Comparing Long Term Earnings Trajectories

Of Individuals with General and Specific Education*

by

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Abstract: A major difference between countries' educational systems is the relative emphasis given to vocational/specific and general/theoretical skills. The long term relative labor market effects of general versus specific education are theoretically ambiguous and largely unexplored empirically. We analyze uninterrupted population register data of annual earnings 1978-2011, using samples of same-sex siblings who between 1971 and 1979 enrolled in either theoretical or vocational tracks of 2-year upper secondary school programs. We control for GPA and family fixed effects. Vocational education is associated with an initial relative earnings advantage, but this is transformed into a relative earnings disadvantage of around 2-3 percent, after about ten years for males (age 28) and for females already after 2-3 years (age 20).

Keywords: Human capital, vocational education, life-cycle, tracking

JEL classification: J24, J64, J31, I20

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1 Introduction

One of the most striking features of developed countries' educational systems is the extent to which they vary with respect to their emphasis on vocational and theoretical education.[1] In southern Europe, the US and the UK, modest shares of the student population attend vocational education before age 18, whereas countries on the European continent track pupils already at ages 10 or 12 (e.g. Austria, Belgium, Germany, Slovakia, the Netherlands), sometimes with apprenticeships at upper secondary level. These differences partly have historical explanations, but the almost complete lack of convergence between countries also reflects an ambiguity in our understanding of the expected long term returns to vocational/specific and theoretical/general education.[2] While vocational education may facilitate the transition from school to work, theoretical education may imply less sensitivity to changes in labor demand and a relative long-term advantage. In this respect, Krueger and Kumar (2004a, 2004b) argue that differences in emphasis between the US and Europe may provide a comparative advantage for the US, as the focus on general skills would enhance the ability to adopt new technologies. Although highly policy relevant, the link between the contents of intermediate education and long term labor market outcomes is still an underdeveloped area of research.

The aim of this article is to compare long term earnings trajectories of those who enrolled in 2-year upper secondary school programs in Sweden between 1971 and 1979. The curricula are categorized as either vocational/specific or general/theoretical, with neither type of program meeting the general requirement for university studies. We use Swedish population register data of individuals born 1955-1963. Annual earnings are observable from 1978, when the individuals are aged 15-23, until 2011

[1] We use, interchangeably, specific/vocational and general/theoretical to refer to these concepts. Schooling is in both cases "formal", leading to an official certificate which is acknowledged on the labor market.

[2] Goldin and Katz (2008) describe how the educational system in the US was developed as a comprehensive system at the start of the 20th Century, which included secondary education at low or no cost. In Europe, secondary educations were costly and less accessible for much of its non-elite population, which mostly relied on acquiring specific skills on the job.

when they are aged 48-56. The register data provide high quality records, free from recall errors. Our analyses test the null hypothesis of no differences in average earnings between vocational and theoretical education. We acknowledge that the contents of human capital investments may influence a plethora of outcomes, e.g. the probability of further education, unemployment patterns, occupational choice, migration, social status, health, fertility, democratic citizenship, etc. To maintain focus, education is considered as an investment with monetary returns only. Other outcomes are essentially regarded as potential mechanism influencing earnings. We use information on Grade Point Averages (GPA) from comprehensive school, completed before upper secondary school enrollment (at age 15), and control for time invariant family background characteristics via family fixed effects of same sex siblings. Ability and family background have been shown to be important predictors of track enrolment. In addition, employing samples of brothers and sisters improves comparability and reduces bias as individuals to a greater extent overlap in terms of unobservable characteristics. While we do not claim that our estimates are unbiased, our controls are likely to take into account the most relevant sources of selection, with remaining bias of the secondary importance.

If one considers the enormous literature on the returns to schooling, there is surprisingly little research on the returns to educational contents. A handful of studies have shown that vocational education may have a relatively positive impact on the school-to-work transition. Kemple and Scott-Clayton (2004) and Kemple and Willner (2008) explore a lottery procedure which assigned individuals in the US to either high school or career academies, which include vocational education. Their results concern individuals from socially disadvantaged families, and show a lower drop-out rate from career academies, and that earnings were 11 percent higher among males eight years after completion. Parey (2012) also explores a partly random variation to compare apprenticeship training and vocational education in Germany. In line with the earlier studies, the results indicate a short run advantage for the schooling con-

tent with the closest connection to the labor market. With outcomes measured at ages 23-26, apprenticeship training leads to a substantial 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. 2003). In contrast, a couple of studies which concern extensions of vocational education have reported zero effects (Hall 2012, Oosterbeek and Webbink 2007). Related to our study, Hall (2012) exploits a pilot scheme in Sweden where a 2-year upper secondary vocational programs were7 extended to three years, with the curricula altered to include apprenticeship training and increased hours of theoretical studies from 4-7 hours to about twice that amount. They find no effects on earnings and a higher amount of drop outs. Oosterbeek and Webbink (2007) studied a reform which extended vocational education for basic track in Holland by one year, without finding any long term effects on wages. Also, for Germany, Pischke and von Wachter (2008) found an extra year at the basic track not to affect log wages. A possible interpretation from these studies is that they offer some support for proponents of theoretical studies. [3]

Malamud and Pop-Eleches (2010) is the only study we are aware of which directly compares long term effects of educational contents. They exploit a 1973 educational reform in Romania which postponed vocational schools, and required individuals to complete ten instead of eight years of general education. Individuals in their sample completed schooling in the 1970s during the communist regime, but average earnings were recorded across several post-communism years, and as late as in 2002 when aged around 40. A higher share of general schooling decreased the likelihood of manual or craft-related

[3] This is of course merely suggestive, using broad brush strokes. The study by Pischke and von Wachter (2008) concerned a vocational track. The extended education is described as emphasizing general skills, although not identical across German regions, and may be considered as a comprehensive extension.

occupations, but generated no differences in labor market participation or earnings between the groups. Their results only pertain to males, and do not include any evidence concerning the short term school to work transition. One may note that their study concerns an economy in transition which included a sharp recession in the mid-1990s; circumstances which one might expect to favor the relative earnings of theoretical studies. However, a potential long term advantage of theoretical education may hinge on on-the-job-training, and Romania had the lowest on-the-job-training incidence in Europe (ten percent, OECD 2004).[4]

The contribution of the present paper is to directly compare uninterrupted series of earnings trajectories 1978-2011 (aged 18-56), associated with vocational and theoretical educations. Our descriptive average earnings trajectories already represent a type of analysis that has not been performed earlier. The analyses are made separately for males and females. Robustness checks present results for samples with different initial ability levels as measures by the GPA and, for males, measures of cognitive and non-cognitive abilities. To examine heterogeneity within vocational and theoretical education, results are also presented for single tracks. Sweden is interesting also as on-the-job-training incidence is one of the highest in Europe (60 percent, OECD 2004). Overall, we find vocational education associated with an initial earnings advantage. The initial advantage lasts for males until about age 28, while until about age 20 for females. This is followed by a long term earnings advantage associated with theoretical education which, for both males and females, lasts throughout our observation window. The net present value reaches break-even at around age 35, slightly later for males and slightly earlier for females. The implications of our results roughly hold when samples are divided into those with above or below median GPA.

[4] Hanushek et al. (2011) use cross-sectional and cross-country data from the International Adult Literacy Survey (IALS). Controlling for cognitive skills, country fixed effects, years of schooling and parental background, their main finding is that an observed relative employment advantage of vocational skills diminishes with the age of cohorts.

2 Theoretical considerations

2.1 The technology of skill formation

Becker (1964) made a distinction between general and firm specific human capital, where the specific skills were not transferable to other firms. We consider skills provided by both vocational and theoretical educations as transferable between employers, but there are differences in the degree of transferability. One may think of vocational education in terms of branch specific skills, and theoretical education as enhancing the ability to learn new tasks. With two different kinds of human capital, we would like to consider how skills are shaped in the short-run and the long-run. In their model of skill formation, Cunha and Heckman (2007) provide useful notions. First, human capital investments in one period increase skills/abilities which persist into later periods. This property is termed *self-productivity*. Second, skill investments in one period make investments in later periods more productive. This is labelled *dynamic complementarity*. Together, self-productivity and dynamic complementarity produce skill multiplier effects.

In the terminology of Cunha and Heckman, to the extent that the skills provided are closely connected to some segment of the labor market, we assume it is linked to a high self-productivity. It is often argued that an advantage of vocational education is that it simplifies the transition from school to working life. This could be because branch specific skills are conveyed into higher immediate productivity on the labor market, and it may explain why several studies have reported an initial earnings advantage of vocational education (Kemple and Scott-Clayton 2004, Fersterer et al. 2008, Kemple and Willner 2008, Parey 2012).

On the other hand, theoretical education is typically viewed as emphasizing abilities which improve the ability to learn. We assume that skills that enhance the ability to learn new tasks yield greater

dynamic complementarity and skill multiplier effects. For instance, as the costs of learning are reduced, investment in on-the-job-training becomes more productive. This may increase the likelihood of receiving on-the-job-training, make individuals more flexible when facing technological and/or organizational changes and facilitate future career changes (Shavit and Müller 1998, Brunello 2001, Rosenbaum 2001, Korpi et al. 2003, Krueger and Kumar 2004a, 2004b). In the longer term, this might also imply that technological changes create an advantage for those who are better at learning new skills. The earnings associated with theoretical education could therefore catch up. As time passes, it may even turn into a relative earnings advantage compared with vocational education. This will depend on the relative size of the skill multiplier effects. Vocational education also enhances productivity in future investments, but theoretical education may increase the relative returns more. In sum, an initial earnings advantage of vocational education may in the long term turn into an earnings disadvantage compared with theoretical educations.

2.2 Who enrolls, and why?

To explain educational enrolment, the human capital model (Becker 1964) stipulates that an individual chooses the educational path which maximizes her net present value of the expected utility and opportunity costs. Under perfect information, choices may still yield suboptimal earnings levels, but be compensated by non-monetary gains in the form of a desired working environment and social status associated with career paths. This is one way to explain why individuals with the same ability levels differ in their educational choices.

The literature in economics and sociology highlights ability levels and family background as the two major sources of influence on educational choice. The influence of family background involves mechanisms which are intertwined with ability. The *primary effect* is that children of advantaged social

origins are more likely to perform well in school. The *secondary effect* is that, for a given level of performance, these children are also more likely to make more ambitious educational choices than their peers from a less advanced social background. For example, all children may be equally concerned about avoiding downward social mobility, and aim for a social position which is at least at the level of their parents. For individuals with the same ability and the same GPA, it may therefore be rational to make different educational choices, as the expected probabilities of reaching the parents' level may differ depending on social background (e.g. Boudon 1974, Breen and Goldthorpe 1997). In sum, we expect sorting into educational paths by ability and, for a given ability level, we also expect family background to influence educational choice. [5]

Besides ability and family background, individual personality traits may explain educational choice. For example, a high individual discount rate may tend to be associated with choosing vocational education because a higher value is given to a potential earnings advantage shortly after school completion. In addition, investments in branch specific skills are associated with a long term risk in case of future falling demand for the specific skill. Individuals with high discount rates will assign less weight to the long-term risk when they make their educational choice.[6]

3 Institutional background

The Swedish setting may be described as one with moderate tracking, more than in the US but less than continental Europe. When the oldest cohort in our sample (born 1955) entered school at the age of sev-

[5] Assuming imperfect information about the future, 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 partly shaped by social circumstances, pupils of different social origins may put different weights on how GPA is a predictor of educational success.

[6] Risk-preferences could of course also be argued as important for educational choice. Analyzing Dutch data, Borghans and Golsteyn (2008) find that adults with vocational educations are more likely to regret their educational choice. It potentially indicates that some individuals underestimate the risks associated with choosing vocational educations.

en, a compulsory nine year comprehensive education had just been fully implemented (in 1962). Within a couple of years, continued education was also re-organized into *yrkesskola*, *fackskola* and *gymnasium*, with the latter comprising 3-year theoretical programs (humanities, natural sciences, social sciences, business and technical science). Yrkesskola encompassed vocational educations and fackskola 2-year theoretical programs in business, social sciences and technology. In 1971, the new *gymnasieskola* was established, fitting in the programs from fackskolor and yrkesskolor as 2-year programs on top of the already existing 3-year programs. Gymnasieskola is what we will refer to as upper secondary school. It was intended to be dimensioned so that 30 percent of a cohort would go to vocational studies, 20 percent to 2-year theoretical studies, 30 percent to the 3-year programs and 20 percent would go directly from compulsory school to the labor market (SOU 2008:27).

The theoretical 3-year programs met the eligibility requirements for university education. For our purposes, the 2-year programs are of main interest as these could be both vocational and theoretical, and as neither of these categories fulfilled the eligibility criteria for university studies. However, the 2-year programs did provide eligibility for short educations, classified as tertiary level, in narrow fields such as physiotherapist, nursing and pre-school teacher. In the results section, we address further education as a potential indirect influence on our earnings estimates.

Table 1 describes the curricula of the most common 2-year upper secondary programs. The tracks were commonly referred to as theoretical or vocational depending on whether the curricula contained professional practice which was taught within the confines of school (not company based). Our stance is that all subjects contain elements of both specific and general skills. We are therefore interested in decomposing the differences in curricula to assess the extent of the differences. This may also facilitate comparability with future studies. In Table 1, we have divided classroom “non vocational” subjects into three categories, 1, 2 and 3 where we consider the first group to provide the most general knowledge.

"Non-vocational 3" includes subjects directly related to a track's intended professional activity (e.g. typing in business program, social policy in social sciences program). This simple categorization shows that the proportion of non-vocational courses is substantially higher in theoretical programs. The widest definition (1, 2 & 3) includes classroom theoretical studies (not music or drawing) and encompasses about 30 hours per week in each of the theoretical tracks, 6 hours per week in vocational tracks dominated by males and 10-15 hours in the female dominated vocational tracks. [7]

4 Data

A novelty of this paper is that the analyses are based on population register data from Upper Secondary School Application Records 1971-1979, not previously used in economic research. The registers provide information on enrolment in upper secondary school for cohorts born 1955-1963, GPA from comprehensive school at age 15, as well as program of enrollment at upper secondary school. The individuals in the data carry a unique identifying number which allows us to merge information with other registers from Statistics Sweden for each year from 1978 until 2011, e.g. of annual earnings. We are also able to link full siblings to each other (we exclude half siblings) via the so-called multiple generation registers.

Tables 2 and 3 display the mean characteristics of the male and female samples. The first column contains the full sample. It is reduced in column (2) by about half as we set the restrictions that individuals enroll a 2-year program at age 16. In column (3), only about one in six of these individuals remain as they are conditioned to have at least one same sex full sibling born 1955-1963 in the sample. Importantly, the restriction has little impact on the descriptive means.[8] It suggests that this sample may yield analyses which are valid also for individuals without a same sex sibling born 1955-1963. The last two col-

[7] Hall (2012) compared the 2-year vocational programs with extended 3-year vocational programs. The extensions increased non-vocational "type 1" courses by 5-6 hours and added apprenticeship training.
[8] While reducing the sample is to throw away information, our priority here is to generate relevant samples adjusted for our research question and to compare comparable individuals.

umns (4 and 5) show the brother/sister samples separately by educational paths, vocational or theoretical. Grades are set from 1 (lowest) to 5 (highest) in each subject at in comprehensive school. The GPA is calculated as the average from these and in case there were more applicants than seats, the GPA was used as a screening device. As one would perhaps expect, the mean GPA is higher for those in theoretical tracks, 3.05 vs. 2.76 for males and 3.37 vs. 3.16 for females (the GPA of girls typically higher than of boys). 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 electrician programs (16 percent). For females, the largest vocational programs are nursing (16 percent), office (30 percent) and Consumer studies (47 percent), which include three main paths (health and social care, large-scale households, textile).

Table 2 also presents scores of cognitive and non-cognitive abilities from military enlistments. These measures are available for all males. They are recorded at age 18-19 which means they may partly be influenced by curricula during upper secondary school. The cognitive test score has been said to stabilize around age 10 (Cunha and Heckman 2007), but Dahl et al. (2012) show for 3-year academic tracks that two of the cognitive scores (inductive and verbal) do change with additional school days (one percent of a standard deviation per 10 days of schooling). In a companion paper, Dahl et al. (2014) find no effects of schooling on the non-cognitive test scores. This would support their use as relevant controls.

As mentioned in the introduction, our empirical method is based on family fixed effects. Table 4 therefore displays descriptive averages of the individuals who will identify the parameter of main interest. These samples are thus restricted to those with at least one same sex sibling choosing a different educational path (theoretical rather than vocational, or vice versa). Naturally, the sample size is now reduced even further. The educational groups become marginally more similar, but there are no substantial differences compared with Tables 2 and 3.

Figure 1 shows the GPA distribution of same sex siblings enrolled in vocational and theoretical studies respectively. While there are apparent differences in frequencies at the tails, there is also considerable overlap between the groups. We only have access to the GPA if individuals applied for upper secondary school between 1971 and 1979. During this period, the share of 16 year olds attending upper secondary school increased from 60.0 percent in 1971 to 77.5 percent in 1979. The GPA was a relative measure of ability, supposed to be normally distributed with mean GPA at 3.0, but in practice slightly higher due to grade inflation. Table 5 displays GPA means separately by gender for the most common programs.

Figure 2 displays descriptive averages of earnings trajectories associated with enrollees in the vocational and theoretical paths. Male earnings are associated with substantially higher levels if they have attended theoretical education. These differences may of course reflect the observed differences in ability (GPA), or differences in social background. There is a visible drop in earnings for males at the start of the 1990s, when there was a sharp recession in Sweden. Figure 3 illustrates the development of numbers in unemployment in Sweden. In the late 1980s, Sweden had very low unemployment rates but a series of events led to an overall dip in demand which saw unemployment rates soar between 1990 and 1993 from 2.1 to 11.3 percent (ILO definition, for details on the Swedish downturn, see Englund 1999), followed by only a slow and partial recovery. The recession is potentially interesting for this study, as structural changes could generate a comparative advantage of theoretical education, if it enhances labor market flexibility.

5 Method

5.1 Empirical model

Our regression analyses are based on a simple framework. Let us denote an outcome variable *Y*, annual labor earnings, which is a generic product of hourly wages and the number of hours worked. Further, a binary variable *D* takes the value one if upper secondary education is "Vocational" and zero if "Theoretical". 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 enrolment in upper secondary school occurs at time *t*, and outcome is observed in post schooling age (or year) *t+*. The vector X_{ijt} includes the GPA of the individual, dummies for year of birth and within family order of birth. The term f_j is the brother- or sister-fixed effects variable, which controls for time invariant family characteristics of full siblings. The parameter of main interest is γ and in the results section we will plot these estimates primarily across age, but also across years. Conditional on our explanatory variables, this coefficient is identified by the variation in participation (D_{ijt}) between siblings. Unless stated otherwise, observations after individuals have turned 16 are not used as they violate the conditional independence assumption. This means that we typically do not use data on cognitive and non-cognitive skills, which were gathered at ages 18-19. We only employ this information in robustness checks to explore how the data behave.

Controlling for GPA takes into account ability levels, which is important as the returns to education are expected to be affected by ability. However, differences in GPA performance may arise due to motivation. For instance, if children from affluent families have more ambitious educational goals they may also have stronger incentives to achieve high GPA. In such a case, if one controls for ability, but not

family background, one may confound an earnings advantage generated by family background and erroneously ascribe it to educational contents.[9]

The inclusion of brother/sister fixed effects entails some obvious advantages as it is likely to reduce omitted variable bias in the estimate of γ. Family background factors are widely believed to affect both educational attainment and labor market outcomes. The fixed effects set up may control for typically elusive factors such as neighborhood effects and parental characteristics in a broad sense, e.g. ability to give advice, help with school, pass on moral values such as work ethics, occupation, attitude towards occupational choices, etc. In addition, using a sample which is restricted to siblings may by itself reduce bias if the groups which we wish to compare to a greater extent overlap in terms of unobservable characteristics (e.g. Imbens and Wooldridge 2009, Heckman et al. 1999, section 8.2). The drawbacks with family fixed effects include that greater weights are given to individuals from large families, and that measurement error bias towards zero is exacerbated (Griliches 1979, Bound and Solon 1999). It is important to recognize that endogenous factors within families may still drive the educational decisions. Keeping in mind the advantages and reservations about family fixed effects, the set-up provides a model with interesting properties for analysing the relation between upper secondary school curricula and long-term earnings.

Given our empirical model, the most important source of potential bias is arguably that educational choices may vary systematically with personality traits (e.g. perseverance, motivation, time-preferences, risk aversion). A prerequisite for bias to be of relevant size is that traits which vary within families affect both educational choice and future earnings. Also, it must do so independently of the

[9] Or social background factors may make vocational education more attractive if there is pressure to earn own money (Erikson and Jonsson 1996).

GPA measure.[10] For males, we present robustness checks which partly address this problem as we add seven different measures of cognitive and non-cognitive ability scores (see Tables 2 and 4). Interestingly, in these models, we find the GPA to have by far the strongest predictive power. The main implications of the results remain also when including these traits.

6 Results

6.1 Main results

In this section we present the relative annual earnings associated with vocational versus theoretical 2-year upper secondary school programs. In line with convention, our estimates are based on log earnings. To avoid exaggerated estimates stemming from low earners, samples are in each year restricted to those earning above SEK 100000 (2011 values, app €11,000). We present robustness checks of estimates using absolute values, including also zero earners.

Figure 4 shows coefficient estimates pertaining to vocational education from separate regressions on earnings at different ages of cohorts. To compare long term estimates, we present above each set of results the average point estimates at ages 39-48 – i.e. the last ten years where all cohorts are observed (born 1963 turn 48 in 2011). With no control variables, the first set of results represents the raw data differences. These are given for the full sample of males and females and for the brother and sister samples. The estimates remain very similar as one goes from males to brothers or from females to sisters, indicating that same sex siblings give a reasonable account of the full sample. In the following regressions, we have added controls for GPA and dummies for year of birth and order of birth (e and f). The parameters only drop modestly despite the strong significance of the GPA variable (for detailed

[10] If two siblings with the same GPA are told that the short term probability of employment is higher if one chooses vocational education, they are more likely to choose vocational if the individual discount rate is high. Bias may arise to the extent that the GPA and family fixed effects does not account for these traits, and that the remaining uncaptured differences are important for future earnings streams, for reasons unrelated to educational contents.

results of five year intervals, see Table A.1 through to Table A.5 in the Appendix). The point estimates are substantially closer to zero when only family fixed effects are included as controls (g and h). When employing the full model, the coefficient trajectories stabilize somewhat, and again move closer to zero for brothers.

The full model results for brothers indicate that vocational education is initially associated with relatively higher log earnings, until age 28. Thereafter, the relation switches to become negatively associated with vocational education, by around 3.5-4.5 percent. For sisters, the initial advantage of vocational education is relatively brief, at ages 18-20. Estimates are thereafter significantly negative at around 2-3 percent, stabilizing at an earlier age than was the case for males. [11] Finally, for brothers, we add controls for cognitive and non-cognitive skills from military enlistment tests, recorded at ages 18-19. If these measures are not affected by schooling, one may take them at face value as conventional controls (see discussion in Section 4). The estimates still indicate significantly lower earnings of vocational education, but with coefficient estimates that on average are about one percentage point closer to zero. However, we emphasize that it is not possible to say if differences in military enlistment test scores emerge from school track curricula, peer effects or from differences in abilities existing already prior to upper secondary.[12]

6.2 Robustness checks

Figure 5 contains additional results where we employ the full model. When displayed across years, there is clearly a drop in the coefficient values for brothers when the recession sets in at the start of the

[11] The potential measurement error bias towards zero is likely not above 10 percent (Bound and Solon 1999, Stenberg 2011). We also ran regressions with GPA squared and interacted with an indicator variable for above median GPA. The estimates changed marginally (away from zero) but the introduced coefficients were insignificant.
[12] We mention peer effects since the tracking at upper secondary level for some may generate dramatically more homogeneous environments.

1990s. Interestingly, for sisters, there is little change in coefficient estimates at this time. One may also note that the initial advantage of vocational education is much weaker with this set-up, as observations at young ages are not concentrated in early estimates (in 1978, individuals are up to 23 years old). So far, our estimates have been based on the restriction that earners below SEK 100,000 are excluded. This may conceal differences in employment probabilities. The set of results 5c and 5d present linear probability estimates of reaching earnings above SEK 100,000. For brothers, vocational education is associated with higher probabilities until age 25. It is followed by lower probabilities across ages 32 to 38 before point estimates after age 40 converge towards zero (increasing the threshold value tends to weaken the differences in probabilities). For sisters, the results also indicate significant differences. These are slightly more persistent in the latter part of our observation window with several significant estimates also after age 40. The set or results 5e and 5f are based on earnings measured in absolute numbers, which allows us to include zero earners. To retain comparability, the results are expressed in percentage terms, where the coefficient values in each year have been divided by the average earnings of brothers/sisters. These percentages indicate slightly larger long term earnings disadvantages of vocational education compared with Figure 4. The average across ages 36-48 is about 7 percent for males and close to 4 percent for females.

Figure 6 present results from separate analyses of individuals with above and below median GPA. For both brothers and sisters, the initial advantage of vocational education is somewhat weaker when samples are restricted to below median GPA. It may be that a relative advantage in the transition from school to work is partly dependent on ability. The earlier finding of a long term advantage for theoretical education is stable across all four groups, with little evidence to suggest that low ability would make vocational education a more beneficial choice. We repeated the exercise using scores from military enlistments (set 6e and 6f), but the impression from samples with below median cognitive or non-cognitive

skills is similar to the results reported earlier. We also tried many different lower thresholds, but without finding a stable pattern in the results.

6.3 Potential mechanisms

Figure 7 and Figure 8 contain results which examine if our results are driven by further education or fertility decisions. Individuals completing 2-year upper secondary school were eligible to enter a limited set of short tertiary level programs. Almost all of these concerned either nursing or teaching. The descriptive patterns in Figures 7a and 7b reveal that the frequency of tertiary level exams for men is 15.6 versus 6.3 percent (theoretical-vocational) and for females 33.2 percent versus 27.1 percent. One should note that of these, the proportions completing four years of tertiary education are less than 3 and 5 percent of the brothers and sisters respectively. Regressions on the probability of completing a tertiary level exam indicate that theoretical education among brothers increases the likelihood by about four percent. For sisters, the unexplained difference is about one percent. To control our earnings estimates for further studies, we include indicator variables for registration in education, for having attained a college exam in any earlier year, and separate indicator variables for exams requiring two years, three years and four years of studies. The estimates are by and large similar compared with the full model estimates from Figure 4. The wage structure for nurses and teachers is relatively compressed, and this may contribute to explain the result. If we turn to fertility, descriptive data in Figure 9 reveal relatively small differences in fertility, though child rearing tends to occur slightly earlier for females in vocational education. When we include control variables for the number of children at home, indicator variables for child below six years old and of parental leave benefits, as well as the amount of parental leave benefits, the estimated results are again similar to the full model estimates from Figure 4.

6.3 Separately by track

Figures 9, 10 and 11 show estimated coefficients where separate educational tracks are compared against the opposite group of tracks (i.e. vocational or theoretical). Figure 9 shows results for the theoretical programs for brothers and sisters. Overall, the implication of a long term advantage for theoretical education holds, even though lack of precision yields a fair number of insignificant estimates. The results that stand out are the ones associated with the technical track (brothers). The average over age 39-48 is above seven percent.[13] Turning to Figure 10 and male vocational tracks, the results associated with the construction and electrician programs demonstrate interesting patterns and results are therefore shown both across age and across years. There is a relatively large earnings advantage in the 1980s, on average .0649 for construction and .0460 for the electrician program. The coefficients drop sharply in the 1990s, in particular for construction, presumably reflecting sensitivity to the business cycle. Post 1990, earnings estimates of electricians remained at least at the level of the theoretical tracks, point estimates actually only drop below zero for estimates at age 50 or above (but in no case across years). Figure 11 displays results for vocational tracks among females, indicating that the initial earnings advantage of vocational educations is foremost associated with nursing. In a longer perspective, interestingly, the office program does not display an earnings disadvantage (we also show their results across years). This is a program with a slightly higher amount of theoretical studies, but also recruiting individuals with relatively low GPA.

7 Concluding discussion

In this article, we compare long term earnings of individuals attending 2-year upper secondary school programs with vocational/specific and general/theoretical curricula respectively. We use Swedish popu-

[13] This illustrates the value of studying tracks separately as one might ascribe this result to the vocational element of technical courses. For example, the electro-technical track of technical studies (theoretical) and electrician (vocational) seemingly open up career paths which are related. However, the latter comprises on average 31 hours per week of practice, whereas the former instead includes 31 hours equally divided between the most general type of subjects and subjects based on mathematics and science.

lation register data of individuals born 1955-1963, who enrolled upper secondary school from 1971 to 1979. We find vocational education associated with an initial relative earnings advantage which lasts about 10 years for males and 2-3 years for females. For the long term, individuals in theoretical tracks are associated with an earnings advantage of 2-3 percent, which lasts throughout our observation window until individuals are aged 48-56.

Long term analyses linking vocational/theoretical contents to earnings are rare. The reported long term earnings advantage of theoretical education is in line a comparative advantage in terms of labor market flexibility and/or of skill multiplier effects. However, based on a compelling identification strategy, Malamud and Pop-Eleches (2010) found no significant differences in earnings between individuals assigned to curricula with different emphasis on vocational and theoretical subjects. Their observation window included a strong recession and concerned an economy in transition, circumstances that could be catalysts for structural changes and strengthen any potential labor market flexibility/advantage of theoretical education. In the present study, the Swedish 1990 recession negatively affected estimates of males with vocational education.

Comparing with our study, there may be several possible sources for the differences in results, e.g. the prevalence of on-the-job-training (OJT) or because of different empirical strategies adopted in the analyses.[14] First, as argued in Section 2, a long-term advantage of theoretical curricula is likely related to dynamic complementarity and skill multiplier effects, which in turn may depend on the supply of OJT. According to Bassanini et al. (2005), OJT incidence in Sweden is among the highest in Europe (60 percent, on average 33 hours per year) compared with Romania which is one of the lowest (10 percent,

[14] There are of course other possibilities like differences in technologies, in wage structures and/or if wages blue-collar workers in Romania until 2002 were still influenced by the culture of the communist regime. The results could also differ to the extent that the additional theoretical education in Romania in the 1970s included e.g. Marxist theory or other subjects considered obsolete for the 1990s labor market.

on average 7 hours per year). The relative level of dynamic complementarity and skill multipliers may also be linked to the level of technology, or the rate of change of the technology, factors which are both likely to differ between Romania and Sweden. Second, the results may reflect the diverging empirically strategies. Malamud and Pop-Eleches (2010) employ a regression discontinuity framework to estimates causal local average treatment effects. In our paper, we control for GPA and sibling fixed effects in order to correct for potential selection problems. If endogeneity bias would drive our results, one would not expect controls for further education to exert only a marginal impact on our estimates. In addition, for males, it is possible to control for seven measures of cognitive and non-cognitive abilities. These are assessed 1-2 years after upper secondary completion and could partly reflect differences in skills acquired during upper secondary school, but the overall implications of our results hold. One may also note that adding family fixed effects exacerbates attenuation bias towards zero, to increase the probability of finding no effects.

Do our results imply that countries such as Germany and Holland should put more emphasis on theoretical subjects? There is undoubtedly an element of that, but proposals for additional emphasis on theoretical studies entail potential opportunity costs due to crowding out of vocational education, higher drop-out rates (Hall 2012) and more sluggish school-to-work-transitions. The results are also heterogeneous within the vocational and theoretical categories, as programs for future electricians (males) and office workers (females) are associated with no or small earnings differences compared with theoretical tracks. To assist policy discussions on educational contents, a substantial body of research remains to be done.

Table 1: Number of hours per week; curricula of the 2-year upper secondary programs of main interest. For expositional reasons, hours are given as averages per year.

	Theoretical 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
Technical 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%

Note: [a)] In total 24 subjects divided across four different educational paths, electro-technical, chemical-technical, machine-technical 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 2: Males - descriptive mean statistics of 16 year old applicants granted admission to upper secondary school 1971-1979

	(1) All	(2) 2-year	(3) Brothers	(4) Voc	(5) Theory
GPA	3.198	2.829	2.824	2.762	3.054
Cognitive	5.537	4.785	4.708	4.537	5.307
Inductive skill	5.423	4.689	4.607	4.406	5.315
Verbal skill	5.371	4.694	4.622	4.430	5.295
Spatial skill	5.491	5.065	5.036	4.927	5.418
Technical skill	5.100	4.587	4.558	4.516	4.702
Non cognitive	5.308	4.947	4.938	4.797	5.431
Leadership	4.027	2.979	2.856	2.548	3.936
Born 1955	0.088	0.081	0.074	0.063	0.111
Born 1956	0.103	0.101	0.096	0.088	0.125
Born 1957	0.107	0.106	0.106	0.100	0.128
Born 1958	0.106	0.105	0.116	0.113	0.125
Born 1959	0.109	0.111	0.128	0.129	0.124
Born 1960	0.111	0.115	0.125	0.132	0.100
Born 1961	0.117	0.120	0.119	0.126	0.091
Born 1962	0.125	0.128	0.115	0.121	0.095
Born 1963	0.133	0.134	0.121	0.127	0.101
3-year education	0.403	0.000			
Humanities	0.016	0.000			
Social sci.	0.037	0.000			
Business	0.069	0.000			
Natural sci.	0.124	0.000			
Technical sci.	0.157	0.000			
2-year education	0.589	1.000	1.000	1.000	1.000
Social sci.	0.061	0.103	0.088	0.000	0.408
Business	0.038	0.065	0.052	0.000	0.242
Technical sci.	0.051	0.087	0.075	0.000	0.350
Office	0.034	0.058	0.054	0.069	0.000
Music	0.001	0.002	0.001	0.001	0.000
Consumer studies	0.003	0.006	0.006	0.007	0.000
Nursing	0.002	0.003	0.003	0.004	0.000
Clothing	0.000	0.000	0.000	0.000	0.000
Food	0.009	0.015	0.016	0.020	0.000
Mechanic eng.	0.118	0.201	0.222	0.283	0.000
Vehicle eng.	0.068	0.116	0.118	0.150	0.000
Woodwork	0.010	0.017	0.021	0.026	0.000
Construction	0.086	0.146	0.167	0.213	0.000
Electrician	0.079	0.135	0.128	0.163	0.000
Process techn.	0.007	0.012	0.013	0.017	0.000
Forestry	0.011	0.018	0.019	0.025	0.000
Farming	0.009	0.016	0.017	0.022	0.000
Other	0.008	0.000	0.000	0.000	0.000
Observations	304295	179162	29468	23143	6325

Table 3: Females - descriptive mean statistics of 16 year old applicants granted admission to upper secondary school 1971-1979

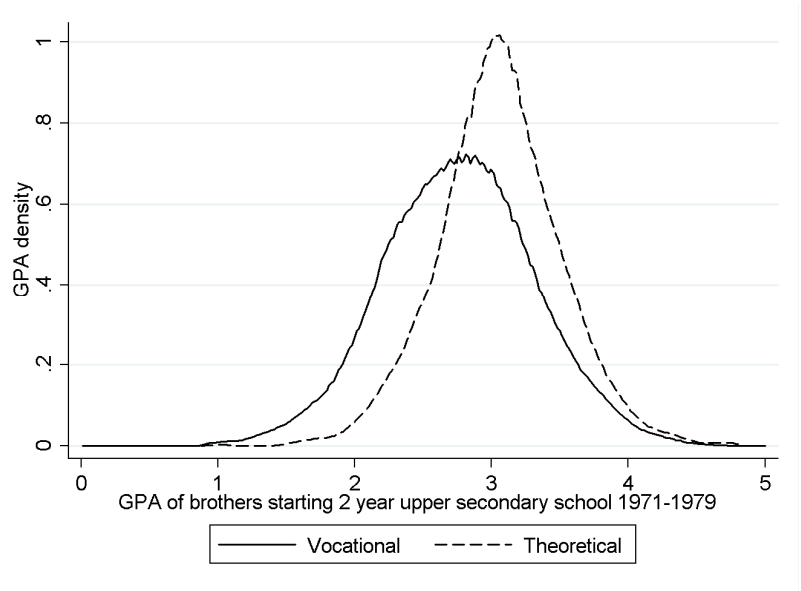
	(1) All	(2) 2-year	(3) Sisters	(4) Voc	(5) Theory
GPA	3.477	3.207	3.229	3.156	3.370
Born 1955	0.087	0.077	0.072	0.048	0.117
Born 1956	0.103	0.105	0.095	0.081	0.121
Born 1957	0.110	0.114	0.113	0.103	0.132
Born 1958	0.105	0.107	0.117	0.114	0.121
Born 1959	0.107	0.109	0.125	0.134	0.107
Born 1960	0.111	0.113	0.123	0.136	0.098
Born 1961	0.117	0.118	0.121	0.132	0.099
Born 1962	0.126	0.128	0.118	0.125	0.106
Born 1963	0.134	0.129	0.118	0.127	0.100
3-year education	0.352	0.000			
Humanities	0.077	0.000			
Social sci.	0.090	0.000			
Business	0.078	0.000			
Natural sci.	0.091	0.000			
Technical sci.	0.016	0.000			
2-year education	0.638	1.000	1.000	1.000	1.000
Social sci.	0.190	0.298	0.265	0.000	0.774
Business	0.052	0.081	0.076	0.000	0.222
Technical sci.	0.001	0.002	0.001	0.000	0.004
Office	0.124	0.194	0.199	0.303	0.000
Music	0.002	0.003	0.003	0.004	0.000
Consumer studies	0.177	0.278	0.307	0.467	0.000
Nursing	0.066	0.103	0.105	0.160	0.000
Clothing	0.006	0.010	0.010	0.015	0.000
Food	0.008	0.012	0.013	0.020	0.000
Mechanic eng.	0.001	0.002	0.002	0.004	0.000
Vehicle eng.	0.001	0.002	0.002	0.003	0.000
Woodwork	0.000	0.001	0.001	0.001	0.000
Construction	0.001	0.002	0.002	0.003	0.000
Electrician	0.001	0.002	0.002	0.003	0.000
Process techn.	0.001	0.001	0.001	0.002	0.000
Forestry	0.000	0.000	0.000	0.000	0.000
Farming	0.006	0.009	0.011	0.016	0.000
Other	0.010	0.000	0.000	0.000	0.000
Observations	293658	187281	30354	19959	10395

Table 4: Same sex sibling samples where educational choices differ.

	(1)	(2)	(3)	(4)
	Brothers		Sisters	
	Voc	Theory	Voc	Theory
Order of birth	1.840	1.521	1.837	1.515
GPA	2.790	3.055	3.188	3.365
Cognitive	4.630	5.267		
Inductive skill	4.505	5.298		
Verbal skill	4.536	5.267		
Spatial skill	4.994	5.382		
Technical skill	4.515	4.656		
Non cognitive	4.889	5.338		
Leadership	2.710	3.801		
Born 1955	0.062	0.114	0.050	0.130
Born 1956	0.072	0.137	0.071	0.131
Born 1957	0.084	0.135	0.091	0.141
Born 1958	0.109	0.128	0.115	0.121
Born 1959	0.131	0.118	0.144	0.100
Born 1960	0.141	0.096	0.135	0.094
Born 1961	0.141	0.081	0.139	0.089
Born 1962	0.127	0.092	0.130	0.098
Born 1963	0.132	0.100	0.125	0.097
2-year education	1.000	1.000	1.000	1.000
Social sci.	0.000	0.401	0.000	0.768
Business	0.000	0.240	0.000	0.228
Technical sci.	0.000	0.359	0.000	0.004
Office	0.102	0.000	0.304	0.000
Music	0.003	0.000	0.005	0.000
Consumer studies	0.010	0.000	0.449	0.000
Nursing	0.005	0.000	0.179	0.000
Clothing	0.000	0.000	0.013	0.000
Food	0.026	0.000	0.018	0.000
Mechanic eng.	0.234	0.000	0.003	0.000
Vehicle eng.	0.152	0.000	0.003	0.000
Woodwork	0.026	0.000	0.001	0.000
Construction	0.207	0.000	0.002	0.000
Electrician	0.177	0.000	0.004	0.000
Process techn.	0.016	0.000	0.002	0.000
Forestry	0.025	0.000	0.000	0.000
Farming	0.016	0.000	0.018	0.000
Other	0.000	0.000	0.000	0.000
Observations	4167	4010	6008	5859

Figure 1: Distribution of GPA among same sex siblings enrolled in 2-year programs 1971-1979.

Brothers



Sisters

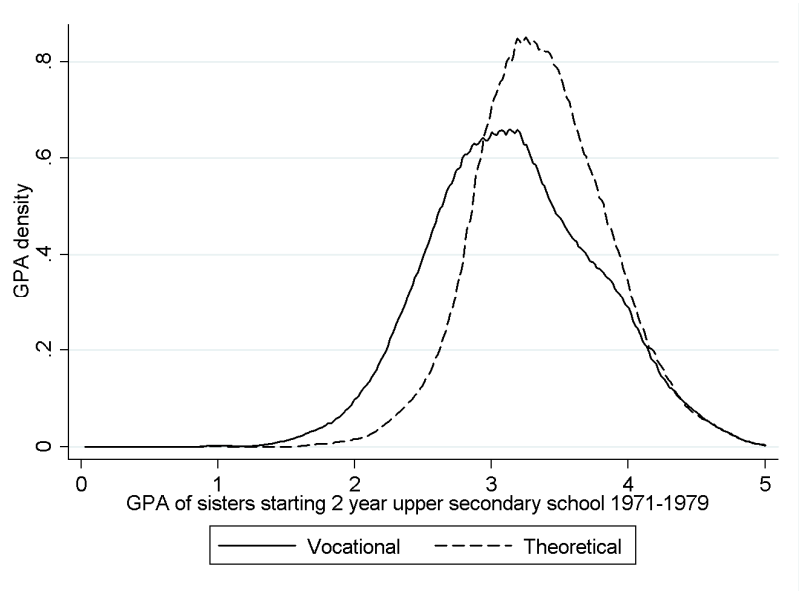
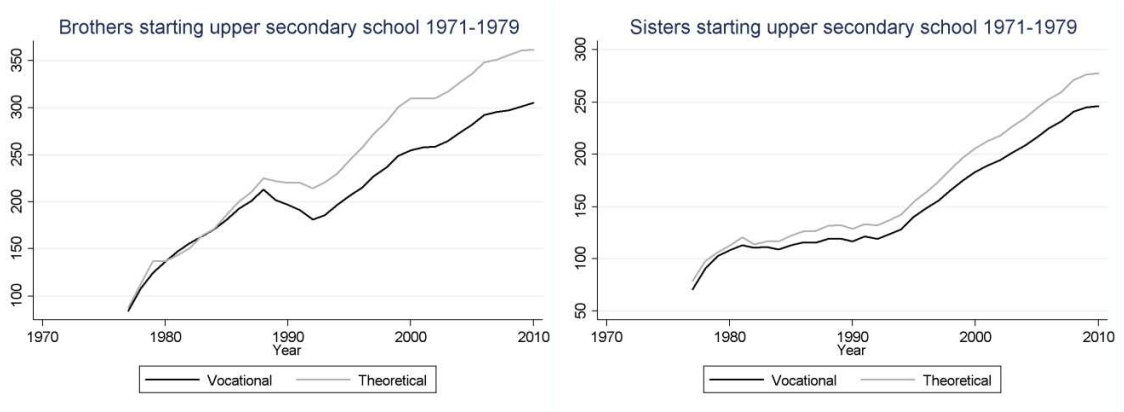
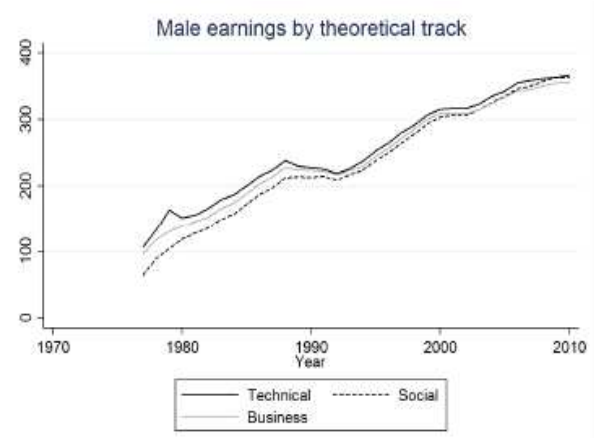
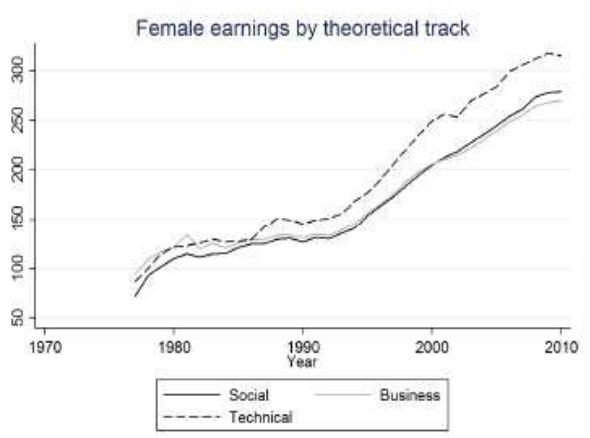


Figure 2: Descriptive earnings trajectories – same sex sibling samples enrolled in 2-year programs.







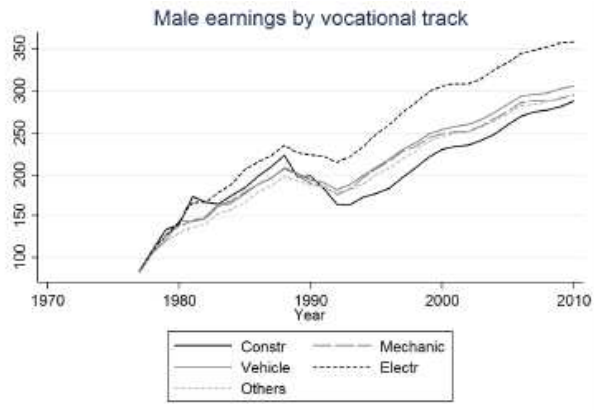


Figure 3. Numbers in unemployment 1977-2009.

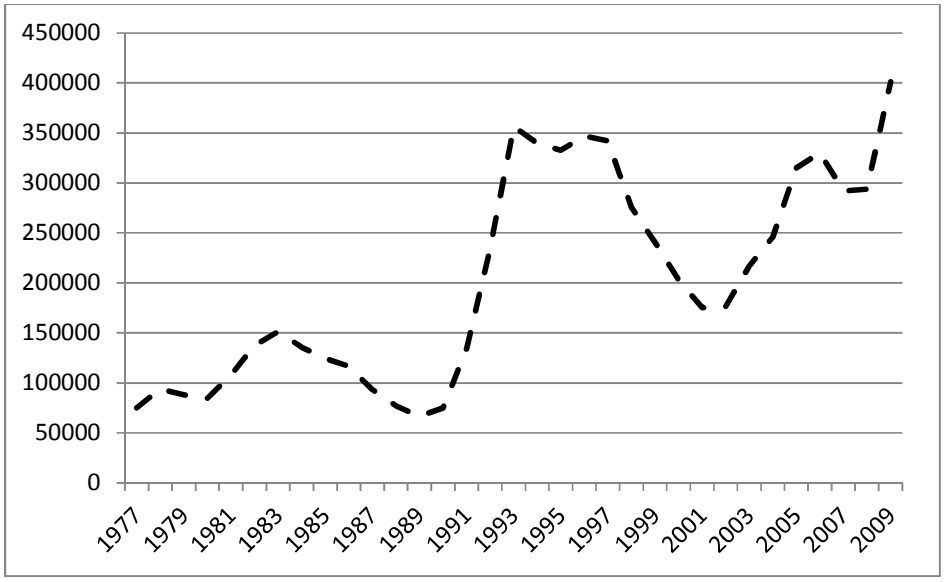
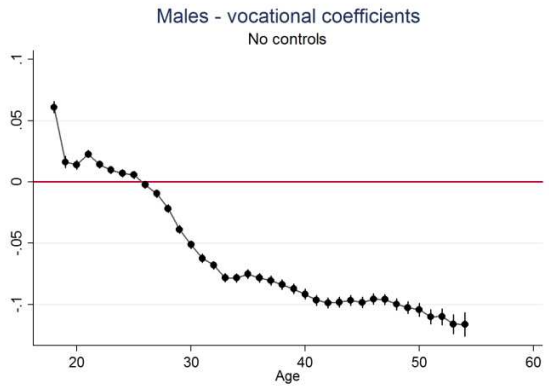
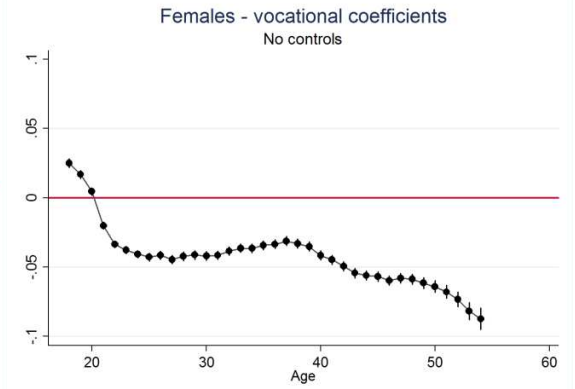


Figure 4: Trajectories of estimated relative returns to vocational education, with average point estimates for ages 39-48..Females/sisters to the right.

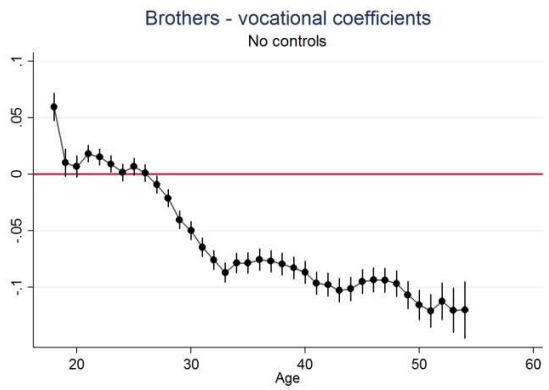
a) Males - average 39-48: -.0958.



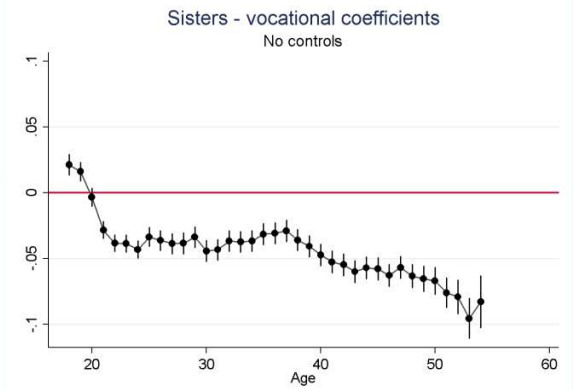
b) Females - average 39-48: -.0515.



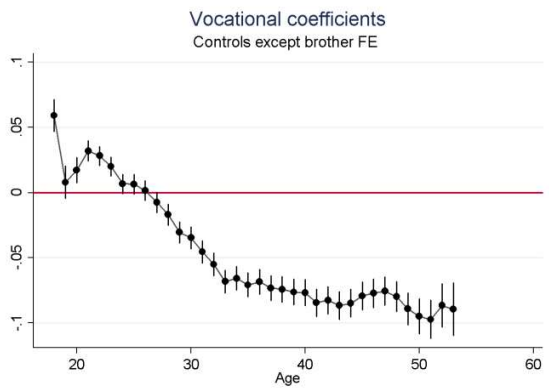
c) Brothers - average 39-48: -.0949.



d) Sisters - average 39-48: -.0553.



e) Brothers - average 39-48: -.0804.



f) Sisters - average 39-48: -.0547.

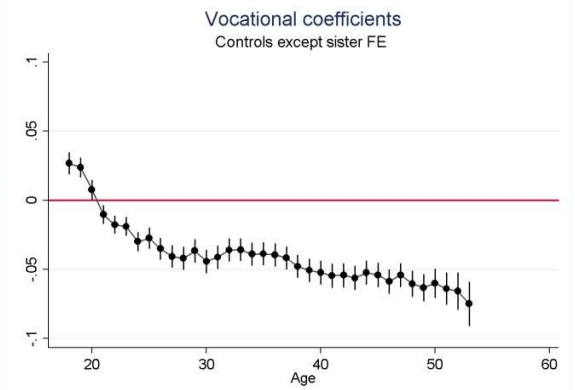
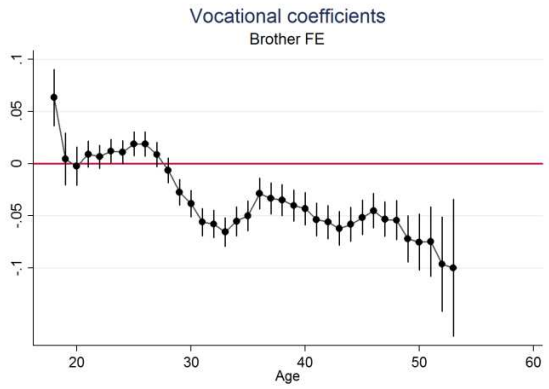
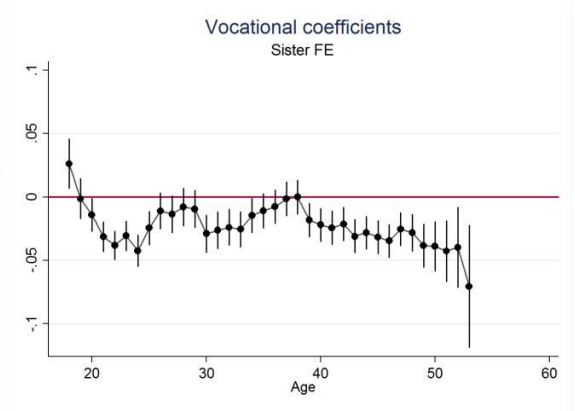


Figure 4 *cont'd*: Trajectories of estimated relative returns to vocational education, with average point estimates for ages 39-48..Females/sisters to the right.

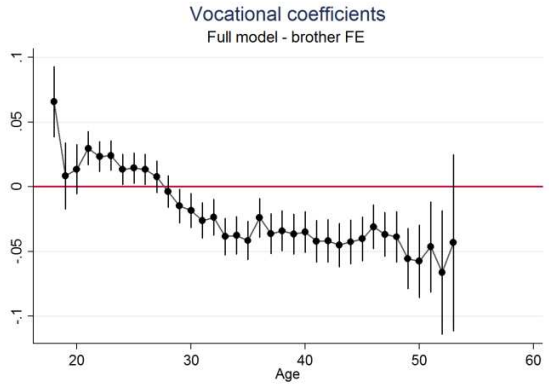
g) Brothers - average 39-48: -.0519.



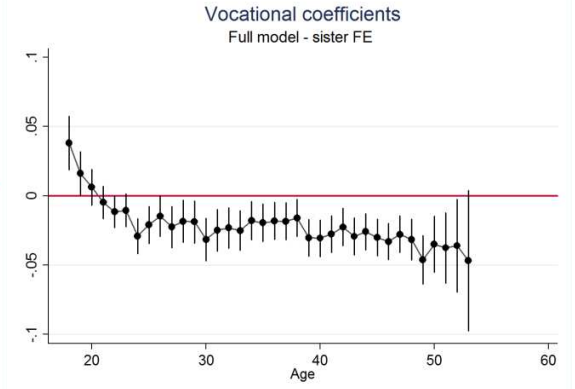
h) Sisters - average 39-48: -.0264.



i) Brothers - average 39-48: -.0389.



j) Sisters - average 39-48: -.0292.



k) Brothers - average 39-48: -.0263.

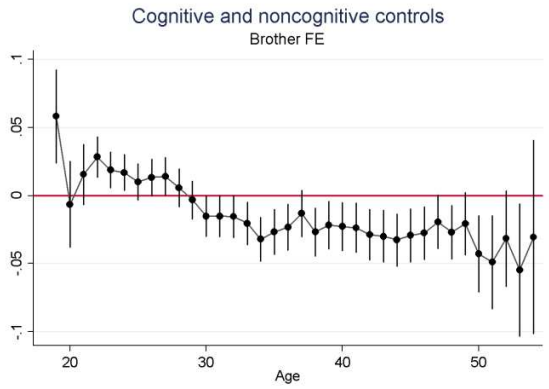
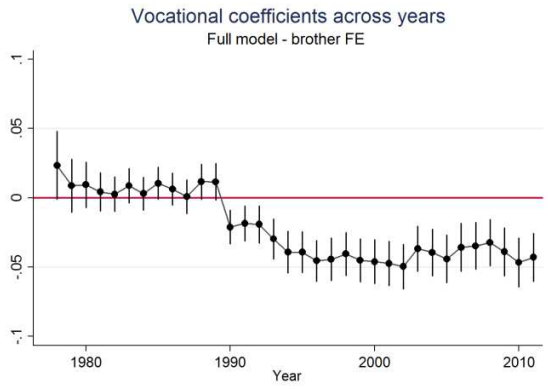
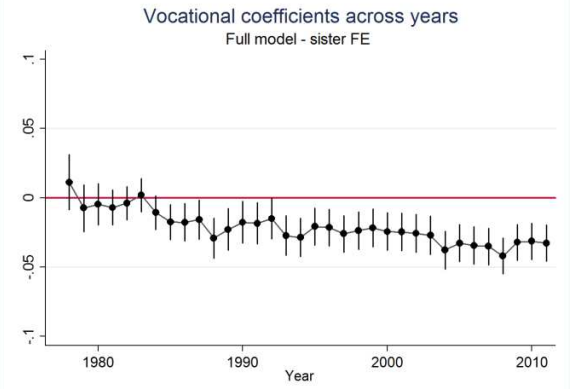


Figure 5: Robustness checks, trajectories of estimated relative returns to vocational education, with average point estimates for ages 39-48..Females/sisters to the right.

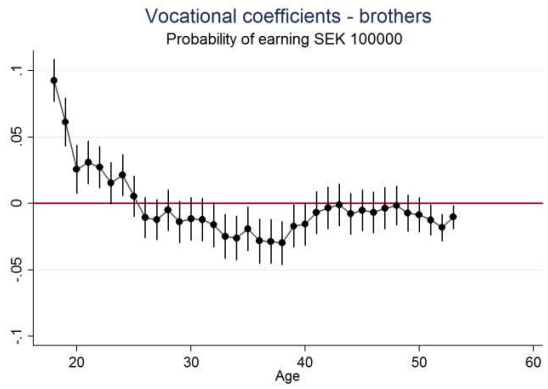
a) Brothers - average 39-48: -.0401.



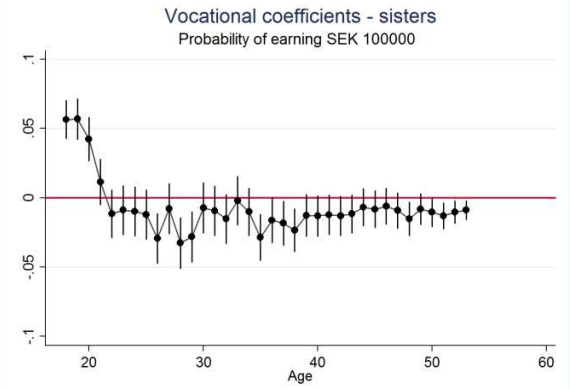
b) Sisters - average 39-48: -.0335.



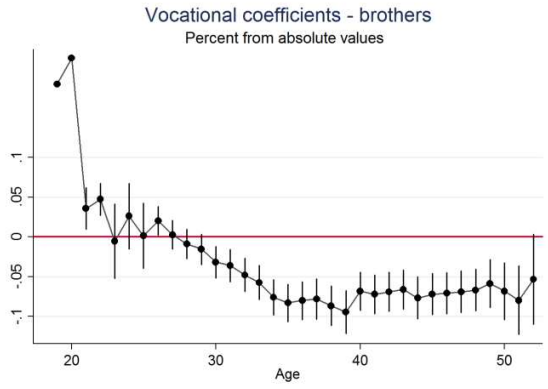
c) Brothers - average 39-48: -.0068.



d) Sisters - average 39-48: -.0108.



e) Brothers - average 39-48: -.0725.



f) Sisters - average 39-48: -.0414.

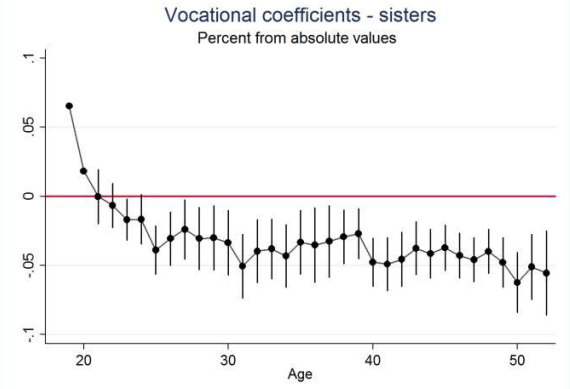
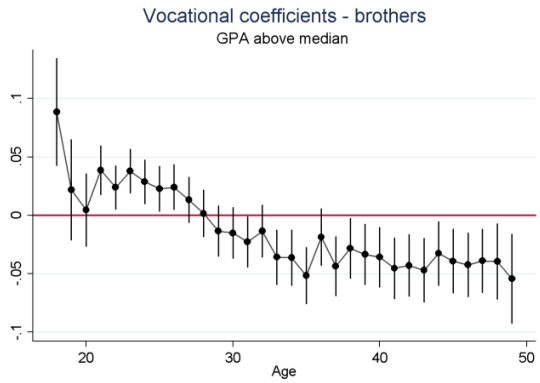
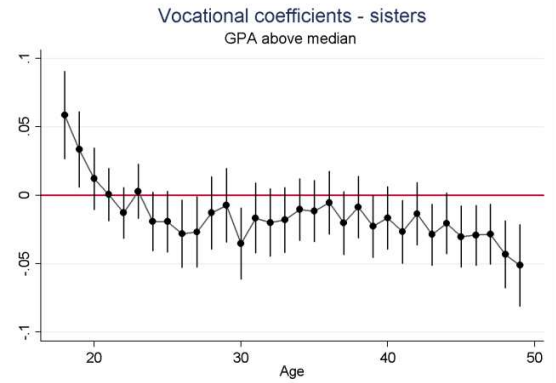


Figure 6: Above or below median ability measures, estimated relative returns to vocational education, with average point estimates for ages 39-48..Females/sisters to the right.

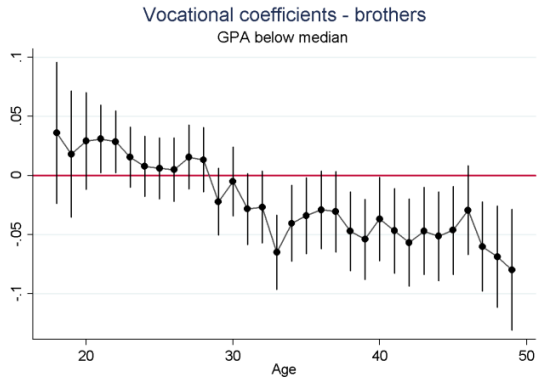
a) Brothers - average 39-48: -.0397.



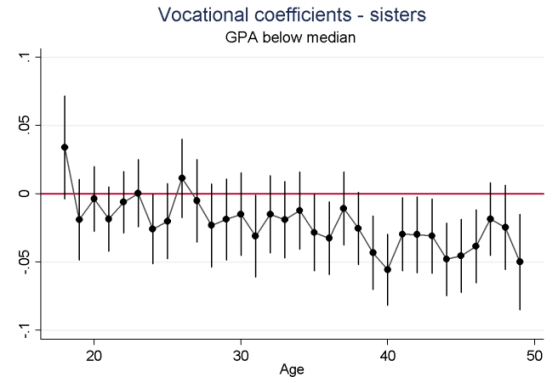
b) Sisters - average 39-48: -.0259.



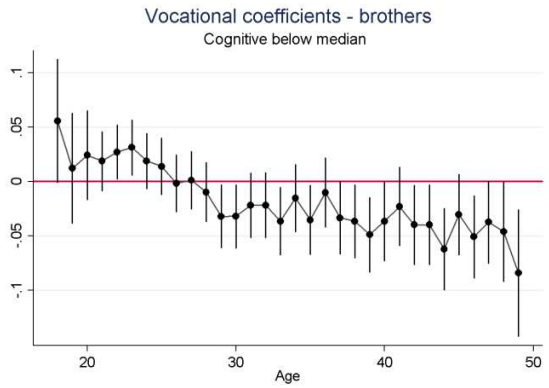
c) Brothers - average 39-48: -.0499.



d) Sisters - average 39-48: -.0364.



e) Brothers - average 39-48: -.0415.



f) Brothers - average. 39-48:- .0307.

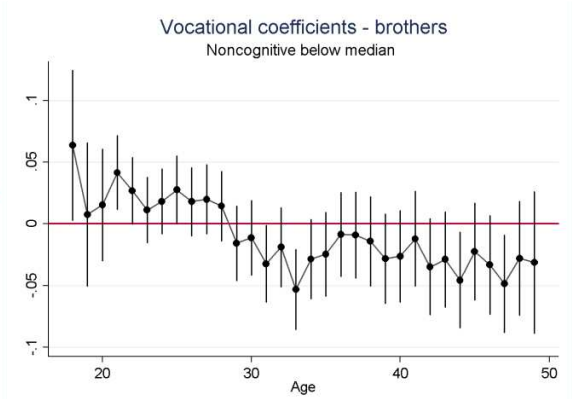
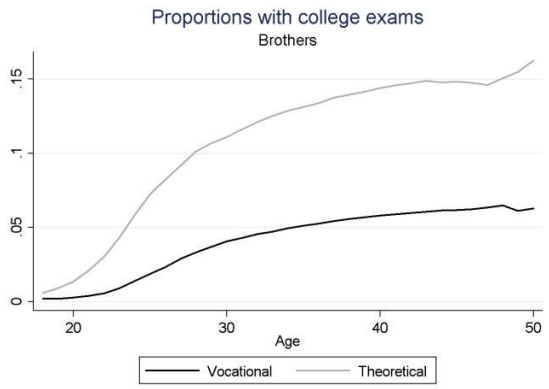
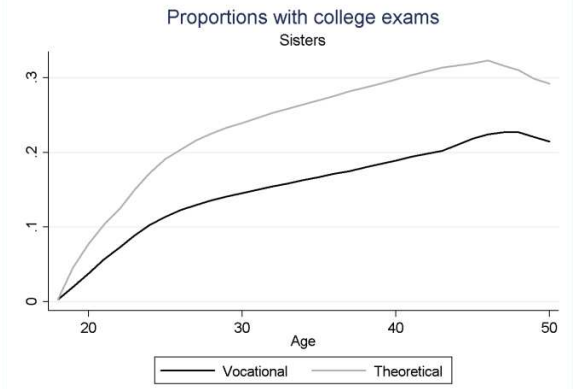


Figure 7: Mechanisms – further education. Females/sisters to the right.

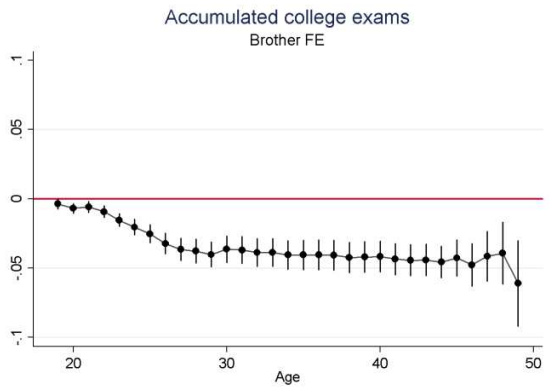
a) Brothers – accumulated college exams.



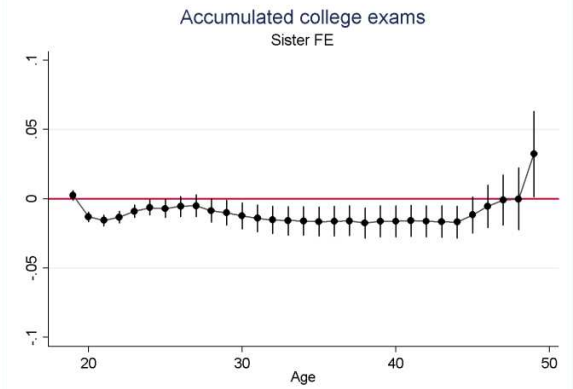
b) Sisters – accumulated college exams



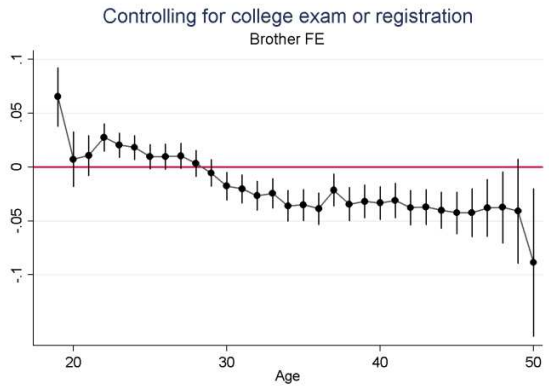
c) Brothers - average 39-48: -.0432.



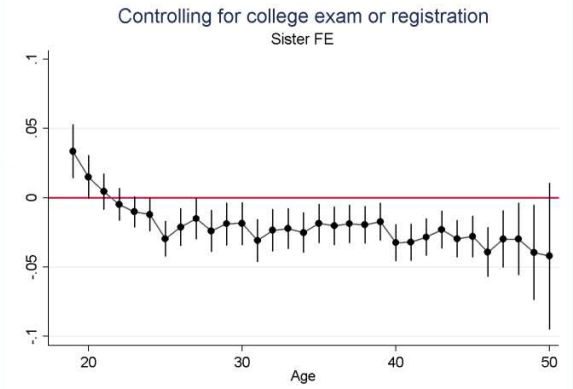
d) Sisters - average 39-48. -.0115.



e) Brothers - average 39-48: -.0371.



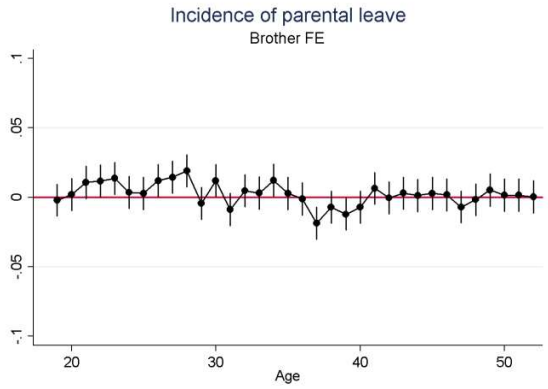
f) Sisters - average 39-48: -.0288.



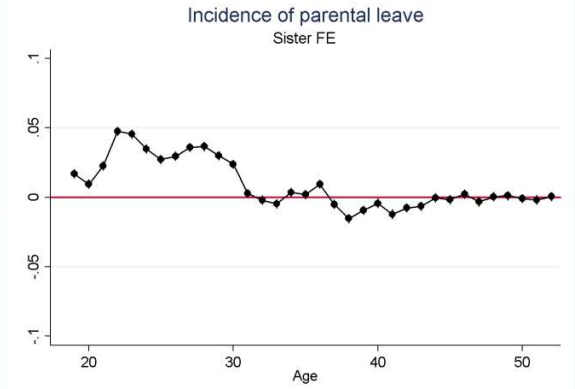
Note: Regressions include controls each year indicator variables for registration in education, for having in any earlier year attained a college exam, for having attained an exam encompassing 2 years of studies, 3 years of studies and 4 years of studies..

Figure 8: Mechanisms – fertility.

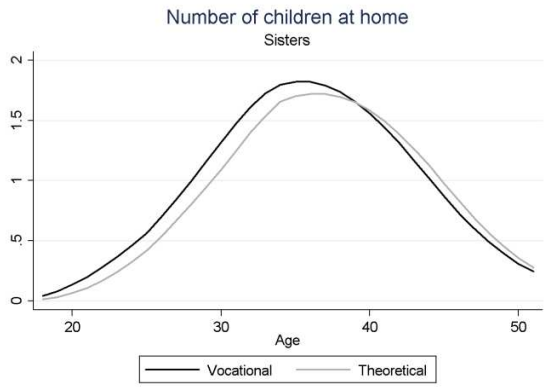
a) Brothers - average 39-48: -.0013.



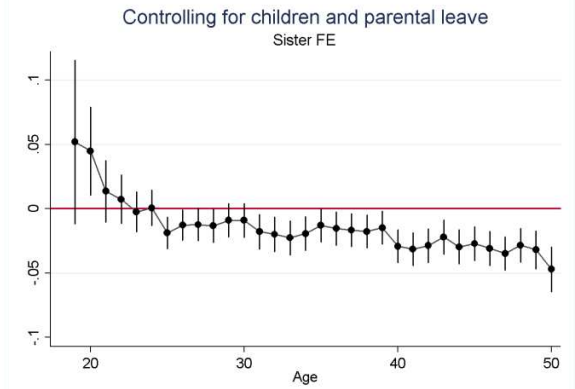
b) Sisters - average 39-48: -.0042.



c) Sisters – descriptive statistics.



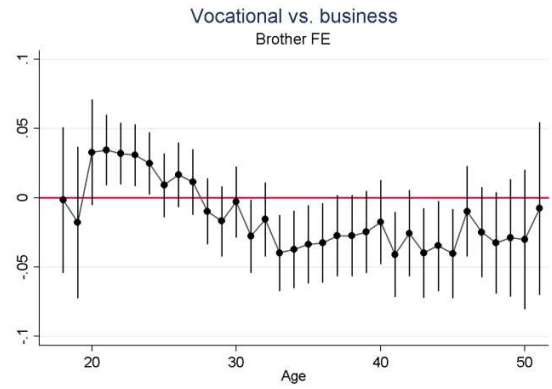
d) Sisters –average 39-48: .0276.



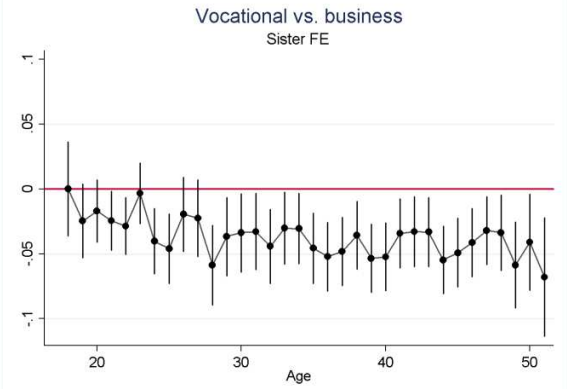
Note: Last regression includes controls each year for the number of children at home and amount of parental leave benefits received, indicator variables for children below six years old and of incidence of parental leave benefits.

Figure 9: Separate theoretical tracks, estimated relative returns to vocational education, with average point estimates for ages 39-48..Females/sisters to the right.

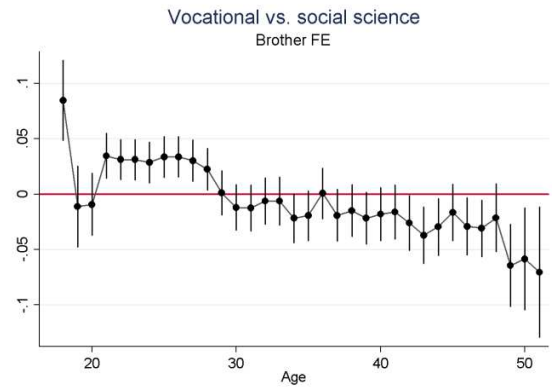
a) Brothers - average 39-48: -.0290.



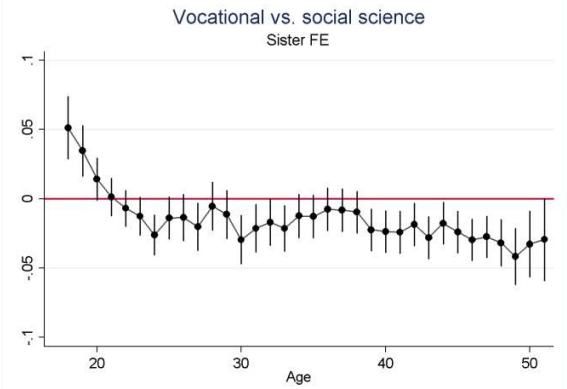
b) Sisters - average 39-48: -.0417.



c) Brothers - average 39-48: -.0247.



d) Sisters - average 39-48: -.0247.



e) Brothers - average 39-48: -.0705.

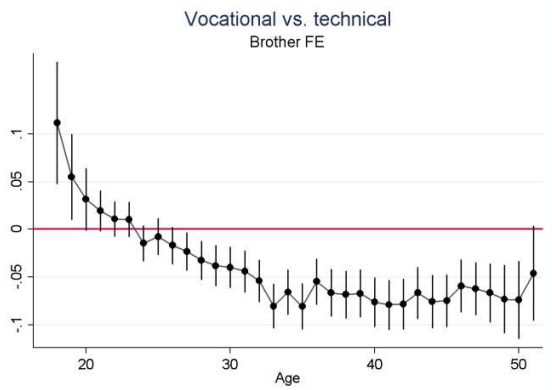
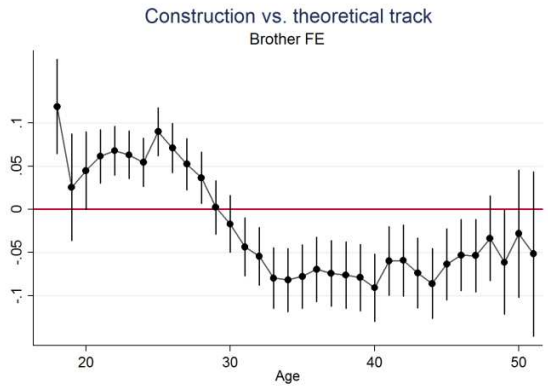
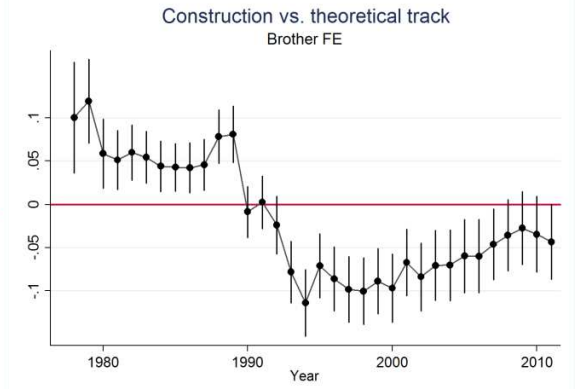


Figure 10: Male separate vocational tracks, estimated relative returns to vocational education, with average point estimates for ages 39-48..

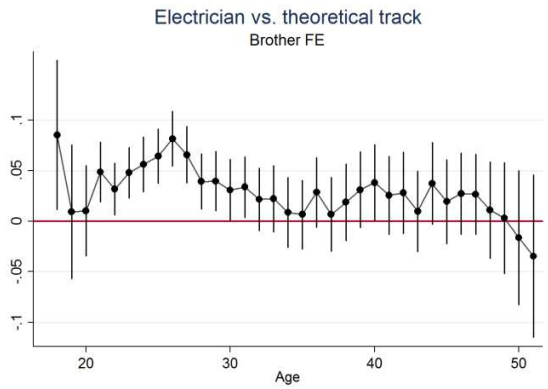
a) Brothers - average 39-48: -.0653.



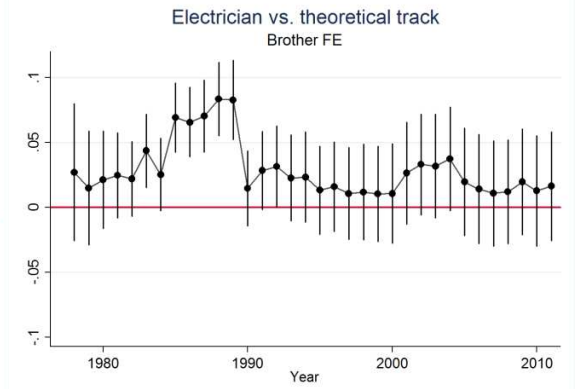
b) Brothers - average 39-48: -.0532.



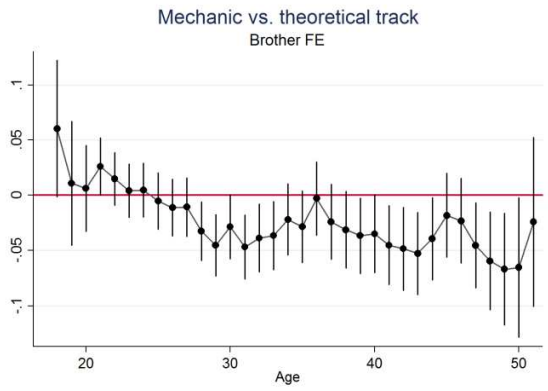
c) Brothers - average 39-48:.0255.



d) Brothers - average 39-48: .0208.



e) Brothers - average 39-48: -.0410.



f) Brothers - average 39-48: -.0442.

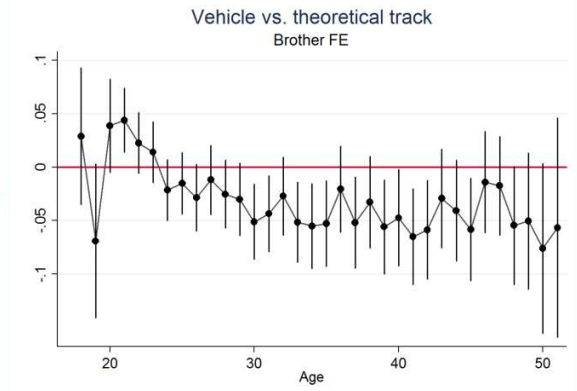
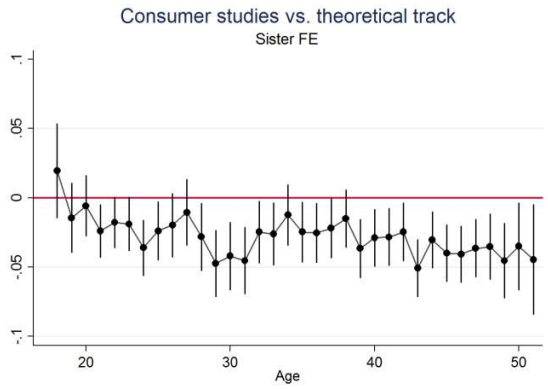
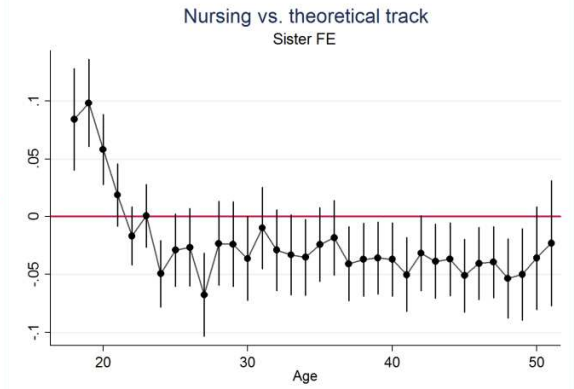


Figure 11: Female separate vocational tracks, estimated relative returns to vocational education, with average point estimates for ages 39-48..

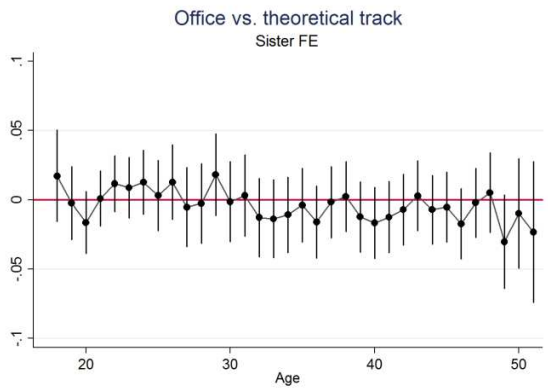
a) Sisters - average 39-48: -.0357.



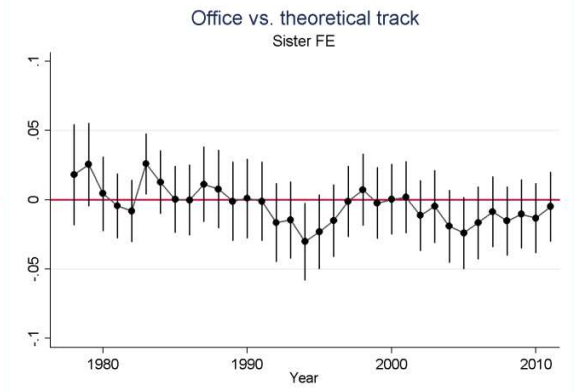
b) Sisters - average 39-48: -.0413.



c) Sisters - average 39-48: -.0081.



d) Sisters - average 39-48: -.0127.



APPENDIX

Table A.1: Brother estimates of log earnings in different age (no family fixed effects)

	(1)	(2)	(3)	(4)	(5)	(6)
	20	25	30	35	40	45
Vocational	0.0078	0.0066	-0.0306***	-0.0658***	-0.0763***	-0.0849***
	(0.0064)	(0.0038)	(0.0042)	(0.0046)	(0.0050)	(0.0054)
GPA	-0.0140***	0.0305***	0.0419***	0.0589***	0.0785***	0.0885***
	(0.0042)	(0.0029)	(0.0032)	(0.0036)	(0.0039)	(0.0042)
Born 1956	0.0000	-0.0328***	0.0228**	-0.0311***	0.0285**	0.0050
	(.)	(0.0073)	(0.0081)	(0.0088)	(0.0099)	(0.0107)
Born 1957	0.0000	-0.0474***	0.0622***	-0.0205*	0.0731***	0.0137
	(.)	(0.0072)	(0.0080)	(0.0088)	(0.0098)	(0.0106)
Born 1958	0.0229**	-0.0497***	0.0676***	-0.0364***	0.0898***	0.0026
	(0.0085)	(0.0072)	(0.0079)	(0.0088)	(0.0097)	(0.0105)
Born 1959	0.0286***	-0.0337***	0.1155***	-0.0346***	0.1192***	0.0259*
	(0.0081)	(0.0072)	(0.0079)	(0.0088)	(0.0097)	(0.0105)
Born 1960	0.0259**	-0.0328***	0.0637***	-0.0266**	0.1394***	0.0489***
	(0.0081)	(0.0073)	(0.0081)	(0.0090)	(0.0099)	(0.0107)
Born 1961	-0.0039	-0.0085	0.0392***	0.0116	0.1469***	0.0739***
	(0.0082)	(0.0075)	(0.0084)	(0.0093)	(0.0102)	(0.0110)
Born 1962	0.0000	0.0343***	0.0362***	0.0368***	0.1642***	0.0809***
	(.)	(0.0078)	(0.0088)	(0.0096)	(0.0106)	(0.0114)
Born 1963	-0.0014	0.0508***	0.0164	0.0790***	0.1687***	0.1063***
	(0.0085)	(0.0079)	(0.0089)	(0.0097)	(0.0107)	(0.0115)
First sibling	0.0000	0.0008	0.0056	0.0078	0.0016	0.0000
	(.)	(0.0059)	(0.0066)	(0.0074)	(0.0079)	(.)
Second sibling	-0.0103	-0.0062	0.0027	-0.0023	0.0005	-0.0056
	(0.0056)	(0.0052)	(0.0058)	(0.0065)	(0.0069)	(0.0057)
Third sibling	-0.0076					0.0035
	(0.0080)					(0.0086)
_cons	5.0014***	5.2228***	5.2686***	5.3788***	5.3649***	5.5378***
	(0.0162)	(0.0121)	(0.0134)	(0.0150)	(0.0162)	(0.0154)
R-squared	0.005	0.025	0.026	0.039	0.056	0.045
N	12031	24844	24742	23858	24133	24258

* p<0.05, ** p<0.01, *** p<0.001

Table A.2: Sister estimates of log earnings in different age (no family fixed effects)

	(1)	(2)	(3)	(4)	(5)	(6)
	20	25	30	35	40	45
Vocational	0.0239***	-0.0299***	-0.0366***	-0.0388***	-0.0506***	-0.0523***
	(0.0036)	(0.0035)	(0.0042)	(0.0041)	(0.0042)	(0.0043)
GPA	0.0376***	0.0430***	0.0286***	0.0264***	0.0453***	0.0764***
	(0.0027)	(0.0029)	(0.0035)	(0.0034)	(0.0035)	(0.0036)
Born 1956	0.0000	-0.0123	0.0232*	-0.0359***	0.0448***	0.0164
	(.)	(0.0080)	(0.0095)	(0.0091)	(0.0095)	(0.0099)
Born 1957	0.0000	-0.0407***	0.0282**	-0.0142	0.0642***	0.0102
	(.)	(0.0077)	(0.0092)	(0.0088)	(0.0093)	(0.0096)
Born 1958	0.0000	-0.0577***	0.0369***	-0.0207*	0.0895***	0.0153
	(.)	(0.0078)	(0.0093)	(0.0090)	(0.0093)	(0.0097)
Born 1959	0.0112*	-0.0735***	0.0567***	-0.0170	0.1209***	0.0390***
	(0.0053)	(0.0078)	(0.0094)	(0.0090)	(0.0095)	(0.0098)
Born 1960	-0.0063	-0.0813***	0.0691***	-0.0191*	0.1486***	0.0567***
	(0.0055)	(0.0080)	(0.0096)	(0.0092)	(0.0096)	(0.0100)
Born 1961	-0.0352***	-0.0443***	0.0558***	0.0407***	0.1696***	0.0762***
	(0.0056)	(0.0082)	(0.0099)	(0.0094)	(0.0098)	(0.0102)
Born 1962	-0.0612***	-0.0222**	0.0773***	0.0694***	0.1832***	0.0845***
	(0.0059)	(0.0084)	(0.0102)	(0.0097)	(0.0102)	(0.0105)
Born 1963	-0.0966***	-0.0249**	0.0439***	0.0893***	0.1848***	0.1086***
	(0.0061)	(0.0086)	(0.0105)	(0.0099)	(0.0104)	(0.0107)
First sibling	0.0000	0.0000	-0.0130	-0.0029	0.0000	0.0000
	(.)	(.)	(0.0077)	(0.0075)	(.)	(.)
Second sibling	0.0011	0.0057	0.0019	0.0030	-0.0015	0.0128*
	(0.0040)	(0.0042)	(0.0068)	(0.0065)	(0.0050)	(0.0052)
Third sibling	-0.0071	0.0032			-0.0074	0.0080
	(0.0056)	(0.0065)			(0.0078)	(0.0080)
Cons	4.8988***	5.0062***	4.9852***	5.0908***	5.1031***	5.2345***
	(0.0104)	(0.0114)	(0.0156)	(0.0150)	(0.0136)	(0.0140)
R-squared	0.053	0.030	0.018	0.033	0.049	0.041
N	13872	18379	17638	20572	23295	24874

* p<0.05, ** p<0.01, *** p<0.001

Table A.1: Brother fixed effects estimates of log earnings in different age

	(1)	(2)	(3)	(4)	(5)	(6)
	20	25	30	35	40	45
Vocational	0.0081	0.0133*	-0.0149*	-0.0377***	-0.0366***	-0.0425***
	(0.0130)	(0.0059)	(0.0066)	(0.0074)	(0.0079)	(0.0086)
GPA	-0.0155	0.0282***	0.0525***	0.0756***	0.0914***	0.1065***
	(0.0100)	(0.0048)	(0.0054)	(0.0062)	(0.0066)	(0.0072)
Born 1956	0.0000	-0.0264**	0.0338**	-0.0237	0.0369**	-0.0032
	(.)	(0.0100)	(0.0112)	(0.0126)	(0.0139)	(0.0150)
Born 1957	0.0000	-0.0498***	0.0640***	-0.0249*	0.0701***	0.0083
	(.)	(0.0099)	(0.0112)	(0.0126)	(0.0138)	(0.0150)
Born 1958	0.0669*	-0.0517***	0.0733***	-0.0326*	0.0964***	0.0045
	(0.0266)	(0.0106)	(0.0120)	(0.0137)	(0.0147)	(0.0159)
Born 1959	0.0483*	-0.0357**	0.1168***	-0.0259	0.1172***	0.0105
	(0.0235)	(0.0114)	(0.0129)	(0.0145)	(0.0158)	(0.0171)
Born 1960	0.0439*	-0.0343**	0.0678***	-0.0350*	0.1276***	0.0386*
	(0.0194)	(0.0124)	(0.0142)	(0.0159)	(0.0173)	(0.0187)
Born 1961	-0.0004	-0.0162	0.0403**	0.0167	0.1419***	0.0616**
	(0.0162)	(0.0136)	(0.0156)	(0.0175)	(0.0189)	(0.0204)
Born 1962	0.0271	0.0341*	0.0409*	0.0498*	0.1661***	0.0732**
	(0.0152)	(0.0151)	(0.0174)	(0.0193)	(0.0209)	(0.0227)
Born 1963	0.0000	0.0473**	0.0131	0.0918***	0.1642***	0.0888***
	(.)	(0.0164)	(0.0189)	(0.0211)	(0.0227)	(0.0247)
Second sibling	0.0022	-0.0054	-0.0049	-0.0200*	-0.0027	-0.0038
	(0.0141)	(0.0065)	(0.0074)	(0.0085)	(0.0090)	(0.0098)
First sibling	0.0161	-0.0032	-0.0090	-0.0258	-0.0084	0.0101
	(0.0271)	(0.0120)	(0.0136)	(0.0154)	(0.0165)	(0.0179)
_cons	4.9754***	5.2258***	5.2302***	5.3195***	5.3021***	5.4610***
	(0.0424)	(0.0168)	(0.0188)	(0.0214)	(0.0230)	(0.0249)
R-squared	0.819	0.631	0.627	0.641	0.649	0.639
N	12031	24844	24742	23858	24133	24258

* p<0.05, ** p<0.01, *** p<0.001

Table A.2: Sister fixed effects estimates of log earnings in different age

	(1)	(2)	(3)	(4)	(5)	(6)
	20	25	30	35	40	45
Vocational	0.0159*	-0.0290***	-0.0186*	-0.0182**	-0.0308***	-0.0264***
	(0.0079)	(0.0065)	(0.0078)	(0.0071)	(0.0068)	(0.0067)
GPA	0.0348***	0.0374***	0.0258***	0.0328***	0.0660***	0.0930***
	(0.0070)	(0.0064)	(0.0075)	(0.0067)	(0.0065)	(0.0064)
o.Born 1956	0.0000	-0.0115	0.0494**	-0.0452**	0.0472***	0.0030
	(.)	(0.0137)	(0.0165)	(0.0146)	(0.0141)	(0.0141)
o.Born 1957	0.0000	-0.0454***	0.0378*	-0.0230	0.0720***	0.0158
	(.)	(0.0133)	(0.0160)	(0.0143)	(0.0140)	(0.0138)
Born 1958	0.1035***	-0.0632***	0.0657***	-0.0305*	0.0881***	0.0075
	(0.0202)	(0.0145)	(0.0174)	(0.0155)	(0.0150)	(0.0149)
Born 1959	0.1310***	-0.0845***	0.0805***	-0.0321	0.1164***	0.0280
	(0.0174)	(0.0155)	(0.0187)	(0.0167)	(0.0162)	(0.0160)
Born 1960	0.0840***	-0.1107***	0.0872***	-0.0352	0.1502***	0.0455**
	(0.0145)	(0.0171)	(0.0204)	(0.0182)	(0.0177)	(0.0174)
Born 1961	0.0603***	-0.0667***	0.0764***	0.0317	0.1792***	0.0734***
	(0.0121)	(0.0187)	(0.0224)	(0.0198)	(0.0193)	(0.0190)
Born 1962	0.0213	-0.0474*	0.0902***	0.0527*	0.1992***	0.0814***
	(0.0110)	(0.0206)	(0.0247)	(0.0218)	(0.0214)	(0.0211)
Born 1963	0.0000	-0.0468*	0.0653*	0.0748**	0.1870***	0.0972***
	(.)	(0.0225)	(0.0268)	(0.0242)	(0.0233)	(0.0229)
First sibling (REF)						
Second sibling	0.0056	0.0164	0.0070	0.0125	-0.0044	0.0112
	(0.0109)	(0.0090)	(0.0106)	(0.0095)	(0.0092)	(0.0091)
Third sibling	-0.0053	0.0192	0.0197	0.0005	-0.0263	-0.0098
	(0.0205)	(0.0165)	(0.0194)	(0.0175)	(0.0169)	(0.0167)
_cons	4.8121***	5.0316***	4.9543***	5.0623***	5.0226***	5.1728***
	(0.0315)	(0.0234)	(0.0275)	(0.0248)	(0.0241)	(0.0236)
R-squared	0.786	0.698	0.723	0.684	0.666	0.650
N	13872	18379	17638	20572	23295	24874

* p<0.05, ** p<0.01, *** p<0.001

Table A.3: Male estimates of log earnings at different ages, controls for cognitive and non-cogntive abilities from military enlistment tests, measured at ages 18-19.

	(1)	(2)	(3)	(4)	(5)	(6)
	20	25	30	35	40	45
Vocational	-0.0066	0.0101	-0.0152*	-0.0267**	-0.0228*	-0.0293**
	(0.0161)	(0.0068)	(0.0076)	(0.0085)	(0.0091)	(0.0099)
GPA	0.0029	0.0171**	0.0377***	0.0601***	0.0641***	0.0688***
	(0.0129)	(0.0058)	(0.0065)	(0.0074)	(0.0079)	(0.0086)
Born 1956	0.0000	-0.0301**	0.0311**	-0.0228	0.0478**	0.0024
	(.)	(0.0107)	(0.0121)	(0.0135)	(0.0149)	(0.0160)
Born 1957	0.0000	-0.0521***	0.0661***	-0.0247	0.0734***	0.0002
	(.)	(0.0108)	(0.0122)	(0.0136)	(0.0149)	(0.0162)
Born 1958	0.0559	-0.0539***	0.0746***	-0.0297*	0.1085***	-0.0016
	(0.0324)	(0.0119)	(0.0134)	(0.0151)	(0.0162)	(0.0175)
Born 1959	0.0417	-0.0329**	0.1206***	-0.0300	0.1186***	0.0052
	(0.0321)	(0.0127)	(0.0144)	(0.0160)	(0.0173)	(0.0188)
Born 1960	0.0000	-0.0214	0.1103***	-0.0126	0.1370***	0.0522
	(.)	(0.0194)	(0.0220)	(0.0252)	(0.0267)	(0.0290)
Born 1961	0.0077	-0.0125	0.0463**	0.0162	0.1480***	0.0566*
	(0.0324)	(0.0152)	(0.0175)	(0.0193)	(0.0208)	(0.0226)
Born 1962	0.0312	0.0340*	0.0457*	0.0504*	0.1686***	0.0680**
	(0.0349)	(0.0166)	(0.0192)	(0.0212)	(0.0229)	(0.0248)
Born 1963	0.0129	0.0522**	0.0190	0.0930***	0.1756***	0.0862**
	(0.0372)	(0.0183)	(0.0211)	(0.0233)	(0.0251)	(0.0273)
First sibling	0.0300					
	(0.0339)					
Second sibling	0.0082	-0.0054	-0.0054	-0.0152	0.0057	0.0096
	(0.0210)	(0.0075)	(0.0085)	(0.0096)	(0.0102)	(0.0112)
Third sibling	0.0000	-0.0053	-0.0062	-0.0167	0.0070	0.0268
	(.)	(0.0135)	(0.0155)	(0.0173)	(0.0185)	(0.0201)
Undisclosed noncog.	0.1218	-0.0450	-0.0695	0.0875	-0.0012	-0.0291
	(0.1008)	(0.0486)	(0.0543)	(0.0619)	(0.0672)	(0.0725)
Non cognitive	-0.1290	0.0539	0.0786	-0.0746	0.0162	0.0446
	(0.1004)	(0.0483)	(0.0540)	(0.0616)	(0.0669)	(0.0721)
Leadership	0.0610	-0.0206	-0.0318	0.0442	0.0048	-0.0061
	(0.0456)	(0.0220)	(0.0246)	(0.0281)	(0.0305)	(0.0329)
Inductive skill	-0.0121	0.0030	0.0070*	-0.0003	0.0046	0.0088*
	(0.0065)	(0.0030)	(0.0033)	(0.0038)	(0.0041)	(0.0044)
Verbal skill	-0.0098	0.0008	0.0019	-0.0015	0.0043	0.0068
	(0.0063)	(0.0029)	(0.0033)	(0.0037)	(0.0040)	(0.0044)
Spatial skill	-0.0098	0.0015	0.0058*	-0.0032	-0.0023	-0.0001
	(0.0056)	(0.0026)	(0.0030)	(0.0034)	(0.0037)	(0.0039)
Technical skill	-0.0099	0.0081**	0.0098**	0.0006	0.0069	0.0089*
	(0.0059)	(0.0028)	(0.0032)	(0.0036)	(0.0039)	(0.0042)
_cons	5.5733***	4.9918***	4.8598***	5.6089***	5.1987***	5.2375***
	(0.4434)	(0.2136)	(0.2388)	(0.2723)	(0.2955)	(0.3189)
R-squared	0.853	0.682	0.683	0.698	0.706	0.695
N	9746	21555	21338	20723	20899	21030

* p<0.05, ** p<0.01, *** p<0.001

References

Aakvik, A., Salvanes, K. and Vaage, K. (2003). Measuring Heterogeneity in the Returns to Education in Norway using Educational Reforms. *IZA Discussion Paper* No. 815.

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

Bassanini, A., Booth, A., Brunello, G., De Paola, M and Leuven, E. (2005). Workplace Training in Europe. IZA Discussion Paper 1704. Also published in Brunello, Garibaldi and Wasmer (eds.). *Education and Training in Europe.* Oxford University Press.

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

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.

Brunello, G. (2001) On the Complementarity between Education and Training in Europe. IZA Discussion Paper No. 309.

Cunha, F. and Heckman, J. (2007). The Economics of Human Development – The Technology of Skill Formation. *American Economic Review*; 97(2): 31–47.

Cunha, F. and Heckman, J. (2009). The Economics and Psychology of Inequality and Human Development. *Journal of European Economic Association*; 7(2): 320–364.

Carlsson, M., Dahl, G. and Rooth, D.-O. (2012). The Effect of Schooling on Cognitive Skills. IZA Discussion Paper 6913.

Englund, P. (1999). The Swedish Banking Crisis – Roots and Consequences. *Oxford Review of Economic Policy* 15(3), 80–97.

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

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.

Goldin, C. och Katz, L. (2008). *The Race between Education and Technology*. Harvard University Press.

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., Woessman, L. and Zhang, L. (2011). General Education, Vocational Education, and Labor market Outcomes over the Life-Cycle. IZA discussion paper 6083.

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. I Ashenfelter, O. and Card, D. (red) *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.

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

Kreuger, D. and Kumar, K. (2004a). Skill-Specfic 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.

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

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

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.

Shavit, Y. and Muller, W. (1098). *From School to Work*. Oxford University press.

Stenberg, A. (2011). Using Longitudinal Data to Evaluate Publicly Provided Formal Education for Low-skilled. *Economics of Education Review* 30(6), 1262-1280.