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Parents' risk aversion and children's educational attainment ☆

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HIGHLIGHTS

- We model parents' risk aversion when they fund children's college under uncertainty.
- Parents' risk aversion has a negative effect on children's college enrollment.
- Results are robust to non-response to risk aversion and different measures of risk.
- Policy implications: graduate tax insures against the risk of investment failure.

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ABSTRACT

In this paper we study the role of parental risk aversion on children's educational choices. In a country like Italy where parental support is the main source of funds supporting college enrollment, we show that parents' risk aversion (elicited by surveys on lottery tolerance) has a significant negative effect on children's college enrollment. This negative effect is robust when we model non-response and introduce measures of liquidity constraints. With the help of a formal model, we interpret this evidence as suggestive that risk averse parents react to the uncertainty of future labour prospects of their children, whose ability is not fully observable. We show that parental risk aversion may contribute to explain the persistence of differences in the odds of attaining a college degree between children of parents with equal educational attainments.

1. Introduction

The existing recent empirical literature on the determinants of schooling decisions has focused on the importance of cognitive skills, parents' background and liquidity constraints.[1]

On the contrary, preference parameters, such as risk aversion or the rate of time discounting, have often been left in the backstage. Yet educational decisions can be viewed as an investment with uncertain outcomes and can be analyzed in accordance with the standard approach of finance theory which assigns a relevant role to risk aversion. The contribution of risk aversion to explaining educational choices is ambiguous: if future returns to college are uncertain, risk averse individuals may want to choose a less risky schooling path. On the other hand, college education may have an insurance character given its positive effects on labour market success. The question is fundamentally empirical.

The link between human capital investment and risk aversion is well-known since the early work of Lehvari and Weiss (1974) followed by more theoretical and empirical research (see, among others (Shaw, 1996; Palacios-Huerta, 2003; Belzil and Hansen, 2004; Belzil, 2007)). The empirical analysis finds ambiguous results or at best obtains that risk aversion is inversely associated with education (Belzil and Leonardi, 2007, 2013).[2]

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[1] See Black and Devereux (2011) for a recent review of the literature. With respect to the determinants of the choice of college enrollment, there is a vast literature on the transmission of socio-economic status suggesting that parental education is still the most important factor for children's educational attainment: see for example Heineck and Riphahn (2009) for Germany, Ermisch and Francesconi (2001) for the UK.

[2] Some papers look at risk aversion and education returns: Brown and Taylor (2005) show that returns to human capital investments are considerably higher among college educated who are risk-takers; Brunello (2002) uses risk aversion as instrument for educational attainment in the estimation of the returns to education; Attanasio and Kaufmann (forthcoming) and Kaufmann (forthcoming) look at the role of subjective expectations.

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Usually the literature has looked at the relationship between schooling attainment and individuals' own risk aversion, whilst there is barely any evidence on whether parental risk attitudes affect the educational attainment of dependent children. In this paper we investigate if parents' risk aversion plays a role in the decision to finance children's college at equal levels of parents' education and wealth and at equal levels of children's ability, measured with various proxies.[3]

The focus on parents' risk aversion rather than on individuals' own risk aversion allows us to alleviate a common problem in the literature: the potential endogeneity of own risk aversion to education choice when risk aversion measures are elicited after school completion (this is the case in all surveys like the Italian SHIW, the German SOEP and the American PSID). In the present paper, exogeneity can be advocated to a greater extent because we study the contribution of parents' risk aversion with respect to children's educational choices. This distinguishes our paper from previous work which used individuals' own risk aversion (Belzil and Leonardi, 2007, 2013) and allows us to complement it with a new perspective. Of course we are well aware that risk aversion is correlated between parents and children (Charles and Hurst, 2003; Dohmen et al., 2010). What matters for one's college attendance decision is probably a mix of the child's own risk aversion and her parents' willingness to fund such choice, which in turn depends on their perceptions of her children's ability (and how this will affect her future earnings) and on their own risk aversion. To our knowledge there is no survey with both parents' and children's measures of risk aversion and education choice, and in this paper we contribute to the literature interpreting parents' risk aversion as the relevant measure. We see parents' risk aversion as an innate personality trait which may very well correlate with a number of other characteristics (because it is a determinant of them) and concur to determine children's education outcome.

Italy is an ideal country to investigate the effect of parents' risk aversion since college education is not as expensive as that in other countries (tuition costs in public universities are around €1500 per year at 2012 constant prices), private universities are not popular and direct costs are low because of geographical diffusion (Di Pietro and Cutillo, 2006; Bratti et al., 2008) and because a very large proportion of college students live with their family of origin (Manacorda and Moretti, 2006). These characteristics of the Italian system allow us to look at children cohabiting with their family of origin and their choice to enrol in a single type of college (public universities). Moreover we can analyse the choice of financing children's college without modeling the access to financial markets. Because of the relatively low cost of college, it is well-known that Italian families traditionally do not take out debt to finance college education (Perali and Barzi, 2011); therefore we do not model credit constraints as in the recent US literature (Lochner and Monge-Naranjo, 2012), rather we assume that there is no access to financial markets and we model the effect of parents' risk aversion on financing children's college under uncertain information on their ability. We show that parents finance children's college only if their optimal investment under uncertainty is higher than the cost of schooling (Stange, 2012) and that the optimal amount of the financing is negatively correlated with risk aversion. The main predictions of the model are then taken to the data (the Italian Survey of Household Income and Wealth, SHIW) in which individual differences in attitudes towards risk are measured through a lottery pricing question.

The fact that tuition costs are low and college education is publicly subsidized and that most children live at home (therefore the direct and mobility costs of college are low) does not mean that the choice of enrolling one's children in college is not risky. Risk aversion is potentially very relevant because one has to take into account the overall cost of tertiary education. The OECD (Education at a Glance 2013, Table A7.3a) provides the following estimates for the private cost of attaining tertiary education in Italy in 2008 (in PPP): direct cost (tuition, books, mobility) $US 7285; foregone earnings $US 50,608; and overall cost $US 57,893. The figures for the OECD average are $US 11,398, $US 44,055 and $US 55,453, respectively. According to these numbers, the cost of college attendance in Italy is slightly above the average expenditure of other OECD countries (and above the EU21 overall average). These cost estimates of forgone earnings suggest that the college education choice in Italy is a risky choice.

Our results show that parents' risk aversion has a significant negative effect on children's probability to go to college. The effect is robust to the introduction of alternative proxies for unobservable children's ability, including high school final exam marks, type of secondary school attended or even educational attainment of grandparents. We also control for non-response to the risk aversion question and test the robustness of the results to different measures of risk aversion. In the course of the paper we also explore some alternative explanations of children's college enrollment and address some concerns typical of the literature. One first concern is that parents' risk aversion may pick up the effect of family credit constraints.

Usually the literature infers the presence of credit constraints from the effect of family income on college choice whilst in the present paper we use direct survey questions designed to elicit the presence of liquidity constraints in the family. We find no evidence that various measures of liquidity constraints affect the significance of parents' risk aversion as a determinant of children's college enrollment.

Overall the results indicate that risk aversion, which is likely to reflect some fundamental preference of parents, is an important determinant of college enrollment. Given the peculiarities of the Italian system (which are common to many European countries), we believe that parents' risk aversion may affect children's schooling through their willingness to finance college and that this mechanism has better chances to rationalize the negative relationship that we find in the empirical part. However due to data limitations we have to remain agnostic relative to the exact mechanism: it could still be the case that risk averse parents motivate less their children to attend college or they have children who are themselves more risk averse. The policy implications of our findings point to a better institutional design, capable of circumventing the negative effect of parental attitudes on children's educational choices.

The plan of the paper is as follows. In Section 2 we introduce a simple model to highlight the role of parents' risk aversion. In Section 3 we describe the data and discuss the risk aversion variable. In Section 4 we introduce our estimation strategy and show the benchmark empirical results. In Section 5 we try the robustness of the results modeling non-response to the risk aversion question and testing different measures of risk aversion. Finally, in Section 6 we conclude.

2. A simple model of parental investment in children's education

We consider a simple model inspired by Galor and Zeira (1993), Banerjee and Newman (1993) and DeFraja (2001) in order to study the determinants of parental investment in children's education. We abstract from the existence of different stages of education (primary, secondary and tertiary) as well as the opportunity costs of school attendance: as long as the initial stages of education are compulsory by law and (almost) freely provided by the state, this model can be considered as relevant for tertiary school investment.

Since we want to consider the educational choice as a risky investment, we need to introduce some uncertainty about future events. There are alternative strategies to pursue this goal, among which we prefer to introduce imperfect observability of children's ability in human capital formation. This is obviously an extreme assumption, since parents form and revise their expectations on the abilities of their children,

[3] It is plausible that the risky aspect of acquiring education involves not only the investment in college but it is anticipated also in the choice of the type of secondary school. Few papers look into the role of parents' risk aversion on children's schooling. Leonardi (2007) and Heineck and Woelfel (2012) look at the effect of parents' risk aversion on secondary school choice in Italy and Germany, while Brown et al. (2006) look at the effect on children's school test scores in the US.

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starting from marks obtained in different school grades. We assume that when parents decide whether to finance the college education of their children they cannot predict what will be the future earnings associated to this choice and they are forced to rely on expected values.[4]

Consider an overlapping generation model where each generation is characterized by the index t. Individuals live in two periods: in the first period of life they attend school and form their human capital, conditional on their ability endowment and parental investment in their education; in the second period of life they produce according to their accumulated human capital, give birth to a child, consume and invest in the education of the offspring, and then pass away.[5]

The parent (generation t) is characterized by altruism and risk aversion, and her utility function can be represented by:

$$U_t = C_t + \alpha \frac{Y_{t+1}^{\sigma}}{\sigma} \tag{1}$$

where C_t is consumption of parents, Y_{t+1} is the income of children (generation $t+1$), α captures the extent of altruism of the parent and σ allows for risk aversion (since $(1-\sigma)$ is the corresponding coefficient of relative risk aversion).

The human capital H_{t+1} of the child is formed according to the following educational production function[6]:

$$H_{t+1} = X_t^{\beta} A_{t+1}^{1-\beta} \tag{2}$$

where X_t represents the financial investment of the parent and A_{t+1} is the (ex-ante unobservable) ability endowment of the child. The parental investment is consistent with the private provision of college education of different qualities and prices, as well as with public provision of identical quality education which is supplemented with family educational resources (in Italy private universities are a small minority). To keep the model simpler, we ignore the intergenerational persistence of ability and we assume that it is independently distributed across generations (DeFraja, 2001). To simplify even further, we suppose that ability can take only two values, A_1 and A_2, $A_1 < A_2$ with known probability π and $(1-\pi)$.

Without loss of generality, we assume a constant (and unitary) labour market return to education (i.e. $Y_{t+1} = H_{t+1}$). Thus parents invest in her offspring's education under uncertainty about the ability endowment of the child, which then can be depicted as a risky investment.

Since the educational production function satisfies the Inada conditions (the marginal return on investing in education goes to infinity as X_t approaches zero), it will always be convenient for parents to invest some money in the education of the child.[7]

Given the budget constraint $Y_t = C_t + X_t$, parents solve the following problem:

$$\max_{X_t} E[U_t] = \max_{X_t} E\left[(Y_t - X_t) + \alpha \frac{\left(X_t^{\beta} A_{t+1}^{1-\beta}\right)^{\sigma}}{\sigma}\right] \text{ subject to } X_t \le Y_t. \tag{3}$$

The first order condition requires:

$$\frac{\partial L}{\partial X_t} = -1 + \alpha\beta X_t^{\beta\sigma-1}\left[\pi A_1^{(1-\beta)\sigma} + (1-\pi)A_2^{(1-\beta)\sigma}\right] - \lambda = 0$$
$$\lambda \ge 0, X_t \le Y_t \text{ and } \lambda(X_t - Y_t) = 0 \tag{4}$$

where L is the Lagrangian associated to the maximisation and λ is the Kuhn–Tucker multiplier associated to the inequality constraint $X_t \le Y_t$ which can be interpreted as the shadow price of the liquidity constraint (and goes to zero as parental income goes up).[8] Solving for the optimal parental investment yields:

$$X_t^* = \begin{cases} \left\{\alpha\beta\left[\pi A_1^{(1-\beta)\sigma} + (1-\pi)A_2^{(1-\beta)\sigma}\right]\right\}^{\frac{1}{1-\beta\sigma}} & \text{if } Y_t > \left\{\alpha\beta\left[\pi A_1^{(1-\beta)\sigma} + (1-\pi)A_2^{(1-\beta)\sigma}\right]\right\}^{\frac{1}{1-\beta\sigma}} \\ Y_t & \text{if } Y_t \le \left\{\alpha\beta\left[\pi A_1^{(1-\beta)\sigma} + (1-\pi)A_2^{(1-\beta)\sigma}\right]\right\}^{\frac{1}{1-\beta\sigma}} \end{cases} \tag{5}$$

or in a more compact form:

$$X_t^* = f\left(\underset{+}{\alpha}, \underset{+}{\beta}, \underset{+}{\left(1-\pi\right)}, \underset{+}{A_i}, \underset{+}{\sigma}, \underset{+}{Y_t}\right). \tag{6}$$

The parent will invest more resources in children's education the more altruistic she is (higher α), the higher is her income ($\lambda \to 0$ when X_t becomes lower than Y_t) and the less risk averse she is (a higher σ implies a lower degree of risk aversion $(1-\sigma)$). Despite the ability of the child being unobservable, an increase in her expected ability (either due to an increase of A_1 and/or A_2 or to an increase in the probability of the better event $(1-\pi)$) induces an increase in parental investment. Finally, an increase in the labour market return of human capital β also raises the resources invested in children's education.

Let us discuss some implications of the model. The model considers the educational choice as a discrete one and neglects opportunity costs (which are assumed to be independent from ability and parental incomes — thus we set them equal to zero for simplicity). Without loss of generality, we could introduce some time spent working in the first period of life, being detrimental to human capital accumulation. In the same vein, if we were to introduce a fixed cost of tuition γ, then $n = \frac{X_t}{\gamma}$ would become the maximum number of college years that a parent is willing to finance. In such a case, all families with parental income lower than γ will not attend college. In addition, when lowering σ (i.e. by increasing risk aversion) we observe a decline in the optimal amount invested in education: this restricts the fraction of families that is unable to attain at least the (optimal) minimum level of investment for a given level of child ability. If the desired level of resources goes below the tuition cost, none will enrol in university.

The model predicts a specific relationship between family income and educational investment: investment is directly proportional to income up to a point, and then it becomes constant. This implies that we may expect a positive correlation between the two among poorer families, whilst there would be no correlation for levels of family incomes beyond the optimal investment (which however is conditional on the expected ability of the child: whenever we introduce

[4] Riskiness could be introduced in alternative ways (for example as uncertain human capital return in the labour market) but the essence of the model would remain unchanged.

[5] Contrary to Galor and Zeira (1993) and Banerjee and Newman (1993) this sequence of actions prevents the possibility of taking out debt in the first period to finance the education of the child, then repaying in the second period under imperfect financial markets. In the present framework, financial market imperfection takes the extreme version of liquidity constraints. As reported in the introduction, in Italy, families very rarely take out debt to finance education. We are also excluding the possibility of a direct monetary transfer to children, as in DeFraja (2001).

[6] We use here a standard formulation of the educational production function where child ability and parental resources are complements: abler individuals benefit more from educational resources. This is in line with the finding of the empirical literature, at least in the Italian case.

[7] On the contrary, for some configuration of the parameters it may occur that the (expected) marginal return of investing in education β falls below one. In this case the optimal decision would become sequential: at the first stage the parent decides how much income to leave over to the next generation, and then the inheritance is split into two shares (monetary transfer and education financing) by equating the marginal return to one. But nothing essential is gained by adding this complication. See De Fraja (2002).

[8] Notice that according to this extreme formulation we are assuming that any resource invested in the child education derives from parental income. We are fully aware that there is an implicit public subsidy, which is constant across individuals, but we omit it for notational simplicity.

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heterogeneity in expected ability, this translates into possible correlation between the two).[9]

Finally, our model neglects a relevant channel of intergenerational persistence of socio-economic status, given by the cultural resources. The empirical literature highlights the existence of a positive correlation between parents' and children's educational attainments (Hertz et al., 2008), which is absent here. In the present model, substituting Eq. (5) into Eq. (2), intergenerational elasticity in incomes takes the following form:

$$\frac{\partial \log Y_{t+1}}{\partial \log Y_t} = \frac{\beta}{1-\beta\sigma} \cdot \frac{-\lambda'(Y_t) \cdot Y_t}{1+\lambda(Y_t)} = \frac{\beta\eta}{1-\beta\sigma} \cdot \frac{\lambda(Y_t)}{1+\lambda(Y_t)} \geq 0 \quad (7)$$

where η is the elasticity of the Khun–Tucker multiplier with respect to parental income. For rich families the intergenerational persistence becomes negligible as long as $\lambda \to 0$ (since the only channel of persistence is given by education financing), whilst the poorer is the parent the higher becomes the intergenerational elasticity, the limiting case being equal to $\frac{\beta\eta}{1-\beta\sigma}$. Notice that other things being constant, the intergenerational persistence is higher the greater is the return to education in the labour market (Solon, 2004) and the lower is the risk aversion. The reason for this apparently counter-intuitive result is that a high degree of risk aversion reduces the educational investment for each family, thus compressing the income distribution in the next generation. However, if risk aversion were correlated with family income (or wealth), a reverse result may be obtained.

When taking this model to the data, we focus on the relationship between parental features and children's educational choices. Parents' income, altruism and risk aversion should drive their willingness to finance costly educational choices, given their expectation on the ability of their children. If the parent were perfectly observing their children's ability (i.e. if the previous educational achievements – like marks and failure – were fully revealing) and they were adequately rich, then the main determinant of educational finance would be the ability of their offspring. In the empirical data we do not observe the intergenerational transfer but only the actual enrollment decisions, which may reflect other motives not included in the model. Think for example of college education as a status symbol: rich parents may push their children to college attendance irrespective of their actual ability endowment. This would translate in an overinvestment in tertiary education that introduces confounding factors. However, as long as parental preferences are correlated with parental observable characteristics, we will be able to control for them. For symmetrical (and opposite) reasons children from poor families may neglect the option of going to college for cultural reasons (ignorance, lack of experience). Once again we can control for these cases as long as these behaviours are correlated with parental observables.

3. Data and sample selection

Every two years the Bank of Italy Survey of Income and Wealth (SHIW) survey collects information on consumption, income and wealth in addition to several individual and household characteristics for a representative sample of around 8000 Italian households. We limit ourselves to the 1995 and 2000 SHIW surveys which are the only waves containing a question on the household heads' willingness to pay for a lottery that can be used to build a measure of their risk attitudes.[10] In year 2000 the question was asked to half of the sampled households i.e. to around 4000 heads of households.

[9] Although the model predicts a non-linear relationship only of income, in the empirical evidence we include both income and wealth to control also for the stock of the family endowment. We include both income and wealth linearly in the regressions because the linear specification is the most common in the empirical literature, however we also tried specifications with log of family income or wealth which are more alike to the kinked relationship between educational investment and parental resources predicted in the model.

[10] We use the two waves of the data in their cross-sectional dimension because the panel is too small and there is basically no overlap between year 1995 and year 2000.

Table 1
Percentage of children aged 19–30 living at home.

Age	% who live at home	% student	% students who live at home
19–24	91.2	37.1	35.8
19–30	76.0	24.8	23.8

Notes: Our calculations on pooled SHIW 1995 and 2000 full sample.

Our sample consists of 3148 children aged 19–30 who cohabit with their original families and who hold a high-school degree and are either students (hence enrolled in a college) or already hold a college degree. The dependent variable in our analysis is college attendance (i.e. whether cohabiting children are college students or college graduates) and holding a high-school diploma is a pre-requisite to college enrollment. The analysis is restricted to children cohabiting with their parents because of data limitations: after children leave their family dwelling we cannot trace them back to their parents whose income and risk aversion are key variables for our analysis. Observations with missing values in education, age, sex, region of birth, or education of the father are dropped. In addition 626 families whose head does not respond to the risk aversion question and 1183 households whose head responds with a lottery price equal to zero (henceforth called "zero bets") are also dropped. This selection process leaves us with a final sample of 1322 individuals. Initially we follow the previous literature and exclude zero-respondents on the grounds that they did not understand the question (see Section 4 below). Given the high number of non-respondents and zero-respondents we then investigate the robustness of our results: in Section 5 we look at non-response and, in particular Section 5.1, we include zero-respondents among the risk averse.

The sample of cohabiting children is potentially affected by sample selection bias. Table 1 shows the percentage of children living with their parents, the percentage of students and the percentage of students living with their parents. In Italy over 91% of children 19–24 years old live with their original family.[11] The sample of children aged 19–30 is larger and more selected because only 76% of individuals of this age range still live with their parents (see Table 1), but has the advantage of including many more individuals who already have completed college education. In the following tables we test the robustness of our results considering the sample of all children aged 19–24 living at their parents' home.

Even observing these large rates of cohabitation the selection bias could potentially be large, given that one may expect cohabitation being correlated with college education if most of those who left their parents' home are from very less risk-averse households. To assess this potential bias we exploit the panel dimension of the SHIW data. About half the sample in each wave takes part to a rotating panel allowing one to trace back the household composition in earlier periods. We traced back all children of age between 14 and 30 who were previously cohabiting in the same households whose heads answered the lottery question in 1995 or in 2000. Around 10% of them left their family household between the years 1993 and 1995 and between 1998 and 2000. We then regressed the probability of leaving the household on household characteristics and risk aversion. The coefficient on risk aversion is always insignificant thus suggesting that there is no evidence that the focus on cohabiting children has substantial implications in terms of selection bias.[12]

3.1. Risk aversion

The 1995 and 2000 waves of the SHIW contain a question – asked only to household heads – on the willingness to pay for a lottery,

[11] The numbers are in line with previous research (Manacorda and Moretti, 2006) and official statistics which put the number of high school graduates continuing to further education at around 40% before the university reforms of the first half of the year 2000s.

[12] Results are not shown for reasons of space but are available from the authors.

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which can be used to build an Arrow–Pratt measure of individual absolute risk aversion. The lottery question is worded as follows: "We would now like to ask you a hypothetical question that we would like you to answer as if the situation was a real one. You are offered the opportunity of acquiring a security permitting you, with the same probability, either to gain a net amount of Lit. 10 million (€5165) or to lose all the capital invested. What is the most you are prepared to pay for this security?". The valid responses to the question range from €0.517 to €5,165. We drop 17 observations of individuals who bet more than €5165 i.e. risk-loving individuals.[13]

At a theoretical level for any level of wealth there is a one-to-one correspondence between the value attached to the lottery and the Arrow–Pratt measure of absolute risk aversion R_i: for a given level of endowment (w_i) and a potential gain of €5165, the optimal willingness to pay (bet_i) must solve the expected utility equation:

$$U_i(w_i) = \frac{1}{2}U_i(w_i + 5,165) + \frac{1}{2}U_i(w_i - bet_i). \quad (8)$$

To compute the measure of absolute risk aversion, following Guiso and Paiella (2008) we assume an exponential utility and we solve the equation for the unknown parameter R_i:

$$-exp(-R_i w_i) = -\frac{1}{2}exp(-R_i(w_i + 5,165)) - \frac{1}{2}exp(-R_i(w_i - bet_i)). \quad (9)$$

Eq. (9) uniquely defines the Arrow–Pratt measure of absolute risk aversion for each individual in the sample in terms of the parameters of the hypothetical lottery of the survey. Note that we use the specific functional form only for mapping the reported willingness to pay into a measure of risk aversion, but this has no effect on the relationship between the endowment w_i and R_i. In other words appropriate simplification of Eq. (9) implies that R_i does not depend on the endowment w_i but only on the variable bet_i.[14] Note that a zero bet would yield an infinite value of absolute risk aversion.

The absolute risk aversion variable R_i takes values from 0.0001 to 0.67 and has an average of 0.028. In Fig. 1 we plot the relationship between deciles of parents' risk aversion and the unconditional mean of children's college enrollment probability. The picture shows a clear downward slope with a concentration of the negative effect on children's schooling at the highest levels of parents' risk aversion. This result is fully consistent with our theoretical expectation: were our lottery price a perfect proxy for risk aversion (the preference parameter $1 - \sigma$ in our theoretical model) we would have proven the validity of our model. However, since we are uncertain about other factors captured by this question, in the empirical analysis we control for many other variables possibly acting as confounding factors that may affect the relationship between risk aversion and children schooling. To model the non-linear relationship at high levels of risk aversion we group the respondents in three terciles of the risk aversion distribution: individuals with low risk aversion whose willingness to pay is high (between €1033 and €5165 inclusive of the 35 risk neutral individuals); individuals with medium risk aversion (with willingness to pay between €258 and €979) and finally individuals with high risk aversion (with willingness to pay below €206). The division in three terciles of the distribution allows us to assess whether the effect of risk aversion is different across groups (the terciles are not exactly 33% of the distribution due to bunching of the bet – and consequently of absolute risk aversion – at some specific values).

Table 2 shows the sample average of all the variables used in the analysis for the full sample and separately for the three risk-aversion groups. It shows that different risk aversion groups are also characterized by different levels of education of the head, as well as by differences in other observables such as wealth, income and consumption. Children of heads with high risk aversion have a lower unconditional probability to go to college (first row of the table). They are also marginally more likely to hold a vocational (rather than a Lyceum) diploma than children of families with low risk aversion. The six types of diplomas expressed as dummies (vocational, technical, lyceum, arts, teacher and other) are those provided in the survey and are used as a proxy of children ability (see below). Also high school marks are used as a proxy of children ability and they are normalized on a 0–1 scale because the original scores change with the type of diploma and the year of high-school graduation and unfortunately are available only in the year 2000 wave. The variable which indicates the head's and spouse's education level assumes values from 1 to 8 in increasing order of attainment level (the large majority of heads in the sample – 73% – holds a lower secondary education title, whilst only 7% holds a college degree).

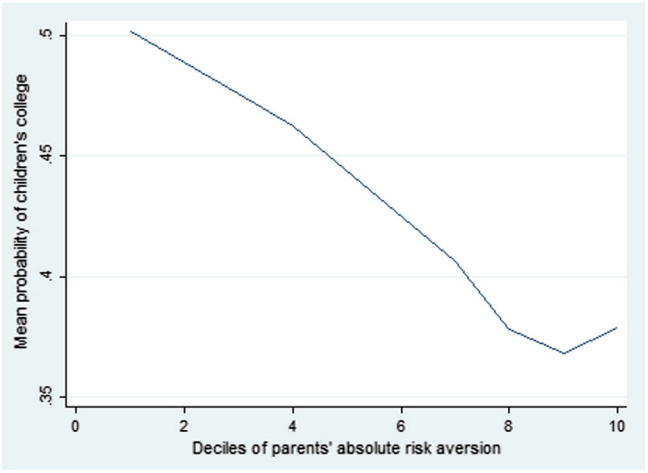

Fig. 1. Parents' risk aversion deciles and children's average probability of college enrollment.

The correlations (not shown) between risk aversion and the main characteristics are consistent with the main findings of the literature: risk aversion is inversely correlated with gender (although it is not significant here because female heads are few), with education, wealth and income; it is positively correlated with age and living in the South.

There is one issue with the variable "bet": whether a bet of zero is to be considered a valid answer. Following Guiso and Paiella (2008) we consider zeros as invalid answers because the solution to Eq. (9) tends to infinity as the willingness to pay(bet) tends to zero. We treat individuals who report a zero bet as non-respondents and in Section 5 we analyse the probability of non-response. An alternative view would claim that zero bets are different than missing answers and denote infinitely risk averse individuals. In the robustness checks in Section 5.1, we put the respondents with zero willingness to pay in a separate group from the high risk averse. [15]

4. The benchmark model and results

We run linear probability models on the choice to enrol in college where the dependent variable (S_i) is equal to 1 if individual i holds a high-school degree and is a student (therefore he or she is a college

[13] The original values in Italian Liras (Lit.) are converted in euros using the official conversion rate Lit. 1936.27 = €1.

[14] An alternative functional form is a CRRA utility function which yields very similar results; the results are not shown here but are available upon request.

[15] A second issue is whether the wording of the question may lead to interpret the potential gain as gross rather than net. A different interpretation of the question would yield the following equation $U_i(w_i) = \frac{1}{2}U_i(w_i + 5,165 - bet_i) + \frac{1}{2}U_i(w_i - bet_i)$ which makes no substantial difference in our results.

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Table 2
Sample averages of main variables.

	N obs	Full sample	Subsample of		
			Low risk averse	Medium risk averse	High risk averse
College student (d)	1322	0.446	0.489	0.451	0.377
Age of child	1322	23.666	23.462	23.695	23.931
Female child (d)	1322	0.485	0.464	0.468	0.537
Vocational diploma (d)	1322	0.091	0.075	0.081	0.126
Technical diploma (d)	1322	0.407	0.427	0.378	0.414
Lyceum diploma (d)	1322	0.277	0.269	0.305	0.251
Arts and design diploma (d)	1322	0.037	0.039	0.037	0.034
Teacher training diploma (d)	1322	0.055	0.054	0.055	0.057
Other diploma (d)	1322	0.133	0.135	0.143	0.117
High-school marks	305	0.803	0.818	0.804	0.791
Number of family components	1322	4.061	4.157	4.020	3.974
Age of household head	1322	54.148	53.952	53.991	54.643
Age of spouse	1173	51.311	51.092	51.642	51.237
Education of head	1322	3.818	4.017	3.890	3.429
Education of spouse	1173	3.453	3.528	3.648	3.091
Education of father of head	1281	2.154	2.237	2.225	1.931
Education of father of spouse	1119	2.157	2.200	2.247	1.976
Head total income (million Euros)	1319	0.023	0.026	0.023	0.019
Spouse total income (million Euros)	1173	0.006	0.006	0.007	0.005
Family consumption (million Euros)	1322	0.025	0.026	0.025	0.022
Family wealth (million Euros)	1322	0.204	0.227	0.208	0.164
Lottery bet (Euros)	1322	1023.337	2175.916	464.990	46.665
Absolute risk aversion	1322	0.028	0.000	0.002	0.104

Notes: (d) indicates a 0/1 dummy variable. The variable "high-school marks" is available only in the year 2000 survey. All monetary values are converted in year 2000 euros using consumer price index and official Lit./euro conversion rates. The sample of low, medium and high risk averse are terciles of the risk aversion distribution. More descriptive statistics are in Table 6.

student) or has already obtained a college degree and is equal to 0 otherwise (i.e. he or she holds a high-school degree but is not a student)[16]:

$$S_i = X_i'\beta_1 + \delta_0 W_i + \delta_1 A_i + \delta_2 R_i + \varepsilon_i, \quad (10)$$

where X_i contains year and regional dummies, a variable for the number of household components, the age and gender of the child and the age and education level of the household head and of the spouse. W_i includes the family net wealth and current income of both the head and the spouse, which control for both the stock and flow of family endowment. A crucial issue is to control for children's ability A_i because the effect of parental risk aversion may be picking up the effect of omitted children's ability. We use three different proxies for children's ability: education of both grandfathers of the student (i.e. the father of the head and of the spouse); the type of secondary school attained (expressed in six dummies from vocational school to lyceum); the final marks obtained at the end of secondary school, which unfortunately are available only in the year 2000 survey. The coefficient of interest is δ_2 that measures the effect of absolute risk aversion R_i expressed in three dummies (the lowest risk averse tercile of the distribution is excluded as reference). In all specifications we use individual survey weights and clustered errors at the level of the family to account for correlations among children of the same household.

We regard R_i as a preference parameter but we cannot exclude that risk aversion may be influenced by environmental conditions (the so-called "background risk"). To control for background risk we added to the regression a measure of GDP variability at the level of the province of residence but, since this was always insignificant, we dropped it. Finally the model predicts a role for altruism, however there are no credible proxies for altruism in the dataset except for the presence of children in the family (since the early work of Hurd (1987) on savings for bequest motives). We control for the number of components of the family in the regression, else we consider all families with children equally altruistic.

4.1. Results on risk aversion

The results of Table 3 indicate that high parental risk aversion is associated with lower probability of the children's enrolling in college. In columns (1) and (2) we look at the full sample which includes children of single parents and of couples, in columns (3)–(6) we restrict the sample to children of couples only (families with two parents), allowing us to control also for spouse's (often the mother) education. The age of the child is significantly negatively correlated with the probability of college enrollment. The coefficient of risk aversion changes from column (1) to column (2) when we introduce the income and education of the head and family wealth. The income of the head is not significant whilst the income of the spouse (there is a large proportion of zeros, around 50%, in income of the spouse) is significant in column (3), suggesting that the spouse's income may be perceived as supplementary to the main income of the breadwinner. The same is often true for the coefficients of the head's and of the spouse's education indicating the spouse as a role model for children (Staffolani and Pigini, 2012). Family wealth loses significance from column (2) to column (3) when we include both income of the head and of the spouse suggesting that income and education of the spouse absorb the effect of family wealth when they are introduced in the regression.

The negative and significant effect of parents' risk aversion on children's college enrollment is robust to the introduction of all three measures of ability in columns (4), (5) and (6). Including the education level of the fathers of head and spouse (notice that in column (4) we lose few observations), only the education level of the father of the spouse is significant, reinforcing the common finding that children education more often follows the mother's line. As expected, the type of secondary school attended is significantly positive for Lyceum graduates (see column (5), the benchmark being vocational school graduates). Finally high-school marks (measured on a scale 0 to 1) are significant: an increase in the final marks of one out of a hundred increases the probability of enrollment by 0.7 percentage points (column 6). The effect of risk aversion on children's schooling is robust across specifications among the very risk averse, who are up to 15 percentage points less likely to send their children to college. The effect of medium risk aversion is lower, around 6–9 percentage points, and significant only in few specifications (columns (4) and (5)), and the medium risk averse are never significant except in two cases.

In the benchmark sample we consider the sample of all children aged 19–30 living at home. One may be worried that the sample is likely to be selected as a relevant proportion of children aged 19–30 might have already left their parents' home (recall Table 1). As a

[16] A probit model yields similar results to the linear probability model.

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Table 3
Effect of parents' risk aversion on children's college enrollment probability.

	(1)	(2)	(3)	(4)	(5)	(6)
	All families		Families with two parents			
High risk aversion	−0.172***	−0.120***	−0.131***	−0.131***	−0.149***	−0.123*
	[0.045]	[0.045]	[0.047]	[0.048]	[0.039]	[0.074]
Medium risk aversion	−0.071*	−0.058	−0.065	−0.072*	−0.094**	0.004
	[0.041]	[0.039]	[0.041]	[0.041]	[0.038]	[0.080]
Age of child	−0.055***	−0.051***	−0.048***	−0.050***	−0.037***	−0.032**
	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.013]
Female child	−0.009	0.003	−0.009	0.002	−0.047	−0.102*
	[0.033]	[0.032]	[0.034]	[0.035]	[0.032]	[0.059]
Education of head		0.066***	0.029*	0.021	0.017	0.001
		[0.011]	[0.015]	[0.016]	[0.016]	[0.027]
Education of spouse			0.046***	0.051***	0.026	0.017
			[0.017]	[0.018]	[0.017]	[0.028]
Head total income		−0.053	0.148	−0.051	−0.221	1.803
		[0.668]	[0.657]	[0.642]	[0.581]	[1.868]
Spouse total income			4.678**	3.282	3.201*	3.654
			[1.995]	[2.032]	[1.921]	[2.615]
Family wealth		0.123**	0.038	0.035	0.010	−0.091
		[0.058]	[0.054]	[0.057]	[0.043]	[0.126]
Number of components	−0.029	−0.036*	−0.042*	−0.046*	−0.035*	−0.031
	[0.019]	[0.019]	[0.023]	[0.025]	[0.020]	[0.034]
Technical diploma					0.036	−0.159
					[0.061]	[0.118]
Lyceum diploma					0.472***	0.409***
					[0.067]	[0.127]
Arts and design diploma					0.156	0.023
					[0.103]	[0.178]
Teacher training diploma					0.229**	0.107
					[0.093]	[0.171]
Other diploma					−0.018	−0.384**
					[0.073]	[0.150]
Education father of head				−0.008		
				[0.021]		
Education father of spouse				0.042**		
				[0.020]		
High-school marks						0.746***
						[0.218]
Constant	2.043***	1.767***	1.716***	1.783***	1.387***	−0.128
	[0.203]	[0.209]	[0.239]	[0.259]	[0.215]	[0.416]
N obs	1,322	1,322	1,173	1,104	1,173	261
R-squared	0.161	0.210	0.238	0.253	0.368	0.575

Notes: In columns (1) and (2) we look at the full sample which includes children of single parents and of couples, and in columns (3)–(6) we restrict the sample to children of couples only (families with two parents). All specifications include the age of the head and of the spouse and regional and year dummies, the omitted risk aversion dummy is "Low risk averse" and the omitted high school diploma is of a vocational secondary school. The last column refers to year 2000 only.

check for robustness we run the same models on the smaller sample of cohabiting children aged 19–24. The results are in Table 4, where we use data on all families to maximize the sample size. Family wealth is significant, most likely because we do not introduce the spouse's education and income. Although the number of observations is greatly reduced, the significance of the risk aversion coefficient still holds and actually the effect of risk aversion on the 19–24 year olds is on average higher than on the larger sample of 19–30 year olds, used in Table 3. Results of the most demanding specification of column (4) show that high risk averse parents are 17 percentage points less likely to send their children to college than low risk averse parents. Net wealth[17] is often non-significant and might reveal that, once we control for the father's and mother's education, liquidity constraints associated to the payment of tuition fees does not seem to be an issue in Italy. To explore the relevance of liquidity constraints in affecting our results, we use specific questions in the next section.

Our interpretation of the results is the following: if risk aversion is an innate preference parameter then it should always be a significant determinant of our outcome and it may also be correlated with other relevant variables of our analysis. When we condition also for the father's and mother's education, they explain part of the residual variation, though the mother's education picks up most of the effect of the father's education (as it is often found in the literature). Controlling also for the type of high-school diploma (and, limited to year 2000 survey, for the high-school marks), college decisions seem to be mostly determined by high-school track and risk-aversion. The coefficient of risk aversion is not affected by the introduction of the high school track; this is consistent with the results in Leonardi (2007) who finds that parents' risk aversion has no effect on the children's choice of secondary school and with Heineck and Woelfel (2012) who find the same results on German data (with the partial exception of a significant effect of the mother' risk aversion when the mother is head of the household). This pattern of results is common to Table 3 and (with a smaller sample) to Table 4 which uses the less selected sample of 19–24 years old.

In previous work that relates own risk aversion with educational attainment, Belzil and Leonardi (2007) find that social determinants like parents' education remain a stronger determinant of schooling attainment than risk aversion; the effect of risk aversion is higher when instrumental variables are used (Belzil and Leonardi, 2013). In the present paper we find that risk aversion is significant and parents' educational attainment is not when we control for the high school track. This is not in contrast with previous results because here we solve much of the exogeneity problem of risk aversion using the

[17] We have tried different measures of wealth, both in log and in levels, including total real wealth, household cash on hands (income plus financial wealth) and household consumption, but in no case did it make any significant difference. The results are not shown for reasons of space but they are available upon request.

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Table 4
Effect of parents' risk aversion on children aged 19–24. All families.

	(1)	(2)	(3)	(4)
High risk aversion	−0.172***	−0.155***	−0.167***	−0.169**
	[0.054]	[0.057]	[0.048]	[0.079]
Medium risk aversion	−0.025	−0.013	−0.068	−0.057
	[0.048]	[0.051]	[0.049]	[0.096]
Age of child	−0.055***	−0.059***	−0.049***	−0.070***
	[0.012]	[0.013]	[0.011]	[0.023]
Female child	0.026	0.041	−0.021	−0.099
	[0.043]	[0.047]	[0.040]	[0.077]
Education of head	0.093***	0.079***	0.057***	0.018
	[0.012]	[0.017]	[0.013]	[0.030]
Head total income	−0.453	−0.291	−0.767	−0.289
	[0.675]	[0.684]	[0.624]	[2.774]
Family wealth	0.190**	0.168*	0.145**	0.193
	[0.077]	[0.080]	[0.066]	[0.190]
Number of components	−0.021	−0.012	−0.022	−0.013
	[0.026]	[0.026]	[0.022]	[0.038]
Technical diploma			0.108	0.048
			[0.066]	[0.098]
Lyceum diploma			0.501***	0.533***
			[0.069]	[0.102]
Arts and design diploma			0.199*	0.216
			[0.118]	[0.151]
Teacher training diploma			0.297***	0.294
			[0.114]	[0.225]
Other diploma			0.132	−0.384**
			[0.113]	[0.162]
Education father of head		0.046**		
		[0.022]		
High-school marks				0.827***
				[0.259]
Constant	1.653***	1.677***	1.515***	1.028
	[0.355]	[0.397]	[0.313]	[0.832]
N obs	809	785	809	155
R-square	0.204	0.221	0.33	0.643

Notes: The sample is restricted to children aged 19–24 of all families. All specifications include the age of the head and of the spouse and regional and year dummies, the omitted risk aversion dummy is "Low risk averse" and the omitted high school diploma is of a vocational secondary school. The last column refers to year 2000 only.

parents' risk aversion on children's educational attainment; in addition, because the results of Belzil and Leonardi (2007, 2013) are actually obtained without using the information on type of secondary school.[18]

From now on we assess the robustness of our results to the omission of some potentially relevant missing variable or observation using the sample of couples only, as single parents in our sample are only 149 and their exclusion does not change significantly the results. This will allow us to comment on the often-significant effect of the spouse's education and income.

4.2. Liquidity constraints

Usually the literature infers the presence of liquidity constraints from the positive significant correlation of family wealth or income with children's educational attainment. However several scholars such as Cameron and Heckman (1998, 2001), Carneiro and Heckman (2002) and Cameron and Taber (2004) attribute differences in college attendance rates between the poor and the rich in the US to differences in "college readiness" rather than to liquidity constraints. For example Carneiro and Heckman (2002) show that controlling for children's ability eliminates the significant effect of family income on college enrollment decision, thus disproving the importance of credit constraints.[19]

In our results, income and wealth are rarely significant determinants of college enrollment and the introduction of various measures of ability in the regressions has not changed significantly the coefficient of wealth and current income, therefore there is little reason to think that there exist substantial liquidity constraints in our sample. However one may be worried about parents' risk aversion reflecting the effect of (omitted) family liquidity constraints; in addition Guiso and Paiella (2008) show that the presence of liquidity constraints may affect directly risk aversion or vice-versa: very risk averse individuals may be less prone to take out loans and may be more liquidity constrained. To be sure that parents' risk aversion really captures a preference parameter rather than picking up the omitted effects of liquidity constraints, we add to the regression alternative measures of liquidity constraints.

We start considering a measure based on self-reported credit rejection. The survey asks whether a credit request was rejected and whether the family did not ask for credit for fear of being rejected. The exact question addressed to the household head is the following: "In 1995 (or 2000) did you or another member of your household consider the possibility of applying to a bank or a financial company for a loan or a mortgage but then change his/her mind thinking that the application would be rejected?". Liquidity constrained families are those who respond "yes" to this question and those whose application for a credit was actually rejected.

Table 5 shows that we find no evidence that the effect of liquidity constraints measured by credit rejection is significant (see the variable

Table 5
Effect of parents risk aversion adding liquidity constraints. Families with two parents.

	(1)	(2)	(3)	(4)	(5)
High risk aversion	−0.141***	−0.132***	−0.133***	−0.150***	−0.121*
	[0.046]	[0.047]	[0.048]	[0.038]	[0.073]
Medium risk aversion	−0.069*	−0.065	−0.072*	−0.095**	0.005
	[0.041]	[0.041]	[0.041]	[0.037]	[0.082]
Age of child	−0.049***	−0.048***	−0.050***	−0.037***	−0.033***
	[0.006]	[0.006]	[0.006]	[0.006]	[0.012]
Female child	−0.008	−0.01	0	−0.047	−0.101*
	[0.034]	[0.034]	[0.035]	[0.031]	[0.059]
Education of head	0.028*	0.029*	0.02	0.017	0.002
	[0.015]	[0.015]	[0.016]	[0.014]	[0.027]
Education of spouse	0.065***	0.046***	0.052***	0.027*	0.017
	[0.015]	[0.017]	[0.018]	[0.015]	[0.029]
Head total income		0.173	0.136	−0.146	0.865
		[0.656]	[0.551]	[0.563]	[1.984]
Spouse total income		4.594**	3.331	3.164	3.491
		[1.990]	[2.035]	[1.963]	[2.849]
Family wealth		0.04	0.032	0.015	−0.090
		[0.054]	[0.057]	[0.043]	[0.126]
Number of components	−0.040*	−0.043*	−0.047*	−0.036**	−0.027
	[0.024]	[0.023]	[0.026]	[0.017]	[0.035]
Technical diploma				0.036	−0.168
				[0.060]	[0.110]
Lyceum diploma				0.472***	0.403***
				[0.062]	[0.120]
Arts and design diploma				0.159	0.011
				[0.101]	[0.175]
Teacher training diploma				0.226**	0.113
				[0.089]	[0.168]
Other diploma				−0.017	−0.385***
				[0.071]	[0.138]
Education father of head			−0.008		
			[0.021]		
Education father of spouse			0.043**		
			[0.020]		
High-school marks					0.731***
					[0.206]
Credit reject	0.103	0.094	0.062	0.088	
	[0.120]	[0.118]	[0.125]	[0.100]	
Liquidity constrained					−0.023
					[0.055]
Constant	1.687***	1.709***	1.781***	1.380***	−0.021
	[0.244]	[0.240]	[0.261]	[0.221]	[0.438]
N obs	1173	1173	1104	1173	261
R-square	0.232	0.238	0.253	0.369	0.574

Notes: all specifications include the age of the head and of the spouse and regional and year dummies, the omitted risk aversion dummy is "Low risk averse" and the omitted high school diploma is of a vocational secondary school. The last column refers to year 2000 only.

[18] Belzil and Leonardi (2007) estimate a grade transition model at all levels of schooling from the lower secondary to college and therefore cannot use the information on type of secondary school.

[19] Overall the literature in the US has not yet found a consensus on the evidence of liquidity constraints as Lochner and Monge-Naranjo (2012) discuss in their survey.

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Table 6
Descriptive statistics of respondents and non-respondents.

	Respondents			Non-respondents		
	N	Mean	Std dev	N	Mean	Std dev
College student (d)	1322	0.446	0.497	1826	0.429	0.495
Age of child	1322	23.666	3.154	1826	23.940	3.187
Female child (d)	1322	0.485	0.500	1826	0.481	0.500
Vocational diploma (d)	1322	0.091	0.287	1826	0.098	0.297
Technical diploma (d)	1322	0.407	0.491	1826	0.409	0.492
Lyceum diploma (d)	1322	0.277	0.448	1826	0.262	0.440
Arts and design diploma (d)	1322	0.037	0.189	1826	0.032	0.177
Teacher training diploma (d)	1322	0.055	0.228	1826	0.062	0.242
Other diploma (d)	1322	0.133	0.340	1826	0.137	0.344
High-school marks	305	0.803	0.141	677	0.802	0.140
Number of family components	1322	4.061	1.024	1826	3.991	0.995
Age household head	1322	54.148	6.331	1826	55.498	6.743
Age of spouse	1173	51.311	5.937	1619	52.153	6.447
Education of head	1322	3.818	1.619	1826	3.636	1.615
Education of spouse	1173	3.453	1.564	1619	3.353	1.554
Education of father of head	1281	2.154	1.014	1731	2.061	1.024
Education of father of spouse	1119	2.157	1.008	1508	2.056	1.033
Head total income (million Euros)	1319	0.023	0.022	1823	0.022	0.020
Spouse total income (million Euros)	1173	0.006	0.009	1619	0.005	0.008
Family consumption (million Euros)	1322	0.025	0.013	1826	0.024	0.013
Family wealth (million Euros)	1322	0.204	0.262	1826	0.207	0.335
Interviewee understands	1322	4.104	0.888	1826	4.023	0.959
Interviewee is trustful on income	1322	3.421	0.831	1826	3.478	0.905
Interview in good climate	1322	4.260	0.818	1826	4.223	0.864
Interviewee has troubles answering	1322	2.483	1.329	1826	2.854	1.380

Notes: (d) indicates a dummy variable. The variable "high-school marks" is available only in the year 2000 survey. All monetary values are converted in year 2000 euros using consumer price index and official Lit./euro conversion rates.

"credit reject" at the end of the table). In column (1) we include the credit rejection variable whilst both income and wealth variables to assess whether collinearity could be an issue, in columns (2) to (4) the credit rejection dummy is included in equations that respectively include income and family wealth and ability measures. In all cases the estimated coefficient of risk aversion remains significant and does not change much in magnitude.

As in the year 2000 survey there is not a single case of credit rejection, we build a measure of credit constraint based on debt (debt greater than 25% of assets) or liquidity (financial liquidity smaller than 1% of assets). According to at least one of the three measures (rejection, high debt or low liquidity), 32% of households are constrained. Results show that the estimated coefficient of risk aversion is robust to the introduction of this liquidity constrained measure[20] also in the regression where we can control for high school marks (column 5). We conclude reaffirming that the significant effect of risk aversion is not simply reflecting the presence of liquidity constraints.

5. Robustness to non-response

There is a potential issue of non-response to the lottery question that we have so far ignored: in the benchmark sample we keep only those who responded to the question with a positive price. The question has a large number of non-responses (626 household heads) and bet equal to zero (1183 household heads), possibly because some respondents may have considered the question too difficult to answer. Table 6 shows that those heads who responded to the lottery question are on average younger and on average slightly better educated.

The difference in education between the sample of non-respondents and the sample of respondents seems to suggest that – in so far as education is also a proxy for better understanding – non-responses can be ascribed partly to differences in the ability to understand the question. To control for the possibility that non-responses may induce selection bias, we model the probability of responding to the risk aversion question as depending on individual characteristics and measures of the quality of the interview given by the interviewer, which are assumed to be exogenous to individual's attitudes towards risk.[21] We estimate the following Heckman selection model:

$$S_i = X_i'\beta_1 + \delta W_i + \delta_1 A_i + \delta_2 R_i + \varepsilon_i \tag{11}$$

$$\text{observed if } Z_{1i}'\phi + \nu_i > 0 \tag{12}$$

with $\upsilon_i \sim N(0,\sigma), \nu_i \sim N(0,1), corr(\upsilon_i,\nu_i) = \rho$. The selection equation depends on Z_1 which includes all regressors of the main equation plus four measures of the quality of the interview. All four measures of interview quality are asked from the interviewer rather than the interviewed and as well as the level of understanding of the questionnaire according to the interviewer. The answers to the four questions related to the quality of the interview are all rated from a minimum of "limited" to a maximum of "very good", coded 1 to 5 respectively.[22]

Table 7 shows the results of the Heckman model. Overall the results do not vary much with respect to the linear specification of Table 3: education and income of the spouse are positively associated with the probability of college enrollment. The magnitude of the effect of risk aversion is slightly lower in size: the high risk averse families are

[20] Although the credit constraint dummy defined above is a clearer measure of liquidity constraints, we have also computed this measure based on debt and introduced it in all specifications of columns (1)–(4), but in no case it entered the regression with a significant coefficient.

[21] One may believe that such individual characteristics are related with parents' cognitive and non-cognitive features that may also influence children's schooling decisions. However it is difficult to think of possible non-cognitive abilities which are unrelated with parental education but correlated with both understanding lottery questions and correctly appreciating the future income of their children. We introduced such measures in the main specification controlling for parents' education and risk aversion and found insignificant coefficients, thus suggesting that parents' risk aversion and education summarize all relevant determinants and that the quality of the interview satisfies the exclusion restriction condition.

[22] The wording of the questions are: How do you rate the interviewee's understanding of the questions?; How do you rate the difficulty the interviewee had in responding?; How do you rate the reliability of the information provided by the interviewee on income and wealth?; How do you rate the general climate of the interview?

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Table 7
Effect of parents risk aversion on children's college enrollment probability: Heckman model. Families with two parents.

	(1)	(2)	(3)	(4)
High risk aversion	−0.078**	−0.072**	−0.092***	−0.124*
	[0.034]	[0.035]	[0.031]	[0.064]
Medium risk aversion	−0.022	−0.029	−0.044	−0.02
	[0.031]	[0.031]	[0.028]	[0.064]
Age of child	−0.046***	−0.045***	−0.036***	−0.033***
	[0.006]	[0.007]	[0.005]	[0.009]
Female child	0.005	0.014	−0.036	−0.131**
	[0.030]	[0.032]	[0.026]	[0.064]
Education of head	0.041***	0.036**	0.018	−0.014
	[0.014]	[0.016]	[0.012]	[0.022]
Education of spouse	0.037**	0.044***	0.031**	0.026
	[0.015]	[0.016]	[0.013]	[0.022]
Head total income	0.834	0.788	0.245	3.638
	[0.774]	[0.839]	[0.632]	[2.710]
Spouse total income	9.019***	8.882**	4.842*	1.992
	[3.267]	[3.958]	[2.785]	[3.394]
Family wealth	0.065	0.053	0.063	−0.187*
	[0.060]	[0.065]	[0.050]	[0.101]
Number of components	−0.026	−0.033*	−0.026*	−0.014
	[0.017]	[0.018]	[0.014]	[0.034]
Technical diploma			0.014	−0.033
			[0.046]	[0.080]
Lyceum diploma			0.440***	0.385***
			[0.050]	[0.086]
Arts and design diploma			0.144*	0.088
			[0.076]	[0.147]
Teacher training diploma			0.200***	0.178
			[0.074]	[0.126]
Other diploma			−0.042	−0.325***
			[0.056]	[0.102]
Education father of head		0.009		
		[0.020]		
Education father of spouse		0.02		
		[0.021]		
High-school marks				0.760***
				[0.192]
Mills ratio	0.452	0.5	0.218	0.101
	[0.266]	[0.359]	[0.228]	[0.315]
Constant	1.093***	1.182***	1.066***	−0.743
	[0.349]	[0.389]	[0.295]	[0.863]
N obs	2792	2575	2792	873
Selection equation excluded variables				
Interviewee seems to understands	0.094**	0.067*	0.092**	0.008
	[0.038]	[0.040]	[0.038]	[0.115]
Interviewee seems trustful on income	0.026	0.012	0.025	0.018
	[0.041]	[0.043]	[0.041]	[0.078]
Interview was in good climate	0.002	0.003	0.003	0.029
	[0.040]	[0.041]	[0.040]	[0.096]
Interviewee has no troubles answering	0.024	−0.008	0.025	0.117
	[0.031]	[0.033]	[0.031]	[0.109]

Notes: all specifications include the age of the head and of the spouse and regional and year dummies, the omitted risk aversion dummy is "Low risk averse" and the omitted high school diploma is of a vocational secondary school. The last column refers to year 2000 only.

between 7 and 12 percentage points less likely to send their children to college. Among the excluded variables in the selection equation only the variable "Interviewee understands" is always significant except in column 4. The other significant variables in the selection equation (not shown) is either the head's or the spouse's total income (the higher the income the more likely to respond). The Mills ratio is never significant indicating that there is no evidence that non-response is an issue. Since there is little evidence of the importance of selection in answering the lottery question, in the following we return to models estimated on the respondents only.

5.1. Zero bets?

There are 3148 cohabiting observations, but estimation so far uses only 1322 individuals. Among the 1826 missing, 1809 have inadequate data for the risk-aversion question: 626 do not answer and 1183 give zero as their lottery bet. So far we have followed the literature (Guiso and Paiella, 2008) and we have excluded the zero bets on the grounds that the zero-respondents did not understand the question. One possible interpretation is that when asked "how much they would bet if they can earn €5000 or lose their bet" people who answer a zero bet are just very risk-averse: they just never play money games. The truth probably lies in the middle and part of these respondents are very risk averse whilst others simply did not understand the question. Although there is no clear way to distinguish the two cases, in this section we include the zeros in the analysis. Of course we cannot calculate absolute risk aversion using formula (9) because a bet of zero would correspond to an infinite absolute risk aversion. However we can add a forth risk aversion category which includes all those persons who answered a zero bet as a separate group. Alternatively we can use the raw lottery bet directly as a measure of risk aversion without the Arrow–Pratt transformation: in this case a high lottery bet corresponds to less risk averse individuals. We replicate the analysis of the previous Sections using these two alternative specifications.

Table 8 shows the results of a specification which includes a dummy indicator for those who answer with a zero lottery bet. The first three columns correspond to the model estimated in the benchmark Table 3 (we take out the results including grandfathers' education because

Table 8
Parents' risk aversion on children's college enrollment probability — Including zero bets. Families with two parents.

	(1)	(2)	(3)	(4) age <= 24
Zero bet	−0.083**	−0.089***	−0.108*	−0.202**
	[0.035]	[0.032]	[0.064]	[0.081]
High risk aversion	−0.145***	−0.151***	−0.155*	−0.163
	[0.045]	[0.038]	[0.080]	[0.099]
Medium risk aversion	−0.065	−0.089**	−0.069	−0.085
	[0.042]	[0.040]	[0.081]	[0.099]
Age of child	−0.046***	−0.036***	−0.020**	−0.039**
	[0.004]	[0.004]	[0.008]	[0.016]
Female child	−0.000	−0.030	−0.010	−0.018
	[0.026]	[0.025]	[0.043]	[0.050]
Education of head	0.013	0.005	0.001	−0.002
	[0.012]	[0.012]	[0.019]	[0.025]
Education of spouse	0.059***	0.035***	0.026	0.051**
	[0.013]	[0.012]	[0.019]	[0.025]
Head total income	0.422	−0.041	0.376	2.230
	[0.628]	[0.601]	[1.212]	[1.727]
Spouse total income	2.901*	1.153	−2.344	−4.843*
	[1.619]	[1.592]	[2.134]	[2.550]
Family wealth	0.017	0.014	−0.016	0.032
	[0.038]	[0.036]	[0.067]	[0.056]
Number of components	−0.042**	−0.029*	−0.044*	−0.042
	[0.018]	[0.015]	[0.025]	[0.029]
Technical diploma		0.062	−0.024	0.149**
		[0.044]	[0.072]	[0.067]
Lyceum diploma		0.475***	0.461***	0.551***
		[0.051]	[0.080]	[0.080]
Arts and design diploma		0.238***	0.224*	0.309**
		[0.084]	[0.124]	[0.124]
Teacher training diploma		0.123*	0.116	0.311***
		[0.066]	[0.103]	[0.112]
Other diploma		0.039	−0.163	−0.144
		[0.054]	[0.100]	[0.098]
High-school marks			0.811***	0.831***
			[0.142]	[0.178]
Constant	1.636***	1.336***	0.412	0.306
	[0.187]	[0.171]	[0.332]	[0.516]
N obs	2240	2240	714	392
Rsquare	0.201	0.320	0.385	0.501

Notes: All specifications include the age of the head and of the spouse and regional and year dummies, the omitted risk aversion dummy is "Low risk averse" and the omitted high school diploma is of a vocational secondary school. Columns 4 and 5 refer to year 2000 only. In column 6 the dependent variable is equal to zero if the child is enrolled in college and equal to one if she has attained the degree.

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they are not very informative) whilst column (4) restricts the sample to children aged 19–24.

The results on risk aversion hold and the dummy indicator of those with a zero bet is significantly negative in all cases. The magnitude is smaller (in absolute value) than the dummy indicating the high risk averse but as stated before the category of those betting zero probably includes some who actually did not understand the question. The channels through which risk aversion affects college enrollment seem to be the same as in Table 3 which did not include the zeros: the father's education is overcome by the positive effect of the mother's education when the mother is present (column 1). When the type of high school and the final marks are introduced in the regression, they capture the children's ability better than any other factor excluding the parents' risk aversion (columns 2 and 3). Column 4 confirms the results on the smaller sample of the 19–24 year olds. Similarly to Table 4, in this sample the effect of risk aversion is larger, but now the significance of high and medium risk aversion coefficients is captured by those who declared zero bets and are no more statistically significant.

Finally, in Table 9 we use the raw lottery bet directly as a measure of risk aversion without the Arrow–Pratt transformation: in this case a high lottery bet corresponds to less risk averse individuals. The raw bet measure allows us to use the information of those 1,183 cohabiting observations whose parents are betting zero and to test the results for robustness against the Arrow–Pratt transformation. Of course the raw lottery bet is a measure of risk aversion which does not take into account the utility function transformation imposed by the Arrow–Pratt measure. Table 9 below shows that the results hold also in this case, even for the sample of children younger than 25.

Table 9
Parents' risk aversion on children's college enrollment probability — lottery bet. Families with two parents.

	(1)	(2)	(3)	(4) age < =24
Lottery bet	0.037***	0.042***	0.060**	0.112***
	[0.014]	[0.013]	[0.030]	[0.040]
Age of child	−0.047***	−0.036***	−0.021***	−0.039**
	[0.004]	[0.004]	[0.008]	[0.016]
Female child	−0.003	−0.033	−0.015	−0.019
	[0.026]	[0.024]	[0.042]	[0.050]
Education of head	0.014	0.006	0.002	−0.001
	[0.012]	[0.012]	[0.019]	[0.024]
Education of spouse	0.060***	0.035***	0.025	0.050**
	[0.013]	[0.013]	[0.020]	[0.025]
Head total income	0.335	−0.152	0.258	1.927
	[0.638]	[0.601]	[1.229]	[1.710]
Spouse total income	2.831*	1.008	−2.278	−4.351*
	[1.647]	[1.618]	[2.181]	[2.530]
Family wealth	0.023	0.021	−0.015	0.029
	[0.038]	[0.036]	[0.067]	[0.057]
Number of components	−0.040**	−0.028*	−0.039	−0.040
	[0.018]	[0.015]	[0.024]	[0.028]
Technical diploma		0.067	−0.021	0.152**
		[0.044]	[0.072]	[0.065]
Lyceum diploma		0.480***	0.469***	0.559***
		[0.051]	[0.080]	[0.080]
Arts and design diploma		0.249***	0.243**	0.359***
		[0.086]	[0.123]	[0.122]
Teacher training diploma		0.132**	0.124	0.303***
		[0.066]	[0.101]	[0.110]
Other diploma		0.043	−0.157	−0.156*
		[0.054]	[0.100]	[0.093]
High-school marks			0.819***	0.818***
			[0.141]	[0.175]
Constant	1.521***	1.211***	0.265	0.074
	[0.186]	[0.171]	[0.334]	[0.512]
N obs	2240	2240	714	392
Rsquare	0.199	0.319	0.384	0.500

Notes: All specifications include the age of the head and of the spouse and regional and year dummies, the omitted risk aversion dummy is "Low risk averse" and the omitted high school diploma is of a vocational secondary school. Columns 4 and 5 refer to year 2000 only. In column 6 the dependent variable is equal to zero if the child is enrolled in college and equal to one if she has attained the degree.

6. Concluding remarks

In this paper we propose a model of children's college attendance choice which predicts that parental risk aversion may drive the children's choices when parents cover the cost of education. We take this prediction to the data in the Italian case, showing that parents' risk aversion negatively affects the enrollment in college of children aged 19–30 (or aged 19–24) who cohabit with their families of origin. The effect is concentrated among parents with very high risk aversion: as long as college enrollment is a risky investment due to unknown future returns in the labour market, risk averse parents may limit the possibility of their children to pursue this choice. The robustness of these results with respect to different measures of risk aversion and the self-selection in responding to the risk aversion question, lends some credibility to the assertion that the results do not reflect omitted variables correlated with both wealth/income and children's college enrollment.

This does not imply that these are the only explanations available: other potential mechanisms at work include the children's unobserved ability (not perfectly controlled for by the three proxies of ability that we use in the regressions) or unobserved peer effects. However the endemic lack of data makes it impossible to test the relative contribution of these further mechanisms. Other characteristics not available in the dataset, which could be correlated to both risk aversion and financing children's education are ethical values, ideology and religion. Religious parents may be less risk averse and at the same time more generous, thus more willing to finance their children education.

The results on the effects of parents' risk aversion on children's schooling complement the results obtained in Belzil and Leonardi (2007, 2013) looking at individuals' own risk aversion and schooling. Both papers conclude that higher risk aversion (whether of the parents or of the children, the two are likely to be correlated) is an obstacle to the investment in college education. Since high risk aversion is correlated with parents' education this mechanism is probably also a significant obstacle to intergenerational mobility. In this sense the results can have some policy relevance.

Italy has been depicted as a country with low intergenerational mobility (Checchi et al., 1999; d'Addio, 2007; Hertz et al., 2008). Access to college remains very low among youths coming from poorly educated families, although the returns to college education, as measured by the difference in compensation of individuals with college education relative to individuals with less than college is substantial, even if Italy has rather low returns to college by international standards.[23] If these are potential explanations for the intergenerational persistence of inequality of opportunities, there is some scope for policies aiming to reverse the situation. Rather than policies aimed solely at relieving credit constraints (which do not seem to be particularly relevant), a new set of policies should address the issue of insurance against the risk of investment failure (both from the point of view of college completion and of earnings uncertainty).[24] Some sort of graduate tax (like those existing in Australia or in Sweden — more recently in the United Kingdom), whose repayment is conditional on achieving a minimum threshold of earnings, can provide a form of partial insurance against earnings uncertainty, thus reducing the influence of risk aversion in preventing college enrolment.

[23] This phenomenon is common to many countries (Heineck and Riphahn, 2009; Riphahn and Schieferdecker, 2012). In a companion paper (Checchi et al., 2013) we show that even for the latest cohorts born in the mid-70s, there is still a gap of 30% in the college attainment rate of children of college-educated parents with respect to children of parents with a lower secondary school degree or less.

[24] Sciclone (2002) has shown that the school and college grants so far implemented have proved to be very ineffective in the Italian education system.

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Additional policies deal with institutional reforms of the educational system. The introduction of the so-called "Bologna system", which pushed all European countries to reorganise their higher education system by creating the possibility of obtaining a degree (equivalent to a Bachelor's degree) after three years of enrollment, should reduce dropout rates, which disproportionately affect students from a poorer background. Since the decision to go to college is conditional on earlier choices, the institutional organization of high schools is also relevant. The Italian high school system, like many other countries', is organised according to different tracks (academic, technical and vocational), and students are selected into different tracks at the age of 14 mostly on the basis of their family background. If different schools teach different abilities, then even when correcting for previous factors (insurance and credit markets) the situation may not improve, because students from less educated parents would more frequently end up in vocational schools, which do not provide an academically oriented education. In such a case, one possible solution would be postponing the tracking age or even fully detrack the current organisation of secondary schools in line of the reforms experienced by many European countries in the 1970s.

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