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ABSTRACT

Earnings over the Life Course: General versus Vocational Education*

Two common hypotheses regarding the relative benefits of vocational versus general education are (1) that vocational skills enhance relative short-term earnings and (2) that general skills enhance relative long-term earnings. Empirical evidence for these hypotheses has remained limited. Based on Swedish registry data of individuals in short (2-year) upper secondary school programs, this study provides a first exploration of individuals' earnings across nearly complete careers. The descriptive earnings patterns indicate support for both hypotheses (1) and (2). The support holds when controlling for GPA and family fixed effects and also when taking into account enrolment in further education and fertility decisions.

JEL Classification: J24, J64, J31, I20

Keywords: human capital, vocational education, life cycle, tracking

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* This article is forthcoming in the Journal of Human Capital. The authors gratefully acknowledge financial support from The Swedish Research Council and valuable feedback from two anonymous referees, Lena Lindahl, Jan Sauermann, and seminar participants at SOFI, RWI Network Conference on the Economics of Education, Berlin, and the Workshop on Educational Governance and Finance, Oslo, the SOLE meeting in Arlington, VA, the ESPE meeting in Braga and the EALE meeting in Ljubljana.

1 Introduction

One of the most striking differences between countries' educational systems lies in their emphases on vocational/specific and theoretical/general education.[1] In southern Europe, the US and the UK, modest shares of the student population attend vocational schools before age 18, whereas in other European countries (e.g., Austria, Germany, Slovakia, the Netherlands) students are tracked as early as age 10 or 12 and complete apprenticeships at the upper secondary level. These differences have historical reasons, but may also partially reflect our incomplete understanding of the expected relative returns of vocational and general education.

There are two widespread theoretical views that, in combination, yield ambiguous long-term implications (see, e.g., Brunello 2003, Hanushek et al. 2015, Korpi et al. 2003, Kreuger and Kumar 2004a, 2004b, Rosenbaum 2001, Shavit and Müller 1998, Wolter and Ryan 2011 and references therein). In the short term, vocational education is assumed to facilitate the transition from school to work, especially for students who are less academically inclined. In the long term, vocational education also entails the risk that the demand for the student's particular skill decreases at a future point in time. General education, however, is assumed to enhance the ability to learn new skills and to make individuals less sensitive to long-term changes in labor demand. Krueger and Kumar (2004a, 2004b) argue that the greater emphasis on general skills in the US relative to Europe provides a comparative advantage for the US, as general skills enhance one's ability to adopt new technologies. Although of clear interest to both labor economists and policy makers, the link between different types of intermediate education and long-term labor market outcomes has remained an underdeveloped area of research.

[1] We use the terms vocational and general to refer to these concepts. Schooling is in both cases "formal," leading to an official certificate that is acknowledged in the labor market.

The aim of this article is to compare the earnings trajectories over the life course associated with vocational and general education.[2] Specifically, we test the two dominant hypotheses: (1) in the *short term*, vocational education is associated with a relative earnings advantage; (2) in the *long term*, general education is associated with a relative earnings advantage. We use rich Swedish population register data to follow individuals who enrolled in either vocational or general 2-year upper secondary school programs between 1971 and 1979.[3] Annual earnings are observable from 1978, when the individuals were aged 15-23, until 2011, when they were aged 48-56. We perform our analyses for males and females separately, as educational choice displays strong gender patterns, and one would also expect earnings differences between genders to arise due to unequal household responsibilities (e.g., Mincer and Polachek 1974, Becker 1985).

One challenge when comparing outcomes of vocational and general education is that they are often linked to different opportunities for higher education. The programs we study involved the same amount of completed schooling, and the programs (whether general or vocational) were not intended to prepare for university studies. The issue of further education is analyzed in detail in Section 5.3. A second challenge for our study is that the track individuals choose to follow is endogenous. Hence, differences in earnings patterns may be the result of selection into these tracks. Our data enable us to explore family fixed effects and control for grade point average (GPA) at age 15, i.e., the year prior to enrollment in vocational or general education. We fully acknowledge that our model does not allow for estimates of causal effects, but we argue that *the*

[2] The contents of human capital investments may influence a plethora of outcomes, e.g., the probability of further education, unemployment patterns, occupational choices, migration, social status, health, fertility, democratic citizenship, etc. To maintain focus, we restrict the analyses to annual earnings. Other outcomes are essentially regarded as potential mechanisms influencing earnings.

[3] The 2-year general programs in Sweden are, albeit one year shorter (9+2), similar in contents to US high-school, whereas the 2-year vocational programs may be seen as a potential vocational alternative. The results of our analysis primarily concern individuals below the top quartile of the ability distribution.

pattern in our results is interesting, since it is difficult to explain on the basis of endogeneity, or at least it requires strong assumptions.

There is surprisingly limited research comparing the returns to vocational and general education. Some studies provide evidence that vocational education has a positive impact on the school-to-work transition relative to general education. Kemple and Scott-Clayton (2004) and Kemple and Willner (2008) explore a lottery procedure that assigned individuals in the US to either high schools or career academies (which include vocational schools). For individuals from socially disadvantaged families, participation in career academies was found to be linked to lower dropout rates and 11 percent higher earnings among males eight years after completion. Parey (2012) also explores a partially random variation to compare apprenticeship training and vocational education in Germany. Outcomes are measured at ages 23-26. The results again indicate a short-term advantage for schooling with the closest connection to practical work in the labor market. Apprenticeship training leads to a reduction in the risk of unemployment, but the effect fades out over time, and there are no effects on wage levels.

Concerning long-term effects, studies of comprehensive school reforms typically report that education has lasting effects on earnings (e.g., Angrist and Krueger 1991, Harmon and Walker 1995, Meghir and Palme 2005, Aakvik et al. 2010). In contrast, studies analyzing reforms that have expanded vocational education report no such effects (Hall 2012, Oosterbeek and Webbink 2007, Pischke and von Wachter 2008). Although merely suggestive, the results from these reform studies might indicate that long-term outcomes differ depending on curricula. Hall (2012) actually represents a hybrid between the two types of educational expansions and merits attention as it is also partially based on Swedish 2-year vocational programs.[4] Hall

[4] Pischke and von Wachter (2008) study an extension in Germany that was not identical across regions.

exploits a pilot scheme in which 2-year upper secondary vocational programs in some regions were expanded to three years (between 1987 and 1991). However, the curricula of the three-year programs constituted an increase in both general and vocational education. The 2-year programs included professional practice within the confines of school, no apprenticeship training, and 2-4 hours per week of general subjects. In the pilot programs, the amount of time allocated to general subjects was increased to 6-7 hours per week. Additionally, company-based apprenticeship training comprising 60 percent of the third year was introduced. The presented estimates of the three-year pilot scheme indicate no effects on earnings up and until age 34, but given that the pilot scheme involved an increase in both vocational and general schooling, the results are difficult to interpret in relation to educational content and in relation to the present study.

The only studies that we are aware of which directly address the long-term earnings effects of vocational vs. general education are Hanushek et al. (2016), Brunello and Rocco (2017), Dustmann et al. (2017) and Malamud and Pop-Eleches (2010). Hanushek et al. (2016) use cross-sectional data from 11 countries in the International Adult Literacy Survey (IALS). Controlling for cognitive skills, country fixed effects, years of schooling and parental background, they find a relative employment advantage for vocational skills, but this diminishes with age. Using German Microcensus data and Austrian administrative data, they also find a short-term advantage for vocational education, which tends to decline with age. The notion of a converging pattern in labor market outcomes is also supported by Brunello and Rocco (2017), using UK cohort data. Dustmann et al. (2014) analyze West German pupils born 1961-1976 who were marginal enrollees into either a vocational or a more advanced track, exploiting birth date as an exogenous source of variation. This evaluation does not only concern curricula *per se*, as eligibility for higher education was granted via the more advanced track. Individuals were

followed until 2006, when they were between the ages of 30 and 45, but no differences were found in terms of educational achievement or long-term labor market outcomes. The authors present evidence suggesting that the results are explained by the flexibility of the tracking system, which allowed individuals to correct (upgrade or downgrade) their initial choice.

Malamud and Pop-Eleches (2010) make an important contribution as they exploit a 1973 educational reform in Romania that enrolled cohorts under different sets of requirements. For the younger cohorts, entrance to vocational schools was delayed by the requirement to complete ten instead of eight years of general education. The authors provide evidence for males based on average earnings recorded in 1992, 1995, 2000 and 2002, when the individuals were 33-44 years old. Their results indicate that more years of general schooling decreased the likelihood of students entering manual or craft-related occupations but generated no differences in labor market participation or earnings. The identification strategy is very compelling, and it is interesting that the context of this study is an economy in transition, where the observation window includes a sharp recession in the mid-1990s. One might have expected both of these circumstances to favor a more flexible work force, i.e., one with more general rather than vocational schooling. It is possible that the compressed wage structure of the communist regime, which was in place until 1989, may have partially endured into the following decade. Additionally, a long-term advantage of general education may, to some extent, hinge on the prevalence of on-the-job-training. In 2002, the incidence of on-the-job-training in Romania was approximately 10 percent (on average, 7 hours per year), which was the lowest in Europe (OECD 2004). In contrast, in the Swedish case that we study, the incidence of on-the-job-training was one of the highest in Europe (60 percent, on average 33 hours per year). A slight drawback to the analyses of Malamud and Pop-Eleches is that there are no earnings observations

before 1992, i.e., from the first 15 years of work experience. As implied by Hanushek et al. (2016) and Brunello and Rocco (2017), it is possible that there was an initial advantage to vocational education, which was followed by converging earnings. In summary, when comparing vocational and general education, there is no coherent evidence as to whether short and long-term relative labor market outcomes differ.

The contribution of the present paper is to provide, for both males and females, the first representative picture of uninterrupted relative earnings as related to vocational and general education. As our data cover a large part of the working lives of our sample, we are able to assess whether relative outcomes differ in the short and the long term. For both males and females, our results imply support for hypothesis (1), i.e. vocational education is associated with an earnings advantage in the short term. In contrast with earlier studies, the results also support hypothesis (2), as the initial earnings difference gradually declines and develops into an earnings advantage for general education. Our analysis is descriptive in nature, which means we cannot exclude the possibility that omitted variables are partially driving our results. However, it is important to note that to dismiss our results on the grounds of endogeneity would require confounding factor(s) to generate bias in one direction in the short term but in the opposite direction in the long term. In the results section, we explicitly address mechanisms other than educational contents which could generate the results pattern. We argue that our results support both hypotheses (1) and (2), but we also emphasize that individual heterogeneity is a key motivation for offering educational tracks. Without knowing the extent to which individuals' schooling choices are based on comparative advantages, our estimates do not have direct policy implications. Rather, our results support an alleged trade-off between a comprehensive curriculum and specialized training. This implies that access to full earnings trajectories is

particularly important for any assessment of the relative benefits of general and vocational education. Without such data, results risk being misleading.

The paper proceeds as follows: Section 2 provides the institutional background, and Section 3 describes the data. The empirical model is presented in Section 4, and results are reported in Section 5. Section 6 concludes.

2 Institutional background

The Swedish setting may be described as one of moderate tracking, falling in between the light tracking of the US and the more rigorous tracking of continental Europe. When the oldest cohort in our sample (born in 1955) entered school at the age of seven, a compulsory nine-year comprehensive education had just been fully implemented in Sweden (in 1962). The reform extended the minimum number of schooling years from seven to nine (Meghir and Palme 2005), and was followed by an increased demand for upper secondary schooling. *Gymnasium* encompassed 3-year general programs (humanities, natural sciences, social sciences, business and engineering) that provided eligibility for university studies. The share of a cohort enrolled in *gymnasium* increased between 1950 and 1960 from 4 percent to 20 percent. The vocational educations (*yrkesskola*) also expanded and tripled the number of slots. In 1962, as a response to the increased demand for upper secondary schooling, the government established *fackskola* which offered 2-year general programs in business, social sciences and engineering. These programs were less specific than the vocational programs but more specific than the academic tracks and the compulsory school.

In 1971, the integrated *Gymnasieskola* was established and the three different forms of schooling were merged into one. This is what we will refer to as upper secondary school. Apart

from the existing academic 3-year programs, the integrated *Gymnasieskola* was organized into 2-year programs that included 14 vocational programs and the three 2-year general programs mentioned above. The intention was that 30 percent of a cohort would go on to the 3-year programs, 30 percent to the 2-year vocational tracks, and 20 percent to the 2-year general tracks, while the remaining 20 percent would move directly from compulsory school to the labor market (SOU 2008).

The general 3-year programs met the eligibility requirements for university education. For our purposes, the 2-year programs are of primary interest, as these could be either vocational or general, and neither of these categories fulfilled the eligibility criteria for conventional university studies (e.g., medicine, business, law etc.). Entering a university would require that students prolong their studies by either switching programs at some point or later returning to adult education institutes, known as *Komvux*. Komvux provides upper secondary school for adults returning to school, i.e., for dropouts or individuals who wish to complement their schooling. However, the 2-year programs did provide eligibility for short college degrees, classified as tertiary-level education, in fields such as physiotherapy, nursing and pre-school teaching. In the results section, we address further education as a potential indirect influence on our earnings estimates.

The tracks were commonly referred to as general or vocational, depending on whether the curricula included professional practica that were taught within the confines of school (i.e., not company based). Our stance is that all of the available subjects contain elements of both specific and general education. The differences in curricula are therefore described in the Appendix Table A.1. The purpose of this appendix is to clarify our classification and facilitate comparability with future studies from other settings. The most obvious vocational subjects are not taught in the

general programs but comprise 78 percent of the curricula in male-dominated vocational education and between 51 and 62 percent in the female-dominated programs. Conversely, the most obvious general subjects (math, language, social science, science) encompass almost two-thirds of the curricula in general programs but less than 10 percent of the curricula in the vocational programs.

3 Data

A novelty of this paper is that the analyses are based on population registry data from Upper Secondary School Application Records from 1971-1979, which have not previously been used in economic research. The registers provide GPAs from comprehensive school at age 15, i.e. prior to upper secondary school, for cohorts born during the period 1955-1963. There is also information on each student's program in upper secondary school and a personal identifying number that everyone in Sweden is assigned. The identifying number makes it possible to merge data with registers from Statistics Sweden containing annual earnings for each year from 1978 until 2011. The outcome of main interest is absolute earnings, including zero earners. We are also able to link siblings to one another via multiple-generation registers. The analyses are performed separately for males and females, as there are strong gender differences with respect to educational choice, and we expect systematic differences in lifecycle earnings due to career choice, career interruptions and household responsibilities (see, e.g., Mincer and Polachek 1974, Becker 1985).

Our samples consist of males and females who enrolled in an upper secondary school program in the autumn of the year they turn 16. During the period we study, the share of 16-year-olds attending upper secondary school increased from 60.0 percent in 1971 to 77.5 percent in

1979. The share of the enrollees in 2-year programs was stable during the period, between 60 and 62 percent. The total number of applicants in our registers is 741,501 individuals, of which 597,494 were accepted to an upper secondary school program. Their mean characteristics are displayed in Tables 1 and 2, for males and females, respectively. The first column contains the full sample of individuals accepted to a program. It is reduced in column (2) by approximately one-half, as we impose the restriction that individuals enroll in a 2-year program at age 16. Within this group, the share enrolled in a vocational program increased from about six out of ten in 1971 to seven out of ten in 1979. In column (3), only approximately one in six of these individuals remain, as they are required to have at least one same-sex full sibling, born during the period 1955-1963 and included in the sample (we exclude half-siblings). It is important to note that this restriction has little impact on the descriptive means. The last two columns (4 and 5) report the brother/sister samples separately according to educational paths, i.e., vocational or general (we refer to the samples as "males" and "females"). There are very strong gender patterns in vocational education. Males are concentrated in mechanical engineering (28 percent), vehicle engineering (15 percent), construction (21 percent) and electronics programs (16 percent). For females, the largest vocational programs are nursing (16 percent), office (30 percent) and consumer studies (47 percent), which include three alternative paths: health and social care, large-scale households and textiles.[5]

Grades in comprehensive school were set from 1 (lowest) to 5 (highest) in each subject. The GPA is the average from these subjects, and in the event that there were more applicants

[5] Since our empirical method is based on family fixed effects, Table A.2 in the Appendix displays descriptive averages of samples restricted to those with at least one same-sex sibling choosing a different educational path (general rather than vocational, or vice versa). These individuals will identify the parameters of interest. The sample includes approximately 8,000 males and 12,000 females. There are no substantial differences relative to the overall samples of brothers and sisters accounted for in Tables 1 and 2.

than seats, the GPA was used as a screening device. The GPA was at that time a relative measure of ability, presumed to be normally distributed with a mean of 3.0. As one would perhaps expect, the mean GPA is higher for those in general tracks, 3.05 versus 2.76 for males and 3.37 versus 3.16 for females (average grades are typically higher for girls). Figure 1 depicts the GPA distribution of same-sex siblings enrolled in vocational and general studies. While there are apparent differences in frequencies at the tails, there is also considerable overlap between the groups.[6]

Figure A.1 in the Appendix reports mean GPAs for the most popular educational tracks, revealing that individuals in 3-year programs (not used in our analyses) score higher than those in 2-year programs. The graph also indicates that there is substantial variation in mean GPAs for the different general tracks and among vocational tracks.

Figure 2 displays descriptive averages of earnings trajectories (2011 values) associated with enrollees in the vocational and general programs (SEK 100,000 was roughly $13,000 during the studied period). To the best of our knowledge, these trajectories represent a type of analysis that has not previously been presented. The averages are reported across calendar years (bottom panel) and across ages (top panel). For males, earnings are considerably higher for those who completed general education. The same impression, but with less pronounced differences, is conveyed by the averages for females. These differences may, of course, reflect the observed differences in ability (GPA) or differences in social background. At the beginning of the 1990s, there was a sharp recession in Sweden that is reflected in a visible decline in earnings for males in vocational education.[7] Otherwise, the average earnings of all groups reveal a consistent

[6] Our empirical analyses include samples in which individuals at GPA levels below 2.0 were excluded, due to the lack of overlap between the groups. The changes in results were marginal.
[7] Figure A.2 in the Appendix shows employment rates in Sweden 1970-2011.

increase during the observation window. This is presumably explained by the relatively high payoff for work experience during the first half of the period, as real wages remained nearly constant in Sweden from 1978-1995. From 1995 onward, real wages in Sweden increased by approximately 40 percent, which likely explains part of the continuous increase in annual earnings.

4 Hypotheses and empirical method

4.1 Skill types and hypotheses

Becker (1964) distinguished between general and firm-specific human capital, where the latter is non-transferable between firms. We consider both vocational/specific skills and general/theoretical skills to be transferable between employers, but we recognize that there are differences in the degree of transferability. Although not formalized into a model, it is often claimed that the relative earnings impacts of vocational and general educations are different in the short and long term.

It is rather straightforward to argue that vocational education has a relative advantage in the short term as it may simplify the transition from school to work (Mane 1999, Kemple and Scott-Clayton 2004, Fersterer et al. 2008, Kemple and Willner 2008, Parey 2012, Wolter and Ryan 2011). General skills have, by definition, no obvious link to a labor market niche. In the short term, this may slow the transition from school to work, with a higher degree of job-hopping before the individual finds her career path. This motivates our hypothesis (1): *in the short term*, vocational education is associated with an earnings advantage relative to general education.

General education is instead presumed to enhance both flexibility and the ability to acquire new skills. In the long term, this may generate a relative advantage compared with vocational

education (Shavit and Müller 1998, Brunello 2003, Rosenbaum 2001, Korpi et al. 2003, Krueger and Kumar 2004a, 2004b, Hanushek et al. 2016). For instance, if general skills reduce the costs of learning, the likelihood of receiving on-the-job-training will increase. This means that work experience (and possibly technological changes) could generate a long-term relative skill advantage for individuals with general education. In addition, a risk associated with vocational education is that the demand for a specific skill may decline at some future point in time and diminish long-run earnings returns. In sum, the long-term annual earnings of individuals with general education may catch up to or exceed those of individuals with vocational education. This motivates our hypothesis (2): *in the long term*, general education is associated with an earnings advantage relative to vocational education.

4.2 Selection into program types

Research in economics and sociology highlights ability level and family background as the two major factors determining educational choice. Vocational education is typically assumed to be more attractive for students of low ability, as it is less academically demanding and facilitates matching to a productive task (e.g., Brunello and Checchi 2007). The influences of ability and family are partly intertwined. Following the terminology of sociological research (e.g., Boudon 1974, Breen and Goldthorpe 1997), a *primary effect* is that children of advantaged social origins are more likely to perform well in school. The *secondary effect* is that, at a given level of performance, these children are also more likely to make more ambitious educational choices than their peers from a less advantaged social background. For example, poor families may exert greater pressure on their children to leave school and earn their own money. Alternatively, all children may strive for a social position that is at least at the level of their parents (Eriksson and

Jonsson 1996). It may therefore be rational for individuals with the same level of ability but different social backgrounds to make diverse educational choices.[8]

4.3 Econometric model

Our empirical model takes into account individuals' differences in social background and ability. Suppose enrolment in upper secondary school occurs at time *t*, and an outcome is observed post schooling at *t*+. Let us denote an outcome variable *Y* and a binary variable *D* that takes the value one if the upper secondary track is "Vocational" and zero if it is "General." The outcome for individual *i* in family *j* may then be described by the following model:

$$Y_{ijt+} = \alpha + \beta X_{ijt} + f_j + \gamma D_{ijt} + \varepsilon_{ij},$$

where the vector X_{ijt} includes the GPA of the individual, dummies for year of birth and place within family birth order. The term f_j is the brother or sister fixed effects variable, which controls for time-invariant family characteristics of full siblings. The main parameter of interest is γ, and in the results section, we will plot these γ estimates from regressions run separately for each age. Conditional on our explanatory variables, the coefficient γ is identified by the variation in participation (D_{ijt}) between siblings.[9]

The main outcome variable in our analyses is annual labor earnings, which is a generic product of hourly wages and the number of hours worked. We control for GPA and brother/sister fixed effects to account for ability levels and family background factors, which are widely

[8] Moreover, the *ex ante* calculation of costs and benefits can be based on mistaken information (see, e.g., Goldthorpe 1998, within rational choice theory). If beliefs are shaped by social circumstances, it may affect how pupils regard GPA as a predictor of educational success.

[9] Separate regressions by age imply that each coefficient is an age-specific estimate. A related approach would be to use the full panel of observations (age 18-52) in one single regression. This yields identical coefficients if one includes interaction variables between dummies for age and all variables of the model. The standard errors then become larger for young age groups (when mean and standard deviation of earnings are smaller), but smaller at ages above the late 30s (when mean and standard deviation of earnings exceed the overall mean).

believed to affect both educational attainment and labor market outcomes. The fixed effects framework is likely to reduce omitted variable bias in the estimate of γ by accounting for typically elusive factors such as neighborhood effects and parental characteristics in a broad sense, e.g., the ability to offer advice, help with school, pass on moral values such as work ethic, occupation, attitude towards occupational choices, etc. In addition, identifying estimates by the variation between siblings also reduces bias as family members to a greater extent overlap in terms of unobservable characteristics (e.g., Imbens and Wooldridge 2009, Heckman et al. 1999, section 8.2). Another aspect is that the family fixed effects in part also control for demand side factors such as regional differences in opportunity costs and local labor markets for vocational and general skills. There are some well-documented disadvantages of using family fixed effects. First, attenuation bias (i.e., bias towards zero) due to measurement error is exacerbated. Second, greater weights are assigned to individuals from large families (Griliches 1979, Bound and Solon 1999), although our analyses are based on two or three siblings (98 percent) due to the gender and year restrictions. Taken together, the econometric model has interesting properties for analyzing the relationship between upper secondary school curricula and long-term earnings.

4.4 Potential confounding factors

Our simple econometric model arguably controls for the two major sources of bias, namely, ability and social background. However, confounding factors may remain, which correlate with both educational choice and future labor market outcomes. As we see it, the main source of potential bias stems from individual personality traits (e.g., anxiety, perseverance, motivation, time-preferences, risk aversion) or abilities not captured by our GPA measure (e.g., technical

skills, verbal skills etc.).[10] For example, individuals who are less patient may tend to choose vocational education because it is perceived to be related to better job opportunities shortly after completing school, and they may attach less weight to the alleged long-term flexibility of general skills.[11] The prerequisite for bias becoming a problem is that within families, the sibling variation in personality traits or skills must affect both educational choice and future earnings, independently of birth order, GPA, and the educational content at the upper secondary level. The confounding factor(s) must also be sufficiently powerful to generate an average bias of relevant magnitude. We provide a detailed discussion on potential confounding factors in Section 5.4.

5 Results

5.1 Baseline results

In this section, we present estimates from regressions on annual earnings. Figures 3 and 4 present the main results for the samples of males and females, respectively. The coefficient estimates pertaining to vocational education are displayed for different ages. Each estimate and confidence interval is extracted from separate regressions on absolute earnings. Above each set of results, for comparability between different set-ups, the average of the point estimates at ages 18-21 and ages 39-48 is presented. The age interval 39-48 includes the last ten years in which all cohorts are observed (those born in 1963 turn 48 in 2011).[12] Additionally, for ease of reading, these

[10] The variation within families represents about one-third of the total variation in GPA. Note that even if siblings develop different skills, their inherent abilities could, conditional on GPA, be fairly similar in their respective fields.
[11] There is no direct empirical evidence to support such claims. However, there is evidence that personality traits such as impatience are related to choice of education. Analyzing Dutch data, Borghans and Golsteyn (2008) find that adults with vocational educations are more likely to regret their educational choices. This is consistent with the observation that some individuals underestimate the risks associated with choosing vocational educations. Dohmen et al. (2010) report a negative correlation between impatience and cognitive ability, adding to our expectation that enrolment in a general track is associated with higher ability.
[12] There is no obvious way to define short term. The purpose of presenting average coefficient estimates of age intervals is mainly for comparability between set-ups.

averages are expressed both in SEK and in percentages of the average earnings of the sample at each respective age interval (SEK 10,000 roughly equaled $1,300 during the studied period). We will primarily refer to the results in percentage terms.

In Figures 3a and 4a, the models do not include any control variables and do not account for family fixed effects. At a young age, there are positive and statistically significant coefficients. At ages 18-21, the point estimates represent, on average, 14.8 percent for males and 11.1 percent for females. The long-term averages at ages 39-48 are instead significantly negative: -16.8 percent for males and -8.8 percent for females. With the inclusion of brother/sister fixed effects (Figures 3b and 4b), but without other control variables, the results are closer to zero, both in the short term and the long term. The full model results are displayed in absolute numbers in Figures 3c and 4c and expressed in percentages of average earnings in Figures 3d and 4d. These include brother/sister fixed effects, controls for GPA and dummies for year of birth and order of birth. The short-term coefficient estimates of vocational education still indicate relatively higher earnings, but the lengths of the advantage differ between males and females. The estimates for females remain positive until age 21, whereas the coefficients pertaining to the sample of males are statistically significant until age 26. At ages 18-21, the point estimates are, on average, 11.7 percent for males and 10.9 percent for females. The coefficients at ages 39-48 are negative, on average, -7.1 percent (males) and -4.7 percent (females), magnitudes that are roughly half of those in the model without control variables.[13]

[13] Tables 3 and 4 provide detailed regression results for ages 20-45, in five-year intervals. In the Appendix, Table A.3, the coefficients pertaining to the vocational dummy variable are displayed for each age 18-52. We also ran regressions which included GPA squared, indicator variables of GPA deciles and GPA interacted with an indicator variable for above-median GPAs, but the estimates only changed marginally.

5.2 Employment

The results in Figures 3 and 4 may reflect differences in employment (hours worked) or in wage levels. From the hypotheses presented in Section 4.1, one would in the short term expect a higher probability of employment for vocational education. [14] For the long term, general education may generate skill multipliers which increase productivity and wages, but it is also possible that general human capital makes individuals less sensitive to business cycle patterns. In this subsection, we address these two issues.

We must first emphasize that the data do not allow us to directly analyze employment and wages separately. What we can do is to use the annual earnings measures to generate rudimentary proxies for employment status. Following Eriksson et al. (2007), employment is defined as a binary variable equal to one if annual earnings exceed 50 percent of the population median earnings at age 45.[15] Across time, this threshold has been remarkably stable in representing the full time earnings of cleaning personnel working 6-7 months in a year. The stability is attractive for the analyses, as it limits the influence of the timing of an observation. Figure A.3 (a) and (b) present estimated probabilities of reaching this threshold earnings level, indicating a clear initial employment advantage of vocational education. Interestingly, when we set the sample condition that individuals are defined as employed, panels (c) and (d), earnings estimations in the short-term are close to zero for males. It implies that the initial earnings advantage of vocational educations in Figure 3 is primarily reflecting differences in hours

[14] This also likely reflects that individuals sort into different occupations based on their educational field. We analyze this issue in Appendix 2.

[15] Employment rates in Figure A.2 hover around 70-85 percent, which is also the case for this measure. An alternative is to use earnings above zero as the threshold, but relatively low fractions are recorded with zero earnings. At age 23 less than 5 percent had zero earnings for any program type or gender, and at age 48 less than 10 percent of the men and 8 percent of the women had zero earnings. Estimating probabilities of positive earnings yields results close to zero, and earnings estimates conditioned on positive earnings are similar to those presented in Figures 3 and 4.

worked. The other short and long term estimates of males and females are relatively stable, at about half a percentage point lower compared with Figures 3 and 4. From this, we conclude that both hours worked and wages may influence these results.

We now turn to the hypothesis that general human capital makes individuals' earnings less sensitive to business cycle fluctuations. If this is true, one would expect the sudden economic recession in the 1990s to be linked with a change in relative earnings to the disadvantage of vocational educations. Figure A.4 in the Appendix presents estimates separately *year-by-year* (as opposed to age-by-age above), where individuals in all regressions are observed in the same year (as opposed to the same age). For males, the results support the hypothesis. Estimates display a change to the disadvantage of vocational education at the start of the 1990s. For females, this results pattern cannot be detected.[16]

5.3 Robustness checks

To assess earnings differences between groups with different types of educations, individuals would ideally not be affected by family engagements or further education. In this subsection, we examine whether our results are driven by differences in fertility decisions (females) or by further education.

Figure 5a shows, for females across age, the average number of children at home. There are small but visible differences between the groups. To investigate whether these differences may be explained by our available background variables, Figure 5b presents linear probability estimates of parental leave incidence using sister fixed effects and the full set of control

[16] The short term advantage of vocational education is mitigated in a year-by-year framework, because earnings are first observed in our data in 1978 when those born 1955 are already 23 years old. This makes it more difficult to analyze the short term effects with the year-by-year estimates.

variables.[17] The results indicate that child rearing tends to occur earlier for females in vocational education, with positive point estimates at young ages, that are also statistically significant from age 22 until age 30. One would expect the presence of small children to hamper annual earnings. Thus, if there is a true short-term positive earnings impact of vocational studies relative to general studies, the results presented in Figure 4 may be underestimated due to fertility decisions. We will return to this issue below.

Participation in further education raises two potential concerns. First, in the short term, the locking in effects (e.g., non-employment) of pursuing further education, rather than actual educational content, may generate a short-term positive association between vocational education and earnings. Second, in the long term, additional years of education, rather than educational content, may explain the higher long-term average earnings of general education.

The 2-year programs only provided eligibility for a limited set of short tertiary level programs classified as tertiary level schooling, primarily in nursing or teaching. As expected, the proportion completing four years of tertiary education was low, just over 2 and 5 percent of males and females respectively. However, it was more common to participate in further education at *Komvux* or in college, with the purpose (presumably) of completing shorter exams. Figures 6a and 6b show descriptive statistics across age groups for registrations in college and/or in Komvux.[18] To determine if the observed differences in Figures 6a and 6b are explained by differences in GPA or social background, Figures 6c and 6d present full model estimates of

[17] We have explicit information on children at home, beginning in 1990. For each year in the 1980s, the amount of parental leave benefits is used to proxy for the number of births (checked against the true value in 1990). The estimated differences for brothers are only minor, but not displayed, as parental leave benefits at this time were much less prevalent among males. Moreover, fertility rates are typically less important for earnings for males.
[18] Komvux is the public agency providing upper secondary schooling for adults (see Section 2). Municipalities are, by law, obliged to offer adult education at the upper secondary level to individuals who wish to re-enroll in school to prolong their upper secondary education with a third year, change their direction of studies, or complement unfinished studies.

linear probability models of educational registrations (Komvux or college). Males in general tracks are at most 4-5 percentage points more likely to be registered for education. For females, the differences are smaller, approximately 1 percentage point, but significant up to and including age 22. Thus, if participation in further education causes locking-in effects, it may explain the short-term earnings advantage of vocational education.

The subsequent question is whether there are differences in terms of completion of college exams. Among males, the total proportions completing a college exam at some point were 15.0 percent among those with general education and 6.4 percent among those with vocational education. For females, the corresponding shares were 33.3 percent (general) versus 23.0 percent (vocational). Figures 6e and 6f display estimated probabilities of a completed tertiary exam. The findings indicate that general education increases the likelihood of completing a college exam by approximately 4-5 percentage points among males. For females, the estimated differences are between one and two percentage points. Hence, if completion of further education increases earnings, it may be a mechanism which explains the long-term earnings advantage of general education.[19]

We employ three different strategies to assess to what extent further education, rather than differences in curricula, influences the estimated short- and long-term earnings differences in Figure 3 and Figure 4. First, we exclude all individuals who at some point registered in further education from age 18 onward. A second option is to impose a sample restriction of the 2-year upper secondary school diploma as the highest completed level of education. This excludes individuals with completed further education as well as dropouts. Third, we instead expand our

[19] The results here contrast with Malamud and Pop-Eleches (2011) who report that increased general education did not affect the probability of enrolling in higher education. However, compared with the Swedish setting, further education in Romania in the 1970s was highly restricted.

regression models by including age-specific controls for registrations in Komvux, registrations in college and information on college exams at each age. The downside is that all three approaches violate the conditional independence assumption, which stipulates that an estimated treatment effect is likely to be biased if conditioned on events that occur after the treatment (these events may be part of the outcome caused by the treatment). However, the purpose of these analyses is that they may convey information about the importance of further education for the reported estimates in Figures 3 and 4. If the relative earnings estimates are entirely driven by further education, one would not expect significant estimates in any of these three cases.[20]

First, we exclude all individuals who at some point were registered in further education. For both males and females, this set-up generates the results that deviate most from those reported in Figure 3 and Figure 4. For the sample of males, the long-term average coefficients at ages 39-48 always remain negative and significantly different from zero, with the average estimate being -5.7 percent (compared with -7.1 percent in Figure 3). For the short term, estimates at ages 18-21 are closer to zero, SEK 9,727 (9.4 percent).[21]

For females, regarding the long term, the average of the coefficients from age 39 to 48 is -6.4 percent (compared with -4.7 percent reported in Figure 4). The wage structure for nurses and teachers is relatively compressed, which may contribute to explaining these results. In the short term, the estimates in Figure 4 indicate an earnings advantage for vocational education corresponding to 10.7 percent at ages 18-21. When one excludes all individuals registered in

[20] The complete set of estimated coefficient results discussed in this section is presented in Tables A.4 (males) and A.5 (females).

[21] With this set-up, a major change in the results is that estimates from age 23 are no longer positive and significantly different from zero, although the first significantly negative estimate is at the same age as in Figure 3. Meanwhile, the coefficient average for ages 18-21 is 12.4 percent when imposing a sample restriction of 2-year upper secondary school as the highest completed level of schooling, and 10.3 percent when using the set-up with additional controls. The latter contains age specific indicator variables for registrations in Komvux, registrations in college and for attained college degree (three different levels: short, Bachelor and higher).

education, there is only one borderline significant result (at the ten percent level), and the average estimates at ages 18-21 are close to zero (SEK 2,142 or 2.3 percent). The short-term results are more positive if the analysis is restricted such that the highest completed level of education is 2-year upper secondary school. This excludes dropouts as well as individuals who have completed further education. Estimates are then significantly different from zero at ages 18-21, on average SEK 6,329, corresponding to 7.0 percent.

As mentioned at the beginning of this subsection, females in vocational studies were also more likely to have children in their early 20s. Thus, there are two contrasting mechanisms. Our short-term baseline estimates for females are likely to be higher due to locking-in effects of further education (which is more common among females in general programs), but they are also likely to be influenced downward by childrearing (which is more common among females in vocational programs). If one simply excludes females with children at home between ages 18 and 22, the estimates indicate a short-term advantage, which is 13.4 percent on average (SEK 12,339). If, *in addition,* one excludes individuals registered for further education before age 23, the estimates are very similar to our baseline estimates (SEK 8,804 or 10.2 percent).[22]

We emphasize that the results from the regression exercises in this subsection should be interpreted with caution. Our stance is that they are useful to probe deeper into the earnings patterns in the data. The main conclusion is that despite several different set-ups, and although magnitudes vary, the estimates generally support the short- and long-term hypotheses. The one exception is when we exclude all females registered for further education. In this case, one may

[22] We also expanded the econometric model with control variables for registrations in education and exams (see previous footnote), with controls for the incidence of a child below age six at home, for the number of children, and for the incidence and amount of parental leave benefits. The parameters at ages 18-21 are then always significantly different from zero, with the average point estimate 15.5 percent.

instead suspect that fertility decisions influence our estimates, an interpretation that is supported by the data.

5.4 Potential confounding factors

The preceding section indicates that the implied short-term advantage of vocational education and the long-term advantage of general education remain stable across alternative regression designs. However, it is not possible to exclude the possibility that results are influenced by unobserved factors that our covariates fail to capture.

Given our econometric model, we believe the most likely source of bias is that siblings, at a given GPA level, sort systematically into different program types depending on their composition of skills. To gauge if this is the case, we use cognitive and non-cognitive skill measures from military enlistment tests for males. These are measured at age 18 or 19, which means we do not have this information on skills *ex ante*, but only *ex post*. Our skill measures include the generic measures cognitive and non-cognitive skills, as well as six underlying test scores (logical skills, verbal skills, technical skills, spatial skills, leadership skills, psychological stability). The observed time profiles in earnings could reflect labor market returns of these skills.

If we add all the skill measures as explanatory variables to the full model in Figure 3, the short-term estimates are virtually unaffected (12.8 percent), and the long-term estimates remain significantly different from zero from age 30 to age 48. The average estimate for age 39-48 is -4.3 percent, which represents about 60 percent of the average reported in Figure 3. Thus, the added measures of skills and personality traits, observed *ex post*, cannot explain the short-term differences and can only partly explain the long-term earnings differences. We emphasize that

the added variables are measured *ex post* because it is likely that the reduced estimates here at least partially reflect *the mechanism* behind higher relative earnings, rather than the potential bias. Carlsson et al. (2015) report that an extra ten days of general schooling (in 3-year programs) increases test scores on technical ability and verbal ability by one percent of a standard deviation.

One may also note that it is difficult to dismiss the pattern in our results on the basis of remaining endogeneity bias. It would require confounders to generate bias with different signs at different points in time, but it is difficult to see that unobserved individual attributes with such an influence would change systematically over time. Also, our full models with family fixed effects exacerbate attenuation bias, increasing the probability of finding insignificant estimates.[23]

The policy implication of our results would be that, if individuals are homogenous, increased hours of general subjects in vocational programs could mitigate their observed long-term disadvantage (Sweden implemented such a reform in the 1990s). However, individual heterogeneity is one of the key motivations for offering vocational education, and findings in recent studies suggest that individuals act on their comparative advantages (Kirkeboen et al. 2016, Stenberg and Westerlund 2015). If hours of vocational studies are exchanged for general subjects, it may have detrimental effects on productivity for individuals with a comparative advantage in vocational studies. Our stance is that to draw any direct policy conclusions from our results, one would need better information on individuals' comparative advantages. The main contribution of our results is instead to provide evidence of what many studies have assumed,

[23] Our observed earnings patterns could also reflect individuals choosing professions according to their time preferences on earnings, but this would require a very strong impact of time preferences on occupational choice which seems unlikely given the relatively small differences in ability measures.

since we find clear support for the often alleged trade-off between the short-term and the long-term earnings, of vocational and general schooling respectively.

5.5 Heterogeneity

Figures A.5, A.6 and A.7 in the Appendix present results from analyses made separately for the most popular programs. The implications of the findings discussed below hold whether one includes or excludes individuals who were at some point registered in further education and/or were mothers before age 23 (results available on request).

Among the estimates for males, separated by different vocational programs (Figure A.5), the electronics program stands out as it is not associated with a long-term earnings disadvantage compared with the general programs. The estimates of the construction program are very positive in the short term, which may reflect the economic boom period of the 1980s. However, when the economic recession suddenly began at the start of the 1990s, with unemployment soaring between 1990 and 1993 from 2 percent to 11 percent, the earnings of those in the construction program fell sharply compared to general programs (estimates across years not displayed). Of the male-dominated vocational programs, construction is associated both with the largest short-term advantage and the largest long-term *dis*advantage.

Turning to the vocational studies of females (Figure A.6), the short-term advantage is present both for office and nursing, but not for those in consumer studies. In the long term, only the office program is associated with estimates that are insignificantly different from zero. This is interesting because the curricula of the office program included approximately twice as many weekly hours of general education compared with nursing or consumer studies (see Table A.1). It is possible that this reflects that the demand for office work remained high in the 1980s,

allowing individuals to learn on the job and gain work experience prior to the revolution of the personal computer.

6 Concluding discussion

Long-term analyses comparing earnings associated with the educational content of vocational and general education are rare. In this article, we compare the earnings trajectories of individuals who, in 1971-1979, enrolled in 2-year upper secondary school programs in Sweden with vocational and general curricula. The records of annual earnings are reported each year from 1978, when individuals in our samples are aged 15-23, and throughout our observation window until they are aged 48-56 in 2011. In our analyses, we control for GPA measured just prior to enrolment and family fixed effects.

Our estimates support the two most common working hypotheses: that of a short-term relative earnings advantage for vocational education and that of a long-term relative advantage for general education. The results thus support an alleged trade-off between specialization in tracks and a comprehensive curriculum that could promote worker flexibility. Our main contribution to the literature is that we provide evidence of what many studies have assumed, i.e. that the relative earnings consequences of vocational vs. general education depend on the length of the follow-up period. This implies that for any assessment of the labor market outcomes of vocational versus general education, it is particularly important to study earnings trajectories or at least earnings at several points across the working life. The results indicate a short-term earnings advantage of vocational contents which is in line with several earlier studies. However, in contrast with earlier studies, we find that general education is linked with a long term earnings advantage compared with vocational education. Both these results hold for both men and

women, although there are substantial gender differences in program choice. The findings are also stable to alternative specifications and changes in the sample set-up, with the exception of a direct comparison between general programs and the (vocational) electronics program. Additional analyses indicate that neither the short term nor the long term result can be explained by further education or the presence of children.

To get at the more precise implications for policy, one would ideally be able to take into account individuals' comparative advantages which may affect the returns to human capital investments (Kirkeboen et al. 2016, Stenberg and Westerlund 2015). In summary, a substantial body of research remains to be performed, and at present, recommendations for policy may only be discussed in very cautious terms.

References

Aakvik, A., Salvanes, K. and Vaage, K. (2010). Measuring Heterogeneity in the Returns to Education in Norway using Educational Reforms. *European Economic Review* 54, 483-500.

Angrist, J.D. and Krueger, A. (1991). Does Compulsory School Attendance Affect Schooling and Earnings? *Quarterly Journal of Economics* 106(4), 979-1014.

Becker, G. (1964). *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. Chicago, University of Chicago Press.

Becker, G. S. (1985). Human Capital, Effort, and the Sexual Division of Labor. *Journal of Labor Economics* 3, 33-58.

Borghans, L. and B. H. Golsteyn (2008). Modernizing Vocational Education and Training: the Importance of Information, Advice and Guidance over the Life-Cycle. CEDEFOP (ed.) *Fourth Report on Vocational Education and Training Research in Europe*, Luxembourg.

Boudon, R. (1974). *Education, Opportunity and Social Inequality. Changing Prospects in Western Society.* New York: John Wiley & Sons.

Bound, J. and Solon, G. (1999). Double Trouble: on the Value of Twins-Based Estimation of the Returns to Schooling. *Economics of Education* Review 18, 169-182.

Breen, R. and Goldthorpe, J.H. (1997). Explaining Educational Differentials: Towards a Formal Rational Action Theory. *Rationality and Society* 9(3), 275-305.

Brunello, G. (2003) On the Complementarity between Education and Training in Europe. In Checchi, D., C. Lucifora (eds.) *Education, Training and Labour Market Outcomes in Europe*, MacMillan.

Brunello, G. and Checchi, D. (2007). Does School Tracking Affect Equality of Opportunity? New International Evidence. *Economic Policy* 22, 781-861.

Brunello, G. and Rocco, L. (2017). The Labor Market Effects of Academic and Vocational Education over the Life Cycle: Evidence Based on a British Cohort. *The Journal of Human Capital* 11(1), 106-166.

Carlsson, M., Dahl, G. and Rooth, D.-O. (2012). The Effect of Schooling on Cognitive Skills. *Review of Economics and Statistics* 97(3), 533-547.

Dohmen, T., Falk, A., Huffman, D. and Sunde, U. (2010). Are Risk Aversion and Impatience Related to Cognitive Ability? *American Economic Review* 100 (3), 1238-1260.

Dustmann, C., Puhani, P. and Schönberg, U. (2017). The Long-Term Effects of Early Track Choice. *Economic Journal*, forthcoming.

Erikson, R. and Jonsson, J. (1996) The Swedish Context. In Erikson, R. and Jonsson, J. (eds.) *Can Education be Equalised?* Oxford, Westview Press, 65-93.

Eriksson, R., Nordström Skans, O., Sjögren, A. and Åslund, O. (2007). Ungdomars och invandrades inträde på arbetsmarknaden 1985-2003. IFAU Rapport 2007:18. Uppsala.

Fersterer, J. Pischke, J.-S. and Winter-Ebmer, R. (2008). Returns to Apprenticeship Training in Austria: Evidence from Failed Firms. *Scandinavian Journal of Economics* 110(4), 733-753.

Goldthorpe, J.H. (1998). Rational Action Theory for Sociology. *British Journal of Sociology* 49, 167-192.

Griliches, Z. (1979). Sibling Models and Data in Economics: Beginnings of a Survey. *Journal of Political Economy* 87(5), 37-64.

Hall, C. (2012). The Effects of Reducing Tracking in Upper Secondary School: Evidence from a Large-Scale Pilot Scheme. *Journal of Human Resources* 47(1), 237-269.

Hanushek, E., Schwerdt, G., Woessman, L. and Zhang, L. (2016). General Education, Vocational Education, and Labor market Outcomes over the Life-Cycle. *Journal of Human Resources*, forthcoming.

Harmon, C. and Walker, I. (1995). Estimates of the Economic Return to Schooling for the United Kingdom. *American Economic Review* 85(5), 1278-1286.

Heckman, J., LaLonde, R. and Smith, J. (1999). The Economics and Econometrics of Active Labor Market Programs. In Ashenfelter, O. and Card, D. (Eds.) *Handbook of Labor Economic*, Vol 3A, Elsevier, Amsterdam.

Imbens, G.W. and Wooldridge, J.M. (2009). Recent Developments in the Econometrics of Program Evaluation. *Journal of Economic Literature* 47(1), 5-86.

Kemple, J. and Scott-Clayton, J. (2004). *Career Academies: Impacts on Labor Market Outcomes and Educational Attainment*. MDRC, New York.

Kemple, J. and Willner, C. (2008). *Career Academies: Long term Impacts on Labor Market Outcomes, Educational Attainment, and Transitions to Adulthood*. MDRC, New York.

Kirkeboen, L., Leuven, E. and Mogstad, M. (2016). Field of Study, Earnings and Self Selection. *Quarterly Journal of Economics* 131(3), 1057-1111.

Korpi, T., de Graaf, P., Hendricks, J. and Layte, R. (2003). Vocational Training and Career Employment Precariousness in Great Britain, the Netherlands, and Sweden. *Acta Sociologica* 46(1), 17-30.

Kreuger, D. and Kumar, K. (2004a). Skill-Specific rather than General Education: A Reason for US-Europe Growth Differences? *Journal of Economic Growth* 9, 167-207.

Kreuger, D. and Kumar, K. (2004b). US-Europe Differences in Technology-Driven Growth: Quantifying the Role of Education. *Journal of Monetary Economics* 51, 161-190.

Lindqvist, E. och R. Vestman (2011), The Labor Market Returns to Cognitive and Noncognitive Ability: Evidence from the Swedish Enlistment, *American Economic Journal: Applied Economics*, 3(1), 101–128.

Malamud, O. and Pop-Eleches, C. (2010). General Education versus Vocational Training. Evidence from an Economy in Transition. *Review of Economics and Statistics* 92(1), 43-60.

Malamud, O. and Pop-Eleches, C. (2011). School Tracking and Access to Higher Education among Disadvantaged Groups. *Journal of Public Economics* 95(11), 1538-1549.

Mane, F. (1999). Trends in the Payoff to Academic and Occupation-Specific Skills: the Short and Medium Run Returns to Academic and Vocational High School Courses for Non-College-Bound Students. *Economics of Education Review* 18(4), 471-437.

Meghir, C. and Palme, M. (2005). Educational Reform, Ability and Family Background. *American Economic Review* 95(1), 414-424.

Mincer, J. and Polachek, S. (1974). Family Investments in Human Capital: Earnings of Women. *Journal of Political Economy* 82(2), S76-S108.

OECD (2004). *Employment outlook*. OECD, Paris.

Oosterbeek, H. and Webbink, D. (2007). Wage Effects of an Extra Year of Basic Vocational Education. *Economics of Education Review* 26(3), 408-419.

Parey, M. (2012). Vocational Schooling versus Apprenticeship Training: Evidence from Vacancy Data. Manuscript, University of Essex.

Pischke, J.-S. and von Wachter, T. (2008). Zero Returns to Compulsory Schooling in Germany: Evidence and Interpretation. *Review of Economics and Statistics* 90(3), 592-598.

Rosenbaum, J. (2001). *Beyond College for All: Career Paths for the Forgotten Half.* New York: Russell Sage Foundation.

SOU (2008). *Framtidsvägen – en reformerad gymnasieskola*. Government Report 2008:27.

Shavit, Y. and Müller, W. (1998). *From School to Work*. Oxford University press.

Stenberg, A. and Westerlund, O. (2014). The Long Term Earnings Consequences of General vs. Specific Training for Unemployed. *IZA Journal of European Labor Studies* 4:22.

Wolter, S. and Ryan, P. (2011). Apprenticeship. In Hanushek, E., Machin, S. and Woessmann, L. (eds), *Handbook of the Economics of Education* vol 3, chapter 11. Amsterdam, North Holland.

Table 1; Males - descriptive mean statistics of 16 year old enrollees in upper secondary school 1971-1979.

	All	2-year	Brothers	Voc	General
GPA, 1 to 5 (top) [a)]	3.198	2.829	2.824	2.762	3.054
Cognitive skill (1-9) [b)]	5.537	4.785	4.707	4.536	5.305
Inductive skill (1-9) [b)]	5.424	4.689	4.606	4.405	5.313
Verbal skill (1-9) [b)]	5.371	4.694	4.621	4.429	5.294
Spatial skill (1-9) [b)]	5.491	5.065	5.034	4.926	5.416
Engineering skill (1-9) [b)]	5.101	4.587	4.557	4.516	4.700
Non-cognitive (1-9) [b)]	5.308	4.947	4.937	4.797	5.428
Leadership score (1-9) [b)]	4.028	2.979	2.854	2.547	3.932
Share born 1955	0.088	0.081	0.074	0.063	0.112
Share born 1956	0.103	0.101	0.096	0.088	0.125
Share born 1957	0.107	0.106	0.106	0.100	0.128
Share born 1958	0.106	0.105	0.116	0.113	0.124
Share born 1959	0.109	0.111	0.127	0.128	0.123
Share born 1960	0.111	0.115	0.125	0.132	0.100
Share born 1961	0.117	0.120	0.119	0.126	0.091
Share born 1962	0.125	0.128	0.116	0.121	0.095
Share born 1963	0.133	0.134	0.122	0.127	0.101
SHARES IN UPPER SECONDARY SCHOOL PROGRAMS					
3-year programs	0.403				
Humanities	0.016				
Social sci.	0.037				
Business	0.069				
Natural sci.	0.124				
Engineering sci.	0.158				
2-year programs [c)]	0.589	1	1	1	1
Social science	0.061	0.103	0.088		0.408
Business	0.038	0.065	0.052		0.242
Engineering science	0.051	0.087	0.075		0.350
Office	0.034	0.058	0.054	0.069	
Music	0.001	0.002	0.001	0.001	
Consumer studies	0.003	0.006	0.006	0.007	
Nursing	0.002	0.003	0.004	0.004	
Clothing	0.000	0.000	0.000	0.000	
Food	0.009	0.015	0.016	0.020	
Mechanic engineering	0.118	0.201	0.222	0.283	
Vehicle engineering	0.068	0.115	0.118	0.150	
Woodwork	0.010	0.017	0.020	0.026	
Construction	0.086	0.146	0.167	0.213	
Electronics	0.079	0.135	0.128	0.163	
Process technology	0.007	0.012	0.013	0.017	
Forestry	0.011	0.018	0.019	0.025	
Farming	0.009	0.016	0.017	0.022	
Observations	304,078	179,016	29,398	23,090	6,308

Note: [a)] The average of final grades in comprehensive school, set from 1 (lowest) to 5 (highest) in each subject. [b)] Test scores from military enlistments at age 18-19. Non-cognitive skills reflects several different skills useful to function in the military, among which willingness to assume responsibility, independence and social skills (Lindqvist and Vestman 2011, p. 108). [c)] Curricula of selected programs are described in Table A.1 of the Appendix.

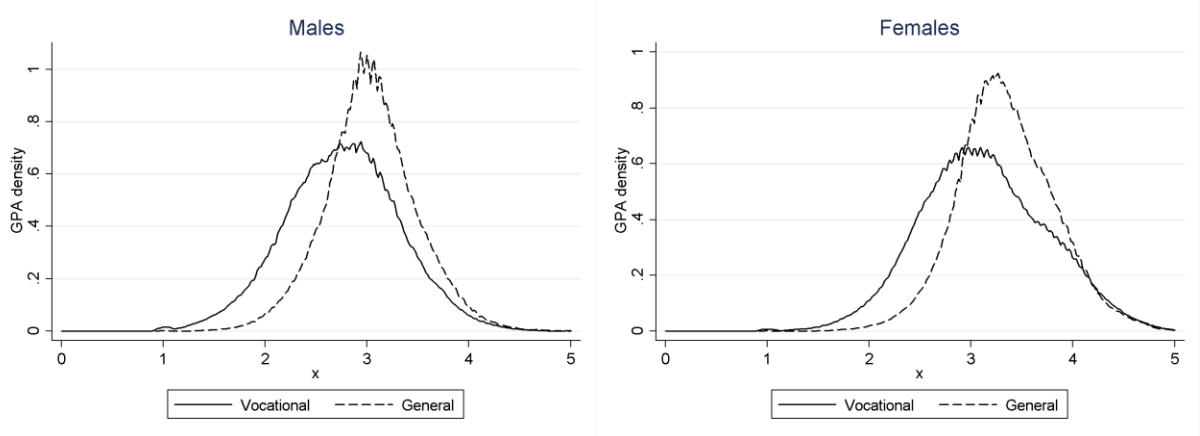
Table 2; Females - descriptive mean statistics of 16 year old enrollees in upper secondary school 1971-1979.

	All	2-year	Sisters	Voc	General
GPA, 1 to 5 (top) [a)]	3.477	3.207	3.229	3.156	3.370
Share born 1955	0.087	0.077	0.072	0.048	0.117
Share born 1956	0.103	0.105	0.095	0.081	0.121
Share born 1957	0.110	0.114	0.113	0.103	0.131
Share born 1958	0.105	0.107	0.116	0.114	0.121
Share born 1959	0.107	0.108	0.124	0.134	0.107
Share born 1960	0.111	0.113	0.123	0.136	0.098
Share born 1961	0.117	0.119	0.121	0.132	0.099
Share born 1962	0.126	0.128	0.119	0.125	0.106
Share born 1963	0.134	0.129	0.118	0.127	0.100
SHARES IN UPPER SECONDARY SCHOOL PROGRAMS					
3-year programs	0.352				
Humanities	0.077				
Social sci.	0.090				
Business	0.078				
Natural sci.	0.091				
Engineering sci.	0.016				
2-year programs [b)]	0.638	1	1	1	1
Social science	0.190	0.298	0.265		0.774
Business	0.052	0.081	0.076		0.222
Engineering science	0.001	0.002	0.001		0.004
Office	0.124	0.194	0.199	0.303	
Music	0.002	0.002	0.003	0.004	
Consumer studies	0.177	0.278	0.307	0.467	
Nursing	0.066	0.103	0.105	0.160	
Clothing	0.006	0.010	0.010	0.015	
Food	0.008	0.012	0.013	0.020	
Mechanic engineering	0.001	0.002	0.002	0.004	
Vehicle engineering	0.001	0.002	0.002	0.003	
Woodwork	0.000	0.001	0.001	0.001	
Construction	0.001	0.002	0.002	0.003	
Electronics	0.001	0.002	0.002	0.003	
Process technology	0.001	0.001	0.001	0.002	
Forestry	0.000	0.000	0.000	0.000	
Farming	0.006	0.009	0.011	0.016	
Observations	293,416	187,109	30,294	19,915	10,379

Note: [a)] The average of final grades in comprehensive school, set from 1 (lowest) to 5 (highest) in each subject.
[b)] Curricula of selected programs are described in Table A.1 of the Appendix.

Figure 1

Distribution of GPA – samples enrolled in 2-year programs 1971-1979.



Note: The average final of grades in comprehensive school. GPA is the average from grades set from 1 (lowest) to 5 (highest) in each subject.

Figure 2

Descriptive trajectories of annual earnings – samples enrolled in 2-year programs 1971-1979.[a)]

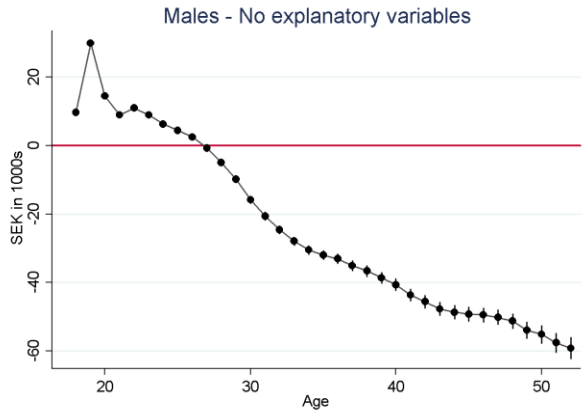
Note: [a)] SEK 100,000 roughly equaled $13,000 during the studied period. The graphs show the mean annual earnings separately by educational background. The upper panel plots these means across age, the bottom panel plots the means across years.

Figure 3

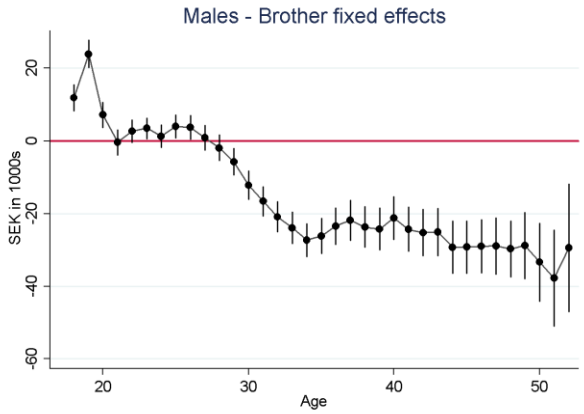
Males: Estimated differences in annual earnings, vocational vs general, across age

Coefficient values pertain to vocational education. Average point estimates for ages 18-21 and 39-48 are indicated in absolute terms and in percentages (in parentheses).

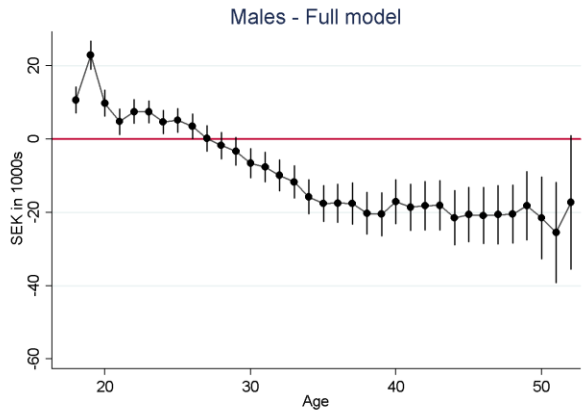
a) Males - average 18-21: 15,770 (.148).
- average 39-48: - 46,580 (-.168).



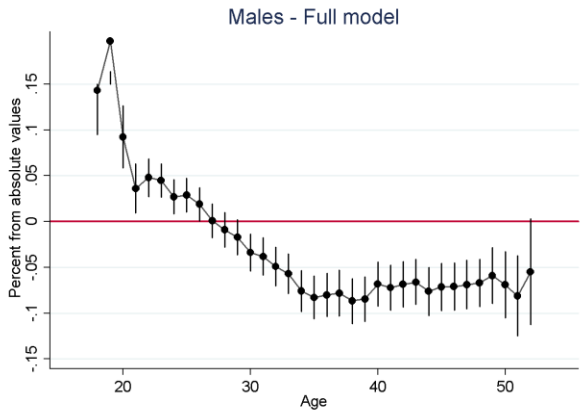
b) Males - average 18-21: 10,650 (.107).
- average 39-48: -26,644 (-.096).



c) Males - average 18-21: 12,024 (.117).
- average 39-48: - 19,649 (-.071).



d) Males - average 18-21: .1173.
- average 39-48: -.0714.



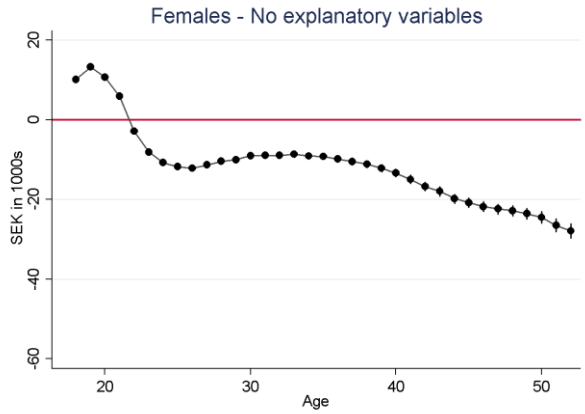
Note: SEK 10,000 roughly equaled $1,300 during the studied period. Estimates above zero indicate higher earnings for vocational education. Each estimate and 95% confidence interval are extracted from separate regressions. Figure 3a does not include any controls. Figure 3b includes family fixed effects. Figure 3c and 3d include family fixed effects and controls for GPA and dummies for year of birth and order of birth. Details of estimations presented in in Figure 3c, coefficients, standard errors and number of observations, are found in Table A.3 in the Appendix.

Figure 4

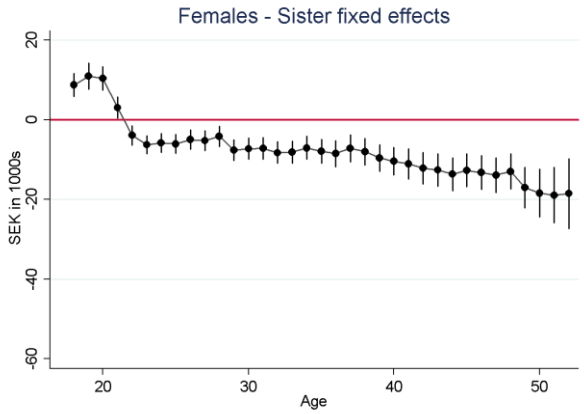
Females: Estimated differences in annual earnings, vocational vs general, across age.

Coefficient values pertain to vocational education. Average point estimates for ages 18-21 and 39-48 are indicated in absolute terms and in percentages (in parentheses).

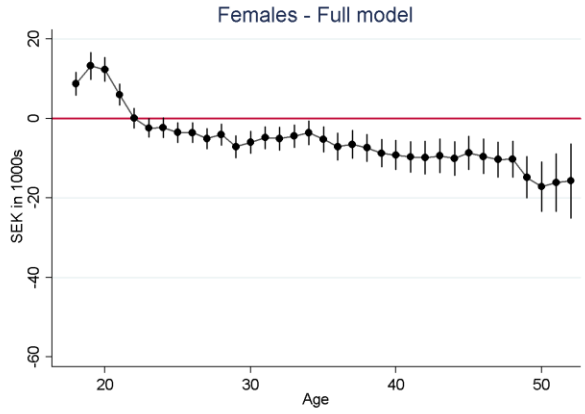
a) Females - average 18-21: 10,008 (.111).
- average 39-48: - 18,259 (-.088).



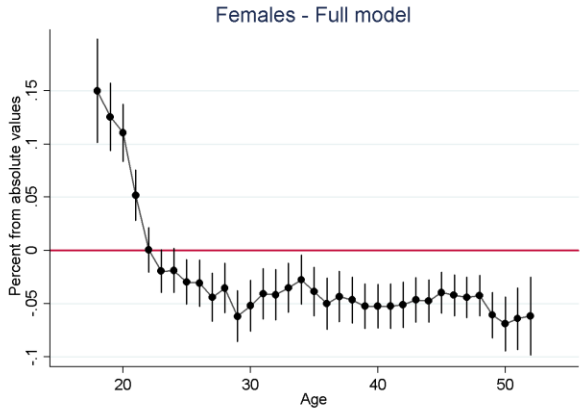
b) Females - average 18-21: 8,311 (.093).
- average 39-48: -12,211 (-.060).



c) Females - average 18-21: 10,122 (.109).
- average 39-48: - 9,536 (-.047).



d) Females- average 18-21: .1094.
- average 39-48: -.0467.



Note: SEK 10,000 roughly equaled $1,300 during the studied period. Estimates above zero indicate higher earnings for vocational education. Each estimate and 95% confidence interval are extracted from separate regressions. Figure 4a does not include any controls. Figure 4b includes family fixed effects. Figure 4c and 4d include family fixed effects and controls for GPA and dummies for year of birth and order of birth. Details of estimations presented in in Figure 4c, coefficients, standard errors and number of observations, are found in Table A.3 in the Appendix.

Table 3

Males – Vocational education and earnings (brother fixed effects estimates) [a)]

	(1)	(2)	(3)	(4)	(5)	(6)
Age	20	25	30	35	40	45
Vocational	9.8***	5.1**	-6.6**	-17.6***	-17.1***	-20.6***
	(1.8)	(1.6)	(2.0)	(2.5)	(3.1)	(3.8)
GPA	1.0	7.0***	17.5***	28.0***	36.4***	45.8***
	(1.4)	(1.3)	(1.6)	(2.0)	(2.5)	(3.1)
Born 1955 (Reference)	-	-	-	-	-	-
Born 1956 [b)]	-	-4.4	4.7	-13.2**	3.3	-6.3
		(2.8)	(3.5)	(4.3)	(5.3)	(6.5)
Born 1957 [b)]	-	-9.4***	13.8***	-19.2***	10.0	-5.6
		(2.8)	(3.5)	(4.3)	(5.3)	(6.5)
Born 1958 [b)]	26.5***	-8.9**	13.9***	-29.1***	20.3***	-6.2
	(3.8)	(3.0)	(3.7)	(4.6)	(5.6)	(7.0)
Born 1959 [b)]	25.3***	-5.2	24.5***	-31.4***	27.3***	-9.9
	(3.3)	(3.2)	(4.0)	(5.0)	(6.0)	(7.5)
Born 1960 [b)]	19.3***	-4.5	10.7*	-26.9***	27.5***	-2.6
	(2.8)	(3.5)	(4.4)	(5.4)	(6.6)	(8.2)
Born 1961 [b)]	10.5***	0.1	1.5	-20.2***	33.2***	7.7
	(2.3)	(3.9)	(4.8)	(5.9)	(7.2)	(8.9)
Born 1962 [b)]	7.6***	8.1	-13.1*	-12.7	33.8***	8.5
	(2.1)	(4.3)	(5.3)	(6.6)	(8.0)	(10.0)
Born 1963 [b)]	-	15.2**	-20.5***	-2.0	38.7***	18.9
		(4.7)	(5.8)	(7.2)	(8.7)	(10.8)
First sibling	-3.9	5.7	-0.7	-0.3	1.0	-9.1
	(3.9)	(3.4)	(4.2)	(5.3)	(6.4)	(7.9)
Second sibling	-1.7	3.3	1.8	-1.3	2.5	-4.8
	(2.5)	(2.3)	(2.9)	(3.6)	(4.3)	(5.3)
Constant	83.6***	149.5***	150.1***	163.7***	136.1***	179.5***
	(4.9)	(6.2)	(7.6)	(9.5)	(11.5)	(14.3)
R-squared	0.949	0.937	0.934	0.933	0.941	0.939
N [c)]	127,437	179,012	178,748	177,614	176,023	174,557

Note: * p<0.05, ** p<0.01, *** p<0.001

[a)] SEK in 1000s, 2011 values. SEK 10,000 equals roughly $1,300 during the studied period.

[b)] All individuals enrolled a program at age 16, so that year of birth dummies represent both cohort effects and year specific effects, e.g. in the case age = 30, the dummy for year of birth 1963 is also a dummy for earnings being observed in 1993.

[c)] Earnings are observed from 1978. For the sample aged 20, individuals born 1955, 1956 and 1957 are therefore missing.

Table 4

Females - Vocational education and earnings (sister fixed effects estimates) [a)]

	(1)	(2)	(3)	(4)	(5)	(6)
Age	20	25	30	35	40	45
Vocational	12.4***	-3.5**	-6.0***	-5.2**	-9.2***	-8.6***
	(1.5)	(1.3)	(1.4)	(1.6)	(1.8)	(2.1)
GPA	6.2***	10.8***	8.4***	14.0***	23.6***	35.9***
	(1.4)	(1.2)	(1.3)	(1.5)	(1.7)	(2.0)
Born 1955 (Reference)	-	-	-	-	-	-
Born 1956 [b)]	-	-7.9**	2.0	-15.0***	2.7	-5.7
		(2.6)	(2.9)	(3.3)	(3.8)	(4.5)
Born 1957 [b)]	-	-11.6***	-0.0	-13.2***	6.9	-5.8
		(2.6)	(2.9)	(3.2)	(3.8)	(4.4)
Born 1958 [b)]	16.8***	-12.1***	3.1	-15.3***	9.6*	-6.3
	(4.0)	(2.8)	(3.1)	(3.5)	(4.1)	(4.8)
Born 1959 [b)]	24.0***	-13.0***	3.9	-17.4***	11.7**	-5.7
	(3.4)	(3.0)	(3.3)	(3.8)	(4.4)	(5.1)
Born 1960 [b)]	20.0***	-18.3***	1.3	-17.3***	17.1***	-5.7
	(2.9)	(3.3)	(3.6)	(4.1)	(4.8)	(5.6)
Born 1961 [b)]	13.6***	-11.5**	0.1	-5.6	25.4***	5.9
	(2.4)	(3.6)	(4.0)	(4.5)	(5.2)	(6.1)
Born 1962 [b)]	7.2***	-9.7*	0.9	-4.6	27.1***	10.3
	(2.1)	(4.0)	(4.4)	(5.0)	(5.8)	(6.7)
Born 1963 [b)]	-	-10.7*	-7.8	-5.0	24.6***	15.1*
		(4.3)	(4.8)	(5.5)	(6.3)	(7.4)
First sibling	-1.8	-5.4	-0.9	1.5	4.8	-0.6
	(4.1)	(3.2)	(3.5)	(4.0)	(4.7)	(5.4)
Second sibling	-0.5	-3.2	0.4	2.6	3.0	3.5
	(2.6)	(2.2)	(2.4)	(2.7)	(3.1)	(3.7)
Constant	71.8***	100.2***	92.3***	102.6***	86.6***	107.5***
	(5.0)	(5.8)	(6.5)	(7.4)	(8.5)	(9.9)
R-squared	0.956	0.927	0.926	0.924	0.933	0.937
N [b)]	131,691	187,107	186,801	185,623	184,562	183,650

Note: * p<0.05, ** p<0.01, *** p<0.001

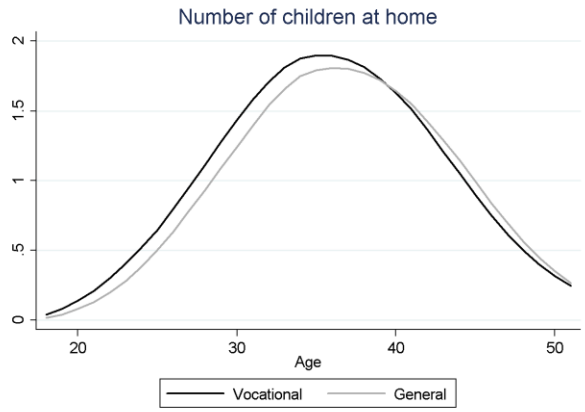
[a)] SEK in 1000s, 2011 values. SEK 10,000 equals roughly $1,300 during the studied period. .

[b)] All individuals enrolled a program at age 16, so that year of birth dummies represent both cohort effects and year specific effects, e.g. in the case age = 30, the dummy for year of birth 1963 is also a dummy for earnings being observed in 1993.

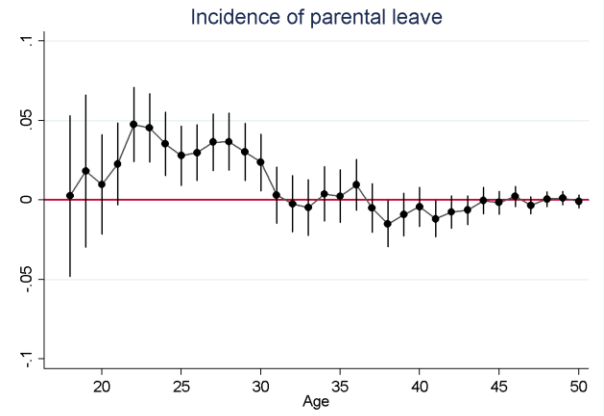
[c)] Earnings are observed from 1978. For the sample aged 20, individuals born 1955, 1956 and 1957 are therefore missing.

Figure 5 - Fertility

a) Females – Number of children at home



b) Females – incidence of parental leave

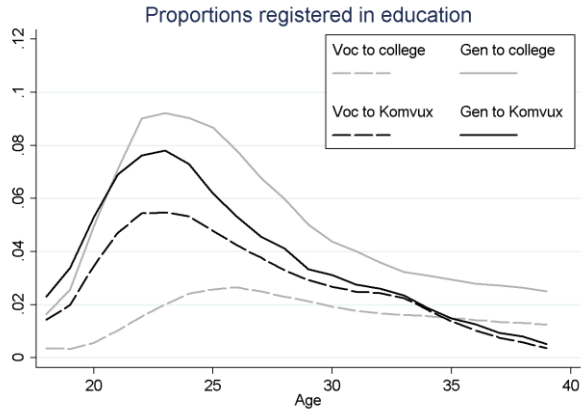


Note: Graph (b) plots estimates from linear probability models of the association between the incidence of parental leave and vocational education relative to general education across age for women. The models include controls for sister fixed effects, GPA, dummies for year of birth and order of birth. The 95% confidence intervals are included.

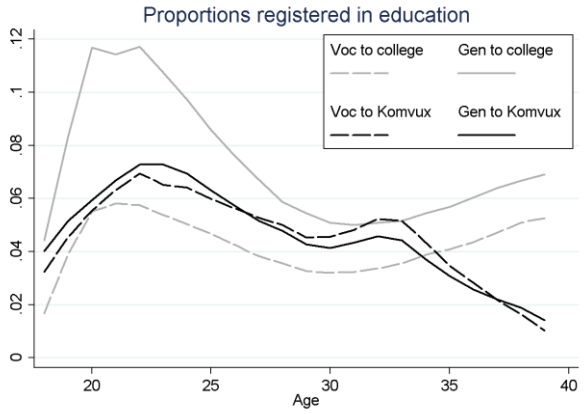
Figure 6 – Further education

Registrations in college education or Komvux upper secondary level education for ages 18-40.

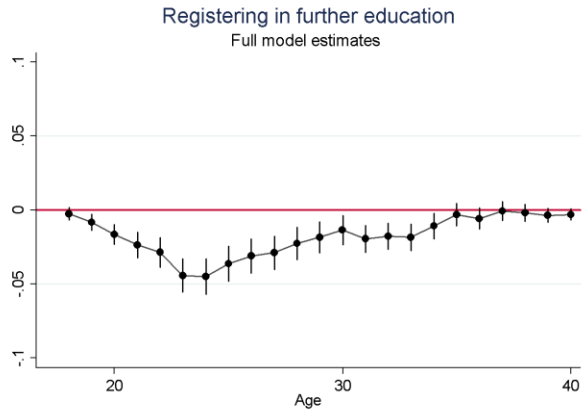
a) Descriptive averages – Males.



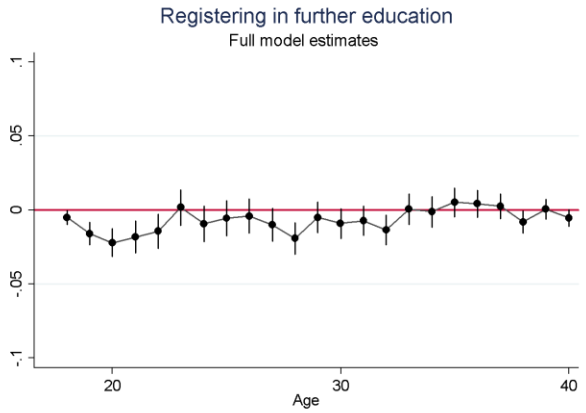
b) Descriptive averages – Females.



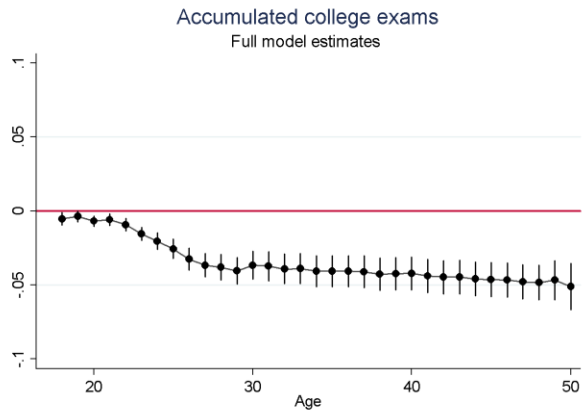
c) Estimated probabilities - Males.



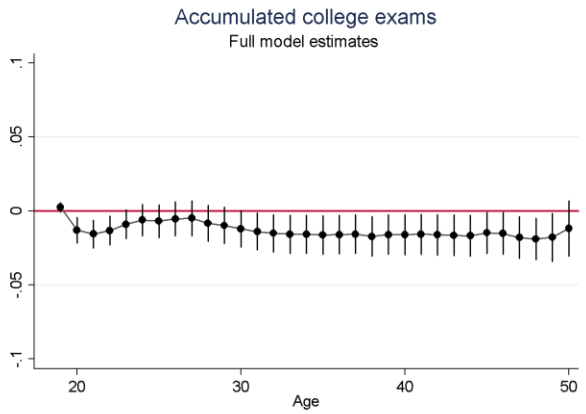
d) Estimated probabilities - Females.



e) Males - average 39-48: -.0452.



f) Females - average 39-48. -.0163.



Note: The graphs (c), (d), (e) and (f) plot estimates of vocational education relative to general education across age for men and women respectively. Graphs (c) and (d) present estimates from linear probability models of the incidence of registration in further education (Komvux or college). Graphs (e) and (f) plot estimates of the accumulated shares with an attained college exam. The models all include controls for brother/sister fixed effects, GPA, dummies for year of birth and order of birth. The 95% confidence intervals are included.

Appendix

Classification of the 2-year programs

In Table A.1 we describe the curricula of the most popular 2-year upper secondary programs. We have divided classroom subjects into "non-vocational", vocational and "other" (physical education, music and drawing). The "non-vocational" subjects have in turn been divided into three categories: 1, 2 and 3, where the first group provides the most general knowledge and "non-vocational 3" includes subjects related to a track's intended professional activity (e.g., typing in business programs, social policy in social sciences programs).

Table A.1

Number of hours per week in curricula of the 2-year upper secondary programs of main interest

	General tracks			Vocational tracks						
Type of subject	Social	Busi	Tech	Consum.	Nurs	Office	Vehic	Mech	Elec.	Constr.
Non-vocational 1:										
Swedish	3.5	4	2	3.5	3.5	3.5	2	2	2	2
English	3	4	1.5							
Math.	3	1.5	4							
Social sci.	3	3	1							
History/Religion	3.5	1	1							
Natural sci.	6		5.25							
Busin. Adm.		8.5	0.5			5				
Sum non-vocational 1	**22**	**22**	**15.25**	**3.5**	**3.5**	**8.5**	**2**	**2**	**2**	**2**
Non-vocational 2:										
Optional	3	4.5		3	3	3	3	3	3	3
Engineering subj.[a)]			15.25							
Sum non-vocational 1& 2	**25**	**26.5**	**30.5**	**6.5**	**6.5**	**11.5**	**5**	**5**	**5**	**5**
Non-vocational 3:										
Worklife knowl.				1	1	1	1	1	1	1
Social studies	2.5			0.33						
Ergonomics			1							
Psychology				0.58	1.65					
Typing/Stenogr.	2	4.5				3.67				
Consumers[b)]				7.2						
Social medicine [c)]					2.8					
Sum non-vocational 1, 2 & 3	**29.5**	**31**	**31.5**	**15.6**	**12**	**16.2**	**6**	**6**	**6**	**6**
Vocational subjects:										
Prof. practice				18.38	13.73	9	31	31	31	31
Nursing				0.83	6.38					
Childcare				1.17	4.33					
Office						10.5				
Sum vocational subjects	**0**	**0**	**0**	**20.4**	**24.4**	**19.5**	**31**	**31**	**31**	**31**
Other subjects[d)]	5.5	4.5	4	2.5	2.8	2.5	2.5	2.5	2.5	2.5
TOTAL HOURS	**35**	**35.5**	**35.5**	**38.5**	**39.2**	**38.2**	**39.5**	**39.5**	**39.5**	**39.5**
Non-voc 1	63%	62%	43%	9%	9%	22%	5%	5%	5%	5%
Non-voc 1 & 2	71%	75%	86%	17%	17%	30%	13%	13%	13%	13%
Non-voc 1 & 2 & 3	84%	87%	89%	41%	31%	42%	15%	15%	15%	15%
Voc	0%	0%	0%	53%	62%	51%	78%	78%	78%	78%

Notes: For expositional reasons, hours are given as averages per year.
[a)] In total 24 subjects divided across four different educational paths, electro-Engineering, chemical-Engineering, machine-Engineering and construction. [b)] Consumer studies include Household economy, hygiene, family science, consumer studies, living environments, design. [c)] Nursing includes household economy, hygiene social medicine, anatomy. [d)] music, drawing, P.E.

Table A.2

Descriptive statistics of same sex siblings with different educational choices

	Brothers		Sisters	
	Voc	General	Voc	General
Sibling order of birth	1.837	1.521	1.837	1.514
GPA, 1 to 5 (top) [a)]	2.790	3.055	3.188	3.365
Cognitive skill (1-9) [b)]	4.631	5.265		
Inductive skill (1-9) [b)]	4.504	5.296		
Verbal skill (1-9) [b)]	4.537	5.267		
Spatial skill (1-9) [b)]	4.994	5.380		
Engineering skill (1-9) [b)]	4.515	4.655		
Non-cognitive (1-9) [b)]	4.888	5.336		
Leadership score (1-9) [b)]	2.710	3.798		
Share born 1955	0.062	0.114	0.050	0.130
Share born 1956	0.072	0.137	0.071	0.131
Share born 1957	0.084	0.135	0.091	0.141
Share born 1958	0.109	0.128	0.115	0.121
Share born 1959	0.131	0.117	0.144	0.100
Share born 1960	0.141	0.096	0.135	0.094
Share born 1961	0.141	0.081	0.139	0.089
Share born 1962	0.127	0.092	0.130	0.098
Share born 1963	0.132	0.100	0.125	0.097
SHARES IN UPPER SECONDARY SCHOOL PROGRAMS				
2-year programs [c)]	1.000	1.000	1.000	1.000
Social science		0.401		0.768
Business		0.240		0.228
Engineering science		0.358		0.004
Office	0.103		0.303	
Music	0.003		0.005	
Consumer studies	0.010		0.449	
Nursing	0.005		0.179	
Clothing	0.000		0.013	
Food	0.026		0.018	
Mechanic engineering	0.234		0.003	
Vehicle engineering	0.151		0.003	
Woodwork	0.026		0.001	
Construction	0.208		0.002	
Electronics	0.177		0.004	
Process technology	0.016		0.002	
Forestry	0.025		0.000	
Farming	0.016		0.018	
Observations	4,159	4,003	6,001	5,854

Note: [a)] The average of final grades in comprehensive school, set from 1 (lowest) to 5 (highest) in each subject. [b)] Test scores from military enlistments at age 18-19. Non-cognitive skills reflects several different skills useful to function in the military, among which willingness to assume responsibility, independence and social skills (Lindqvist and Vestman 2011, p. 108). [c)] Curricula of selected programs are described in Table A.1 of the Appendix.

Table A.3

Detailed information regarding earnings estimates related to Figure 3c and 4c

Brother/Sister fixed effects estimates of earnings (SEK in 1000s, 2011 values). [a)]

	MALES			FEMALES		
Age	Coeff.	Std.err.	N	Coeff.	Std.err.	N
18	10,684	1,832	88831	8,794	1,458	91411
19	22,875	1,954	108672	13,270	1,712	111612
20	9,776	1,811	127437	12,387	1,531	131691
21	4,761	1,804	146431	6,038	1,392	152987
22	7,496	1,632	164568	0,084	1,274	172646
23	7,464	1,528	179011	-2,323	1,221	187107
24	4,646	1,634	179013	-2,255	1,277	187103
25	5,126	1,646	179012	-3,491	1,263	187107
26	3,449	1,713	179014	-3,561	1,289	187108
27	0,187	1,780	179015	-5,047	1,324	187109
28	-1,747	1,851	178962	-4,033	1,350	187059
29	-3,333	1,937	178875	-7,078	1,394	186958
30	-6,638	2,038	178748	-5,974	1,398	186801
31	-7,607	2,103	178592	-4,787	1,425	186623
32	-9,884	2,176	178435	-5,005	1,453	186393
33	-11,665	2,253	178198	-4,383	1,467	186154
34	-15,786	2,369	177939	-3,563	1,535	185925
35	-17,571	2,530	177614	-5,214	1,591	185623
36	-17,461	2,645	177264	-7,066	1,733	185382
37	-17,616	2,907	176958	-6,475	1,802	185124
38	-20,260	2,941	176632	-7,317	1,741	184913
39	-20,505	3,026	176326	-8,690	1,769	184738
40	-17,092	3,072	176023	-9,158	1,847	184562
41	-18,639	3,216	175766	-9,646	1,982	184374
42	-18,217	3,370	175486	-9,833	2,097	184219
43	-18,077	3,454	175201	-9,387	2,147	184028
44	-21,462	3,780	174889	-9,999	2,148	183821
45	-20,570	3,800	174557	-8,619	2,150	183650
46	-20,843	3,874	174226	-9,515	2,214	183461
47	-20,626	4,051	173795	-10,324	2,256	183221
48	-20,457	4,049	173432	-10,193	2,312	182978
49	-18,173	4,793	149952	-14,769	2,669	159242
50	-21,470	5,695	127515	-17,071	3,189	135748
51	-25,506	7,004	106595	-16,099	3,712	114020
52	-17,285	9,319	86670	-15,653	4,757	93259

[a)] SEK 10,000 roughly $1,300 during the studied period. Earnings are observed from 1978. For the sample aged 18, individuals born 1955-1960 are therefore missing. All cohorts are observed for the first time at age 23 and for the last time at age 48.

Table A.4

Robustness checks of brothers earnings estimates (SEK in 1000s, 2011 values). [a].

	Controls expanded [b]			At most 2-year prog. [c]			Register in educ excluded [d]		
	Coeff.	Std.err.	N	Coeff.	Std.err.	N	Coeff.	Std.err.	N
18	10,115	1,838	88836	10,480	2,221	67140	5,589	2,946	55004
19	21,970	1,954	108673	27,715	2,596	81275	21,751	3,119	67073
20	8,634	1,810	127440	12,523	2,552	94361	13,800	2,861	78599
21	2,667	1,798	146432	3,193	2,549	107184	-2,230	3,031	90369
22	4,472	1,614	164570	6,925	2,272	119299	4,753	2,406	101834
23	3,862	1,496	179016	5,410	2,099	129023	1,184	2,206	111007
24	0,959	1,597	179016	4,363	2,181	129023	1,062	2,562	111006
25	2,476	1,604	179016	2,168	2,172	129023	-0,777	2,611	111007
26	0,514	1,670	179016	2,360	2,320	129023	-3,835	2,625	111007
27	-2,085	1,740	179016	0,760	2,417	129023	-4,028	2,742	111009
28	-3,645	1,815	178962	-2,296	2,527	128983	-2,569	2,797	110969
29	-4,527	1,904	178875	-2,685	2,675	128929	-2,192	2,952	110921
30	-7,275	2,006	178749	-2,859	2,803	128836	-5,024	3,102	110849
31	-8,672	2,077	178592	-7,217	2,907	128732	-9,198	3,232	110768
32	-10,387	2,151	178435	-9,583	3,011	128635	-10,567	3,360	110681
33	-12,181	2,227	178198	-10,481	3,060	128462	-11,657	3,408	110547
34	-15,320	2,342	177939	-15,010	3,224	128291	-16,850	3,585	110405
35	-16,518	2,502	177615	-16,441	3,393	128081	-17,389	3,825	110220
36	-16,381	2,617	177264	-16,039	3,471	127849	-12,115	3,887	110041
37	-15,868	2,878	176958	-16,090	3,741	127655	-17,240	4,315	109879
38	-18,404	2,914	176632	-19,925	3,916	127461	-18,825	4,461	109718
39	-18,744	3,008	176327	-19,318	3,849	127238	-14,828	4,542	109527
40	-15,115	3,053	176023	-15,104	3,945	127010	-12,639	4,365	109325
41	-16,124	3,199	175767	-14,483	4,121	126813	-14,052	4,557	109155
42	-15,807	3,354	175490	-14,913	4,256	126649	-13,901	4,669	108975
43	-15,556	3,439	175201	-15,032	4,407	126441	-16,751	4,898	108772
44	-18,167	3,761	174889	-18,021	4,599	126224	-15,622	5,006	108568
45	-17,396	3,787	174558	-14,873	4,752	125985	-17,317	5,249	108353
46	-17,336	3,865	174226	-16,457	4,882	125760	-18,705	5,379	108159
47	-17,035	4,044	173795	-19,007	5,064	125461	-17,173	5,625	107899
48	-16,442	4,042	173432	-14,340	5,161	125178	-17,930	5,849	107654

[a] SEK 10,000 roughly $1,300 during the studied period. Earnings are observed from 1978. For the sample aged 18, individuals born 1955-1960 are therefore missing.
[b] Controls expanded to include registrations in education and completed further education.
[c] Sample conditioned to have completed a 2-year upper secondary program as their highest education.
[d] All individuals at some point registered in further education excluded

Table A.5

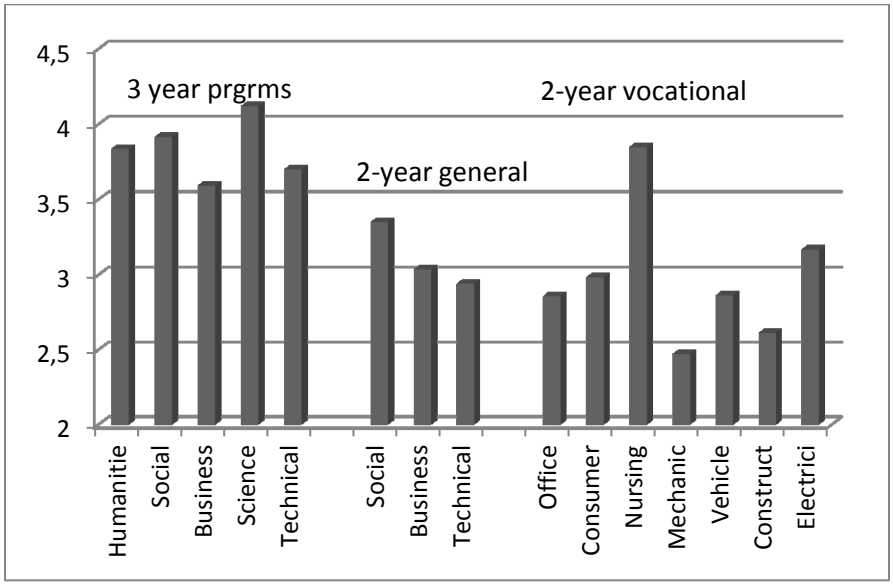
Robustness checks of sisters earnings estimates (SEK in 1000s, 2011 values). [a].

	Controls expanded [b]			**At most 2-year prog.** [c]			**Register in educ excluded** [d]		
	Coeff.	Std.err.	N	Coeff.	Std.err.	N	Coeff.	Std.err.	N
18	7,998	1,455	91411	7,001	2,041	62179	1,304	3,530	34890
19	11,305	1,678	111615	8,098	2,319	75257	6,545	3,693	42514
20	9,362	1,442	131692	7,348	2,113	87549	3,177	3,826	50087
21	3,258	1,321	152991	2,869	1,871	100522	-2,459	3,138	58417
22	-1,470	1,220	172648	-3,100	1,779	112360	-2,872	2,945	66460
23	-2,498	1,175	187109	-3,003	1,740	121012	-2,874	2,847	72421
24	-2,630	1,243	187109	-0,930	1,803	121012	-2,962	2,972	72421
25	-3,533	1,240	187109	-0,525	1,836	121012	-2,596	3,032	72421
26	-3,802	1,274	187109	-3,370	1,868	121012	-3,954	3,059	72422
27	-5,658	1,313	187109	-2,857	1,914	121012	-5,737	3,176	72422
28	-4,573	1,344	187061	-2,326	1,944	120980	-7,251	3,168	72409
29	-7,264	1,388	186958	-6,654	1,983	120917	-9,795	3,203	72372
30	-6,055	1,393	186801	-3,970	1,997	120808	-8,339	3,186	72304
31	-4,801	1,418	186623	-2,321	2,036	120706	-5,902	3,234	72239
32	-5,311	1,446	186393	-5,400	2,061	120587	-5,016	3,297	72162
33	-4,412	1,457	186154	-3,100	2,086	120441	-4,204	3,275	72070
34	-3,541	1,521	185925	-1,882	2,131	120324	-5,440	3,327	71992
35	-4,882	1,574	185623	-1,886	2,186	120151	-5,127	3,409	71886
36	-6,792	1,714	185382	-3,286	2,241	120024	-9,846	3,454	71812
37	-6,161	1,781	185124	-3,888	2,331	119861	-6,462	3,615	71713
38	-7,435	1,720	184913	-4,649	2,399	119753	-6,557	3,711	71644
39	-8,437	1,742	184738	-6,149	2,465	119655	-6,609	3,758	71582
40	-9,187	1,817	184562	-4,731	2,549	119542	-5,637	3,979	71497
41	-9,721	1,947	184374	-5,605	2,640	119414	-11,046	4,090	71425
42	-9,786	2,068	184219	-6,441	2,759	119308	-14,967	4,238	71343
43	-9,130	2,116	184028	-7,787	2,857	119177	-13,905	4,558	71249
44	-9,966	2,117	183821	-9,465	2,921	119014	-15,402	4,610	71159
45	-8,667	2,117	183650	-8,050	2,961	118899	-15,741	4,619	71094
46	-9,398	2,185	183461	-9,083	3,054	118774	-15,140	4,790	71000
47	-9,978	2,225	183221	-9,912	3,130	118612	-16,175	4,913	70915
48	-9,794	2,282	182978	-8,892	3,230	118445	-17,179	4,994	70821

[a] SEK 10,000 roughly $1,300 during the studied period. Earnings are observed from 1978. For the sample aged 18, individuals born 1955-1960 are therefore missing.
[b] Controls expanded to include registrations in education and completed further education.
[c] Sample conditioned to have completed a 2-year upper secondary program as their highest education.
[d] All individuals at some point registered in further education excluded

Figure A.1

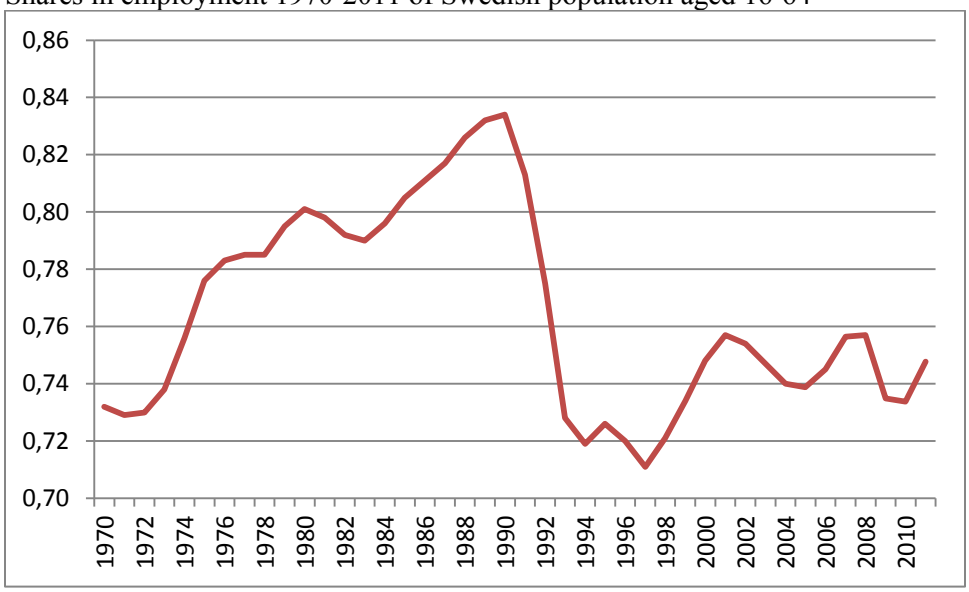
GPA by program



Note: Average GPA by program of enrolment 1971-1979, 3-year programs and the most popular 2-year programs. Our main analyses are restricted to 2-year programs.

Figure A.2

Shares in employment 1970-2011 of Swedish population aged 16-64



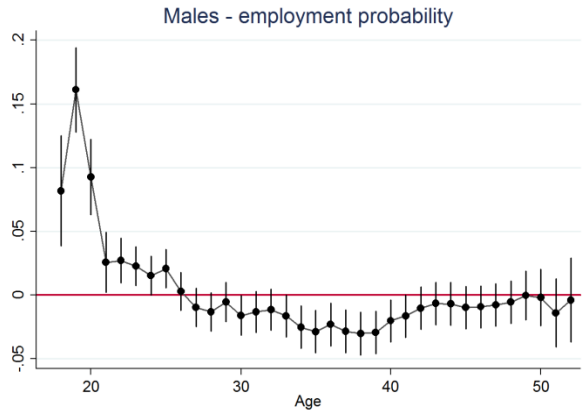
Source: Statistics Sweden, labor force surveys.

Figure A.3

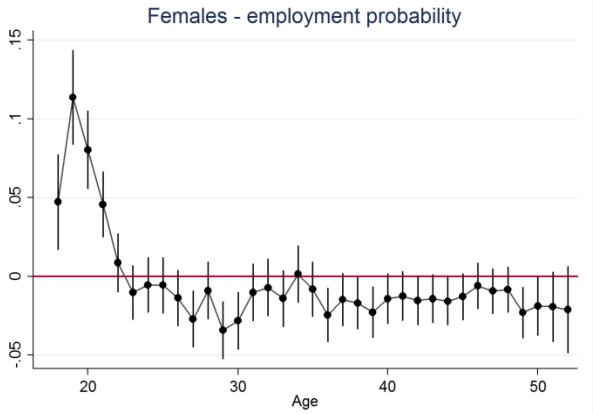
Relative likelihood of being employed (as defined) across age with a vocational vs general education.

Coefficient values pertain to vocational education. Average point estimates for ages 18-21 and 39-48 are indicated in absolute terms and in percentages (in parentheses).

a) - average 18-21: .090
- average 39-48: - .012



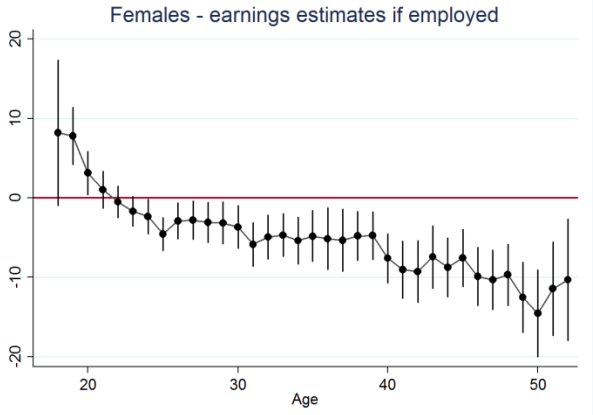
b) - average 18-21: .072
- average 39-48: - .013



Earnings estimates for samples conditioned on employment (as defined).

c) - average 18-21: - 184 (-.002)
- average 39-48: - 18,230 (-.065)

d) - average 18-21: 5,036 (.063)
- average 39-48: - 8,452 (-.041)



Note: Panels (a) and (b) present estimated differences in probabilities of reaching annual earnings exceeding half of the median earnings of the Swedish population aged 45. Panels (c) and (d) present estimated differences in annual earnings for samples conditioned to earn at least this level. SEK 10,000 roughly equaled $1,300 during the studied period. Estimates above zero indicate higher probabilities or earnings for vocational education. Each estimate and 95% confidence interval are extracted from separate regressions. Estimated models include family fixed effects, controls for GPA, dummies for year of birth and order of birth.

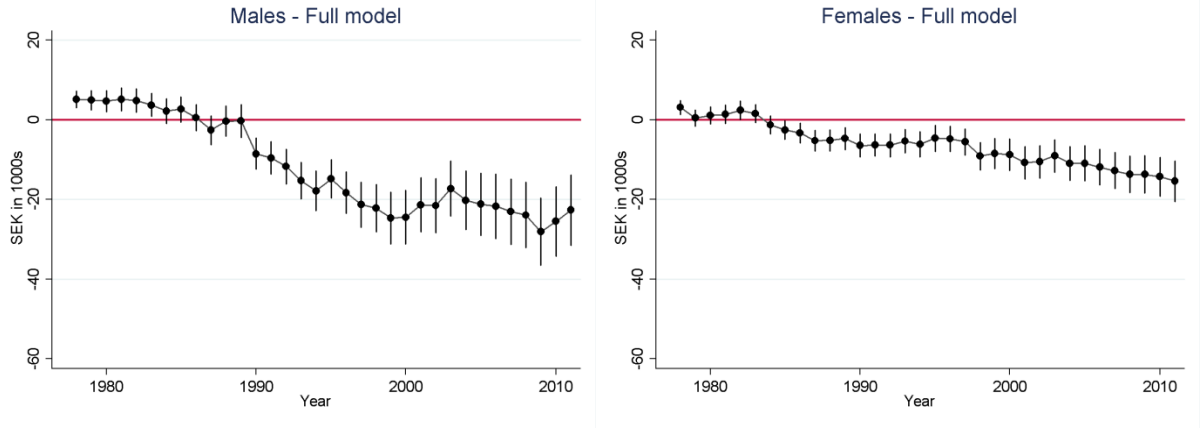
Figure A.4

Estimated differences in annual earnings, vocational vs general, across years.

Coefficient values pertain to vocational education. Average point estimates for the years 1978-1980 and 2002-2011 are indicated in absolute terms and in percentages (in parentheses).

a)- average 1978-1980: 4,949 (.048).
- average 2002-2011: - 22,496 (-.075).

b) - average 1978-1980: 1,590 (.020)
- average 2002-2011: - 12,291 (-.053)



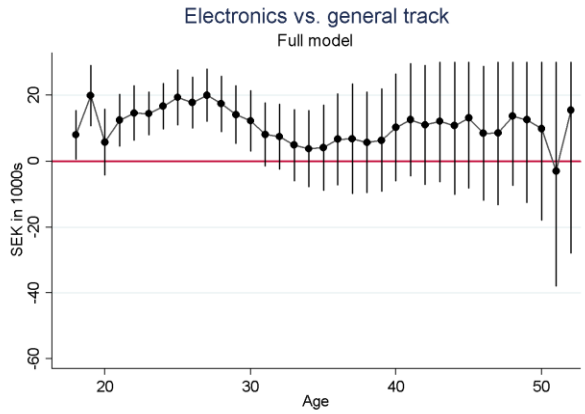
Note: SEK 10,000 roughly equaled $1,300 during the studied period. Estimates above zero indicate higher earnings for vocational education. Each estimate and 95% confidence interval are extracted from separate regressions. Estimated models include family fixed effects, controls for GPA, dummies for year of birth and order of birth.

Figure A.5

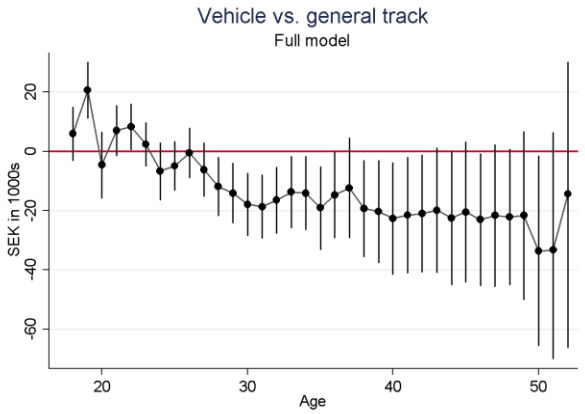
Males – Estimated differences in annual earnings, vocational vs general across age for separate vocational tracks

Coefficient values pertain to vocational education. Average point estimates for ages 18-21 and 39-48 are indicated in absolute terms and in percentages (in parentheses).

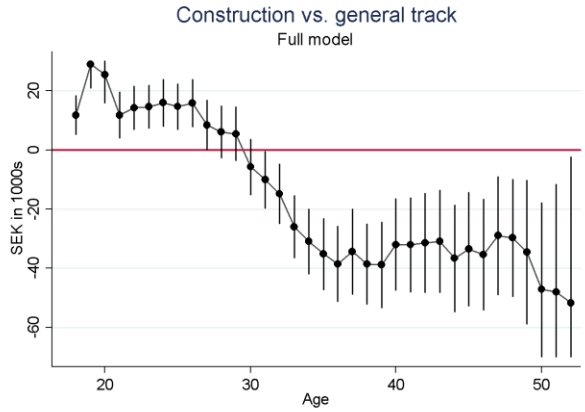
a) Males - average 18-21: 11,522 (.114).
- average 39-48: 10,683 (.034).



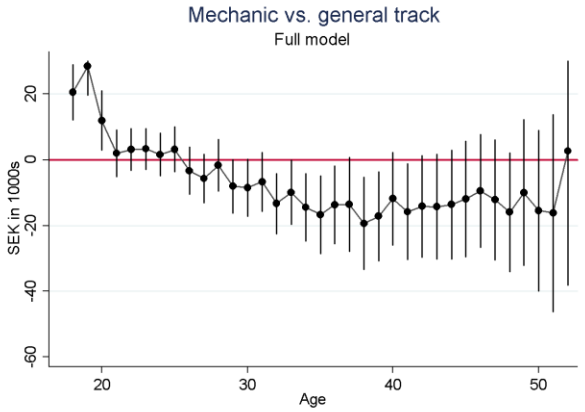
b) Males - average 18-21: 7,232 (.069).
- average 39-48: -21,526 (-.073).



c) Males - average 18-21: 19,464 (.179).
- average 39-48: -32,955 (-.117).



d) Males - average 18-21: 15,721 (.163).
- average 39-48: -13,646 (-.048).



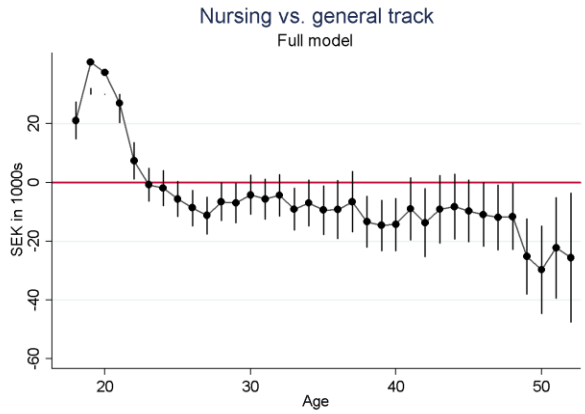
Note: SEK 10,000 roughly equaled $1,300 during the studied period. For men only, these graphs plot the return in annual earnings to four types of vocational tracks (construction, electronics, mechanical engineering, vehicle engineering) relative to general education. Each estimate and 95% confidence interval are extracted from separate regressions which include controls for sibling fixed effects, GPA, dummies for year of birth and order of birth.

Figure A.6

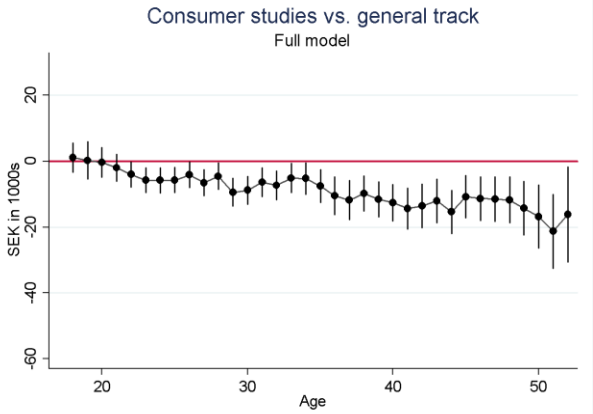
Females – Estimated differences in annual earnings, vocational vs general across age for separate vocational tracks

Coefficient values pertain to vocational education. Average point estimates for ages 18-21 and 39-48 are indicated in absolute terms and in percentages (in parentheses).

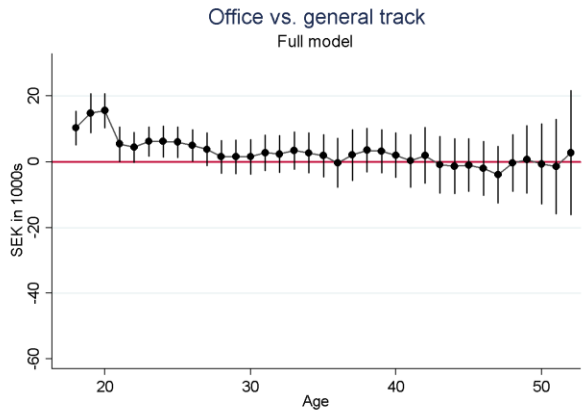
a) Females - average 18-21: 31,534 (.327).
- average 39-48: -11,310 (-.053).



b) Females - average 18-21: -278 (-.000).
- average 39-48: -12,505 (-.062).



c) Females - average 18-21: 11,514 (.127).
- average 39-48: -218 (-.000).



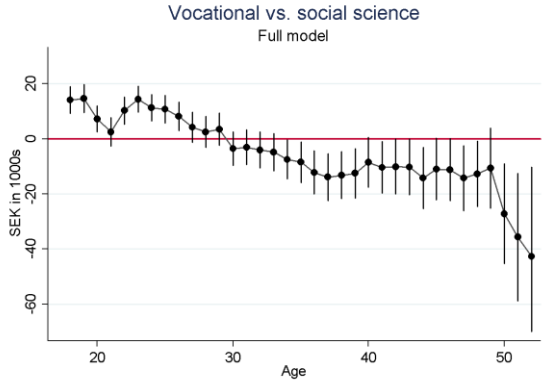
Note: SEK 10,000 roughly equaled $1,300 during the studied period. For women only, these graphs plot the return in annual earnings to three types of vocational tracks (consumer studies, nursing, office) relative to general education. Each estimate and 95% confidence interval are extracted from separate regressions which include controls for sibling fixed effects, GPA, dummies for year of birth and order of birth.

Figure A.7

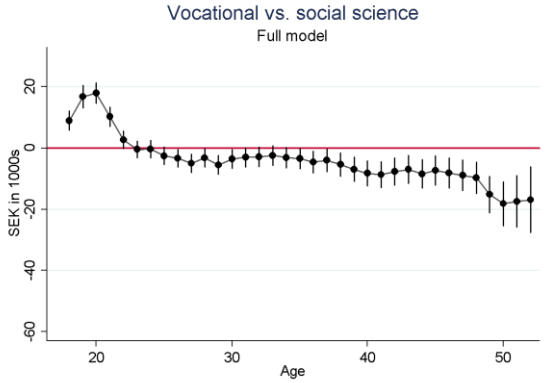
Estimated differences in annual earnings, vocational vs general across age for separate general tracks.

Coefficient values pertain to vocational education. Average point estimates for ages 18-21 and 39-48 are indicated in absolute terms and in percentages (in parentheses).

a) Males - average 18-21: 9,608 (.095).
- average 39-48: -11,541 (-.043).

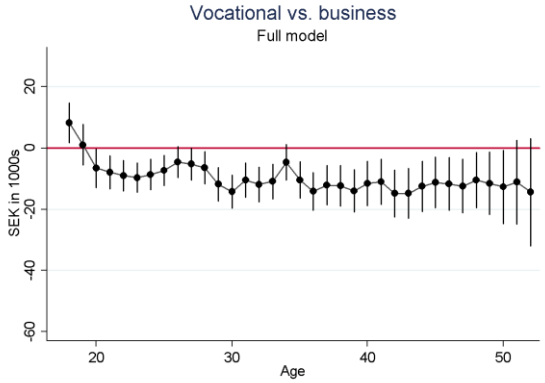


b) Females - average 18-21: 13,452 (.140).
- average 39-48: -8,141 (-.040).

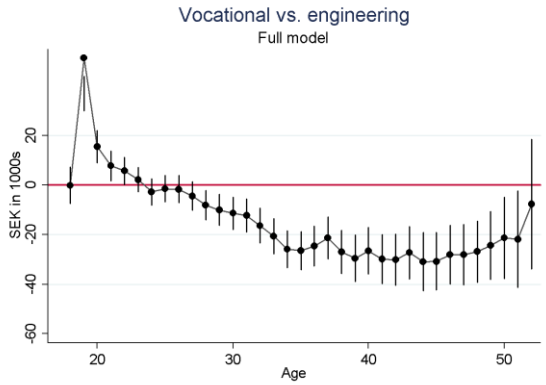


c) Males - average 18-21: 9,989 (.097).
- average 39-48: -21,940 (-.081).

d) Females - average 18-21: -1,352 (-.004).
- average 39-48: -12,474 (-.064).



e) Males - average 18-21: 18,658 (.155).
- average 39-48: -28,792 (-.108).



Note: SEK 10,000 roughly equaled $1,300 during the studied period. The graphs plot the return in annual earnings to vocational education relative to three types of general tracks (business, social science and Engineering tracks). Each estimate and 95% confidence interval are extracted from separate regressions which include controls for sibling fixed effects, GPA, dummies for year of birth and order of birth.

Appendix 2

Occupations

The hypotheses on relative outcomes in the short- and the long-term are based on the underlying assumption that individuals sort into different careers depending on the type of upper secondary school program. Put differently, if our models reflect educational contents, one would also expect individuals to sort into different occupations. We have access to the Swedish Classification of Occupations from 2004, when individuals in our sample are aged 41-49. At the one digit level, the shares in the categories "construction / manufacturing" and "machinery / transportation" are about twice as high for males with vocational programs compared with general programs (38.0 percent vs. 17.7 percent). For females, the category "service / nursing / sales" is about one third higher if enrolment was in a vocational program (34.1 percent vs. 22.6 percent).

The occupational definitions partly reflect the expected skill levels linked with positions. The shares in these occupations may differ if general education is associated with stronger skill multiplier effects or because further schooling is more common. We therefore also examine the probability of being in an occupation we label as *advanced*, which includes the categories "leading position," "specialized," or "short college." The descriptive data indicate higher shares among individuals with general education (44.4 vs. 22.7 percent for males and 45.9 vs. 29.6 percent for females).

We investigate the probability of having a vocational occupation also with linear probability regressions, using the full set of explanatory variables presented in Section 4.3. First, those with a vocational program have a higher likelihood of a typical vocational occupation (12.6 percentage points for males and 7.6 percentage points for females). If one excludes individuals

with further education, these estimates are 12.7 and 7.0 percentage points respectively. Turning to the probability of an advanced occupation, it is lower for individuals with a vocational education by 8.9 percentage points (males) and 5.4 percentage points (females). These estimates are 6.5 percentage points and 5.1 percentage points respectively if we exclude individuals with further education.