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The intergenerational transmission of educational attainment in East and West Germany

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Abstract

Socialist societies often emphasized the abolition of traditional social classes. To achieve this objective, educational opportunities were at times "actively managed" and allocated to children of less educated parents. What happened to these patterns after the demise of socialist rule in Eastern Europe? We study the development of educational mobility after the fall of the iron curtain in East Germany and compare the relevance of parental educational background for secondary schooling outcomes in East and West Germany. Based on data from the German *Mikrozensus* we find that educational mobility is lower in East than in West Germany and that it has been falling in East Germany after unification. While the educational advantage of girls declined over time, having many siblings presents a more substantial disadvantage in East than in West Germany.

Zusammenfassung

In sozialistischen Ländern wurde oft die Auflösung sozialer Klassen angestrebt. Dazu wurden vor allem Kinder von weniger gebildeten Eltern aktiv in ihrer Bildungskarriere gefördert. Was passierte mit diesem Muster nach dem Fall der Mauer in Ostdeutschland? Wir untersuchen die Entwicklung der Bildungsmobilität zwischen Eltern und Kindern in Ostdeutschland nach dem Fall der Mauer und vergleichen die Relevanz der Elternbildung für den Besuch eines Gymnasiums von 17 jährigen Jugendlichen in Ost- und Westdeutschland über die Zeit. Daten des Mikrozensus zeigen, dass die Bildungsmobilität in Ostdeutschland sogar geringer als in Westdeutschland ist und nach dem Fall der Mauer noch gefallen ist.

JEL classification: I21, I28, J11

Keywords: education transmission, intergenerational mobility, equality of opportunity, schooling, human capital, transition economy, Mikrozensus

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1 Introduction

Intuitively, one might have expected that the liberation of Eastern European former socialist countries after 1990 contributed to enhanced opportunities and a richer set of individual career options. However, concomitant with the ensuing economic crises and substantial drops in national GDPs also educational opportunities dwindled: for the case of Bulgaria, Hertz et al. (2009) discuss the closure of public schools, rising out-of-pocket expenditures and falling returns to education in times of high unemployment as the main causes of falling educational attainment and indeed a doubling of intergenerational immobility. Mateju et al. (2003) discuss the case of the Czech Republic. Here, similarly, social origin increasingly determines educational outcomes in the post-socialist period. The authors see funding problems of the education system on the one hand and increasing income inequality on the other hand at the origin of the increasingly elitist character of Czech higher education. Hazans et al. (2008) study the development in the three Baltic countries and find that the impact of paternal education and income increased during transition. Thus, after a general increase in intergenerational educational mobility in Eastern Europe up through the 1980s (Ganzeboom and Nieuwbeerta 1999) the post-socialist transformation appears to have brought a return to educational immobility.¹

This paper studies the development of educational mobility in East Germany after unification. The East German case is of special interest for at least two reasons: first, even though the East German economy experienced a substantial crisis after unification and unemployment was high with official rates reaching 20 percent,² funding for the East German education system was provided by transfers from West Germany. Thus, budget cuts as a cause of reduced educational opportunities should not be central here. Also, East Germans could migrate to West Germany where wages were high and unemployment comparatively low.³ This differentiates the East German case from other Eastern European countries. Second, after unification, the East German education system was modelled after its West German counterpart. This provides a natural benchmark in the evaluation of intergenerational educational mobility in East Germany. We study whether the patterns of intergenerational educational mobility differ between East and West Germany and how they have developed since the early years of unified Germany. The situation right after unification may approximate the initial East-West comparison with respect to educational opportunity. The development over time then indicates the relevance of German educational institutions as determinants of intergenerational education transmission.

¹ For a discussion of Poland see Beblo and Lauer (2004) and for Hungary Varga (2006).

² Inofficial unemployment rates, counting open and hidden unemployment, reached 35 percent (SVR 1994).

³ Hunt (2006) shows that the migration decision of young East Germans since unification has been sensitive to wages while older East Germans responded more strongly to source-region unemployment. This is confirmed by Fuchs-Schündeln and Schündeln (2009) who consider more recent data and separately evaluate the age and gender composition of migrants.

While the issue of intergenerational education transmission, its determinants, patterns, and developments has been discussed frequently in empirical studies of the German education system, we found no study which specifically looked at the situation in East Germany.⁴ Following the international literature on intergenerational mobility in educational attainment we chose a descriptive approach to compare educational outcomes, mobility, and further correlates of educational choices in East and West Germany since unification. Typically, three factors are cited to explain educational mobility: genetics, parental behaviour, and educational institutions. We do not attempt to identify causal effects of "nature" (or genetic effects) and "nurture" (or behavioural effects) in the relationship between parent and child educational outcomes.⁵ Also, we do not focus on the relevance of specific institutional aspects in the secondary education system.⁶ Our analysis is based on large cross-sectional datasets of the German *Mikrozensus* gathered between 1991 and 2004. This allows us to follow developments in educational choices and intergenerational education transmission over time and to distinguish regional and other subsamples.

This study contributes to the literature in three ways: first, we are the first to draw attention to differences in educational attainment and mobility patterns between East and West Germany and to relate East German developments to those in other transition economies. Second, we provide evidence on changes in educational mobility in East and West Germany over time. Finally, we approach the issue of equality of educational opportunity from a variety of perspectives in addition to intergenerational effects and describe, for instance the correlation between child educational outcomes and gender, the number of siblings, and rural vs. urban residence over time and in East and West Germany.

This extends the analysis of Heineck and Riphahn (2009), which studies the correlation patterns between parent and child educational outcomes for the birth cohorts 1940-1978 in West Germany. They apply data from the German Socioeconomic Panel and find substantial improvements in the level of secondary educational attainment over time. However, the relative opportunities of children of parents with low education did not improve compared to those of children of parents with high education, and no group benefited more from the education expansion than children from advantaged backgrounds, namely those with few siblings, in urban areas, and with highly educated parents.

⁴ Couch and Dunn (1997), Dustmann (2004), Heineck and Riphahn (2009), Henz and Maas (1995), Lauer (2003), Müller and Haun (1994), Riphahn and Schieferdecker (2008), and Tamm (2008) all exclusively use evidence from West Germany. Schnepf (2002) and Wößmann (2008) appear to consider East German observations in their PISA and TIMSS test data but do not evaluate East-West differences.

⁵ For studies pursuing this avenue see e.g. Black et al. (2005), Sacerdote (2002), or Plug and Vijverberg (2003).

⁶ For studies on such school design issues see e.g. Hanushek and Woessmann (2006) and Woessmann (2010) on the relevance of tracking regimes, or Currie (2001) on the age at school entry or Deming and Dynarski (2008) on pre-school education.

Changes in educational mobility over time have rarely been addressed. Among sociological contributions Blossfeld (1993) looks at West German birth cohorts 1916-1965. 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 1910-1969 and conclude that the relevance of parental social class for child educational outcomes declined over time (see also Henz and Maas (1995)). Economic analyses of intergenerational education mobility mostly neglect the perspective of changes over time and instead determine an average indicator of the correlation between child and parent educational attainment (e.g. Couch and Dunn (1997), Lauer (2003), or Dustmann (2004)).

While these authors typically focus on the intergenerational correlation of track choices, a few contributions study intergenerational mobility based on test score outcomes instead: Woessmann (2008) compares the correlation between parental background and youth test scores using the 1995 TIMSS (Third International Mathematics and Science Study) data for 18 countries. Schuetz et al. (2008) present similar evidence on a cross-section of 54 different countries. These cross-sectional analyses do not separate East and West Germany. However, they show that parental background is more important for child education in Germany than in most other countries. Generally, Schuetz et al. (2008) list the transition economies in the group of countries with low equality of educational opportunity.⁷ Woessmann (2010) evaluates the impact of educational institutions on the performance of 15 years olds as well as on the equity of educational opportunities using 2003 data from the PISA (Programme for International Student Assessment) survey. Here, average equity is slightly higher in the East than in the West German states. However, developments over time are not investigated.

Our main findings can be summarized as follows: the cohort share of East German youth attending Advanced School, which is the most academically oriented secondary school track, has increased substantially after unification and - starting from much lower initial attendance rates - has almost reached West German levels. This increase in educational attainment in the East, however, has not been accompanied by a development towards higher intergenerational educational mobility. Instead, intergenerational mobility declined by absolute and relative measures since unification: contrary to the cross-sectional results of Woessmann (2010) the relevance of parental background for child educational success is now higher in East than in West Germany, Advanced School participation increased particularly among children of higher educated East German parents. At the same time, gender differences became more balanced in the East where males started to catch up to females over

⁷ Out of a group of 54 countries ranked by inequality of opportunity (with 1 being the most unequal) we observe Hungary on position 4, Germany on 5, Macedonia on 7, the Slovak Republic on 8, Bulgaria 9, Lithuania 11, the Czech Republic 14, Slovenia 15, Russia 22, and Romania 24. Only Latvia (33) and Moldova (35) are in the bottom half of the distribution.

time. When comparing children from differently sized families, those with few siblings advanced further than those with many and the difference is larger in East than in West Germany.

2 Institutional Background

2.1 Secondary Education in Former East and West Germany

Historically, secondary education in Germany is organized in a threefold track system. This implies a hierarchical order in terms of academic reputation, financial returns to educational degrees, and subsequent educational opportunities.⁸

West German pupils start primary school at the age of 6. Typically, after four years they chose one out of three alternative secondary school tracks: Basic Schools (*Volksschule / Hauptschule*) last another 6 years and prepare for apprenticeships or vocational schools. Middle Schools (*Realschule / Mittelschule*) also provide 6 years of instruction and typically prepare pupils for training in white collar jobs. Only at Advanced School (upper secondary school, *Gymnasium*) education continues for an additional 8 or 9 years. The Advanced School degree (*Abitur*) is required for university admission. Thus educational choices taken at the end of primary school at age 10 are important, even though the educational system increasingly offers ways to modify past tracking choices. The regulations which govern the transition from primary to secondary school vary by federal state. Some states are restrictive and allow only pupils with the best grades to enter Advanced School. Others are more flexible and give parents more say in the choice of the secondary school track for their child.⁹

The education system in East Germany prior to unification differed in a number of respects (see Figure 1). First, children entered primary school typically at the age of 6 or 7 years. In most cases they had already attended Kindergarten for about three years which conferred some first elements of instruction.¹⁰ As a second difference relative to the West German secondary school system there was no ability-based tracking in East Germany. Instead, everybody attended *Polytechnische Oberschule* (POS). Those who dropped out after grade 8 or 9 are considered to have an education that is equivalent to the West German Basic School. Finishing POS after grade 10 is considered to be equivalent to the West German Middle School. A third difference is that in the East German schooling system around 10 percent of each birth cohort was admitted to *Erweiterte Oberschule* (EOS), where pupils could attain the *Abitur* (cf. Fuchs-Schündeln and Schündeln 2005). As in the West, only the *Abitur*

⁸ For analyses of educational mobility in the similarly structured Swiss secondary school system see e.g. Bauer and Riphahn 2006 and 2007.

⁹ For a detailed discussion of the German secondary education system see Schnepf (2002).

¹⁰ For details on early childcare in East and West Germany see Felfe and Lalive (2010).

degree granted eligibility to tertiary education.¹¹ For some birth cohorts EOS pupils were separated already after grade 9 from POS, for other birth cohorts that happened only after grade 10. East German pupils regularly attained their *Abitur* degree after 12 years in school compared to 13 years in West Germany.

Figure 2 depicts the distribution of completed secondary school degrees for the birth cohorts 1935 through 1970 in East and West Germany, who attended and completed secondary school prior to reunification. The data are taken from the *Mikrozensus* surveys and describe the resident native population in East and West Germany in the survey year.¹² Three differences between East and West German degree distributions stand out: (a) the cohort share attaining the *Abitur* is much higher in the West than in the East. (b) The socialist education system generated very little heterogeneity as the vast majority of the population leaves school with the POS degree.¹³ (c) In East Germany, the number of individuals indicating that they left school with a basic school certificate dropped to below twenty percent already for the birth cohort of 1950.¹⁴

2.2 The Transition Process

Historically, the East German school system took over West German institutions after unification. Already prior to the formal unification on Oct. 3, 1990 numerous meetings between official East and West German educational policy bodies had taken place to prepare the re-organization of the East German institutional framework.¹⁵ Since conservative parties won the first free East German election of March 18, 1990 and conservative parties ruled in West Germany at the time, the unification treaty and preparatory measures were shaped by their ideas. The treaty copied the West German educational governance rules to the East and assigned the responsibility for education policies to the level of federal states which were to be established

¹¹ Those, who did not commence EOS education, could attain a "restricted *Abitur*" by combining an apprenticeship with additional schooling in a three year program (BmA, *Berufsausbildung mit Abitur*). The "restricted *Abitur*" allowed them to take up studies in fields related to their apprenticeship. They took a year longer to the *Abitur* than through the EOS pathway. In addition, the system provided for alternative routes to tertiary education by means of vocational schools, which, however, only few individuals took.

¹² In order to depict the distribution of educational degrees in East Germany at the time of unification, i.e. prior to east-west migration, we present results of the spring 1991 survey. Because east-west migration has a smaller impact for West Germany we use the most recent survey of 2007 here.

¹³ Unfortunately, the data do not provide details on the number of grades after which the POS degree was conferred. Thus we cannot measure the population share leaving after grade 8 vs. grade 10, i.e. with basic versus middle school equivalent degrees.

¹⁴ It is not obvious why East German birth cohorts at all indicate Basic School attainment after POS had been introduced in 1959. One explanation may be that these individuals had migrated to the East from West Germany, where they had obtained a Basic School degree. Alternatively, individuals may have considered the value of their POS degree as comparable to a traditional basic school degree, when asked in the survey. Below we test the robustness of our results when we give up the distinction between Basic School and POS degrees for East Germany.

¹⁵ For a detailed account see e.g. Fuchs (1997).

in East Germany. Meanwhile, East German education policy had to solve problems related e.g. to ideology-based instruction, teaching materials, local school governance and choice of headmasters, language instruction (English vs. Russian), or cooperation of schools with politically oriented youth organizations. After the unification treaty of August 31, 1990 the federal states took over responsibility in educational policies. The first state elections in East Germany took place October 14, 1990. The subsequently established state-specific secondary schooling system depended on the outcome of the election. In most regions the conservatives won and established the tracked West German secondary education system. Only in the state of Brandenburg social democrats with a preference for a more comprehensive school system dominated.

Even after the states and their governments were established, the discussion about the structure of the secondary education system continued for a few years. Most school laws were passed in the mid 1990s. In all five East German states Advanced Schools (*Gymnasien*) were established, which prepared for the *Abitur* degree. In three states (Thuringia, Saxony, Saxony-Anhalt) basic and middle schools were combined in one. The state of Mecklenburg-Westpomerania merged the two tracks later. Only Saxony never established comprehensive schools. In sum, all states copied the dominant "hierarchical" position of Advanced Schools in the secondary school system. Therefore it is meaningful to conduct an analysis which investigates the correlates of Advanced School attendance in East and West Germany.

2.3 Aggregate Statistics

Before we study micro-data, this section briefly describes the development of East and West German secondary educational attainment and school quality from an aggregate perspective. Figure 3 presents the development of cohort shares with basic school, middle school, and Advanced School degrees for birth cohorts 1970-1986 in both regions after unification. The graph shows the transition of institutions in East Germany with a decline of POS and an increase in West German type Middle and Basic Schools for birth cohorts after 1974. We also see a fast increase in Advanced School attainment among the East German birth cohorts after 1970, from 17.3 percent in 1970 to 35.9 percent in 1985. In the end, only a small East-West difference remains.

A comparison of the development of nominal expenditures per pupil by state and year in West and East Germany yields that average schooling expenditures per pupil are similar and now even higher in East than in West Germany (see Figure A.1 in the Appendix). Thus, to the extent that expenditures can serve as an indicator, average quality should not differ substantially between the two regions. To gauge average distance to Advanced Schools as a proxy for individual travelling costs, we calculated the number of Advanced Schools in a given state relative to the state area for non city-states in East and West Germany (see Figure A.2 in the Appendix): in East German states there are on average about 6 Advanced Schools in 1000

square-kilometers, compared to more than 10 in the West. Thus on average the individual cost of reaching an Advanced School might be higher in East than in West Germany, if population density and distribution are comparable in the two regions. A final indicator of educational quality may be the number of students at Advanced Schools per teacher. We find increasing numbers of students per teacher in the West and declining numbers in the East (see Figure A.3 in the Appendix). While this development may be connected to demographic changes in the East,¹⁶ it also indicates that educational quality might be high in East Germany. This is further supported by positive outcomes for East German pupils in student competence tests (PISA-Konsortium 2005).

3 Data and Descriptive Evidence

3.1 Data Issues

Our empirical analysis is based on data from the German *Mikrozensus*, an about annually administered survey, which collects data on one percent of the German resident population. Participation is mandatory. The *Mikrozensus* has been conducted since 1957 in West Germany and since 1991 in East Germany. A typical survey contains information on about 390,000 households and 830,000 individuals.

There are several reasons why *Mikrozensus* data are particularly useful to study the development of regional educational mobility over time: first, we need information on both, the education of parents and their children. Both can be measured reliably with the *Mikrozensus* when focusing on secondary school attendance of 17 years olds, who typically still live in the parental household.¹⁷ At age 17 we can determine whether youths attend Advanced School and we can match the information of children and parents in a given household to describe the intergenerational transmission of education. A second advantage of the *Mikrozensus* is its size. Given that we look at 17 years olds only and split the sample further, e.g. by region and gender, most surveys would not provide sufficiently large samples to generate reliable results. Third, the *Mikrozensus* has been using the identical questionnaire over a long period of time. Therefore the information allows for reliable comparisons.

Lengerer et al. (2007) harmonized parts of the *Mikrozensus* data for the survey years 1962-2004. We use these harmonized data for the years 1991, 1993, 1995, 2000, and 2004.¹⁸ East Germany is covered since 1991, the first year of our East-West comparison. We inspect the situation every four to five years. However, as the adjustment process in East Germany might have been concentrated in the first

¹⁶ East German fertility dropped at unification from about 1.8 to 0.8 and has been recovering to the West German level of 1.4 since then.

¹⁷ Rübenach and Weinmann (2008) show that as of 2007 about 98 percent of male and 95 percent of female 17 years olds still live with their parents.

¹⁸ The 2004 survey is the last one available in harmonized format and which is collected during one single survey week. If we were to use more recent data the education outcome might be affected by the modifications in data collection.

years after unification we add the survey of 1993 to our sample (the data for 1992 and 1994 are not available).

We study the resident population of East and West Germany over time, when substantial migration occurred in both directions. The literature investigating these migration flows agrees that those migrating from East to West were higher educated, younger, less likely to be married, and better qualified in unobservable ways than those who stayed in East Germany.¹⁹ If we were interested in the educational mobility of the East German population as of the end of the German Democratic Republic, migration could invalidate our results if those who left the East differed in their intergenerational mobility from those who stayed. However, we are not interested in the East German population as a fixed and time constant group but instead investigate the development of the situation in East Germany over time. If we find that educational mobility changed then migration streams might be one of several explanatory factors. It is important to note that we focus on the educational attainment of the birth cohorts 1974-1987. For migration to affect our results their parents would have had to migrate in a non-random fashion. However, we know that married couples and families are not likely to migrate. In addition, those migrating had to differ in their propensity to transmit their educational attainment to their children from those who stayed. This is not an obvious correlation to expect.²⁰ Therefore migration is not a concern for our analysis.

Out of all 17 years olds, we can consider only those with information on at least one parent. The data identify married parents with their children as one family. If both parents live with their child but are not married, only one of them is coded to live in a family with the child. The data considers the other parent to be a separate family in the same household. Here, our single parent indicator captures situations where a non-married parent lives in the same household.

We only consider German citizens to avoid measurement problems with foreign schooling degrees. We drop 75 observations of youths with missing information on their current education. Our sample then holds 17,439 observations of 17 years old youths for West and 5,794 observations for East Germany (see Table 1).

Our dependent variable describes whether an individual attends Advanced School. Figure 4 describes Advanced School attendance in the two regional subsamples over time separately for male and female youths. The cohort share attending Advanced School in East Germany is initially much below that observed in West Germany but catches up rapidly. In both regions of the country the share of females attending Advanced School is above the share of males. While East German fe-

¹⁹ See e.g. Brücker and Trübswetter (2007), Hunt (2006), Fuchs-Schündeln and Schündeln (2009), Uhlig (2008) and studies cited there.

²⁰ Woessmann (2008) shows that there is little variation in family background effects across the student ability distribution.

males fast reach the Advanced School participation rates of their western peers, Advanced School participation among East German males remains below western levels throughout.

Our most important explanatory variables are indicators of parental education. If the education of two parents is available, we use the higher of the two available schooling degrees. Parental education is coded using indicators of missing information (including no degree), low, middle, or high education. Low education characterizes parents with a Basic School degree. Middle education is coded for parents with Middle School degree or a *Polytechnische Oberschule* (POS) degree from East Germany, and high education describes parents with Advanced School degrees (*Abitur*). Figure 5 characterizes the distribution of parental educational background over time in East and West. The shift in parental educational attainment to higher categories reflects the educational expansion of recent decades. Over the entire period the share of East German parents with an Advanced School degree is similar to that of West German parents (see Table A.1 in the Appendix). Certainly, East and West German parents with a given educational level did not receive identical instruction as the educational systems differed in many dimensions. However, in both societies educational degrees were indicators of social status, a requirement for academic training, and typically conferred based on ability. Therefore it is meaningful to compare outcomes for East and West German parents with similar levels of formal education.²¹

As additional control variables we consider youth gender and the age of the older parent, assuming, that older parents are more settled and can afford to invest more time and money in their children. We control for whether there is a single father or a single mother, the number of siblings living in the household (zero being the reference). Federal state fixed effects are included to account for different schooling systems. The indicator for urban (vs. rural) residence describes whether an individual lives in a town with more than 20,000 inhabitants. Descriptive statistics on the explanatory variables are summarized in Appendix Table A.1.

3.2 Descriptive Evidence on Education Mobility

Table 2 presents a transition matrix for East and West Germany across all survey years and confirms the strong intergenerational educational correlation in East and West Germany: the probability for a 17 years old to attend Advanced School in West Germany increases by 200 percent (to a factor 3) if at least one parent holds an Advanced School rather than a basic school degree (see bottom row). This amounts to even 243 percent (or factor 3.43) in East Germany. The absolute differences in

²¹ In his comparison of the impact of parental background for child educational outcomes across 18 countries Woessmann (2008) uses both, the level of parental education as well as the number of books in the parental household, where the number of books is more comparable across countries. Our data, unfortunately, do not contain this indicator, which is why we use parental education outcomes.

the probability of attending Advanced School are similar in East and West Germany and reach a 40 percentage points advantage for children of high vs. low educated parents.

Next, we investigate how the conditional probabilities of Advanced School attendance developed in the two regions over time (see Table 3). We consider both, the relative and absolute difference in the probability to attend Advanced School for different parental education outcomes. Among West Germans (see Panel A) the relative advantage of children with high vs. low educated parents declined from a factor of 3.41 in 1991 to 3.06 in 2004. This development is paralleled by a decline in absolute differences over time. Thus, the disadvantage of children of parents with basic school education declined but they are still only one third as likely to attend Advanced School compared to children of highly educated parents. At the same time, the relative and absolute difference in the probability of attending Advanced School for children of highly educated parents compared to children of parents with a middle school degree stayed about constant.²²

Even though Advanced School attendance in East Germany increased from 21 to 34 percent over time (see Panel B) the evidence does not indicate a trend towards higher mobility there: three out of four immobility indicators increased over time, at times even substantially. This suggests that relative and absolute educational enrollment probabilities now depend more on parental background than they did immediately after unification. The distribution of educational opportunity has become more unequal.²³ The bottom rows in Table 3 show that the share of parents with Advanced School degrees in East Germany increased only slightly over time and did not yet reach recent West German levels.

4 Multivariate Analysis

The descriptive statistics yielded similar patterns for the correlation between parent and child education in East and West Germany in 1991 and declining mobility in East Germany since. These descriptions do not account for composition effects. In multivariate Probit regressions we estimate the correlation between parental characteristics and child Advanced School attendance, conditioning on potentially relevant covariates.

²² The figures in Table 3 match results of Heineck and Riphahn (2009, Figure 4) who generate similar ratios based on the German Socioeconomic Panel. The decline in the propensity of children of highly educated parents to attend Advanced School (see row 3) is connected to the increase in the share of parents holding Advanced School degrees over time (see bottom rows).

²³ The unusual increase in the probability of Advanced School attendance among children of East German basic school educated parents in 2000 is likely connected to the decline in the total number of parents with basic education (cf. Figure 2.2 and Figure 5) in East Germany from about 17 percent of the parents in 1991 to about 4 percent of the parents in 2004. With fewer observations the resulting shares are less stable.

As a first step of our analyses we investigate the average correlation between parental education (PE), individual and household characteristics (X), and child Advanced School enrollment (AS) for East and West Germans. As we are interested in differences between East and West Germany, we consider interaction terms for East German observations (East):

$$\Pr (AS_i = 1) = \Phi (\beta_0 + \beta_1 PE_i + \beta_2 X_i + \gamma_1 PE_i \text{ East}_i + \gamma_2 X_i \text{ East}_i + \beta_3 FE_i).$$

Here i indicates the individual youth, Φ represents the cumulative standard normal distribution function, β and γ are parameters to be estimated, and FE stands for a vector of year and state fixed effects. This specification allows us to test whether correlation patterns differ significantly between East and West Germany.

Results of the probit estimation are presented in Table 4. The coefficient estimates in column 1 describe West German patterns, those in column 2 indicate deviations for East German 17 years olds from West German patterns. The results suggest that a number of correlations are significantly different for East and West Germany. In particular, the coefficient vector γ_1 for the East German interaction of parental education is jointly significant at the one percent level: the disadvantage of children of parents with only middle school education appears to be substantially larger in East compared to West Germany. Surprisingly, men differ more strongly from women in the East, and urban residence seems to be less helpful for educational enrollment in the East than in the West. In both regions, children with one sibling have the highest probability of attending Advanced School with slightly larger disadvantages for children from larger families in the East than in the West.

Since the interpretation of interaction terms in nonlinear models is somewhat involved (Ai and Norton 2003), we calculated predicted probabilities of Advanced School attendance at sample characteristics separately by parental education for both regions and averaged across survey years (see bottom of Table 4). The predictions are close to the aggregate figures in Table 2 and show that the probability to attend Advanced School declines with parental schooling.

Besides investigating average differences, we are interested in changes over time. To measure such developments in the most flexible way we re-estimate the probit model separately by region and survey year. This allows for heterogeneity in all covariate effects over time and by subsample. We do not depict estimated coefficients or marginal effects, but instead generated average predicted probabilities for child Advanced School attendance at the observed characteristics of the sample.

Table 5 shows the predicted annual probabilities by parental education for the 17 years olds between 1991 and 2004 in East and West (see rows numbered 1-3 in Panels A and B). While general Advanced School attendance remained about constant in West Germany (see row labeled "Average") we see an increase in the East by more than 60 percent from 21 to 34 percent. The children of highly educated parents residing in the East appear to have caught up with their counterparts in West

Germany as about 60 percent attend Advanced School. However, the predicted average Advanced School attendance rates among children of parents with basic and middle school degrees in the East are still significantly below those in West Germany: in 2004, 14 and 27 percent attended Advanced School in East Germany compared to 21 and 39 percent in West Germany. Similar to the unconditional results in Table 3, the falling relative and absolute differences (see bottom rows of Panel A, Table 5) indicate that educational mobility increased over time in the West. In the East, the differences in Advanced School attendance by parental educational background are not all statistically significant. However, the general patterns show that they grew over time (see the last two columns). The multivariate results thus confirm that educational mobility and equality of opportunity declined in East Germany and are now below that in West Germany.

As the basic school outcome among East German parents might reflect some measurement error - this track was abolished as early as 1959 - we performed a robustness test: instead of estimating the correlation between basic and middle school educated parents separately we combined the categories and redid the analysis. The results are presented in Panels C and D of Table 5. The results confirm increasing educational mobility in West Germany. In East Germany the relative difference declined somewhat between 1991 and 2004 but the absolute difference in predicted Advanced School attendance probabilities increased over time. These results are slightly more ambiguous than those in Panel B, however they do not yield improvements in educational mobility in East Germany. Overall the children of well educated parents quickly caught up with West German education patterns, while the children of parents with lower education in East Germany did not.²⁴

Equality of educational opportunity is limited if parental educational background has strong effects on child educational attainment. Similarly, educational opportunity may be unequally distributed with respect to students' gender, family size, and rural residence. We evaluate the correlation of these outcomes with Advanced School attendance in East and West Germany over time in Tables 6.1-6.3. Again, predictions were generated based on separate estimations by region and year. Generally, women are significantly more likely to attend Advanced School than men. This difference has increased in relative and absolute terms over time in West Germany, while it declined in the East (see bottom rows of Table 6.1). Whereas in the East boys caught up more than girls over time, attendance rates in the West increased only for girls (see rightmost columns of Table 6.1).

²⁴ This suggests that the impact of East-West differences in parental ability sorting across educational degrees is limited. One might expect parents with less than Advanced School degrees in East Germany to possess more unobserved ability than their West German counterparts. Apparently they did not succeed in passing this advantage on to their offspring by way of higher quality schooling.

The association of the number of siblings with educational enrolment indicates that family time and budget constraints may still be binding. Generally, the literature does not focus on the educational success of single children. Instead, the relevance of constraints is typically identified by comparing the impact of one versus more siblings. This is why we compare predicted outcomes for families with at least two ("One sibling") versus families with more children ("More than one sibling") (see bottom of Table 6.2). Overall, having just one sibling appears to be correlated with a slightly higher probability of attending Advanced School compared to having more than one sibling. While the relative disadvantage of children from large families decreased somewhat in West Germany since 1991 (see bottom rows of panel West), it has increased strongly in the East from no difference in 1991 to a 32 percent higher probability of Advanced School attendance in small families in 2004. This ratio is significantly different from one. The probability of attending Advanced School in West Germany increased most for those with many siblings and in the East it increased most for single children. These opposite regional developments support the notion that social mobility did improve somewhat over time in the West while it worsened in East Germany.²⁵

In Table 6.3 we inspect whether children growing up in the countryside are disadvantaged in their Advanced School attendance compared to those being raised in urban areas. The rationale for such a disadvantage is connected to the higher cost of transport for these youths. Riphahn and Heineck (2009) found clear differences in opportunities. Average predicted probabilities in Table 6.3 show slight disadvantages for rural children, which are significant only in relative terms. This difference stayed about constant in West Germany and disappeared in the East by 2004.²⁶

5 Conclusions

This is the first study to investigate educational mobility in East and West Germany after unification. Our empirical analysis is based on the German *Mikrozensus* (1991-2004) and measures the correlation between child secondary school choice at age 17 and parental education. We compare schooling outcomes and educational mobility in East and West and evaluate developments over time.

Historically and prior to unification, the East German secondary school system provided restrictive access to Advanced School for about 10 percent of any birth cohort compared to almost 30 percent in West Germany. As of 1991, the probability of holding an Advanced School degree and of attending Advanced School was much

²⁵ One might argue that selective East German fertility adjustments affect the shift in these correlations over time. However, as all our youths were still born under socialist system any education-specific fertility adjustment after reunification would not show up in our sample.

²⁶ The only definition of rural origin that could be used in all *Mikrozensus* surveys refers to communities with fewer than 20,000 inhabitants. In contrast, Heineck and Riphahn (2009) applied subjective information, where about one third of the respondents indicated that they grew up in the countryside.

lower in East than in West Germany. However, adjustments occurred rapidly. Already in 1993, the cohort share of East German 17 years olds attending Advanced School had almost reached West German levels. With respect to the development of parent-child educational correlation patterns, descriptive evidence indicates that intergenerational mobility increased slightly in West Germany and declined in the East after unification.

We apply multivariate probit analyses to determine the correlation of parental education and the probability that a 17 years old attends Advanced School. Parental education is significantly correlated with child education and the correlation patterns differ significantly between East and West. We estimated our model separately for each survey year and region to study the development of the association between parent and child education over time. The results confirm that - similar to other post-socialist countries (see e.g. Hertz et al. 2009, Hazans et al. 2008, and Mateju et al. 2003) - intergenerational mobility declined in East Germany since 1991.

In separate estimations we evaluated the correlation of youth educational choices with gender, family size, and rural vs. urban origin to evaluate the extent of equal opportunities in East and West and the developments over time. Already in 1991 females had higher Advanced School attendance rates than males in both parts of the country. However, while females advanced even further over time in West Germany, males were able to somewhat reduce their disadvantage in East Germany. Most recently, gender-related patterns converged to an almost identical advantage for females in both regions.

A comparison of the correlation of family size with educational choices yields that children with one sibling enjoy advantages compared to those with more than one sibling in both regions of the country and at all times. Whereas this advantage declined in West Germany it increased in the East suggesting that also with respect to family size equality of opportunity is declining. Inequality with respect to growing up in rural vs. urban regions appears to be small.

We compare the resident population in East and West Germany without consideration to the fact that demographic developments such as migration and fertility differed in the two regions. It is for further research to decompose the observed changes in educational mobility and to study their potential determinants. Overall, the conversion to the West German secondary school system did not improve equality of access to Advanced School education for the resident population in East Germany, which confirms trends observed in other transition economies. However, while shifts to greater inequality in other transition economies might be due to economic crises and thus transitory, this does not hold for East Germany, as budget cuts were not a driving force of the development. Instead, the results call for further research into the institutional determinants of intergenerational mobility in the German secondary school system (see e.g. Woessmann 2010, Schuetz et al. 2008) and deserve the attention of researchers and policy makers.

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Tables and figures

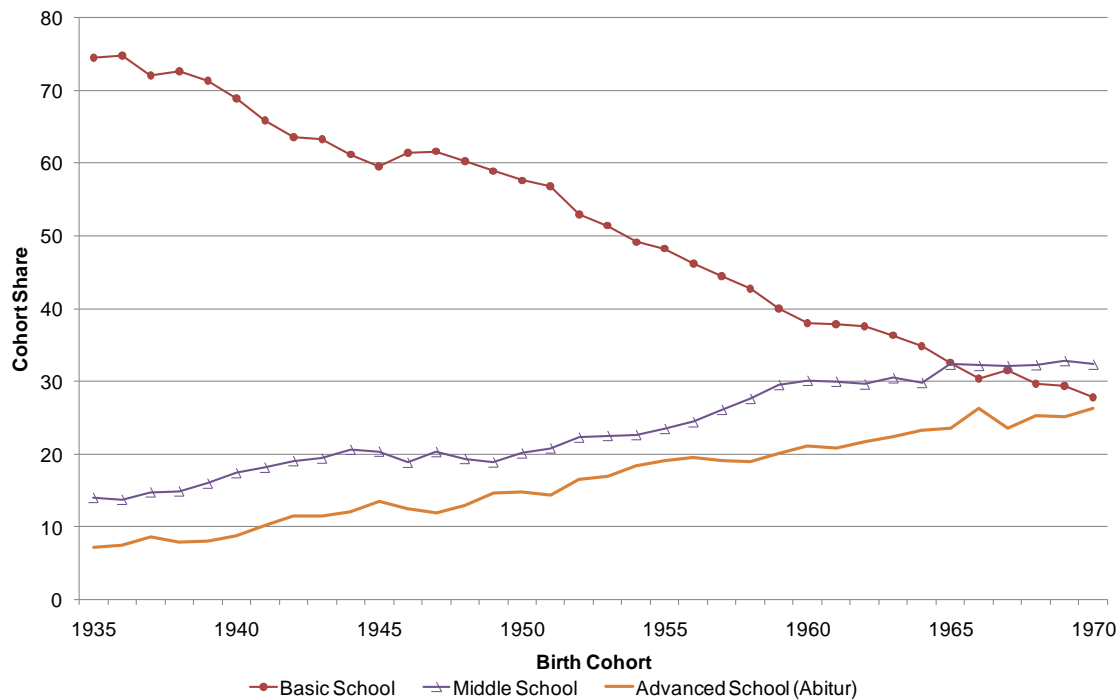
Figure 1
Traditional Secondary School Systems in East and West Germany prior to Unification

Age	Grade	West			Grade	East			
4						Kindergarten			
5									
6	1	Primary School				P.O.S.			
7	2								1
8	3								2
9	4								3
10	5	Basic School	Middle School	Advanced School	4				
11	6				5				
12	7				6				
13	8				7				
14	9				8				
15	10				9				
16	11				10				
17	12				11	EOS	BmA		
18	13				12				
19									

Source: Own presentation.

Figure 2
Cohort Shares of Secondary School Degrees in East- and West Germany
- as Completed at Unification

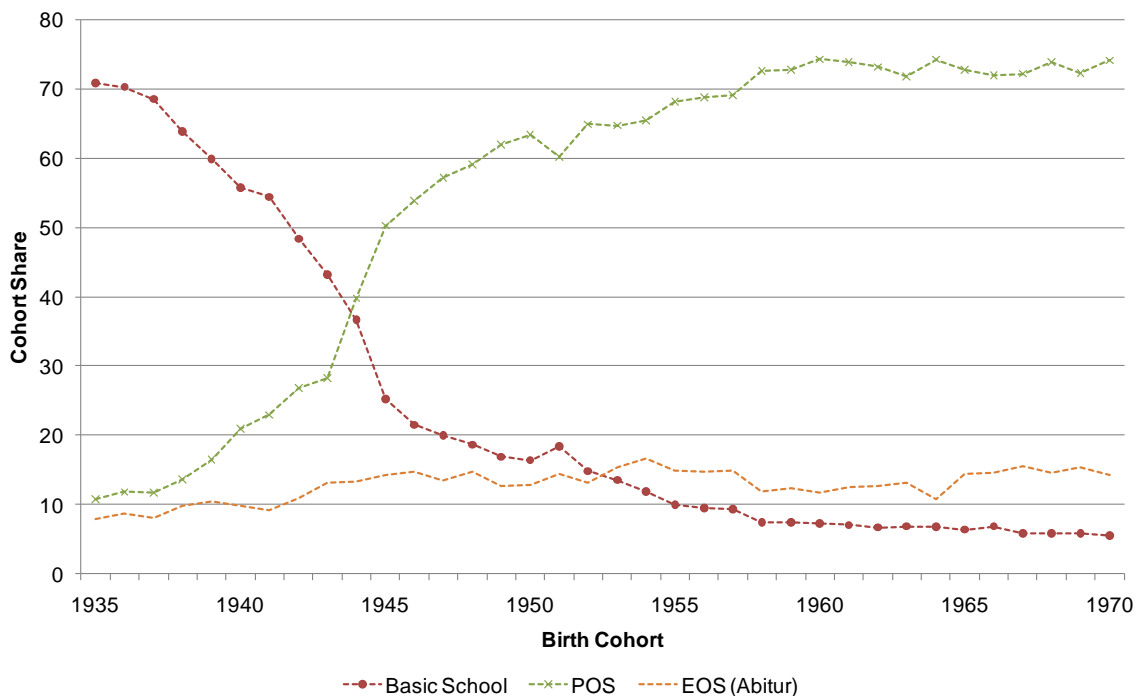
2.1 West Germany based on Mikrozensus 2007 Survey (Cohorts 1935-1970)



Notes: The shares do not add up to 100 percent per cohort as those without degrees (less than 5 percent), those with POS-East degrees living in the West (less than 5 percent) and those with polytechnic-eligibility (mostly less than 10 percent) were omitted to enhance clarity.

Source: *Mikrozensus 2007*.

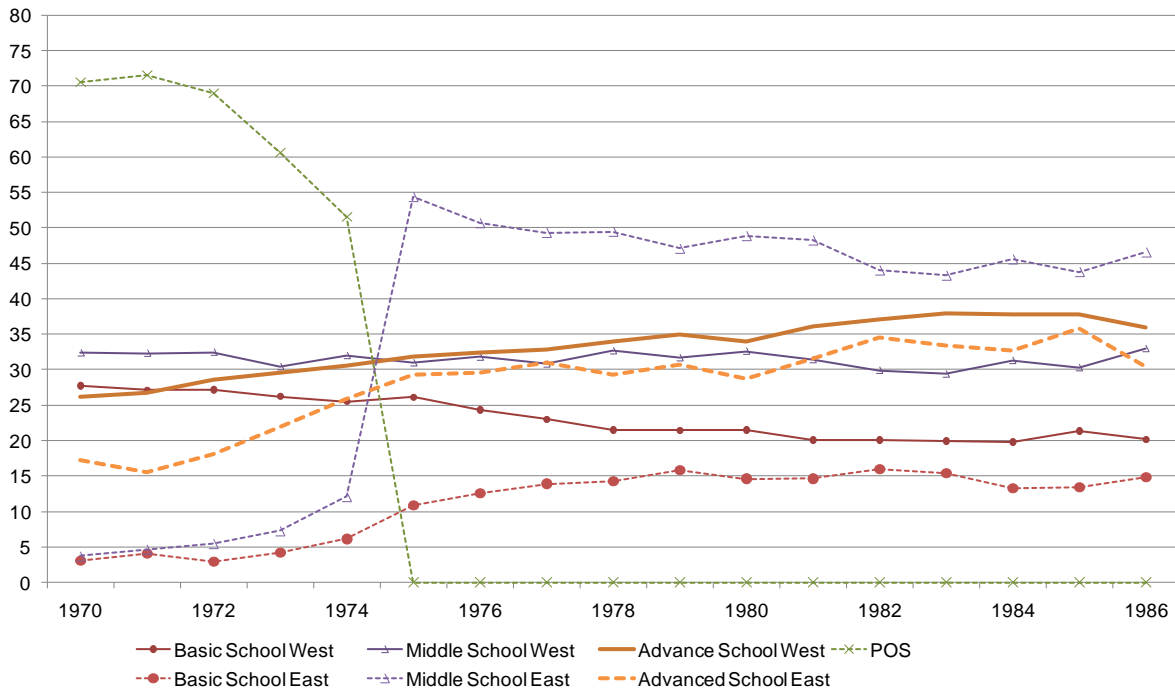
2.2 East Germany based on Mikrozensus 1991 Survey (Cohorts 1935-1970)



Notes: The shares do not add up to 100 percent per cohort as those without degrees (less than 5 percent), those with Middle School degrees (mostly less than 5 percent) and those with polytechnic-eligibility (less than 5 percent) were omitted to enhance clarity.

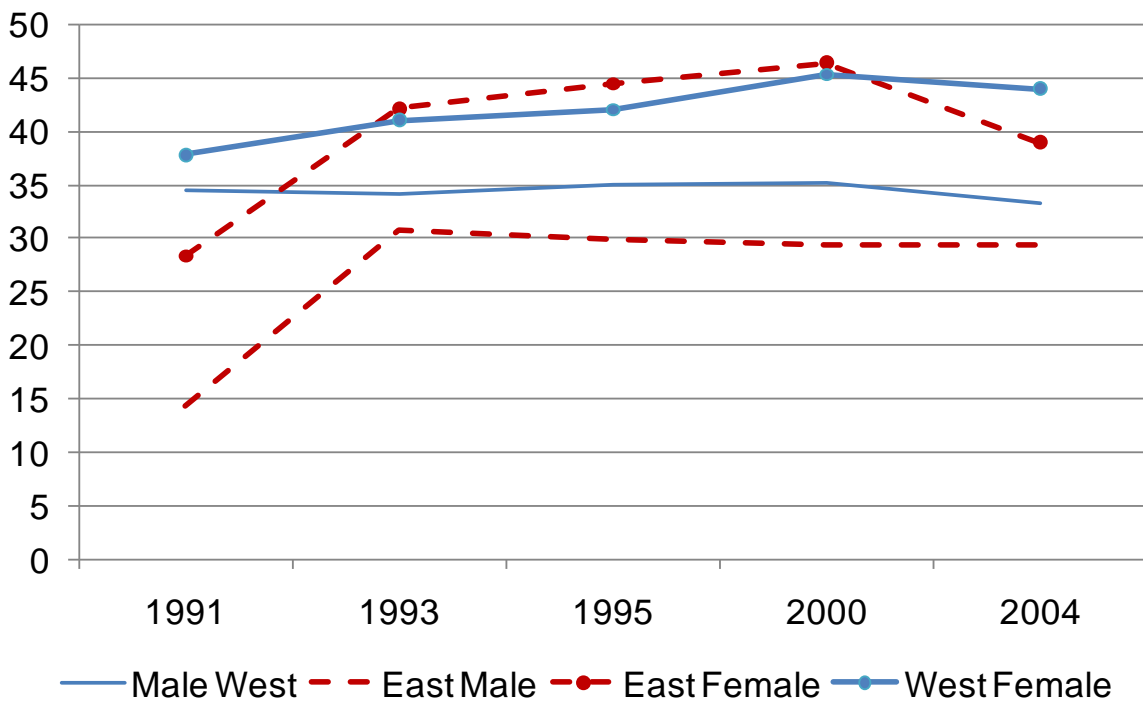
Source: *Mikrozensus 1991*.

Figure 3
Cohort Shares of Secondary School Degrees in East- and West Germany based on Mikrozensus 2007 Survey (Cohorts 1970-1986)



Source: *Mikrozensus 2007*.

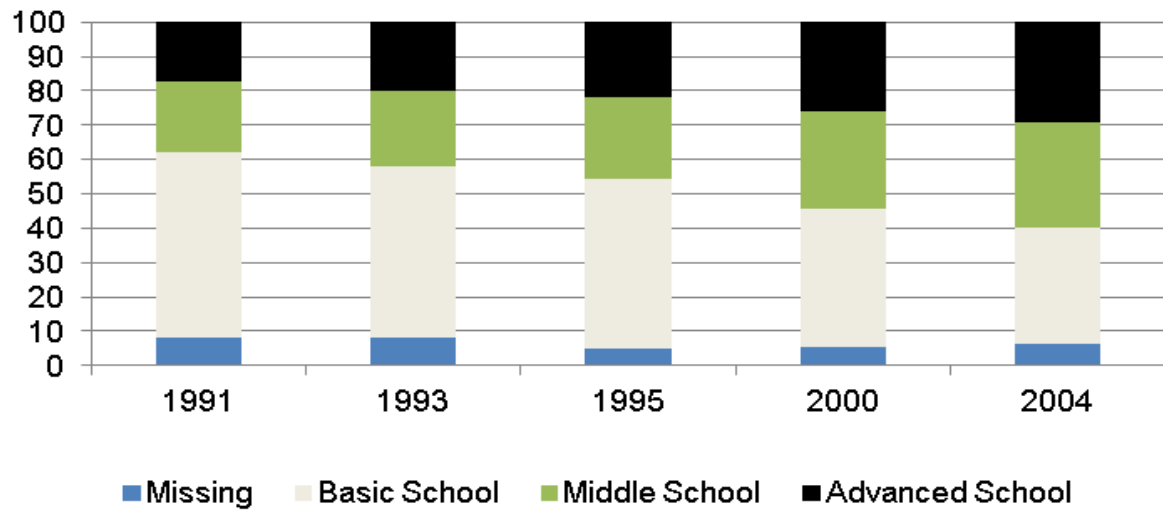
Figure 4
Share of 17 Years Olds in Advance School by Region and Year



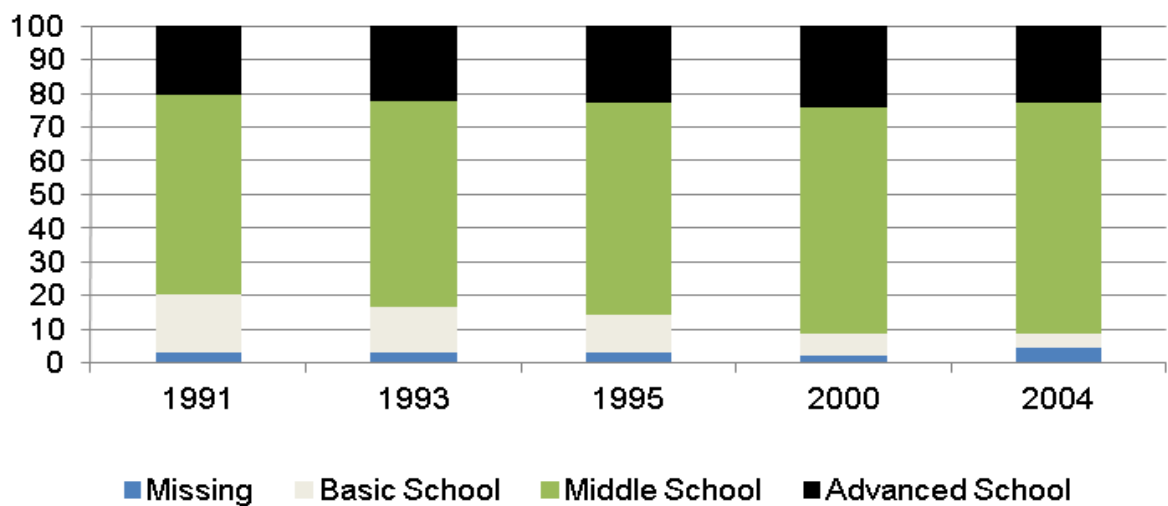
Source: *Mikrozensus* samples 1991, 1993, 1995, 2000, and 2004 and own calculations.

Figure 5
Parental Educational Attainment over Time in East and West Germany by Survey Year

(a) West Germany



(b) East Germany



Source: *Mikrozensus* samples 1991, 1993, 1995, 2000, and 2004 and own calculations.

Table 1
Sample Sizes of 17 Years Olds in East and West Germany over Time

	All	West Men	Women	All	East Men	Women
1991	3,399	1,764	1,635	1,051	529	522
1993	3,287	1,706	1,581	1,019	528	491
1995	3,336	1,749	1,587	1,314	693	621
2000	3,598	1,882	1,716	1,235	636	599
2004	3,819	1,965	1,854	1,175	613	562
Total	17,439	9,066	8,373	5,794	2,999	2,795

Source: *Mikrozensus* samples 1991, 1993, 1995, 2000, and 2004 and own calculations.

Table 2
Average Transition Matrix by Region Across All Survey Years

	Child Advanced School Attendance	
	West	East
Parental Education		
1 Missing	36.0	25.7
2 Basic School	22.0	17.1
3 Middle School	41.9	27.6
4 Advanced School	65.8	58.7
All Parents:	38.2	33.7
Ratio: row 4 / row 2	3.00	3.43

Source: *Mikrozensus* samples 1991, 1993, 1995, 2000, and 2004 and own calculations.

Table 3
Observed Advanced School Enrollment Ratios – By Region and Over Time

	1991	1993	1995	2000	2004
A - West					
Overall share children advanced school	0.36	0.37	0.38	0.40	0.38
1 P(child advanced parent basic)	0.21	0.20	0.23	0.26	0.20
2 P(child advanced parent middle)	0.46	0.46	0.44	0.39	0.38
3 P(child advanced parent advanced)	0.71	0.69	0.66	0.65	0.61
Relative Difference 3 / 1	3.41	3.41	2.87	2.53	3.06
Absolute Difference 3 - 1	0.50	0.49	0.43	0.39	0.41
Relative Difference 3 / 2	1.55	1.50	1.49	1.66	1.62
Absolute Difference 3 - 2	0.25	0.23	0.22	0.26	0.24
B - East					
Overall share children advanced school	0.21	0.36	0.37	0.38	0.34
1 P(child advanced parent basic)	0.12	0.18	0.16	0.29	0.15
2 P(child advanced parent middle)	0.17	0.31	0.31	0.30	0.27
3 P(child advanced parent advanced)	0.42	0.64	0.63	0.61	0.60
Relative Difference 3 / 1	3.36	3.58	3.83	2.12	4.14
Absolute Difference 3 - 1	0.29	0.46	0.46	0.32	0.46
Relative Difference 3 / 2	2.43	2.03	2.00	2.04	2.26
Absolute Difference 3 - 2	0.24	0.33	0.31	0.31	0.34
West - Share parents advanced school	0.18	0.20	0.22	0.26	0.29
East - Share parents advanced school	0.20	0.22	0.23	0.24	0.23

Source: *Mikrozensus* samples 1991, 1993, 1995, 2000, and 2004 and own calculations.

Table 4
Probit Estimation Results – Fully Interacted Model for East and West

	Coefficients	
	Interactions	
	West (Std.Err.) 1	East (Std.Err.) 2
Parental Education		
missing	-0.750** (17.14)	-0.103 (0.89)
basic school	-1.159** (43.72)	-0.078 (1.00)
middle school	-0.566** (20.02)	-0.206** (4.16)
advanced school	reference	reference
Individual and Household Characteristics		
male	-0.226** (11.09)	-0.167** (4.09)
urban residence	0.071** (3.07)	-0.043 (0.99)
age of oldest parent	0.021** (12.18)	-0.004* (2.14)
single father household	-0.059 (1.23)	0.067 (0.63)
single mother household	-0.060* (2.06)	0.052 (0.96)
no siblings	reference	reference
one sibling	0.045+ (1.93)	0.012 (0.27)
two or more siblings	-0.033 (1.07)	-0.025 (0.37)
Year fixed effects	yes	yes
Federal state fixed effects	yes	yes
Predicted Probability of Youth Advanced School Attendance		
Parent basic school	0.22	0.17
Parent middle school	0.43	0.28
Parent advanced school	0.64	0.57

Notes: The estimation was performed using 23,233 observations. +, * and ** indicate statistical significance at the 10, 5 and 1 percent level. We present heteroskedasticity robust standard errors.

Predicted probabilities were generated at observed sample characteristics and averaged over time.

Source: *Mikrozensus* samples 1991, 1993, 1995, 2000, and 2004 and own calculations.

Table 5
Development of Predicted Advanced School Attendance Probabilities over Time

	All Years (Std.Err.)	1991 (Std.Err.)	1995 (Std.Err.)	2004 (Std.Err.)	Rel. Diff. 2004 / 1991	Abs. Diff. 2004 - 1991
A - West						
Average	0.38	0.36	0.38	0.38	1.06	0.02
1 Parent basic school	0.22	0.21	0.24	0.21	0.97	-0.01
2 Parent middle school	0.43	0.46	0.45	0.39	0.83	-0.08
3 Parent advanced school	0.64	0.69	0.64	0.60	0.87	-0.09
Relative Difference 3 / 1	2.91 (.547)	3.24 (.702)	2.67 (.743)	2.90 (.738)	0.90	-0.34
Absolute Difference 3 - 1	0.42 (.022)	0.48 (.029)	0.40 (.044)	0.39 (.038)	0.81	-0.09
Relative Difference 3 / 2	1.49 (.134)	1.48 (.172)	1.42 (.187)	1.55 (.196)	1.04	0.06
Absolute Difference 3 - 2	0.21 (.015)	0.22 (.035)	0.19 (.035)	0.21 (.025)	0.94	-0.01
B - East						
Average	0.33	0.21	0.37	0.34	1.62	0.13
1 Parent basic school	0.16	0.10	0.14	0.14	1.38	0.04
2 Parent middle school	0.28	0.18	0.33	0.27	1.48	0.09
3 Parent advanced school	0.57	0.41	0.60	0.61	1.49	0.20
Relative Difference 3 / 1	3.56 (1.094)	3.94 (2.298)	4.33 (2.256)	4.28 (3.756)	1.08	0.33
Absolute Difference 3 - 1	0.40 (.055)	0.30 (.083)	0.46 (.063)	0.47 (.088)	1.57	0.17
Relative Difference 3 / 2	2.04 (.394)	2.24 (.540)	1.84 (.376)	2.27 (.565)	1.01	0.02
Absolute Difference 3 - 2	0.29 (.034)	0.23 (.062)	0.27 (.044)	0.34 (.047)	1.51	0.11
C - West (joint category: parents with basic or middle school degrees)						
1 Parent basic / middle school	0.30	0.28	0.31	0.29	1.04	0.01
2 Parent advanced school	0.64	0.69	0.64	0.60	0.87	-0.09
Relative Difference 2 / 1	2.13 (.331)	2.46 (.544)	2.06 (.470)	2.07 (.391)	0.84	-0.40
Absolute Difference 2 - 1	0.34 (.016)	0.41 (.034)	0.33 (.039)	0.31 (.029)	0.76	-0.10
D - East (joint category: parents with basic or middle school degrees)						
1 Parent basic / middle school	0.27	0.16	0.30	0.26	1.61	0.10
2 Parent advanced school	0.57	0.41	0.61	0.61	1.49	0.20
Relative Difference 2 / 1	2.11 (.519)	2.51 (.748)	2.05 (.496)	2.32 (.626)	0.92	-0.19
Absolute Difference 2 - 1	0.30 (.037)	0.25 (.066)	0.31 (.041)	0.35 (.046)	1.41	0.10

Notes: The predicted probabilities are generated in separate estimations of the specification as presented in Table 4 by year and region (east vs. west). The predicted values in the column labeled average were generated in the joint estimation over all five years of data. The standard errors for the absolute and relative differences are obtained via bootstrap with 100 replications.

Source: *Mikrozensus* samples 1991, 1993, 1995, 2000, and 2004 and own calculations.

Table 6
Development of Predicted Advanced School Attendance Probabilities by Gender,
Number of Siblings, and Urban vs. Rural Residence

6.1 Gender Differences

	Average (Std.Err.)	1991 (Std.Err.)	1995 (Std.Err.)	2004 (Std.Err.)	Rel. Diff. 2004 / 1991	Abs. Diff. 2004 - 1991
West						
1 Female	0.42	0.38	0.42	0.44	1.16	0.06
2 Male	0.35	0.34	0.35	0.33	0.97	-0.01
Relative Difference 1 / 2	1.20 (.101)	1.12 (.071)	1.20 (.100)	1.33 (.175)	1.19	0.22
Absolute Difference 1 - 2	0.07 (.014)	0.04 (.016)	0.07 (.020)	0.11 (.025)	2.75	0.07
East						
1 Female	0.40	0.28	0.44	0.39	1.39	0.11
2 Male	0.27	0.14	0.30	0.30	2.14	0.16
Relative Difference 1 / 2	1.48 (.272)	2.00 (.549)	1.47 (.371)	1.30 (.278)	0.65	-0.70
Absolute Difference 1 - 2	0.13 (.031)	0.14 (.052)	0.14 (.043)	0.09 (.034)	0.64	-0.05

6.2 Difference by Number of Siblings

	Average (Std.Err.)	1991 (Std.Err.)	1995 (Std.Err.)	2004 (Std.Err.)	Rel. Diff. 2004 / 1991	Abs. Diff. 2004 - 1991
West						
1 No siblings	0.38	0.35	0.36	0.38	1.09	0.03
2 One sibling	0.39	0.38	0.42	0.40	1.05	0.02
3 More than one sibling	0.37	0.34	0.36	0.38	1.12	0.04
Relative Difference 2 / 3	1.05 (.042)	1.12 (.103)	1.17 (.112)	1.05 (.076)	0.94	-0.07
Absolute Difference 2 - 3	0.02 (.011)	0.04 (.028)	0.06 (.030)	0.02 (.020)	0.50	-0.02
East						
1 No siblings	0.33	0.22	0.35	0.36	1.64	0.14
2 One sibling	0.35	0.21	0.40	0.33	1.57	0.12
3 More than one sibling	0.31	0.21	0.35	0.25	1.19	0.04
Relative Difference 2 / 3	1.13 (.102)	1.00 (.258)	1.14 (.217)	1.32 (.556)	1.32	0.32
Absolute Difference 2 - 3	0.04 (.023)	0.00 (.048)	0.05 (.039)	0.08 (.056)		0.08

6.3 Difference by Urban vs. Rural Residence

	Average (Std.Err.)	1991 (Std.Err.)	1995 (Std.Err.)	2004 (Std.Err.)	Rel. Diff. 2004 / 1991	Abs. Diff. 2004 - 1991
West						
1 Rural	0.37	0.33	0.38	0.37	1.12	0.04
2 Urban	0.39	0.39	0.39	0.40	1.03	0.01
Relative Difference 1 / 2	0.95 (.030)	0.85 (.079)	0.97 (.054)	0.93 (.064)	1.09	0.08
Absolute Difference 1 - 2	-0.02 (.010)	-0.06 (.021)	-0.01 (.018)	-0.03 (.018)	0.50	0.03
East						
1 Rural	0.33	0.21	0.35	0.34	1.62	0.13
2 Urban	0.34	0.22	0.38	0.34	1.55	0.12
Relative Difference 1 / 2	0.97 (.046)	0.95 (.139)	0.92 (.103)	1.00 (.133)	1.05	0.05
Absolute Difference 1 - 2	-0.01 (.012)	-0.01 (.029)	-0.03 (.025)	0.00 (.028)	0.00	0.01

Notes: see Table 5.

Source: *Mikrozensus* samples 1991, 1993, 1995, 2000, and 2004 and own calculations.

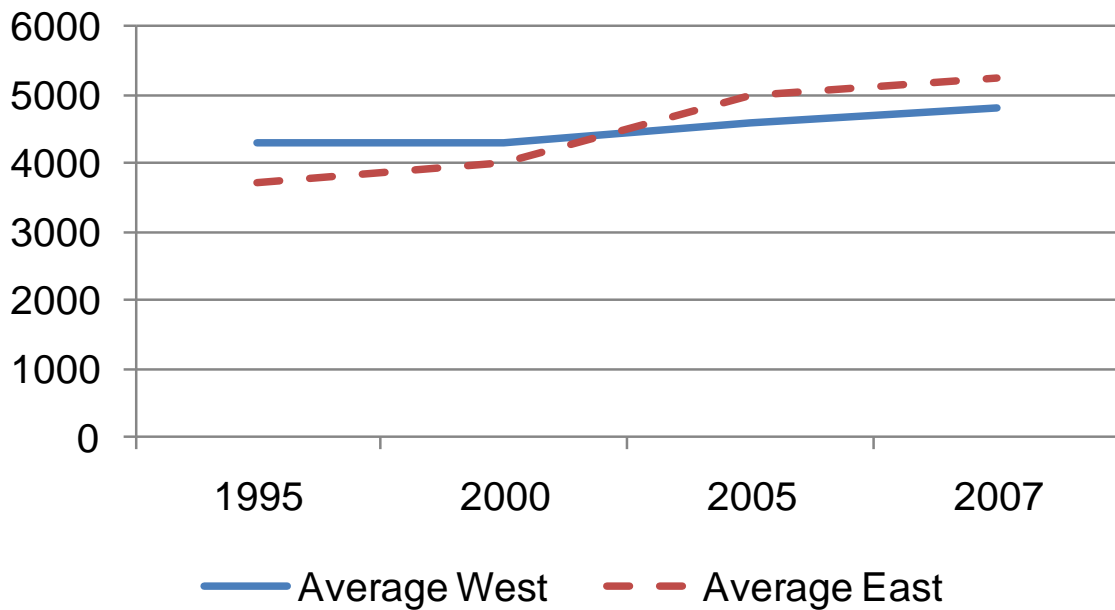
Appendix

Table A.1
Descriptive Statistics

	West Mean (Std. Dev.)	East Mean (Std. Dev.)
Dependent Variable:		
Advanced School Attendance	0.38	0.33
Highest parental education		
Missing	0.07	0.03
Basic School	0.45	0.10
Middle School	0.25	0.64
Advanced School	0.23	0.23
Additional explanatory variables		
Male	0.52	0.52
Urban	0.53	0.45
Age of older parent	47.04 (5.86)	43.89 (5.30)
No mother in family	0.05	0.04
No father in family	0.16	0.20
No sibling	0.50	0.51
One sibling	0.35	0.38
Two and more siblings	0.15	0.11
Calendar Year		
1991	0.19	0.18
1993	0.19	0.18
1995	0.19	0.23
2000	0.21	0.21
2004	0.22	0.20
Federal State		
Schleswig-Holstein	0.04	
Hamburg	0.02	
Niedersachsen	0.12	
Bremen	0.01	
Nordrhein-Westfalen	0.26	
Hessen	0.09	
Rheinland-Pfalz	0.06	
Baden-Württemberg	0.16	
Bayern	0.20	
Saarland	0.02	
Berlin	0.02	0.07
Brandenburg		0.17
Mecklenburg-Vorpommern		0.13
Sachsen		0.29
Sachsen-Anhalt		0.16
Thüringen		0.17
Number of observations	17439	5794

Source: *Mikrozensus* samples 1991, 1993, 1995, 2000, and 2004 and own calculations.

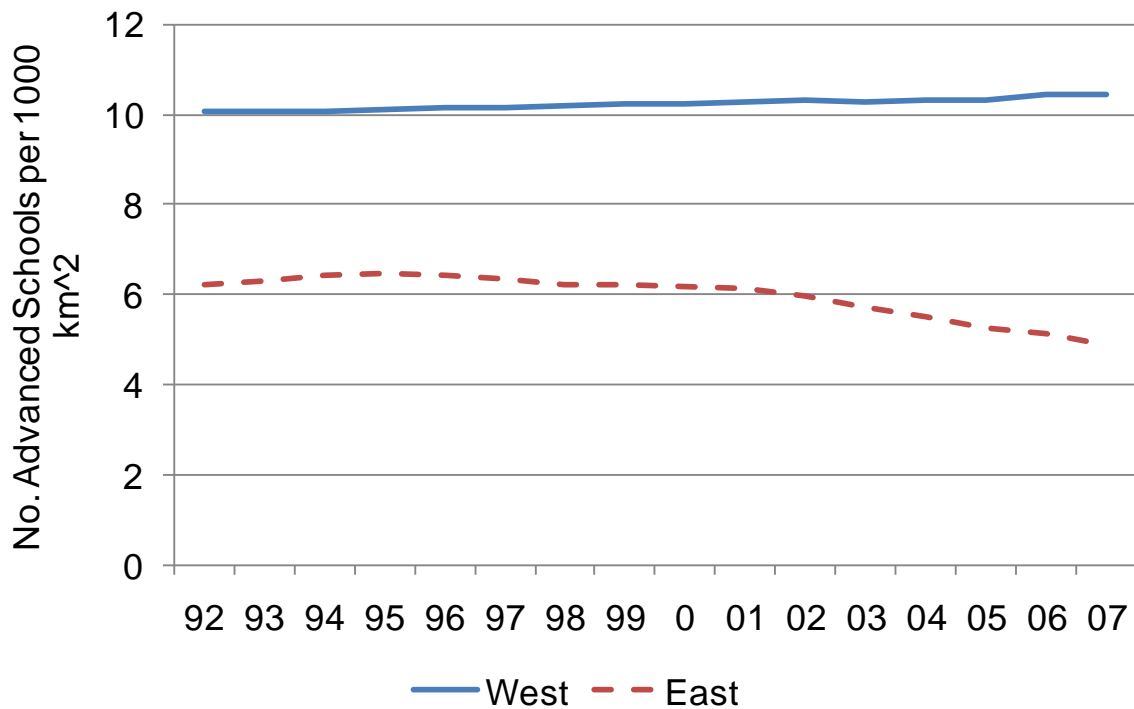
Figure A.1
Development of nominal annual expenditures per pupil for East vs. West German non-city states (in nominal Euro)



Note: Not considered in the calculation of averages are the city states of Berlin, Hamburg and Bremen, because they differ structurally from larger federal states.

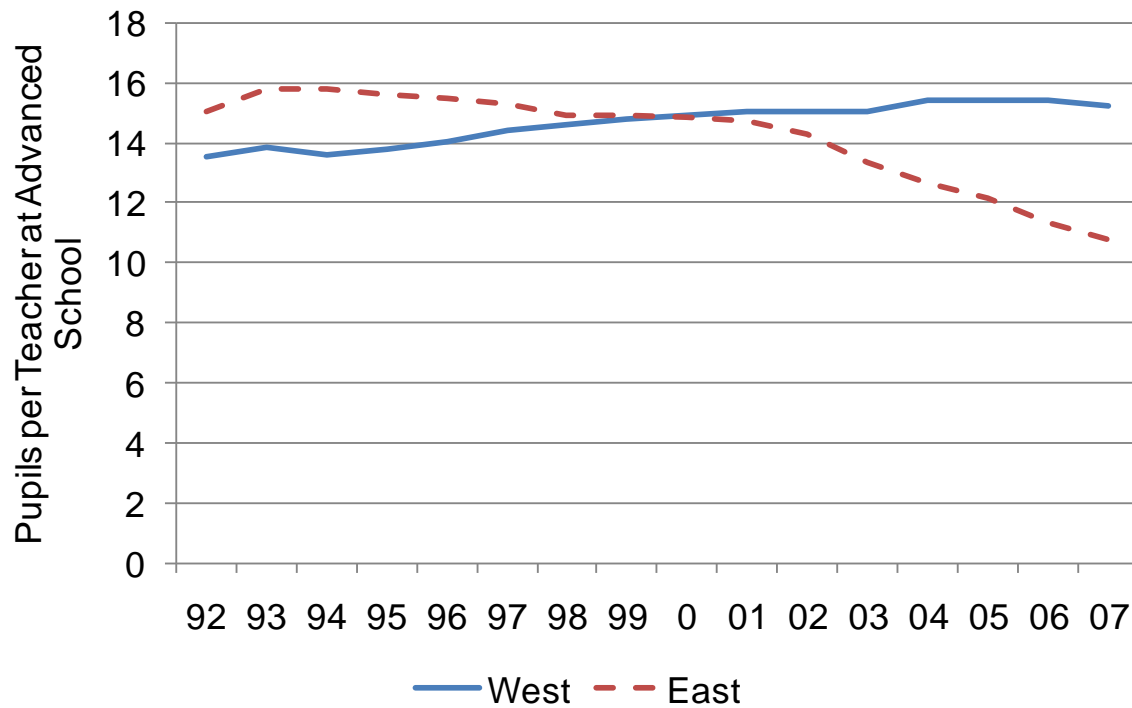
Source: Statistisches Bundesamt (2010): Bildungsausgaben. Ausgaben je Schüler/-in 2007, Wiesbaden, p. 10 and own calculations.

Figure A.2
Number of Advanced Schools per 1000 km² in East and West German States (omitting the city states Bremen, Hamburg, Berlin)



Source: Federal Statistical Office, various annual yearbooks and Fachserie 11, Reihe 1, and own calculations.

Figure A.3
Number of Students per Teacher at Advanced Schools in East and West German States (omitting the city states Bremen, Hamburg, Berlin)



Source: Federal Statistical Office, various annual yearbooks and Fachserie 11, Reihe 1, and own calculations.

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