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Cohort changes in educational pathways and returns to education*

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Preliminary - Comments welcome

Abstract: This paper analyzes educational pathways of West German birth cohorts 1944 to 1986. We use a new data set including survey data with detailed information on educational biographies linked to administrative social security records. We find a strong expansion of higher secondary school degrees over time. Especially in the cohorts since the 1960s, most of this increase is accounted for by changes in demographic characteristics, in particular rising education of the parental education and a decrease in family size. Moreover, a sizable and growing share of those pupils that had a lower or middle secondary degree as their first degree upgrade to the next school degree, suggesting that the German education system provides “second chances” to revise decisions made after early tracking at age 10. However, these upgraders have different postsecondary and labour market outcomes than students who obtained the higher secondary degree on the direct path. Finally, we estimate labour market returns to the different educational pathways, and find rising differentials in employment and earnings at the bottom, i.e. between lower and middle secondary graduates, as well as rising returns to tertiary compared to vocational education.

Keywords: school-to-work transition, intergenerational mobility, school tracking, returns to education

JEL-Classification: I20, I26, J24

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1 Introduction

A large literature in labour economics has shown that differences in education explain a large share of differences in wages and employment at adult ages. Over the last decades, returns to education have also increased in many industrialized countries (see, among others, Autor et al. 2008 for the US, and Dustmann et al. 2009 as well as Reinberg and Hummel 2007 for Germany). Thus, it is important to understand how educational attainment of young individuals has changed over time, and how differences between demographic groups, e.g. between men and women, or between children from different parental background, have developed.

For the case of Germany, numerous studies have focused on the determinants of secondary school degrees. This is because Germany has an early tracking system in which students are typically selected into the three tracks of lower, middle and higher secondary school at age 10.¹ The type of school degree obtained has implications for the access to better-paid occupations in vocational training, and a higher secondary degree also opens access to academic tertiary education at universities or universities of applied sciences. The literature has found that there are still strong differences in the attainment of school degrees by parental background even after decades of educational expansion, as demonstrated by e.g. Schimpl-Neimans (2000), Dustmann (2004) or Heineck and Riphahn (2009). At the same time, there has been a reversal of the gender education gap in secondary schooling, with girls performing better than boys in terms of school grades and school degrees in recent cohorts (Riphahn and Schwientek 2014).

Even though children are selected into different secondary school tracks at an early age, mobility between tracks at later ages is also possible. Jacob and Tieben (2007) document an increase in upward mobility between school tracks for birth cohorts until 1971. They argue that various educational reforms in the 1950s and 1960s have made it easier for students from the lower or middle track to upgrade to the next higher track. These reforms include the increase in the duration of compulsory schooling from 8 to 9 years, or the introduction of foreign languages in lower and middle secondary schools. Puhani and Mühlenweg (2010) and Dustmann et al. (2014) find that the age of entering primary school only has an effect on educational outcomes and wages until grade 10, but that its effect fades afterwards. Their interpretation is that the German education system provides opportunities to correct educational decisions made after early tracking at age 10, by allowing students from lower or middle secondary school to

¹See also Appendix A for an explanation of the institutional details of the German education system.

upgrade to a higher secondary degree after 10th grade. Sterrenberg (2014) focuses on birth cohorts 1956 to 1968 and analyzes the labour market returns to different pathways leading to a higher secondary degree. She finds that higher secondary degrees obtained until the mid-20s yield similar payoffs as earlier degrees, but the returns fade for degrees obtained at later ages. However, the aforementioned papers did not consider more recent cohorts.²

With respect to postsecondary education, a special feature of Germany is the prominent role of the vocational training system, either in form of firm-based apprenticeships or full-time vocational schools (OECD 2014). Hence, the number of individuals entering tertiary education has been relatively low until recently. Mayer et al. (2007) as well as Riphahn and Schieferdecker (2012) focus on the transition of higher secondary graduates to tertiary education, in particular how it depends on parental background.

The existing literature typically focuses on transitions at specific stages of the educational system. In contrast, the contribution of this paper is to provide a more comprehensive picture of educational biographies, and how they have changed over time. We consider West German birth cohorts 1944 to 1986, ranging from the cohorts born directly after the Second World War, over the baby boom generation until those young persons who are just about to enter the labour market. In the first part of the analysis, we consider the sequential educational choices. This starts from the first secondary school degree a person has obtained, continues with the decision whether a person who had a lower or middle secondary degree as their first degree upgrades to a higher track, until the decision whether to attend tertiary education. We study how socio-demographic characteristics such as parental education, migration background, or family size are associated with the different choices. A similar strategy is pursued by Biewen and Tapalaga (2016) and Lauer (2003) who also study multiple educational decisions for Germany. However, a new perspective we add to this literature is that we also use decomposition analyses to show to what extent changes in these characteristics across cohorts can explain changes in educational pathways. In the second step of the analysis, we show how these educational pathways are associated with employment and earnings at the early stage of the career. Here, a further contribution of our paper is that we use a newly available linkage between survey data and administrative data. The Adult Cohort of the National Educational Panel Study (NEPS) is a survey which contains detailed information on the respondents' social background as well as

²A related literature on “second chance” education exists for the US, where a number of studies have analyzed the GED, an achievement test which allows high school dropouts to earn a certificate equivalent to a high school diploma (see Heckman et al. 2011 for a review).

their complete educational biographies. These data are linked to administrative social security records from the Integrated Employment Biographies (IEB) which include precise information on the individuals' wages and employment.

Our main results can be summarized as follows. First, there is a strong expansion of higher secondary school graduation over time. Our results suggest that this process is driven by different factors in different time periods. For the birth cohorts of the 1940s and 1950s, the changes are unexplained by demographic characteristics. For the birth cohorts of the 1960s and later, most of the increase can be explained by changing demographic characteristics, in particular rising education of the parental generation and a decrease in family size. Second, a sizable and growing share of students who leave with a lower or middle secondary degree at ages 15 or 16 upgrade to the next higher track afterwards. However, these "upgraders" differ in their postsecondary choices: those that obtained the higher secondary school degree after upgrading are much less likely to continue with university education and are more likely to choose the vocational path. Third, we find that gaps between parental background groups are large in all cohorts. There is no evidence for a decrease of these gaps over time, and, if anything, evidence for a slight increase. Women have caught up to men and surpassed them in terms of reaching higher secondary degrees. However, for much of the cohorts in the 1960s and 1970s, female higher secondary graduates are much less likely to continue with tertiary education than males. The gap in tertiary education only closes in more recent cohorts. Fourth, concerning labour market returns, we find that individuals at the bottom of the education distribution, i.e. lower secondary graduates, face substantially worse employment rates and earnings in the younger cohorts. Returns to university compared to vocational education increase as well.

The paper continues with Section 2, which describes the data, the sample selection criteria and discusses various issues related to the merging of survey and administrative data. Section 3 analyzes transitions at different stages of the educational system, from secondary schooling to postsecondary education and presents the results of the decomposition analyses. Section 4 analyzes the labour market returns to these different educational pathways. Section 5 concludes.

2 Data

The paper uses a linkage between two data sources: survey data from the Adult Cohort (Starting Cohort 6) of the National Educational Panel Study (NEPS) and administrative social security

records from the Integrated Labour Market Biographies (IEB).³ This section describes these two data sources and the different steps of sample selection.

NEPS data

The NEPS Adult Cohort contains about 17.000 individuals from the birth cohorts 1944 to 1986, who were retrospectively asked about their complete educational and labour market biographies. We use the first five waves of the data, corresponding to the survey years 2007 to 2013.⁴

Table B1 in the Appendix shows the sample selection criteria. In the NEPS data, we kept only individuals who were born and had their complete schooling history in West Germany, since the educational systems in communist East Germany or countries outside of Germany differ considerably. Moreover, we delete individuals without school degrees, those who visited special-needs schools (*Sonderschulen*), or those whose school degrees could not be classified. A few cases with apparent inconsistencies in their reported educational biographies are also dropped (see the Appendix for a further discussion). This results in a final sample of 10650 individuals for which educational biographies can be analyzed. We use survey weights provided by the NEPS in all analyses.⁵

IEB data

To analyze the respondents' labour market histories, we utilize the linkage between the NEPS survey data and administrative social security records from the Integrated Labour Market Biographies (IEB). The IEB data are based on employers' mandatory social security notifications as well as internal process data by the German Federal Employment Agency. They contain daily labour market histories for employees covered by social security and registered unemployed (see also Jacobebbinghaus and Seth 2007).

³It builds upon ALWA-ADIAB, the linkage of the ALWA survey data and IEB data, see Antoni and Seth (2012), and Antoni (2011).

⁴Blossfeld et al. (2011) provide a further description of the different data sets associated with the NEPS project. The NEPS Adult Cohort is a follow-up to the data set *Working and Learning in a Changing World* (ALWA) collected by the Institute for Employment Research (IAB). In particular, about half of the NEPS sample is from the old ALWA study, while the other half has been sampled anew.

⁵In most of the paper, we compare the outcomes of individuals grouped by their birth cohorts (e.g. those born in 1955-65). When computing the averages per cohort group, we account for the fact that the distribution of birth years is not uniform within groups (e.g., within the 1955-65 group, there are more individuals born in the early 1960s than in the late 1950s). This is done by multiplying the survey weight for each observation with the inverse of the cohort size.

For a number of reasons, not all persons in the NEPS sample can be matched in the administrative data. First, a person can refuse the linkage. Second, a person can only be matched if she had at least one spell in the administrative data when the NEPS survey took place. If a person was found in that time window, her whole history of spells (possibly from 1975 on) is available. However, the data will exclude e.g. persons who were out of the labour force, self-employed or civil servants at the time of the survey. This sampling design leads to very low match rates for the oldest cohorts, many of whom had already exited the labour force at that time.

Thus, to avoid sample selection problems, we drop the oldest cohorts born before 1955 when estimating the labour market returns. We also drop cohorts born after 1976, who are not sufficiently long in the labour market. This gives a “target sample” of 6658 persons in the 1955-76 birth cohorts. Among these 6658 target persons, 6253 (=94 %) consented to the linkage, and 4926 persons (=79 % of the consenters, and 74 % of all target persons) were matched at least once in the administrative data. To examine the selectivity of the linked sample, we utilize the fact that even for those who refused or who are not found, we observe a rich set of background information based on the NEPS survey. Table B2 shows how various observable characteristics predict consent and matching success.⁶ We find little selectivity of giving consent to matching, especially with respect to cohort and education, the most important variables in our analysis. When it comes to the determinants of being matched, the 1966-76 cohort shows slightly higher match rates than the 1955-65 cohort, though the magnitude is small (about 4.1 ppts.). We find no differences by secondary school degree. Vocational graduates have slightly higher match rates than all other groups, which is plausible given that the administrative records include firm-based vocational training episodes. As expected, there are strong differences by occupational status: self-employed, civil servants, or persons who are out of the labour force have a significantly lower probability to be matched in the administrative data compared to dependent employees. Other socio-demographic background variables such as migration background or parental education do not seem to be associated with successful linkage. Overall, our findings show that the strongest sample selection effects arise with respect to occupational status, but that conditional on this factor, the matched sample is fairly representative of the total sample in terms of education or personal background characteristics.

⁶The 6 groups of secondary school degrees and 4 groups of postsecondary degrees are the same used in the estimations of Section 4.

3 Cohort trends in education

3.1 First school degrees

Figure 1 shows the share of each birth cohort having obtained a lower, middle or higher secondary degree as first school degree. The share of lower secondary graduates decreases sharply over time, while the share of higher secondary graduates increases. The graph also highlights important gender differences. In terms of higher secondary degrees, women are behind men in the cohorts born up to the mid-1960s, but they catch-up rapidly and eventually overtake men in the cohorts born in the early 1980s. But a remarkable result is that, even in the oldest cohorts, women are much less likely to obtain a lower secondary degree and more likely to obtain a middle secondary degree. In other words, while the female advantage at the bottom of the schooling distribution is already present in the oldest cohorts, the female advantage at the top only opens up for younger cohorts.

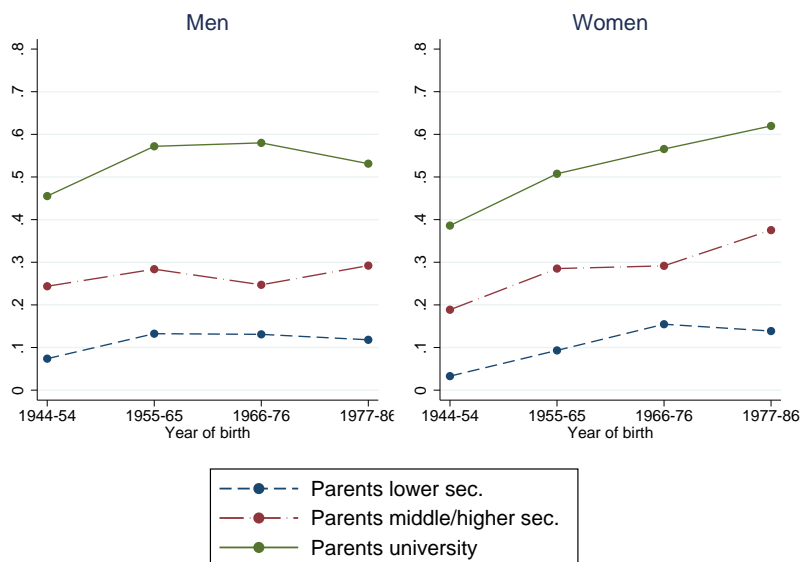
Figure 1: First secondary school degree



In Figure 2, we show the trends in higher secondary graduation separately by parental education. The educational expansion after the Second World War explicitly had the goal to reduce differences by parental background (Becker et al. 2006). However, this aim has not proven successful. Although children from parents with lower secondary education have made some progress towards reaching a higher secondary degree (+ 3 ppts. for men, + 9 ppts. for

women), the increase has been stronger for children from academic parents in absolute terms (+ 7 ppts. for men, and + 22 ppts. for women). Women from higher educated parents have shown the largest increases. For men, it is also remarkable that the share of higher secondary graduates has been constant or declining within each of the three parental background groups since the 1955-65 cohort. But as shown in Figure 1, the total share of higher secondary graduates among men has been rising also for these younger cohorts. This must mean that it is rising education level of the parental education (a shift in the relative shares of the groups) that drives rising education for males. This argument will be taken up again in the decomposition analysis below.

Figure 2: Higher secondary graduation (first school degree), by parental education



In the following, we model the relationship between observable demographic characteristics of a person – such as migration background, parental education, or family structure – and the probability to have a higher secondary degree as first school degree, separately for each of the four cohorts. Then, we use a standard Blinder-Oaxaca decomposition to separate the change in the share of school degrees into an ”explained” or ”characteristics” effect, which reflects changes in the distribution of characteristics across cohorts, and into an ”unexplained” or ”coefficient” effect, which reflects changes in the returns to characteristics.⁷ For example, comparing the

⁷An informal discussion on how these characteristics affect educational trends in Germany is given by Becker et al. (2006). Our approach is also similar to Altonji et al. (2012) who use a decomposition to analyze how changes in the characteristics of two US cohorts of youth affect wages at adult age.

birth cohorts 1944-54 and 1955-65, the decomposition reads:

$$\begin{aligned} & \overline{Pr}(HigherSec^{55,65} = 1|X^{55,65}) - \overline{Pr}(HigherSec^{44,54} = 1|X^{44,54}) \\ &= \underbrace{\overline{X}^{55,65}(\beta^{55,65} - \beta^{44,54})}_{\text{coefficient effect}} + \underbrace{\beta^{44,54}(\overline{X}^{55,65} - \overline{X}^{44,54})}_{\text{characteristics effect}} \end{aligned}$$

The corresponding formula applies when comparing changes between the other cohort groups. X denotes the vector of socio-demographic background variables (see below for a further description). The coefficient vectors β are obtained by estimating Linear Probability Models separately for each cohort. Besides the aggregate decomposition into a composition and a coefficient effect, we also report the contributions of the single variables or blocks of variables.⁸

Table 1 shows how socio-demographic background characteristics – the vector of X in the decomposition – have changed over time. Parental education has increased considerably: the share of persons whose parents have obtained a university degree increased from 8.3 % to 21.4 %. While the change is minor between the 1944-54 and 1955-65 cohorts, the change is dramatic afterwards. The increase in parental education should contribute to higher education of the younger cohorts, given that a large literature shows the positive intergenerational association of education, as surveyed in Black and Devereux (2010) and Homlund et al. (2011). Parental occupational status has shifted as well, away from unskilled to professional employee positions. Although parental occupation and education are closely correlated, the parents' occupation might have an independent effect to the extent that occupational role models are transmitted to the children which then affect educational choices. The share of persons with migration background increased from 5.7 % to 16.9 %. To the extent that migrants are less successful in the education system, this might have a negative effect on average education in the population.⁹ Moreover, families also have become smaller over time. The average number of siblings decreased from 2.1 to 1.5, mostly driven by the decline of birth rates in the mid-1960s. The economic theory of the family developed by Becker (1960) suggests a tradeoff between child quantity and “quality”. Thus, the decrease in family size should allow parents to invest more resources per child and raise the average education of the children generation, *ceteris paribus*.

⁸For categorical variables such as parental education, parental occupation and Federal state, we consider the joint effect of the separate dummies for each category.

⁹On the other hand, Krause et al. (2015) have shown for Germany that native-migrant gaps in education can be entirely explained by socio-economic background.

Another factor is family structure. Positive correlations between intact family structures and children’s educational attainment have been documented e.g. by Haveman and Wolfe (1995) or Wößmann (2015). The share of individuals who grew up with both biological parents was lowest in the 1944-54 cohorts which were born during and immediately after the Second World War. It has then increased and decreased again slightly due to the rising number of single parents in younger cohorts.¹⁰

Table 1: Social background characteristics – by birth cohort

	1944-54	1955-65	1966-76	1977-86
<i>Parental education</i>				
Parents lower sec.	0.736	0.704	0.597	0.404
Parents middle/ higher sec.	0.164	0.186	0.243	0.370
Parents university	0.083	0.091	0.137	0.214
Parents educ missing	0.018	0.019	0.023	0.012
<i>Parental occupation</i>				
Parents low occupation	0.198	0.187	0.155	0.102
Parents middle occupation	0.435	0.415	0.395	0.384
Parents high occupation	0.261	0.285	0.359	0.428
Parents’ occupation missing	0.106	0.113	0.092	0.086
<i>Migration background</i>				
Migration background	0.057	0.069	0.113	0.169
Migration background missing	0.038	0.024	0.027	0.029
No. of siblings	2.140	2.084	1.652	1.511
No. of siblings missing	0.002	0.103	0.125	0.153
Grew up with both parents	0.843	0.910	0.885	0.853
N	2277	4019	2639	1715

Note: Parental education and occupation refer to the highest category of either father or mother. Parental occupation follows the classification by Erikson, Goldthorpe and Portocarero (EGP), where the 11 classes were combined into 3: “Low occupation” includes EGP classes VIIa and VIIb (unskilled manual and agricultural workers), “Middle occupation” classes IIIa to VI (self-employed, routine non-manual employees, technicians and skilled manual workers), and “High occupation” classes I and II (professionals and managers). A person is defined to have a migration background if at least one parent was born outside of Germany.

Table 2 shows the determinants of having a higher secondary degree as first school degree. We confirm results of the intergenerational mobility literature (Heineck and Riphahn 2009, Dustmann 2004, Schimpl-Neimans 2000) that educational gaps by parental background in West Germany are high and persistent even after decades of educational expansion. The gap

¹⁰All regressions also control for the federal state (Bundesland) of birth since school systems are administered at the state level. However, there have been little changes in the distribution of individuals between states over time.

Table 2: Determinants of higher secondary graduation (first school degree) – by birth cohort

	Men				Women			
	1944-54	1955-65	1966-76	1977-86	1944-54	1955-65	1966-76	1977-86
Parents lower sec.	Ref.							
Parents middle/ higher sec.	0.176*** (0.036)	0.164*** (0.027)	0.121*** (0.033)	0.141*** (0.034)	0.173*** (0.030)	0.183*** (0.028)	0.104*** (0.035)	0.193*** (0.041)
Parents university	0.387*** (0.057)	0.397*** (0.043)	0.514*** (0.046)	0.434*** (0.051)	0.384*** (0.054)	0.451*** (0.044)	0.439*** (0.058)	0.422*** (0.053)
Parents low occupation	Ref.							
Parents middle occupation	0.012 (0.019)	0.028 (0.019)	0.053* (0.029)	0.101*** (0.037)	0.025 (0.015)	0.029 (0.019)	0.126*** (0.030)	-0.014 (0.048)
Parents high occupation	0.091*** (0.033)	0.148*** (0.027)	0.138*** (0.037)	0.196*** (0.045)	0.059** (0.025)	0.088*** (0.027)	0.169*** (0.038)	0.190*** (0.056)
Migration background	0.068 (0.056)	-0.007 (0.035)	-0.012 (0.036)	0.016 (0.040)	0.026 (0.035)	-0.049 (0.032)	0.095* (0.051)	-0.094** (0.047)
No. of siblings	-0.010** (0.005)	-0.022*** (0.005)	-0.034*** (0.008)	-0.028** (0.013)	-0.010*** (0.003)	-0.017*** (0.005)	-0.027*** (0.009)	-0.026* (0.014)
Grew up with both parents	-0.002 (0.030)	0.122*** (0.027)	0.090** (0.037)	0.119*** (0.041)	0.023 (0.022)	0.092*** (0.024)	0.104*** (0.036)	0.008 (0.049)
Constant	0.182*** (0.014)	0.249*** (0.010)	0.241*** (0.012)	0.231*** (0.014)	0.187*** (0.035)	0.208*** (0.010)	0.254*** (0.013)	0.281*** (0.017)
N	1183	1919	1247	883	1094	2100	1392	832

Note: The table reports coefficients from Linear Probability Models. Heteroscedasticity-robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

between children from the lowest (“Parents Low”) and the highest (“Parents university”) group remained at around 40 ppts. in all cohorts. If anything, it has become slightly larger over time. Differentials by parental occupational status – in particular, the gap between “Parents high occupation” and “Parents low occupation” – widen for both genders. There also is a strong association between growing up with more siblings and a lower probability to graduate from higher secondary school, and this gradient increases across cohorts.

Table 3 reports the decomposition results for the changes in higher secondary graduation across cohorts, using the estimated regression coefficients in Table 2.¹¹ We find that the increase in higher secondary graduation between the 1944-54 and 1955-65 cohorts can’t be explained by changes in demographic characteristics. However, for later cohorts, changes in characteristics account for a large part of the increase over time. Among the different characteristics, rising education of the parental generation is by far the most important factor, which drives an increase of about 3 ppts. between the 1955-65 and 1966-76 cohorts, and 5 ppts. between the 1966-76 and 1977-86 cohorts. The effect of changes in parental occupation is also visible, but smaller. The decrease in the number of siblings explains about 1 ppt. of the increase between the 1955-65 and 1966-76 cohorts. Finally, the detailed decomposition of the coefficient effect – that is, changing effects of parental education or family structure across cohorts – does not show systematic effects of single variables.

Our findings suggest that changes in educational attainment have been driven by quite different factors in different time periods. The cohorts born directly after the Second World War could benefit from a number of educational reforms during the 1950s and 1960s. These were, among others, the abolishment of school fees, the lengthening of the duration of compulsory schooling from 8 to 9 years, or rising public expenditures on education relative to GDP (see Becker et al. 2006 as well as Heineck and Riphahn 2009 for a detailed analysis). As shown in Figure 2, this allowed boys and girls from all parental background groups to achieve higher school degrees than the previous generation. After this early phase, the educational expansion had to some extent become a self-reinforcing process. For the birth cohorts in the 1960s and later, rising education seems largely be driven by the rising education of the parental generation.

On top of these general demographic trends, which affect both genders in a similar way, there are also strong gender-specific trends. Among men, the characteristics effect is the only

¹¹We also investigate whether the results are sensitive to the order of the decomposition. The previous results are obtained by using the coefficients of the older cohort as reference when weighting the changes in characteristics. However, the results are very similar when the coefficients of the younger cohort are used as reference.

Table 3: Decomposition of changes in higher secondary graduation (first school degree)

	Men			Women		
	44-54 to 55-65	55-65 to 66-76	66-76 to 77-86	44-54 to 55-65	55-65 to 66-76	66-76 to 77-86
Observed Change	0.068*** (0.015)	0.038** (0.017)	0.046** (0.022)	0.081*** (0.013)	0.078*** (0.018)	0.092*** (0.025)
Characteristics Effect	0.005 (0.007)	0.048*** (0.009)	0.059*** (0.015)	0.009 (0.006)	0.031*** (0.009)	0.065*** (0.013)
Coefficient Effect	0.063*** (0.014)	-0.009 (0.016)	-0.013 (0.022)	0.071*** (0.012)	0.047*** (0.017)	0.027 (0.024)
Characteristics effect						
Parental education	0.005 (0.005)	0.029*** (0.006)	0.052*** (0.012)	0.008 (0.005)	0.030*** (0.007)	0.049*** (0.011)
Parental occupation	0.002 (0.002)	0.009*** (0.003)	0.008** (0.003)	0.001 (0.001)	0.004 (0.002)	0.008** (0.004)
Migration background	0.000 (0.001)	-0.000 (0.002)	0.001 (0.003)	0.000 (0.001)	-0.002 (0.002)	0.007 (0.004)
No. of siblings	0.001 (0.001)	0.010*** (0.003)	0.003 (0.002)	0.000 (0.001)	0.007*** (0.002)	0.005* (0.002)
Grew up with both parents	-0.000 (0.002)	-0.002 (0.002)	-0.004* (0.002)	0.001 (0.001)	-0.003* (0.002)	-0.002 (0.002)
Federal state	-0.003 (0.003)	0.001 (0.002)	-0.002 (0.005)	-0.001 (0.002)	-0.004 (0.003)	-0.002 (0.004)
Coefficient effect						
Parental education	-0.000 (0.005)	0.002 (0.002)	-0.003 (0.010)	-0.004 (0.004)	-0.001 (0.002)	0.004 (0.011)
Parental occupation	-0.003 (0.002)	-0.000 (0.001)	0.005 (0.005)	-0.001 (0.002)	0.000 (0.001)	0.005 (0.006)
Migration background	0.003 (0.003)	-0.002 (0.001)	0.001 (0.004)	0.003 (0.002)	0.001 (0.002)	-0.014** (0.006)
No. of siblings	-0.003* (0.002)	0.003 (0.002)	-0.002 (0.005)	-0.002 (0.002)	0.001 (0.001)	-0.000 (0.005)
Grew up with both parents	0.006*** (0.002)	-0.001 (0.001)	-0.001 (0.001)	0.002* (0.001)	0.000 (0.000)	0.001 (0.002)
Federal state	0.003 (0.002)	0.000 (0.003)	-0.001 (0.003)	0.003 (0.002)	0.000 (0.002)	0.003 (0.004)
Constant	0.058*** (0.016)	-0.011 (0.015)	-0.012 (0.018)	0.070*** (0.014)	0.044*** (0.016)	0.028 (0.021)
N	3102	3166	2130	3194	3492	2224

Note: The table reports Blinder-Oaxaca decompositions based on the models in Table 2. Heteroscedasticity-robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

driving force for the increase in education of later cohorts. The characteristics effect even slightly overexplains the increase – that is, given their improvement in parental background, men in the younger cohorts should perform better than they actually do. In contrast, women have larger gains in education than their change in parental background would predict. They are behind men in the oldest cohorts, but catch-up rapidly and even surpass men in the younger cohorts. As shown in Figure 2, in the 1977-86 cohort, 35 % of females have a higher sec. degree as their first degree, compared to 30 % of men. This reversal of the gender gap in education has been found in a large number of industrialized countries (see OECD 2015 for a recent overview). Most papers have argued that changes in social norms such as access to contraceptives or rising age at marriage have increased incentives for women to invest in education (see, among others, Goldin et al. 2009 for the US or Riphahn and Schwientek 2015 for Germany). However, another question is what explains the female advantage in education among younger cohorts: Becker et al. (2010) develop a model which emphasizes gender differences in the distribution of non-monetary costs of education (such as cognitive or non-cognitive skills). Based on findings from achievement tests in various countries, they argue that this distribution of costs is more compressed for women than for men. In particular, there is a higher share of women with low non-monetary costs. This implies that if returns to education increase (as it has been the case in many countries over the last decades) women’s supply of education will react more elastically than men’s. Similarly, a decrease in the costs of education – e.g. due to public investments in schooling infrastructure – will also attract more women than men.

3.2 Upgrading school degrees

The previous section has considered a person’s first school degree, which is basically determined by the track to which the person is assigned after primary school at age 10.¹² However, pupils who finished with a lower secondary degree (at age 15) or a middle secondary degree (at age 16) as their first degree in principle have the option to continue schooling on the next higher track. These “second-chance” degrees are offered by a variety of school types in Germany. For example, the higher secondary degree can be obtained either at traditional higher secondary schools (*Gymnasien*), or at specialized vocational higher secondary schools such as *Fachoberschulen*, *Berufliche Gymnasium* or *Technische Gymnasien*. These schools are typically directed to students who continue directly after leaving middle secondary school at age 16. Moreover,

¹²Switching tracks *before* having obtained a first degree is in principle possible, but very uncommon.

there are also specialized school types for older students who already have completed vocational training, and some can be attended parallel to full-time work.¹³

For students who upgrade directly after finishing their first degree, a motivation can be to increase chances in the apprenticeship market, i.e. to obtain access to more qualified and higher-paid occupations. For example, apprenticeships as a bank clerk nowadays typically require a higher secondary degree. Upgrading to a higher secondary degree also means one obtains the allowance to enter tertiary education at universities or universities of applied sciences. These interpretations view the decision to continue with further schooling after the first school degree as a strategic investment in human capital. On the other hand, continuing with schooling can also be a way to postpone career planning if youth do not yet know about their plans after school.¹⁴ These considerations suggest that the upgraders are a rather heterogeneous group, both in terms of their motivation, and in terms of the institutions they attend. Thus, the present analysis has to confine itself to discussing a number of stylized facts.

Table 4 shows the share of lower and middle secondary graduates who upgrade to the next higher degree, separately by cohort and gender. Among lower secondary graduates, upgrading to a middle secondary degree has increased over time, particularly between the 1966-76 and 1977-86 cohorts. Female lower secondary graduates are more likely to upgrade than their male peers.¹⁵ Most upgrading takes place in a short time window after the first school degree (within 4 years). But there are also a few who upgrade later (between 5 to 8 years after the first degree), possibly after having completed vocational training. Late upgrading is more common among men.

Among those finishing with a middle secondary degree as their first degree, upgrading is an important phenomenon as well, and it has also increased over time. In the 1977-86 cohorts, about 32 % of male and 25 % of female middle secondary graduates have obtained a higher secondary degree within 8 years. However, one also has to differentiate by the length of further schooling. Some of the vocational schools only offer a higher secondary degree after 12th grade (*Fachhochschulreife, FHR*), as compared to the traditional *Abitur* after 13th grade. The former

¹³For a detailed explanation of the institutional settings in the different German federal states, see BA (2007). Sterrenberg (2014) and the literature cited therein also provides further information on second-chance schooling in Germany.

¹⁴Fitzenberger and Lickleder (2015) show that those lower secondary graduates who continue with further schooling rather than entering vocational training directly have completed fewer internships and were less likely to know their desired training occupation.

¹⁵One possible explanation is that many women plan to enter vocational training at full-time vocational schools (which offer occupations in nursing and health care) which require at least a middle secondary degree.

Table 4: Upgrading after lower or middle secondary school – by birth cohort

	Men				Women			
	1944-54	1955-65	1966-76	1977-86	1944-54	1955-65	1966-76	1977-86
<u>A. Share of lower sec. graduates who upgrade to middle sec.</u>								
Total within 8 years	0.124	0.159	0.149	0.269	0.148	0.253	0.238	0.344
<i>By time of upgrading</i>								
Within 4 years	0.062	0.103	0.099	0.196	0.125	0.231	0.211	0.286
Within 5-8 years	0.061	0.056	0.051	0.073	0.022	0.022	0.028	0.058
N	696	766	396	221	611	709	315	162
<u>B. Share of middle sec. graduates who upgrade to higher sec.</u>								
Total within 8 years	0.157	0.286	0.285	0.322	0.103	0.140	0.197	0.246
<i>By time of upgrading</i>								
Within 4 years	0.094	0.199	0.193	0.213	0.080	0.120	0.163	0.174
Within 5-8 years	0.063	0.087	0.091	0.109	0.023	0.021	0.033	0.072
<i>By type of degree</i>								
Fachhochschulreife (12th grade)	0.074	0.145	0.170	0.143	0.048	0.060	0.082	0.101
Abitur (13th grade)	0.082	0.141	0.114	0.179	0.055	0.081	0.115	0.145
N	262	611	479	314	306	834	599	300

only allows entrance to universities of applied sciences, while the latter also allows entrance to traditional universities. Indeed, we find that a large share of the “middle” to “high” upgraders (about 40 % in the youngest cohorts) complete only FHR. The shorter duration of schooling for FHR graduates, as well as their restricted options for postsecondary education, have to be taken into account when comparing direct and indirect pathways to the higher secondary degree.¹⁶

The next question is what explains the rise in upgrading over time which Table 4 has documented. Jacob and Tieben (2009) argue that various educational reforms in the 1950s and 1960s have made it easier for students from the lower or middle track to upgrade to the next higher track. These reforms include e.g. the increase in the duration of lower secondary school from 8 to 9 years, or the introduction of foreign languages in lower and middle secondary schools. Table 5 investigates the changing composition of lower and middle secondary graduates as a possible explanation.¹⁷ Our results mirror those for the first school degrees in Table 3: the strong increase between the 1944-54 and 1955-65 cohorts is unexplained by characteristics, suggesting a role for the educational reforms during this period. The increase for later cohorts is to a large part explained by compositional changes. The detailed decomposition results (which are not shown here) show that parental education again is the dominant factor among the observables. This may seem puzzling at first sight because lower and middle secondary graduates – who constitute the pool of possible upgraders – on average have lower educated parents than the general population. However, parental education has risen also within this more negatively selected group.

Figure 3 considers the share of the total population who are “direct” higher secondary graduates, i.e. those that had the higher secondary degree as their first school degree, and “indirect” graduates, i.e. those that first had a lower or middle secondary degree, and then upgraded to a higher secondary degree by age 24. In all cohorts, the upgraders make up a sizeable share of all higher secondary graduates. This holds especially among men. In particular, the fact that women make use of upgrading less often seems to be the main reason why their cumulative rate of higher secondary graduation lags behind men.

An open question is whether the possibility to upgrade at later stages of the educational career contributes to overcome the strong intergenerational persistence of school degrees asso-

¹⁶Among the “direct” higher secondary graduates, almost all have completed 13 years.

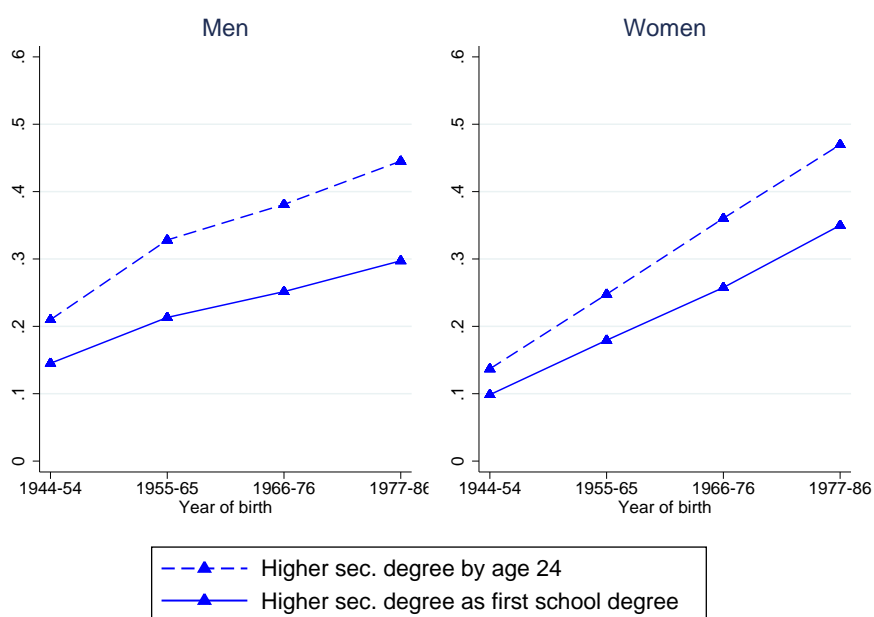
¹⁷For this, we regress, separately for each school type and gender, a dummy for upgrading on the full set of socio-economic background characteristics shown in Table 2.

Table 5: Decomposition of changes in upgrading

	Men			Women		
	44-54 to 55-65	55-65 to 66-76	66-76 to 77-86	44-54 to 55-65	55-65 to 66-76	66-76 to 77-86
<u>A. Upgrading lower sec. to middle sec.</u>						
Observed Change	0.035* (0.020)	-0.010 (0.027)	0.120*** (0.042)	0.105*** (0.024)	-0.015 (0.035)	0.106* (0.054)
Characteristics Effect	0.012 (0.008)	0.025 (0.015)	0.087*** (0.031)	-0.011 (0.010)	-0.011 (0.024)	0.080* (0.042)
Coefficient Effect	0.023 (0.020)	-0.035 (0.024)	0.033 (0.044)	0.116*** (0.024)	-0.004 (0.027)	0.026 (0.052)
<u>B. Upgrading middle sec. to higher sec.</u>						
Observed Change	0.130*** (0.031)	-0.001 (0.033)	0.038 (0.039)	0.037* (0.022)	0.056** (0.027)	0.050 (0.036)
Characteristics Effect	0.001 (0.019)	0.029 (0.019)	0.039 (0.027)	0.004 (0.012)	0.011 (0.012)	0.047** (0.023)
Coefficient Effect	0.128*** (0.034)	-0.030 (0.029)	-0.001 (0.034)	0.034 (0.023)	0.045* (0.025)	0.003 (0.031)

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 3: Direct vs. indirect higher sec. degrees



ciated with early tracking at age 10. Table 6 compares regressions (using the full population) of whether a person achieved the higher secondary degree as her first degree, or whether she received the degree “indirectly”, after upgrading from middle secondary school. To save space, we only show these regressions for the 1977-86 cohort, but the patterns are very similar for the other cohorts. The coefficients of parental education and occupation are generally smaller in magnitude in the regressions for indirect degrees. This implies that the group of indirect higher secondary graduates is more homogeneous in terms of parental background than the group of direct graduates. Nevertheless, the *cumulative* chance of obtaining a higher secondary degree – either indirectly or directly – still differs strongly by parental background, simply because the gaps in terms of direct graduation are so large. This suggests that “second chance” school degrees overall have little effect on intergenerational educational mobility.

Table 6: Upgrading and intergenerational mobility (1977-86 birth cohort)

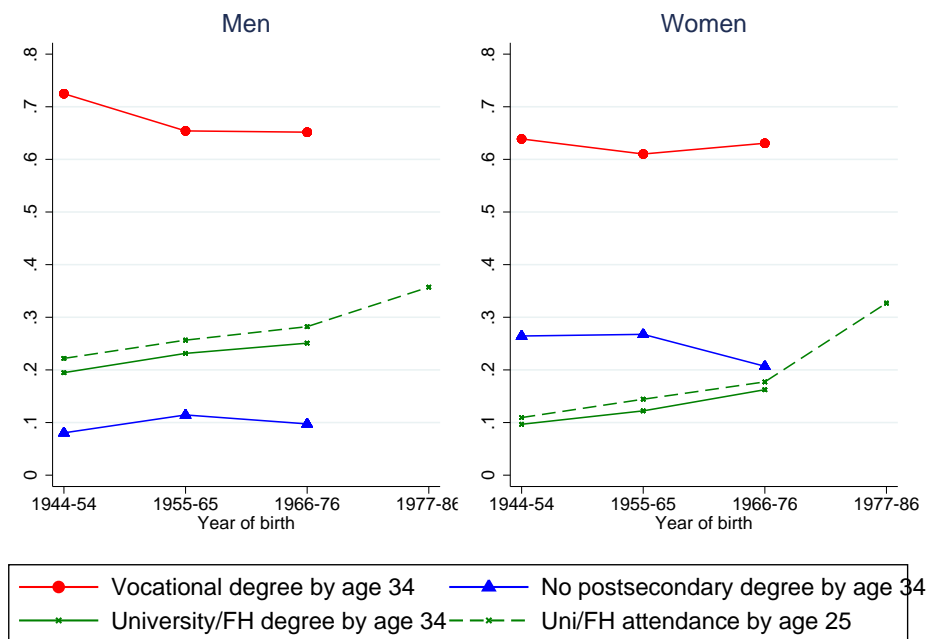
	Men		Women	
	Direct Higher sec.	Indirect Higher sec.	Direct Higher sec.	Indirect Higher sec.
Parents lower sec.	Ref.			
Parents middle/ higher sec.	0.141*** (0.034)	0.038 (0.038)	0.193*** (0.041)	0.022 (0.038)
Parents university	0.434*** (0.051)	-0.069 (0.048)	0.422*** (0.053)	-0.021 (0.038)
Parents low occupation	Ref.			
Parents middle occupation	0.101*** (0.037)	-0.056 (0.067)	-0.014 (0.048)	0.020 (0.067)
Parents high occupation	0.196*** (0.045)	-0.069 (0.069)	0.190*** (0.056)	-0.102 (0.066)
Migration background	0.016 (0.040)	0.028 (0.045)	-0.094** (0.047)	-0.035 (0.041)
No. of siblings	-0.028** (0.013)	0.018 (0.016)	-0.026* (0.014)	-0.000 (0.015)
Grew up with both parents	0.119*** (0.041)	-0.062 (0.052)	0.008 (0.049)	-0.028 (0.048)
Constant	0.297*** (0.015)	0.209*** (0.015)	0.350*** (0.016)	0.185*** (0.015)
N	883	883	832	832

The variable “direct higher sec.” is equal to one if the person obtained the higher secondary degree as her first school degree. The variable “indirect higher sec.” is equal to one if a person obtained a higher secondary degree after upgrading. The table reports coefficients from Linear Probability Models. Further controls include federal state dummies and dummies for missing covariates. Heteroscedasticity-robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

3.3 Postsecondary education

We now analyze trends in postsecondary education. Figure 4 shows that the share of tertiary graduates (from universities and universities of applied sciences, FH) increases slightly for both genders, by about 6 ppts. for men, and by 8 ppts. for women. But in Figure 3 we saw that the share of higher secondary graduates during this period increased by 24 ppts. for men, and by 35 ppts. for women. This means there is a large and growing number of higher secondary graduates that do not continue with tertiary education and instead opt for vocational training.¹⁸ Indeed, the share of individuals completing vocational education is between 60-70 % in all cohorts. It is only in the most recent cohorts – those born in the late 1970s and 1980s – that participation in tertiary education increases considerably (measured by whether a person has attended a university or FH by age 24). Again, the strong increase for women is noteworthy.

Figure 4: Postsecondary attainment



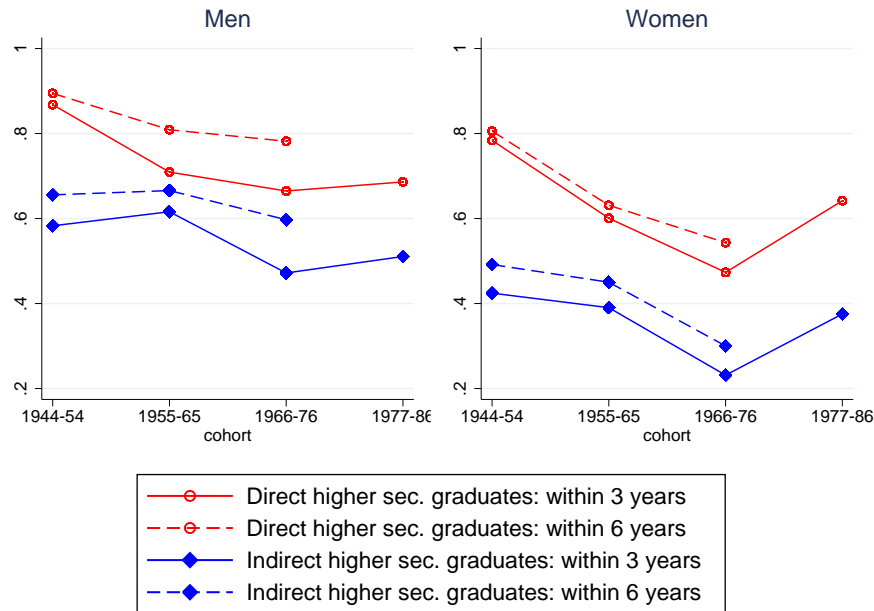
In the following, we focus more closely on the group of students that obtained a higher secondary degree. Figure 5 displays the share of higher secondary graduates that have attended tertiary education within 3 years or 6 years after school.¹⁹ In light of the analyses in

¹⁸The graph also shows that the slow increase of tertiary graduation is driven by tertiary attendance, and not by rising dropout rates from tertiary education.

¹⁹In the cohorts we consider, young men had to complete military or alternative community service after school, which, depending on the school leaving cohort, lasted between 9 and 20 months. Thus, it would make little sense to consider a narrower time window than 3 years.

the previous subsection, we also distinguish between those who obtained the higher secondary degree on the “direct” path (as their first school degree) and those who obtained the degree after upgrading from middle secondary school.

Figure 5: Tertiary attendance after higher sec. graduation



The following stylized facts emerge. First, in all cohorts, the upgraders are less likely to attend tertiary education. We will explore this finding in greater detail below. Second, in all cohorts there is a number of higher secondary graduates – especially males – that only take up university education relatively late after leaving school (between 3 to 6 years). It can be shown in further analyses that most of these “late” students have first completed vocational training before entering university. This demonstrates the need for observing higher secondary students over longer periods after graduation if one wants to get a complete picture of their postsecondary attainment. Third, tertiary attendance rates of higher secondary graduates changed considerably across cohorts. The rates have decreased continuously for both genders from the 1944-54 to the 1966-76 cohorts. However, from the 1966-76 to the 1977-86 cohorts, attendance rates for women increased again strongly, and the gender gap almost closes. We have conducted decompositions similar to the ones in the previous sections (results not shown here) and find that changes in the demographic characteristics of higher secondary graduates can’t explain these large fluctuations – in fact, the characteristics effect would predict a steady increase in university graduation. Another possible explanation for the decrease over time is

that the pool of higher secondary graduates has become more negatively selected over time. However, women in younger cohorts seem to be an exception for this pattern.

Multivariate results on the determinants of tertiary attendance are shown in Table 8. The outcome variable is attendance at a university or university of applied sciences within 3 years after leaving higher secondary school, since this is the only outcome that can be compared across all four cohorts. We find that, also controlling for background characteristics, upgraders are significantly less likely to start tertiary education than direct higher secondary graduates. The effect sizes are remarkable: around 30 ppts. in the oldest cohort, and 10-20 ppts. in the other three cohorts. Below, we will discuss these differences further.

Table 8 also shows that, as expected, the final mark of the higher secondary degree is a significant predictor of tertiary attainment. The effect of the final school mark also becomes stronger across cohorts, in particular for females.²⁰ This is consistent with the idea that the expansion of higher secondary graduation has created a more heterogeneous group of graduates, and cognitive ability relative to one's peers becomes increasingly important for the decision whether to continue with academic education.

Next, we investigate the role of parental background, conditional on the type of school and final mark of the degree. Higher secondary graduates from university-educated parents are more likely to attend tertiary education than their peers from less educated parents, and these differences are significant in all subgroups (except for females in the youngest cohort). Remarkably, these differences persist after controlling for final school marks as a proxy for cognitive ability. Monetary costs of academic education, which are extensively discussed in the US literature (Cameron and Heckman 2002, Belley and Lochner 2009), are unlikely as an explanation since universities were public and free of tuition for the cohorts considered here. Moreover, the fact that we typically don't find significant effects of parental occupation (which can be seen as a proxy for parental income) also speaks against monetary costs as an explanation. However, academic education is associated with opportunity costs compared to vocational education as the student has to forgo earnings she would earn as an apprentice, and the duration of education is also longer.²¹ Mayer et al. (2007) argue that for children from

²⁰Marks are normalized with mean zero and standard deviation one within each cohort, school type and state. This takes into account that grading standards may differ over time and across states. That is, the coefficient estimates give the effect of one standard deviation improvement in school marks relative to one's peers.

²¹Regularly, vocational training lasts for about 2-3 years, while university studies last for at least 4 years. In some occupations, higher secondary graduates are also able to complete vocational training in shorter time than lower or middle secondary graduates, which increases opportunity costs of academic education even further.

Table 8: Determinants of tertiary attendance within 3 years after higher sec. graduation

	Men				Women			
	1944-54	1955-65	1966-76	1977-86	1944-54	1955-65	1966-76	1977-86
Indirect higher sec.	-0.309*** (0.080)	-0.117*** (0.043)	-0.144*** (0.055)	-0.151*** (0.057)	-0.346*** (0.089)	-0.192*** (0.055)	-0.193*** (0.051)	-0.200*** (0.062)
Final school mark	0.051** (0.023)	0.066*** (0.016)	0.084*** (0.025)	0.059** (0.025)	0.047 (0.037)	0.075*** (0.024)	0.111*** (0.024)	0.109*** (0.025)
Parents middle/ higher sec.	0.034 (0.055)	0.027 (0.046)	0.053 (0.064)	-0.030 (0.073)	0.105 (0.083)	0.065 (0.057)	0.005 (0.056)	-0.014 (0.075)
Parents university	0.034 (0.065)	0.101** (0.049)	0.213*** (0.070)	0.171** (0.080)	0.099 (0.092)	0.154** (0.067)	0.318*** (0.067)	0.092 (0.080)
Parents middle occupation	0.086 (0.111)	-0.001 (0.069)	0.021 (0.124)	0.139 (0.133)	0.076 (0.157)	-0.032 (0.084)	-0.103 (0.103)	-0.079 (0.132)
Parents high occupation	0.071 (0.106)	0.006 (0.069)	0.029 (0.126)	0.208 (0.134)	0.088 (0.151)	0.031 (0.089)	-0.074 (0.103)	0.029 (0.132)
Migration background	0.112 (0.084)	-0.098 (0.076)	0.107 (0.099)	0.102 (0.078)	-0.055 (0.145)	0.150** (0.069)	-0.041 (0.082)	0.074 (0.077)
No. of siblings	0.024* (0.013)	-0.007 (0.014)	0.005 (0.025)	-0.014 (0.029)	0.011 (0.019)	0.006 (0.018)	0.002 (0.020)	-0.026 (0.025)
Grew up with both parents	-0.016 (0.070)	0.017 (0.096)	-0.011 (0.085)	-0.091 (0.088)	-0.021 (0.115)	-0.002 (0.093)	0.001 (0.102)	0.000 (0.077)
Constant	0.892*** (0.024)	0.756*** (0.021)	0.660*** (0.029)	0.682*** (0.032)	0.847*** (0.036)	0.652*** (0.025)	0.478*** (0.028)	0.606*** (0.032)
N	264	715	517	466	209	684	590	446

Note: The table reports coefficients from Linear Probability Models. Further controls include federal state dummies and dummies for missing covariates. Heteroscedasticity-robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

less-educated families, the vocational system acts as a safety net in the sense that it allows them to achieve qualified postsecondary degrees with good prospects in the labour market. Peter and Zambre (2014) also discuss the role of informational differences, i.e. higher secondary graduates from less educated families might have less access to information about returns to university education, possible study options or scholarships.

Next, Table 9 shows (for the 1977-86 cohort) a number of further specifications to better understand the differences in tertiary attendance between direct and indirect higher secondary graduates. Panel A shows raw gaps between the two groups, while Panel B shows the gaps when controlling for differences in social background characteristics such as parental education (the coefficients in Panel B of Table 9 correspond to those in Table 8). These observable differences explain 4.6 ppts. of the 19.9 ppts. gap among men, and 9.6 of the 30.2 ppts. gap among women. Once background variables are controlled for, the gaps are of similar magnitude for both genders. In Panel C, we explicitly distinguish between those upgraders that obtained the higher secondary degree after 12th grade (with *Fachhochschulreife*, *FHR*) and those obtaining the degree after 13th grade (with *Abitur*).²² *FHR* upgraders typically show the lowest participation in tertiary education, but there are also negative effects for upgraders with *Abitur*. This shows that the differences are not simply due to the upgraders' shorter average duration of schooling. In Panel D, we distinguish further between "early" upgraders (who have obtained the higher secondary degree within 4 years after middle secondary school), and "late" upgraders (who have obtained it after 5-8 years). It is plausible that many of those pupils that upgrade directly after school do so to improve their chances on the apprenticeship market, and do not intend to obtain tertiary education anyway. In contrast, "late" upgraders, who for a large part have already completed vocational training before returning to school, may upgrade with the clear intention in mind to attend tertiary education. This indeed seems to hold for men, where there is no negative effect for late upgraders. However, early and late upgraders show relatively similar coefficients for women. Next, while the previous analyses only considered as outcome variable whether a person has attended any tertiary institution – university or university of applied sciences (FH) –, Panel E considers university attendance only.²³ Focusing on university attendance increases the gap between direct and indirect graduates considerably, especially for men. This is because many male upgraders attend FHs (which offer mainly

²²The reference category in all regressions in Tables 8 and 9 are direct higher secondary graduates with *Abitur*. Direct graduates with *FHR* are dropped, since the sample sizes are extremely small.

²³University studies are more theoretically oriented than FH studies and involve a longer duration.

Table 9: Differences in postsecondary education between indirect and direct higher sec. graduates (1977-86 birth cohort)

	Men	Women
Dependent variable in Panels A-D: University or FH attendance within 3 years after school		
<u>A. Raw gap</u>		
Indirect higher sec.	-0.199*** (0.057)	-0.302*** (0.061)
<u>B. With controls</u>		
Indirect higher sec.	-0.154*** (0.057)	-0.206*** (0.062)
<u>C. Abitur vs. FHR upgraders</u>		
Indirect higher sec. (Abitur)	-0.147** (0.070)	-0.125 (0.080)
Indirect higher sec. (FHR)	-0.163** (0.079)	-0.327*** (0.082)
<u>D. Early vs. late upgraders</u>		
Early Abitur upgrader	-0.186** (0.074)	-0.096 (0.080)
Late Abitur upgrader	0.009 (0.182)	-0.224 (0.212)
Early FHR upgrader	-0.259*** (0.096)	-0.319*** (0.096)
Late FHR upgrader	-0.059 (0.120)	-0.348** (0.136)
<u>E. Outcome: University attendance</u>		
Indirect higher sec. (Abitur)	-0.375*** (0.062)	-0.165** (0.077)
Indirect higher sec. (FHR)	-0.553*** (0.043)	-0.443*** (0.057)
<u>F. Outcome: Vocational attendance</u>		
Indirect higher sec. (Abitur)	0.283*** (0.074)	0.103** (0.051)
Indirect higher sec. (FHR)	0.495*** (0.067)	0.363*** (0.082)
N	466	446

Note: The entries in each line give the coefficient of having a indirect vs. direct higher secondary degree in separate regressions by gender. Panel A reports unconditional differences between the two groups, while Panels B to F control for the full set of background characteristics shown in Table 8.

degrees in commercial or technical subjects), while FHs are generally less common among women. Finally, Panel F shows that upgraders are more likely to attend vocational education than direct graduates.

An open question of the previous analyses is how much of the upgraders' lower participation

in tertiary education is causal. A causal effect could arise e.g. due to differences in curricula between vocational and traditional higher secondary schools. Vocational higher secondary schools put greater emphasis on vocational knowledge (e.g. in business or technical subjects) which better prepares pupils for vocational training than for studies at universities. Other possible channels are differences between schools in financial resources or teacher quality. However, self-selection of students based on unobserved ability or preferences for academic education likely plays an important role as well. It is plausible that many of the upgraders obtained a higher secondary degree to increase their chances on the apprenticeship market, and did never intend to go to university in the first place. It would certainly be interesting for future research to test between these different theories. This would require more information on pupils' abilities, and their motives for upgrading, both of which are not available in the present data.

4 Cohort trends in returns to education

This section analyzes how the different educational pathways described above are associated with employment and earnings. Ideally, we would like to estimate total returns over the lifecycle. Since complete earnings histories are not available for most of our sample, we choose a more pragmatic solution and measure the labour market outcomes between ages 30 and 35, allowing us to capture individuals from different cohorts at a similar stage of their life-cycle. We chose this age restriction since the existing literature has found that including observations from younger ages would lead to substantial life-cycle bias, i.e. an underestimation of wage returns for highly educated individuals who have particularly steep earnings profiles in the first years of their career.²⁴ This age restriction means that we can't estimate labour market returns for the youngest cohort group (those born 1977-86), many of whom are not yet in the labour market or only for a short time. As mentioned in Section 2, we also exclude the oldest 1944-54 cohorts, because they had extremely low match rates in the administrative data.

We generate a person \times age panel at ages 30-35. For the employment regressions, the dependent variable is one if a person was employed at least once in a given year, and zero else. This information is taken from the NEPS survey data which include self-reported activities for

²⁴For Germany, Bönke et al. (2015) find that the correlation between annual earnings and lifetime earnings is highest between the late 30s and mid 50s, with a rank correlation coefficient of 0.9. However, a fairly high correlation of 0.8 is already reached in the early 30s, while it is substantially smaller before age 30. Haider and Solon (2006) for the US, as well as Bhuller et al. (2011) for Norway also find substantial life-cycle bias when earnings are measured before age 30. The latter paper actually recommends 33 as the optimal age for measuring returns to education.

the complete life-course on a monthly basis. Thus, we are able to estimate the employment equations for all individuals in the target sample. For the earnings regressions, the dependent variable is yearly labour earnings, including also zeros for non-working individuals. The earnings information is drawn from the IEB social security records since the survey data do not include this information. This measure of earnings is of high accuracy due to the administrative nature of the data.²⁵ However, the drawback is that, as discussed in Section 2, persons who refused consent to the linkage, or those who worked as civil servants or self-employed, are not included. Among the group of matched individuals, a further issue is how to deal with years in which no earnings are reported for an individual, either because she did not work in that year, or because she worked in other types of employment not covered in the IEB data. For this, we can use the information from the NEPS survey data which show self-reported yearly activities for each person. We impute zero earnings for years in which the individual reported being unemployed or out of the labour force. We drop years in which the person was still in education, as well as years in which the individual reported any other types of employment not covered in the IEB data (as a self-employed or civil servant). Based on this procedure, we are left with 4427 (=66 %) of the 6658 target individuals with at least one non-missing earnings observation at ages 30 to 35. This constitutes the estimation sample for the earnings regressions.

In the following, we compare two different specifications for the educational career of a person. The first one only controls for the six schooling groups, “Lower sec.”, “Lower sec.+Middle sec.”, the reference category “Middle sec.”, “Middle sec.+Higher sec. (FHR)”, “Middle sec. + Higher sec. (Abitur)”, and “Higher sec. (Abitur)”. In these regressions, one part of the estimated coefficients reflect the direct return to the school degree itself, and the other part reflects indirect returns, because the different schooling degrees lead to different types of postsecondary education. This indirect component likely constitutes an important part of the return to the higher secondary degree, because this degree opens the way to tertiary education. To filter out these indirect effects from the direct effects of the school degrees, we estimate a second specification in which we additionally control for 4 groups of postsecondary attainment: no postsecondary degree, vocational degree, degree from a university of applied science (“FH”) and university degree (“Uni”). All specifications also control for age and age squared, calendar year dummies, and the socio-demographic characteristics used in the educational choice

²⁵The IEB data provide daily wages for each spell of employment covered by social security. Since daily wages are right-censored at the threshold of social security contributions, we impute censored wages using the procedure described in Gartner (2005). We then calculate yearly earnings and also convert all values to 2010 Euros.

equations in Section 3. The regressions are estimated separately for men and women. Interpreting the coefficients for the different school and postsecondary dummies causally requires a selection-on-observables assumption, i.e. that the education dummies are uncorrelated with the error term u_i , conditional on the large set of socio-demographic characteristics we control for.²⁶

Table 10 shows the employment equations. For men, employment differentials between education groups are small, reflecting their generally high labour force attachment. But it is visible that differentials increase at the bottom of the schooling distribution (between lower and middle secondary graduates). For women, employment differentials increase both at the bottom and at the top (between middle and higher secondary graduates). In the 1966-76 cohort, women have also sizable employment returns for tertiary education in the order of 10.8 ppts. for FH degrees and 16.6 ppts. for university degrees, respectively.

Table 11 shows the results from the earnings equations. For both genders, annual earnings differentials between lower and middle secondary graduates increase across cohorts, in line with the previous results from the employment equations. The size of the effects in the 1966-76 cohort – about -9000 € for men, and -3300 € for women – are remarkable given that the two groups are only separated by one year of schooling. There seem to be no statistically significant differences between “Low+Middle” upgraders and direct “Middle” graduates. When comparing the different types of higher secondary degrees, we find that for both genders, “Middle + Higher sec.” upgraders who completed only FHR (after 12 years) have lower earnings premia than those who completed *Abitur* after 13 years. Among men, indirect *Abitur* graduates earn less than direct *Abitur* graduates, but there are less differences for women.

It also emerges that a large part of the return to a higher secondary degree arises because it opens the way to academic tertiary education. This indirect component is especially important for men. For example, consider men in the 1966-76 cohort. Returns to “Higher sec. (*Abitur*)” decrease from 6877 € to 2094 € (or by 70 %) after postsecondary education is controlled for. This means that male higher secondary graduates who do not continue with tertiary education have little payoff from their degrees (relative to a middle secondary degree). For men, the returns to all types of higher secondary degrees (relative to a middle secondary degree) also decrease across cohorts. The picture is different for women: their returns to higher secondary

²⁶An instrumental variable strategy is not feasible in our setting since strong and valid instruments for each of the different educational paths are not available. Fixed effects models are complicated by the fact that there is little within-person variation in education.

Table 1: Employment Equations at age 30-35 – by birth cohort

	Men				Women			
	1955-65		1966-76		1955-65		1966-76	
<i>Secondary school degrees</i>								
Lower sec.	-0.000 (0.010)	-0.000 (0.010)	-0.048** (0.018)	-0.045** (0.018)	-0.093** (0.031)	-0.091** (0.031)	-0.111*** (0.042)	-0.106*** (0.042)
Lower sec. + Middle sec.	0.019 (0.012)	0.021 (0.019)	-0.023 (0.028)	-0.018 (0.027)	0.011 (0.042)	0.013 (0.042)	0.002 (0.065)	0.004 (0.064)
Middle sec.	Ref.							
Middle sec. + Higher sec. (FHR)	0.005 (0.015)	-0.001 (0.018)	-0.007 (0.018)	-0.004 (0.016)	0.008 (0.058)	-0.011 (0.061)	0.048 (0.051)	0.020 (0.052)
Middle sec. + Higher sec. (Abitur)	-0.019 (0.016)	-0.014 (0.016)	-0.021 (0.025)	-0.013 (0.024)	0.051 (0.028)	0.034 (0.047)	0.150*** (0.042)	0.122** (0.043)
Higher sec. (Abitur)	-0.022* (0.013)	-0.012 (0.019)	-0.006 (0.014)	0.005 (0.020)	0.044 (0.031)	0.023 (0.037)	0.086*** (0.032)	0.061* (0.048)
<i>Postsecondary degrees</i>								
No postsecondary		-0.028 (0.023)		-0.036 (0.037)		-0.030 (0.034)		-0.069 (0.043)
Vocational		Ref.						
FH		0.016 (0.014)		-0.005 (0.023)		0.073 (0.045)		0.108*** (0.045)
Uni		-0.019 (0.019)		-0.017 (0.020)		0.020 (0.039)		0.166*** (0.037)
N	1831	1831	1206	1206	2009	2009	1350	1350
N × T	10333	10333	6581	6581	11679	11679	7746	7746

Note: Estimations are based on a person × year panel at ages 30 to 35. The dependent variable is 1 if a person was ever employed in a given year. Standard errors are clustered at the individual level. Further controls include: year dummies, age, age squared, migration background, parental education, parental occupation, number of siblings, grew up with single parent, state dummies, dummies for missing covariates.

Table 2: Earnings Equations at age 30-35 – by birth cohort

	Men				Women				
	1955-65		1966-76		1955-65		1966-76		
<i>Secondary school degrees</i>									
Lower sec.	-3372*** (1189)	-2911** (1174)	-9039*** (1693)	-8972*** (1710)	-2364* (1044)	-2228* (1042)	-3384*** (1571)	-3286*** (1581)	
Lower sec. + Middle sec.	69 (1694)	644 (1673)	-4741 (3701)	-4620 (3631)	1424 (1545)	1472 (1543)	-183 (2477)	-70 (2437)	
Middle sec.	Ref.								
Middle sec. + Higher sec. (FHR)	4340** (1997)	3288 (2156)	1204 (2491)	-2718 (2585)	4003* (2796)	4035* (3044)	3168 (2503)	1457 (2403)	
Middle sec. + Higher sec. (Abitur)	4420** (2225)	2845 (2352)	1876 (3402)	-1602 (3452)	6164*** (2065)	4081** (2182)	7430*** (2198)	6511*** (2269)	
Higher sec. (Abitur)	7787*** (1869)	5126** (2375)	6877*** (2192)	2094 (2362)	6049*** (1480)	3738*** (1542)	8405*** (1974)	6816*** (2179)	
<i>Postsecondary degrees</i>									
No postsecondary		-5459* (1807)		1994 (4084)		-2404** (1008)		-2349 (1641)	
Vocational		Ref.							
FH		5691*** (2100)		8414*** (2479)		3529 (2731)		8701*** (3244)	
Uni		3035 (2489)		7638*** (2821)		2319 (2243)		5562** (2781)	
Adjusted R^2	0.135	0.151	0.156	0.168	0.070	0.075	0.117	0.129	
N	1831	1831	1206	1206	2009	2009	1350	1350	
N × T	10333	10333	6581	6581	11679	11679	7746	7746	

Note: Estimations are based on a person × year panel at ages 30 to 35. The dependent variable is yearly earnings, converted to 2010 Euros. Standard errors are clustered at the individual level. Further controls include: year dummies, age, age squared, migration background, parental education, parental occupation, number of siblings, grew up with single parent, state dummies, dummies for missing covariates.

graduation decrease much less when controlling for postsecondary education, implying that the degree pays off also to those women that do not continue with tertiary education.²⁷ For both genders, earnings differentials between tertiary (both “University” and “FH”) and vocational graduates increase across cohorts: for example, the return of university education increases from 3035 € to 7638 € for men, and from 2319 € to 5562 € for women.²⁸

5 Conclusion

This paper has described some of the complex pathways young individuals take through the German education system, and how they have changed for West German birth cohorts from 1944 to 1986. Our main results can be summarized as follows. *First*, there is a strong expansion of secondary school degrees. For the cohorts born in the 1960s and later, a large part of this can be explained by changing socio-demographic characteristics, in particular the rising education of the parental generation and a decrease in family size. A possible interpretation is that, after the initial takeoff triggered by educational reforms after Second World War, educational expansion had to some extent become a self-reinforcing process. *Second*, the paper has stressed the role of mobility between secondary school tracks. A sizable share of pupils that had a lower or middle secondary degree as their first degree upgrade to the next school degree, and this share has also increased considerably for younger cohorts. This suggests the German education system provides “second chances” to revise decisions made after early tracking at age 10. On the other hand, these upgraders have different postsecondary and labour market outcomes than those who have reached the school degree on the direct path. Those that reached a higher secondary degree after upgrading are less likely to attend academic tertiary education and are more likely to choose vocational education. They also seem to have lower wage premia than those who reached the higher secondary degree directly (although the evidence for this is more mixed). It is still an open question how much of these differences are causal, but our findings demonstrate that an educational policy that focuses only on expansion of school degrees is not sufficient for guaranteeing success in the labour market. *Third*, we have shown how education differences by gender and parental background have developed over time. In all cohorts, women are much less represented at the bottom of the education distribution (in lower secondary school) than men.

²⁷The differentials between the “Low” or “Low+Middle” groups relative to the “Middle” group do not change much between the specifications, since most pupils from these three groups complete vocational degrees.

²⁸Contrary to the existing German literature (see e.g. Schmillen and Stüber 2010), we also find that returns to universities of applied sciences (FH) are typically higher than returns to university.

Females have also caught up to men in terms of reaching higher secondary degrees. Educational differences in school degrees between parental background groups are large in all cohorts, and we don't find evidence that these gaps have become smaller across cohorts. The option for obtaining "second-chance" school degrees also has little effect on intergenerational mobility. Higher secondary graduates from non-academic parents are also less likely to attend academic tertiary education, even after controlling for school grades. For these students, vocational training seems to be an attractive alternative. Future research might help to better understand the origins of these gaps, and whether policy interventions, such as educational counseling of higher secondary graduates from disadvantaged family backgrounds, can increase attendance rates for this group. *Fourth*, the paper has estimated how the different educational paths are associated with labour market outcomes at ages 30 to 35. Both employment and earnings differentials have increased at the bottom of the education distribution, i.e. between lower and middle secondary graduates. Earnings returns to tertiary relative to vocational education have increased as well.

There are a number of questions for further research. We only considered selection into educational degrees based on observable socio-demographic characteristics such as parental background, but it is possible that selection on unobservables changed as well across cohorts. For example, it remains an open question how much of the worse performance of lower secondary graduates in the labour market in younger cohorts arises because this group has become a more negative selection over time, and how much because labour demand has shifted away from less-skilled workers induced by, for example, skill-biased technological change or globalization. Distinguishing these selection effects from demand-side effects was beyond the scope of this paper (see Carneiro and Lee 2011 or Juhn et al. 2005).

Moreover, for the youngest individuals in our sample – those born up to the mid-1980s –, we could not yet observe complete educational biographies or a sufficiently long time in the labour market. An obvious question is how their labour market entry, as well as that of even younger cohorts, will develop. The literature documents considerable problems among today's low-qualified school leavers in entering vocational training and the labour market (see e.g. Fitzenberger and Lickleder 2015, Solga and Kohlrausch 2013, Autorengruppe Bildungsberichterstattung 2012). In light of ongoing technical change and globalization, it is likely that the considerably lower employment rates and earnings of lower secondary graduates that we documented in our analysis will continue in the future. At the upper end of the education spectrum, our results showed an increase of the returns to tertiary education for cohorts born

until the mid-1970s. However, given that tertiary attendance rates have increased considerably for later cohorts, it remains an open question as to whether this will decrease the returns to these qualifications in the future.

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Appendix A: The German Education System

In Germany, schools and universities are administered at the state (*Bundesland*) level, and the systems differ across states and over time. We thus can only give a brief overview. For more detailed expositions, see KMK (2008).

Compulsory schooling lasts 9 years in all West German states since 1969. At age 10, after 4 years of primary school, children are tracked based on their school performance. The three main tracks are lower secondary school (*Hauptschule*), which lasts 5 years, middle secondary school (*Realschule*), which lasts 6 years, and higher secondary school (*Gymnasium*), which lasts 9 years.^{29,30} While lower and middle secondary schools typically prepare students for vocational education, higher secondary school opens the way to tertiary education at universities and universities of applied sciences. However, higher secondary graduates can also enter vocational training. Although students are tracked after primary school (i.e., at the age of 10 or 12), mobility between the secondary school tracks is possible. After obtaining a lower or middle secondary degree, pupils who have reached a minimum grade can switch to a higher track. To this end, there also exist various forms of vocationally-oriented secondary schools – such as *Berufliches Gymnasium*, *Technisches Gymnasium*, or *Fachoberschulen*. These are frequented mostly by students who come from a lower track. Some of these schools also are directed to individuals who have already completed vocational training. Moreover, there exist evening middle or higher secondary schools which can be attended parallel to full-time work. See BA (2007) for a detailed exposition of “second chance” schooling in the different federal states.

The vocational training system in Germany consists of two main sectors: firm-based apprenticeship training and full-time vocational schools. In *apprenticeships*, young individuals attend vocational schools during part of the week, and obtain within-firm training during the rest of the week, which is why this type of training is also called “dual” vocational education. The apprenticeship market in principle works like the regular job market: school leavers apply for training positions and firms decide on which applicants they hire. Training is certified through a contract between the apprentice and the training firm. Apprenticeships typically last

²⁹In the state of West Berlin, tracking takes place only after 6 years of primary school. In the state of Niedersachsen, the 5th and 6th grade are “orientation grades”, after which students are tracked.

³⁰Beside those three main tracks, there also exist comprehensive schools (*Gesamtschulen*) or reform-pedagogic Waldorf schools. These schools offer all three school types “under one roof”, but track students internally. In our analysis, graduates from these schools are classified according to the last degrees they obtained in their schooling history. Moreover, there are special-needs schools (*Sonderschulen*), which are not considered in our analysis.

between 3 and 3.5 years, depending on the chosen occupation. The length and curricula of the different training occupations are regulated by federal law (*Berufsbildungsgesetz*). Besides the apprenticeship system, there also exist *full-time vocational schools* (*Berufsfachschulen, Schule des Gesundheitswesens*), which contain no within-firm training component. Full-time vocational schools offer only a limited number of occupations, typically in health and social services or assistant positions. Most require at least a middle secondary degree.

Finally, tertiary education takes place at universities of applied sciences (*Fachhochschulen, FH*) and universities. The former are more practically oriented and offer mainly degrees in business, natural sciences or technical studies. Entry into tertiary education typically requires a higher secondary degree.

Appendix B: Sample selection

Table B1: Sample selection criteria

<i>NEPS sample</i>	
All respondents	17140
Only those born and raised in West Germany	11266
Only those with completed school degree by age 24	10908
Only those with plausible education biographies*	10650
<i>NEPS sample: Birth cohorts 1944-1986</i>	10650
<i>NEPS target sample for estimating labour market returns: Birth cohorts 1955-1976</i>	
	6658
<i>Linkage NEPS-ADIAB data</i>	
Persons in the NEPS target sample	6658 (=100 %)
Consented to linkage	6253 (=94 %)
Found at least once in the administrative data	4926 (=74 %)

* Persons are dropped who claimed they have obtained a lower secondary degree before age 13, a middle secondary degree before age 14, a higher secondary degree before age 16, a vocational degree before age 15, and a university degree before age 20. Those who reported “downgrading” in their history of school degrees, e.g. first a higher secondary and then a middle secondary degree, are also dropped.

For classification of a person’s “first” school degree, we also perform the following adjustments to the data. The first concerns pupils in comprehensive schools (*Gesamtschulen*), which offer all three types of degree and only track students internally. These pupils can obtain e.g. a middle secondary degree after grade 10, and then go on to the higher secondary degree without actually switching the school. For them, the first degree is defined as the last degree they obtained in their schooling history. That is, these persons are not counted as upgraders. The same holds for persons who left higher secondary school after 10th grade with a middle secondary degree, but returned to school and obtained the higher sec. degree within 5 years later.

Table B2: Selectivity of the matched NEPS-ADIAB sample

The table shows coefficients from Linear Probability Models estimated for the individuals in the NEPS target sample, birth cohorts 1955-76 (N=6658, see Table B1). The dependent variables are whether a person in the target sample accepted the linkage (column 1), and whether a person in the target sample was found at least once in the administrative data (column 2).

Dependent variable:	Person accepted linkage	Person was matched
<i>Birth cohort (Ref: 1955-65)</i>		
1966-76	-0.032** (0.009)	0.041** (0.012)
<i>Secondary school degrees (Ref: Middle sec.)</i>		
Lower sec.	0.003 (0.004)	-0.004 (0.010)
Lower sec. + Middle sec.	0.010 (0.013)	0.005 (0.024)
Middle sec. + Higher sec. (FHR)	-0.012 (0.014)	0.003 (0.024)
Middle sec. + Higher sec. (Abitur)	0.004 (0.012)	0.010 (0.024)
Higher sec. (Abitur)	-0.003 (0.009)	-0.013 (0.019)
<i>Postsecondary degrees (Ref: Vocational degree)</i>		
No postsecondary	-0.012 (0.010)	-0.023 (0.018)
FH	-0.019 (0.016)	-0.045* (0.022)
Uni	-0.004 (0.014)	-0.033 (0.023)
<i>Occupational status at age 30 (Ref: Dependent employee)</i>		
Civil servant	0.018 (0.014)	-0.555*** (0.023)
Self-employed	0.005 (0.018)	-0.231*** (0.024)
Unemployed/ OLF	-0.022 (0.020)	-0.115*** (0.034)
Education	-0.021 (0.033)	-0.069 (0.049)
Other/ Missing	0.033 (0.027)	-0.020 (0.068)

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Social background characteristics

Female	-0.002 (0.005)	0.004 (0.012)
Migration background	-0.003 (0.013)	-0.010 (0.020)
Migration background missing	-0.097* (0.043)	-0.064 (0.043)
Number of siblings	-0.001 (0.005)	0.002 (0.006)
Number of siblings missing	-0.015 (0.014)	-0.248*** (0.023)
Grew up with both parents	0.007 (0.013)	0.020 (0.019)
Parents middle sec.	0.002 (0.009)	-0.015 (0.015)
Parents higher sec.	0.007 (0.014)	-0.015 (0.025)
Parents university	-0.000 (0.012)	0.001 (0.020)
Parental education missing	-0.044* (0.021)	-0.032 (0.030)
Parents middle occupation	-0.002 (0.011)	-0.010 (0.016)
Parents high occupation	-0.003 (0.013)	-0.033 (0.021)
Parental occupation missing	-0.000 (0.010)	-0.004 (0.018)
Constant	0.911*** (0.019)	0.879*** (0.029)
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N	6658	6658