Intergenerational transmission of educational attainment in Germany – the last five decades

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23. October 2008

Abstract

Over the last decades the German education system underwent numerous reforms in order to improve "equality of opportunity", i.e. to guarantee all pupils independent of parental background equal access to higher education. At the same time internationally comparative evidence yields that Germany features particularly low intergenerational mobility with respect to educational attainment. This study investigates the development in intergenerational education mobility in Germany for the birth cohorts 1929 through 1978 with respect to secondary school attainment. We test whether the impact of parental educational background on child educational outcomes changed over time. In spite of massive public policy interventions and education reforms our results yield no significant reduction in the role of parental educational background for child outcomes over the last decades.

Keywords: education transmission, intergenerational mobility, schooling, human capital transmission

JEL Code: I21, I28, J11

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We gratefully acknowledge helpful comments from seminar participants at the Universities of Dresden and Maastricht, the RWI Essen, and the Max Planck Institute Rostock as well as the social policy group of the Verein für Socialpolitik. We also thank two anonymous referees and the editor. All remaining errors are ours.

1. Introduction

In most industrialized countries public and private education expenditures increased vastly over the last fifty years. Yet, it is not clear who benefited from this development: studies for the United Kingdom show that the expansion of higher education did not reduce the educational attainment gap between children of rich and poor parents (Blanden and Machin 2004, Blanden et al. 2005). Similarly, Cameron and Heckman (1998) conclude from U.S. data that government programs to reduce short term liquidity constraints will not affect schooling choices. Examining the evidence from 20 countries Chevalier et al. (2003, p.20) conclude that "the expansion of access to higher education has been concomitant with an increase in the effect of paternal education." Higher public education expenditures do not seem to guarantee equitable results.

We study the development of intergenerational educational mobility over the last five decades for the case of Germany, which next to the United States and the United Kingdom is known for low intergenerational educational mobility (OECD 2004, Woessmann 2004). Applying German data on birth cohorts from the late 1920s through the 1970s we investigate the relevance of parental education, family size, region of residence, and child sex for educational attainment and test whether these correlation patterns changed over time, e.g. as a consequence of education policies.

The contributions of this paper are threefold: first, this is the first study to test economic hypotheses regarding *changes* in parent-child education transmission over time for Germany. This complements a literature which focused almost exclusively on the case of the United Kingdom. Second, our analysis provides both up-to-date evidence as well as a long term perspective and updates related sociological contributions (e.g. Blossfeld 1993). Finally, we apply more flexible empirical methods than prior studies to discover shifts in intergenerational education transmission patterns that could not be detected by more restrictive approaches.

Surprisingly, the extant empirical evidence on *changes* in intergenerational education mobility is sparse. The issue raised attention in the United Kingdom where Blanden et al. (2003), and Blanden and Machin (2004) analysed changes in the correlation between parental relative income position and child educational outcomes. The studies use various datasets, provide comparisons of the U.S. and the U.K., and discuss whether the relevance of student cognitive ability increased with easier access to higher education. Their key findings are that the expansion of the higher education system predominantly benefited the children of rich parents and that the participation gap between children of more and less affluent parents widened over time. This would be an acceptable outcome if it were the children of rich parents who were the most able and who had previously suffered from rationed access to higher education. However, Galindo-Rueda and Vignoles (2005) show that while the relevance of parental background for educational attainment increased that of cognitive ability declined, and educational attainment increased far more for those with low ability and high income background than for those with high ability and low income background.

Beyond these contributions economic analyses of the intergenerational transmission of education typically neglect the perspective of mobility developments over time. Couch and Dunn (1997) for example compare the intergenerational education correlation in the U.S. and Germany, Lauer (2003) compares German and French cohorts born between 1929 and 1968, and Dustmann (2004) looks at the correlation between parental characteristics and child schooling and earnings for the German birth cohorts 1920 through 1966. Findings from these studies indicate that parental background affects child outcomes. However, the empirical approaches do not allow one to determine the variation in this relationship over time.

Also, sociological interest focused on the question of educational mobility and intergenerational status transmission. Shavit and Blossfeld (1993) survey the developments in 13 countries, with Blossfeld (1993) covering the German case. He investigates the birth cohorts 1916 through 1965 for which he finds no change in the impact of parental

background over time. Müller and Haun (1994) analyze educational outcomes and transitions for the birth cohorts 1910 through 1969 and arrive at the opposite conclusion: the relevance of parental social class for child educational outcomes declined over time. Their findings are corroborated by Henz and Maas (1995).

In addition to these contributions, a separate literature examines whether it is the inheritance of genes that drives intergenerational correlation patterns ("nature") or whether a productivity effect of parental education matters ("nurture") (e.g. Sacerdote 2002, Plug and Vijverberg 2003). While we do not attempt to distinguish the nature vs. nurture elements of education transmission recent contributions by Cunha and Heckman (2007) point out that the assumed separability of nature and nurture is obsolete, as the mechanisms interact in more complex ways.

The analysis of changes in intergenerational education mobility over time is informative and important for various reasons. First and foremost, they inform about whether past reforms and developments in the provision of education and the related increases in education expenditures succeeded in reaching their explicitly stated goal of reducing inequities. The results from Germany are an interesting complement to the evidence from the UK and the U.S. which suggests that support in short-term liquidity problems does not further equal access to education. Additionally, the findings indicate (a) the extent of intergenerational education correlation which co-determines intergenerational mobility with respect to economic well-being, and (b) whether promising opportunities for human capital investments may be foregone through low educational mobility.[1]

If intergenerational mobility does not increase in the face of expansive education policies this may indicate that the measures were inappropriate: possibly lower educated parents did not have enough information to take advantage of the opportunities or they were

[1] The laissez faire approach of not intervening in mobility outcomes can be efficient if the distortionary costs of government intervention exceed the efficiency gains from educating the most able (Piketty 2000).

less mobile and more frequently rationed in access to higher education. It is possible that expansive policies failed due to parental behavior.

Our analysis does not separate alternative causal mechanisms for intergenerational transmission. Instead we describe the development of intergenerational correlation patterns over time. In addition, we draw attention to the heterogeneity in intergenerational education mobility over time. We propose several indicators of educational mobility and compare the findings across cohorts, by gender, family structure, and region instead of considering only one single education correlation coefficient for an entire society.[2] Our results indicate that the level of education and the extent of upward mobility increased over recent decades.[3] However, the relative probabilities of reaching high educational degrees for children from low compared to high education parental backgrounds hardly changed over the last decades and the gap in the probability of reaching high educational degrees at the expense of those with many siblings, from rural region of origin and a low education parental background increased substantially.

2. Institutional Background

The German secondary education system has always been structured by parallel tracks with different performance requirements.[4] Since the 19th century standard education has been provided by lower secondary schools (*Volksschule* / *Hauptschule*), which used to last 8 years and prepared pupils for apprenticeships or vocational schools. After 4 years at lower secondary school it is possible to advance to either secondary school (*Realschule* / *Mittelschule*) or upper secondary school (*Gymnasium*),[5] where education continues for an

[2] Bauer and Riphahn (2007) show that there can be substantial heterogeneity in mobility even in a given institutional framework.
[3] This may well be a consequence of both widening access and lowering standards. We do not try to distinguish the two.
[4] See Schnepf (2002) for a detailed description.
[5] Depending on region and period more or less demanding entrance exams were required to enter secondary or upper secondary school.

additional 6 or 9 years, respectively. The system hardly changed over time, and the upper secondary school degree still is the key requirement for university studies.[6]

Over time numerous measures were introduced to strengthen public education, to allow for more general access, and to increase the cohort share with higher education. These measures fall into two major groups, those with direct effects on individual household finances[7] and those regulating institutions to strengthen equal educational opportunity.[8] In addition to these reforms of the educational system economic and social trends supported the expansion of education demand and supply: public annual education expenditures increased substantially followed by a) increasing numbers of secondary and upper secondary schools, b) a parallel extension of the number of teachers and an increase in the cohort share of graduates entering tertiary education from 6 percent in 1960 to 25 percent in 1982, and than 30 percent in 2003 (KMK 2005).

Figure 1 illustrates this educational expansion after the war. It shows (a) rising total expenditures on schools as a fraction of GDP, (b) similar patterns for the number of teachers per pupil, and (c) the changing distribution of pupils across the three educational tracks.

3. Theoretical Background and Hypotheses

We base our hypotheses on two theoretical arguments discussed in the economic literature.[9] On the one hand Cameron and Heckman (1998) and Lauer (2003) model individual child educational attainment as a utility maximizing choice that is determined by a comparison of

[6] While today the degree can be attained via alternative educational pathways, such as polytechnical schools, these were not available in the past. Therefore the educational decision taken at the end of primary school was crucial.

[7] Reforms that belong to this group are e.g. a) the abolishment of school fees, b) the provision of free public transportation to school and free secondary school textbooks, and c) the introduction of a scholarship program for university students.

[8] Reforms of this second group are e.g. a) the abolishment of formal tests for a transition from primary to secondary or upper secondary schools, b) the improvement of opportunities to flexibly transit between educational tracks or c) the combination of all tracks in integrated schools (*Gesamtschule)* in order to allow students to flexibly study different subjects at different academic levels and to avoid the early tracking of students. Currently about 9 percent of pupils attend this type of school (STBA 2007).

[9] Different disciplines have looked at the phenomenon from a number of angles. For a general framework for various approaches see e.g. Feinstein et al. (2004).

marginal costs and benefits and therefore as a function of any characteristic that affects the net utility of reaching a given educational level. On the other hand Fernandez and Rogerson (1998) model the aggregate equity and welfare effects of increased educational opportunity for poor children.

In their empirical analysis of educational outcomes for five birth cohorts of American males Cameron and Heckman (1998) conclude that it is not short run credit constraints which are central for schooling decisions but long-term factors such as permanent parental income and possibly genetic family background. They suggest that government subsidies have only small effects and tend to attract students from the lower tail of the *ability* distribution to higher education. Translated to the German case these findings imply that the educational reforms should have affected neither educational choices nor the correlation between child and parent educational outcomes, as they cannot modify long-term factors or family abilities.

If, to the contrary, equal opportunity policy successfully reached its objectives, the relevance of household and parent characteristics for child education choices should have declined, e.g. because reductions in the cost of education may have reduced the impact of permanent parental income.[10] In that case we expect a falling correlation between educational attainment and parental and household background. The differences between male and female educational attainment should also decline with growing wealth if they were due to sex-specific differences in the expected returns to child education. Similarly, the disadvantage of children with many siblings should decline if government redistribution and increasing household incomes enable parents to invest more in the education of their children. Also, disadvantages related to growing up in rural rather than urban areas should diminish as more schools are built and transportation is provided free of charge.

[10] Similarly, a change in returns to education may affect the correlation patterns. However, existing studies on the developments in returns to education in Germany only reach back to the 1980s. They show that returns to education declined slightly since that time (Boockmann and Steiner 2006).

Fernandez and Rogerson (1998) argue that children of poor parents underinvest in education because they cannot borrow against the future. A policy intervention that enhances educational opportunities for the poor will then yield welfare improvements and reductions in educational and income inequality (see also Fernandez and Rogerson 1996). Given that German policy reforms of the 1960s and 1970s were geared to enhance educational opportunity the Fernandez and Rogerson model suggests that inequality, e.g. with respect to parental background, declined over time. – Based on these arguments we propose six hypotheses, which are tested below:

H1: Parental education is positively correlated with child educational outcomes.

H2: This correlation declines over time for subsequent birth cohorts.

H3: Growing up with many siblings and/or in rural areas is correlated with lower educational attainment.

H4: The educational disadvantage related to siblings and region declines over time.

H5: Educational attainment differs for boys and girls, and girls catch up over time.

H6: The correlation of child and parent education varies by sex of child and parent.

4. Data Description and Empirical Methods

4.1 Data and Methods

Our analysis uses the 2003 data wave of the German Socio-Economic Panel (SOEP). The SOEP is a representative annual household panel survey which gathers information on a variety of topics, some regularly every year others only in certain years (SOEP Group 2001). We chose the 2003 cross section for our analysis because it provides information on an individual's number of siblings and because it is relatively recent. In total about 23,000 individuals were surveyed in the 2003 wave of the German SOEP. In our descriptive analysis we consider individuals born between 1929 and 1978 whereas our regressions use only those born between 1940 and 1978 to minimize any biases resulting from non-random, selective mortality. To generate a sample of individuals with a comparable background in terms of

educational institutions we exclude non German citizens as well as those who were raised in the former East Germany. After these selections our sample for the regression analyses contains 4,516 men and 4,815 women who attended school within the educational system described above.

Our outcome of interest is secondary school attainment. Given the German track system our dependent variable differentiates four states, upper secondary school degree (*Abitur*), secondary school degree (*Realschulabschluss* including *Fachhochschulreife*), lower secondary school (*Hauptschulabschluss*) or no degree, and missing information.[11] This coding of educational outcomes differs from some of the prior literature, which focuses on sequential transition decisions instead of levels reached.[12] However, Cameron and Heckman (1998) emphasize that a model of sequential grade transitions is an unattractive framework as it implicitly assumes that agents are myopic in their investment decision.[13]

Among our key explanatory factors we consider parental education.[14] We define parental education in the same manner as child outcomes and use the same four categories for both parents. The missing category is coded both, if a parent is not observed at all and if just the education measure is unavailable for an otherwise known parent. In our basic specification we consider only one joint indicator for both parents reflecting the highest educational degree between father and mother. Additionally, we provide analyses which treat the two parents separately.

[11] Information on a "Fachschule" degree is not available in the data.
[12] Riphahn and Schieferdecker (2008) find that the share of individuals holding the Abitur degree and transiting to tertiary education remained about constant at about 20 percent for men while it increased from 5 to 15 percent of the female birth cohort.
[13] Frequently, authors in this literature compared coefficients across bivariate logit estimations to see if e.g. parental characteristics affected various transition decisions differently. Since this comparison across separate logit models is inappropriate, we interpret marginal effects in the framework of a multinomial logit estimator.
[14] This differs from parts of the literature which concentrate on parental income. Parental income measures are not available for our sample. However, since educational attainment is highly correlated with income the resulting trends in correlation patterns might be comparable to those found in similar studies e.g. for the United Kingdom. In addition, we are interested in the overall transmission of secondary school degrees rather than the transmission conditional on income earned by parents at some later point in time. For a discussion of the intricacies of income vs. education effects see e.g. Feinstein et al. (2004).

Additional explanatory variables include a categorical indicator of individual birth cohort, the federal state of residence at the time of the interview, indicators of the number of siblings, and of whether the individual grew up in the countryside. For every individual these are non-time varying indicators. Descriptive statistics are presented in Table 1.[15]

We first describe the developments of educational attainment and intergenerational education correlation patterns over time. Then we evaluate the determinants of educational attainment and trends in their relevance over time in a multivariate framework. As our dependent variable comprises four categorical outcomes j (missing, lower secondary, secondary, upper secondary school degree) and we use cross-sectional data we apply the multinomial logit model as a very flexible estimator, which allows for differences in each covariate's marginal effect across categories. Our baseline model (1) describes the correlation of birth cohort, parental education, number of siblings, rural origin, and federal state.

$$(1) \quad P(Y_i = j \mid X_i) = f_j(\text{parent education}_i, \text{child sex}_i, \text{birth cohort}_i, \text{number siblings}_i, \text{rural origin}_i, \text{federal state}_i)$$

Based on this specification we can test hypotheses 1, 3, and 5. Initially, we estimate the model jointly for males and females. To test whether the impact of parental education changed over time (hypothesis 2) we add birth cohort interactions with parent education measures in a second step. Hypothesis 4 is considered when adding birth cohort interactions with both the number of siblings and the rural origin indicator to the baseline model. In step 4 of the analysis we examine whether the difference in educational attainment between sons and daughters changed over time (hypothesis 5). Finally, we investigate whether the impact of parental education on child educational outcomes differs depending on which of the two parents is considered and whether the effect is measured for a son or a daughter (hypothesis 6).

[15] We would have liked to control for child birth order effects, however, unfortunately this information is not available in our data.

4.2 Descriptive Evidence

In order to summarize the development in educational attainment over time, Figure 2 describes the distribution of educational attainments by gender over the considered birth cohorts. The overall shift to higher educational degrees is clearly visible for both sexes. After the cohort share with upper secondary school degree was about half that of men for female birth cohorts in the 1930s, women completely caught up since the birth cohorts of the 1960s.

A number of indicators are available to describe the development in the overall intergenerational transmission of education. For a description of average mobility of the birth cohorts 1929 – 1978 Table 2 presents transition matrices separately for the two sexes. The numbers on the main diagonal are generally around 50 percent which indicates a low level of mobility. The entry in the third column of either table's first row indicates the probability that the child of parents with only lower secondary education attains an upper secondary school degree. Comparing these figures to those provided two rows below we see that child educational outcomes vary greatly with parental characteristics.

Figure 3 describes the development of upward and downward mobility by sex and separately for birth cohort groups over time. Over time the fraction of any given cohort group which attained higher educational outcomes than their parents went up. The fraction of individuals with the same attainment as their parents stayed constant and the extent of downward mobility declined.

Finally, we investigate whether this improvement in educational attainment equally enhanced the opportunities of children from all parental educational backgrounds. Figure 4 entails two indicators of relative opportunities: Ratio 1 describes the probability of attaining an upper secondary school degree for children of parents with an upper secondary school degree relative to children of parents with only lower secondary education. For individuals born throughout the 1930s we observe a more than 8-fold difference in probabilities. Starting with the birth cohorts around 1949 for men and around 1954 for women the ratio reached the

value 4 which hardly changed for subsequent cohorts and indicates a rather permanent level of inequality in opportunity. Ratio 2 describes the relative probability of attaining a secondary school degree for children of parents who themselves had a secondary school degree relative to children of parents with only lower secondary education. Here we see a different picture. This ratio never reached high values and has been close to parity for females since the birth cohort of 1954 and for men born after 1944. A comparison of Ratio 1 and Ratio 2 thus suggests that the impact of parental background is particularly striking when we consider the probability of attaining an upper secondary school degree. Overall the figures yield a surprising level of stability in probability ratios, relative opportunities hardly improved since the 1950s.

5. Multivariate Results and Robustness Tests

5.1 Results

Next we investigate whether the lack of improvements in relative education opportunities can be confirmed in multivariate regression analyses and test the hypotheses set out in section 3.

In a first estimation we applied a multinomial logit estimator of specification 1 to our 9,331 observations of child educational outcomes.[16] The marginal effects are presented in Table 3 and indicate the impact of the explanatory variables on the alternative outcome probabilities, calculated as the mean marginal response to a change in the dummy variables. We find significant differences in the distribution of educational outcomes by child sex (hypothesis 5). Boys have significantly higher probabilities of being in the lowest and highest educational group than girls. The second group of indicators describes the highest level of secondary schooling among the parents of a child. Jointly the effects are highly significant. The patterns are as expected (see predicted probabilities at the bottom of the table with

[16] We tested whether the independence of irrelevant alternatives assumption implied by the multinomial logit model holds and found no evidence to the contrary.

bootstrapped standard errors[17]), i.e. the higher parental education, the less likely children are to reach only lower secondary educational outcomes and the more likely they are to reach an upper secondary school degree. Having highly educated parents is correlated with an average increase in the probability of attaining upper secondary school by about 50 percentage points compared to children whose parents have only lower secondary education.

The descriptive evidence on changes in educational outcomes over time is confirmed as more recent birth cohorts attain significantly higher degrees. Finally, the results on the correlation of the number of siblings and growing up in a rural area confirm hypothesis 3: compared to children without siblings educational attainment is significantly lower for the others and it decreases as the number of siblings goes up.

In order to test whether the impact of parental educational background on child educational outcomes changed over time we extended the baseline specification by four interaction terms of a linear time trend with the indicators of parent educational attainment. The coefficient estimates are presented in Table 4a. The trend interactions are jointly significant at the one percent level. As the calculation of marginal effects of interaction terms in nonlinear models is rather involved (Ai and Norton 2003), we interpret the change in parental education effects over time by way of simulation exercises. Table 4b describes the average predicted probabilities of attaining lower secondary, secondary, or upper secondary educational degrees conditional on parental education and birth cohort. For every observation in the sample each dependent variable was predicted after modifying the values of the parental education and year indicators. Table 4b presents the average predicted probabilities. A comparison across rows yields that the probability of attaining an upper secondary school degree increased for children of all parental backgrounds over time (cf. last column 'Diff. 78-40'). Interestingly, the largest absolute increase occurs for the children of highly educated parents (plus 21.36 percentage points, cf. row 3). This increase is highly statistically

[17] We calculated bootstrapped standard errors through simulation by averaging predicted probabilities after modifying the values of parental education. See also the explanation given for the results of Table 4.

significant and also implies that the percentage point difference in the probability of attaining uppers secondary school for children from high vs. low parental education background increased from 38.90 for the 1940 birth cohort to 53.94 for the 1978 birth cohort (cf. row four 'Diff. parents high-low'). The parental background effect regarding upper secondary school attainment increased over time and absolute educational opportunities increased the most for the children of the highly educated.

The bottom half of Table 4b describes the developments regarding the probability of attaining only a lower secondary school degree. With respect to this outcome the absolute improvement is highest for the children with low parental education background, whose probability of completing lower secondary school declined by more than half over the four decades. This compares to a smaller absolute but larger relative improvement for the children of parents with upper secondary education. The absolute gap decreased and the relative gap grew over time. However, improved educational outcomes for children of low educated parents did not result in an equalization of access to tertiary education, i.e. higher graduation rates from upper secondary school, but stopped at an improved access to secondary school degrees.

In order to test whether the correlation between child educational outcome and the number of siblings and the region of origin declined (hypothesis 4), we added time trend interactions of the sibling and rural origin indicators in the baseline specification. The estimated coefficients of the trend interactions are jointly significant at the one percent level, both for the group of sibling indicators as well as for the rural residence indicators (Table 5a). Again we apply simulations to interpret the effects (see Tables 5b and 5c).[18] The simulations confirm the general shift from lower secondary to higher degrees over time as the predicted share of individuals with only low educational outcomes declined. The gap in the probability

[18] As before, we predict the probability of each outcome for each observation in the sample at the observed covariates after modifying the values of rural residence and of the year indicators or of the number of siblings and the year indicators. Tables 5b and 5c present the average predicted values.

of reaching an upper secondary school degree by regional origin or the number of siblings increased over time and reached the largest absolute value for the birth cohort of 1978 (see rows labeled 'Difference'). Thus the educational expansion did not succeed in improving access to higher education for those with many siblings or those from rural areas. The developments are to the contrary, those who were originally disadvantaged are now more disadvantaged than ever.

So far we found differences in average educational outcomes for males and females. Table 6 presents the results obtained when testing whether these remained constant over time (hypothesis 5): the gender indicator is interacted with a linear time trend. The significant coefficients indicate that the time trends indeed differ by child sex. The simulation results yield that females caught up over time. Their disadvantage in terms of attaining only a low degree switched to a significant advantage and the difference in the probability of upper secondary school attainment disappeared for the most recent cohorts.

In order to test the hypothesis that the correlation between child and parent education differs depending on the sex of the child we extended the baseline specification by interaction terms between the sex of the child and parent educational degrees. The results yield that the child sex interaction terms are not jointly significant. We tested whether these interaction terms changed over time but found no significant effects.[19]

Finally, we investigate whether the impact of fathers' education differs from that of mothers'. Here we re-estimated the baseline models separately for male and female children and allowing for separate effects of the two parents. The results are presented in Table 7. The coefficient estimates for the parental education groups are jointly significant. In both cases the marginal effects – again calculated as the mean response to a dummy variable change – of paternal education are generally larger than those of maternal educational background. Interestingly the paternal effects are somewhat larger for male children than for female

[19] Results are not presented to save space. They are available from the authors upon request.

children and the maternal education effects are somewhat larger for female than for male children. However, the patterns do not differ substantially.

In sum, we find the expected positive correlations of the probability of upper secondary school degree with being male (hypothesis 5), having highly educated parents (hypothesis 1), few siblings, and growing up in a non-rural area (hypothesis 3). Over the last decades the probability of attaining upper secondary school degrees increased strongest for children of highly educated parents, and for those from an urban region of origin and for children with few siblings, contradicting the expectations formulated in hypotheses 2 and 4. Hypothesis 5 that girls catch up with boys and hypothesis 6 regarding heterogeneous correlation patterns by parent and child sex cannot be rejected.

5.2 Robustness Tests

One shortcoming in the above analyses of developments over time consists of the restrictive assumption that the time trend takes a linear form and exclusively affects certain groups of explanatory variables. We used two alternative estimation approaches to test whether the results are robust. First, we combine all time trend interactions jointly in one single multivariate model specification, then we apply a flexible specification without parametric restrictions on the shape of time trends by estimating the baseline model separately for three cohort groups, those born 1940-1952, 1953-1965, and 1966-1978.

The coefficient estimates on the model with jointly estimated trend interaction terms are presented in Table 8. While each of the four groups of trend interactions was jointly statistically different from zero at the 1 percent level, the full model generates less precise estimates. While the hypotheses of constant effects of parental education and male sex are rejected at the one percent level, the p-values for the joint tests of the rural trend interactions is at 3 percent, that for the number of siblings at 12 and thus no longer significantly different from zero at conventional levels. However, based on the signs of the coefficients, which

typically though not always indicate the sign of the marginal effect, our findings from the separate regressions presented above are confirmed: the probability of attaining upper secondary schooling increased for all parental education backgrounds with the largest coefficient for highly educated parents. Similarly, the probability of secondary and upper secondary training increased for children with all numbers of siblings, children from rural areas experienced significant increases in the probability of secondary school attainment and none in the probability of upper secondary school attainment. Finally, the advantage of male pupils in attaining higher secondary school degrees declined over time. Thus, our results presented above pass this first robustness test.

If the findings summarized above are due only to the linear specification of the time trend they should change or disappear when no parametric restriction is imposed. Descriptive statistics for the three cohort groups (Table 9a) indicate shifts in childhood residence, sibship sizes, and educational expansion over time for children and parents. The estimation results are presented for the first and last cohort group in Table 9b. The previously used controls for birth cohort groups are now substituted by linear time trends for the birth cohorts within the birth cohort groups.

A comparison of the marginal effects across cohort group columns confirms most of the findings described above. The largest increase in the marginal effect of parental education on the probability of reaching an upper secondary school degree (see the two rightmost columns) is observed for children of parents with upper secondary education: plus 6 percentage points comparing the early and the late cohort groups, thus increasing the gap in the probability of reaching upper secondary school for children of parents with uppers secondary school instead of lower secondary school from 44.8 to 51.4 percentage points (from 17.0 to 25.4 percentage points relative to parents with secondary education). Similarly, the disadvantage in the probability of reaching upper secondary school education for children from large families with at least 3 siblings relative to those with no siblings almost doubled

from 8.3 percentage points for the earliest cohort group to 15.5 percentage points for the last. The negative effect of growing up in a rural area on the probability of reaching upper secondary education went up from 3.7 to 5.9 percentage points. The difference in the probability of attaining an upper secondary school degree by child sex became statistically insignificant and smaller in size over time. It is of separate interest to evaluate the association of background characteristics with lower secondary school outcomes over time. Here we find that the disadvantage of children with low educated parents, with many siblings and from rural origin declined over time. However, this improvement of educational outcomes apparently stopped at the level of secondary schools. While the average educational outcomes improved over time they did not balance individual background effects when it comes to access to tertiary education, which we saw already in Figure 4. Our results are robust to this more flexible modeling approach of changes over time.

6. Conclusions

During the last decades a variety of reforms and developments supported a massive expansion of the German educational system.[20] This paper investigates whether this expansion concurred with enhanced relative educational opportunities for children of parents with low educational background. The descriptive evidence yields a general increase in the average educational level over time. A higher cohort share attained upper secondary educational degrees, and we see a positive trend in upward and a negative trend in downward intergenerational mobility over time. However, the relative educational opportunity of children from disadvantaged backgrounds did not improve for over 25 years. This evidence agrees, both, with recent findings for the United Kingdom, where the increase in education funding predominantly ended up supporting the rich, and with Cameron and Heckman (1998) who argue and show for the U.S. that only long term factors affect child educational

[20] Recent evidence on changes in returns to education is surveyed by Flossmann and Pohlmeier (2006). Genandt and Pfeiffer (2007) discuss the relevance of education and its return for the wage distribution.

outcomes and government subsidies have at best small effects. Our analyses show that the educational outcomes of children with disadvantaged backgrounds improved over the course of the last decades to the extent that their probability of attaining the lowest educational degree declined. However, an evaluation of the characteristics of those with the highest educational outcomes suggests that it is those with few siblings, highly educated parents in urban areas whose probability of attaining high educational outcomes increased the most. This suggests that the main beneficiaries of the education expansion in Germany are those who were advantaged already before the education expansion.

Galindo-Rueda and Vignoles (2005) showed for the U.K. that the correlation of ability and educational attainment became weaker at the same time as parental impact increased. We have no such evidence for the case of Germany. However, nationally representative ability surveys allow a cross-sectional evaluation of pupil competencies across different school types. A comparison of the distribution of pupils' competencies by type of secondary school yields large overlapping areas: Schnepf (2002) reports based on TIMSS (Third International Mathematics and Science Study) data that more than 8 (13) percent of lower secondary school pupils and 30 (36) percent of secondary school pupils scored above the bottom quartile in the upper secondary school math (science) distribution. The majority of these high scoring pupils in lower secondary tracks had parents without tertiary educational degrees. Similarly, Baumert et al. (2003) report for e.g. the state of Bavaria that with respect to competencies as measured in the PISA (Programme of International Student Assessment) survey 40 percent of secondary school pupils reach the level of the bottom 10 percent of upper secondary school requirements in both reading and math competencies.

This confirms that the streaming into school types in Germany is not purely based on ability. Other factors intervene and we have shown that their influence on upper secondary school participation has not been declining in recent decades.

Literature

Ai, Chunrong and Edward C. Norton, 2003, Interaction terms in logit and probit models, *Economics Letters* 80, 123-129.

Bauer, Philipp and Regina T. Riphahn, 2007, Heterogeneity in the Intergenerational Transmission of Educational Attainment: Evidence from Switzerland on Natives and Second Generation Immigrants, *Journal of Population Economics* 20(1), 121-148.

Baumert, Jürgen, Ulrich Trautwein, and Cordula Artelt, 2003, Schulumwelten – institutionelle Bedingungen des Lehrens und Lernens, in: Baumert, Jürgen et al. (eds.), *PISA 2000 – Ein differenzierter Blick auf die Länder der Bundesrepublik Deutschland*, 261-332.

Blanden, Jo, Paul Gregg, and Stephen Machin, 2003, Changes in Educational Inequality, CMPO Working Paper Series No. 03/079, Bristol.

Blanden, Jo, Paul Gregg, and Stephen Machin, 2005, Intergenerational Mobility in Europe and North America. A Report Supported by Sutton Trust, Centre for Economic Performance, London, *mimeo.*

Blanden, Jo, and Stephen Machin, 2004, Educational Inequality and the Expansion of UK Higher Education, *Scottish Journal of Political Economy* 51(2), 230-249.

Blossfeld, Hans-Peter, 1993, Changes in Educational Opportunities in the Federal Republic of Germany. A Longitudinal Study of Cohorts Born Between 1916 and 1965, in: Shavit, Yossi and Hans-Peter Blossfeld (eds.), 1993, *Persistent Inequality. Changing Educational Attainment in Thirteen Countries*, Westview Press: Boulder et al., 51-74.

Boockmann, Bernhard and Viktor Steiner, 2006, Cohort Effects and the Returns to Education in West Germany, *Applied Economics* 38(10), 1135-1152.

Cameron, Stephen V. and James J. Heckman, 1998, Life Cycle Schooling and Dynamic Selection Bias: Models and Evidence for Five Cohorts of American Males, *Journal of Political Economy* 106(2), 262-333.

Chevalier, Arnaud, Kenny Denny, and Dorren McMahon, 2003, A multi-country study of inter-generational educational mobility, *ISSC Discussion Paper* 2003/06, Dublin.

Couch, Kenneth A. and Thomas A. Dunn, 1997, Intergenerational Correlations in Labor Market Status. A Comparison of the United States and Germany, *Journal of Human Resources* 32(1), 210-232.

Cunha, Flavio and James J. Heckman, 2007, The Technology of Skill Formation, *American Economic Review* 97(2), 31-47.

Dustmann, Christian, 2004, Parental background, secondary school track choice, and wages, *Oxford Economic Papers* 56, 209-230.

Feinstein, Leon, Kathryn Duckworth, and Ricardo Sabates, 2004, A Model of the Inter-Generational Transmission of Educational Success, *Wider Benefits of Learning Research Report* No. 10, London.

Fernandez, Raquel and Richard Rogerson, 1996, Income Distribution, Communities, and the Quality of Public Education, *Quarterly Journal of Economics* 111(1), 135-164

Fernandez, Raquel and Richard Rogerson, 1998, Public Education and Income Distribution: A Dynamic Quantitative Evaluation of Education-Finance Reform, *American Economic Review* 88(4), 813-833.

Flossmann, Anton L. and Winfried Pohlmeier, 2006, Causal Returns to Education: A Survey on Empirical Evidence for Germany, *Jahrbücher für Nationalökonomie und Statistik (Journal of Economics and Statistics)* 226(1), 6-23.

Galindo-Rueda, Fernando and Anna Vignoles, 2005, The Declining Relative Importance of Ability in Predicting Educational Attainment, *Journal of Human Resources* 40(2), 335-353.

Genandt, Johannes and Friedhelm Pfeiffer, 2007, Rising Wage Inequality in Germany, *Jahrbücher für Nationalökonomie und Statistik (Journal of Economics and Statistics)* 227(4), 358-380.

Henz, Ursula and Ineke Maas, 1995, Chancengleichheit durch die Bildungsexpansion?, *Kölner Zeitschrift für Soziologie und Sozialpsychologie* 47(4), 605-633.

KMK (Kultusministerkonferenz), 2005, *Prognose der Studienanfänger, Studierenden und Hochschulabsolventen bis 2020*, Dokumentation Nr. 176, Sekretariat der Ständigen Konferenz der Kultusminister der Länder, Bonn.

Lauer, Charlotte, 2003, Family background, cohort and education: A French-German comparison based on a multivariate ordered probit model of educational attainment, *Labour Economics* 10(2), 231-251.

Müller, Walter and Dietmar Haun, 1994, Bildungsungleichheit im sozialen Wandel?, *Kölner Zeitschrift für Soziologie und Sozialpsychologie* 46(1), 1-42.

OECD, 2004, *Learning for Tomorrow's World – First Results from PISA 2003*, OECD, Paris

Piketty, Thomas, 2000, Theories of persistent inequality and intergenerational mobility, in: Atkinson, A.B. and F. Bourguignon (eds.), *Handbook of Income Distribution, vol. 1* Elsevier Science, North Holland, 429-476.

Plug, Erik and Wim Vijverberg, 2003, Schooling, Family Background, and Adoption: Is It Nature or Is It Nurture, *Journal of Political Economy* 111(3), 611-641.

Riphahn, Regina T. and Florian Schieferdecker, 2008, The Transition to Tertiary Education and Parental Background over Time, *BGPE Discussion Paper* No. 63, Univ. of Erlangen-Nuremberg.

Sacerdote, Bruce, 2002, The Nature and Nurture of Economic Outcomes, *American Economic Review* 92(2), 344-348.

Schnepf, Sylke Viola, 2002, A Sorting Hat that Fails? The Transition from Primary to Secondary School in Germany, *Innocenti Working Paper* No. 92, UNICEF Innocenti Research Center, Florence.

Shavit, Yossi and Hans-Peter Blossfeld (eds.), 1993, *Persistent Inequality. Changing Educational Attainment in Thirteen Countries*, Westview Press: Boulder et al.

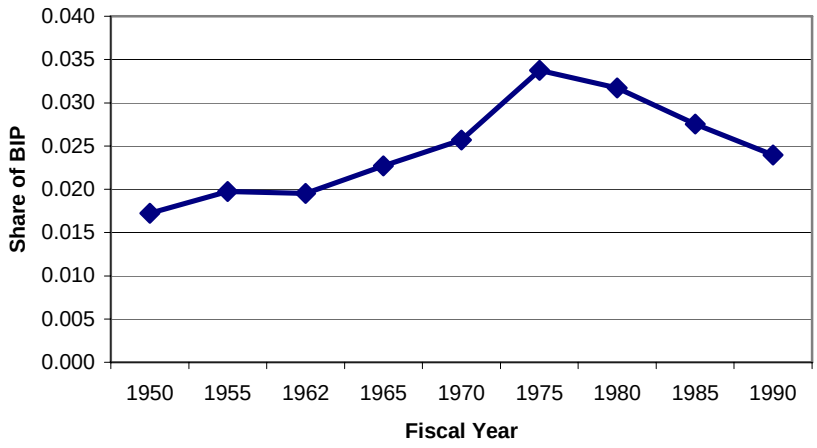
STBA (Statistisches Bundesamt), 2007, *Bildung und Kultur: Allgemeinbildende Schulen Schuljahr 2006/07, Fachserie 11 – Reihe 1*, Wiesbaden.

SOEP Group, 2001, The German Socio-Economic Panel (GSOEP) after more than 15 years - Overview. In: Elke Holst, Dean R. Lillard, and Thomas A. DiPrete (eds.): Proceedings of the 2000 Fourth International Conference of German Socio-Economic Panel Study Users (GSOEP2000), *Vierteljahrshefte zur Wirtschaftsforschung* 70(1), 7-14.

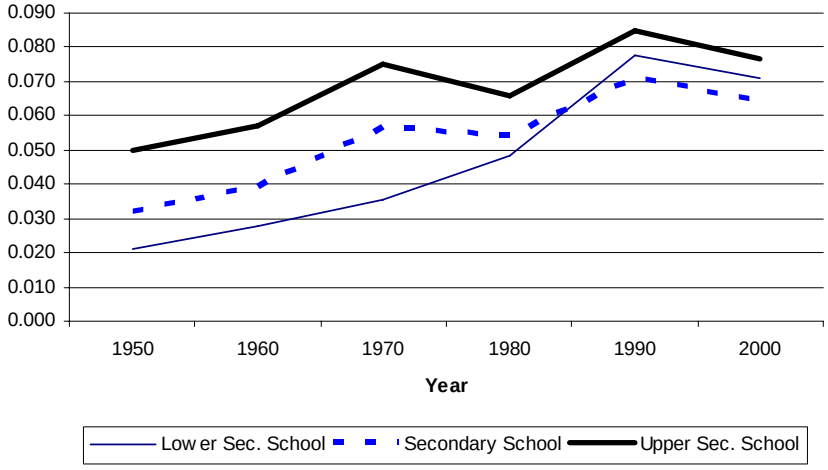
Woessmann, Ludger, 2004, How equal are educational opportunities? Family background and student achievement in Europe and the United States, *CESifo Working Paper* No. 1162, Munich.

Figure 1 Education Expansion after WWII in Germany

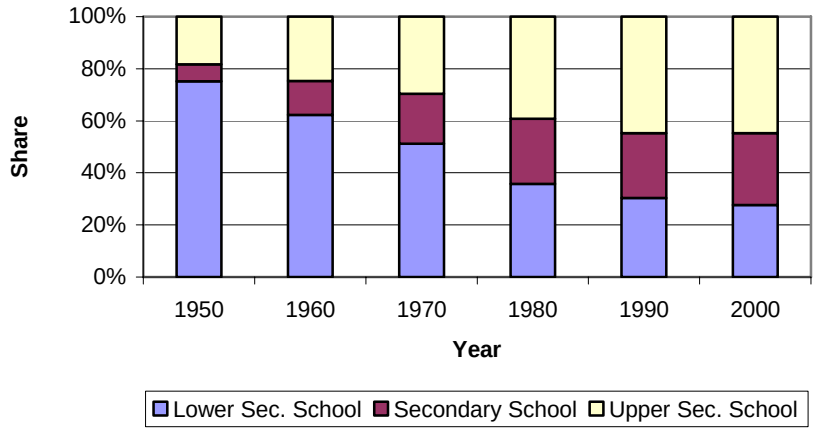
(a) Total Expenditures on Schools as a Share of GDP



(b) Teachers per Pupil



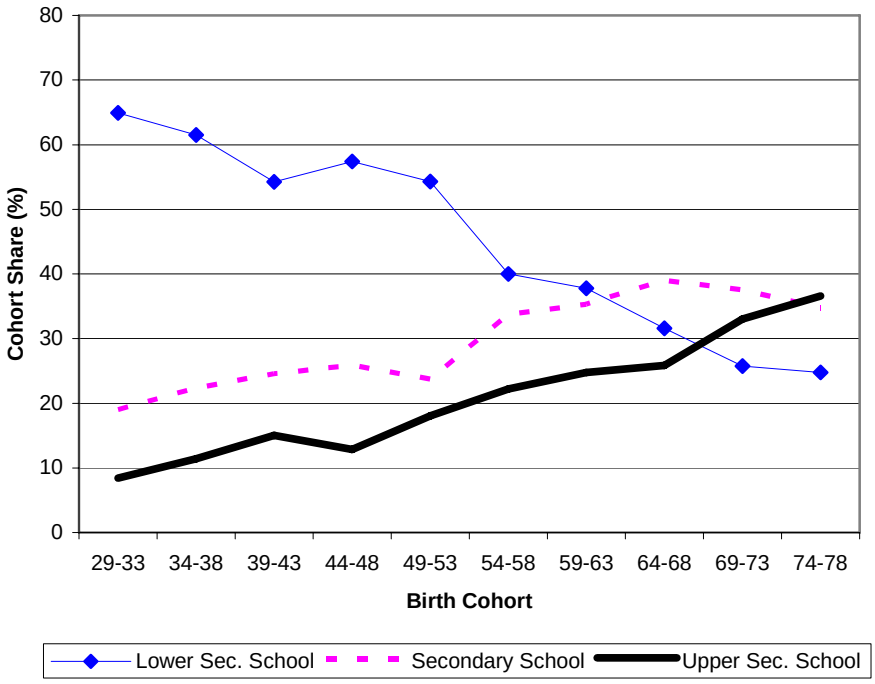
(c) Distribution of Pupils



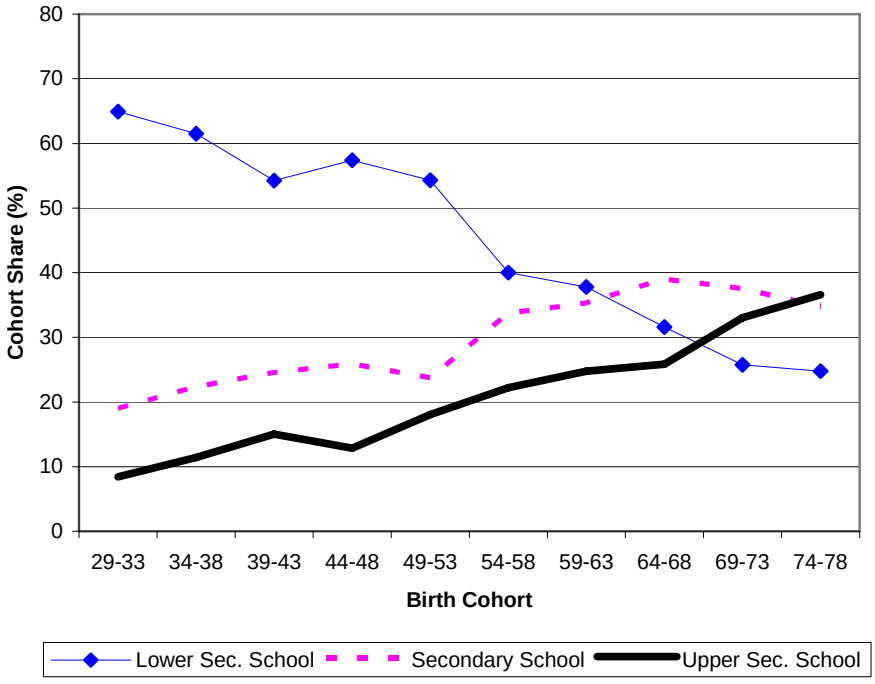
Note: All figures describe the situation in West Germany only.
Source: (a) Federal Statistical Office, Fachserie 14 Reihe 3.1 (b)-(c) Federal Statistical Office, Fachserie 11 Reihe S.2, various years.

Figure 2 Educational Attainment by Sex and Birth Cohort

(a) Males

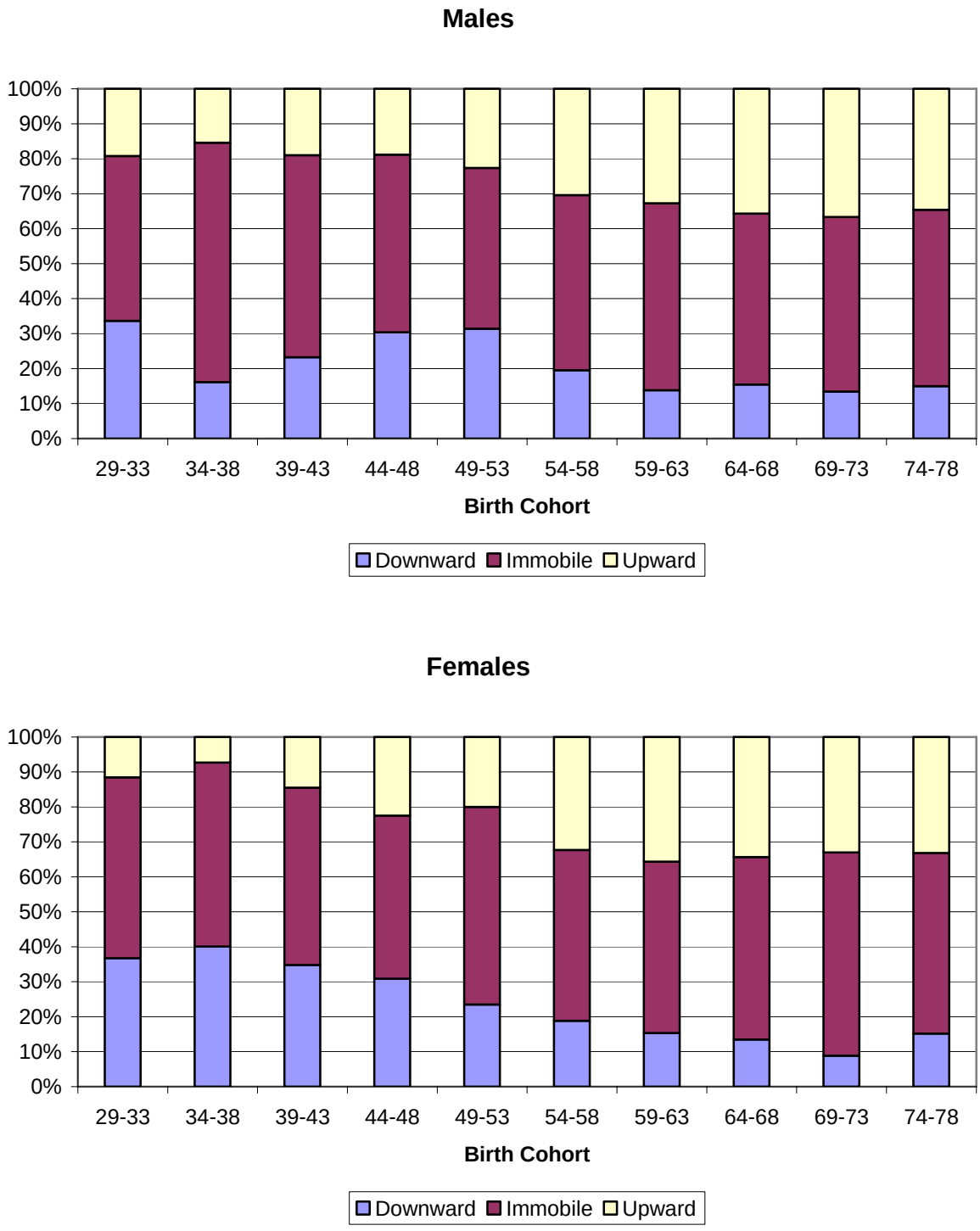


(b) Females



Note: For clarity we do not depict the share of individuals with missing education information. The share averages to about 4 percent.
Source: German Socio-Economic Panel (2003), own calculations using weighted data.

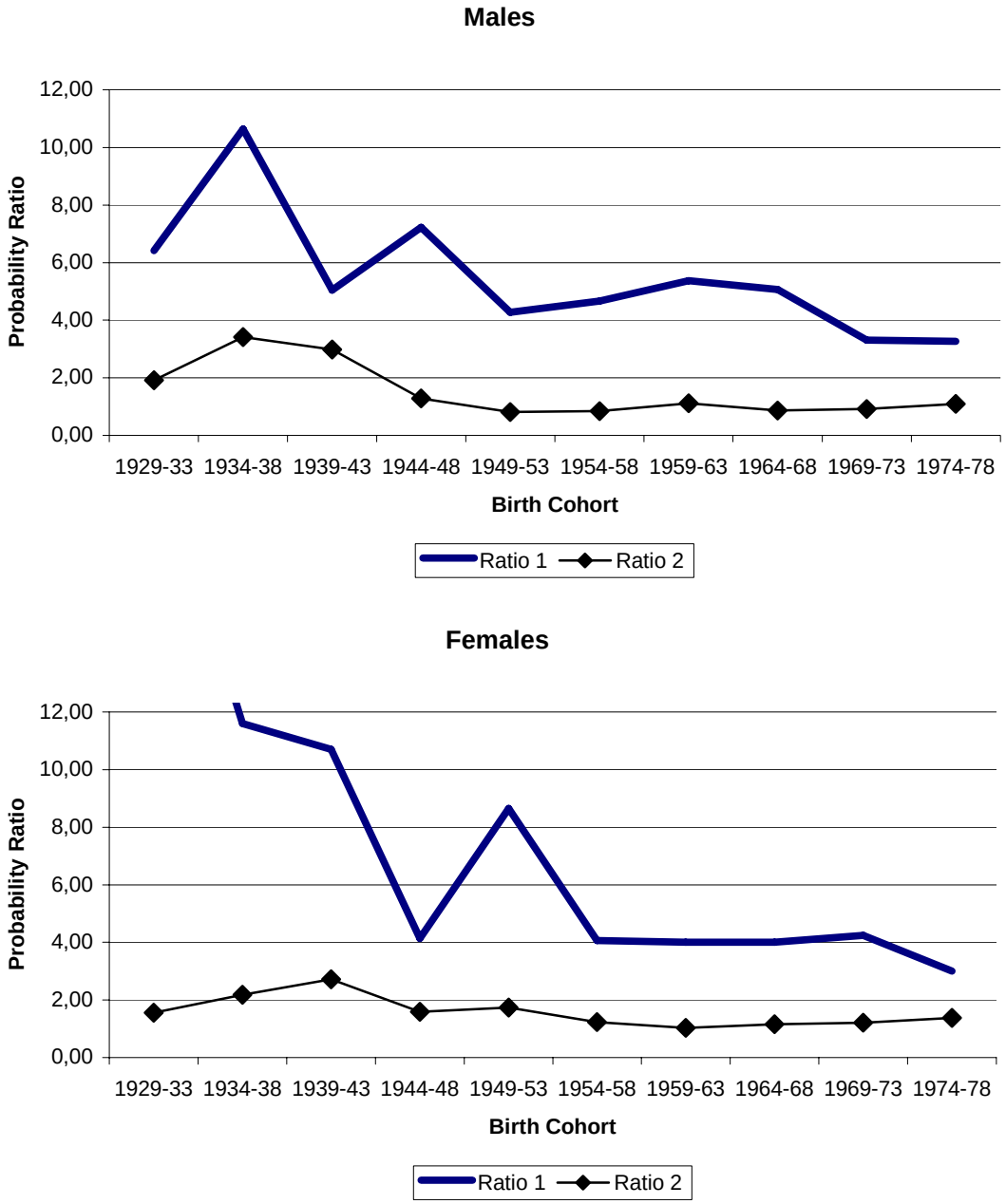
Figure 3 Educational Mobility by Sex and Birth Cohort



Note: For clarity we do not depict the share of individuals with missing education information. The share averages to about 4 percent. Downward (upward) mobility is calculated as the average value of the three entries below (above) the diagonal of the birth cohort and sex-specific transition matrices. Immobility is calculated as the average value of the three entries on the main diagonal of these matrices.

Source: German Socio-Economic Panel (2003), own calculations.

Figure 4 Relative Educational Attainment by Sex and Birth Cohort



Note:
Ratio 1: P (child upper sec. | parent upper sec.) / P (child upper sec. | parent lower sec.)
Ratio 2: P (child secondary | parent secondary) / P (child secondary | parent lower sec.)

Source: German Socio-Economic Panel (2003), own calculations.

Table 1 Descriptive Statistics

	Mean	**Std. Dev.**	**Min**	**Max**
Age	44.537	(10.3323)	25	63
Gender: male	0.4840	(0.4997)	0	1
Birth cohort: 1940-49	0.2339	(0.4233)	0	1
Birth cohort: 1950-59	0.2811	(0.4495)	0	1
Birth cohort: 1960-69	0.3246	(0.4682)	0	1
Birth cohort: 1970-78	0.1603	(0.3669)	0	1
Childhood in rural area	0.3460	(0.4757)	0	1
Number of siblings: 0	0.1505	(0.3576)	0	1
Number of siblings: 1	0.3446	(0.4752)	0	1
Number of siblings: 2	0.2482	(0.4319)	0	1
Number of siblings: 3 or more	0.2565	(0.4367)	0	1
Education: Missing	0.0241	(0.1534)	0	1
Education: Lower secondary	0.3634	(0.4810)	0	1
Education: Secondary	0.3657	(0.4816)	0	1
Education: Upper secondary	0.2467	(0.4311)	0	1
Father's education: Missing	0.0964	(0.2952)	0	1
Father's education: Lower secondary	0.6458	(0.4782)	0	1
Father's education: Secondary	0.1284	(0.3345)	0	1
Father's education: Upper secondary	0.1180	(0.3227)	0	1
Mother's education: Missing	0.0826	(0.2753)	0	1
Mother's education: Lower secondary	0.7021	(0.4573)	0	1
Mother's education: Secondary	0.1548	(0.3617)	0	1
Mother's education: Upper secondary	0.0456	(0.2087)	0	1
Highest parental education: Missing	0.0729	(0.2601)	0	1
Highest parental education: Lower secondary	0.6239	(0.4844)	0	1
Highest parental education: Secondary	0.1726	(0.3779)	0	1
Highest parental education: Upper secondary	0.1304	(0.3367)	0	1
Federal state: Berlin	0.0275	(0.163)	0	1
Federal state: Schleswig-Holstein	0.0420	(0.2006)	0	1
Federal state: Hamburg	0.0201	(0.1405)	0	1
Federal state: Lower Saxony	0.1156	(0.3198)	0	1
Federal state: Bremen	0.0101	(0.1003)	0	1
Federal state: North-Rhine Westphalia	0.2764	(0.4472)	0	1
Federal state: Hesse	0.0898	(0.2859)	0	1
Federal state: Rhineland-Palatinate, Saarland	0.0767	(0.2661)	0	1
Federal state: Baden-Wuerttemberg	0.1473	(0.3544)	0	1
Federal state: Bavaria	0.1940	(0.3955)	0	1

Note: The sample contains 9,331 observations.
Source: German Socio-Economic Panel (2003), own calculations.

Table 2 Average Transition Matrices By Sex of Child for Birth Cohorts 1929-1978

	Daughter			
Parent	**Lower sec.**	**Secondary**	**Upper sec.**	**Total**
Lower sec.	51.8	34.5	9.3	100
Secondary	13.4	52.7	29.2	100
Upper sec.	7.8	36.3	52.1	100
Total	40.4	37.8	17.3	100

	Son			
Parent	**Lower sec.**	**Secondary**	**Upper sec.**	**Total**
Lower sec.	51.5	32.9	11.8	100
Secondary	17.3	44.1	34.6	100
Upper sec.	9.4	28.5	58.1	100
Total	40.8	34.6	20.6	100

Note: The row entries do not add up to 100 percent because the share of children with missing information is not depicted.

Source: German Socio-Economic Panel (2003), own calculations.

Table 3 Baseline Specification - Educational Attainment of Birth Cohorts 1940 - 1978: Multinomial Logit Estimation

	Pr(y=lower sec.)	**Pr(y=secondary)**	**Pr(y=upper sec.)**
Marginal Effects			
Male	0.030***	-0.074***	0.044***
	(0.011)	(0.011)	(0.009)
Parental education: missing	0.058***	-0.054***	-0.014
	(0.020)	(0.021)	(0.020)
Parental education: secondary	-0.271***	-0.001	0.275***
	(0.010)	(0.015)	(0.015)
Parental education: upper sec.	-0.351***	-0.146***	0.499***
	(0.008)	(0.014)	(0.015)
Birth cohort: 1950-59	-0.152***	0.066***	0.092***
	(0.013)	(0.016)	(0.016)
Birth cohort: 1960-69	-0.217***	0.132***	0.090***
	(0.012)	(0.015)	(0.015)
Birth cohort: 1970-78	-0.217***	0.104***	0.101***
	(0.012)	(0.019)	(0.018)
Number of siblings: 1	0.035**	-0.026	-0.019
	(0.017)	(0.016)	(0.013)
Number of siblings: 2	0.087***	-0.039**	-0.059***
	(0.019)	(0.017)	(0.013)
Number of siblings: 3 or more	0.200***	-0.098***	-0.115***
	(0.019)	(0.017)	(0.012)
Childhood in rural area	0.040***	0.014	-0.048***
	(0.011)	(0.012)	(0.010)
Log likelihood		-9536.4387	
Predicted Probabilities			
Pr(...| parental educ=lower sec.)	0.384***	0.370***	0.176***
	(0.142)	(0.096)	(0.057)
Pr(...| parental educ=secondary)	0.118	0.374***	0.446***
	(0.092)	(0.064)	(0.092)
Pr(...| parental educ=upper sec.)	0.043	0.229***	0.666***
	(0.049)	(0.058)	(0.088)

Note: N = 9,331 observations. The estimation controlled for fixed effects at the level of federal states. The marginal effects are calculated as the mean marginal response to a dummy variable change. The predictions were generated as the average of all individual predicted probabilities (calculated with the individually observed values of the covariates), after the parental education variable was modified.

Source: German Socio-Economic Panel (2003), own calculations.

Table 4 Extended Specification - Educational Attainment of Birth Cohorts 1940 - 1978: Multinomial Logit Estimation: Adding Interactions of Parental Education with Time Trend

(a) Coefficient Estimates

	Pr(y=missing)	**Pr(y=secondary)**	**Pr(y=upper secondary)**
Parental educ.: missing * trend	0.0034 (0.031)	0.0449*** (0.013)	0.0691*** (0.018)
Parental educ.: lower sec. * trend	0.0312 (0.025)	0.0480*** (0.0092)	0.0294*** (0.011)
Parental educ.: secondary * trend	0.0426 (0.028)	0.0430*** (0.011)	0.0291** (0.013)
Parental educ.: upper sec. * trend	0.0646** (0.030)	0.0219 (0.014)	0.0367** (0.015)
Log likelihood	-9504.9641		

(b) Simulation Results: Predicted Conditional Probabilities

	Year=1940	**Year=1960**	**Year=1978**	**Diff. 78-40**	Std. Err.
P(high | parents=lower sec., year)	0.0917	0.1525	0.1549	**0.0632*** **	(0.0178)
P(high | parents=secondary, year)	0.3247	0.4013	0.3908	**0.0661**	(0.0420)
P(high | parents=upper sec., year)	0.4807	0.6392	0.6943	**0.2136*** **	(0.0503)
Diff. parents high – low	**0.3890*** ** (0.0303)	**0.4867*** ** (0.0172)	**0.5394*** ** (0.0310)		
P(low | parents=lower sec., year)	0.6680	0.4169	0.3083	**-0.3597*** **	(0.0288)
P(low | parents=secondary, year)	0.3120	0.1444	0.1018	**-0.2102*** **	(0.0371)
P(low | parents=upper sec., year)	0.1416	0.0603	0.0414	**-0.1002*** **	(0.0310)
Diff. parents high – low	**-0.5264*** ** (0.0270)	**-0.3566*** ** (0.0141)	**-0.2669*** ** (0.0206)		

Note: (i) Labels 'high' and 'low' correspond to upper secondary and lower secondary educational attainment. (ii) The baseline model from Table 3 was extended by four interaction terms. Their coefficient estimates are presented above, where the outcome 'lower secondary education' is the omitted category. (iii) Standard errors are in parentheses. The standard errors in Panel (b) are obtained via bootstrap with 500 repeated draws. (iv) The simulation results were generated as the average of individual predicted values, which were calculated after setting parental education and year of observation to the values described in the table, while all other covariates remained at the individually observed values.

Source: German Socio-Economic Panel (2003), own calculations.

Table 5 Extended Specification - Educational Attainment of Birth Cohorts 1940 - 1978: Multinomial Logit Estimation: Adding Interactions of Sibling and Rural Origin with Time Trend

(a) Coefficient estimates.

	Pr(y=missing)	**Pr(y=secondary)**	**Pr(y=upper secondary)**
Number of siblings=0 * trend	0.0386 (0.030)	0.0282*** (0.011)	0.0291** (0.013)
Number of siblings=1 * trend	0.0508* (0.026)	0.0444*** (0.0098)	0.0409*** (0.012)
Number of siblings=2 * trend	0.0338 (0.027)	0.0385*** (0.010)	0.0411*** (0.013)
Number of siblings=3 * trend	0.0309 (0.027)	0.0381*** (0.010)	0.0193 (0.013)
Childhood in rural area * trend	-0.0062 (0.015)	0.0157*** (0.0055)	-0.0007 (0.0069)
Log likelihood	-9511.2295		

(b) Simulation Results: Rural vs. Urban Origin

	Year=1940	**Year=1960**	**Year=1978**
P(high | urban, year) P(high | rural, year)	0.2169 0.2044	0.2672 0.2254	0.2651 0.2012
Difference	**0.0125** (0.0179)	**0.0418***** (0.0093)	**0.0638***** (0.0177)
P(low | urban, year) P(low | rural, year)	0.3822 0.4520	0.3364 0.3655	0.3840 0.3808
Difference	**-0.0698***** (0.0197)	**-0.0291***** (0.0099)	**0.0032** (0.0241)

(c) Simulation Results: Number of Siblings

	Year=1940	**Year=1960**	**Year=1978**
P(high | sibs3, year) P(high | sibs1, year)	0.1539 0.1929	0.1969 0.2873	0.1853 0.3189
Difference	**-0.0389**** (0.0181)	**-0.0904***** (0.0118)	**-0.1336***** (0.0245)
P(low | sibs3, year) P(low | sibs1, year)	0.6095 0.5133	0.4303 0.2882	0.3601 0.2003
Difference	**0.0961***** (0.0255)	**0.1421***** (0.0124)	**0.1598***** (0.0258)

Note: (i) Labels ‘high’ and ‘low’ correspond to upper secondary and lower secondary educational attainment. (ii) The baseline model from Table 3 was extended by five interaction terms. Their coefficient estimates are presented above. (iii) Standard errors are in parentheses. The standard errors in Panels b and c are obtained via bootstrap with 500 repeated draws. (iv) The simulations are generated as the average of individual predicted values, which were calculated after setting parental education and year to the values provided in the table, while all other covariates remained at the individually observed values.
Source: German Socio-Economic Panel (2003), own calculations.

Table 6 Extended Specification - Educational Attainment of Birth Cohorts 1940 - 1978: Multinomial Logit Estimation: Adding Interactions of Child Sex with Time Trend

(a) Coefficient estimates

	Pr(y=missing)	**Pr(y=secondary)**	**Pr(y=upper secondary)**
Male	0.201 (0.29)	0.0736 (0.11)	0.761*** (0.13)
Male * trend	-0.0180 (0.012)	-0.0186*** (0.0049)	-0.0335*** (0.0059)
Log likelihood	-9519.7957		

(b) Simulation Results

	Year=1940	**Year=1960**	**Year=1978**
P(high | male, year) P(high | female, year)	0.2392 0.1539	0.2926 0.2485	0.2560 0.2725
Difference	**0.0853***** (0.0137)	**0.0441***** (0.0083)	**-0.0165** (0.0169)
P(low | male, year) P(low | female, year)	0.4717 0.5232	0.3085 0.2714	0.3469 0.2374
Difference	**-0.0515***** (0.0187)	**0.0371***** (0.0083)	**0.1095***** (0.0189)

Note: (i) Labels 'high' and 'low' correspond to upper secondary and lower secondary educational attainment. (ii) The baseline model from Table 3 was extended by one interaction term. Their coefficient estimates are presented above. (iii) Standard errors in parentheses. The standard errors in Panel (b) are obtained via bootstrap with 500 repeated draws. (iv) The simulations are generated as the average of individual predicted values, which were calculated after setting sex and year to the values provided in the table, while all other covariates remained at the individually observed values.

Source: German Socio-Economic Panel (2003), own calculations.

Table 7 Extended Specification - Educational Attainment of Birth Cohorts 1940 - 1978: Marginal Effects of Parental Education from Multinomial Logit Estimation by Child Sex

(a) Females (N= 4798)

	Pr(y=lower secondary)	**Pr(y=secon-dary)**	**Pr(y= upper secondary)**
Marginal Effects			
Father's education: missing	0.0065	0.0085	-0.0044
	(0.0305)	(0.0343)	(0.0296)
Father's education: secondary	-0.2215***	0.0441*	0.1749***
	(0.0158)	(0.0250)	(0.0241)
Father's education: upper secondary	-0.2751***	-0.0874***	0.3618***
	(0.0144)	(0.0274)	(0.0275)
Mother's education: missing	0.0378	-0.0412	-0.0270
	(0.0342)	(0.0366)	(0.0298)
Mother's education: secondary	-0.2060***	0.0234	0.1817***
	(0.0181)	(0.0242)	(0.0225)
Mother's education: upper secondary	-0.2689***	-0.0718*	0.3341***
	(0.0190)	(0.0430)	(0.0431)
Log likelihood		-4748.8893	

(b) Males (N= 4508)

	Pr(y=lower secondary)	**Pr(y=secon-dary)**	**Pr(y= upper secondary)**
Marginal Effects			
Father's education: missing	0.0277	-0.0137	-0.0135
	(0.0349)	(0.0357)	(0.0337)
Father's education: secondary	-0.2295***	0.0306	0.2044***
	(0.0191)	(0.0249)	(0.0253)
Father's education: upper secondary	-0.3248***	-0.0603**	0.3857***
	(0.0172)	(0.0278)	(0.0289)
Mother's education: missing	0.0527	-0.0576	-0.0009
	(0.0383)	(0.0360)	(0.0361)
Mother's education: secondary	-0.1703***	-0.0177	0.1845***
	(0.0231)	(0.0239)	(0.0243)
Mother's education: upper secondary	-0.1138**	-0.1467***	0.2481***
	(0.0499)	(0.0390)	(0.0478)
Log likelihood		-4648.2808	

Note: The baseline model from Table 3 was extended by separating fathers' and mothers' education and estimated separately for male and female youth. The marginal effects are calculated as the mean response to a change in the dummy variable and are presented with standard errors in parentheses.

Source: German Socio-Economic Panel (2003), own calculations.

Table 8 Extended Specification - Educational Attainment of Birth Cohorts 1940 - 1978: Coefficients from Multinomial Logit Estimation with Joint Controls for all Time Trend Interactions

	Pr(y=missing)	**Pr(y=secondary)**	**Pr(y=upper sec.)**
Male	0.306	0.240*	0.891***
	(0.30)	(0.11)	(0.14)
Parental education: missing	0.786	-0.273	-1.206**
	(0.49)	(0.24)	(0.39)
Parental education: secondary	0.814	1.213***	2.122***
	(0.43)	(0.17)	(0.18)
Parental education: upper secondary	1.301**	2.131***	3.378***
	(0.49)	(0.23)	(0.23)
Birth cohort: 1950-59	-0.148	0.239*	0.564***
	(0.33)	(0.12)	(0.14)
Birth cohort: 1960-69	-0.155	0.185	0.468*
	(0.53)	(0.19)	(0.24)
Birth cohort: 1970-78	0.208	-0.163	0.258
	(0.74)	(0.28)	(0.34)
Number of siblings: 1	0.056	-0.480**	-0.411*
	(0.49)	(0.16)	(0.19)
Number of siblings: 2	0.312	-0.552**	-0.729***
	(0.51)	(0.17)	(0.21)
Number of siblings: 3 or more	0.123	-0.978***	-0.895***
	(0.50)	(0.17)	(0.21)
Childhood in rural area	-0.291	-0.374**	-0.354*
	(0.33)	(0.12)	(0.15)
Parental educ.: missing * trend	0.018	0.044**	0.086***
	(0.04)	(0.01)	(0.02)
Parental educ.: lower secondary * trend	0.045	0.045***	0.045**
	(0.03)	(0.01)	(0.01)
Parental educ.: secondary * trend	0.055	0.043***	0.044**
	(0.03)	(0.01)	(0.01)
Parental educ.: upper secondary * trend	0.078*	0.022	0.051**
	(0.03)	(0.02)	(0.02)
Number of siblings=1 * trend	0.010	0.017*	0.012
	(0.02)	(0.01)	(0.01)
Number of siblings=2 * trend	-0.008	0.011	0.011
	(0.02)	(0.01)	(0.01)
Number of siblings=3+ * trend	-0.009	0.010	-0.012
	(0.02)	(0.01)	(0.01)
Childhood in rural area * trend	-0.003	0.015**	0.001
	(0.01)	(0.01)	(0.01)
Male * trend	-0.025*	-0.028***	-0.041***
	(0.01)	(0.01)	(0.01)
Log Likelihood		-9468.5764	

Note: Controls for federal state fixed effects and the constant are not presented to save space. We tested for the joint statistical significance of the groups of time trend interactions and obtained the following p-values: parental education < 0.1 percent, number of siblings 12.1 percent, childhood in rural area 3.3 percent, male < 0.1 percent.

Source: German Socio-Economic Panel (2003), own calculations.

Table 9 Baseline Specification - Educational Attainment by Birth Cohort Groups

(a) Descriptive Statistics by Birth Cohort Group

	Mean (1940-52)	**Mean (1953-65)**	**Mean (1966-78)**
Gender: male	0.4998	0.4788	0.4743
Childhood in rural area	0.3504	0.3675	0.3111
Number of siblings: 0	0.1831	0.1275	0.1475
Number of siblings: 1	0.3208	0.3014	0.4312
Number of siblings: 2	0.2323	0.2719	0.2321
Number of siblings: 3 or more	0.2636	0.2990	0.1890
Education: Missing	0.0234	0.0197	0.0310
Education: Lower secondary	0.4905	0.3443	0.2519
Education: Secondary	0.2857	0.3832	0.4283
Education: Upper secondary	0.2003	0.2527	0.2886
Highest parental educ.: Missing	0.0564	0.0758	0.0868
Highest parental educ.: Lower sec.	0.6585	0.6617	0.5331
Highest parental educ.: Secondary	0.1459	0.1435	0.2426
Highest parental educ.: Upper sec.	0.1390	0.1187	0.1374
N	2905	3755	2671

(b) Marginal Effects from Multinomial Logit Estimation

	Pr(lower sec.) 1940-52	**Pr(lower sec.) 1966-78**	**Pr(sec.) 1940-52**	**Pr(sec.) 1966-78**	**Pr(upper sec.) 1940-52**	**Pr(upper sec.) 1966-78**
Marginal Effects						
Male	-0.0607***	0.0851***	-0.0313*	-0.1023***	0.0939***	0.0208
	(0.0208)	(0.0165)	(0.0184)	(0.0200)	(0.0147)	(0.0188)
Par. educ.: missg.	0.0670	0.0162	0.0243	-0.0510	-0.1156***	0.0325
	(0.0443)	(0.0271)	(0.0429)	(0.0380)	(0.0259)	(0.0403)
Par. educ.: secondary	-0.3249***	-0.2046***	0.0491**	-0.0549**	0.2780***	0.2603***
	(0.0228)	(0.0147)	(0.0271)	(0.0251)	(0.0283)	(0.0252)
Par. educ.: upper sec.	-0.4785***	-0.2451***	0.0386	-0.2768***	0.4476***	0.5144***
	(0.0172)	(0.0121)	(0.0271)	(0.0257)	(0.0283)	(0.0268)
# Sibl. = 1	0.0936***	0.0125	-0.0666***	0.0251	-0.0352*	-0.0411
	(0.0303)	(0.0262)	(0.0251)	(0.0307)	(0.0186)	(0.0265)
# Sibl. = 2	0.1219***	0.0740**	-0.0683**	-0.0047	-0.0699***	-0.0713**
	(0.0320)	(0.0313)	(0.0263)	(0.0341)	(0.0182)	(0.0276)
# Sibl. = 3 +	0.2235***	0.1700***	-0.1547***	-0.0244	-0.0833***	-0.1545***
	(0.0301)	(0.0357)	(0.0242)	(0.0361)	(0.0179)	(0.0251)
Childh: rural area	0.0904***	-0.0048	-0.0533***	0.0752***	-0.0367**	-0.0594***
	(0.0221)	(0.0175)	(0.0200)	(0.0225)	(0.0158)	(0.0207)
Trend	-0.0107***	-0.0001	0.0038	-0.0072***	0.0072***	0.0045*
	(0.0027)	(0.0022)	(0.0024)	(0.0027)	(0.0019)	(0.0025)
N	2905	2671	2905	2671	2905	2671
Log likelihood	-2806.74	-2744.74	-2806.74	-2744.74	-2806.74	-2744.74

Note: The marginal effects are calculated as the mean response to a change in the dummy variable.
Source: German Socio-Economic Panel (2003), own calculations.