Intergenerational Transmission of Educational Attainment in Austria *

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Abstract

The Austrian Household Survey on Housing Wealth shows strong persistence in educational attainment. The size of educational persistence varies over time in Austria. Using a Markovian approach and uni- as well as multivariate econometric techniques we show that educational mobility increased over time. In general our results question the existence of meritocratic values and equal opportunity for educational advancement in the Austrian society. Intergenerational transmission of disadvantages in education matters for policies.

VERY PRELIMINARY / DO NOT CITE

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1 Introduction

In this paper we try to 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 Hoehere 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 (Berhman and Rosenzweig, 2002), adoptee datasets (Plug, 2004), or school reforms (Black et al., 2005) to control for parents' unobserved endowments, we instead concentrate on the intergenerational correlation of education (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 in testing the ubiquity of this result is the fact that many datasets do not provide adequate information; when we do have a dataset that contains educational information of both the parents and descendants, we often lack many human capital variables which we could use to control for abilities of descendants to estimate direct causal effects in educational transmission (Dardanoni et al., 2008). Nevertheless, 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 parents' unobserved endowments in order to identify total causal effects[1], 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 relationship between education of parents and children is in general overestimated and our estimates are to be interpreted as correlations, not as direct causal effects.

[1]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).

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 varies over time? (iv) Is gender relevant for the educational outcome?

We use a Markovian approach as well as univariate and multivariate econometric approaches. The variety of methods allows us to check the robustness of our results. Due to the absence of long panel data series for Austria we use the Household Survey on Housing Wealth (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 may have problems in claiming meritocratic ideals at the same time.
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.
The paper is organized as follows: In section 2 we review the literature on the inheritance of social status including the literature on the transmission of educational attainment. Section 3 provides empirical evidence in a descriptive way in subsection 3.1, using the Markovian approach in subsection 3.2 and using econometric techniques, namely a univariate Ordinary Least Squares and a multivariate Ordered Logit Model, in subsection 3.3. Section 4 concludes.

2 Literature Overview and Theoretical Reasoning

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 children will attain as adults. Intergener-

ational 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.
D'Addio (2007) surveys the research in OECD countries on intergenerational mobility. The main findings of the literature survey are:

- Intergenerational earnings mobility varies significantly across countries. It is higher in the Nordic countries, Canada and Australia but 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 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 structure, and the socio-economic and cultural background of the parents' educational mobility across generations matters.

- Moreover, some of the cross-country differences in the extent of intergenerational mobility of education are shaped by policies. For example, early streaming of students, based on their ability, 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 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.

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 marketst 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 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 bigger 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.

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 char-

acteristics 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.
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.

Further particular issues are the inheritance of poverty across generations (D'Addio 2007, p.38), and 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.

There is substantial literature within both economics and sociology to compare inheritance of inequalities across generations for different countries (D'Addio 2007). 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*[2].
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-

[2]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.

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 with their specific focus (either on income, occupation or education) show that more cooperation in the future between economists, sociologists and psychologists would be fruitful. Research up to now addresses different aspects of social mobility but as the extent of mobility will vary across different domains no overall picture of intergenerational mobility will emerge. Still intergenerational correlation of income, wealth, consumption, and education is well documented in a tremendous number of empirical studies, as shown by Mulligan (1999, Table 1).

All the mentioned factors are interwoven in the process of intergeneration transmission of inequality. 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 does not include that 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 uncover 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. 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. And the main advantage of our approach is the reference to a recent micro data basis and the use of different methodological tools.

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 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. Furthermore the interviewee is asked to state the educational level of her mother and father. The survey asked for six different school levels[3] which we aggregated into 4 classes[4]. Table 1 shows the educational distributions of the resulting populations (descendants, fathers, mothers).

	descendants			fathers			mothers		
	n	%	*c.%**	n	%	c.%	n	%	c.%
max. compulsory school	356	17	17	745	37	37	1125	55	55
apprenticeship; vocational school	878	42	59	832	41	78	570	28	83
Matura; medium	635	30	89	341	17	94	309	15	98
University; Fachhochschule	215	10	100	113	6	100	40	2	100
Total	2,081	100		$2,031^{1}$	100		$2,044^{2}$	100	

Source: Author's calculations of HSHW 2008

* c.% denotes cumulative percent

[1] For 50 observations in the dataset, paternal educational levels are missing

[2] For 37 observations in the dataset, maternal educational levels are missing

Table 1: Distributions of Educational Levels for descendants', fathers' and mothers' populations

The descendant population is in general higher educated than the fathers and moth-

[3] 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

[4] 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.

ers population. Furthermore fathers are generally higher educated than mothers (table 1). Table 2 shows the distributions for female and male descendants. In general the male population is higher educated than the female population. But in contrast to the mothers' versus fathers' distribution in table 1 the educational gender differences seem to be reduced substantially in the descendant population. The mothers' population is the only one with mode max. compulsory education, whereas the apprenticeship and vocational school class is the mode for all the other distributions. To gain further evidence on intergenerational transmission the next step is to look at joint distributions of parental and descendant populations. One well established approach to do so is the Markovian approach[5].

	descendant=male			descendant=female		
	n	%	*c.%**	n	%	*c.%**
max. compulsory school	137	14	14	219	20	20
apprenticeship; vocational school	452	46	60	426	39	59
Matura; medium	273	28	88	359	33	91
University; Fachhochschule	119	12	100	96	9	100
Total	981	100		1100	100	

Source: Author's calculations on HSHW 2008

* c.% denotes cumulative percent

Table 2: Distributions of Educational Levels for descendants by male and female descendants

3.2 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.

Let $\mathcal{E}$ be a finite state space, where $e_i \in \mathcal{E}$ are the states and e is the number of states. Let $P = [p_{ij}] \in \mathbb{R}_+^{e \times e}$ be a stochastic matrix where the probability of moving from state e_i to state e_j is defined as $Pr(j|i) = p_{ij} \geq 0$ which is given by the element in row i and column j of the matrix P. Of course $\sum_{j=1}^{e} p_{ij} = 1$, which means that

[5]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

every origin state leads to some final state with probability 1.
In our case the states e_i are given by the set of different educational levels. E^f denotes the row vector which gives the marginal distribution of the education levels of the fathers, E^d denotes the vector which gives the marginal distribution of the education levels of the descendants. Therefore, a row vector $p_{i1}, p_{i2}, \ldots, p_{ie}$ is the educational "lottery" faced by a descendant whose father belongs to educational class i.

Example. To illustrate the intuition for this approach let us suppose a simple example, where we have a population of six fathers and six descendants. Education levels are just low or high. Three fathers have low education, three fathers have high education. Three descendants have low education, three descendants have high education. Let us assume that one descendant has higher education than her father and one descendant has lower education than her father. The transition propability is given by $Pr(j|i) = p_{ij} = w_{ij} / \sum_{j=1}^{e} w_{ij}$, 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 $i, j = 1, 2, \ldots, e$. The associated transition matrix P is therefore given by

$$P = \begin{bmatrix} p_{1,1} & p_{1,2} \\ p_{2,1} & p_{2,2} \end{bmatrix} = \begin{bmatrix} 2/3 & 1/3 \\ 1/3 & 2/3 \end{bmatrix}$$

which gives the transition from the educational distribution of the fathers population to the educational distribution of the descendant population, in this case

$$\underbrace{\begin{bmatrix} 3 & 3 \end{bmatrix}}_{E^f} \times \underbrace{\begin{bmatrix} 2/3 & 1/3 \\ 1/3 & 2/3 \end{bmatrix}}_{P} = \underbrace{\begin{bmatrix} 3 \\ 3 \end{bmatrix}}_{E^d}$$

We use HSHW 2008 data to construct vectors of educational distributions. The vectors E^f and E^d and therefore the corresponding transition matrix (by rows and columns) $P^{f \to d}$ are ordered from high (e_1) to low education level (e_4) [6]. The transition matrix for the educational transmission from fathers to descendants is given by $P^{f \to d}$, which is based on 1905 observations in the total sample of 2081 (128 descendants aged 24 and less are set to missing, 50 missings for fathers education, for two of the cases both is true).

[6] $e_i = \{e_1, e_2, \ldots, e_4\}$, where $e_1 =$ *university, Fachhochschule*, $e_2 =$ *Matura and Medium − level technical and vocational school*, $e_3 =$ *apprenticeship, vocational school*, $e_4 =$ *max compulsory school*

$$P^{f\to d} = \begin{bmatrix} 0.51 & 0.43 & 0.06 & 0.00 \\ 0.23 & 0.55 & 0.19 & 0.03 \\ 0.08 & 0.30 & 0.57 & 0.05 \\ 0.04 & 0.17 & 0.42 & 0.37 \end{bmatrix}$$

The transition matrix $P^{f\to d}$ shows that e.g. for a descendant of a father with the highest education level ($e_1 = university$) degree the probability of holding an university degree is 0.51 and to hold at least a level e_2 degree 0.94, while for a descendant of a father with maximum compulsary education the same probabilities are 0.04 and 0.21 respectively. Generally we would guess that a descendant of a father with a higher educational attainment will be facing a somehow "better" lottery than a descendant of a father with a lower educational attainment.
A possibility to order the lotteries which two given descendants are facing given their fathers education is the stochastic dominance ordering. Let p_i denote the row vector of the ith row of a right stochastic transition matrix P. Lets assume a "at least as good as" preference relation $\succeq$. In the sense of stochastic dominance the lottery p_i is "as least as good" as lottery p_j if $p_{i,1}+p_{i,2}+\cdots+p_{i,m} \geq p_{j,1}+p_{j,2}+\cdots+p_{j,m}\ \forall\ m = 1,2,\cdots,e-1$ and "better" ($\succ$) if at least one ineqality holds. In the case of $P^{f\to d}$ that means that $p_1 \succ p_2 \succ p_3 \succ p_4$. Therefore the transition matrix is said to be monotone because $\forall\ i = 1,2,\cdots,e-1,\ \sum_{j=1}^{k} p_{i,j} \geq \sum_{j=1}^{k} p_{i+1,j},\ k = 1,2,\cdots,e-1$.
In other words: Let us suppose that two descendants from the children population with different education levels of fathers are chosen. Then the following statement is always true: The one with the higher educated father faces a "better" lottery in the stochastic dominance sense.
To investigate the transmission of educational attainment further, we calculate the following transition matrices, of wich all turned out to be monotone: $P^{f\to d_{<1960}}$, $P^{f\to d_{1960-1980}}$, $P^{f\to d_{>1980}}$, where d_{x_i} with
$x_i = \{<1960, 1960-1980, >1980\}$ denote subsets of the descendent population according to there starting of primary school.

Mobility Measures Shorrocks (1978) provides a general framework to measure mobility when the data are provided in the form of a transition matrix. In general those measures can be defined as continous real funtcions of the form $M(\cdot) : P \mapsto \mathbb{R}$ over the set of transition matrices $\mathcal{P}$.
Generally, there are two ways of analyzing mobility. Mobility as *movement* and mobility as *independence*. If mobility is defined as movement, a measure of mobility should prefer mobility matrices which incorporate more movement to those which incorporate less movement. If mobility is defined as independence, a mobility mea-

sure should prefer those mobility matrices which incorporate less unequal lotteries to those which incorporate more unequal lotteries. In this sense independence can also be interpreted as "equality of opportunity".
In order to follow an independence approach, which means that the highest mobility is achieved if a matrix induces perfect origin independence it's convenient that for a measure of mobility it holds that $M(I) \leq M(P) \leq M(\bar{P})$, where $I \in \mathcal{P}$ is the identity matrix and $P \in \mathcal{P}$ is any transition matrix and $\bar{P} \in \mathcal{P}$ is any transition matrix all rows of which are identical. The identity matrix generates no transition between states and should be assigned by the index with the least level of mobility while the matrix $\bar{P} \in \mathcal{P}$ should be assigned with 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 if mobility is defined as movement. However, it is for an intergenerational framework where it makes sense to concentrate on mobility as independence. Furthermore for convienience the measures are normalized to the intervall $[0, 1]$. The axioms introduced by Shorrocks (1978) are inconsistent on the full domain of $\mathcal{P}$[7]. Therefore, the standard measures are not appropriate to measure mobility defined as independence on the full domain of $\mathcal{P}$ as is shown by van de Gaer et al. 2001. For our empirical analyzes of transition matrices this is not problematic because we can restrict the set to $\Xi \subset \mathcal{P}$, the set of monotone transition matrices (Fields and Ok, 1996, van de Gaer et al., 2001).
A widely used measure of this 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 $\lambda_i = |\lambda_1| \geq |\lambda_2| \geq \ldots, \geq |\lambda_n|$. For every transition matrix $\lambda_1 = 1$. The Eigenvalue Index measures the distance of any given transition matrix to the origin independent matrix $\bar{P}$ and is given by $M^{SE}(P) \equiv 1 - |\lambda_2|$. If λ_2 equals to zero the transition matrix equals to the limiting origin independent matrix. Therefore Ml equals 1 when the outcome distribution is independent of the original distribution. If Ml equals 0 on the other hand the educational attainment of the descendant population (E^d) is perfectly determined by the educational attainment of the fathers population (E^f). As a second measure of this family we use the measure proposed by Shorroks (1978)[8]. Based on the trace of the transition matrix the index

[7]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.
(iii) *Perfect Mobility*: Let $P'' = (1/n)uu'$ where u is an n-dimensional vector of ones. Then $\forall P \neq P'' \in \mathcal{P}$ it follows that $M(P'') > M(P)$
Clearly (i) and (iii) are inconsistent on the domain of $\mathcal{P}$

[8]Sometimes also refered to as Shorroks Mean exit Time or Prais Index.

evaluates the concentration arround the diagonal of the matrix, $M^S(P) \equiv \frac{e-trace\ P}{e-1}$. As third index which is bounded between 0 and 1 we use the Determinant Index given as $M^D(P) \equiv 1-|det(P)|^{1/n-1}$. The determinant index is related to the average magnitude of the moduli of the eigenvalues of P.
All of the above indices give no indication about the number of classes an average descendant is away from the educational class of his father. The so called absolute average jump $AAJ(P)$ gives the mean number of classes moved in absolute value. Therefore in our case $AAJ(P) \in [0, 3]$.
One more possibilty to summarize the information of a transition matrix, which is based on rank order correlation, is Kendall's tau-b $(Ktau - b(P))$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. Table 3 shows all selected mobility indices for all described transition matrices.

	$M^{SE}(P)$	$M^S(P)$	$M^D(P)$	$AAJ(P)$	$Ktau - b(P)$
$P^{f\to d_{>1980}}$	0.543 (1)	0.732 (1)	0.765 (2)	0.677 (1)	0.390 (1)
$P^{f\to d_{1960-1980}}$	0.427 (2)	0.656 (2)	0.689 (3)	0.599 (2)	0.447 (2)
$P^{f\to d_{<1960}}$	0.344 (3)	0.642 (3)	0.851 (1)	0.543 (3)	0.516 (3)
$P^{f\to d}$	0.469	0.666	0.700	0.602	0.468
Indices with rank in parentheses (1 is most mobile)					

Table 3: Mobility Indices of selected transition matrices of educational transmission

Besides the Determinant Index all of the indices lead to the same ranking implying increasing mobility over time, i.e. $P^{f\to d_{>1980}}$ incorporates more mobility than $P^{f\to d_{1960-1979}}$ and $P^{f\to d_{1960-1979}}$ incorporates more mobility than $P^{f\to d_{<1960}}$.

3.3 Econometric Evidence

Most studies dealing with the intergenerational transmission of education concentrate on the correlation between parents and descendants educational attainment. Mostly the data do not include good measures of social environment, parental care or wealth. Therefore most studies have to assume that at least partially educational achievement includes also the other aspects. 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 $i = 1, 2, \cdots, N$, where E_i^d, E_i^f, E_i^m describes 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.

Univariate Analysis - OLS and Correlation In order to be able to make comparisons with other countries we use univariate methods, which have been heavily used to analyze intergenerational transmission of educational attainment for a large number of countries (Chevalier et al., 2003). Following the approach by Checchi et. al (2008)we estimate OLS regressions of the form,

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

where $p = f$ in the first estimation and $p = m$ in the second estimation. ε_i is an normally distributed error term with zero mean and σ^2 variance. The according OLS estimate for each regression is

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

with $\sigma_d, \sigma_f, \sigma_m$ being the standard deviations of education of the according populations and ρ_{dp} beeing the correlation coefficient between descendants and fathers $(p = f)$ or mothers $(p = f)$ 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

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

where the evolution of γ over the separately estimated subsets of the descendant population according to there starting of primary school $(< 1960, 1960 - 1980, > 1980)$ can be interpreted as evolution of the correlation between parents and descendants. Table 4 shows the estimation results of Model 1 and 2 with (i) fathers as independent $(p = f)$ and (ii) mothers as independent variable $(p = m)$. Note that for this exercise we have to transfer the categorical variables into statuory schooling years, i.e. the years which are at least necessary to complete a certain educational degree[9].

[9]In doing so we use all the 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 Fach-

Furthermore as our data does not allow for instrumental variable estimation the 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.

	Model 1		Model 2	
	$\hat{\beta}_{father}$	$\hat{\beta}_{mother}$	$\hat{\gamma}_{father}$	$\hat{\gamma}_{mother}$
< 1960	0.674***	0.744***	0.588***	0.648***
	(0.049)	(0.075)	(0.043)	(0.065)
R^2	0.35	0.21	0.35	0.21
$1960 - 1980$	0.640***	0.821***	0.524***	0.453***
	(0.037)	(0.057)	(0.030)	(0.032)
R^2	0.27	0.20	0.27	0.20
> 1980	0.542***	0.576***	0.455***	0.381***
	(0.039)	(0.052)	(0.033)	(0.034)
R^2	0.21	0.14	0.21	0.14
overall	0.623***	0.717***	0.519***	0.436***
	(0.024)	(0.034)	(0.019)	(0.021)
R^2	0.27	0.19	0.27	0.19

Source: authors calculations on HSHW 2008 data.
Notes: *,**,*** denotes significance at 10%, 5%, 1% level
Standard errors are given in parenthesis.

Table 4: Estimation Results for Models 1 and 2 with fathers or mothers as independent variable

The coefficients in all estimations are clearly lower for the younger descendant subset (starting primary school > 1980) than for the subset with the oldest descendants (starting primary school < 1960). The dependence of the educational outcome of the descendants from their parents decreased over time. The fact that we find higher β coefficents for the fathers regressions than for the mothers' regressions but the other way round for the γ coefficents shows that a large part of β coefficient is due to differences in the distributions. The starting level of the standard deviations is clearly

hochschule=16. Due to the complex educational system it is not unambigously clear which would be the right statuory values but for the set of reasonable values results are pretty robust.

lower for the mothers' population than for the fathers' population. The standard deviation of all populations (mothers, fathers and descendants) is rising over time. The one of the mothers' population stays lower in all three subsets but is rising faster (The change from the subset < 1960 to the subset > 1980 is 19% for mothers and 9% for fathers) which explains the evolution of the differences between the β and γ coefficients. All in all fathers' as well as mothers' education correlate significantly with descendants' education. The correlation generally decreased over time with the exception of the β coefficient for the mothers distribution, which increased slightly from the subset < 1960 to the subset $1960 - 1980$ and than decreased sharply to the subest > 1980. But also this slight increase was due to distributional issues as one can see at the corresponding evolution of the corresponding γ coefficient. Disregarding distributional differences of the population and their changes over time the correlation between fathers and descendants is higher than between mothers and descendants. Concerning trend and magnitude of the evolution of the coeficcients our results are in line with the results of Checchi et al. (2008) for Italy.
Compared to measures estimated[10] by Hertz et al. (2008) our results seem to be quite reasonable. Their estimated β coefficients for Italy is 0.67, 0.58 for Sweden and the Netherlands,0.54 for Slovenia, 0.48 for Finland and 0.46 for the USA. The Correlation estimate γ (disregarding distributional changes is 0.54 for Italy, 0.52 for Slovenia, 0.46 for the USA, 0.40 for Sweden, 0.36 for the Netherlands and 0.33 for Finland.

Furthermore we included a gender dummy variable, which equals one if the descendant is female as an independent variable in the model. Being female has a significant (on 1% significance level) negative effect in regressions, where either mothers' or fathers' education as independent variables, for the descendants starting primary school before 1960. For the mothers regression it is already insignificant for the regression on descendants starting primary school from 1960 to 1980, while it stays significant (at least at 10% significance level) for the fathers regression. For the regression on descendants starting primary school after 1980 it gets insignificant for both.

Multivariate Analysis - Ordered Logit In order to obtain further evidence on the gender issue also concerning the comparison between the influence of mothers versus fathers and to check for robustness of results, we conduct a multivariate

[10]for their estimation Hertz et al. used the average of the schooling years of fathers and mothers and calculated overall coefficients by averaging cohort coefficients

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 educationl attainment of the fathers (E^f) and mothers (E^f) 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 population subsets ($< 1960, 1960 - 1980, < 1980$). The lowest levels of the educational attainment are excluded for fathers' and mothers' education to serve as reference category. Table 5 shows the marginal effects of the ordered logit estimation evaluated at the means and modes. The probabilities for an average descendant having educational levels e_4, e_3, e_2, e_1 are given in the first row of table 5. Having a father with education level e_1 (university, fachhochschule) instead of e_4 increases ceteris paribus the probability of holding a e_1 by 0.264 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 and higher probability of lower education. The same holds true for being female. Fathers education seem to have generally a stronger effect than mothers education.

4 Conclusions

The Austrian Household Survey on Housing Wealth shows strong persistence in educational attainment. 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 varies over time? (iv) Is gender relevant for the educational outcome?

We find (i) that there is persistence in educational outcomes, i.e. there is positive and significant correlation between educational attainment of fathers and descendants as well as mothers and descendants. The evidence is robust in relation to the use of different approaches, namely the markovian approach and econometric techniques.

We find (ii) that as far as results are comparable 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.

	descendant e_4	descendant e_3	descendant e_2	descendant e_1
	$Pr(Y\|X) = 0.336$	$Pr(Y\|X) = 0.526$	$Pr(Y\|X) = 0.122$	$Pr(Y\|X) = 0.017$
father e_3	-0.165***	0.021*	0.121***	0.023***
	(0.022)	(0.012)	(0.018)	(0.004)
father e_2	-0.274***	-0.140***	0.316***	0.098***
	(0.020)	(0.032)	(0.026)	(0.016)
father e_1	-0.314***	-0.336***	0.386***	0.264***
	(0.020)	(0.039)	(0.021)	(0.049)
mother e_3	-0.126***	0.030***	0.081***	0.015***
	(0.021)	(0.011)	(0.019)	(0.004)
mother e_2	-0.199***	-0.001	0.166***	0.034***
	(0.022)	(0.024)	(0.029)	(0.008)
mother e_1	-0.227***	-0.034	0.213***	0.049**
	(0.040)	(0.059)	(0.071)	(0.024)
descendant age	0.004***	-0.002***	-0.002***	-0.000***
	(0.001)	(0.000)	(0.000)	(0.000)
descendant female	0.046**	-0.019**	-0.024**	-.004**
	(0.019)	(0.008)	(0.010)	(0.002)
obs.=1892; Log likelihood=-2039.839; χ-squared= 722.38				
Cox-Snell R^2=0.32; Nagelkerke R^2=0.35; McFadden R^2=0.15				
Source: authors calculations on HSHW 2008 data.				
Notes: *,**,*** denotes significance at 10%, 5%, 1% level				
Standard errors are given in parenthesis.				

Table 5: Marginal Effects at Mean (Mode) for Ordered Logit Estimation

We find (iii) that the dependence of the educational outcome of the descendants on the education of parents is decreasing over time, a result which is robust over the applied approaches.

We find (iv) that on the one hand being female has a negative impact on educational outcomes of descendants and on the other hand that education of the father has a stronger effect on educational outcames than education of the mother (disregarding distributional differences).
The results therefore question the existence of meritocratic values and equal opportunity for educational advancement in the Austrian society.

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