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WORKING PAPER

The relationship between formal education and skill acquisition in young workers' first jobs

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The relationship between formal education and skill acquisition in young workers' first jobs[a]

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Abstract

We analyse the relationship between formal education and on-the-job skill acquisition (SA) for a sample of Flemish school-leavers. SA is measured directly through subjective assessments. Formal education is found to reinforce labour market inequality because additional years of education enhance the probability of all types of SA. With respect to general SA, this impact is higher for generally-educated compared to vocationally-educated individuals. This is predominantly explained by between-occupation effects; jobs that require more years of formal education also require more additional SA. Within occupations, we find some limited evidence on both dominant complementary and substitution effects. Under-educated workers have lower overall SA probabilities than adequately educated workers in similar occupations; over-educated workers with a vocational degree acquire less transferable or general skills than their adequately educated colleagues. Because over-educated workers work in jobs with less additional SA requirements, they also acquire less additional skills than adequately educated workers with similar educational backgrounds.

Keywords: OJT, vocational education, overeducation, overqualification, underemployment

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Introduction

Human capital is largely recognised as an important component in establishing successful careers for individual workers and maintaining a sustainable level of economic growth. This capital is not only advanced by means of investments in formal education but also through work-related training activities. Among economists, there is a long tradition of both theoretical and empirical research on the economics of on-the-job training (see, e.g., Bishop, 1997). An important research question is investigating the link between formal education and skill acquisition on the job (Brunello, 2004). This relationship depends on two basic functions of education that have opposite effects. First, formal education and on-the-job training might be complements if educated workers are more efficient producers of job skills. For instance, Thurow (1975) stated that formal education serves as a signal for worker trainability. Other authors have argued that education in itself enhances the efficiency of training (Rosen, 1976; Heckman, 1999). We will call this the *generic function* of education. Second, formal education and post-school skill acquisition might also serve as substitutes. One of the first to express this idea was Maton (1969), who showed that the level of skills required for a job could be obtained by several alternative combinations of formal education and experience. In later contributions, authors stated that company training operates as a way to match attained with required skills (see, e.g., van Smoorenburg and van der Velden, 2000; Heijke et al., 2003b)[1]. We will term this the *vocational function* of education.

Research on the link between formal education and on-the-job skill acquisition is highly relevant from a policy perspective. First, the direction of this relationship has clear consequences for society in terms of inequality. On the one hand, if complementary effects between formal education and post-school skill formation prevail, the skills gap between lower and higher educated persons will further expand during individuals' work careers. On the other hand, substitution might help to narrow the gap created by formal education. Second, this research might shed some light on the virtues of vocational formal education (Ryan, 2003; Hayward, 2004). If general, formal education is indeed an efficient and effective way of promoting future skill acquisition while on the job, vocationalisation should be limited. Alternatively, if the ability to enhance an individual's learning skills by means of general education is rather low, vocational formal education is likely to be a more efficient alternative. Third, the connection between these two types of human capital also plays a central role in the debate about over- and under-education (Hartog, 2000; Green et al., 2002). If there are substantial complementary effects between over-education and on-the-job skill acquisition, over-education might not be problematic because the accumulated skills could lead to larger promotion probabilities inside or outside the firm. As the Career Mobility Theory of Sicherman and Galor (1990) predicts, over-education will be an investment in experience. Under-education appears to be an efficient option if both factors serve as substitutes; if not, workers will never manage to catch up with their adequately educated colleagues.

A large number of empirical studies have already dealt with the relationship between formal education and training participation. Apart from Ariga and Brunello (2006), most studies found that higher educated workers participate more often in training (see Booth, 1991; Brunello, 2004; Arulampalam et al., 2004). Hence, it seems that in general the generic function of formal education dominates over its vocational function. However, relying on training participation measures as indicators for skill acquisition has several drawbacks. The first disadvan-

tage is that these measures often do not incorporate more informal ways of training, such as learning by doing. Further, they indirectly measure skill acquisition by the time spent on skill formation and fail to account for the efficiency of the training. Finally, information about the types of the acquired skills is usually lacking. From the point of view of the worker, it makes a big difference whether the acquired skills are only useful in the current job or can be applied to other jobs. An alternative is to measure skill acquisition more directly using subjective assessments. The studies that have applied this approach confirm the dominance of the generic function of formal education. For instance, Green and Montgomery (1998) concluded that high levels of prior human capital enhance the probability of acquiring transferable skills in the first job of British school-leavers. Verhaest and Omey (2010) also noted a positive relationship between education and skill acquisition for Flemish young workers. Moreover, their estimates of a skill's production function revealed that this positive relationship mainly results from the complementarity between education and learning by doing. Formal training participation, however, was found to work as a substitute for formal education.

In this paper, we build on this research and investigate the relationship between education and skill acquisition in young workers' first jobs in more detail. We contribute in two main ways to the literature. First, we differentiate between general and vocational types of formal education. As already stated, the effects of general and vocational education on skill acquisition are likely to be different. However, hardly any studies have tested this hypothesis. Second, we decompose the effects of education into between-occupation effects resulting from differences in required education and within-occupation effects resulting from over- and under-education. This investigation will assess the extent to which over- and under-education is problematic while also providing additional insights about the extent to which education and post-school skill acquisition serve as complements or substitutes. A number of studies have already investigated the impact of educational mismatches on training participation. However, as reviewed in the next section, the conclusions are not consistent across the various studies. A probable explanation might be that the applied training indicators do not equally capture skill acquisition. Moreover, it is also unknown whether the effects differ for job-specific and general skill acquisition. With our analysis, which relies on direct measures of skill acquisition, we try to shed some light on these issues.

The paper is structured as follows. In section II, we outline our theoretical framework, review the evidence in related studies and formulate the hypotheses that will be tested. Our data and estimation approach are outlined in section III. In sections IV and V, we review and discuss the estimation results. Section VI concludes.

II. Theoretical framework and hypotheses

As stated in the introduction, there is ample evidence showing that higher educated persons have more training opportunities. Moreover, periodic studies also reveal an overall positive relationship between education and the probability of skill acquisition. Hence, we hypothesise that a similar relationship will be found in our analysis:

(H1) Higher educated individuals acquire more skills in their first job.

This overall relationship might be explained both by within-occupation and between-occupation effects. Our

basic premise with respect to the between-occupation effect is that the profit-maximising output level in an occupation can be produced by an optimal mix of formal education and on-the-job training (cf. Maton, 1969). This optimal input combination is a function of the respective investment costs in both types of skill acquisition and the occupation-specific production function[2]. In the case of significant complementarities, occupations that require a high level of formal education will also be the occupations with high requirements of additional on-the-job training. At first sight, this situation seems to be consistent with reality. Surgeons, for example, only reach their optimal productivity by combining a long period of academic education with several years of work experience; office cleaners, on the other hand, can perform adequately with a low level of education and a short introduction period of on-the-job training. This statement is also confirmed by a number of studies that noted a positive relationship between the level of education that is required for the job and training participation (Verhaest and Omey, 2006a; Korpi and Tåhlin, 2009). Robst (1995) also found a positive relationship between required education and the probability that workers feel they are learning things that could lead to a better job or promotion. We test the following hypothesis with respect to the between-occupation effects:

(H2) Occupations that require more formal education are associated with more on-the-job skill acquisition.

In the case of labour market imperfections or non-optimal investments in education, some people will have a job for which they don't have the optimal level of formal education; in this case, they will be over- or under-educated. As their actual level of formal education deviates from the optimal level of education for the job, their ex-post optimal level of post-school skill acquisition will also differ from the ex-ante optimal level. Thus, apart from the between-occupation effects, within-occupation effects may also be found. Over-education can have two opposite consequences. On the one hand, the surplus of skills acquired at school can be substituted for less on-the-job skill acquisition. On the other hand, over-educated workers might be more trainable and thus, their ex-post level of skill acquisition might exceed the ex-ante optimal level for the job. Similar effects might be found among under-educated workers. On the one hand, they might solve their skill shortages by additional on-the-job skill acquisition. On the other hand, their lack of the necessarily formal education skills might make these extra investments highly inefficient. Among the previously mentioned studies that relied on direct indicators for skill acquisition, only Robst (1995) investigated this issue. He found no significant effects of over- and under-education on on-the-job learning. More evidence on this issue is available using training participation indicators. For instance, the results of Beneito et al. (2000) suggested that substitution effects dominate over complementary effects because training participation is lower among over-educated workers and higher among under-educated workers. Similarly, Bartel and Sicherman (1998) noted that low-skilled non-production workers receive more training than higher-skilled non-production workers at higher rates of technological change. In line with dominant complementary effects, however, Büchel (2002) found that the training probability in low-skill jobs is higher among qualified individuals. Verhaest and Omey (2006a) also noted some limited evidence on higher training participation among over-educated workers. However, as de Grip et al. (1998), they did not find significant effects for under-education. Finally, Korpi and Tåhlin (2009) did not find significant effects of over- and under-education on both formal and informal training participation. Given this inconclusive evidence, we formulate two competing hypotheses regarding the between-occupation effects of education:

(H3A) The surplus (deficit) of formal education skills of over-educated (under-educated) school-leavers induces complementary effects with post-school skill acquisition.

(H3B) Over-educated (under-educated) school-leavers substitute (fill) their surplus (deficit) of formal education skills with less (more) post-school skill acquisition.

Apart from over-investments in education or labour market imperfections, other factors might also explain why individuals start jobs in over-education positions. As Sicherman and Galor (1990) state, over-education might be part of an optimal career plan if the acquired skills in such a job sufficiently improve workers' productivity after promotion into a job for which they are adequately educated. This theory implicitly assumes that over-educated workers acquire more additional skills than if they would have been employed directly in a job for which they have the appropriate education. This would be the case if the within-occupation effect of over-education exceeds the between-occupation effect from working in a job with a higher required level of formal education. Alternatively, if over-education truly reflects over-investments or imperfect matching, we might expect that starting a job as an over-educated worker will be harmful to the individual's future career prospects. This is the case if the within-occupation effect of education is lower than the between-occupation effect. A number of studies already investigated this topic by comparing the training participation of over-educated workers with that of adequately educated workers with a similar educational background. Except for Groot (1993), most authors found that over-education results in less training participation (Hersch, 1991; van Smoorenburg and van der Velden, 2000; Büchel and Mertens, 2004; Verhaest and Omey, 2006a). These findings are not in favour of the career mobility hypothesis and suggest that over-education rather results from over-investments and labour market imperfections[3]. Given this evidence, we test the following hypothesis:

(H4) Compared to adequately educated workers with identical years of education, over-educated workers acquire less additional skills.

Although the theory provides no prediction on whether substitution or complementary effects dominate, we can expect that their relative importance varies across the alternative types of skill acquisition. Because the focus of formal education is on the production of skills that are applicable in more than just one job, we can expect that substitution effects are stronger with general skill acquisition, whereas complementary effects dominate with the acquisition of job-specific skills. Because of this, we test if:

(H5) Substitution effects (complementary effects) are relatively more important with respect to general (job-specific) post-school skill acquisition.

Finally, the relative importance of substitution and complementary effects is also expected to depend on the orientation of formal education. Nurses, for example, typically combine a more vocationally-oriented formal education with a relatively short introductory period of training; bank employees, on the other hand, usually have followed a more general education trajectory and have to learn most of their tasks on the job. Several studies have already investigated the earnings consequences of both types of education. For instance, Karasiotou (2004) noted slightly higher returns for academic qualifications than for vocational qualifications in Belgium. However,

fairly little research recognises the differential impact on skill acquisition. An interesting exception is a study of Heijke et al., (2003b), who linked generic and vocational skills to mismatches and training participation. They found that generic competencies positively influence a person's probability to be working outside his/her field of study and to be trained. Inversely, vocational competencies were found to negatively influence a person's probability to work outside his/her field of study and had no significant impact on training participation. In a related paper, Heijke et al. (2003a) showed that general academic skills enhance the probability to be employed in jobs that require more management competencies. Hence, we define the following hypothesis:

(H6) Substitution effects (complementary effects) are relatively more important among vocationally (generally) educated individuals

III. Data and empirical model

Our analysis is based on data from two cohorts of the SONAR survey about school-to-work transitions in Flanders. Each cohort consists of about 3000 randomly selected individuals who were born in 1978 and 1980, respectively. At the age of 23 (i.e., at the end of 2001 and 2003), they were questioned in person about their educational and labour market careers. For the 1978 cohort, also data on a follow-up survey at the age of 26 are available[4]. We base the analysis on skill acquisition during the first standard job[5]. This focus on first jobs has several advantages. First, both skill acquisition and skill mismatches are likely to be concentrated at the start of the working career. Second, the focus on first jobs ensures that the results are not biased by possible substitution and complementary effects with labour market experiences or training activities in previous jobs. Third, as stated by McMillen et al. (2007), a solid test of the career mobility theory requires identifying over-education at the start of a career. For instance, if workers are indeed promoted to an adequate job after having completed their training, only those without training and skill acquisition opportunities or those who did not yet complete the training trajectory remain in the over-education category. On the other hand, if over-education is just a temporary situation in search for an appropriate job, there might be fewer incentives to invest in further training. However, this problem only applies to specific training and is likely to be modest as long as learning by doing is the most important source of skill acquisition[6].

At age 23, this first job could be observed for 78.0% of the respondents. The remaining 22% had pursued advanced degrees (15.4%) or were unemployed or inactive without any prior job experience (6.6%). The follow-up survey at age 26 for cohort 1978 further raised the number of first job observations to 84.1%. As data on a similar follow-up for the 1980 cohort were not available, those with a higher tertiary degree remain somewhat underrepresented in our sample[7]. Given the compulsory schooling age of 18 years, those with an observed first job entered the labour market during the period 1996-2004. An extensive description of the data collection process and general summary statistics can be found in SONAR (2003, 2005). We restricted the analysis to the non-self-employed with jobs in Flanders (including Brussels). After further exclusion of individuals with missing values on any of the variables used in the analysis, the sample size was reduced to 4389 respondents.

To evaluate the relationship between education and post-school skill acquisition, we estimated the following

three model specifications:

(1) $y = \beta_{01} + \beta_{11} YEDUC + \mathbf{\beta_{51}} \mathbf{X} + \varepsilon_1$

(2) $y = \beta_{02} + \beta_{22} YREQE + \beta_{32} YOVER + \beta_{42} YUNDER + \mathbf{\beta_{52}} \mathbf{X} + \delta_2 + \varepsilon_2$

(3) $y = \beta_{03} + \beta_{33} YOVER + \beta_{43} YUNDER + \mathbf{\beta_{53}} \mathbf{X} + \delta_3 + \varepsilon_3$

with y = a skill acquisition indicator, *YEDUC* = years of education, *YREQE* = years of required education, *YOVER* = years of over-education, *YUNDER* = years of under-education, $\mathbf{X}$ = a vector of control variables, δ_2 = an occupation-specific random effect[8], δ_3 = an occupation-specific fixed effect, and residual terms ε_1, ε_2 and ε_3. Specification (1) investigates the overall relationship between formal education and post-school skill acquisition (cf. *Hypothesis 1*). This overall relationship results both from between-occupation and within-occupation effects. In specification (2), *YEDUC* are divided into the *YREQE* for the school-leavers' occupation, *YOVER* and *YUNDER*. Coefficient β_{22} then measures the between-occupation effect and reflects the overall distribution of optimal combinations of formal education and on-the-job skill acquisition across occupations (cf. *Hypothesis 2*). Coefficients β_{32} and β_{42}, on the other hand, reflect the within-occupation effects resulting from educational mismatches (cf. *Hypothesis 3*). Note that if $\beta_{32} > \beta_{22}$, over-educated workers acquire more additional skills than if they would have been employed in a job for which they were adequately educated. This outcome would reject *Hypothesis 4* and confirm the statement of the career mobility theory, which suggests that over-education is a good investment in experience. Specification (2) assumes that there is a linear relationship between the formal education requirements and skill acquisition. This assumption might be too restrictive to control adequately for requirement heterogeneity across occupations. Because of this, in specification (3), we included detailed occupation fixed effects instead of *YREQE* and random effects[9].

In the previous three specifications, it is assumed that the effects of education are identical for vocationally- and generally-educated individuals. To test whether these effects differ by educational orientation, we also estimated the following three alternative specifications:

(4) $y = \beta_{04} + \beta_{14} YEDUC + \beta_{14}^{g} YEDUC * GEN + \mathbf{\beta_{54}} \mathbf{X} + \varepsilon_4$

(5) $y = \beta_{05} + \beta_{25} YREQE + \beta_{25}^{g} YREQE * GEN + \beta_{35} YOVER + \beta_{35}^{g} YOVER * GEN$
$+ \beta_{45} YUNDER + \beta_{45}^{g} YUNDER * GEN + \mathbf{\beta_{55}} \mathbf{X} + \delta_5 + \varepsilon_5$

(6) $y = \beta_{06} + \beta_{36} YOVER + \beta_{36}^{g} YOVER * GEN + \beta_{46} YUNDER + \beta_{46}^{g} YUNDER * GEN + \mathbf{\beta_{56}} \mathbf{X} + \delta_6 + \varepsilon_6$

with *GEN* = a general education dummy and δ_5 or δ_6 = separate occupation-specific random or fixed effects for vocationally- and generally-educated individuals[10]. The outcomes $\beta_1^g > 0$, $\beta_2^g > 0$, $\beta_3^g > 0$, and $\beta_4^g < 0$ would be in support of *Hypothesis 6*, which states that complementary effects are relatively more important with respect to general degrees.

The measurement of years of formal education (*YEDUC*) is based on the standard study length that is required to achieve the individual's highest educational qualification. Hence, we rely on certified years and not on actual years of education. If based on actual years, someone who repeated years of schooling would be considered to have a higher level of human capital than a student with a standard trajectory and would dually risk being wrongly classified as over-educated[11]. Five educational categories were distinguished: less than lower secondary education (<LS, 6 years of education), lower secondary education (LS, 10 years)[12], higher secondary education (HS, 12 years)[13], lower tertiary education (LT, 15 years)[14], and higher tertiary education (HT, 16 years)[15]. We also distinguished between vocational education (*GEN*=0) and generally oriented programs (*GEN*=1). Secondary education in Flanders is organised along three main tracks: general, technical and vocational education. In the study by Karasiotou (2004), the technical track was classified under vocational education despite its ambiguous orientation that differs across educational subjects and schools. We based the classification of school-leavers from the technical track on the presence of work-placement schemes in their curriculum. These schemes comprise of a period of work experience in private firms or public organisations. If these school-leavers reportedly had at least three months of curriculum-based experience, they were classified as being vocationally educated. Also the orientation of tertiary education is not homogeneous[16]. Therefore, the same criterion of three months of work-placement experience was used with respect to those with a tertiary education degree. Table 1 reports some summary statistics for the analysed sample. According to our definition, about 58% of the sample group has an educational background with a vocational orientation. Vocationally-oriented education is more prevalent among individuals with lower secondary or lower tertiary education degrees. However, using three months of curriculum-based work experience as a criterion to distinguish between general and vocational programs is arbitrary because neither program is completely vocational or completely general. Thus, we also reviewed some results using one month and six months of curriculum-based work experience as alternative criteria to distinguish between the two types of orientation in formal education. The incidences of generally-educated individuals using these two alternative criteria are 30.8% for the one-month indicator and 55.2% for the six-month indicator.

Table 1: Distribution of educational orientation across educational levels for the analysed sample

	Overall sample	< lower secondary	Lower secondary	Higher secondary	Lower tertiary	Higher tertiary
Generally educated	0.420	0.383	0.271	0.476	0.265	0.630
Vocationally educated	0.580	0.617	0.729	0.524	0.735	0.370
Total	1.000	0.038	0.088	0.487	0.258	0.130

Data source: SONAR 1978(23) and SONAR 1980(23), own calculations; N = 4389.

The measurement of years of over- and under-education is based on comparisons between years of attained education and years of required education (*YREQE*). We measured *YREQE* using a job analysis indicator that is derived from the Dutch CBS classification. The CBS classification is well suited for the research in this paper. First, this classification is in agreement with our theoretical framework, as job experts defined an optimal combination of formal education and practical work experience for each occupation. The functional levels of the classification correspond to our five distinguished educational levels. Moreover, the categorisation is based on the tasks to be executed rather than on the job title. This minimises the heterogeneity of requirement within

occupations. Finally, this measure performed fairly well in a number of validation and reliability studies (van der Meer, 2006; Verhaest and Omey, 2006b) [17]. Table 2 reports the incidences of over- and under-education for our sample of school-leavers. About half of the school-leavers are over-educated for their first job, whereas approximately 8% are under-educated. Over-education is found to be more prevalent among generally- opposed to vocationally-educated school-leavers. This outcome is logical from a career mobility perspective. Given the focus on generic skills in general education, starting as an over-educated worker might be an optimal option for these types of school-leavers.

The measure for skill acquisition in the first job is derived from the following question in the SONAR-survey: 'In your first job, have you learnt some new skills which you didn't possess before?' [18] Also of importance is the extent to which the acquired skills are job-specific or general (cf. *Hypothesis 5*). The transferability of the acquired skills can be derived from the question: 'Are these skills of use (1) only in your first job, (2) also in similar jobs, but with other employers or (3) also in other jobs?' The first type of skills can be classified as being job-specific, the second as transferable, and the last as general skills. We derive three indicators from these two questions: any skill acquisition (SA-S/T/G), transferable or general skill acquisition (SA-T/G), and general skill acquisition (SA-G). For the full sample, the incidences amounted to approximately 73% for SA-S/T/G, 66% for SA-T/G and 34% for SA-G (cf. Table 2)[19]. Incidences are greater for generally rather than vocationally educated school-leavers (cf. Table 2). However, the differences are only statistically significant with respect to SA-G. As previously stated, most other studies in the literature indirectly measure skill acquisition using (formal) training participation indicators. To assess if our results are measurement- or data-specific, we also reviewed some evidence using formal and informal training participation. Our formal training participation indicator (TRF) includes both off-site and on-side training, whereas informal training (TRI) includes informal co-worker training and learning by watching. Learning by doing, however, is not captured. As shown in Table 2, about 25% of the individuals surveyed participated in formal training and 40% of them had some informal training. Moreover, generally-educated individuals were found to participate more often than vocationally-educated ones in informal training. Finally, we also analyse the number of formal training courses (TRFN) to account for possible differences in the intensity of training[20]. Also on the basis of this indicator, we note higher participation among generally educated individuals. Yet, this difference is not statistically significant.

Table 2: Summary statistics for the analysed sample (average values)

	Overall sample	Generally educated	Vocationally educated	Chi² or F statistic
OVER	0.515	0.560	0.482	26.0***
UNDER	0.081	0.084	0.078	0.5
SA-S/T/G	0.731	0.735	0.727	0.3
SA-T/G	0.655	0.661	0.650	0.6
SA-G	0.340	0.378	0.313	20.3***
TRF	0.245	0.256	0.237	2.3
TRI	0.397	0.433	0.372	16.9***
TRFN	0.549	0.570	0.534	0.7

Data source: SONAR 1978(23), SONAR 1978(26), and SONAR 1980(23), own calculations; N = 4389; *: p <.10; **: p < .05; ***: p < .01.

All estimations were based on binary logit models. A disadvantage of the fixed-effects model (Specifications (3) and (6)) is that it can only rely on occupations with varying values of the explanatory variable. This leads to a substantial loss of information, particularly if fixed effects for occupations at the most detailed (five-digit) level would be included. Further, also the within-group variation in years of over- and under-education might become too small. On the other hand, including fixed effects using more aggregate occupations comes at the cost of more within-occupation heterogeneity in skill acquisition requirements. Therefore, we grouped our respondents in occupational groups by means of an alternative multiple-step procedure. In a first step, all respondents in the full sample were grouped using their two-digit CBS code. For the groups with less than 20 observations, the fixed effects were based on this two-digit aggregation level. The other groups, however, were further divided using the three-digit CBS codes. The same procedure was then repeated with groups with less than 20 observations, which were assigned a fixed effect using three-digit codes, whereas the others were assigned using the most detailed five-digit codes. This procedure results in a total of 376 occupational groups with on average of 11.7 observations per occupation[21]. Further, we executed two robustness checks. First, we also executed some estimations using 100 observations instead of 20 observations as criterion to disaggregate occupations. Second, in the spirit of Mundlack's (1978) procedure for panel data, we estimated random-effects models with occupation mean years of over- and under-education included as additional control variables.

The control variables (**X**) that were included in every equation are gender (1 dummy), non-European descent (1), cohort (1), age, student work experience (1), region of employment (5), firm size (3), industry (11), public sector worker (1), short-term contract (1), temporary agency contract (1), employment measure contract (1)[22], the percentage of employment (full-time = 100%), observed job tenure and its square[23]. Tenure might be endogenously related to skill acquisition. To correct for this, we applied the control function approach as proposed by Rivers and Vuong (1988). This procedure estimated the endogenous variable (i.e., observed tenure) in the first stage. The estimated error term of this equation was then included as an additional explanatory variable in the second-stage logit equation. Rivers and Vuong showed that these estimates are consistent and at least as efficient as other two-stage approaches, such as the simple two-stage instrumental variables probit[24]. Of course, classical maximum likelihood approaches are better alternatives. However, these approaches often suffer from computational problems when applied to large models[25]. The potentially observed length of tenure and its square were included as additional regressors in the first stage regressions to enhance identification. This length, which is measured as the time between the start of the first job and the date of the survey, largely explained the actual observed tenure length without being correlated with the error term[26].

Apart from tenure, years of (required) education might be endogenously related to post-school skill acquisition. For instance, the incentive to invest in higher education might be positively related to the extent to which the individuals' education is expected to enhance further skill acquisition. Similarly, whether or not individuals are inclined to accept jobs at lower levels of education might depend on the extent to which they are compensated with additional learning opportunities. To account for these potential problems, we report in Appendix H some additional estimates that also apply a control function approach with respect to years of education and years of required education. As identification variables for years of education, we use social background variables such as the number of siblings, the occupational level of the father and the educational level of both parents. These kind

of variables have been regularly used in the literature to account for possible endogeneity with respect to the impact of education on earnings (see Card, 1999), and might be relevant within the context of our paper as well. For the identification of the effect of years of required education, we rely, amongst others, on a battery question in the SONAR survey that gauges the individual's willingness to accept jobs with alternative characteristics. We select those items that refer to characteristics that are expected to be associated with the job level, but, given the job level, not with skill acquisition – i.e. work at a lower level than originally presupposed, shift work, physically demanding work, assembly line work, and work with irregular working hours. The answers on those items are, along with some of the social background variables[27], included as explanatory variables in the first stage regression, but not in the skill acquisition regressions. Further, to account for possible correlation between the willingness to accept these types of jobs and the willingness to accept jobs with learning opportunities, we include in both stages the item "work for which it is required to follow an additional training of six months" as additional variable. As shown, this procedure does not deliver strong indications for endogeneity. Nevertheless, it should be mentioned that, at least with respect to years of required education, the instruments are rather weak. Moreover, also the validity of these instruments might be questioned. Hence, we consider these results to be only indicative.

IV. Estimation results

Table 3 presents the main estimation results regarding the impact of formal education on skill acquisition[28]. For easier interpretation, we report marginal effects instead of coefficient values[29]. Six model specifications are estimated. Models (1) and (4) investigate the overall impact of formal education irrespective of the educational match. The other models divide overall effects into between- and within-occupation effects and specify either random effects ((2) and (5)) or fixed effects ((3) and (6))[30]. For the ease of reading, we review these results in the light of our hypotheses. At the end of the section, we also review some additional results with respect to training participation.

Hypothesis 1, which states that higher educated school-leavers acquire more additional skills in their job, is largely confirmed by the estimation results on the basis of specification (1). This outcome is supported by previous findings in the literature regarding the relationship between formal education and training participation and suggests that complementary effects dominate over substitution effects. Moreover, the effect of years of education is even more pronounced if we subtract deficit and surplus years of education (cf. specification (2) and *Hypothesis 2*). One extra year of required education increases the likelihood to acquire new skills in the first job with about 4 percentage points. This suggests that jobs that require additional years of formal education also require more additional on-the-job training and experience.

Apart from between-occupation effects, within-occupation effects of years of education were also revealed. However, their effects differ between the three types of skill acquisition and depend on whether they are influenced by surplus or deficit years of education (cf. specification (3)). We found evidence of dominant complementary effects on years of under-education (cf. *Hypothesis 3A*) in which a deficit of formal education results in less transferable and overall on-the-job skill acquisition. Years of over-education, were not found to have a

statistically significant impact on skill acquistion on the basis of specification (3). Yet, as over-educated workers are employed in jobs that require fewer advanced skill acquisition on the job, they have lower skill acquisition probabilities than adequately educated workers with a similar educational background. This supports *Hypothesis 4* and rejects the career mobility thesis that over-education is a good investment in additional skill acquisition. A similar conclusion cannot be made with respect to under-education because the negative effect from years of under-education is compensated for by a positive effect from working at higher job levels.

Table 3: The relationship between formal education and skill acquisition: logit marginal effects

	Any skill acquisition			*Transferable or general skill acquis.*			*General skill acquisition*		
	Standard logit	Occupation random effects	Occupation fixed effects	Standard logit	Occupation random effects	Occupation fixed effects	Standard logit	Occupation random effects	Occupation fixed effects
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
YEDUC	0.019***			0.021***			0.011**		
YREQE		0.037***			0.043***			0.023***	
YOVER		-0.002	-0.004		-0.006	-0.011		-0.003	-0.011
YUNDER		-0.019**	-0.027**		-0.025***	-0.029***		-0.009	-0.012
Individuals	4389	4389	3997	4389	4389	4074	4389	4389	4159
Groups (occup.)		376	206		376	219		376	236
Chi²	484.8***	400.1***	184.9***	464.9***	398.1***	158.0***	193.6***	186.3***	80.8***
	(4)	(5)	(6)	(4)	(5)	(6)	(4)	(5)	(6)
YEDUC	0.019***			0.021***			0.010**		
YREQE		0.038***			0.043***			0.021***	
YOVER		-0.004	-0.014		-0.007	-0.022**		-0.004	-0.019*
YUNDER		-0.017*	-0.024		-0.022**	-0.021		-0.004	-0.005
*YEDUC*GEN*	0.000			0.001			0.003***		
*YREQE*GEN*		0.000			0.000			0.004**	
*YOVER*GEN*		0.005	0.024*		0.005	0.024*		0.002	0.013
*YUNDER*GEN*		-0.004	-0.016		-0.006	-0.022		-0.012	-0.014
Individuals	4389	4389	3584	4389	4389	3786	4389	4389	3896
Groups (occup.)		596	264		596	302		596	322
Chi²	485.3***	521.5***	182.6***	465.5***	460.5***	161.7***	202.8***	189.5***	79.6***

YEDUC = years of education, *YREQE* = years of required education, *YOVER* = years of over-education, *YUNDER* = years of under-education, *GEN* = dummy for general study program orientation;
Also included, but not reported: intercept, dummies for gender (1 dummy), non-European descent (1), cohort (1), region of employment (5), firm size (3), industry (11), public sector worker (1), contract type (3), student work experience (1), age, percentage of employment (full-time = 100%), tenure, tenure squared, and tenure residual;
Data source: SONAR 1978(23), SONAR 1978(26), and SONAR 1980(23), own calculations;
* : p <.10; **: p < .05; ***: p < .01.

Further, we stated that substitution effects are likely to be more important with respect to general skill acquisition, whereas complementary effects can be expected to dominate for more specific skill acquisition (*Hypothesis 5*). Some of our results support this hypothesis. For instance, the impact of one extra year of required education is found to be about 4 pp on overall and transferable skill acquisition compared to about 2 pp on general skill acquisition. Further, the complementary effects with respect to years of under-education are noted for overall and transferable skill acquisition but not for general skill acquisition.

Also for the last hypothesis (*Hypothesis 6*), which states that complementary effects are more pronounced for

generally-educated individuals than for vocationally-educated individuals, we found some evidence (cf. Specification (4), (5) and (6)). We found a small but statistically significantly higher impact of years of education or years of required education on general skill acquisition for generally-educated individuals. Further, on the basis of specification (6), we found that years of overeducation has a negative impact on transferable or general skill acquisition for vocationally-educated workers, but not for generally-educated workers[31]. With respect to undereducation, we found no evidence on differential effects. We also executed alternative estimates by using one month and six months of work-placement experience as criterion to distinguish between generally- and vocationally-educated individuals. As shown in Appendix E, these definitions delivered similar results regarding the differential impact of years of education on general skill acquisition (specification (4)) and of years of overeducation on transferable or general skill acquisition (specification (6)). However, the differential impact of years of required education on general skill acquisition was in both cases not statistically significant. Finally, the one-month indicator delivered a more pronounced negative effect for years of undereducation among those with a general degree, and a statistically insignificant interaction effect between years of overeducation and general education on any skill acquisition.

Table 4: The relationship between formal education and training participation: logit marginal effects and Poisson coefficients

	Formal training participation (logit marginal effects)			*Informal training participation* (logit marginal effects)			*Number of formal training courses* (Poisson coefficients)		
	Standard logit	Occupation random effects	Occupation fixed effects	Standard logit	Occupation random effects	Occupation fixed effects	Standard logit	Occupation random effects	Occupation fixed effects
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
YEDUC	0.010**			0.013***			0.087***		
YREQE		0.017***			0.015***			0.158***	
YOVER		0.000	-0.006		0.012*	0.009		0.030	0.022
YUNDER		-0.008	-0.009		-0.011	-0.014		-0.069**	-0.056*
Individuals	4389	4389	3921	4389	4389	4174	4389	4389	3961
Groups (occup.)		374	201		374	240		376	215
Chi²	669.6***	383.8***	275.9***	251.8***	226.7***	102.4***	1956.4***	836.4***	696.0***
	(4)	(5)	(6)	(4)	(5)	(6)	(4)	(5)	(6)
YEDUC	0.010**			0.012**			0.089***		
YREQE		0.017***			0.013**			0.158***	
YOVER		0.000	0.008		0.015**	0.008		0.026	0.033
YUNDER		0.005	0.018		-0.018	-0.022		0.010	0.013
*YEDUC*GEN*	-0.001			0.002			-0.005*		
*YREQE*GEN*		0.000			0.003*			-0.003	
*YOVER*GEN*		-0.002	-0.031*		-0.006	0.004		-0.008	-0.059
*YUNDER*GEN*		-0.027*	-0.058**		0.011	0.012		-0.156***	-0.143**
Individuals	4389	4389	3590	4389	4389	4006	4389	4389	3641
Groups (occup.)		596	274		596	346		596	292
Chi²	670.2***	415.2***	271.6***	254.3***	224.0***	100.6***	1958.0***	864.8***	690.9***

YEDUC = years of education, *YREQE* = years of required education, *YOVER* = years of over-education, *YUNDER* = years of under-education, *GEN* = dummy for general study program orientation; Also included, but not reported: intercept, dummies for gender (1 dummy), non-European descent (1), cohort (1), region of employment (5), firm size (3), industry (11), public sector worker (1), contract type (3), student work experience (1), age, percentage of employment (full-time = 100%), tenure, tenure squared, and tenure residual;
Data source: SONAR 1978(23), SONAR 1978(26), and SONAR 1980(23), own calculations;
* p <.10; **: p < .05; ***: p < .01.

A disadvantage of the fixed-effects logit model is that the identification of the mismatch effects only relies on occupations with varying values of skill acquisition and also requires sufficient within-occupation variation in years of over- and undereducation. Therefore, we also executed fixed-effects estimates relying on more aggregate occupations and on random-effects estimates with occupation mean years of over- and undereducation as additional control variables. As shown in Appendix F and G, also these estimates did reveal a differential impact of years of overeducation on transferable of general skill acquisition. However, the differential impact on any skill acquistion did not show up on the basis of the fixed-effect model that relies on more aggregate occupations.

Finally, we also review some results regarding the impact of formal education on training participation (cf. Table 4). The estimates for informal training confirm some of the trends that had been previously established by our direct self-assessment indicators. For instance, years of required education were found to have a positive effect on informal training participation. Furthermore, this impact was higher for generally-educated individuals. However, results were clearly different for the within-occupation effects. The impact of overeducation on transferable and general skill acquisition was found to be negative for vocationally-educated individuals, and we found no such impact on training participation. Our results suggest that the impact of overeducation on formal training participation is even higher for vocationally-educated than for generally-educated ones, what contradicts *hypothesis 5*[32]. Finally, we found no evidence on a differential impact of undereducation on skill acquisition for generally- and vocationally educated individuals, whereas the impact of undereducation on formal training participation was found to be significantly lower for generally-educated individuals.

V. Discussion

Our outcomes clearly revealed that higher-educated individuals are more likely to acquire skills during their first jobs than lower-educated people, what suggests that complementary effects dominate substitution effects. This outcome was mainly explained by between-occupation effects; higher-educated school-leavers are selected for occupations that require more additional on-the-job skill acquisition. The most pronounced between-occupation effect was noted on the acquisition of job-specific skills. The effect on general skill acquisition equally was found to be more modest and appears to depend on the orientation of education; additional years of general education seem to be more helpful for employment in occupations that require further general skill acquisition than additional years of vocational education. Within-occupation effects were also revealed, but they appeared to depend on the type of mismatch, and differed for the various types of skill acquisition. Under-educated workers, for example, do not make up their deficit of formal education skills with more skill acquisition on the job. On the contrary, they were found to acquire less additional job-specific and transferable skills than adequately educated workers who occupy similar occupations. Over-educated workers with a vocational degree substituted their surplus of formal education for less additional transferable or general skill acquisition. Hence, given the negative between-occupation effect that is associated with working at lower job levels, over-educated workers also have lower skill acquisition probabilities than adequately educated workers with similar educational backgrounds.

Several of these findings were supported by analyses on the relationship between formal education and training

participation, both in this study and in the literature. The dominance of complementary effects, for instance, is largely confirmed (see, e.g., Brunello, 2004). Further, Heijke et al. (2003b) found that general skills also have a positive impact on training participation, whereas we found such an impact on informal training participation. Finally, also the career mobility thesis is typically rejected on the basis of training participation indicators (see, e.g., Büchel and Mertens, 2004). Other outcomes, however, were clearly different. Undereducation, for instance, seems to have a clear negative impact on skill acquisition, but not on training participation. Further, along with other studies, we found that over-educated workers have at least as many training opportunities as their adequately educated colleagues. For vocationally educated individuals, however, this does not seem to translate into equal transferable and general skill acquisition. These differential outcomes might, inter alia, be explained by the importance of learning by doing and substitution effects between formal education and formal training (cf. Verhaest and Omey, 2010). Overeducated workers with a vocational degree, for instance, might experience less learning by doing, or their training might be merely a repetition of what has been learned in education.

Our findings have important policy implications. As Thurow (1975) states, education generates inequality. The skills gap created in formal education between individuals expands further during their careers. Moreover, the finding that under-educated workers acquire just as much or even fewer additional skills than their adequately educated colleagues in similar occupations seems to confirm Heckman's (1999) statement that there are some limits to the trainability of low-skilled workers. At least, learning by doing alone will not solve their skills deficit and more formalised training and education are likely to be needed. Also, the finding that vocationally educated workers acquire fewer additional general skills compared with generally educated individuals might have substantial implications. One interpretation is that generally educated individuals compensate an initial shortage of relevant labour market skills with more skill acquisition on-the-job.[33] An alternative interpretation, however, might be that a lack of generic skills impedes the ability of vocationally educated school-leavers to acquire further skills on the job. This would be problematic, especially during times of rapid technological change when technology-specific skills become less valuable and more generic skills, such as learning abilities, become more valuable. Moreover, as Autor et al. (2003) showed, growing computerisation might raise the demand for non-routine tasks requiring general skills, such as problem-solving or complex communication skills. Lastly, the statement that over-education is the best way to invest in experience is questionable if over-educated workers have lower skill acquisition probabilities than those with a similar educational background who are adequately educated. Previous studies have shown that over-educated workers have lower wage growth (Büchel and Mertens, 2004) or are less satisfied (Verhaest and Omey, 2009). These results suggest that over-education is, at least at labour market entry, rather involuntary.

An important research implication of this study is that training indicators are not well suited to capturing skill acquisition. Nevertheless, our indicators have their limitations. For instance, it was not possible to separate specific from overall skill acquisition on the basis of our data. Moreover, we have no information on the intensity of skill acquisition. Finally, the general skills category groups a variety of skills that can have different implications. Some skills, such as problem-solving, are generic as they stimulate further learning. Others, such as the knowledge of how to work with a specific software package, can also be general but might have less impact on further skill acquisition. Thus, a further analysis should be conducted using more detailed information

regarding the types of acquired skills. Another direction for further research is a more detailed analysis of the influence of general and vocational education. Some of our conclusions regarding this issue were not robust across our alternative indicators for general and vocational education. An analysis that is based on a more detailed and accurate indicator might clarify this. Further, although we attempted to control for possible endogeneity in education, it remains arguable whether the detected relationships are actually causal. Hence, additional evidence that accounts for this, based for instance on natural experiments, would be welcome as well. Next, there is a focus on first jobs in this study. Although this focus has several advantages, it would clearly be interesting to know how the relationship between education and skill acquisition further evolves over a person's career. Finally, with respect to the within-occupation effects of education, we only focused on the impact of over- and under-education, and some individuals might also be mismatched to the subject of their study programmes. Moreover, research shows that educational mismatches do not necessarily correspond to skill mismatches (see Allen and van der Velden, 2001; Green and McIntosh, 2007). Hence, it might also be interesting to investigate the consequences of these types of mismatches for skill acquisition on the job.

VI. Conclusion

The central aim of our paper was to analyse the relationship between formal education and skill acquisition in young workers' first jobs. The overall effect of years of formal education was divided into between- and within-occupation effects. We directly measured skill acquisition using subjective assessments, and we discriminated between general and vocational types of formal education. The overall effect of education on skill acquisition was found to be positive. This is predominantly explained by between-occupation effects; jobs that require more formal education also require more additional skill acquistion. Within occupations, we found some evidence on both dominant complementary and substitution effects. Under-educated workers have lower overall skill acquisition probabilities than adequately educated workers in similar occupations; over-educated workers with a vocational degree acquire fewer transferable or general skills than their adequately educated colleagues. Further, over-educated workers also acquire fewer additional skills than adequately educated workers with similar educational backgrounds. These findings have important implications with respect to labour market inequality, the merits of vocationalisation, and the debate on overeducation. More research relying on more detailled measurements and on more experimental approaches, however, would be welcome.

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Appendix A: Pooled regresssion results

Table A1: The relationship between formal education and skill acquisition: logit coefficients – pooled regression

	Any skill acquisition	*Transferable or general skill acquisition*	*General skill acquisition*
	(3)	(3)	(3)
Years of required education	0.206***	0.193***	0.101***
Years of over-education	-0.009	-0.022	-0.013
Years of under-education	-0.105**	-0.114***	-0.041
LR Chi² (35)	617.8***	601.7***	229.4***
	(6)	(6)	(6)
Years of required education	0.209***	0.195***	0.093***
Years of over-education	-0.022	-0.033	-0.012
Years of under-education	-0.095*	-0.101**	-0.017
Years of req. education * general program	-0.002	-0.001	0.017**
Years of over-education * general program	0.028	0.023	0.001
Years of under-education * general program	-0.021	-0.026	-0.062
LR Chi² (38)	619.8***	604.4***	237.7***

Also included, but not reported: cf. Table 3; Data source: SONAR 1978(23), SONAR 1978(26), and SONAR 1980(23), own calculations; * p <.10; **: p < .05; ***: p < .01.

Appendix B: Summary statistics on covariates

	Mean	Std. dev.
Male	0.500	
Non-western background	0.052	
Cohort: born in 1980	0.464	
Age	20.848	1.826
Student work/holiday work experience	0.808	
Region of employment: Antwerp	0.288	
Region of employment: Limburg	0.131	
Region of employment: Eastern Flanders	0.197	
Region of employment: Western Flanders	0.174	
Region of employment: Flemish Brabant	0.131	
Region of employment: Brussels	0.080	
Type of contract: permanent	0.439	
Type of contract: fixed term	0.343	
Type of contract: casual/seasonal	0.193	
Type of contract: employment measure	0.025	
Firm size: < 10 workers	0.223	
Firm size: 10 – 49 workers	0.311	
Firm size: 50 – 249 workers	0.257	
Firm size: > 249 workers	0.209	
Public sector	0.184	
Sector: Agriculture, mining & fishing	0.011	
Sector: Industry	0.229	
Sector: Construction	0.057	
Sector: Commerce	0.163	
Sector: Catering	0.049	
Sector: Transport and communication	0.057	
Sector: Finance	0.036	
Sector: Professional services	0.105	
Sector: Government	0.041	
Sector: Education	0.098	
Sector: Health Care	0.115	
Sector: Other Services	0.039	
Percentage of employment	0.940	0.162
Observed tenure (months)	15.654	15.113

Data source: SONAR c78 (23), c78 (26), and c80 (23), own calculations; N = 4389.

Appendix C: Alternative specifications with respect to tenure

Table C1: The relationship between formal education and skill acquisition: logit coefficients – specification without tenure residual

	Any skill acquisition			*Transferable or general skill acquisition*			*General skill acquisition*		
	Standard logit	Occupation random effects	Occupation fixed effects	Standard logit	Occupation random effects	Occupation fixed effects	Standard logit	Occupation random effects	Occupation fixed effects
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Years of education	0.102***			0.098***			0.052**		
Years of required education		0.204***			0.193***			0.102***	
Years of over-education		-0.012	-0.017		-0.024	-0.042		-0.010	-0.039
Years of under-education		-0.107**	-0.113**		-0.118***	-0.121***		-0.048	-0.058
Individuals	4389	4389	3997	4389	4389	4074	4389	4389	4159
Groups (Occupations)		376	206		376	219		376	236
Chi²	481.0***	401.7***	183.6***	458.2***	396.7***	156.8***	188.2***	181.5***	77.8***
	(4)	(5)	(6)	(4)	(5)	(6)	(4)	(5)	(6)
Years of education	0.100***			0.096***			0.045**		
Years of required education		0.205***			0.190***			0.092***	
Years of over-education		-0.021	-0.057		-0.032	-0.092**		-0.016	-0.082**
Years of under-education		-0.097*	-0.101		-0.105**	-0.095		-0.024	-0.032
Years of education * general program	0.005			0.006			0.017***		
Years of req. educ. * general program		-0.001			0.002			0.019**	
Years of over-educ. * general program		0.029	0.103*		0.024	0.115**		0.011	0.075
Years of under-educ. * general progr.		-0.022	-0.065		-0.028	-0.091		-0.058	-0.057
Individuals	4389	4389	3584	4389	4389	3786	4389	4389	3896
Groups (occupations)		596	264		596	302		596	322
Chi²	481.7***	520.1***	182.1***	459.2***	456.6***	159.8***	198.8***	187.8***	76.1***

Also included, but not reported: dummies for gender (1 dummy), non-European descent (1), cohort (1), region of employment (5), firm size (3), industry (11), public sector worker (1), contract type (3), student work experience (1), age, percentage of employment (full-time = 100%), tenure and tenure squared; Data source: SONAR 1978(23), 1978(26) and 1980(23), own calculations; *: p <.10; **: p < .05; ***: p < .01.

Table C2: The relationship between formal education and skill acquisition: logit coefficients – specification without tenure controls

	Any skill acquisition			*Transferable or general skill acquisition*			*General skill acquisition*		
	Standard logit	Occupation random effects	Occupation fixed effects	Standard logit	Occupation random effects	Occupation fixed effects	Standard logit	Occupation random effects	Occupation fixed effects
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Years of education	0.097***			0.094***			0.050**		
Years of required education		0.202***			0.194***			0.102***	
Years of over-education		-0.025	-0.017		-0.034	-0.042		-0.014	-0.039
Years of under-education		-0.107***	-0.113**		-0.117***	-0.121***		-0.046	-0.058
Individuals	4389	4389	3997	4389	4389	4074	4389	4389	4159
Groups (Occupations)		376	206		376	219		376	236
Chi²	346.5***	283.7***	183.6***	358.7***	318.2***	156.8***	172.4***	173.2***	77.8***
	(4)	(5)	(6)	(4)	(5)	(6)	(4)	(5)	(6)
Years of education	0.096***			0.093***			0.044**		
Years of required education		0.204***			0.191***			0.092***	
Years of over-education		-0.029	-0.062		-0.038	-0.095**		-0.020	-0.084**
Years of under-education		-0.103*	-0.102		-0.110**	-0.101*		-0.026	-0.035
Years of education * general program	0.001			0.003			0.016***		
Years of req. educ. * general program		-0.001			0.000			0.018**	
Years of over-educ. * general program		0.016	0.081		0.017	0.099*		0.009	0.067
Years of under-educ. * general progr.		-0.013	-0.039		-0.014	-0.066		-0.051	-0.047
Individuals	4389	4389	3584	4389	4389	3786	4389	4389	3896
Groups (occupations)		596	264		596	302		596	322
Chi²	346.5***	359.7***	96.7***	359.0***	386.7***	97.1***	181.6***	177.1***	62.8***

Also included, but not reported: dummies for gender (1 dummy), non-European descent (1), cohort (1), region of employment (5), firm size (3), industry (11), public sector worker (1), contract type (3), student work experience (1), age, and percentage of employment (full-time = 100%); Data source: SONAR 1978(23), 1978(26) and 1980(23), own calculations; *: p <.10; **: p < .05; ***: p < .01.

Appendix D: Full estimation results

Table D1: Overall skill acquisition: Logit coefficients and standard errors

	STANDARD LOGIT		OCCUPATION RANDOM EFFECTS		OCCUPATION FIXED EFFECTS	
Years of education	0,101***	(,022)				
Years of required education			0,209***	(,027)		
Years of over-education			-0,022	(,032)	-0,055	(,041)
Years of under-education			-0,095*	(,055)	-0,096	(,066)
Years of education * general program	0,002	(,006)				
Years of req. educ. * general program			-0,002	(,009)		
Years of over-educ. * general program			0,028	(,029)	0,095*	(,057)
Years of under-educ. * general program			-0,021	(,081)	-0,065	(,097)
Male	0,501***	(,083)	0,444***	(,085)	0,309***	(,107)
Non-western background	0,164	(,164)	0,189	(,167)	0,244	(,181)
Age	0,003	(,050)	0,014	(,052)	0,000	(,056)
Cohort: born in 1980	-0,058	(,075)	-0,035	(,076)	-0,011	(,085)
Student job experience	0,160*	(,095)	0,191**	(,096)	0,200*	(,106)
Percentage of employment	0,004	(,003)	0,000	(,003)	-0,002	(,003)
Type of contract: permanent (ref.)						
Type of contract: fixed term	-0,351***	(,134)	-0,218	(,135)	-0,203	(,153)
Type of contract: casual/seasonal	-0,885***	(,191)	-0,450**	(,188)	-0,507**	(,214)
Type of contract: employment measure	-0,518**	(,252)	-0,260	(,256)	-0,134	(,294)
Region of employment: Antwerp (ref.)						
Region of employment: Limburg	0,072	(,120)	0,045	(,122)	0,171	(,132)
Region of employment: Eastern Flanders	0,049	(,108)	0,064	(,110)	0,133	(,118)
Region of employment: Western Flanders	-0,167	(,110)	-0,168	(,112)	-0,017	(,123)
Region of employment: Flemish Brabant	0,020	(,124)	0,027	(,127)	0,057	(,140)
Region of employment: Brussels	0,145	(,165)	0,038	(,168)	0,156	(,189)
Firm size: < 10 workers (ref.)						
Firm size: 10 – 49 workers	-0,231**	(,104)	-0,138	(,106)	-0,084	(,118)
Firm size: 50 – 249 workers	-0,114	(,115)	-0,016	(,117)	0,104	(,135)
Firm size: > 249 workers	0,074	(,133)	0,148	(,136)	0,222	(,157)
Sector: Industry (ref.)						
Sector: Agriculture, mining & fishing	-0,106	(,350)	0,035	(,353)	0,640	(,576)
Sector: Construction	0,808***	(,203)	0,736***	(,204)	0,698**	(,282)
Sector: Commerce	-0,174	(,123)	-0,075	(,125)	0,184	(,160)
Sector: Catering	-0,132	(,187)	-0,027	(,189)	0,163	(,299)
Sector: Transport and communication	0,358**	(,182)	0,410**	(,186)	0,662***	(,240)
Sector: Finance	0,341	(,238)	0,207	(,242)	0,101	(,337)
Sector: Professional services	0,225	(,151)	0,093	(,158)	0,256	(,193)
Sector: Government	0,082	(,240)	-0,127	(,246)	-0,110	(,304)
Sector: Education	0,612***	(,212)	-0,010	(,222)	-0,184	(,367)
Sector: Health Care	0,367**	(,155)	0,013	(,161)	-0,011	(,260)
Sector: Other Services	0,214	(,209)	0,080	(,213)	-0,146	(,285)
Public sector	0,037	(,151)	-0,030	(,153)	-0,071	(,170)
Tenure (years)	0,535***	(,174)	0,630***	(,175)	0,572***	(,198)
Tenure^2	-0,009***	(,002)	-0,008***	(,002)	-0,007***	(,002)
Residual first stage tenure regression	0,313*	(,164)	0,148	(,165)	0,131	(,187)
Intercept	-1,129	(1,067)	-2,196**	(1,074)		

Data source: SONAR c78(23), c78(26), and c80(23), own calculations; N = 4389.

Table D2: Transferable or general skill acquisition: Logit coefficients and standard errors

	STANDARD LOGIT		OCCUPATION RANDOM EFFECTS		OCCUPATION FIXED EFFECTS	
Years of education	0,097***	(,021)				
Years of required education			0,196***	(,026)		
Years of over-education			-0,033	(,031)	-0,088**	(,040)
Years of under-education			-0,101**	(,051)	-0,087	(,060)
Years of education * general program	0,003	(,006)				
Years of req. educ. * general program			0,000	(,009)		
Years of over-educ. * general program			0,021	(,031)	0,100*	(,055)
Years of under-educ. * general program			-0,028	(,075)	-0,091	(,089)
Male	0,317***	(,078)	0,250***	(,081)	0,150	(,100)
Non-western background	0,104	(,154)	0,121	(,157)	0,187	(,172)
Age	0,018	(,047)	0,027	(,049)	0,014	(,052)
Cohort: born in 1980	-0,135*	(,070)	-0,115	(,071)	-0,087	(,079)
Student job experience	0,213**	(,088)	0,238***	(,090)	0,249**	(,098)
Percentage of employment	0,005*	(,003)	0,001	(,003)	0,000	(,003)
Type of contract: permanent (ref.)						
Type of contract: fixed term	-0,375***	(,125)	-0,261**	(,126)	-0,278**	(,142)
Type of contract: casual/seasonal	-0,970***	(,180)	-0,583***	(,178)	-0,644***	(,200)
Type of contract: employment measure	-0,357	(,240)	-0,117	(,244)	-0,069	(,276)
Region of employment: Antwerp (ref.)						
Region of employment: Limburg	0,129	(,113)	0,111	(,115)	0,215*	(,123)
Region of employment: Eastern Flanders	0,004	(,099)	0,016	(,102)	0,060	(,109)
Region of employment: Western Flanders	-0,134	(,103)	-0,136	(,105)	-0,040	(,116)
Region of employment: Flemish Brabant	0,019	(,115)	0,023	(,117)	0,017	(,129)
Region of employment: Brussels	0,226	(,152)	0,135	(,155)	0,173	(,172)
Firm size: < 10 workers (ref.)						
Firm size: 10 – 49 workers	-0,125	(,097)	-0,035	(,099)	0,022	(,110)
Firm size: 50 – 249 workers	0,082	(,107)	0,184*	(,111)	0,312**	(,125)
Firm size: > 249 workers	-0,024	(,121)	0,049	(,126)	0,200	(,144)
Sector: Industry (ref.)						
Sector: Agriculture, mining & fishing	-0,383	(,321)	-0,250	(,328)	-0,300	(,535)
Sector: Construction	0,554***	(,169)	0,503***	(,173)	0,511**	(,244)
Sector: Commerce	-0,074	(,117)	0,018	(,122)	0,163	(,151)
Sector: Catering	-0,042	(,179)	0,079	(,192)	0,240	(,288)
Sector: Transport and communication	0,358**	(,167)	0,392**	(,173)	0,393*	(,219)
Sector: Finance	0,341	(,216)	0,210	(,222)	0,084	(,314)
Sector: Professional services	0,188	(,140)	0,039	(,148)	0,017	(,181)
Sector: Government	0,191	(,223)	-0,020	(,231)	-0,165	(,285)
Sector: Education	0,644***	(,196)	0,048	(,212)	-0,182	(,333)
Sector: Health Care	0,388***	(,145)	0,038	(,157)	-0,119	(,248)
Sector: Other Services	0,255	(,196)	0,113	(,204)	-0,062	(,273)
Public sector	-0,056	(,139)	-0,120	(,142)	-0,113	(,157)
Tenure (years)	0,321**	(,160)	0,390**	(,162)	0,366**	(,182)
Tenure^2	-0,008***	(,002)	-0,007***	(,002)	-0,007***	(,002)
Residual first stage tenure regression	0,388**	(,154)	0,253	(,155)	0,240	(,174)
Intercept	-1,546	(,998)	-2,432**	(1,010)		

Data source: SONAR c78(23), c78(26), and c80(23), own calculations; N = 4389.

Table D3: General skill acquisition: Logit coefficients and standard errors

	STANDARD LOGIT		OCCUPATION RANDOM EFFECTS		OCCUPATION FIXED EFFECTS	
Years of education	0,044 **	(,022)				
Years of required education			0,095 ***	(,026)		
Years of over-education			-0,018	(,033)	-0,077 *	(,042)
Years of under-education			-0,020	(,053)	-0,021	(,060)
Years of education * general program	0,014 ***	(,005)				
Years of req. educ. * general program			0,017 **	(,008)		
Years of over-educ. * general program			0,008	(,034)	0,055	(,057)
Years of under-educ. * general program			-0,057	(,076)	-0,056	(,086)
Male	0,151 **	(,075)	0,143 *	(,079)	0,214 **	(,095)
Non-western background	-0,164	(,162)	-0,171	(,165)	-0,139	(,175)
Age	0,039	(,043)	0,037	(,044)	0,014	(,048)
Cohort: born in 1980	0,005	(,069)	0,028	(,070)	0,056	(,077)
Student job experience	0,104	(,091)	0,112	(,093)	0,110	(,099)
Percentage of employment	0,005 **	(,003)	0,004	(,003)	0,004	(,003)
Type of contract: permanent (ref.)						
Type of contract: fixed term	-0,201 *	(,116)	-0,156	(,117)	-0,259 **	(,131)
Type of contract: casual/seasonal	-0,639 ***	(,170)	-0,459 ***	(,168)	-0,589 ***	(,189)
Type of contract: employment measure	-0,174	(,229)	-0,051	(,232)	-0,194	(,262)
Region of employment: Antwerp (ref.)						
Region of employment: Limburg	-0,015	(,112)	-0,018	(,114)	0,067	(,122)
Region of employment: Eastern Flanders	0,127	(,096)	0,155	(,098)	0,235 **	(,105)
Region of employment: Western Flanders	-0,171 *	(,103)	-0,164	(,105)	-0,083	(,114)
Region of employment: Flemish Brabant	-0,050	(,109)	-0,043	(,111)	0,023	(,122)
Region of employment: Brussels	0,153	(,132)	0,120	(,135)	0,152	(,150)
Firm size: < 10 workers (ref.)						
Firm size: 10 – 49 workers	0,012	(,096)	0,060	(,099)	0,037	(,109)
Firm size: 50 – 249 workers	0,164	(,104)	0,228 **	(,108)	0,342 ***	(,120)
Firm size: > 249 workers	0,150	(,117)	0,217 *	(,122)	0,333 **	(,139)
Sector: Industry (ref.)						
Sector: Agriculture, mining & fishing	-0,382	(,353)	-0,302	(,364)	-0,441	(,578)
Sector: Construction	-0,105	(,162)	-0,144	(,169)	-0,377 *	(,226)
Sector: Commerce	-0,019	(,119)	-0,001	(,126)	-0,134	(,153)
Sector: Catering	-0,087	(,186)	0,015	(,203)	-0,182	(,301)
Sector: Transport and communication	0,279 *	(,155)	0,281 *	(,161)	-0,084	(,206)
Sector: Finance	0,208	(,189)	0,159	(,198)	0,001	(,281)
Sector: Professional services	0,083	(,133)	0,008	(,140)	-0,147	(,169)
Sector: Government	0,180	(,210)	0,035	(,218)	-0,387	(,269)
Sector: Education	0,132	(,180)	-0,131	(,200)	-0,352	(,296)
Sector: Health Care	-0,250 *	(,144)	-0,376 **	(,161)	-0,514 **	(,243)
Sector: Other Services	-0,068	(,194)	-0,105	(,204)	-0,271	(,274)
Public sector	0,032	(,131)	-0,009	(,133)	0,000	(,148)
Tenure (years)	0,050	(,145)	0,071	(,145)	0,019	(,164)
Tenure^2	-0,004 ***	(,002)	-0,003 **	(,002)	-0,004 **	(,002)
Residual first stage tenure regression	0,279 **	(,141)	0,227	(,141)	0,298 *	(,159)
Intercept	-2,657 ***	(,912)	-3,081 ***	(,921)		

Data source: SONAR c78(23), c78(26), and c80(23), own calculations; N = 4389.

Appendix E: The relationship between formal education and skill acquisition using alternative definitions for the orientation of the study program: Logit coefficients and standard errors (in parentheses)

	Any skill acquisition			*Transferable or general skill acquisition.*			*General skill acquisition*		
	STANDARD LOGIT	OCCUPATION RANDDOM EFFECTS	OCCUPATION FIXED EFFECTS	STANDARD LOGIT	OCCUPATION RANDDOM EFFECTS	OCCUPATION FIXED EFFECTS	STANDARD LOGIT	OCCUPATION RANDDOM EFFECTS	OCCUPATION FIXED EFFECTS
Definition: GENA1	(4)	(5)	(6)	(4)	(5)	(6)	(4)	(5)	(6)
YEDUC	0.102*** (.022)			0.098*** (.021)			0.051** (.022)		
YREQE		0.210*** (.028)			0.202*** (.026)			0.108*** (.026)	
YOVER		-0.023 (.031)	-0.056 (.037)		-0.038 (.030)	-0.085** (.036)		-0.024 (.032)	-0.072* (.038)
YUNDER		-0.067 (.054)	-0.064 (.061)		-0.076 (.049)	-0.063 (.056)		-0.042 (.051)	-0.043 (.058)
*YEDUC*GENA1*	0.005 (.007)			0.003 (.006)			0.011** (.006)		
*YREQE*GENA1*		-0.001 (.010)			-0.003 (.009)			0.007 (.008)	
*YOVER*GENA1*		0.042 (.034)	0.136** (.063)		0.048 (.034)	0.112** (.060)		0.043 (.035)	0.117* (.063)
*YUNDER*GENA1*		-0.100 (.085)	-0.165 (.103)		-0.100 (.078)	-0.183* (.096)		-0.013 (.078)	-0.029 (.090)
Individuals	4389	4389	3592	4389	4389	3793	4389	4389	3938
Groups		598	259		598	294		598	320
Chi²	485.8***	455.6***	180.8***	465.7***	426.3***	162.6***	199.1***	188.2***	81.5***
Definition: GENA2	(4)	(5)	(6)	(4)	(5)	(6)	(4)	(5)	(6)
YEDUC	0.099*** (.023)			0.094*** (.022)			0.038* (.022)		
YREQE		0.206*** (.029)			0.194*** (.028)			0.089*** (.027)	
YOVER		-0.036 (.035)	-0.058 (.046)		-0.046 (.034)	-0.111** (.045)		-0.028 (.036)	-0.063 (.048)
YUNDER		-0.100* (.058)	-0.090 (.068)		-0.088* (.053)	-0.092 (.063)		-0.010 (.055)	0.029 (.061)
*YEDUC*GENA2*	0.004 (.007)			0.005 (.006)			0.011* (.006)		
*YREQE*GENA2*		-0.003 (.010)			0.001 (.009)			0.012 (.008)	
*YOVER*GENA2*		0.041 (.033)	0.089 (.059)		0.034 (.032)	0.119** (.056)		0.015 (.033)	0.020 (.059)
*YUNDER*GENA2*		-0.018 (.082)	-0.073 (.095)		-0.057 (.075)	-0.090 (.088)		-0.061 (.075)	-0.134 (.085)
Individuals	4389	4389	3633	4389	4389	3808	4389	4389	3949
Groups		590	263		590	298		590	326
Chi²	485.6***	436.6***	182.7***	466.3***	428.7***	166.0***	198.7***	190.8***	84.7***

YEDUC = years of education, *YREQE* = years of required education, *YOVER* = years of over-education, *YUNDER* = years of under-education, *GENA1* = dummy for general study program orientation, based on one month of work-placement experience; *GENA2* = dummy for general study program orientation, based on six month of work-placement experience; Also included, but not reported: cf. table 3. Data source: SONAR c78(23), c78(26), and c80(23), own calculations; N = 4390.

Appendix F: Estimates relying on more aggregate occupations

Table F1: The relationship between formal education and skill acquisition: logit coefficients – occupation fixed effects

	Any skill acquisition	*Transferable or general skill acquisition*	*General skill acquisition*
	(3)	(3)	(3)
Years of over-education	-0.018	-0.045	-0.042
Years of under-education	-0.103**	-0.108***	-0.062
Individuals	4207	4255	4283
Groups (occupations)	138	144	150
Chi²	194.6***	161.2***	80.8***
	(6)	(6)	(6)
Years of over-education	-0.050	-0.084**	-0.065
Years of under-education	-0.106*	-0.097*	-0.050
Years of over-education * general program	0.082	0.092*	0.041
Years of under-education * general program	-0.034	-0.048	-0.045
Individuals	4026	4127	4128
Groups (occupations)	206	224	230
Chi²	190.5***	161.8***	80.0***

Also included, but not reported: cf. Table 3; Data source: SONAR 1978(23), SONAR 1978(26), and SONAR 1980(23), own calculations; * p <.10; **: p < .05; ***: p < .01.

Appendix G: Occupation random-effects estimates – alternative specification with occupation mean years of over- and under-education

Table G1: The relationship between formal education and skill acquisition: logit coefficients – occupation random effects

	Any skill acquisition	*Transferable or general skill acquisition*	*General skill acquisition*
Years of required education	0.201***	0.227***	0.173***
Years of over-education	-0.012	-0.036	-0.045
Years of under-education	-0.106**	-0.117***	-0.046
Mean (Years of over-education)	-0.009	0.064	0.154***
Mean (Years of under-education)	-0.001	0.005	-0.004
Individuals	4389	4389	4389
Groups (occupations)	376	376	376
Chi²	400.0***	402.1***	193.1***
Years of required education	0.213***	0.230***	0.153***
Years of over-education	-0.056	-0.090**	-0.077*
Years of under-education	-0.090	-0.082	-0.023
Years of required ed.*general program	-0.002	-0.002	0.019**
Years of over-ed. * general program	0.094*	0.107*	0.061
Years of under-ed. * general program	-0.057	-0.101	-0.068
Mean (Years of over-education)	0.056	0.131**	0.180***
Mean (Years of under-education)	-0.034	-0.100	0.012
Mean (Years of over-ed. * general program)	-0.089	-0.117*	-0.079
Mean (Years of under-ed. * general progr.)	0.174	0.321*	0.013
Individuals	4389	4389	4389
Groups (occupations)	376	376	376
Chi²	500.0***	467.1***	198.6***

Also included, but not reported: cf. Table 3; Data source: SONAR 1978(23), SONAR 1978(26), and SONAR 1980(23), own calculations; * p <.10; **: p < .05; ***: p < .01.

Appendix H: Control function approach estimates

Table H1: First stage estimates: linear regression coefficients and standard errors (in parentheses)

	Years of education		*Years of required education*	
Number of siblings	-0,092 ***	(,026)	-0,058 *	(,030)
Education father: < Lower secondary (ref.)				
Education father: Lower secondary	0,536 ***	(,126)	0,227	(,152)
Education father: Higher secondary	0,688 ***	(,122)	0,356 **	(,165)
Education father: Lower tertiary	1,191 ***	(,162)	0,254	(,249)
Education father: Higher tertiary	1,284 ***	(,177)	0,398	(,263)
Occupation father: workless / no father in the family (ref.)				
Occupation father: elementary level job	0,049	(,197)	0,090	(,211)
Occupation father: lower level job	-0,020	(,150)	-0,117	(,161)
Occupation father: Medium level job	0,289 **	(,147)	-0,049	(,162)
Occupation father: Higher level job	0,397 **	(,171)	0,132	(,192)
Occupation father: Scientific level job	0,838 ***	(,205)	-0,244	(,242)
Education mother: < Lower secondary (ref.)				
Education mother: Lower secondary	0,515 ***	(,122)		
Education mother: Higher secondary	0,778 ***	(,116)		
Education mother: Lower tertiary	1,370 ***	(,138)		
Education mother: Higher tertiary	0,850 ***	(,217)		
Willingness to accept work at a lower level than originally aimed			-0,188 **	(,095)
Willingness to accept shift work			-0,103	(,090)
Willingness to accept physically demanding work			-0,261 ***	(,097)
Willingness to accept assembly line work			-0,094	(,127)
Willingness to accept work with irregular working hours			0,240 ***	(,087)
Willingness to accept work that requires a further training of six months			0,053	(,082)
Male	-0,854 ***	(,067)	0,536 ***	(,122)
Non-western background	-0,429 **	(,179)	0,153	(,205)
Age			0,162 ***	(,029)
Cohort: born in 1980	-0,384 ***	(,068)	-0,075	(,084)
Region of residence: Antwerp (ref.)				
Region of residence: Limburg	0,383 ***	(,109)	-0,150	(,125)
Region of residence: Eastern Flanders	0,200 **	(,100)	-0,126	(,109)
Region of residence: Western Flanders	0,081	(,094)	-0,122	(,101)
Region of residence: Flemish Brabant	0,095	(,110)	-0,048	(,118)
Firm size: < 10 workers (ref.)				
Firm size: 10 – 49 workers			0,338 ***	(,121)
Firm size: 50 – 249 workers			-0,200 *	(,108)
Firm size: > 249 workers			-0,244 **	(,108)
Sector: Industry (ref.)				
Sector: Agriculture, mining & fishing			0,502	(,366)
Sector: Construction			0,847 ***	(,173)
Sector: Commerce			-0,126	(,127)
Sector: Catering			-0,102	(,191)
Sector: Transport and communication			0,341 **	(,173)
Sector: Finance			1,172 ***	(,206)
Sector: Professional services			1,348 ***	(,143)
Sector: Government			1,577 ***	(,238)
Sector: Education			3,060 ***	(,199)
Sector: Health Care			2,073 ***	(,153)
Sector: Other Services			1,025 ***	(,211)
Public sector			0,293 **	(,146)
Student work experience			-0,190 *	(,101)
Years of education			0,533 ***	(,108)
Years of education * general program			0,004	(,006)
Residual years of education first stage regression			-0,130	(,107)
Intercept	12,053 ***	(,185)	-0,096	(1,381)
R^2	0,222		0.459	

Data source: SONAR c78(23), c78(26), and c80(23), own calculations; *: p <.10; **: p < .05; ***: p < .01; N = 3513.

Table H2: Second stage estimates: logit coefficients and standard errors (in parentheses)

	Any skill acquisition			*Transferable or general skill acquisition*			*General skill acquisition*		
	STANDARD LOGIT	OCCUPATION RANDDOM EFFECTS	OCCUPATION FIXED EFFECTS	STANDARD LOGIT	OCCUPATION RANDDOM EFFECTS	OCCUPATION FIXED EFFECTS	STANDARD LOGIT	OCCUPATION RANDDOM EFFECTS	OCCUPATION FIXED EFFECTS
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
YEDUC	0.128** (.056)			0.119** (.052)			0.114** (.051)		
YREQE		0.197** (.083)			0.177** (.077)			0.199*** (.075)	
YOVER		-0.051 (.136)	-0.089 (.145)		-0.043 (.125)	-0.091 (.134)		-0.082 (.117)	-0.030 (.124)
YUNDER		-0.108 (.140)	-0.057 (.150)		-0.115 (.129)	-0.075 (.138)		-0.002 (.120)	-0.058 (.128)
WTRAINING	0.303*** (.087)	0.370*** (.089)	0.418*** (.093)	0.353*** (.081)	0.406*** (.082)	0.434*** (.086)	0.488*** (.080)	0.494*** (.080)	0.487*** (.084)
YEDUC residual	-0.020 (.054)	0.025 (.073)	0.031 (.078)	-0.018 (.050)	0.020 (.067)	0.031 (.072)	-0.069 (.048)	-0.011 (.062)	-0.028 (.066)
YREQE residual		-0.031 (.181)	-0.085 (.191)		-0.002 (.167)	-0.039 (.178)		-0.168 (.158)	-0.040 (.166)
Individuals	3513	3513	3132	3513	3513	3223	3513	3513	3304
Groups		345	181		345	198		345	213
Chi²	407.1***	347.1***	166.6***	398.5***	408.4***	164.0***	212.5***	218.9***	117.6***
	(4)	(5)	(6)	(4)	(5)	(6)	(4)	(5)	(6)
YEDUC	0.131** (.057)			0.119** (.053)			0.104** (.052)		
YREQE		0.198** (.084)			0.176** (.079)			0.186** (.077)	
YOVER		-0.051 (.135)	-0.178 (.153)		-0.051 (.125)	-0.146 (.142)		-0.083 (.118)	-0.089 (.133)
YUNDER		-0.097 (.147)	0.022 (.166)		-0.099 (.136)	-0.003 (.154)		-0.005 (.129)	-0.038 (.142)
*YEDUC*GEN*	-0.002 (.007)			0.000 (.006)			0.008 (.006)		
*YREQE*GEN*		-0.003 (.010)			-0.001 (.009)			0.009 (.008)	
*YOVER*GEN*		0.011 (.033)	0.100 (.069)		0.011 (.032)	0.096 (.065)		-0.005 (.034)	0.059 (.067)
*YUNDER*GEN*		-0.021 (.091)	-0.074 (.110)		-0.027 (.085)	-0.114 (.102)		0.008 (.087)	0.034 (.099)
WTRAINING	0.304*** (.087)	0.356*** (.088)	0.460*** (.097)	0.353*** (.081)	0.391*** (.082)	0.448*** (.089)	0.485*** (.080)	0.492*** (.081)	0.511*** (.087)
YEDUC residual	-0.022 (.055)	0.026 (.072)	0.057 (.080)	-0.018 (.051)	0.024 (.067)	0.046 (.074)	-0.060 (.049)	-0.005 (.062)	-0.018 (.068)
YREQE residual		-0.027 (.181)	-0.144 (.200)		-0.002 (.168)	-0.043 (.185)		-0.163 (.160)	-0.069 (.174)
Individuals	3513	3513	2776	3513	3513	2989	3513	3513	3088
Groups		545	234		545	271		545	290
Chi²	407.2***	419.2***	169.5***	398.5***	424.1***	166.0***	215.7***	214.2***	115.0***

SA-S/T/G = any skill acquisition, *SA-T/G* = transferable of general skill acquisition, *SA-G* = general skill acquisition, *YEDUC* = years of education, *YREQE* = years of required education, *YOVER* = years of over-education, *YUNDER* = years of under-education, *GEN* = dummy for general study program orientation; *WTRAINING* = dummy that indicates if the individual is willing to accept work that requires a further training of six months. Also included in every specification, but not reported: cf. table 3. Data source: SONAR c78(23), c78(26), and c80(23), own calculations; *: p <.10; **: p < .05; ***: p < .01.

Notes

[1] Also, Barron et al. (1989) link job matching to training. However, the supposed complementarity between ability and training is more related to Thurow's arguments.

[2] Knight (1979) developed a similar occupational production function approach but only focused on education as a factor of human capital.

[3] In another paper by McMillen et al. (2007), it was found that over-education has a positive impact on training participation. However, they included not only years of education but also job level dummies as control variables in their training participation equations. Hence, given that over-education is also associated with working at a lower job level, it is not fully clear whether or not over-educated workers indeed receive more training than adequately educated workers with similar years of education.

[4] The response rate for this follow-up was 71.2%. For the 1980 cohort, a follow-up was conducted at age 29. Yet, these data were not yet available at the time of the research.

[5] In the SONAR data, the first job is defined as the first standard job with a working week of at least one hour/week and tenure of at least one month. A standard job is defined as a paid job with a temporary or permanent contract or being self-employed. Excluded are employment with a student work contract, holiday work, apprenticeship contracts, employment as part of a work placement and informal work.

[6] We also executed some estimates relying on first jobs with tenure of at least two months (expressed in full-time equivalents). This delivered very similar outcomes.

[7] About 14.4% of those with a first job observation had a higher tertiary degree. If we restrict the sample to the 1978 cohort, this percentage increases to about 19.1%.

[8] An alternative would be to estimate a simple pooled regression. As shown in Appendix A, this results in conclusions that are largely similar to those based on the random-effects model. Yet, the estimated intra-class variation is regularly found to be significantly different from zero.

[9] The linearity in years of over- and under-education might also be questioned. Therefore, we executed estimates relying on over- and under-education dummies. Conversely to the fixed-effects model based on years, the fixed-effects model based on mismatch dummies did not reveal a statistically significant effect of over-education on transferable of general skill acquisition. However, the year specification delivered a higher likelihood than the dummy specification.

[10] We do not include a separate *GEN* dummy in our equations because there is a strong collinearity between this dummy and its interaction effect with years of education (correlation = 0.975). Hence, it is assumed that the effect of the orientation of the study program is proportional to the length of the program.

[11] Within this context, it could be argued that over- and under-qualification are better terminologies than over- and under-education. However, over- and under-qualification might also refer to qualifications outside formal education. Moreover, in the literature, both terms are often used interchangeably.

[12] Lower secondary education consists of two different tracks: general and vocational education.

[13] Higher secondary education consists of four different tracks: general, technical, vocational and art education. Those who ended their education in the art track were excluded from the sample. From 16 years, it is possible to follow the vocational track either on a full-time basis or on an apprenticeship basis. In the apprenticeship system, individuals get a certificate both for the school-based part and for the work-based part. Only those with both certificates are assigned to have a higher secondary education degree.

[14] Lower tertiary education degrees are provided by so-called "hogescholen". Before the introduction of the bachelor's and master's degrees in 2004, universities did not provide lower tertiary degrees. Although students got a so-called "candidate degree" after two years, this was never perceived as being a full lower tertiary education degree.

[15] Higher tertiary education degrees can be earned both at a "hogeschool" and at university.

[16] Karasiotou (2004) classified lower tertiary education as vocational and higher tertiary education as general education. However, several subjects at university, such as medicine, clearly have vocational orientations.

[17] The classification was originally developed for the Dutch labour market. Whereas similar jobs sometimes have different titles in Flanders and The Netherlands, this did not cause major problems since the CBS classification is based on tasks to be executed instead of job titles.

[18] Many individuals (32.4%) were still in their first job at the time of the survey. For these individuals, the question was slightly adapted and referred to the *current* job. In the survey at age 26, the question was only included for those who started in their first job between age 23 and age 26.

[19] It might seem odd that not 100% of the respondents answered positively on the question whether they acquired new skills in their first job. From an objective point of view, it might indeed be questionable whether it is possible to acquire no new skills in a job. Yet, the measure is subjective and will be influenced by an individual's expectation. Hence, to our opinion, a 'no' should simply be interpreted as a situation

whereby the volume of acquired skills is extremely low. An indication that this measure is indeed a valid measure for the extent of skill acquisition is that it is correlated with all types of training participation (see Verhaest and Omey, 2010).

[20] No information is available regarding the intensity of the informal types of training.

[21] The number of occupations with variation in years of over-education was 52.9%, representing 84.5% of all individuals in the sample. These figures for years of under-education were respectively 30.6% and 57.5%.

[22] As it can be argued that the choice of the contract is likely to be endogenously related to skill acquisition, we also executed some estimates without type of contract included. Yet, outcomes were similar.

[23] For summary statistics on these variables, see Appendix B.

[24] The procedure delivers consistent estimates of the original parameters up to a scaling constant. This is sufficient because we are not interested in the theoretical values of the parameters. For the reported marginal effects (Table 3 and 4), we rely on rescaled coefficients.

[25] In particular models with more than one endogenous variable deliver problems. Estimating our models using the ivprobit command in STATA 9.0, for instance, did not lead to convergence.

[26] Although potential tenure is a function of educational attainment, the correlation between years of education and potential tenure is far from perfect (-0.67). This stems, amongst others, from the difference in survey date (see SONAR, 2003, 2005). The survey was spread over several months, from December to April for the 1978 cohort and from September to December for the 1980 cohort. Moreover, to guarantee geographical representativeness, a small number of additional interviews were executed in the summer months for the 1978 cohort. Estimation results without control function and without any tenure related variables can be found in Appedix C. As shown, the statistical significance of some of the coefficients of interest changed somehow. However, our fundamental conclusions regarding the relationship between formal education and skill acquisition are unaffected.

[27] Because of lack of statistical significance, we did not include the educational level of the mother in this equation.

[28] Full estimation results can be found in Appendix D. The included residual terms are treated as observed values, so the reported standard errors are not adjusted. With respect to the simple two-stage probit model, there is some Monte Carlo evidence that there is no gain from calculating the more complex standard errors, as these adjusted standard errors are no more effective in large finite samples than the unadjusted standard errors (see Bollen et al., 1995).

[29] Marginal effects are computed at average values on the independent variables and average individual effects.

[30] Hausman-test results suggest that the fixed-effects estimates should be preferred. However, both types of estimates are reported, as the effects regarding years of required education can only be identified on the basis of the random-effects specification.

[31] Note that a Hausman-test failed to reject the random-effects model in this case. The test result changed, however, after exclusion of control variables that were not statistically significant in both the random- and fixed-effects model. This exclusion did not affect the statistical significance of years of overeducation, whereas its interaction effect with the general program dummy was just not significant at $p < 0.10$. Also separate estimates for vocationally- and generally-educated individuals revealed that overeducation has a negative impact for the first but not for the latter.

[32] Nevertheless, the impact of years of overeducation was not found to be statistically different from zero for generally-educated individuals.

[33] Another potential explanation is that vocationally educated individuals had already participated in training during their work placement or apprenticeship. Therefore, we also estimated models that included a variable measuring whether the individuals had a first job with a previous employer (apprenticeship, work placement, student job…). The effect of this variable was statistically insignificant, however, and the results for the other variables were not affected.