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Intergenerational Transmission of Educational Attainment in Austria

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Intergenerational Transmission of Educational Attainment in Austria[1]

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Abstract

Up to now there exist several studies documenting the educational expansion in the 20th century in Austria but only few studies measureing the degree of persistence of educational attainment over generations. Furthermore, for Austria there are no internationally comparable persistence-measures of educational attainment available. This study aims to fill this gap. The Austrian Household Survey on Housing Wealth includes information on socioeconomic characteristics of respondents and their parents. The results demonstrate strong persistence in educational attainment in Austria. Using unit- as well as multivariate econometric techniques and a Markovian approach we show that educational persistence decreased over time. Our study delivers key-measures for intergenerational persistence of educational attainment. In particular we deliver results comparable to those of Hertz et al. (2008) in their multi-country analysis. This allows us to rank Austria in terms of intergenerational educational attainment persistence among a number of european countries and the US. In general our results question the existence of meritocratic values and equal opportunity for educational advancement in the Austrian society.

Keywords: intergenerational transfers, educational attainment, educational transmission, Austria

JEL classification: J62, I38

[1] Valuable comments from Alyssa Schneebaum, Oliver Gorbach, Verena Halsmayer, Markus Knell, Peter Lindner and Ina Matt are gratefully acknowledged. STATA was used for all calculations. Furthermore the user written STATA program matrxmob by Phillipe van Kerm was used for some calculations.

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1 Introduction

In this paper we examine the stylised fact that descendants of parents with higher education are also better off in terms of education than descendants of parents with lower education. The Austrian education system is mainly public. However, the division between "Hauptschule" (Secondary Modern School) and "Allgemeine Höhere Schule" (Grammar School) at the age of 10 might imply a low level of educational mobility.

While there is a strand of literature aimed at identifying total causal effects of the education of parents on the education of their children via twin datasets (Behrman and Rosenzweig, 2002), adoptee datasets (Plug, 2004), or school reforms (Black et al., 2005) to control for parents' unobserved endowments, we concentrate on the intergenerational correlation of education (see Hertz et al., 2008; Mulligan, 1999).

Speaking specifically of educational attainment, the literature at hand concludes that parents' education is the most important factor explaining the educational attainment of children (Haveman and Wolfe, 1995). The main difficulty is the fact that many datasets do not provide adequate information. Micro-datasets do often not contain educational data on both the parents and descendants, and often lack human capital variables which we could use to control for abilities of descendants in order to estimate direct causal effects in educational transmission (Dardanoni et al., 2008). It remains unclear if abilities – even if tested at a young age – are not already formed by the social environment and especially parental education. With regard to strategies to control for parents' unobserved endowments in order to identify total causal effects[3], it remains unclear if the child rearing abilities of twins (Berhman and Rosenzweig, 2002) are identical or, in the case of adoptee datasets (Plug, 2004), if the process of adoption is random or if there is some selection going on which would be comparable to inheritable abilities. Furthermore different approaches for controlling for parental endowment can lead to different and contradicting results (Holmlund et al., 2008). Therefore, analyzing intergenerational correlation seems to be valuable even in the face of the possibility that the causal relationship between education of parents and children is in general overestimated and our estimates are therefore to be interpreted as correlations, not as direct or total causal effects.

We test the following questions: (i) Is there persistence in educational outcomes, i.e. is the education of parents and descendants positively correlated? (ii) Is persistence relatively strong in comparison to other European countries? (iii) Does the dependence vary over time? (iv) Is gender relevant for the educational outcome? [4]

We use a Markovian as well as univariate and multivariate econometric approaches. On the one hand employing the commonly used univariate measures allows for international comparison, on the other hand such a variety of methods allows us to check the robustness of our results. Due to the absence of long panel data series for Austria[5] we use the Household Survey on Housing Wealth 2008 (HSHW), a cross sectional survey, which incorporates information on the descendants education as well as information on the educational level of their parents.

Advantages and disadvantages are passed from one generation to the next. A society that is characterised by a high degree of transmission of social status contradicts meritocratic ideals.

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[3] For a discussion of the differences between controlling for parental endowments versus controling for children's endowments in order to estimate total causal effects, see Dardanoni et al. (2008).

[4] For a more detailed analysis on the gender issue using the same dataset see Fessler and Schneebaum (2009).

[5] Note that even if a panel data series would exist they would hardly be long enough to include a sample of the representative descendant population and their parents as one can use with cross section data, where education of parents is recalled by the interviewed descendants which represent the population as a whole.

Educational attainment is significantly correlated across generations. Education traits persist between generations in all OECD countries and the OECD claims that parental education is by far the most important background characteristic (see OECD 2008, p. 216). Belzil and Hansen (2003) argue that household background variables (in particular parents´ education) account for 68% of the explained cross sectional variations in schooling.
Our study delivers key-measures for intergenerational persistence of educational attainment which are widely used in a number of empirical applications. We aim at regression coefficients (grade persistence) and correlations (standardized persistence) measuring the relation between parental educational attainment and descendants educational attainment (Hertz et al., 2008; Checci et al., 2008).
Especially we deliver comparable results to the multi-country paper of Hertz et al. (2008), which allows us to rank Austria in terms of intergenerational educational attainment persistence within a huge number of countries.

The paper is organized as follows: In section 2 we review the literature on the inheritance of social status with a focus on the transmission of educational attainment. Section 3 provides empirical evidence in a descriptive way in subsection 3.1, using a univariate Ordinary Least Squares, which allows for international comparisons in subsection 3.2, using the Markovian approach in subsection 3.3, and a multivariate Ordered Logit Model in subsection 3.4. Section 4 concludes.

2 Literature Overview

2.1 International Literature

It is common to state that inequality is not inherently wrong as long as the following three conditions are met: the whole society gets richer; there is a safety net for the poor and everybody regardless of social background has the same opportunity to climb up through the system. This idea of meritocracy and equal opportunity is shared by most people in democratic societies.
In general intergenerational mobility refers to the relationship between the socio-economic status of parents and the status their children will attain as adults. Intergenerational mobility reflects numerous facts such as resources of parents, social norms, and public policies. Parents provide their children with genetic endowments, different forms of capital, finance their education and transmit also values and beliefs. Neighbourhood and social conditions, ethnic origin and race, family size and health status are further important factors. All these different factors are difficult to unbundle and there is no single indicator providing a complete picture of intergenerational mobility.

The academic literature on intergenerational mobility was not that clear on the significance of intergenerational persitence from the beginning. Blau and Duncan (1967) found only a weak statistical relationship between parents‘ and children’s ‘ economic status. The models of Becker and Tomes (1979, 1986) are classical references in the literature on intergenerational mobility. Capital markets are assumed to be perfect and parents are altruistic. The earnings are therefore determined exclusively by endowments. With leaving the assumption of complete markets and introducing liquidity constraints the results change. Becker and Tomes (1986) found a weak correlation between parents´ and their children’s income. The simple correlation averaged 0,15 and therefore suggested a quite high level of intergenerational mobility. Earnings regress to the mean at slower rates for poor families than for rich

families. There were mainly two kinds of problems in the data: there were mistakes in reporting income in particular when people were asked to recall the income of their parents and the current income was uncorrelated with underlying permanent income.
Bhaskar Mazumder (2005) shows that correcting for these two errors the intergenerational correlation for economic status increased by almost three times. The measurement issues are in general crucial for any research on intergenerational mobility. Neri (2003) shows measurement errors and transitory shocks may account up to 30-50% of the observed wealth mobility. The better the association is measured the stronger it gets.
Solon (2002) demonstrates theoretically that the intergenerational correlation of income will be highest when public investments in education are least progressive. Solon (2004) develops a stylized version of the Becker-Tomes model. Parents cannot borrow to finance educational investments that would be paid back by the child, the only source of finance being reduced consumption. Wealthier families tend to invest more in their children's human capital and this investment is increasing in labour market return. Government spending on education can increase intergenerational mobility. Progressive public spending on education can offset sub-optimal parental investment in educations so far as the offspring of liquidity constrained parents benefit relatively more from these public programs.

There is substantial literature within both economics and sociology to compare inheritance of inequalities across generations for different countries (D'Addio 2007). D'Addio (2007) surveys the research in OECD countries on intergenerational mobility. The main findings of the literature are:

- Intergenerational earnings mobility varies significantly across countries. It is higher in the Nordic countries, Canada and Australia and lower in Italy, the United States and the United Kingdom.
- The extent of intergenerational earnings mobility varies over the income distribution (i.e. mobility is lower at both at the top and the bottom of the distribution in many countries).
- Education is a major contributor to intergenerational income mobility and educational differences tend to persist across generations.
- The ethnic origin, the language spoken at home, family size and family structure, and the socio-economic and cultural background of the parents matter for mobility across generations.
- Moreover, some of the cross-country differences in the extent of intergenerational mobility of education are shaped by policies. For example, early streaming of pupils, based on their abilities, seems to considerably reduce mobility across generations.
- A key role is played by early childhood education, care and health. Financial transfers and in-kind services to parents are also important as they provide them with the resources to better rear and care for their children.
- Overall, a strategy based on a greater investment in children may reduce child poverty and contribute to child development and therefore, break the cycle of intergenerational disadvantages.

The OECD (2009) assesses further patterns of intergenerational mobility and concludes that intergenerational social persistence is correlated across countries with cross-sectional inequality and poverty. Intergenerational social mobility is associated with a higher degree of unionisation and a greater coverage of collective wage agreements.

Bowles et al. (2005) provide an extensive survey on the relationship between family background and economic success. The effect of education on the intergenerational transmission of income is found to be large and significant. Parental social background influences their offspring's wages in different ways. Wealth and income passed from one generation to another are crucial forms of transmitting advantages. A great deal of intergenerational mobility can be attributed to characteristics of parents that cannot be measured simply by looking at their economic resources. The propensity to undertake education, work ethics and risk-related factors are further elements.

A further focus of academic work is on changes in intergenerational mobility over time. Blandena and Machin (2007) show changes in intergenerational mobility by considering relationships between intermediate outcomes (degree attainment, test scores and non-cognitive abilities) and parental income for cohorts born between 1970 and 2000. There is no evidence that these relationships have changed in a consistent way over this period. Wiborg and Hansen (2009) show on the basis of a rich data set for Norway that intergenerational transmission of social disadvantage does not decline over time.
A further particular issue is the role of bequests. Hertz (2006) finds that inheritance contributes very little to intergenerational correlation of income. However, in his study the reference group of adults was quite young (i.e. average of 37 years). But while inheritance of wealth clearly matters for the top of the population, we may doubt that it fulfils the same role for the large part of the population.

Economists have explored intergenerational transmission of economic status (mainly income, education and occupation). Sociologists have been concerned with the intergenerational transmission of attitudes and values. Bourdieu (1984) emphasizes the relevance of economic, cultural and social capital for the reproduction of class inequality. But individuals are not assumed to follow rational strategies. What is more important is their *habitus*[6].
Psychologists underline the key role played by parenting behaviour such as warmth and control. Heckman and Carneiro (2003) suggest that better family resources during a child's formative years are associated with a higher quality of education and a better environment for fostering cognitive skills such as verbal ability and non-cognitive habits, including self-discipline, which improve life chances. Loehlin (2005) presents estimates of the correlations between parents and their children's personality traits, attitudes, values and interests across various family types: The unweighted mean of the correlation is 0.13 for personality traits and 0.32 for attitudes, values and interests. Osborne Groves (2005) reviews estimates of intergenerational correlation of personality traits in "ordinary families" based on several studies and argues that personality traits are both persistent across generations and relatively stable over time.

The different strands of research on intergenerational mobility haven often a rather narrow focus (either on income, occupation or education). Intergenerational correlation of income, wealth, consumption and education is well documented in a number of empirical studies (for a survey see Mulligan (1999)). In any case to consider different perspectives will be useful. And more interdisciplinary cooperation between economists, sociologists and psychologists would be fruitful.

2.2 Literature on Austria

[6] In Bourdieu's work, habitus is a system of dispositions (perception, thought and action). The individual agent develops these dispositions in response to the determining structures (such as class, family, and education) and external conditions (field)s they encounter. They are therefore neither wholly voluntary nor wholly involuntary.

In Austria, since beginning of the 20th century a continuing positive trend – with some phases of stagnation and an interruption during the second world war – towards higher education can be observed. This trend is documented in several studies. Steiner (1998) shows the educational expansion starting from the cohorts of the 1950ies at around 6% Matura[7] and higher education and reaching 25% and more in the 1990ies. A number of studies, which are based on Austrian School Statistics are dealing with social selection in the Austrian Schooling System. In general Austrian School Statistics do not allow to analyze the influence of social background (e.g. education of parents), except for university students (e.g. Landler, 1997). Bacher (2003) conducted a study, using survey data on adolescents living with their parents to analyze social selection in Secondary Schools. A fallback of those studies is that they are not including the whole population and also not focusing at the whole educational system. A study which does include the whole population and the whole educational system is the one by Spielauer (2004) on the intergenerational educational transmission within families. Spielauer finds that there exists considerable intergenerational persistence of educational careers contrasting the strong educational expansion over the past decades. The main aim of Spielauers study is to analyse school choices and -paths and to compute a projection of the distribution of educational attainment of the society. That is why Spielauers approach does not allow for international comparison.
A thorough assessment would require a survey containing data on all kinds of individual and social characteristics of parents and children. The Austrian household survey on housing wealth does not include such extensive information. However, we know about parent's education and this is - as shown in numerous studies (see this literature Survey) - a good indicator for intergenerational inequality.
With our data we cannot discover the channels through which parents' education influences offspring education. The fact that education is important does not tell us why and how parent's education is important. We miss some important variables. Cultural transmission of cognitive skills and non-cognitive personality traits will be important but are hard to measure/disentangle. Thus, data availability governs in fact our actual choice of education concept. But there are also good arguments for using the parents' education as respondents of surveys will not remember their parents' income and its often unclear at which time in the lifecycle it should be measured. The main aim of our study is to present evidence on a matter on which there is in Austria little knowledge and that has far reaching policy implications.

3 Empirical Evidence

3.1 Data

To analyze intergenerational transmission processes one needs to rely on data incorporating information on at least two generations, mostly one descendant and her parents. For Austria there are few datasets[8] containing this information for a representative sample of descendants. The dataset we use is the HSHW 2008, which incorporates questions on the educational level of the interviewee, which is in our case the owner or tenant of a main residence of an austrian household. The questionnaire contained a total of 168 questions, 28 of which were related to socio-economic characteristics (additionally, 8

[7] This is comparable to high-school (grammar school, upper secondary education).

[8] EU-SILC 2005 contains the information on parental education for Austria. By examining the dataset we found that there must have been some problems in the fieldwork concerning these variables because the quality of the variables needed to do the analysis is very low. Furthermore the microcensus of 1996 contains educational background of parents (see Spielauer, 2004).

questions had to be answered personally by the interviewers themselves). The survey was carried out using computer-assisted personal interviewing (CAPI). Furthermore the interviewee was asked to state the educational level of her mother and father. In line with Hertz et al. out of our 2081 we select a sample of descedants born between 1916 and 1984, which makes sense for Austria because 24 is a reasonable, but still quite young, age to finish an university degree. We also drop cases, where educational attainment for either father or mother is missing, which leaves us a sample of 1918 observations to work with[9]. In order to produce international comparable measures we have to transfer the categorical educational variables of the survey into statuory schooling years, i.e. the minimum years necessary to complete a certain educational degree[10]. Table 1 shows the age and statutory schooling years of descendants and their fathers and mothers by age cohorts. In order to produce the most comparable age cohorts to fit the Hertz et al. (2008) measures we produce the ten age groups, *born before 1940* and nine 5-year age cohorts up to 1984. Hertz et. al (2008) used nine to ten 5-year age cohorts for descedants born between 1916-1984, but the 45 to 50 year periods are differing from country to country whereas they use always descendants in age brackets from 20 or 25 to 64 or 69. By choosing our age groups we can compare both, the whole period of 1916 to 1984 by including the first age group *born before 1940*, and nine 5-year age cohorts with a comparable age between 24 and 68 by droping the first age cohort. Average age of descendants in our selected sample is 50 years and the same for females and males. The age structure of the parents and descendants seems to be reasonable as well. In terms of mean statutory schooling years those in the descendant population generally have higher levels of education than their parents. Furthermore, fathers are generally more educated than mothers and the expansion of statutory schooling years is clearly visible. In all these aspects the data ties in with previous studies about the educational expansion in Austria (see e.g. Steiner, 1998).

----------Table 1 here----------

The survey allows to distinguish six different school levels[11] which we aggregate – for the markovian approach and the ordered logit model – into 4 classes[12]. Table 2 shows the distributions of educational attainment of descendants, fathers and mothers. The mothers' population is the only one with mode max. compulsory education, whereas the apprenticeship and vocational school class is the mode for the descendants' and fathers' distributions.

----------Table 2 here----------

[9] 102 cases have been droped because descendants are too old or too young and annother 61 have been droped because education of father or mother is missing.

[10] In doing so we use all categorical information available and replace them with appropriate statuory schooling years: max. compulsory school=9, apprenticeship and vocational school=10, medium technical school=11, Matura and higher vocational school=12.5, University and Fachhochschule=16. Due to the complex educational system it is not clear which would be the *right* statuory values. For the set of reasonable values results are robust.

[11] 1. no degree ; 2. compulsory school level ; 3. apprenticeship or vocational school degree; 4. medium-level or technical school; 5. Matura and higher level vocational school; 6. University, Fachhochschule

[12] The classification is basically maximum primary, secondary and high education, but splitting up the medium education into two parts: one is the original class 3 (taking 10 or less statuory school years to finish and is more manual labor oriented). The other is the aggregated original classes 4 and 5 (taking 11 and more statuory school years to finish and are in general not manual labor oriented). For a detailed discussion of the Austrian Educational System in an economical context see Fersterer (2001).

While this paper is not dealing with the educational expansion in Austria in the past century the descriptives tie in with these well documented phenomenon (see Biffl, 2002; Landler, 1997; Steiner 1998).

3.2 Grade Persistence and Standardized Persistence

Mostly the data do not include good measures of social environment, parental care or wealth. Therefore most studies dealing with the intergenerational transmission of education concentrate on the correlation between parents' and descendants' educational attainment. The general functional form of the following estimations will therefore be $E_i^d = E_i^d(E_i^f, E_i^m, C_i^d)$ for $i=1,2,..,N$, where E_i^d, E_i^f, E_i^m denote the individual educational attainment of individuals from the descendant's and her fathers or mothers education respectively and C_i^d are additional characteristics of an individual belonging to the descendant population.

In order to be able to compare the data with other countries we use univariate methods, which have been widely used to analyze intergenerational transmission of educational attainment for a large number of countries (Chevalier et al., 2003). Following the approach by Hertz et al. (2008) we estimate simple OLS regressions where education of descendants is the dependent variable and education of parents is the independent variable. To make the results comparable to the multi-country analysis of Hertz et al. (2008), we use the average statutory schooling years of the parents as the independent variable and calculate also simple correlations. Regression coefficients are referred to as *grade persistence* while correlations are refered to as *standardized persistence*. The basic difference between the two measures is that the second controls for differences in standard deviations of educational attainment over time. For the background of this approach see Appendix A. We run regressions over all different age groups and report grade- and standardized persistence in Graph 1.

----------Graph 1 here----------

All estimates are significantly different from zero at a 1% significance level, implying significant persistence for intergenerational transmission of educational attainment in Austria for all cohorts born between 1916 and 1984. Grade persistence is clearly higher than standardized persistence. Concerning the trend and magnitude of the evolution of the coefficients our results are in line with the results of Checchi et al. (2008) for Italy. The linear downward trend is clearly significant, also without inclusion of the first age group *born before 1940* (see table 3). This implies that persistence decreased over time, implying that mobility increased.

----------Table 3 here----------

To compare the level of persistence and rank of Austria in terms of the transmission of educational attainment among other countries we follow again the approach of Hertz et al. (2008) and produce simple averages of grade- and standardized persistence. To illustrate the robustness of our results we report averages over (i) the whole sample, (ii) excluding the age group *born before 1940*, (iii) excluding the age groups *born before 1940* and the youngest 5-year age cohort *born 1980-1984* and rank them among the measures for european countries and the USA produced by Hertz et al. (see Hertz et al., 2008, table 2). The resulting ranking is reported in table 4, where all countries are ranked by standardized persistence which allows to control for changes and differences in standard deviations and is therefore a more reliable measure for cross-country comparisons (see Appendix A).

----------Table 4 here----------

Ranked by standardized persistence (as well as grade persistence) in the intergenerational transmission of educational attainment in Austria is among those countries with the highest persistence, that is to say with the lowest mobility. Just Italy and Slovenia exhibit higher levels of standardized persistence. Concerning grade persistence Austria is at the top which is due to the strong influence of changes in standard deviations of the educational distribution, which itself is due to the strong educational expansion in Austria in the 20th century. The result for Austria is fairly robust. We estimate three different measures: (i) including the whole sample from 1916 to 1984, (ii) including just the nine 5-year age cohorts from 1940 to 1984, which is the best measure in order to compare to the Hertz et al. (2008) data, and droping the cohort born before 1940 as well as the youngest 5 year cohort lead to the same position in the ranking. Furthermore both measures are robust in relation to reasonable different specifications of coding statutory schooling years and using different age-category definitions.

Since our data (as in Hertz et al., 2008) does not allow for instrumental variable (IV) estimation a causal interpretation of the level of the estimates may be biased due to the lack of controls for parental care, parental ability, social environment and so on. The literature shows that IV-estimates tend to be lower, which is due to the generally positive correlation of the possible control variables with parental education. The interpretation of the changes over time is valid under the assumption that the influence of the possible biasing factors are time invariant, but the level should be interpreted in a correlative not causal way.

To show robustness of our results we apply annother well established approach of mobility measurement, namely the Markovian approach[13].

3.3 Markovian Approach

In this section we calculate right stochastic matrices for the transitions of the Markov process describing the intergenerational educational transmission. For the reader's convienience we recall the basic framework as well as the basic measurement issues concering the markovian approach for analysing intergenerational transmission of education in Appendix B. The calculated transition

[13] For Markovian approach theory relevant to intergenerational transmissions/transfers see e.g. Shorrocks (1978), Geweke (1986) and Van de Gaer (2001). See Norris (1997) for theory on markov chains.

matrices are describing the probabilities a descendant faces to attain a certain level of education given a certain education of her/his parents. For this approach we use the maximum of the education of the father and mother of a descendant. Table 5 shows the transition matrix resulting from the whole sample including all descedants born between 1916 and 1984, which should be a arguably representative sample of the Austrian Population aged 24 and more.

----------Table 5 here----------

The transition matrix shows that a descendant of a parent with the highest education level (university, fachhochschule) has a probability of holding an university degree of 0.49 and to hold at least a second level degree of 0.95, while a descendant of a parent with maximum compulsory education has respective probabilities of 0.03 and 0.20. Due to strong assortative mating the matrix does not change to much if we use fathers or mothers education instead of the maximum of both. Nevertheless it can be showed that fathers education seem to have more influence on the descendants education than mothers education. But in order to control for assortative mating and check for differences in relation with the gender of the parent we will use annother approach, namely an ordered logit model, in subsection 3.4.
In order to compare persistence (mobility) over time we split the sample into subsamples and calculate transition matrices for those periods. As those have to fullfill certain conditions, as e.g. stochastic monotonicity (see Appendix B), to be analysed in an axiomatic way, we need to restrict ourselves to three subsamples in order to get sufficient observations for each matrix. Stochastic monotonicity in intergenerational socio-economic mobility tables is a widely accepted result. Dardanoni et al. (2008) show that for a set of 149 socio-economic intergenerational mobility tables from 35 Countries that stochastic monotonicity can hardly be rejected for any table. We calculate transition matrices for descendants *born 1916 to 1949*, *born 1950 to 1969* and *born 1970 to 1984*. All transition matrices turn out to be monotone. The subsamples shall reflect the major periods of educational (legislative) changes in Austria. The first subsample covers the cohorts born before, during and shortly after the second world war, the second subsample covers the first cohorts gaining from school reforms in the 1960ies (Schulgesetzwerk 1962, see Steiner, 1998) and the third subsample covers the youngest cohorts fully gaining from the school and university reforms of the 1960ies and 1970ies[14] (e.g. costless access to universities from 1972 onwards, costless public schooling transport for pupils from 1971 onwards and costless schooling materials from 1972 onwards).
To compare transition matrices with respect to their inherent mobility there exist well established measures, whereas some are based on an axiomatic framework and some are of an ad-hoc type.

Mobility Measures

Generally, there are two ways of analyzing mobility. Mobility can be defined as *movement* or as *independence*. If mobility is defined as movement, a measure of mobility prefers mobility matrices which incorporate more movement to those which incorporate less movement. If mobility is defined as independence, a measure should prefer those mobility matrices which incorporate less unequal chances

[14] In the 1970's, the Austrian government introduced several policies to increase educational attainment in general, but particularly for children from a low-income background (1971, Schulorganisationsnovelle; 1972, free university access; 1974, Schulorganisationsgesetz).

– given certain origin states – to those which incorporate more unequal chances. In this sense independence can be interpreted as "equality of opportunity".

Shorrocks (1978) developed an axiomatix framework for mobility measureing if the data is available in form of a transition matrix.. We are using these three indices of the Shorrocks type family of indices, namely the Second Eigenvalue Index, the Shorrocks Index and the Determinant Index, and two ad-hoc measures of mobility, namely the Absolute Average Jump and Kendall's Tau-b to rank the resulting transition matrices.[15] The Indices of the Shorrocks type are all normalized between 0 and 1. They reach the value zero for the identity matrix which implies no mobility that is to say perfect dependence, i.e. a descendant of a parent with a certain education level will attain the same education level with a probability of one. The value one is reached for perfect independence, i.e. where all rows of the matrix are identical implying that regardless of the education level of the parent every descendant faces the same probabilities for attaining certain education levels. The Absolute Average Jump, can in our case take values between zero and three. The higher it gets the higher the measured mobility is. Kendalls Tau-b[16] takes values between -1 and +1, where 0 means perfect independence and -1 and +1 perfect negative respectively positive rank correlation. Table 6 shows the measures for all subsamples and the sample as a whole.

----------Table 6 here----------

All of the indices lead to the same ranking implying increasing mobility over time which is a very strong result given the differences in the construction of the different measures. It clearly confirms our results from the univariate approach in section 3.2.

3.4 Multivariate Analysis - Ordered Logit

In order to compare between the educational influence of mothers versus fathers and to check for robustness of results, we conduct a multivariate ordered logit estimation, as did for example Bauer and Riphan (2004) or Daouli et al. (2008). Educational attainment of the descendant (E^d) is the dependent variable and educational attainment of the fathers (E^f) and mothers (E^m) as well as a gender dummy for the descendant equaling one for females are the independent variables. For the sake of including as much observations as possible we integrate in the multivariate case the age of the descendant instead of estimating the regression for the different descendant age categories. The lowest levels of the educational attainment are excluded for fathers' and mothers' education to serve as reference category. Table 7 shows the marginal effects of the ordered logit estimation evaluated at the means and modes. The probabilities for an average descendant having certain educational levels are given in the first row of table 7. Having a father with the highest education level (university, fachhochschule) instead of the lowest (max. compulsory school) increases, for example, ceteris paribus the probability of attaining the highest level of education by 0.25 percentage points. All the significant marginal effects have the expected signs, higher educated parents lead to higher chances for higher education and lower chances for lower education. Being older leads to a lower probability of higher education. The same holds true for females. Fathers education seem to have generally a stronger effect than mothers education. This

[15] For detailed information on the necessary conditions for the use of these measures and their construction see Appendix B.

[16] This measure was calculated using the joint distribution of the variables, the transition matrices are based on.

can be testet for all the educational levels of parents included in the regression. The test rejects the null hypothesis of coefficients being the same for fathers and mothers for the highest education level (university, fachhochschule) and the second highest education level (Matura, medium), but does not reject for the third highest education level (apprenticeship, vocational school).

----------Table 7 here----------

For reasons of illustration of the results of the ordered logit model we calculate probabilities of attaining a certain education level varying the age of the descendant from 24 to 80 for different selected combinations of parental education. Graph 2 shows the results for low (father: max. compulsory school; mother: max. compulsory school), average (father: apprenticeship, vocational school; mother: max. compulsory school), high (father and mother: matura, medium school) and very high (father and mother: university, fachhochschule) educational background of parents. All other variables are held at their means.

----------Graph 2 here----------

Note that under perfect mobility at every point in time all graphs should be the same. Furthermore, note that under perfect mobility at every point in time with the same chances to attain a certain educational level (no educational expansion) for all cohorts all the graphs should be the same and all lines separating the different propabilities of attaining a certain education level should be horizontal. Clearly chances of attaining a certain educational level are strongly increasing with higher educational attainment of the parents.

4 Conclusions

We tested the following questions: (i) Is there persistence in educational outcomes, i.e. is the education of parents and descendants positively correlated? (ii) Is persistence relatively strong in comparison to other European countries? (iii) Does the dependence vary over time? (iv) Is gender relevant for the educational outcome?

We find (i) there is a positive and significant correlation between educational attainment of parents and descendants. The evidence is robust in relation to the use of different approaches, namely econometric techniques and the markovian approach.

We discover (ii) the level of correlation seem to be higher than in northern european countries as The Netherlands, Finland or Sweden and closer to southern european countries like Italy or Slovenia.

We come across (iii) that the dependence of the educational outcome of the descendants on the education of parents is decreasing over time. This result is robust over the applied approaches. Note that in general an educational expansion does not imply that after the expansion mobility is higher than before.

We find (iv) that education of the father has a stronger effect on educational outcomes than education of the mother.

Our results therefore allow to question the significance of meritocratic values and equal opportunity for educational advancement in the Austrian society.

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Tables and Graphs

Table 1: Mean Age and Mean Statutory Schooling Years of Descendants, their Fathers and Mothers for Descendants born from 1916 to 1984

	Descendants		Fathers		Mothers	
	Age	Statutory Schooling Years	(Hypothetcial) Age	Statutory Schooling Years	(Hypothetcial) Age	Statutory Schooling Years
born before 1940	76.6	10.1	101.5	9.7	99.9	9.3
born 1940-1944	66.0	10.6	97.2	9.9	94.4	9.5
born 1945-1949	60.8	10.6	92.8	10.0	90.0	9.5
born 1950-1954	55.5	11.3	86.9	10.2	83.0	9.7
born 1955-1959	50.9	11.2	82.5	10.3	78.8	9.8
born 1960-1964	46.0	11.4	76.4	10.4	72.8	9.9
born 1965-1969	40.9	11.2	71.4	10.4	67.8	9.8
born 1970-1974	36.2	11.2	65.7	10.2	62.6	10.0
born 1975-1979	30.8	11.4	60.9	10.7	57.4	10.1
born 1980-1984	26.1	11.1	54.0	10.6	51.1	10.2
Total	49.5	11.0	77.3	10.2	74.8	9.8

Table 2: Distributions of Educational Attainment of Descendants, their Fathers and Mothers for Descendants born from 1916 to 1984

	Number of Observations	Percent	Cumulative Percent
Descendants			
University, fachhochschule	210	10.95	10.95
Matura, medium school	579	30.19	41.14
Apprenticeship, vocational school	811	42.28	83.42
max compulsory school	318	16.58	100.00
Fathers			
University, fachhochschule	100	5.21	5.21
Matura, medium school	318	16.58	21.79
Apprenticeship, vocational school	782	40.77	62.57
max compulsory school	718	37.43	100.00
Mothers			
University, fachhochschule	35	1.82	1.82
Matura, medium school	279	14.55	16.37
Apprenticeship, vocational school	526	27.42	43.80
max compulsory school	1,078	56.20	100.00
Total	1,918	100.00	

Table 3: Linear Trend

	Grade Persistence	Standardized Persistence
Linear Trend	-0.036	-0.022
	(0.014)	(0.005)
Linear Trend excluding first cohort (born before 1940)	-0.046	-0.023
	(0.016)	(0.006)

Notes:
(i) Standard errors in parentheses.

Table 4: International Comparison of Grade and Rank Persistence

Country	Grade Persistence	Rank	Standardized Persistence	Rank
Italy	0.67	6	0.54	1
Slovenia	0.54	12	0.52	2
Austria***	0.81	1	0.52	3
Austria*	0.78	2	0.51	4
Austria**	0.77	3	0.50	5
Hungary	0.61	7	0.49	6
USA	0.46	18	0.46	7
Switzerland	0.49	14	0.46	8
Ireland	0.70	5	0.46	9
Poland	0.48	16	0.43	10
Belgium	0.41	20	0.40	11
Estonia	0.54	13	0.40	12
Sweden	0.58	10	0.40	13
Ukraine	0.37	22	0.39	14
Slovakia	0.61	8	0.37	15
Czech Republic	0.44	19	0.37	16
The Netherlands	0.58	11	0.36	17
Norway	0.40	21	0.35	18
Finland	0.48	17	0.33	19
Northern Ireland	0.59	9	0.32	20
Great Britain	0.71	4	0.31	21
Denmark	0.49	15	0.30	22

Notes:
(i) *including the whole sample; **excluding the age group *born before 1940*
***excluding the age groups *born before 1940* and *born 1980-1984*
(ii) All other than Austrian measures are taken from Hertz et. al 2008, table 2

Table 5: Transition matrix of maximum educational attainment of parents and descendants educational attainment

Parents/Descendant	University, fachhochschule	Matura, medium school	Apprenticeship, vocational school	max compulsory school
University, fachhochschule	0.49	0.46	0.05	0.00
Matura, medium school	0.21	0.53	0.23	0.03
Apprenticeship, vocational school	0.07	0.29	0.58	0.06
Maximum compulsory school	0.03	0.16	0.42	0.39

Table 6: Selected mobility measures

	Shorrocks-Index	Second Eigenvalue-Index	Determinant-Index	Absolute Average Jump	Kendalls-tau-b
Born 1916-1949	0.61	0.38	0.68	0.53	0.53
Born 1950-1969	0.66	0.41	0.70	0.60	0.45
Born 1970-1984	0.80	0.59	0.87	0.72	0.38
Overall	0.67	0.46	0.71	0.60	0.48

Table 7: Marginal Effects at Means and Modes of Ordered Logit Model

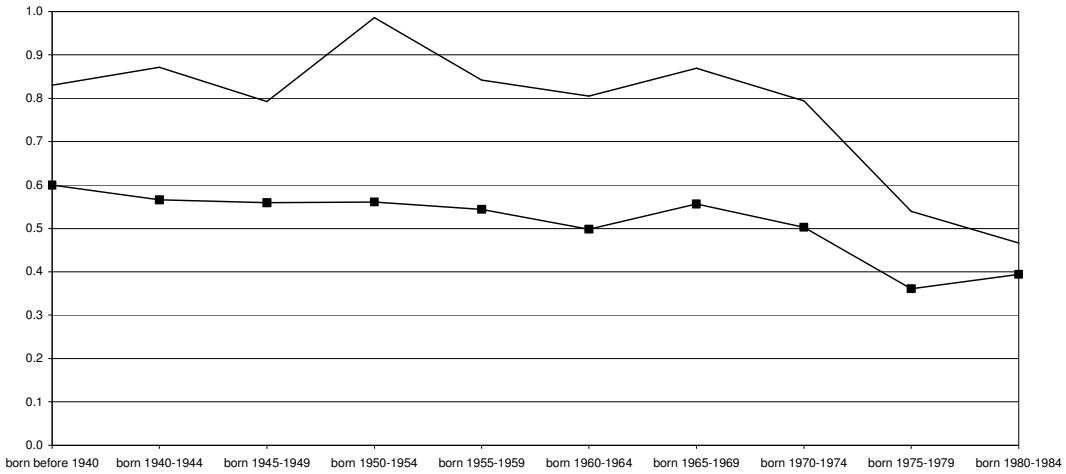
		Descedants Educational Attainment			
		max compulsory school	Apprenticeship, vocational school	Matura, medium school	University, fachhochschule
	P(Y|X)	0.333	0.528	0.122	0.016
Father	Apprenticeship, vocational school	-0.162	0.02	0.12	0.023
		(0.022)***	(0.012)	(0.018)***	(0.004)***
	Matura, medium school	-0.270	-0.137	0.313	0.095
		(0.020)***	(0.032)***	(0.026)***	(0.015)***
	University, fachhochschule	-0.310	-0.329	0.389	0.250
		(0.020)***	(0.039)***	(0.019)***	(0.047)***
Mother	Apprenticeship, vocational school	-0.130	0.029	0.086	0.015
		(0.021)***	(0.011)***	(0.019)***	(0.004)***
	Matura, medium school	-0.200	-0.005	0.17	0.035
		(0.022)***	(0.025)	(0.029)***	(0.008)***
	University, fachhochschule	-0.220	-0.029	0.204	0.045
		(0.039)***	(0.054)	(0.067)***	(0.022)**
Descendant	Age	0.003	-0.002	-0.002	-0.001
		(0.001)***	(0.000)***	(0.000)***	(0.000)***
	Female	0.043	-0.017	-0.022	-0.004
		(0.019)**	(0.008)**	(0.010)***	(0.002)**

Notes:

(i) No.Obs.=1918; Log Likelihood=-720.77; Cox-Snell R^2=0.31; Nagelkerke R^2=0.34; McFadden R^2=0.14

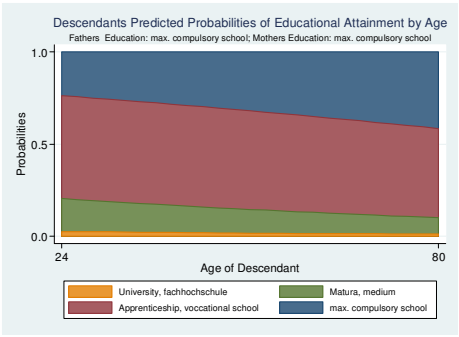
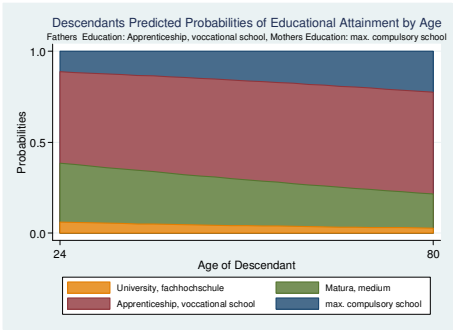
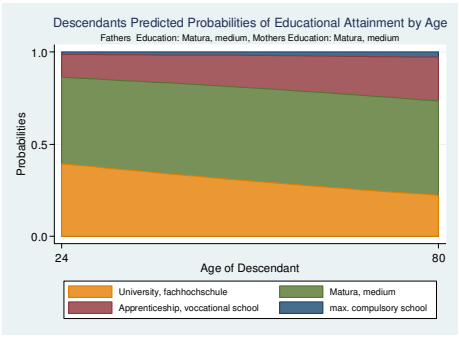
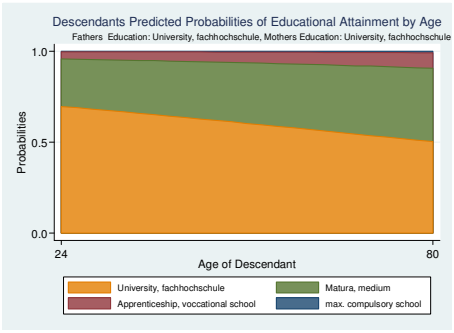
(ii) *,**,*** denotes significance at 10%, 5%, 1% level; Standard errors are given in parentheses

Graph 1: Grade Persistence and Standardized Persistence



Note:
(i) Statutory schooling years of descendants regressed on average statutory schooling years of parents.

Graph 2: Predicted Probabilities for Descendants Educational Attainment by Age – given a certain educational background of the Parents

Low parental background	Average parental background
	
High parental background	**Very high parental background**
	

Notes:

(i) All graphs are based on the ordered logit model estimated in section 3.3.

APPENDIX

A Grade Persistence and Standardized Persistence

Following Hertz et al. (2008) and Checci et al. (2008) we apply a measure of grade persistence, which is defined as a simple regression,

$$E_i^d = \alpha + \beta E_i^p + \varepsilon_i \quad \text{for} \quad i = 1,2,..,N, \tag{1}$$

where E_i^d is descendants statutory schooling years and E_i^p is average parental statutory schooling years. ε_i is a normally distributed error term with zero mean and σ^2 variance. The according OLS estimate for this regression is

$$\hat{\beta} = \frac{\sigma_{dp}}{\sigma_p^2} = \rho_{dp} \frac{\sigma_d}{\sigma_p},$$

with σ_d and σ_p being the standard deviations of education of the according educational distributions of descendants and parents and ρ_{dp} beeing the correlation coefficient between descendants and parents education. An decreasing $\hat{\beta}$ over time can be interpreted as more independence concerning educational outcomes. To ensure that a possible decrease or increase is not only due to an evolution of the distributions of the educational attainments, namely the term $\frac{\sigma_d}{\sigma_p}$ one can normalise the individual educational attainment variables by the corresponding standard deviations which is an intuitive interpretation of correlation, and leads to

$$\frac{E_i^d}{\sigma_d} = \alpha + \gamma \frac{E_i^p}{\sigma_p} + \varepsilon_i \quad \text{for} \quad i = 1,2,..,N, \tag{2}$$

where the evolution of γ (the correlation) over the separately estimated subsets of the descendant cohorts can be interpreted as equality of opportunity (Checci et al., 2008).

B Markovian Approach

B.1 Transition Matrix

In section 3.2 we calculate right stochastic matrices for the transitions of the Markovian process, which describes the intergenerational educational transmission. For the reader's convenience we recall

the basic framework as well as the basic measurement issues concerning the Markovian approach for analyzing intergenerational transmission of education.

Let E be a finite state space, where $e_i \in E$ are the states and e is the number of states. Let $P = \left[p_{ij} \right] \in R_+^{e \times e}$ be a stochastic matrix where the probability of moving from state e_i to state e_j is defined as $Pr(j \mid i) = p_{ij} \geq 0$, given by the element in row i and column j of the matrix P. The transition probability is given by $Pr(j \mid i) = p_{ij} = w_{ij} / \sum_{j=1}^{e} w_{ij}$, where w_{ij} is the sum of the weights for father-descendant pairs associated with educational transition from educational class i to class j for $i, j = 1, 2, \ldots, e$. Of course, $\sum_{j=1}^{e} p_{ij} = 1$, meaning that every origin state leads to some final state with probability 1.

In the case of educational attainment, the states e_i are given by the set of different educational levels. E^p denotes the row vector which gives the marginal distribution of the education levels of the parent (either father or mother or as in our case the maximum of both). E^d is that of the descendants. Therefore, a row vector $p_{i1}, p_{i2}, \ldots, p_{ie}$ is the educational "lottery" faced by a descendant whose parent belongs to educational class i.

One way of ordering the lotteries that any two descendants face given their parents' education is the stochastic dominance ordering. Let p_i denote the row vector of the ith row of a right stochastic transition matrix P. Let us assume an "at least as good as" preference relation $\succsim$ on educational lotteries. In the sense of stochastic dominance, the lottery p_i is "at least as good as" lottery p_j if $p_{i,1} + p_{i,2} + \ldots + p_{i,k} \succsim p_{j,1} + p_{j,2} + \ldots + p_{j,k}$ (for all) k=1, 2, …, e-1 and "better" ($\succ$) if at least one inequality holds. In the case of table 5 this translates to $p_1 \succ p_2 \succ p_3 \succ p_4$. Therefore, the transition matrix is said to be monotone because (for all) i= 1, 2, …, e-1, $\sum_{j=1}^{k} p_{i,j} \geq \sum_{j=1}^{k} p_{i+1,j}$, (for all) k=1, 2, …, e-1. Put simply, let us choose two people from the descendant population whose parents have different education levels. The following statement is always true: The one with the more highly educated parent faces a "better" lottery in the stochastic dominance sense.

Let P be the set of transition matrices. To follow an independence approach, which requires that the highest mobility is achieved if a matrix induces perfect origin independence, it is convenient to assert that $M(I) \leq M(P) \leq M(\overline{P})$, where $I \in \mathrm{P}$ is the identity matrix, $P \in \mathrm{P}$ is any transition matrix, and $\overline{P} \in \mathrm{P}$ is a transition matrix whose rows are identical. The identity matrix generates no transition between states and should be assigned with the least level of mobility. The matrix $\overline{P} \in \mathrm{P}$, on the other hand, should be assigned the highest level of mobility, because it induces perfect origin independence (Fields and Ok, 1996; Prais, 1955). Of course, this property is not always desirable especially when mobility is defined as movement. However, for an intergenerational framework, such a conception is relevant because we consider mobility to be independence. For convenience, the measures are normalized to the interval [0,1]. Van de Gaer et al. (2001) show that because the axioms introduced by Shorrocks (1978) are inconsistent on the full domain of P[17], the standard measures are not appropriate

[17]The relevant axioms are

(i) *Monotonicity*: $P \succ P'$ when $p_{ij} \geq p'_{ij} \forall i \neq j$ and $p_{ij} > p'_{ij}$ for some $i \neq j$.Therefore $M(P) > M(P')$.

(ii) *Immobility*: $M(I) = 0$. Minimum should be reached for identity matrix.

to measure mobility defined as independence on the full domain of P. Van de Gaer et al. (2001) introduce suitable measures for the full domain of P but since we only have to deal with monotone transition matrices, we can restrict our set to $\Xi \subset \mathrm{P}$, which contains only monotone transition matrices in order to be able to use conventional measures (Fields and Ok, 1996, van de Gaer et al., 2001).

B.2 Mobility Measures

One widely used measure of the independence family of indices is the Second Eigenvalue Index. The eigenvalues of a given transition matrix ordered by the absolute value of their real part are given by $\lambda_i = |\lambda_1| \geq |\lambda_2| \geq \ldots, \geq |\lambda_n|$. Every transition matrix has $\lambda_1 = 1$. The Second Eigenvalue Index measures the distance of any given transition matrix to the origin independent matrix $\overline{P}$; it is given by $M^{SE}(P) \equiv 1 - |\lambda_2|$. If λ_2 is equal to zero, then the transition matrix is equivalent to the limiting origin independent matrix. Therefore M^{SE} equals 1 when the outcome distribution is independent of the original distribution. If, on the other hand, M^{SE} equals 0, then the educational attainment of the descendant population is perfectly determined by the educational attainment of the parent population.

A second measure in this family of indices is the measure proposed by Shorrocks (1978)[18]. Based on the trace of the transition matrix, this index evaluates the concentration arround the diagonal of the matrix: $M^{S}(P) \equiv \frac{e - trace\, P}{e-1}$. We use the Determinant Index, given as $M^{D}(P) \equiv 1 - det(P)^{1/n-1}$ as our third index fullfilling Shorroks axioms on Ξ. It is related to the average magnitude of the moduli of the eigenvalues of P.

The three indices above provide no indication of the number of classes an average descendant stands away from the educational class of his or her parent. Therefore we also take a look at an ad-hoc measure which does so. The so-called absolute average jump *AAJ(P)* gives the mean number of classes moved in absolute value. One more possibilty to summarize the information of a transition matrix, which is based on rank order correlation, is Kendall's tau-b which lies in the intervall $[-1;+1]$, where a value of zero would be independence and values of -1 and +1 perfect negative respectively positive dependence.

(iii) *Perfect Mobility*: Let $P'' = (1/n)uu'$ where u is an n-dimensional vector of ones. Then $\forall P \neq P'' \in P$ it follows that $M(P'') > M(P)$

Clearly (i) and (iii) are inconsistent on the domain of P.

[18] Sometimes referred to as Shorrocks Mean Exit Time or Prais Index.