skills? A panel data analysis of a Swiss graduate cohort

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Abstract

Using two periods' panel data from the Swiss Graduate Survey, this study examines the incidence and wage effects of overeducation. Contrary to most prior research, we account for graduate heterogeneity in perceived skills mismatch when measuring overeducation and correct for potential omitted ability bias in the estimated pay penalty associated with overeducation. We find that graduates who are overeducated and mismatched in skills (i.e. genuinely overeducated) are the most penalized in terms of earnings. This evidence is still valid when using the fixed effects approach, while the pay penalty is no more significant for graduates who are overeducated but matched in skills (i.e. apparently overeducated). This indicates that the wage effects for apparently overeducated graduates are mainly due to the omission of unobserved ability.

Keywords: Overeducation, skills mismatch, wages, panel data analysis

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1 Introduction

As in most European countries, participation in higher academic education has increased significantly in Switzerland since the 1990s.[1] According to the Swiss Federal Statistical Office (SFSO), the increase rate reaches almost 50% between 1990 and 2009.[2] Moreover, the association of the *Swiss Academies of Arts and Sciences*[3] claimed in a report that two thirds of the youth in Switzerland should get a degree from a tertiary education institution by the year 2030 (Zimmerli et al., 2009). This stand follows in part from the fact that selected professional fields are experiencing a shortage of qualified labour. In parallel, a significant share of the graduate labour force has more education than is actually required for their jobs and are referred to as overeducated:[4] four or five years after graduation, the incidence of overeducation is ranging between 5% and 20% among university graduates (Storni et al., 2008). Thus, the fostered expansion of graduates may appear meaningless given the existing evidence of overeducation. In this study, we argue that basic measurement methods to defining educational mismatch in the labour market are prone to imprecision since overeducated workers may have lower skill levels and overeducation does therefore not necessarily imply skills mismatch. As pointed out by Chevalier (2003), most prior studies have measured educational mismatch as the difference between workers' actual education and required education for their job, ignoring that workers with a given level of schooling are heterogeneous in skills. We address this measurement issue by proposing an alternative method that incorporates both the educational and skill requirements of the job into an improved measure of educational

[1] Higher academic education institutions include cantonal universities and federal institutes of technology. There are ten cantonal universities and two federal institutes of technology. The ten cantonal universities are in Basel, Bern, Fribourg, Geneva, Lausanne, Lucerne, Lugano, Neuchâtel, St. Gallen and Zurich; the two federal institutes of technology are in Lausanne (EPFL) and in Zurich (ETHZ).

[2] A wide range of statistics covering education in Switzerland are available at the SFSO website (http://www.bfs.admin.ch/bfs/portal/en/index/themen/15.html).

[3] The Swiss Academies of Arts and Sciences are the association of the four Swiss academies of sciences. Their co-operation focuses primarily on the following three fields of competence: foresight, ethics and the dialog between science and society. More details on this association can be found at http://www.swiss-academies.ch.

[4] In the literature, there exist different corresponding terms such as overschooled or overqualified.

mismatch.

The overeducation literature tends to support the view that surplus schooling is a costly phenomenon, in particular for workers. Indeed, overeducation is generally found to be associated with a notable pay penalty relative to those adequately educated with the same level of schooling (for reviews, see McGuinness, 2006; Leuven and Oosterbeek, 2011). However, most existing studies have relied on cross-sectional evidence when estimating the wage effects of overeducation and, therefore, have neglected that overeducation may be correlated with unobserved ability.[5] A growing number of studies have indicated that the omission of unobserved ability overstates the pay penalty for being overeducated (e.g. Bauer, 2002; Chevalier, 2003; Frenette, 2004; Verhaest and Omey, 2009; Lindley and McIntosh, 2010; Mavromaras et al., 2010). However, almost none of these studies have attempted to better account for worker heterogeneity when measuring educational mismatch; exceptions are Chevalier (2003) and Mavromaras et al. (2010). The former proposes an alternative measure based on objective overeducation and job satisfaction. Objective overeducation is derived from the *job analysis* method that allows to define graduate and non-graduate occupations on the basis of an occupational classification (equivalent to the United States Dictionary of Occupational Titles).[6] Overeducation is then either *apparent* or *genuine*, according to whether overeducated workers are satisfied or not with the match between their education and their job. Analysing the determinants of overeducation and its impact on wages in the UK graduate labour market, he controls for unobserved ability through the inclusion of a proxy in cross-sectional analyses.[7] Nevertheless, we note two possible points for improvement in his contribution: first, the satisfaction measure is likely to

[5]In econometrics, unobservables are generally called the *unobserved heterogeneity* (describing productivity, ability, motivation and other unobserved characteristics). Instead we use the term 'unobserved ability' as in the overeducation literature. In this study, the term 'heterogeneity' is rather devoted to addressing the implicit assumption of worker homogeneity in basic measurement methods of educational mismatch.

[6]Further information on the the US Dictionary of Occupational Titles is available at http://www.oalj.dol.gov/libdot.htm.

[7]Chevalier (2003) has constructed a measure of unobserved ability using the OLS residual from a first-job earnings equation which correponds to the deviation between the expected and observed earnings in the first job.

be endogenous, as it may actually reflect other factors than the quality of the match;[8] second, by definition, a proxy do not cover a complete range of potentially unobservable attributes. The other contribution by Mavromaras et al. (2010) presents a different measure constructed from statistical overeducation and subjective overskilling. Statistical overeducation is measured as the difference between the education attainted by the worker and the modal education attained in the worker's occupation. Unlike Chevalier (2003), they base the decomposition of overeducation on an explicit indicator capturing underutilization of skills, rather than indirectly via a satisfaction measure. In addition, they use the fixed effects method in order to control for unobserved ability when studying the effect of job mismatch on various labour market outcomes for Australian university graduates. As their statistical measure of overeducation is computed from the whole labour force, we suspect however that their overeducation variable is subject to measurement error due to cohort effects.[9] In contrast, we rely on subjective measures of overeducation and skills mismatch, both available in a longitudinal survey of Swiss graduates conducted one and five years after graduation in 2002. We postulate that overeducated graduates with suitable skills for their job are apparently overeducated, whilst those with unsuitable skills are genuinely overeducated. The same applies to adequately educated graduates: the match is apparent if their skills do not correspond to the job, otherwise it is genuine.

Our contribution to the overeducation literature is that we account for graduate heterogeneity in perceived skills mismatch when measuring overeducation and correct for potential omitted ability bias in the estimated pay penalty associated with overeducation. As in Mavromaras et al. (2010), we use the longitudinal nature of our survey data for the purpose of taking into account unobserved ability. We replicate estimates from existing studies,

[8] As pointed out by Robst (2008), job satisfaction may be a function of earnings. The fact that low earnings can increase workers' dissatisfaction may in part explain Chevalier's result that the pay penalty associated with overeducation is larger when overeducated workers indicate low levels of satisfaction with their job.

[9] As pointed out by Verhaest and Omey (2006), the statistical method of measuring educational mismatch neglects skill acquisition through experience and on-the-job training. Accordingly, the required level of education tends to be underestimated, especially if the statistical measure is calculated on the basis of the whole labour force (composed of workers with different career histories).

based on an extended specification of the Mincer wage equation with a single dummy for graduate overeducation. Our estimates are consistent with earlier findings: the pooled OLS estimates show that overeducation has a significant negative impact on earnings, while the penalty for being overeducated is still significant but substantially reduced with the fixed effects method. We then consider another version of the wage equation that incorporates our alternative measure of educational mismatch. When fixed unobserved ability is controlled for, overeducated graduates with suitable skills for their job (i.e. those apparently overeducated) earn the same return on their education as adequately educated graduates, *ceteris paribus*. It means that apparently overeducated graduates have low values of other unobserved aspects of human capital and are then less able compared to adequately educated graduates.

The rest of the paper is structured as follows. The first part of Section 2 presents the panel data from the Swiss Graduate Survey; the second part provides an alternative method to measuring educational mismatch, while the third part describes the econometric models and the estimation strategies employed in the empirical analysis. The first and second parts of Section 3 show respectively the incidence of educational mismatch and the estimation results. Section 4 summarizes the descriptive and analytical results.

2 Data and empirical methodology

This section begins with an overview of the latest data derived from the Swiss Graduate Survey. Then, we propose an alternative measure of educational mismatch that allows to identify whether overeducated graduates have suitable or unsuitable skills for their job. Finally, we consider two regression specifications and different panel data methods to estimate the wage effects of educational mismatch.

2.1 Data source

For the empirical analysis, we rely upon the data from the Swiss Graduate Survey performed by the SFSO among the cohort graduated in the year 2002. The survey's main focus is the employment situation of graduates from higher academic and higher vocational education in Switzerland, one and five years

after graduation. In the first-wave survey, all graduates having successfully completed a degree in a recognised Swiss institution of higher education are asked to complete a questionnaire one year after graduation. Only graduates who participated in the first-wave survey are asked to take part in a second-wave survey four years later (i.e. five years after graduation). The questionnaire covers a standard set of variables capturing individual, educational and job characteristics.[10] In this study, we use a balanced panel of 4,510 individuals graduated in the year 2002 in a cantonal university or a Federal Institute of Technology (including 538 PhD graduates), this cohort having been surveyed a first time in 2003 and a second time in 2007. Moreover, we only keep graduates with a *Licence* or *Diploma* degree, working at the time of both surveys as salaried employees and reporting valid information for the variables of interest.[11] The final sample resulting from this selection reaches a size of 1,370 graduates, which amounts to 2,740 observations given the balanced nature of our panel.

2.2 Measuring educational mismatch

The first step for defining educationally mismatched graduates in the labour market consists in identifying those overeducated. In our case, the most convenient way comes down to derive overeducation from the *graduate's self-assessment of educational requirement* directly available in the questionnaire. The other existing methods for measuring overeducation are indeed difficult to be implemented on the basis of our data: while the *job analysis* method is actually unavailable for Switzerland, the *realized matches* method is generally computed from the whole labour force.[12] As noted by Chevalier (2003), the

[10]The response rates (referring to the ratio between the respondent sample and the surveyed population) at the first and second interviews are 56% and 38%, respectively. Further details on the sampling methodology and questionnaires are available at the SFSO website.

[11]Hereafter, the effect of sample selection is neglected. The detailed procedure of the sample selection is described in Table 5 of the appendix, while Table 6 shows the descriptive results computed from the entire sample (only university graduates without a PhD) and the selected sample. Interestingly, most of the mean values obtained from the selected sample do not appear to be different from those calculated on the basis of the entire sample.

[12]For a complete overview regarding each measurement method, see Hartog (2000).

subjective method has the advantage of adjusting the measure of overeducation to the specific requirements of the job, while the objective and statistical methods assume that all jobs within a given occupation have the same requirements. In our data, overeducation is subjectively defined by means of the following question asked at each wave 'Was a degree required by your current employer for your main job?' with two possible answers: (1) yes or (2) no. While the affirmative answer refers to the case of adequate education, the negative one reflects situations of overeducation.

Only relying on the aforementioned measure amounts to naively assume that overeducated graduates are homogeneous in terms of skills. We reject this assumption by adopting an improved concept of educational mismatch based on the subjective measure of overeducation that incorporates the *graduate's self-assessment of skills matching*. To some extent, it amounts to account for worker heterogeneity in terms of perceived skill utilization as in Green and Zhu (2010) and Mavromaras et al. (2010). Respondents were asked at the first wave 'Do you think that your job corresponds to your education in terms of *specialized skills*?' and at the second wave 'Do you think that your job corresponds to your education in terms of *skills profile of the job*' on a 1 to 5 scale, where 1 is 'not at all' and 5 is 'to a large extent'. Graduates are considered to have inadequate skills for their job if they responded 1 or 2, whereas their skills are adequate in other cases.

The subjective measure of skills matching is used for identifying whether skills among overeducated graduates do or do not correspond to the job. It also serves to distinguish adequately educated graduates that are matched in skills from those being mismatched in skills. Accordingly, it allows to determine if the self-reported states of adequate education and overeducation are either genuine or apparent.[13] Overeducated graduates that assess their skills as unsuitable (resp. suitable) for the job are defined as genuinely (resp. apparently) overeducated. Identically, adequately educated graduates that assess their skills as unsuitable are defined as apparently matched, the remainder of this group being genuinely matched. Table 1 summarizes how the subjective measure of educational mismatch is disaggregated into four

[13]Instead of utilizing the 'formal/real' duality as in Green and Zhu (2010), we rely on the corresponding 'apparent/genuine' duality introduced by Chevalier (2003).

possible categories.[14]

Table 1: Alternative measure of educational mismatch

	Matching status between job and education	
	Genuine	Apparent
Adequately educated		
▷ suitable skills	×	
▷ unsuitable skills		×
Overeducated		
▷ suitable skills		×
▷ unsuitable skills	×	

2.3 Wage effects of educational mismatch

For estimating the impact of overeducation on earnings, we use an extended version of the **Mincer wage equation** often used in the literature on overeducation in the graduate labour market (e.g. Dolton and Vignoles, 2000; Chevalier, 2003; Frenette, 2004; McGuinness and Bennett, 2007; Dolton and Silles, 2008; Green and Zhu, 2010):

$$\ln w_{it} = \alpha_o O_{it} + \beta_1 X_{it} + \beta_2 X_{it}^2 + E_{it}\delta + \epsilon_{it} \tag{1}$$

where w_{it} corresponds to gross hourly earnings for individual i at wave t, O_{it} is a dummy for self-assessed overeducation, X_{it} the potential work experience in month since graduation[15] and E_{it} a vector of personal characteristics

[14]Green and Zhu (2010) consider also four types of matching status: 'matched' (i.e. adequate qualification and skills fully utilized), 'qualification matched and skills underutilized', 'formal overqualification' (i.e. overqualification and skills fully utilized) and 'real overqualification' (i.e. overqualification and skills underutilized). Mavromaras et al. (2010) employ a comparable typology: 'well-matched' (i.e. matched in both education and skills), 'only overskilled', 'only overeducated' and 'overeducated and overskilled'.

[15]Potential work experience is equal to the difference between the date of respective wave and the date of the first job after graduation. Actual work experience is also available, as it can be calculated from the graduate's career history; however, the exclusion of graduates with incomplete career history generates too many missing observations (at least 20% of our final sample in Table 5).

fixed at graduation including the type of higher academic institution, actual length of study, average grade at graduation, non study-related work experience acquired during studies, study-related work experience acquired during studies, gender and foreign nationality. This specification with a single dummy for graduate overeducation is actually a special case of the one proposed by Verdugo and Verdugo (1989) which includes both dummies for being over- or undereducated. According to equation 1, overeducated graduates are compared to graduates who are adequately educated. Dolton and Vignoles (2000) proposed a formal test of the **human capital theory** in the context of the graduate labour market, stating that the job's educational requirements do not matter in the wage determination process. In other words, overeducated graduates should earn the same return on their education as graduates who are adequately educated, *ceteris paribus*: $\alpha_o = 0$. If, however, wages are determined by the job's educational requirement, the returns to excess schooling would tend to zero and, thus, overeducated graduates would earn less than adequately educated graduates: $\alpha_o < 0$. As in most earlier studies dealing with educational mismatch among the whole labour force (for general surveys of this literature, see McGuinness, 2006; Leuven and Oosterbeek, 2011), Dolton and Vignoles (2000) reject the human capital hypothesis, in particular overeducated workers suffer from a pay penalty compared to those comparably educated who are adequately educated.

If the assumption that overeducation is uncorrelated with unobserved ability does not hold, cross-sectional estimation of equation 1 by OLS would be subject to the problem of **omitted variable bias** since overeducation would be correlated with the error term. Accordingly, we modify the error term ϵ_{it} in the wage equation in order to include unobserved ability c_i:

$$\epsilon_{it} = c_i + u_{it}$$

where u_{it} are the i.i.d. errors. Given the longitudinal aspect of our data, a fixed effects (FE) analysis seems appropriate;[16] indeed, it allows for c_i to be arbitrarily correlated with the explanatory variables since its main

[16]Another method to address the problem of omitted variable bias is the use of instrumental variables (IV). As pointed by Leuven and Oosterbeek (2011), it is however very difficult to apply this method, in particular to find convincing instruments for educational mismatch. The study by Korpi and Tåhlin (2009) is among the few studies that attempt to

assumption is strict exogeneity of the covariates conditional on c_i:

$$\mathbb{E}[u_{it}|O_{i1},...,O_{iT},X_{i1},...,X_{iT},X_{i1}^2,...,X_{iT}^2,E_{i1},...,E_{iT},c_i]=0$$

for $t=1,...,T$. If overducation O_{it} and unobserved ability c_i are negatively correlated, then the cross-sectional estimate of α_o is upward biased. Controlling for unobserved ability should therefore reduce the estimated wage penalty associated with graduate overeducation: $\alpha_o^{\text{OLS}} < \alpha_o^{\text{FE}} \leq 0$. Few papers have controlled for unobserved ability when estimating equation 1 (Frenette, 2004) or the Verdugo and Verdugo's specification (including dummies for being over- or undereducated) on the basis of the whole labour force (Bauer, 2002).[17] Using the fixed effects method to account for unobserved ability, Bauer (2002) and Frenette (2004) have shown that overeducation has little if any impact on earnings.[18]

Other studies have estimated another version of equation 1 where the single dummy for overeducation is replaced by a vector of dummies including different types of mismatch (see, e.g., Chevalier, 2003; Green and Zhu, 2010; Mavromaras et al., 2010). To some extent, we rely on a similar equation that incorporates our alternative measure of educational mismatch:

$$\ln w_{it}=\alpha_{am}AM_{it}+\alpha_{ao}AO_{it}+\alpha_{go}GO_{it}+\beta_1X_{it}+\beta_2X_{it}^2+E_{it}\delta+\epsilon_{it} \quad (2)$$

where AM_{it} is a dummy for apparent match (i.e. adequate education with unsuitable skills), AO_{it} dummy for apparent overeducation (i.e. overeducation

estimate the returns to over- and undereducation using the instrumental variables method; while their IV results give support to the job competition model (i.e. wages are entirely determined by required education), the use of weak instruments is likely to cast doubt on the robustess of their estimates.

[17]Other studies have controlled for unobserved ability when estimating returns to educational mismatch. Korpi and Tåhlin (2009) have relied on the ORU (Over-, Required and Undereducation) equation introduced by Duncan and Hoffman (1981); this specification corresponds to the Mincer wage equation where actual years of education are decomposed into years of required education, years of overeducation and years of undereducation. See also working papers by Verhaest and Omey (2009) and Lindley and McIntosh (2010) that have relied on modified versions of the ORU specification.

[18]Using fixed effects, Korpi and Tåhlin (2009) have found that the return to overeducation decreases but still remains smaller than the return to required education. Verhaest and Omey (2009) and Lindley and McIntosh (2010) have shown that the estimates of the overeducation penalty are lower for the fixed effects model than the random effects or pooled OLS models, but they do not disappear.

with suitable skills) and GO_{it} dummy for genuine overeducation (i.e. overeducation with unsuitable skills). Apparently matched, apparently overeducated and genuinely overeducated graduates are thus compared to graduates who are genuinely matched (i.e. adequately educated with suitable skills). Given that apparently overeducated graduates work in jobs commensurate with their skills, they should face a more moderate penalty than those mismatched in both education and skills (i.e. genuinely overeducated) who are unable to fully utilize the human capital acquired in university: $\alpha_{go} < \alpha_{ao} < 0$.[19] This argument is consistent with findings from Chevalier (2003), Green and Zhu (2010) and Mavromaras et al. (2010), who have shown that apparently overeducated graduates suffer from a lower pay penalty compared to those genuinely overeducated.[20]

What would happen if we estimate equation 2 after controlling for unobserved ability? We argue that apparently overeducated graduates are less able compared to those adequately matched, since they are in non-graduates jobs but their skills correspond to the job. Accordingly, their pay penalty should tend to disappear when controlling for unobserved ability: $\alpha_{ao}^{\text{OLS}} < \alpha_{ao}^{\text{FE}} \leq 0$.[21] Few studies that propose an alternative measure of educational mismatch also control for unobserved ability when estimating the wage equation. Among them are the studies of Chevalier (2003) and Mavromaras et al. (2010). Including a proxy of unobserved ability in a cross-sectional regression, Chevalier (2003) have reached the conclusion that the wage effects to apparent and genuine overeducation remain significant even if they are both reduced by a small fraction. Using a representative sample of the whole graduate labour force (as opposed to our sample which is representative of a specific cohort of graduates making their transition from university to work), Mavromaras et al. (2010) have, in contrast, not found a significant pay penalty for men who are matched in skills but overeducated (i.e. appar-

[19]The same reasoning applies to apparently matched graduates, i.e. $\alpha_{go} < \alpha_{am} < 0$, since they work in jobs commensurate with their education.

[20]Green and Zhu (2010) and Mavromaras et al. (2010) have also indicated that gradutes who are matched in education but overskilled (i.e. apparently matched) experience lower pay penalties than those overeducated and overskilled at the same time (i.e. genuinely overeducated).

[21]This argument also works for apparently matched graduates, i.e. $\alpha_{am}^{\text{OLS}} < \alpha_{am}^{\text{FE}} \leq 0$.

ently overeducated) or matched in education but overskilled (i.e. apparently matched) after controlling for unobserved ability in fixed effects analysis.

In the empirical analysis, we test different hypotheses about the impacts of educational mismatch on earnings that crucially depend on the assumption about the correlation between overeducation and unobserved ability.

Hypothesis 1: The pay penalty associated with self-assessed overeducation is significantly positive when unobserved ability is omitted.

Hypothesis 2: When self-assessed overeducation is decomposed according to whether skills do or do not correspond to the job, the pay penalty associated with apparent overeducation is lower compared to the pay penalty associated with genuine overeducation.

Hypothesis 3: The pay penalty associated with self-assessed overeducation is reduced (even non-significant) when unobserved ability is controlled for.

Hypothesis 4: The pay penalty associated with apparent overeducation is reduced (even non-significant) when unobserved ability is controlled for.

All the tested hypotheses are reformulated in Table 2 according to which estimation strategy is employed (OLS vs FE) and whether the wage equation includes a single dummy for overeducation or a vector of dummies including different types of educational mismatch.

Table 2: Summary of the tested hypotheses

	Wage equation	
	(1)	(2)
Estimation strategy		
Ordinary Least Squares	**Hypothesis 1** $\alpha_o < 0$	**Hypothesis 2** $\alpha_{go} < \alpha_{ao} < 0$
Fixed Effects	**Hypothesis 3** $\alpha_o^{\text{OLS}} < \alpha_o^{\text{FE}} \leq 0$	**Hypothesis 4** $\alpha_{ao}^{\text{OLS}} < \alpha_{ao}^{\text{FE}} \leq 0$

Equations 1 and 2 are estimated using different econometric techniques: [i] the Pooled Ordinary Least Squares with robust standard errors; [ii] the Random and Fixed Effects, where $\epsilon_{it} = c_i + u_{it}$ and $t = 1, 2$. The fixed effects approach will only identify the wage effects of educational mismatch from information on graduates who change their matching status. This is a very attractive feature in our case since identification does not need to rely on individual variation in the level of education.[22] The dependent variable is the natural logarithm of gross hourly earnings in the respondent's current job.[23] Pooled ordinary least squares and random effects regression models include all the time-invariant and time-varying covariates and a dummy for the second year of interview. When estimating previous equations with the fixed effects procedure, only the time-varying controls are introduced (i.e. potential work experience since graduation and potential work experience since graduation squared).[24] All the explanatory variables are presented in Table 7, while descriptive sample statistics are presented in the second column of Table 6 and in Table 8 (see the appendix).

[22]Individual variation in the level of education is generally required for identifying the fixed effects estimates of the returns to over/required/underschooling from the ORU specification; otherwise, individual variation in years of over/required/underschooling is characterized by perfect multicollinearity for persons with constant actual schooling (since actual years of schooling are decomposed into years of required schooling, years of overschooling and years of underschooling).

[23]We derive gross hourly earnings (deflated into 2000 Swiss francs) by dividing the reported gross annual wage by the reported number of contractual hours worked per week, multiplied by 13 (months) and 4.3 (weeks). Note that the calculated gross hourly wage is likely to contain measurement error since the respondent may not work the entire year. Measurement error in the dependent variable can cause biases in cross-sectional and panel estimations if it is correlated with one or more of the explanatory variables. In order to obtain unbiased estimators, all estimation results reported below have also been performed on the basis of a sample of graduates working full-time at each interview wave. This procedure reduces the sample to 868 gradutes observed in each panel wave (i.e. 1,736 observations). The main findings of the empirical analysis do not change when graduates working part-time are excluded from the sample. The estimation results when excluding graduates working part-time are presented in Table 12 (see the appendix).

[24]The dummy for the year of second interview and the potential experience variable are nearly perfectly linearly related, so the year dummy is excluded.

3 Results

This section includes the results regarding the incidence and wage effects of educational mismatch in the Swiss labour market, where the mismatch variable either corresponds to self-reported overeducation (basic measurement method) or is derived from a combination of self-reported overeducation and perceived skill mismatch (alternative measurement method).

3.1 Incidence of educational mismatch

Table 3 presents the incidence of educational mismatch one and five years after graduation. It also gives information about the changes occurring in the matching status between both interviews.

According to the basic measure, a minority of graduates are overeducated and their share reaches 16% in 2003. This proportion has significantly decreased four years later: at least one out of ten graduates are overeducated in 2007. It appears that these proportions are generally below those computed in other studies of graduate overeducation: Frenette (2004) found that at least 30% of Canadian graduates are overeducated; Green and Zhu (2010) provided rates of overeducation ranging between 23% and 33% among UK graduates; rates presented by Mavromaras et al. (2010) for Australian graduates are ranging between 14% and 23%. Finally, it is worth noting that 40% of overeducated graduates in 2003 are still overeducated in 2007 (i.e. 6% of all the graduates in our sample); in other words, a change from overeducation to adequate education is observed for a large share of graduates (about 60% of those overeducated in 2003).[25]

When overeducated graduates are disaggregated depending on perceived skills mismatch, it turns out that half of them are in a situation of genuine overeducation one year after graduation. Only three out of ten overeducated graduates are in such a situation four years later. Indeed, the share of genuinely overeducated graduates is significantly reduced between the first and the second interviews. Among the whole graduate population in our sample, it corresponds to a proportion of 8% in 2003 decreasing up to 3%

[25]For more details on the transition process from overeducation to adequation education and *vice versa*, see Tables 9 and 10 of the appendix.

in 2007. The low proportion of genuinely overeducated graduates is in line with the fact that there is a shortage of qualified labour in Switzerland (Huth, 2004; Schellenbauer et al., 2010). Interestingly, these proportions of genuinely overeducated graduates are comparable to those found in the UK (Chevalier, 2003; Green and Zhu, 2010) and Australia (Mavromaras et al., 2010). While there is no significant change in the incidence of apparent match or apparent overeducation between 2003 and 2007, we observe a large amount of variation within each group of mismatched graduates during this lapse of time.[26] For instance, 86% of genuinely overeducated graduates in 2003 moved into another matching category in 2007; this means that genuine overeducation is a permanent state for very few graduates (i.e. only 1.2% of all the graduates in our sample). The substantial variation in each mismatch status is some good news for the identification of the wage effects associated with educational mismatch in the fixed effects model.

Table 3: Incidence and changes of educational mismatch (col. proportions)

	Year of interview		Changes in
	2003	2007	matching status
Basic measure			
Overeducated	0.158	0.109**	0.597
	(0.366)	(0.311)	
Alternative measure			
Apparently matched	0.084	0.076	0.817
	(0.277)	(0.265)	
Apparently overeducated	0.077	0.078	0.667
	(0.266)	(0.268)	
Genuinely overeducated	0.081	0.031**	0.856
	(0.273)	(0.172)	
Observations	1,370	1,370	

Source: Swiss Graduate Survey 2002, data are unweighted.

Notes: Standard deviation in parentheses; test for a significant difference in proportions across both samples (** $p<0.05$, * $p<0.10$).

[26]Table 11 of the appendix provides with precision the transition process from one matching category to another.

Table 4: Wage effects of educational mismatch: Panel results

	POLS	FE	RE
Wage equation (1)			
Overeducated	-0.109**	-0.048**	-0.094**
	(0.017)	(0.020)	(0.014)
Observations	2,740	2,740	2,740
Number of i	1,370	1,370	1,370
Adjusted R^2	0.204		
Overall R^2		0.153	0.209
Hausman test			17.67**
Wage equation (2)			
Apparently matched	-0.052**	-0.008	-0.039**
	(0.016)	(0.021)	(0.016)
Apparently overeducated	-0.083**	-0.019	-0.068**
	(0.022)	(0.024)	(0.017)
Genuinely overeducated	-0.158**	-0.087**	-0.140**
	(0.024)	(0.026)	(0.020)
H_{01}: $\alpha^{GO} = \alpha^{AM}$	17.89**	6.43**	17.59**
H_{02}: $\alpha^{GO} = \alpha^{AO}$	8.59**	5.16**	8.90**
H_{03}: $\alpha^{AM} = \alpha^{AO}$	1.91	0.14	1.72
H_{04}: $\alpha^{AM} = \alpha^{AO} = 0$	15.08**	0.39	19.92**
Observations	2,740	2,740	2,740
Number of i	1,370	1,370	1,370
Adjusted R^2	0.209		
Overall R^2		0.157	0.214
Hausman test			23.70**

Standard errors in parentheses, POLS with robust standard errors,
** p<0.05, * p<0.10

Source: Swiss Graduate Survey 2002, data are unweighted.
Additional controls are unreported.

Note: Hausman tests on the hypothesis that the coefficients in the ramdom effects model and the fixed effects model are the same could be rejected for all specifications at least at the 1% level.

3.2 Wage effects of educational mismatch

Table 4 displays the estimation results of equations 1 and 2. At first, we focus our attention on the pooled OLS regression analysis according to which graduate overeducation and unobserved ability are assumed to be uncorrelated. The pooled OLS estimate derived from equation 1 shows that overeducated graduates earn 10.3% less than adequately educated graduates.[27] As in most earlier studies, this result gives support to **Hypothesis 1** stating a significant wage penalty associated with graduate overeducation, which means that the human capital hypothesis is rejected. Pooled OLS estimates derived from equation 2 suggest that all types of mismatch negatively affect earnings, the effect of genuine overeducation being the most detrimental with a wage loss of 14.6%. In line with Chevalier (2003), Green and Zhu (2010) and Mavromaras et al. (2010), the impact of genuine overeducation on earnings is significantly more negative than for apparent overeducation. **Hypothesis 2** is confirmed by the rejection of the null hypothesis H_{02}: $\alpha^{GO} = \alpha^{AO}$ using the F statistic. In other words, the large difference observed in pay penalty reinforces the view that overeducated graduates cannot be considered as a homogeneous group. While apparent match is also associated with a negative penalty, the size of this penalty is much smaller than for genuine overeducation (the null hypothesis H_{01}: $\alpha^{GO} = \alpha^{AM}$ is rejected according to the F statistic). Interestingly, the non-rejection of the null hypothesis H_{03}: $\alpha^{AM} = \alpha^{AO}$ proves that apparent overeducation and apparent match have similar effects on wages.

At this stage, we only discuss the fixed effects estimates as the random effects model is inconsistent given that unobserved ability is correlated with each explanatory variable (the Hausman test is rejected for all specifications of the wage equation). In accordance with **Hypothesis 3**, the fixed effects estimate of overeducation derived from equation 1 is much lower than in the case of the pooled OLS model: overeducated graduates earn 4.7% less than adequately educated graduates. Therefore, the human capital hypothesis is still rejected even if the fixed effects estimate provide some evidence that the wage penalty associated with graduate overeducation can be partially explained by unobserved ability. Fixed effects estimates derived from

[27] Given the log-linear form of the wage equation, the percentage effect of graduate overeducation is calculated as $e^{\alpha_o} - 1$.

equation 2 indicate that only genuinely overeducated graduates suffer from a significant pay penalty, reaching 8.3%. This result gives support to **Hypothesis 4** since the impact of apparent overeducation on earnings is no more significant when controlling for fixed unobserved ability.[28] Accordingly, a substantial fraction of the overeducated graduates have unobserved ability that allows them to work in jobs commensurate with their human capital.

4 Conclusion

In this paper, we have studied the incidence and wage effects of educational mismatch among Swiss graduates making their transition from university to labour market, on the basis of the latest panel data from the Swiss Graduate Survey. While basic measures of overeducation in most earlier studies exclusively refers to the concept of excess schooling, we have gone a step further by considering an improved measure of overeducation that accounts for graduate heterogeneity in perceived skills mismatch. Graduates that have reported being overeducated but actually work in jobs that match their skills are defined as apparently overeducated, otherwise they are taken for genuinely overeducated since they are mismatched in both education and skills. This distinction is particularly important when estimating the wage effects of overeducation, given that genuinely overeducated graduates cannot use most of their human capital in their job compared to those apparently overeducated. Another important contribution with respect to the literature is to solve the problem of omitted ability bias. Indeed, most prior findings are based on the assumption that overeducation is uncorrelated with unobserved ability. Since our panel data allow us to relax this assumption, we are able to reassess the result according to which overeducation is associated with a significant pay penalty.

While Switzerland is facing a shortage of qualified labour, at least 10% of Swiss graduates work in a non-graduate job five years after graduation. It means that the Swiss educational system, on the one hand, needs to pro-

[28]Note that the penalties associated with apparent match and apparent overeducation are jointly equal to zero; this evidence is indeed confirmed by the non-rejection of the null hypothesis H_{04}: $\alpha^{AM} = \alpha^{AO} = 0$ using the F statistic.

duce more graduates and, on the other hand, produces too many graduates. The coexistence of these phenomena originates from the fact that 70% of overeducated graduates are matched in skills (i.e. apparently overeducated), the remaining 30% being mismatched in both education and skills (i.e. genuinely overeducated). The latter category actually represents around 3% of all graduates. Moreover, genuine overeducation appears to persist for very few graduates over time. This low persistence is consistent with the view that genuine mismatch may be the manifestation of frictions in the labour market.

In a second step, we have estimated the impact of self-assessed overeducation on earnings using cross-sectional and panel estimation techniques. While the OLS method is based on the assumption that overeducation is uncorrelated with unobserved ability, the use of the fixed effects method allows for unobserved ability to be correlated with overeducation. Whatever which estimation method is applied, our results give support to previous studies: self-reported overeducation is associated with a significant pay penalty, the OLS estimate being about twice the size of the fixed effects estimate. We have then estimated an augmented specification where graduate overeducation is disaggregated according to perceived skills mismatch. In line with Chevalier (2003), Green and Zhu (2010) and Mavromaras et al. (2010), genuinely overeducated graduates are less rewarded than those apparently overeducated, *ceteris paribus*. This result is verified within both OLS and fixed effects frameworks. Moreover, the fixed effects analysis reveals that only genuinely overeducated graduates face a sizeable wage loss. In other words, controlling for unobserved ability shows that the wage effect of overeducation is independent of the job requirements when graduates are matched in skills. Consistent with the human capital hypothesis, apparent overeducation substitutes for other unobserved aspects of human capital, such as innate ability. This indicates that the wage effects for apparently overeducated graduates are mainly due to a lack of account for unobserved ability.

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A Appendix

Table 5: Graduates of higher academic education retained in the analysis

Jointly surveyed in both interviews	No. of i	%
All respondents	4,510	100.0
Valid information on whether employed or not	4,501	99.8
Employed*	3,590	79.6
Valid information on employment status	3,548	78.7
Salaried employees**	2,062	45.7
Valid information on self-assessed overeducation	2,044	45.3
Valid information on self-assessed overskilling	2,022	44.8
Valid information on potential exp. since graduation	1,981	43.9
Valid information on gross hourly earnings	1,709	37.9
Graduates without a PhD	1,478	32.8
Valid information on length of study	1,461	32.4
Valid information on average grade	1,370	30.4

Source : Swiss Graduate Survey 2002, data are unweighted.

* We exclude individuals who reported being unemployed or not in the labour force.

** We exclude individuals who reported being self-employed, in trainee jobs or PhD students.

Table 6: Characteristics at graduation: Summary statistics

	Entire sample*		Selected sample	
	Mean	S.D.	Mean	S.D.
Gender				
Women	0.489	0.500	0.466	0.499
Nationality				
Foreign	0.074	0.262	0.059	0.236
Length of study (semesters)	10.317	2.505	10.577	2.581
share of missing	0.076			
Average grade at graduation	0.568	0.209	0.565	0.202
share of missing	0.010			
Higher academic education				
Federal Institutes of Technology	0.182	0.386	0.225	0.418
Non study-related work experience during higher education (x_1)				
Missing value	0.100	0.300	0.061	0.240
$x_1 = 0$ years	0.325	0.468	0.353	0.478
0 years $< x_1 \leq$ 2 years	0.402	0.490	0.400	0.490
2 years $< x_1 \leq$ 4 years	0.103	0.305	0.104	0.306
4 years $< x_1$	0.069	0.253	0.081	0.273
Study-related work experience during higher education (x_2)				
Missing value	0.092	0.290	0.054	0.226
$x_2 = 0$ years	0.296	0.456	0.258	0.438
0 years $< x_2 \leq$ 2 years	0.438	0.496	0.466	0.499
2 years $< x_2 \leq$ 4 years	0.108	0.310	0.134	0.340
4 years $< x_2$	0.066	0.249	0.088	0.284
Observations	3,972		1,370	

Standard deviation in parentheses

Source: Swiss Graduate Survey 2002, data are unweighted.

* University graduates without a PhD.

Table 7: Explanatory variables included in the empirical analysis

Variable	Reference cat.
Basic measure of educational mismatch	
Adequately educated	×
Overeducated (O_i)	
Alternative measure of educational mismatch	
Genuinely matched	×
Apparently matched (AM_i)	
Apparently overeducated (AO_i)	
Genuinely overeducated (GO_i)	
Higher academic education	
Cantonal Universities	×
Federal Institutes of Technology	
Length of study (semesters)	continuous variable
Average grade ($0 \leq \overline{g}_i \leq 1$)	continuous variable
Non study-related work experience during higher education	
Missing value	
No experience ($x_1 = 0$)	×
0 years $< x_1 \leq 2$ years	
2 years $< x_1 \leq 4$ years	
4 years $< x_1$	
Study-related work experience during higher education	
Missing value	
No experience ($x_2 = 0$)	×
0 years $< x_2 \leq 2$ years	
2 years $< x_2 \leq 4$ years	
4 years $< x_2$	
Potential work experience since graduation (months)	
EXP (X_i)	continuous variable
$EXP^2/100$	continuous variable
Gender	
Women	
Men	×
Nationality	
Foreign	
Swiss	×
Year of interview	
2003	×
2007	

Source: Swiss Graduate Survey 2002.

Table 8: Characteristics since graduation: Summary statistics

Year of interview	2003	2007	Total
Overeducation (O_i)			
Mean	0.158	0.109	0.133
S.D.	0.366	0.311	0.340
Apparent match (AM_i)			
Mean	0.084	0.076	0.080
S.D.	0.277	0.265	0.271
Apparent overeducation (AO_i)			
Mean	0.077	0.078	0.077
S.D.	0.266	0.268	0.267
Genuine overeducation (GO_i)			
Mean	0.081	0.031	0.056
S.D.	0.273	0.172	0.230
Gross hourly earnings (Swiss francs)			
Mean	33.233	40.018	36.625
S.D.	7.974	9.952	9.633
Potential work experience since graduation (months)			
Mean	9.601	53.333	31.467
S.D.	4.413	4.478	22.317
Observations	1,370	1,370	2,740

Source: Swiss Graduate Survey 2002, data are unweighted.

Table 9: Changes in overeducation from 2003 to 2007

Basic measure	Overeducated one year after graduation (2003)	
Status five years after graduation (2007)	Observations	Proportions
Adequately educated	129	0.597
Overeducated	87	**0.403**
Total	216	1.000

Source: Swiss Graduate Survey 2002, data are unweighted.

Bold: 40% of overeducated graduates in 2003 are still overeducated in 2007.

Table 10: Changes in adequate education from 2003 to 2007

Basic measure	Adequately educated one year after graduation (2003)	
Status five years after graduation (2007)	Observations	Proportions
Adequately educated	1,092	**0.946**
Overeducated	62	0.054
Total	1,154	1.000

Source: Swiss Graduate Survey 2002, data are unweighted.

Bold: 95% of adequately educated graduates in 2003 are still adequately educated in 2007.

Table 11: Changes in matching status from 2003 to 2007 (column proportions)

Alternative measure	Genuinely matched	Apparently matched	Apparently overeducated	Genuinely overeducated
	one year after graduation (2003)			
Status five years after graduation (2007)				
Education genuinely matched	**0.934**	0.704	0.543	0.523
Apparently matched	0.066	**0.183**	0.038	0.090
Apparently overeducated	0.036	0.070	**0.333**	0.243
Genuinely overeducated	0.012	0.044	0.086	**0.144**
Observations	1,039	115	105	111

Source: Swiss Graduate Survey 2002, data are unweighted.

Table 12: Wage effects of educational mismatch: Panel results based on graduates working full-time at each interview wave

	POLS	FE	RE
Wage equation (1)			
Overeducated	-0.084**	-0.045**	-0.072**
	(0.019)	(0.022)	(0.016)
Observations	1,36	1,736	1,736
Number of i	868	868	868
Adjusted R^2	0.309		
Overall R^2		0.207	0.315
Hausman test			17.52**
Wage equation (2)			
Apparently matched	-0.025	-0.008	-0.019
	(0.021)	(0.022)	(0.018)
Apparently overeducated	-0.052**	-0.026	-0.045**
	(0.022)	(0.026)	(0.019)
Genuinely overeducated	-0.145**	-0.079**	-0.122**
	(0.030)	(0.031)	(0.024)
H_{01}: $\alpha^{GO} = \alpha^{AM}$	11.46**	3.92**	12.89**
H_{02}: $\alpha^{GO} = \alpha^{AO}$	6.55**	2.47	7.25**
H_{03}: $\alpha^{AM} = \alpha^{AO}$	0.86	0.29	1.11
H_{04}: $\alpha^{AM} = \alpha^{AO} = 0$	3.41**	0.53	6.27**
Observations	1,736	1,736	1,736
Number of i	868	868	868
Adjusted R^2	0.312		
Overall R^2		0.211	0.319
Hausman test			19.97**

Standard errors in parentheses, POLS with robust standard errors,
** p<0.05, * p<0.10

Source: Swiss Graduate Survey 2002, data are unweighted.
Additional controls are unreported.

Note: Hausman tests on the hypothesis that the coefficients in the ramdom effects model and the fixed effects model are the same could be rejected for all specifications at least at the 1% level.