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The role of paternal risk attitudes in long-run education outcomes and intergenerational mobility

Mathias Huebener

Universität Zürich
IBW – Institut für Betriebswirtschaftslehre

UNIVERSITÄT BERN

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Mathias Huebener,
DIW Berlin, Department of Education and Family

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ABSTRACT

This paper studies the role of paternal risk attitudes in sons' long-run education outcomes and in the intergenerational transmission of incomes and education. Based on 1984–2012 German Socio-Economic Panel Study data of sons and fathers, I show that fathers' risk aversion is inversely related to sons' long-run levels of education. I find signs that sons with risk averse fathers experience lower educational mobility and considerably lower income mobility than their peers with risk taking fathers, though these differences can only be measured with large standard errors. The direct link between paternal risk attitudes and offspring's education outcomes can provide a novel explanation for the mechanism underlying the intergenerational persistence of economic statuses. It can further challenge the traditional view of own risk attitudes in the human capital investment theory and suggests that parental risk attitudes should be incorporated.

1. Introduction

Education decisions involve many uncertainties. Standard economic theory either ignores the risky element in education decisions or assigns an important role to individuals' own risk attitudes in the educational investment process. Thereby, it abstracts from the timing of education decisions and path dependencies.

Important education decisions, such as the school track, are made in early years of a lifetime and involve path dependencies. Thus one can assume that parents either influence or outright make their children's decisions and that these decisions are related to parental risk attitudes. First research finds a negative relationship between parental risk aversion and children's education outcomes, measured at rather early stages in life (Brown, Ortiz-Nunez, & Taylor, 2012; Checchi, Fiorio, & Leonardi, 2014; Leonardi, 2007; Wölfel & Heineck, 2012). These decisions could be revised as children become more independent of their parents. However, the education process involves path dependencies such that decisions made by their parents can have a long lasting impact. Considering that education is an important determinant of labour market outcomes,

identifying a direct link between parental risk attitudes and education outcomes can help clarify the mechanisms behind the considerable correlations in economic statuses across generations.

This paper is the first to combine the literature on the role of parental risk attitudes in children's educational attainments with the literature on economic mobility. If children of risk taking parents have consistently more education than their peers from risk averse parents, their education levels are less similar to their parents, ceteris paribus. Higher levels of education are not just associated with higher incomes, but also higher income dispersions. Consequently, children's incomes are also less similar to that of their parents. Children of risk taking parents would experience greater economic mobility because of higher investments into education.

Following the income mobility literature, this paper focuses on fathers and sons. It employs German Socio-Economic Panel Study data from 1984 through 2012, which provides information on the labour market history of both generations, a large set of socio-economic information, as well as measures of self-reported risk attitudes that Dohmen et al. (2005) experimentally confirm to be valid predictors of actual decisions involving risk. Germany is an optimal case to study the relationship as children are typically tracked before they turn 12.[1]

First, I empirically test the impact of paternal risk attitudes on sons' long-run educational attainments, which are measured when sons have at least 3 years of full time employment above age 30. I complement and confirm the pioneering findings by Brown et al. (2012), Wölfel and Heineck (2012) and Checchi et al. (2014), showing that paternal risk aversion is inversely related to their sons' completed years of education and on the probability of graduating from university. I then study the role of paternal risk attitudes in educational and income mobility. By estimating the mobility differences between the two groups of rather risk averse and rather risk taking fathers, point estimates suggest that education mobility and income mobility is lower for sons of risk averse fathers. The mobility difference estimates exhibit large standard errors and are statistically not significant. Still, the patterns in the point estimates of the mobility differences are in line with previous findings in the literature that suggest that education is an important moderator of intergenerational mobility in economic status.

The paper makes at least four contributions to the literature. First, it complements the nascent literature on the role of parental risk attitudes in offspring's educational attainments by establishing the long-run persistence of the relationship between fathers' risk attitudes and sons'

[1] For further details about the German education system, see e.g. Winkelmann (1996).

education. Second, I cannot find support for the alternative explanation for the observed relationship that sons' own risk attitudes are a source of spurious correlation with parental risk attitudes, as I incorporate sons' own risk attitudes in the analysis. Third, I suggest a direct link between paternal risk attitudes, offspring's education outcomes and intergenerational mobility. This improves the understanding of the mechanism underlying the intergenerational persistence of economic statuses. Finally, I further challenge the traditional view on the important role of individuals' own risk attitudes in the human capital investment process. Theories on human capital investments should not ignore the timing dimension of educational decisions and incorporate parental risk attitudes as well.

The remainder of this study is organised as follows. Section 2 reviews the existing literature and develops the research hypotheses. Section 3 describes the econometric strategy. The data and key variables are described in Section 4. Section 5 summarises the empirical findings. Section 6 discusses the results and concludes.

2. State of the literature and research hypotheses

2.1. Parental risk attitudes and investments in human capital

Human capital investments are traditionally seen as an individual choice. The investment process involves several sources of risk, such as uncertainty about their abilities, interest, career aspirations, the matching of interests and abilities with the curriculum, the capabilities of passing exams and, eventually, about the valuation of the acquired human capital in future labour markets. Further uncertainty seems to arise through increasing wage dispersions with increasing levels of education (Chay & Lee, 2000; Hartog & Diaz-Serrano, 2014; Lemieux, 2006). Avery and Kane (2004) show that public high school students are aware of this increasing dispersion. These students expect the wage variance to be higher for college graduates.

In the human capital investment process, theory assigns a role to individuals' own risk attitudes (Becker, 1993; Levhari & Weiss, 1974) or even ignores the risk element in the decision process (Hartog & Diaz-Serrano, 2014). The empirical evidence on the relationship between own risk attitudes and investments into education yields ambiguous findings. The scarce literature only identifies a small role for individuals' own risk attitudes in the human capital investment process (Belzil & Leonardi, 2007; Shaw, 1996).

The theoretical foundations abstract from important institutional settings that could explain the absence of convincing empirical evidence. Many decisions in the education investment process are made during the early stages of life. In many education systems, such as in Germany and Italy, early school tracking lays the corner stone for the participation in higher education later in life.

The wide range of involved uncertainties and the limited information set of children justify the assumption that parents accompany, advise or even outright make their children's education decisions, especially during their early years. This creates a source for parental risk attitudes to impact the educational outcomes of their children. Risk averse parents may want to choose a less risky school track for their children, thereby opting for the alternative that requires less cognitive abilities and that does not prepare for university education. At a later stage, when children have to decide about college education, risk averse parents may restrain themselves from advising higher education to their children in order to avoid the aforementioned uncertainties.

One nascent strand of research is dedicated to the link between parental risk attitudes and offspring's educational attainments. The existing studies concentrate on the link at rather early ages of the children. Brown et al. (2012) use the US Panel Study of Income Dynamics to establish the relationship between parental risk aversion and children's academic test scores when they are, on average, 9 years old, as well as on the probability of attending college after high school. They derive parental risk attitudes from hypothetical gambles and find that higher parental risk aversion is associated with lower educational achievements.

Wölfel and Heineck (2012) establish a relationship of parental risk attitudes and children's attended school track between 10 and 15 years of age. Using the German Socio-Economic Panel Study and a measure of self-reported risk attitudes, they find that the probability of attending a school track that prepares for university education is higher when mothers exhibit a higher risk tolerance. Analysing the relationship for Italy with a structural model on the decision process, Checchi et al. (2014) also find a negative relationship between parental risk aversion and college enrolment in Italian data, although Leonardi (2007) could not establish the hypothesised link to the school track choice in Italy.

In contrast to Wölfel and Heineck (2012), who employ self-reported risk attitudes, Leonardi (2007) and Checchi et al. (2014) derive parental risk attitudes from hypothetical lottery questions. In an experimental study, Dohmen et al. (2005) show that self-reported risk attitudes

predict behaviour in risky situations more reliably than measures derived from standard lottery questions. This may explain ambiguous findings for different education outcomes.

The link between parental risk attitudes and children's education outcomes could vanish in the long-run as children become more independent from their parents. Earlier decisions could be revised through evening schools or college attendance subsequent to vocational trainings. However, school track mobility is low and path dependencies are strong. Therefore, I hypothesise that *the link between parental risk attitudes and children's education persists in the long run*, even after children have established themselves in the labour market.[2] Driven by the data requirements of subsequent analyses, I concentrate on the impact of paternal risk attitudes on sons' education outcomes.

This long-run perspective allows to account for short comings of the existing literature, which lacks controls for children's own risk attitudes or their innate ability. This is critical in that Dohmen, Falk, Huffman, and Sunde (2010) show that risk attitudes are correlated with individual ability. Furthermore, risk attitudes feature a substantial positive correlation between parents and children (Dohmen, Falk, Huffman, & Sunde, 2006).[3] This raises the concern of an omitted variable bias in which parental risk attitudes capture the effect of children's innate ability. I am able to circumvent this shortcoming by including sons' own risk attitudes into my analyses.

2.2. Parental risk attitudes and economic mobility

Considering that education is an important determinant of labour market outcomes (Card, 1999), the direct link between parental risk attitudes and children's education can provide important insights into the long standing discussion on intergenerational correlations in economic statuses, which are regularly measured by economists (see e.g. Black and Devereux, 2011). As intergenerational income correlations are closely linked to economic inequality (see, e.g., Shorrocks, 1978; Atkinson, 1981), a clear understanding of the underlying mechanism is very important. Still, little is known about the transmission channel.

Theoretical work (Becker & Tomes, 1986) and empirical analyses on cross-country differences and within-country trends (Jäntti et al., 2006; Machin, 2007; Solon, 2002) suggest that education is an important moderator of income mobility. With a difference-in-differences approach on a

[2] Educational outcomes are measured after sons have at least 3 years of full time labour market experience above age 30. This definition derives from data requirements for the estimation of intergenerational income elasticities.
[3] Table A.1 shows regression results of sons' risk attitudes on fathers' risk attitudes and establishes a significant correlation in the sample of this paper.

specific education reform, Pekkarinen, Uusitalo, and Kerr (2009) demonstrate the impact of educational institutions on intergenerational mobility. The authors find that the Finnish change in the school tracking age from 11 to 16 years reduced the intergenerational income elasticity by 23%. They justify their findings with higher dependences of education outcomes on parental backgrounds the earlier students are tracked.

Not only does income show intergenerational persistence, but also education attainment. This is important because labour market outcomes are significantly determined by individual educational achievement. The measured education correlations are usually attributed to the persistent use of financial and time resources (Tom et al., 2008; Heineck and Riphahn, 2009). Employing a cross-country difference-indifferences approach, Hanushek and Wössmann (2006) contribute to this argument and conclude that early school tracking favours educational inequality. Other research finds that personal traits and abilities, which themselves determine educational attainments, are transmitted between generations (Anger, 2012; Bowles & Gintis, 2002). These correlations appear to be stronger, the more parents invest in the upbringing of their children (Zumbühl, Dohmen, & Pfann, 2013).

The hypothesised link between parental risk attitudes and children's level of education would constitute a, so far neglected, direct source of intergenerational dependencies. If children of risk taking parents obtain higher levels of education, less of sons' levels of education can be explained by the paternal level of education for risk taking fathers, which is to say that sons of risk taking fathers experience higher educational mobility. If this higher education mobility stems from higher educational attainment of sons from risk taking fathers, income levels are also less likely to be similar across generations as the mean and the variance of sons' income distribution increases with education levels. Income mobility would consequently be higher for sons of risk taking fathers.

I summarise the arguments in the hypothesis that *the impact of paternal risk attitudes on sons' education translates into higher educational mobility and higher income mobility for sons with risk taking fathers*. The analysis focuses on males, which arises from the convention of the income mobility literature. This circumvents complications in modelling female lifetime labour incomes.

3. Econometric strategy

The first part of the analysis addresses the link between fathers' risk attitudes and sons' educational outcomes. In the second part of the analysis, I estimate the intergenerational persistence of educational attainments and labour incomes separately by fathers' risk attitudes. This identifies differences in educational and income mobility.

For ease of reference, I will follow this wording convention: Risk aversion refers to individuals reporting a relatively low willingness to take risk in their intragenerational risk distribution. Risk taking individuals reported a relatively high willingness to take risk in their intragenerational risk distribution. Details about the definition of variables are provided in Section 4.

3.1. Investments in education

Building on previous research by Brown et al. (2012) and Wölfel and Heineck (2012), I isolate the role of fathers' risk attitudes in sons' education outcomes by a selection-on-observables approach according to the following relationship:

$$E_{ij}^{S} = \beta R_{j}^{F} + Z_{ij}'\gamma + \varepsilon_{ij}\,.$$

The education outcome E^S of son *i* in family *j* can be expressed by fathers' risk attitude R^F, a vector *Z* of family background and individual characteristics along with normally distributed random variations in sons' education that are not captured by the covariates, *ε*. The sample contains also brothers that were raised in the same household. Unobserved factors of brother's education levels may be correlated within the same family, such that $cov(\varepsilon_{aj}, \varepsilon_{bj}) \neq 0$ for brothers *a* and *b* from household *j*. In the analysis, standard errors are clustered at the family level.

The coefficients β and γ are to be estimated, where β is the coefficient of main interest. When paternal risk taking favours education investments, we would expect that $\beta > 0$. A consistent estimate of β requires the error term ε to be uncorrelated to R^F, conditional on *Z*. In all specifications, I include sons' own risk attitudes as control variable to circumvent the intergenerational correlation of risk attitudes pointed out by Dohmen et al. (2006). In the selection of further control variables, I build on Brown et al. (2012) and Wölfel and Heineck (2012). The parental education background remains the main determinant of children's educational achievements in Germany. I include quadratic terms for the number of years of

completed education of fathers and mothers and dummies for parents' ISCED classification. These variables proxy for parents' cognitive skills. Further, I control for the family background by including the number of siblings, a quadratic term of father's mean log real income,[4] a dummy for the migration background, dummies indicating the religious background of the family and a quadratic term of parents' age at the birth of the child. Furthermore, I include fathers' and mothers' body mass index, which is associated with individuals' health status and time preferences (Case, Fertig, & Paxson, 2005; Zhang & Rashad, 2008).

In a subsequent specification I include sons' characteristics that are associated with educational attainments. I control for individuals' body height, their health status and their body mass index. I further capture time effects in general attainment levels of education by a dummy variable indicating the generation in which the son was born.

3.2. Intergenerational mobility

The analyses for differences in educational and income mobility build on Galton's (1889) classical statistical model for the analyses of correlations between individual characteristics of parents and their children,

$$y_{ij}^{S} = \alpha_1 + \beta_1 \, y_{ij}^{F} + \varepsilon_{ij},$$

with y^S and y^F denoting some characteristic of offspring *i* in family *j*, where *S* indicates the child's own characteristic and *F* characteristics of the parents. β_1 represents the intergenerational, statistical association. ε_{ij} is an error term capturing variation in sons' characteristic that cannot be explained by variations in fathers' characteristic. This model is used extensively by economists to analyse the persistence of economic outcomes between generations. The β_1 -coefficient is then interpreted as the intergenerational persistence of economic outcomes (Solon, 1999, Chap. 29).

The analysis in this paper considers educational outcomes and log lifetime incomes while aiming to identifying differences in the persistence of these characteristics by the risk attitude of fathers. I generate dummy variables indicating fathers' position in their generation's risk distribution. If their mean risk attitudes are in the upper half, they are considered as risk taking fathers and

[4] In Germany, the parental income is of negligible importance in the de- termination of education outcomes if parental education is accounted for. Tamm (2008) demonstrates that parental income plays an insignificant role in the determination of the school track. Also for higher education, the link seems to be of minor importance. Germany abstains from tuition fees and provides public student subsistence loans.

$R_j^F = 1$, while those in the lower half are risk averse fathers. By including interaction terms with fathers' risk groups in Eq. (2), I allow the regression coefficients to vary by paternal risk attitudes. The equation can be written as

$$y_{ij}^S = \alpha_1 + \alpha_2 R_j^F + \beta_1 y_{ij}^F + \beta_2 R_j^F \left(y_{ij}^F - \bar{y}^F\right) + Z'_{ij}\gamma + \varepsilon_{ij}.$$

The variable y^S denotes the outcome of son *i* in family *j*, which is either their completed years of education, the completion of a university degree or their log lifetime income. Fathers' respective outcomes are denoted by y^F. The intergenerational correlation for sons of risk averse fathers is captured by β_1, whereas the mobility difference for sons of risk taking fathers is measured by β_2. Including the deviation of father j's outcome from its sample mean in the model, $\left(y_{ij}^F - \bar{y}^F\right)$, allows to interpret α_2 as the difference in the outcome for sons having a risk taking father at the sample mean of the outcome. Again, ε is an error term capturing random variations in sons' outcomes. The standard errors are again clustered at the family level.

In the estimations of the intergenerational income persistence, including further covariates *Z* into the regression decomposes the summary measures β_1 and β_2 into their direct and indirect effects (Bowles & Gintis, 2002). If the inclusion of control variables changes the coefficients β_1 and β_2, these variables capture variations that have previously been captured by fathers' outcomes y_{ij}^F. I include father's and son's years of education in this vector, which controls for mobility differences that can be attributed to education. The final model additionally incorporates son's mean firm tenure and mean work experience.

When y denotes log lifetime incomes in the analysis, the β-coefficient is referred to as the intergenerational income elasticity (IGE); a higher β-value denotes a stronger intergenerational link of incomes. It is known that certain transmitted characteristics are rewarded in the labour market which naturally renders $\beta > 0$ (Solon, 1999, Chap. 29).

4. Data

4.1. Description of the German Socio-Economic Panel Study

The empirical analysis of the relationship between paternal risk attitudes and economic mobility requires rigorous data. The main challenges lie in the approximation of individual's risk

attitudes, the measurement of lifetime income, and linking this information between fathers and sons.

The German Socio-Economic Panel Study (SOEP) is an annually collected representative panel data set on the German population. Launched in 1984, the SOEP contained nearly 11,000 households and around 30,000 responding individuals as of 2012. The survey provides information for each household member at least 17 years old; the information is collected in separate, personal interviews, thus guaranteeing independent answers of household members. It collects personal and household information including individual's incomes and socio-economic backgrounds as well as attitudes towards risk.

An important feature of the survey is the tracking of family members after they move out and form new, separate, households. Children leaving the parental household are asked to keep participating in the survey. This allows matching of family members across generations. A detailed documentation of the panel study is provided by Wagner, Frick, and Schupp (2007).

4.2. Sample selection and variable definitions

The selection of the sample is driven by the strong data restrictions for the estimation of intergenerational income elasticities, which require the approximation of individual's lifetime income.

For my study, I use data from 1984 through 2012 on males from West Germany. I focus on males as their high labour market participation simplifies the required estimation of their lifetime income (Black & Devereux, 2011). This is common in the literature on intergenerational mobility as it circumvents the complexity arising from modelling female labour supply patterns (Killingsworth & Heckman, 1987).

Observations from East Germany are excluded as the reunification in 1990 constitutes a structural break in Eastern German's biography, which led to unrepresentative and strong wage growth as well as to an increase in professional and geographic mobility (Hunt, 2002). An extra sample over-representing high income households is also discarded.

Individual's lifetime income is approximated based on the SOEP's annual information on last month's gross labour income in Euro, as it is the main source of income for most people. I discard income observations for males in unemployment, part-time employment, vocational training or education, imputed incomes and observations smaller than 200 Euro, as these are

unreliable (Dustmann, Ludsteck, & Schönberg, 2009; Pfeiffer & Eisenhauer, 2008). The reported monthly gross labour income is deflated to a common base year using the Consumer Price Index for Germany.

Estimates of individual's lifetime income can have measurement errors that depend upon when incomes are observed (Haider & Solon, 2006; Jenkins, 1987). This measurement error biases IGE estimates through both the dependent variable (son's income) and the independent variable (father's income). This bias was found to be strongest when sons' incomes are observed below age 30. Age-dependent measurement errors in fathers' income observations introduce an amplification bias to IGE estimates. In order to cope with these life-cycle biases, I follow the literature and exclude income observations below age 30 and over age 55.

There remains a source for classical errors-in-variables as only one monthly income observation is available per year. This can introduce an attenuation bias to IGE estimates. I follow Solon (1992) and Zimmerman (1992) and average at least three income observations as a proxy for individuals' lifetime incomes. Individuals with less than three income observations satisfying all the restrictions are dropped from the sample.

Another variable of core interest is the individual's risk attitude. In 2004, 2006, 2008 and then annually, individuals have been asked about their willingness to take risks. The original phrasing of the relevant survey question is the following: "How do you see yourself: Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?" Individuals then rank themselves on an 11-point-scale from zero, indicating absolute risk aversion, to ten, indicating full risk taking.

Dohmen et al. (2005) experimentally validated the question. The authors drew a random sample of 450 adults living in Germany and asked the subjects to make risky choices with real money at stake and to answer the risk attitude question. Dohmen et al. find that answers to the risk question accurately predict actual risk taking behaviour in the conducted experiments. Using the SOEP, they link answers to the risk question and answers to hypothetical lotteries to individuals' reported risky behaviours, such as smoking, portfolio choices and occupational choices. In contrast to the standard lottery measure, they find that the general risk question reliably predicts reported behaviours. This provides evidence for the validity of the self-reported risk attitudes as a proxy for actual risk attitudes.

The risk question has been repeatedly asked. As the analysis requires a proxy for individuals' general risk attitudes, I average the reported risk attitude over all periods for which risk attitudes have been reported. This should reduce potential measurement errors. They find that risk attitudes differ by gender and age. As analysis focuses on males, only an adjustment for age differences is required.

In order to account for age differences, the mean risk attitudes are standardised using information of all male SOEP participants for whom risk attitudes have been reported. This standardisation is undertaken separately for three distinct generations, which will allow for intergenerational comparisons in relative positions in the risk distribution. The definition of a generation accounts for historical breaks that might impact socio-economic characteristics and labour market experiences. The first generation covers birth cohorts born before and during World War II (1204 observations), the second generation contains post-war cohorts up to 1960 (2375 observations), and the third generation covers all males born after 1960 (4570 observations). As seen in panel A of Table 1, mean risk attitudes differ considerably across generations, which could arise through the described age differences at the time risk attitudes were measured (Dohmen et al., 2005). The respective means for the sample employed in this paper are reported in panel B.

Standardised risk attitudes have a generational mean of zero and a standard deviation of one. An individual is relatively risk taking if his standardised risk attitude is greater than zero. This indicates that he is in the upper half of the risk distribution in his generation.

The analysis of the educational attainment uses the latest information on the completed years of education and on whether or not the individual has graduated from university. It is measured once the individual has at least three years of full-time employment experience above age 30. This ensures that individuals have established themselves in the labour market and satisfies the data restrictions for income observations required for the measurement of intergenerational income elasticities.

The data set is of cross-sectional structure. Time varying characteristics, such as firm tenure, working experience and health state,[5] are averaged over the years for which income information is considered. I eventually match fathers and sons, keeping multiple sons with the same father in

[5] The health status is self-reported measure on a 5-point-scale ranging from one (very good) to five (very bad).

the sample.[6] This favours a larger sample size, but also introduces some sample homogeneity (Pfeiffer & Eisenhauer, 2008) that is discussed in Section 6. The final sample consists of 347 father–son pairs.

Table A.1 shows that risk attitudes are indeed significantly and positively correlated between generations, which justifies controlling for sons' risk attitudes in the regressions. The sample estimate is close to the coefficient estimated by Dohmen et al. (2006). Descriptive statistics on the main variables are presented in Table A.2, and group comparisons between risk averse and risk taking fathers in Table A.3. It can be seen that both groups differ significantly in education levels, fathers' incomes, migration background and religious background, which needs to be taken into account in the analyses.

5. Results

5.1. Education outcomes

This section analyses the link between fathers' risk attitudes and sons' educational attainments. Table 2 present Ordinary Least Squares (OLS) estimation results with years of education as the dependent variable. Table 3 present the results of a linear probability model with a dummy indicator of university degree as the dependent variable.[7] In both tables, the first model incorporates individuals' risk attitudes only into the regression. There is no direct correlation between sons' own risk attitudes and their educational outcomes.

Adding fathers' risk attitudes to the regressions (column 2), one finds that paternal risk attitudes are highly correlated with sons' educational attainments. A one standard deviation higher risk attitude of fathers is associated with $0.674 \times 12 = 8.1$ months more education of sons, and a 9.2 percentage point higher chance of holding a university degree. The comparison of paternal risk group means in Table A.3 shows that paternal risk attitudes are related to factors other than their sons' education and risk attitudes. The specification in column 3 further controls for a wide range of socio-demographic and economic characteristics, as well as the fathers' and mothers' body mass index, as outlined in Section 3. The coefficient on fathers' risk attitudes reduces strongly, suggesting that other factors that determine children's education levels are also correlated with

[6] 53 fathers are matched to two sons, and 10 to three sons.

[7] All results presented in Table 3 are robust to non-linear specifications of the probability model. The coefficients of logit and probit model specifications, evaluated at the mean of the variables, are similar to the coefficient in the linear probability model, and so are the significance levels.

paternal risk attitudes. Still, the statistical association between fathers' risk attitudes and sons' education outcomes persists. Column 4 additionally accounts for sons' characteristics, time preferences and a time fixed effect. Compared to the previous specification, the coefficient on fathers' risk attitudes changes only slightly and remains statistically significant at $p = 0.074$ (years of education) and $p = 0.059$ (university degree). Given the same level family background, family time preferences, sons' characteristics and generation, a one standard deviation higher risk attitude of fathers is associated with $0.247 \times 12 = 3$ months more of education and a 5 percentage points higher probability of obtaining a university degree.

The results of this section support the first hypothesis and suggest an inverse relationship between paternal risk aversion and sons' educational attainments. Sons of risk taking fathers obtain higher levels of education, even when a wide set of control variables has been taken into account. This complements previous findings of Brown et al. (2012) and Wölfel and Heineck (2012) and shows that the link between parental risk attitudes and offspring's educational outcomes persists until they establish themselves in the labour market.

5.2. Education mobility and income mobility

This section measures educational persistence and intergenerational income elasticities separately by fathers' risk attitudes in order to identify group differences in educational mobility and income mobility.

Table 4 presents the OLS estimation results of educational persistence across generations. Generally, one additional year of paternal education is associated with $0.498 \times 12 = 6$ more months of education for sons. As can be seen from column 2, this intergenerational link is smaller for sons with risk taking fathers and does not change once sons' own risk attitudes are controlled for (column 3). Where the fathers are rather risk averse, one more year of paternal education is associated with $0.518 \times 12 = 6.2$ months more education for sons, while this intergenerational association is $0.067 \times 12 = 0.8$ months smaller if fathers are more willing to take risks.

The difference in intergenerational persistence in the years of education can only be measured imprecisely. It is not statistically significant. However, as with years of education, the same pattern can be confirmed in the point estimates for the attainment of a university degree, reported in columns 4–6. The intergenerational association of holding a university degree is 12.3

percentage points smaller for risk taking fathers (column 6), but again this difference is not statistically significant.

The test statistics for differences in sons' education outcomes by fathers' risk attitudes is reported in the last row of Table 4. In this parsimonious model of intergenerational mobility, the direct role of paternal risk attitudes in sons' long-run education outcomes cannot be isolated.

Estimation results for intergenerational income elasticities are presented in Table 5. The first column serves as reference point of the estimation results and allows for a comparison to benchmark IGE estimates for Germany. Pfeiffer and Eisenhauer (2008) use SOEP information through 2006 and estimate intergenerational income elasticities based on 5-year averages of labour incomes observed between 30 and 50 years of age. They find a point estimate of 0.282, which is near the estimate of 0.291 in my sample. Their standard error of 0.087 is higher as their sample incorporates only 180 father–son pairs. The higher point estimate in this study compared to Pfeiffer and Eisenhauer could arise from a positive life-cycle bias (Haider & Solon, 2006), as fathers' incomes are observed at later stages in life (on average at age 49.1, while fathers were on average aged 44.4 in Pfeiffer and Eisenhauer (2008)).

The IGE estimate for the full sample, reported in column 2 of Table 5, is 0.313 and ranges above the estimate for 2006. This could arise through changes in the magnitude of a lifecycle bias as sons' average age increased by 1.2 years from 33.8 to 35.0 with the inclusion of all waves up to 2012. Alternatively, the average income mobility could have decreased in recent years. The estimate implies that sons with fathers earning 10% above the mean income are on average associated with incomes that are 3.1% above the mean.

Columns 3–5 present the IGE estimates for sons of risk averse fathers and the mobility difference for sons of risk taking fathers. In column 3, the IGE for risk averse fathers is 0.417 and the income elasticity difference of risk taking fathers is 0.127, suggesting a lower intergenerational persistence of incomes for sons of risk taking fathers. However, the mobility difference can only be imprecisely estimated. High standard errors in intergenerational income elasticity analyses may arise through generally small sample sizes and the outlined sources of errors in the approximation of lifetime earnings.

Column 4 controls for sons' and fathers' educational background which reduces the mobility gap by 4.5 percentage points to 8.2 percentage points. In column 5, where important labour market

characteristics of sons are incorporated, this tendency remains unchanged. Separate regressions by paternal risk attitude, show a persistently lower R-squared for sons with risk taking fathers, implying less predictive power of paternal incomes on sons' incomes.[8]

The 4.5 percentage point drop in differences in income mobility, after controlling for the educational outcomes of both generations, suggests that education explains a considerable amount of the difference in intergenerational income mobility between sons with risk taking and risk averse fathers. However, next to education, there remains another 8.2 percentage points difference in income mobility that cannot be explained by differences in education.

Concluding, even though the difference in intergenerational mobility can only be imprecisely estimated, the point estimates support the hypothesis that sons of risk taking fathers are associated with higher educational mobility and higher income mobility. It suggests that higher educational mobility translates into higher income mobility through parental risk attitudes, although there remains a mobility gap between both groups that cannot be explained by differences in human capital investments only.

6. Discussion and conclusion

Education decisions involve several ex-ante uncertainties. Standard economic theory either ignores the risky element in education decisions or considers individual's own risk attitudes in the decision process. Thereby, it abstracts from important elements of the investment decision. The accumulation of education is a long-lasting process. It involves significant path dependencies. Important decisions, such as the choice of the school track, considerably determine this path and are made early in life. At young ages of children, it is reasonable to assume that parents make or advise education decisions. If these decisions involve uncertainties, they depend on parental risk preferences.

Research establishes this link between parental risk attitudes on school test scores and college attendance at rather early ages (Brown et al., 2012; Checchi et al., 2014; Leonardi, 2007; Wölfel & Heineck, 2012). Lower levels of parental risk aversion are associated with higher educational attainments. Little is known about the persistence of the link between parental risk attitudes and children's education outcomes in the long-run. Earlier decisions could be revised as children

[8] For the sake of brevity, the results are not reported in the paper, but are available from the author upon request.

become more independent of their parents. However, the education process involves path dependencies that might lead to a lasting parental impact.

Considering that education is an important determinant of labour market outcomes, this direct link of parental risk attitudes on offspring education outcomes could also improve our understanding of the intergenerational transmission of economic status, for which education has been found to be an important moderator. If parental risk taking favours higher investments into education of sons, education levels might exhibit a lower intergenerational resemblance. This higher educational mobility is associated with higher income mobility. It has been shown that the mean and the variance of incomes increase with education levels. Therefore, a lower intergenerational resemblance in education levels reduces the probability that fathers' and sons' lifetime incomes are alike. Consequently, the income of risk taking fathers could explain less of sons' incomes and sons would experience a higher income mobility.

This paper studies the role of fathers' risk attitudes in educational outcomes and intergenerational mobility of their sons, combining two strands of the economic literature. First, I examined the impact of fathers' risk attitudes on the long-run educational achievement of sons, measured when sons have at least 3 years of full-time labour market experience above age 30. There is considerable evidence that sons of risk taking fathers complete more years of education, ceteris paribus. Also, they have a higher chance of earning a university degree. This complements previous findings by Brown et al. (2012) and Wölfel and Heineck (2012) in several dimensions. First, it shows that the hypothesised link persists even in the long-run. Second, unlike Brown et al. (2012) and Wölfel and Heineck (2012), I further control for individuals' own risk attitudes and exclude the scope for spurious correlations between fathers' and sons' risk attitudes that could drive the findings. Third, for the choice of the school track, Wölfel and Heineck (2012) assign a small role to fathers' risk attitudes. I find that fathers' risk attitudes matter in a lifetime perspective of sons' educational attainments.

My analysis cannot assign a direct role to individuals' own risk attitudes. The empirical economic literature is also inconclusive on this relationship. Belzil and Leonardi (2007), for example, show that own risk attitudes have only a small impact on education levels. Their analysis neglects parental risk attitudes. Again considering the intergenerational correlation in risk attitudes established by Dohmen et al. (2005), it is conceivable that the identified modest

role of own risk attitudes arises through a positive correlation with parental risk attitudes. Also, the research design is limited in the identification of the direction of causality.

Due to the importance of education in the intergenerational transmission of economic status, I further hypothesise that fathers' risk attitudes interact with sons' educational and economic mobility. The point estimates suggest that sons of risk taking fathers exhibit a lower educational similarity to their fathers. Though the mobility difference estimates are not statistically significant, it reappears throughout different model specifications and outcomes. Sons of risk taking fathers were found to make higher educational investments that may be more different from their fathers' own experiences. The more the levels of education differ between generations, the higher educational mobility is. In this case, children of risk taking parents experience a higher educational mobility.

Furthermore, point estimates of intergenerational income elasticities suggest a higher income mobility for sons of risk taking fathers. Adding control variables for educational outcomes in both generations to the analysis, reduces the income mobility gap by 4.5 percentage points and may suggest that education is an important moderator of income mobility. A possible explanation arises through increasing means and variances of incomes with increasing levels of education. This reduces the probability that fathers' and sons' lifetime incomes are alike. Consequently, the income of sons with risk taking fathers can be explained to a smaller extend by the income of their fathers.

However, the strong differences in group elasticities could also arise through varying magnitudes of measurement errors and life-cycle biases in both groups. First, abstracting from the role of life-cycle bias, higher transitory fluctuations in reported incomes of fathers with higher risk attitudes could more strongly attenuate intergenerational income elasticities of the group with risk taking fathers. Indeed, the literature suggests higher income volatility for individuals with higher risk attitudes (Shore, 2011).

Second, abstracting from measurement errors, one could also falsely identify differences in income elasticities by the risk attitude of fathers if the life-cycle bias varies by ability, as suggested by Pfeiffer and Eisenhauer (2008). Through the intergenerational similarity of risk attitudes and the correlation of risk attitudes and abilities, a stronger attenuation of the IGE estimate for sons of risk taking fathers could be introduced through a steeper income growth path for high ability sons in early years of their labour market experience. This also generates a

stronger, attenuating life-cycle bias for sons with risk taking fathers. As there is no complete earnings history, which would provide certainty about the magnitude of life-cycle biases, no reliable test could provide certainty about their actual impact. Still, given the same magnitude of measurement errors and life-cycle bias, the mobility gap reduces by 4.5 percentage points when educational attainments are controlled for, suggesting that group differences in education investments may account for income mobility differences.

In the selection of the sample, multiple sons of the same father have been kept in favour of a larger sample size. This introduces some sample homogeneity, which can lead to a downward bias in the estimates of intergenerational income elasticities (Pfeiffer & Eisenhauer, 2008). The subsample of risk averse fathers contains more sons with the same fathers. If this determines the degree of sample homogeneity, the IGE estimate would be more downward biased for sons of risk averse fathers. The difference could be even larger without this homogeneity. To my knowledge, there is no research that quantifies the magnitude of the potential downward bias.

These findings add to the understanding of the transmission mechanism of economic status between generations. I add evidence to the scarce existing literature for a direct intergenerational link between parental risk attitudes and children's education attainments and relate this to intergenerational mobility.

The results can also be important for public policy addressing economic inequality. If risk averse parents tend to exhibit lower abilities, lower educational levels and lower incomes, comparably lower investments in human capital would be recommended to children from more deprived backgrounds. This leads to human capital investments below the individual's optimal level, preventing the income distribution from convergence and increasing economic inequality. Finally, the results give further rise to critically re-assess the role for individual risk preferences in the human capital investment theory.

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Tables

Table 1
Male risk attitudes and incomes by generation.

	Generation		
	Born before 1946 (1)	Born between 1946–1960 (2)	Born after 1960 (3)
Panel A: SOEP 1984–2012			
Mean original risk attitude[a]	4.075	4.740	5.304
	(1.918)	(1.766)	(1.781)
Mean age when risk attitude was measured	69.443	54.276	35.439
	(5.509)	(4.669)	(8.138)
Mean real income	3336.871	3540.910	2853.254
	(1991.481)	(2084.164)	(1585.074)
N	1204	2375	4570
Panel B: Main sample			
Mean original risk attitude[a]	3.658	4.575	5.277
	(1.966)	(1.599)	(1.592)
Mean age when risk attitude was measured	68.064	57.679	36.877
	(3.529)	(3.558)	(4.904)
Mean real income	3346.435	3394.607	3086.511
	(1758.182)	(1724.850)	(1295.411)
N	221	132	341

Notes: The table reports risk attitudes, the age at which they were reported, and the mean real income in 2010 Euro for three distinct generations. Standard deviations are reported in parentheses. Panel A provides the SOEP means, while panel B reports the means for the sample employed in this paper (347 observations of fathers and sons).

Table 2
Determinants of educational outcomes: years of education.

	Years of education			
	(1)	(2)	(3)	(4)
Son's z-risk attitude[a]	− 0.017	− 0.110	− 0.026	− 0.024
	(0.189)	(0.186)	(0.145)	(0.142)
Father's z-risk attitude[a]	–	0.674***	0.236*	0.247*
		(0.155)	(0.135)	(0.136)
Control variables				
Family background characteristics[b]	–	–	Yes	Yes
Family's time preference[c]	–	–	Yes	Yes
Son's characteristics[d]	–	–	–	Yes
Son's time preference[e]	–	–	–	Yes
Generation fixed effect[f]	–	–	–	Yes
R^2	0.000	0.057	0.336	0.347
N	347	347	347	347

Notes: The table reports coefficients from OLS regressions. Standard errors are clustered at the family level (274 clusters) and reported in parentheses.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

[a] The variable is standardised by generation.

[b] Father's and mother's quadratic years of education, dummy for father's and mother's ISCED qualification, father's and mother's quadratic age at son's birth, father's quadratic mean log real income, number of siblings, dummy for migration background, dummies for religious background.

[c] Proxied by mother's and father's body-mass-index.

[d] Son's body height and mean health state.

[e] Proxied by son's body-mass-index.

[f] Dummy variable indicating the generation in which the son was born.

Table 3
Determinants of educational outcomes: holding a university degree.

	University degree			
	(1)	(2)	(3)	(4)
Son's z-risk attitude[a]	− 0.039	− 0.052*	− 0.037	− 0.038
	(0.028)	(0.028)	(0.025)	(0.025)
Father's z-risk attitude[a]	–	0.092***	0.046*	0.050*
		(0.026)	(0.026)	(0.026)
Control variables				
Family background characteristics[b]	–	–	Yes	Yes
Family's time preference[c]	–	–	Yes	Yes
Son's characteristics[d]	–	–	–	Yes
Son's time preference[e]	–	–	–	Yes
Generation fixed effect[f]	–	–	–	Yes
R^2	0.006	0.043	0.184	0.188
N	347	347	347	347

Notes: The table reports coefficients from OLS regressions. Standard errors are clustered at the family level (274 clusters) and reported in parentheses.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

[a] The variable is standardised by generation.

[b] Father's and mother's quadratic years of education, dummy for father's and mother's ISCED qualification, father's and mother's quadratic age at son's birth, father's quadratic mean log real income, number of siblings, dummy for migration background, dummies for religious background.

[c] Proxied by mother's and father's body-mass-index.

[d] Son's body height and mean health state.

[e] Proxied by son's body-mass-index.

[f] Dummy variable indicating the generation in which the son was born.

Table 4
Intergenerational persistence of education outcomes.

	Years of education			University degree		
	Pooled	By fathers' risk attitudes		Pooled	By fathers' risk attitudes	
	(1)	(2)	(3)	(4)	(5)	(6)
Father's education outcome[a]	0.498***	0.518***	0.518***	0.285***	0.340***	0.349***
	(0.057)	(0.081)	(0.081)	(0.065)	(0.092)	(0.092)
Father's education outcome		− 0.068	− 0.067		− 0.124	− 0.123
∗ risk *taking* father, dummy[b] (β_2)		(0.117)	(0.117)		(0.129)	(0.130)
Risk taking father, dummy (α_2)		0.290	0.289		0.035	0.035
		(0.187)	(0.187)		(0.032)	(0.030)
Risk taking son, dummy			0.049			0.069
			(0.282)			(0.051)
R^2	0.19	0.19	0.19	0.07	0.08	0.09
N	347	347	347	347	347	347
$p(\alpha_2 = 0, \beta_2 = 0)$		0.198	0.204		0.133	0.130

Notes: The table reports coefficients of OLS regressions with son's education outcome as dependent variable. Standard errors are clustered at the family level (274 clusters) and reported in parentheses.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.
[a] 'Father's years of education' and 'father holds a university degree, dummy', respectively.
[b] The coefficient indicates the persistence of educational attainments depending on the risk attitude of the fathers.

Table 5
Intergenerational persistence of incomes.

	Pooled		By fathers' risk attitudes		
	1984–2006	1984–2012			
	(1)	(2)	(3)	(4)	(5)
Father's mean log real income	0.291***	0.313***	0.417***	0.390***	0.417***
	(0.073)	(0.065)	(0.099)	(0.103)	(0.099)
Father's mean log real income			− 0.127	− 0.082	− 0.132
∗ risk *taking* father, dummy[a] (β_2)			(0.143)	(0.132)	(0.127)
Risk taking father, dummy (α_2)			0.050	0.058	0.079*
			(0.057)	(0.049)	(0.047)
Risk taking son, dummy			0.034	0.032	0.053
			(0.049)	(0.043)	(0.042)
Father's years of education				− 0.049***	− 0.037***
				(0.013)	(0.013)
Son's years of education				0.063***	0.079***
				(0.008)	(0.008)
Son's firm tenure					0.011***
					(0.004)
Son's work experience					0.019***
					(0.006)
R^2	0.081	0.087	0.094	0.242	0.309
N	264	347	347	347	347
$p(\alpha_2 = 0, \beta_2 = 0)$			0.450	0.407	0.141

Notes: The table reports coefficients of OLS regressions with dependent variable: Son's mean log real income. Standard errors are clustered at the family level (274 clusters) and reported in parentheses.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.
[a] The coefficient indicates the persistence of incomes depending on the risk attitude of fathers.

Appendix A

Table A.1
The relation between fathers' and sons' risk attitudes.

	Son's mean risk attitude (1)	Son's z-risk attitude (2)
Father's risk attitude	0.134**	0.117**
	(0.052)	(0.056)
Constant	4.732***	0.011
	(0.232)	(0.050)
R^2	0.024	0.016
N	347	347

Notes: The table reports coefficients from OLS regressions. Standard errors are clustered at the family level (274 clusters) and reported in parentheses. Column 1 uses the mean of reported risk attitudes for fathers and sons, measured on a scale from zero to ten. Column 2 uses the risk attitude standardised by generation, as outlined in the paper.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A.2
Descriptive statistics for main sample.

	Mean	SD	Minimum	Maximum
Son's mean monthly log real income	8.025	0.439	6.176	9.450
Son's years of education	12.687	2.866	7.000	18.000
Son has university degree, dummy	0.372	0.484	0	1
Son's mean reported risk attitude	5.266	1.615	0.000	9.429
Son's mean age at income observation	35.015	2.740	31.000	43.500
Son's # of income observations	9.101	4.912	3	25
Son's height in cm	179.697	6.753	162.000	208.400
Son's health status	2.234	0.570	1.000	4.364
Son's BMI	26.201	3.990	19.152	48.980
Son's firm tenure	7.797	5.311	0.475	22.916
Son's work experience	11.408	4.692	1.667	26.148
Father's mean monthly log real income	8.019	0.383	6.860	9.389
Father's years of education	11.105	2.431	7.000	18.000
Father has university degree, dummy	0.268	0.444	0	1
Father's mean reported risk attitude	3.990	1.874	0.000	9.286
Father's mean age at income observation	50.283	3.489	39.438	56.500
Father's # of income observations	11.781	5.203	3	26
Father's age at son's birth	27.484	4.644	14	44
Father's BMI	28.238	4.736	19.568	62.500
Mother's years of education	10.218	1.867	7.000	18.000
Mother has university degree, dummy	0.127	0.333	0	1
Mother's age at son's birth	24.994	4.822	14	39
Mother's BMI	27.576	4.869	18.424	47.405
Migration background, dummy	0.179	0.384	0	1
Christian background, dummy	0.648	0.478	0	1
Other religious background, dummy	0.127	0.333	0	1
N			347	

Notes: The table reports descriptive statistics of main variables from the analyses. Column 1 reports sample means, column 2 standard deviations, column 3 and 4 the minimum and maximum values. Mean log real incomes are measured in 2010 Euro. The risk attitude was measured on a scale ranging from zero (fully risk averse) to ten (fully risk taking). The health state was measured on a scale ranging from one (very good) to five (bad).

Table A.3
Mean comparisons for main sample.

		Fathers' risk attitudes		Difference (3) − (2)
	Pooled (1)	Risk averse (2)	Risk taking (3)	(s.e.) (4)
Son's mean monthly log real income	8.025	8.010	8.041	0.031
	(0.439)	(0.384)	(0.493)	(0.047)
Son's years of education	12.687	12.122	13.296	1.174***
	(2.866)	(2.742)	(2.880)	(0.302)
Son has university degree, dummy	0.372	0.294	0.455	0.161***
	(0.484)	(0.457)	(0.499)	(0.051)
Son's mean reported risk attitude	5.266	5.060	5.488	0.428**
	(1.615)	(1.704)	(1.486)	(0.172)
Son's mean age at income observation	35.015	35.006	35.026	0.020
	(2.740)	(2.819)	(2.662)	(0.295)
Son's height in cm	179.697	179.233	180.197	0.964
	(6.753)	(6.853)	(6.628)	(0.725)
Son's health status	2.234	2.237	2.232	− 0.005
	(0.570)	(0.541)	(0.602)	(0.061)
Son's BMI	26.393	26.434	26.349	− 0.086
	(4.068)	(4.194)	(3.940)	(0.438)
Son's firm tenure	7.797	8.116	7.454	− 0.662
	(5.311)	(5.297)	(5.321)	(0.570)
Son's work experience	11.408	12.024	10.744	− 1.280**
	(4.692)	(4.667)	(4.641)	(0.500)
Father's mean monthly log real income	8.019	7.935	8.110	0.175***
	(0.383)	(0.319)	(0.425)	(0.040)
Father's years of education	11.105	10.642	11.605	0.963***
	(2.431)	(2.147)	(2.620)	(0.256)
Father has university degree, dummy	0.268	0.183	0.359	0.176***
	(0.444)	(0.388)	(0.481)	(0.047)
Father's mean reported risk attitude	3.990	2.589	5.500	2.911***
	(1.874)	(1.309)	(1.025)	(0.127)
Father's mean age at income observation	50.283	50.313	50.250	− 0.063
	(3.489)	(3.672)	(3.291)	(0.375)
Father's age at son's birth	27.484	27.378	27.599	0.221
	(4.644)	(4.654)	(4.644)	(0.499)
Father's BMI	28.129	28.257	27.992	− 0.265
	(4.361)	(4.527)	(4.185)	(0.469)
Mother's years of education	10.218	9.875	10.587	0.712***
	(1.867)	(1.887)	(1.778)	(0.197)
Mother has university degree, dummy	0.127	0.117	0.138	0.021
	(0.333)	(0.322)	(0.346)	(0.036)
Mother's age at son's birth	24.994	24.678	25.335	0.658
	(4.822)	(5.037)	(4.570)	(0.518)
Mother's BMI	27.576	28.584	26.489	− 2.095***
	(4.869)	(5.206)	(4.231)	(0.512)
Migration background, dummy	0.179	0.261	0.090	− 0.171***
	(0.384)	(0.440)	(0.287)	(0.040)
Christian background, dummy	0.648	0.567	0.737	0.170***
	(0.478)	(0.497)	(0.442)	(0.051)
Other religious background, dummy	0.127	0.200	0.048	− 0.152***
	(0.333)	(0.401)	(0.214)	(0.035)
N	347	180	167	

Notes: The table reports the sample means of main variables from the analyses for the pooled sample (column 1), the group with risk averse fathers (column 2) and the group with risk taking fathers (column 3). Standard deviations for the means in columns (1)–(3) are reported in parentheses. Mean log real incomes are measured in 2010 Euro. The risk attitude was measured on a scale ranging from zero (fully risk averse) to ten (fully risk taking). The health state was measured on a scale ranging from one (very good) to five (bad). Column 4 reports the difference in statistical means between both groups. Standard errors are reported in parentheses.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

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