UNIVERSITÀ DELLA CALABRIA

Dipartimento di Economia e Statistica
Ponte Pietro Bucci, Cubo 0/C
87036 Arcavacata di Rende (Cosenza)
Italy
http://www.ecostat.unical.it/

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Maria De Paola
Dipartimento di Economia e Statistica
Università della Calabria
Ponte Pietro Bucci, Cubo 1/C
Tel.: +39 0984 492459
Fax: +39 0984 492421
e-mail: m.depaola@unical.it

Francesca Gioia
Dipartimento di Economia e Statistica
Università della Calabria
Ponte Pietro Bucci, Cubo 1/C
Tel.: +39 0984 492437
Fax: +39 0984 492421
e-mail: francesca.gioia@unical.it

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Risk Aversion and Major Choice: Evidence from Italian Students

Maria De Paola
(Department of Economics and Statistics, University of Calabria)
Francesca Gioia*
(Department of Economics and Statistics, University of Calabria)

Abstract

Does the choice of the field of study depend on individual risk aversion? The direction of the relationship between individual risk attitudes and type of college major chosen is potentially ambiguous. On the one hand, risk adverse individuals may prefer majors allowing high returns on the labour market; on the other hand, if these majors expose students to a higher probability of dropping out, those who are more risk adverse may be induced to choose less challenging fields. Using data from a sample of students enrolled in 2009 at a middle-sized Italian public University, we find that, controlling for a large number of individual characteristics, including cognitive abilities, personality traits and family background, more risk adverse students are more likely to choose any other field (Humanities, Engineering and Sciences) compared to Social Sciences. We interpret this result considering that some of these fields, such as Humanities, allow to reduce the risk of dropping out, while others (such as Engineering and Sciences)involve a lower risk on the labour market. It also emerges that the effect of risk aversion on major choice is related to student ability. Risk adverse students characterized by high abilities tend to prefer Engineering, while the propensity of risk adverse students to enrol in Humanities decreases when ability increases, suggesting that the attention paid to labour market risks and drop out risks varies according to student skills.

JEL Classification: I21; Z13; J24.
Keywords: *risk aversion, college choice, education*

1. Introduction

Individual choices in education are characterized by a high level of uncertainty along a number of dimensions. The individual who enrols in a certain educational process is generally not able to assess whether he will be able to attain the qualification, that is, he faces a risk of drop-out. Even in the case we exclude the risk of dropping out, it may be difficult to predict how long it will take to accomplish a given educational process. Moreover, it is often hard to define ex-ante whether the individual, once obtained a certain educational qualification, will be able to find an adequate job and what wage level will be perceived. Finally, the market value of the educational qualification may change over time in response to market factors, such as technological changes or changes in demand and supply.

The economic literature has only partially examined the role of uncertainty in defining educational choices and in shaping the returns to educational investments. Christiansen et al. (2007)

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and Palacios-Huerta (2003) analyze investment in human capital considering the same framework used to analyse risky financial assets. Rochat and Demeulemeester (2001) show that the decision-making process in educational investments is driven by individual characteristics, such as income, that influence risk perception. Belzil and Leonardi (2007) have recently analyzed the effect of risk aversion on educational attainments and university enrolment.

Little attention has been devoted to the relationship between the choice of the college major and the degree of individual risk aversion. A number of papers document large differences in college premium across majors. Arcidiacono (2004) and Grogger and Eide (1995) show that large earnings differences exist across majors, with returns being particularly high in the Natural Sciences and in Business. Similar results are obtained for Italy, where graduates in Hard Sciences (Maths, Sciences and Engineering) obtain higher wages compared to graduates in Business, who in turn gain more than graduates in Humanities (De Paola, Brunello and Scoppa, 2010).

In spite of these figures, a large number of students tend to prefer in their educational choices fields that are scarcely demanded on the labour market instead of choosing fields that allow them to obtain high wages and good employment perspectives. For instance, in the academic year 2007-08, 44% of Italian undergraduate students were enrolled at a major degree in Humanities or Social Sciences (ISTAT, http://www.istat.it/lavoro/sistema_istruzione/tavoleuniversitario.html).

Individual risk aversion and the different risks taken into account by individuals when choosing the field of study may help to understand why this happens. In fact, in order to explain this behaviour, some recent studies have tried to examine the effects of income risk and perceived probability of success in accomplishing the academic career on the college major choice. Saks and Shore (2005) show that the financial risk associated to different fields influences college major choice and that wealthier individuals are more likely to choose majors characterized by higher income risk. Caner and Okten (2010) use family income and father's self employment status as indicators of individual risk aversion to analyse college major choice and show that students from wealthier families and students whose fathers are self employed are more likely to enrol in majors involving riskier income streams. Buonanno and Pozzoli (2009), using individual data from a survey on Italian high school graduates enrolled at university, analyse how the perceived probability of success influences the major choice. It emerges that students take into account the probability of failure when choosing the college subject and that students from poorer socio-economic conditions are more risk-adverse.

In this paper we contribute to this emerging literature by investigating how risk attitudes affect the choice of alternative college majors, which are characterized by different returns on the labour market and which are heterogeneous in terms of dropping out probability. At this aim we estimate a multinomial logit model to explain the probability that a particular college field is chosen by an

individual as a function of a set of independent variables including individual risk attitudes. Estimates are based on a rich dataset on a sample of 3661 undergraduate students enrolled at different college majors offered by an Italian University.

This data set allows us to measure individual risk aversion relying on a survey question asking students about their willingness to invest in a risky asset. Since the survey was proposed to students at the moment of their enrolment at University, individual risk attitudes are measured in the same period in which the individual has undertaken the college major choice.[1]

Disentangling the effect of risk aversion on college major choice is not an easy task. First of all, risk aversion might proxy for unobserved individual characteristics, which may also be correlated with the outcome variable. Thanks to the data at hand, which provide detailed information on student's family and social background (family economic conditions and parents' education), on student cognitive abilities and on a number of personality traits, we are confident that bias deriving from omitted variables should not be a major concern in our analysis. Secondly, our analysis could be affected by sample selection bias related to the fact that we only observe students' risk aversion when they decide to participate to the survey on which our analysis is based. We handle this problem using Heckman's correction and including among the regressors the inverse Mills ratio based on a probit model for the probability of responding to the survey question on which are based our measures of risk aversion.

Sample students can choose among four different fields: Engineering, Sciences (Mathematics, Chemistry, Physics, Pharmacy), Humanities and Social Sciences (Economics and Political Sciences). Multinomial logit estimates show that more risk adverse students are significantly more likely to enrol in Humanities and Engineering than in Social Sciences. They also slightly prefer to enrol in Sciences rather than in Social Sciences. The preference reserved by more risk adverse students to these fields can be interpreted looking at the data on labour market returns and on the probability of academic failure. Humanities and Engineering are the college majors that allow our sample students to minimize respectively the risk of dropping out and the risk faced on the labour market. Students enrolled at Humanities face the lowest risk of academic failure, but the higher risk of unemployment and low returns once entered in the labour market. On the other hand, students attending Engineering have better labour market prospects compared to graduates in all other fields, but are also characterized by a higher probability of dropping out.

To explain which reasons lead students to decide to avoid a kind of risk rather than the other, we interact our measures of risk aversion with a measure of student ability. It emerges that the effect of risk aversion on major choice is heterogeneous: risk adverse students endowed with higher abilities are

[1] Other data-set (for example SHIW, 1995) provides measures of risk attitudes observed in a moment of time far from that in which the educational choice has been undertaken.

more concerned of risks faced on the labour market and more prone to choose majors allowing them to ensure against these types of risks (i.e. Engineering); on the other hand, risk adverse students characterized by lower ability are more likely to choose majors that reduce the risk of dropping out from academic career (i.e. Humanities).

The paper is organized as follows. In section two we describe the two risks students face when they choose the college major. Section three describes the data used in the empirical analysis and offers a number of descriptive statistics. Section four presents multinomial logit estimates. In section five we look for possible motivations of the main results of our analysis. Section six offers some concluding remarks.

2. The Risks of College Major Choice

In order to choose the major to attend at the university, students take into account different risks characterizing educational investments. A particularly relevant role is played by the risk of dropping out from academic career and by risks faced on the labour market. In fact, the individual is not able to assess ex-ante whether he will be successful in accomplishing the educational process, and even once he has obtained a certain qualification, there is uncertainty as regards the prospect of finding a job and on the wage that will be gained.

A number of empirical works show that graduates obtain higher wages and have a better chance of finding a job than non graduates, but there are large differences among different fields of study. Arcidiacono (2004), using US data, shows that large earnings differences exist across majors even after controlling for self-selection according to ability, with returns being particularly high in the Natural Sciences and in Business. Similarly, Grogger and Eide (1995) find that Science majors earn on average 32 percent more than high school graduates, while Humanities majors only earn a 10 percent premium. As far as Italy is concerned, De Paola, Brunello and Scoppa (2010), show that graduating in Hard Sciences (Maths, Sciences and Engineering) yields a 6.9 percent earnings premium with respect to graduating in a Business field, and a 13.3 percent gain with respect to the Humanities. Similar results emerge from Di Pietro and Catillo (2006) and Ballarino and Bratti (2009).

These results seem to hold true also for students graduated at the University of Calabria. To investigate the labour market performance of these graduates we have used data from the ALMALUREA Interuniversity Consortium,[2] which provide information on a number of individual characteristics (such as gender, academic performance, age etc.) and on occupational conditions and

[2] Founded in 1994 by the Statistical Observatory of the University of Bologna and co-financed by the Italian Ministry of Education, the Consortium covers 77% of the Italian graduates from 62 Italian University. It collects and organizes on-line information about graduate students, such as personal information, university grades, course duration, high school education, work experiences, job preferences.

wages. We have based our analysis on students who graduated in 2004 considering their labour market performance three years after graduation. We have estimated a Probit model for the probability of being employed and an Ordered Probit model for the wage gained by employed subjects (students were asked to choose among five different wage categories). Conditional on the observed individual characteristics, we assume that there is no residual correlation between field dummies and the error term, and that the relevant coefficients can be consistently estimated.[3] Results (reported in Table A1 in the Appendix) show that, after controlling for a number of individual characteristics, graduating in Engineering allows the better chances of being employed, while the worst performance is obtained by graduates in Humanities. Ordered Probit estimates show that graduates in Engineering are also more likely to obtain higher wages compared to graduates in all other fields (Sciences, Humanities and Social Sciences).[4]

Nevertheless, fields allowing higher wages and better employment prospects typically coincide with more challenging fields that are characterized by high failure rates. A number of studies show that grading standards vary across fields of study: Sciences and Mathematics are harder than the Social Sciences and Humanities, while Economics behaves more like the Natural Sciences than like the Social Sciences (see Sabot and Wakeman-Linn 1991, Achen and Courant 2009). According to a study conducted by Stinebrickner and Stinebrickner (2010) students entering at college believe that Mathematics and Sciences are the most difficult majors and this belief is strengthened over time.

Grading standards are relevant also because they affect student probability of dropping out from academic career. More challenging fields are characterized by higher failure rates and involve a higher risk of drop out. Montmarquette et al. (2001) consider four different fields (Business, Liberal Arts, Science and Education) and find that the observed probability of success in taking the degree is higher for Education than for other majors, while students enrolled in Science have the lowest probability of success. Similarly, Leppel (2001) studies the impact of major on student persistence within the higher education system, from the first to the second year of college, showing that majors differ in terms of college persistence rates. It emerges that women enrolled in education and health majors are more likely to persist into the second year of college, while those enrolled in business majors are less likely to persist. On the other hand, men have a higher college persistence rate in Business and a lower one in Education.

In order to better understand how the different college majors offered by the University considered in this study differ in terms of grading standards and drop out probabilities, we use data on

[3] Our results are to be considered as suggestive since, even if we control for a number of factors that are related to individual ability and that may influence field choice, there is no guarantee that our assumption is going to be met.

[4] Similar results are obtained also by De Luca, Lombardo and Passarelli (2010), who using the same data we use, estimate a duration model and show that Engineering ensures the highest probability of finding a stable job, while graduates in Humanities have the longest unemployment durations.

the academic performance of 7 cohorts of students enrolled at the University of Calabria from 2001-02 to 2007-08 and estimate a Probit model for the probability of dropping out and an OLS model for the average grade obtained at exams. Controlling for student observed ability and a number of individual characteristics, it emerges that students enrolled in Humanities obtain better grades compared to all other students and show the lowest probability of dropping out. Differences are particularly relevant with respect to students enrolled in Engineering and Sciences (see Appendix).

Therefore, in investigating the relationship between risk aversion and the choice of the college major, we expect that if risk adverse students pay attention to employment perspectives and wages offered on the labour market they are more prone to enrol in Engineering, while if they are concerned about the risk of failing to graduate, then, higher risk aversion should induce them to enrol in Humanities.

3. Data and Descriptive Statistics

Our empirical analysis on the relationship between risk aversion and major choice relies upon individual-level data on a sample of 3661 first-year undergraduate students enrolled in the academic year 2008-2009 at the University of Calabria, a middle-sized public university located in the South of Italy[5].

Since the 2001 reform, the Italian University system is organized around three main levels: First Level Degrees (3 years of legal duration), Second Level Degrees (2 years more) and Ph.D Degrees. When starting their university career, students choose a field and within that field they enrol to a certain First Level Degree course. Our sample students are enrolled in four different fields (Engineering, Sciences, Social Sciences, and Humanities) and on different First Level Degree (FLD) courses within the same field.[6] We focus our attention on the field of study because at field level the Italian University system, with few exceptions, [7] does not restrict enrolment and, as a consequence, the field of study chosen by the students coincides with their preferred field. On the other hand, within the same field, some First Level Degree courses select their students on the basis of past academic performance and students may end up to enrol at a First Level Degree that is different from their preferred one.

Sample students at the moment of their enrolment were invited to participate at an on-line survey asking a number of questions on individual characteristics, family background, previous studies, motivation, expectations etc. The participation to the survey was on voluntary basis (only

[5] The University of Calabria currently has about 33,000 students, who are enrolled in different degrees and at different levels of the Italian University system.
[6] More precisely, Engineering offers 9 FLD, Sciences 13 FLD, , Humanities 12 FLD and Social Sciences 8 FLD.
[7] A *numerus clausus* is imposed for Architecture, Medicine and Veterinary Science. None of these fields is on offer at the University of Calabria.

questionnaires that were completed in all their parts were accepted) and about 70% of freshmen have answered to the questionnaire. Among the survey's questions there was one interviewing students about a hypothetical lottery, in which they could choose how much of 100,000 Euros to invest in a risky asset. More in detail the question posed students with the following hypothetical lottery[8]: "Imagine that you had won 100,000 Euros in a lottery. Almost immediately after you collect the winnings, a reputable bank offers you the following investment opportunity, the conditions of which are as follows: You can invest money. There is the chance to double the invested money. However, it is equally possible that you could lose half of the amount invested. You have the opportunity to invest the full amount, part of the amount or reject the offer. What share of your lottery winnings would you be prepared to invest in this financially risky, yet potentially lucrative investment?" Respondents can indicate an investment amount of either 0, 20,000, 40,000, 80,000, or 100,000 Euros.

Table 1 shows the distribution of individuals by reported levels of willingness to invest in the lottery. About 34% of students refused to invest any amount of money in the proposed investment. About 31% of students decided to invest €20,000, while 25.73% of them have chosen to invest €40,000. Finally, only 5.68% and 3.77% of students have invested respectively €80,000 and €100,000.

Table 1. Risk aversion: Willingness to invest in a risky asset

Investment	*Frequencies*	*Percent*
€100,000	138	3.77
€80,000	208	5.68
€40,000	942	25.73
€20,000	1125	30.73
€0	1248	34.09
	3661	100

We use the answers to the question on the willingness to invest in the risky asset to build two indicators of risk attitudes: *Risk Aversion* taking values from 1 (for students who invest all the amount of the win) to 5 (for students who refuse to invest any money), and a dummy variable *Very Risk Adverse* taking value 1 for those who invest strictly less than €40,000 and zero otherwise.

The measures of risk aversion we have obtained seem quite reliable, since they behave as emerging from a number of recent papers on the subject. In fact, when we analyze the relationship between our measures of risk aversion and a number of individual characteristics we find that females are more risk adverse than males, more skilled individuals tend to be less risk adverse and individuals with a better family background show a lower degree of risk aversion compared to individuals with

[8] The same question is posed by the German Socio-Economic Panel (SOEP, 2004).

worse social and family conditions (see De Paola, 2010).

Table 2 provides some descriptive statistics of the sample of students considered in our analysis. About 59% of sample students are females. There are on average 20 years old. Students come from two different types of high school: Lyceums (about 53%) and Technical and Vocational Schools (about 47%). High school grade ranges from 60 to 100, with a mean of about 86.

Thanks to the richness of our data, we are also able to build an additional indicator of student ability based on students' answers to an entrance examination. In fact, students applying for a place at the University of Calabria were required to participate to an entry test, consisting in multiple choice questions, aimed at assessing the initial levels of knowledge in a number of subjects.[9] We consider student performance at the sections of the test aimed at evaluating maths and language skills (30+30 questions), which were proposed to the whole population of applicants independently from the field of study chosen. The same questions were proposed to all students. On the basis of student performance we build *Entry Test*, given by the percentage of correct answers on the total number of questions at test sections ascertaining mathematics and language competences. The percentage of correct answers at the entry test is on average 48%.

In order to define a single index of individual ability (denoted as *Abilities*), we undertook a principal component analysis summarizing the different measures of ability which we had available (*High School Grade*, *Lyceum* and *Entry Test*). Principal component analysis creates linear combinations of the original variables which capture the greatest variance. We only use the first principal component.

About 34% of the students in the sample are enrolled in Social Sciences, 30% in Sciences, 21% in Humanities and 15% in Engineering.

The survey questions allowed us to have information on a number of family characteristics, such as parents' education and type of occupation. The average number of years of education of parents ranges from 0 to 18, with a mean of 11.53. Most of the fathers work in the public sector (46%) underlining the South Italian labour market structure whereby public employment is particularly attractive and job chances in the private sector are scarce. Among fathers working in the private sector about 7% and 3% are respectively entrepreneurs and self-employed. Unfortunately, we do not have information on student family income. However, we use a question proposed in the on-line survey asking if students have chosen to enrol at the University of Calabria also because of the lower costs involved by this choice[10]. We build the dummy *Poor Economic Conditions* taking value of one for

[9] The entry test took place on the 1st September 2008, before the beginning of the academic year. This test was proposed in relation to a particular project offered by the Regional Government (Regione Calabria), with the financial support of the European Union (through the European Social Fund), aimed firstly at assessing student skills and then at improving them through a number of remedial courses.

[10] Most of students enrolled at the University of Calabria live in the same area where the University is located.

students pointing out to lower costs among the reasons driving their university choice. This variable as a mean value of 0.327.

Table 2. Descriptive statistics for the sample of students

Variables	*Mean*	*Std. Dev.*	*Min*	*Max*	*Obs.*
Risk Aversion	3.857	1.070	1	5	3661
Very Risk Adverse	0.648	0.478	0	1	3661
Social Sciences	0.344	0.475	0	1	3661
Engineering	0.153	0.359	0	1	3661
Humanities	0.207	0.405	0	1	3661
Sciences	0.295	0.455	0	1	3661
Female	0.589	0.492	0	1	3661
Age	19.830	3.110	17.717	63.118	3661
Lyceum	0.535	0.499	0	1	3661
High School Grade	86.399	11.893	60	100	3661
Entry Test	0.486	0.149	0.033	0.95	3661
Abilities	0.000	1.266	-3.470	3.191	3661
Parent's Education	11.534	3.611	0	18	3661
Father in Public Sector	0.460	0.498	0	1	3661
Father Entrepreneur	0.067	0.250	0	1	3661
Father Self-employed	0.031	0.172	0	1	3661
Poor Economic Conditions	0.327	0.469	0	1	3661
Difficult_Relationships_Peers	0.080	0.271	0	1	3661
Difficult_Relationships_Teachers	0.176	0.381	0	1	3661
Internal Locus of Control	0.452	0.498	0	1	3661
Happy	0.630	0.483	0	1	3661
Curious	0.769	0.421	0	1	3661
Worried	0.447	0.497	0	1	3661

We also have information on a number of personality traits such as social behaviour and psychological attitudes. More precisely we have build: two dummy variables, *Difficult_Relationships_Peers* and *Difficult_Relationships_Teachers*, for students who declared that during their educational career had difficult relationships respectively with their peers and with their teachers; these students are respectively about 8% and 18% of the sample; a dummy variable *Internal Locus of Control* for students declaring that results obtained at school reflect their effective value[11], in the sample they represent about the 45%; three dummy variables, *Happy*, *Curious* and *Worried*, describing the feelings aroused by the idea of beginning the new course of study, most of the students in the sample include happiness and curiosity among these feeling, while 45% of them feel also worried.

Choosing another University will imply higher costs since students should move outside their area of residence.

[11] These students recognize that results obtained at school depend primarily from their own behavior and actions and, as a consequence, can be classified as having an *Internal Locus of Control*.

4. Risk Attitudes and College Major Choice: a Multinomial Logit Model

In this section we use a multinomial logit model to analyse whether individual risk attitudes affect the choice of the college major controlling for a large number of individual characteristics.

We start introducing a theoretical framework describing the utility function maximised by the individual (the student in our case) and the behaviour of college major choices with respect to risk aversion and to a vector of other variables. Let $U_{ic} = \beta_c Risk\_Aversion_i + \chi_c X_i + \varepsilon_{ic}$ be the utility that student *i* receives from choosing major *c* among C possible choices, where X_i is a vector of individual characteristics, $Risk\_Aversion_i$ is a variable measuring individual risk, ε_{ic} is an error term.

We want to examine the probability that student *i* enrols in major *c*, assuming that $U_{ic} \succ U_{ik}$ for all $k \neq c$. To apply a multinomial logit model, since there are multiple categories, we have to choose a base category as the comparison group. So we refer to the probability of choosing one outcome category, i.e. *c*, with respect to the probability of choosing the reference category; the ratio between these two categories is often referred as relative risk.

Let Z be a random variable indicating the choice made. If the C disturbances are independent and identically distributed with Weibull distribution $F(\varepsilon_{ic}) = \exp\left(e^{-\varepsilon_{ic}}\right)$, then normalizing $\beta_0 = 0$ and $\chi_0 = 0$:

$$\Pr_{ic} = \Pr(Z_i = c) = \frac{e^{(\beta_c Risk\_Aversion_i + \chi_c X_i)}}{\left(1 + \sum_{K=1}^{C} e^{(\beta_k Risk\_Aversion_i + \chi_k X_i)}\right)}, \text{ for } c = 1,2,....C$$

$$\Pr_{i0} = \Pr(Z_i = 0) = \frac{1}{\left(1 + \sum_{K=1}^{C} e^{(\beta_k Risk\_Aversion_i + \chi_k X_i)}\right)}$$

So we can calculate C relative risk ratios $\Pr_{ic} / \Pr_{i0} = e^{(\beta_c Risk\_Aversion_i + \chi_c X_i)}$, using as base category $Z_i = 0$. Our sample students can choose among four college fields, one of them is the reference field, so we compute three relative risk ratios.

The aim of our analysis is to test if and how student attitude towards risk affects the college major chosen, so the main variable of interest is *Risk Aversion* (or *Very Risk Adverse*). In the vector X_i there are many variables representing individual characteristics typically correlated to both the type of major chosen and the degree of risk aversion. Being able to control for a large number of

individual characteristics including cognitive abilities, personality traits and family background allows us to considerably reduce problems deriving from omitted variables, which may lead to a distortion of the *Risk_Aversion*'s coefficient.

This vector includes: a gender dummy; *Age*; different indicators of individual ability (*High School Grade*, *Lyceum*, *Entry Test* - or alternatively *Abilities*-); a number of personality traits (*Internal Locus of control*; *Difficult Relationships* with *Peers* and with *Teachers*, *Happy*, *Curious* and *Worried);* variables describing family background (*Parents' education, Poor Economic Conditions*, dummies for parents' occupation); dummies for student province of residence.

To handle sample selection related to nonresponse, we include among controls the inverse Mills ratio computed on the basis of a probit model for the probability that students enrolled at the University of Calabria in the academic year 2008-09 participate to the survey on which our variables of interest are based (Heckman, 2002). This model includes among regressors all the variables available for the whole population of enrolled students (gender, age, high school type, high school grade, etc) plus a variable measuring the *Distance* (in kilometres) between the student place of residence and the place where the university is located, since we expect that students living near the university have more information and then are more prone to join the survey. Indeed, from probit estimates it emerges that the probability of participating to the survey is negatively related to *Distance* (the effect is statistically significant at the 1 percent level, *t*-stat=2).

In Table 3 and 4 we report Multinomial Logit estimates, respectively for *Risk Aversion* and *Very Risk Adverse,* considering as reference field Social Sciences and all the coefficients have to be interpreted with respect to this reference major. We decided to choose Social Sciences as base category since this field has intermediate characteristics both in terms of returns on the labour market than in terms of probability of dropping out of university studies and then it allows us to show more clearly the effects of individual risk attitudes on major choice. The coefficients in the tables are expressed in terms of relative risk ratio, that is, as the probability of choosing each major relative to the residual field, so a coefficient of one for a given college major means that increasing the correspondent variable has no impact on choosing that major relative to the residual field whereas a coefficient above one implies a positive impact and a coefficient below one a negative impact.

In the Table 3 we present two sets of results, both controlling for the full set of controls but one using our different measures of ability (*High School Grade*, *Lyceum* and *Entry Test*) and the other considering the broad indicator *Abilities*. In both specifications to correct for sample selection we include among the regressors the inverse Mills ratio. Standard errors are bootstrapped (100 replications).

From both specifications it emerges that more risk adverse students are significantly more likely to choose any other field rather than Social Sciences. For instance, for one unit change increasing in

the variable *Risk Aversion* students are about 25% more likely to choose Humanities as opposed to Social Sciences. As regards student preference for Humanities it may be related to the fact that Humanities is usually perceived as an easy subject and more risk adverse students may prefer to enrol in a field where they think to face a high probability of accomplishing the educational program and obtaining the degree, although it offers less chances on the labour market.

Increasing the difficulty of the college major, students might try to minimize risks faced on the labour market and choose fields which guarantee more employment opportunities; this could explain why they prefer to attend Engineering (about 15%) and Sciences (about 10%) over Social Sciences.

The coefficient on the inverse Mills ratio (not reported) is statistically significant only for Engineering. More precisely, students who are more likely to participate to the survey are less likely to enrol in Engineering compared to Social Sciences.

Table 3. Multinomial Logit Estimates. The choice of college major. Risk indicator: Risk Aversion.

	Engineering	*Sciences*	*Humanities*	*Engineering*	*Sciences*	*Humanities*
Risk_Aversion	1.1501**	1.1002**	1.2459***	1.1598**	1.1109**	1.2564***
	(0.0579)	(0.0380)	(0.0564)	(0.0592)	(0.0465)	(0.0575)
Female	0.1563***	0.9941	4.0201***	0.2031***	1.1393	3.5498***
	(0.0221)	(0.1108)	(0.5246)	(0.0247)	(0.1015)	(0.4402)
Age	0.7604**	0.9265**	1.1137***	0.8138*	0.9495*	1.0509***
	(0.0926)	(0.0300)	(0.0317)	(0.0891)	(0.0254)	(0.0143)
Lyceum	3.1105***	2.1597***	1.2185			
	(0.6334)	(0.2996)	(0.1795)			
High School Grade	1.1011***	1.0392*	0.9415**			
	(0.0310)	(0.0216)	(0.0228)			
Entry Test	1.1023	0.4914*	0.3019**			
	(0.5052)	(0.1873)	(0.1282)			
Abilities				1.4009***	1.1631**	0.9747
				(0.0957)	(0.0594)	(0.0625)
Poor Ec. Conditions	1.4707**	1.1629	1.4645***	1.4290**	1.1201	1.4064***
	(0.1749)	(0.1180)	(0.1550)	(0.1667)	(0.1076)	(0.1480)
Parents' Education	0.9993	0.9878*	0.9883*	1.0025	0.9932	0.9950
	(0.0080)	(0.0063)	(0.0071)	(0.0079)	(0.0067)	(0.0070)
Father Entrepreneur	1.1510	0.5989**	0.5691**	1.1363	0.5891**	0.5461**
	(0.2480)	(0.1214)	(0.1303)	(0.2673)	(0.0984)	(0.1051)
Father Public Sector	1.0194	1.2031**	1.1799*	1.0416	1.2289*	1.2057*
	(0.1176)	(0.1022)	(0.1037)	(0.1251)	(0.1090)	(0.1128)
Father Self Employed	1.0696	0.8977	0.8811	1.0371	0.8575	0.8572
	(0.4018)	(0.2514)	(0.2912)	(0.3212)	(0.2291)	(0.2452)
Diff. Rel. Teachers	0.8814	0.8209*	0.7873*	0.9204	0.8631	0.8402
	(0.1359)	(0.0922)	(0.1140)	(0.1384)	(0.1064)	(0.1222)
Diff. Rel. Peers	1.0023	1.1813	1.0805	0.9823	1.1635	1.0441
	(0.2035)	(0.1668)	(0.1957)	(0.2212)	(0.1804)	(0.2024)
Internal Locus of Control	1.0364	1.0449	1.0633	1.0386	0.9948	0.9114
	(0.1276)	(0.1138)	(0.1411)	(0.1345)	(0.0968)	(0.1057)
Happy	1.0781	1.2020**	1.2113	1.0723	1.2034*	1.2207*
	(0.1374)	(0.1074)	(0.1440)	(0.1505)	(0.1185)	(0.1451)
Curious	0.9440	0.9941	0.9710	0.9288	0.9832	0.9618
	(0.1266)	(0.1143)	(0.1331)	(0.1178)	(0.0980)	(0.1172)
Worried	1.3932**	1.2217**	0.8248*	1.4350**	1.2422**	0.8218**
	(0.1715)	(0.1115)	(0.0861)	(0.1674)	(0.1020)	(0.0758)
Pseudo R-Square	0.0990	0.0990	0.0990	0.0926	0.0926	0.0926
N	3661	3661	3661	3661	3661	3661

Notes. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level. In both specifications we control for dummies for province of residence.

As far as the control variables are concerned, we find that females and older students are more likely to enrol in Humanities. Students with a higher *High School Grade* are more likely to choose Engineering and Sciences compared to Social Sciences and less likely to choose Humanities, while students with a good performance at the entry test prefer Social Sciences compared to Humanities and Sciences. In addition, the relative probability of choosing all majors over Social Sciences increases for those who graduated from a *Lyceum*. The broad indicator *Abilities* (columns 4, 5 and 6 of Table 3) shows that more skilled students prefer to enrol in Engineering and Sciences over Social Sciences.

Regarding family background we find that parents' education, which is a measure of parental ability that is likely to be correlated across generations, negatively affects the probability of choosing Sciences and Humanities over Social Sciences. Students whose father are entrepreneurs are also less likely to choose Sciences and Humanities compared to Social Sciences. Students from poorer families are more likely to choose all majors as opposed to Social Sciences with a statistically significant coefficient for Engineering and Humanities.

*S*tudents choosing more challenging field feel *Worried* by the idea of beginning the new course of study, while students feeling *Happy* are more likely to choose Sciences and Humanities.

Table 4 presents the same estimates discussed above using as indicator of risk aversion the variable *Very Risk Adverse*. Our results remain essentially the same. In fact the coefficient on *Very Risk Adverse* shows that a student who is very risk adverse is about 55% more likely to choose Humanities as opposed to Social Sciences and increasing the difficulty of the college majors he prefers fields with higher chances on the labour market. Control variables produce the same effects discussed above and are not reported in the Table to save space.[12]

Table 4. Multinomial Logit Estimates. The choice of college major. Risk indicator: Very Risk Adverse.

	Engineering	*Sciences*	*Humanities*	*Engineering*	*Sciences*	*Humanities*
Very Risk Adverse	1.2659**	1.1111***	1.5549***	1.283**	1.1330***	1.5825***
	(0.1505)	(0.1393)	(0.1690)	(0.1376)	(0.1120)	(0.1582)
Pseudo R-Square	0.0989	0.0989	0.0989	0.0925	0.0925	0.0925
N	3661	3661	3661	3661	3661	3661

Notes. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level. In both specifications we control for the whole set of controls: Dummies for province of residence, Female, Age, Poor Economic Conditions, Parents' Educations, dummies for Father type of occupation, controls for personality traits and the Inverse Mills Ratio. In the first specification we measure individual ability using High School Grade, Lyceum and Entry Test, in the second specification we measure individual ability using Abilities.

[12] We have also experimented using as alternative measure of risk aversion the percentage of omitted answers at the entry test, as at this test wrong answers were penalised. This measure is strongly correlated to the variable *Risk Aversion* (or alternatively to the dummy *Very Risk Adverse*), the correlation between the two variables is 0.0424, statistically significant at the 1% level – *p*_value 0.008 –). Results obtained are very similar to that reported in Table 3 and in Table 4. However, when using this measure we are not able to handle in a convincing way sample selection problems since we are not able to identify variables that affect the probability of participating at the entry test without affecting major choice.

5. Heterogeneous Effects of Risk Aversion According to Individual Ability

According to their ability risk adverse students may be more concerned about the probability of dropping out from university career or about unemployment or low returns once entering in the labour market. In fact, it could be that students characterized by lower ability are more afraid of being unable to get the degree, while this type of risk is perceived as less relevant by high ability students. To investigate this issue we estimate our model including among explanatory variables an interaction term between risk aversion and student ability.

To measure student ability we use the composite index of individual ability *Abilities*.[13] This variable has mean zero and standard deviation 1.27. Results are reported in Table 5. In the first set of results we use the indicator *Risk Aversion*, while in the second set of estimates we consider *Very Risk Adverse*. The coefficient on risk aversion in these specifications represents the effect of risk aversion on choices made by students characterized by ability equal to the average level. The coefficient on the interaction term *Risk_Aversion*Abilities* turns out to be positive and statistically significant at the 1 percent level for Engineering, not statistically significant for Sciences and negative and significant for Humanities. This implies that the effect of risk aversion on college major choice is heterogeneous according to individual ability. High ability students characterized by a higher degree of risk aversion tend to prefer Engineering. On the other hand, students endowed with high ability are less prone to choose Humanities when their degree of risk aversion increases.

Table 5. Multinomial Logit Estimates. The Impact of Risk Aversion on College Major Choice: Heterogeneity Across Individuals with Different Abilities.

	Engineering	*Sciences*	*Humanities*	*Engineering*	*Sciences*	*Humanities*
Risk Aversion	1.1100**	1.1119**	1.2093***			
	(0. 0590)	(0.0485)	(0.0598)			
Abilities	0.8181	1.0747	1.5949***	1.2524**	1.1087	1.0795
	(0.9079)	(0.1153)	(0.2023)	(0.1120)	(0.0731)	(0.0903)
*Risk Aversion * Abilities*	1.1358***	1.0243	0.8664***			
	(0.0363)	(0.0247)	(0.0271)			
Very Risk Adverse				1.1929*	1.1311***	1.5498***
				(0.1257)	(0.1122)	(0.1567)
*Very Risk Adverse * Abilities*				1.2144*	1.0925	0.8494**
				(0.1131)	(0.0723)	(0.0650)
Pseudo R-Square	0.0983	0.0983	0.0983	0.0940	0.0940	0.0940
N	3661	3661	3661	3661	3661	3661

Notes. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level. In both specifications we control for the whole set of controls.

Results are of easier interpretation when we use as measure of risk aversion the dummy variable *Very Risk Adverse*. As it is possible to see from columns 4, 5 and 6 of Table 5 very risk adverse students

[13] We have also experimented using as measure of student ability the variable *Entry Test* obtaining results similar to those shown in Table 5. We have not done the same with the grade obtained at high school as ability indicator since this measure may be affected by the grading policy adopted by different types of schools.

characterized by average ability are more likely to choose Engineering compared to Social Sciences. This preference becomes stronger when Abilities increase: very risk adverse students with *Abilities* of one standard deviation higher (1.27) than the mean are about 23% (*p*-value=0.000) more likely to choose Engineering compared to Social Sciences.[14] The same holds true for Sciences, but in this case differences between low and high ability students are weaker and not statistically significant.

The heterogeneous effect of risk aversion on the probability of choosing a more challenging major can be seen in Figure 1 where the estimated probability (for an average student) of choosing Engineering compared to Social Sciences is graphed against *Abilities*, respectively, for *Very Risk Adverse* students and for students with a low level of risk aversion. It emerges that the probability of choosing Engineering increases with *Abilities*, but the relationship is much steeper for *Very Risk Adverse* students.

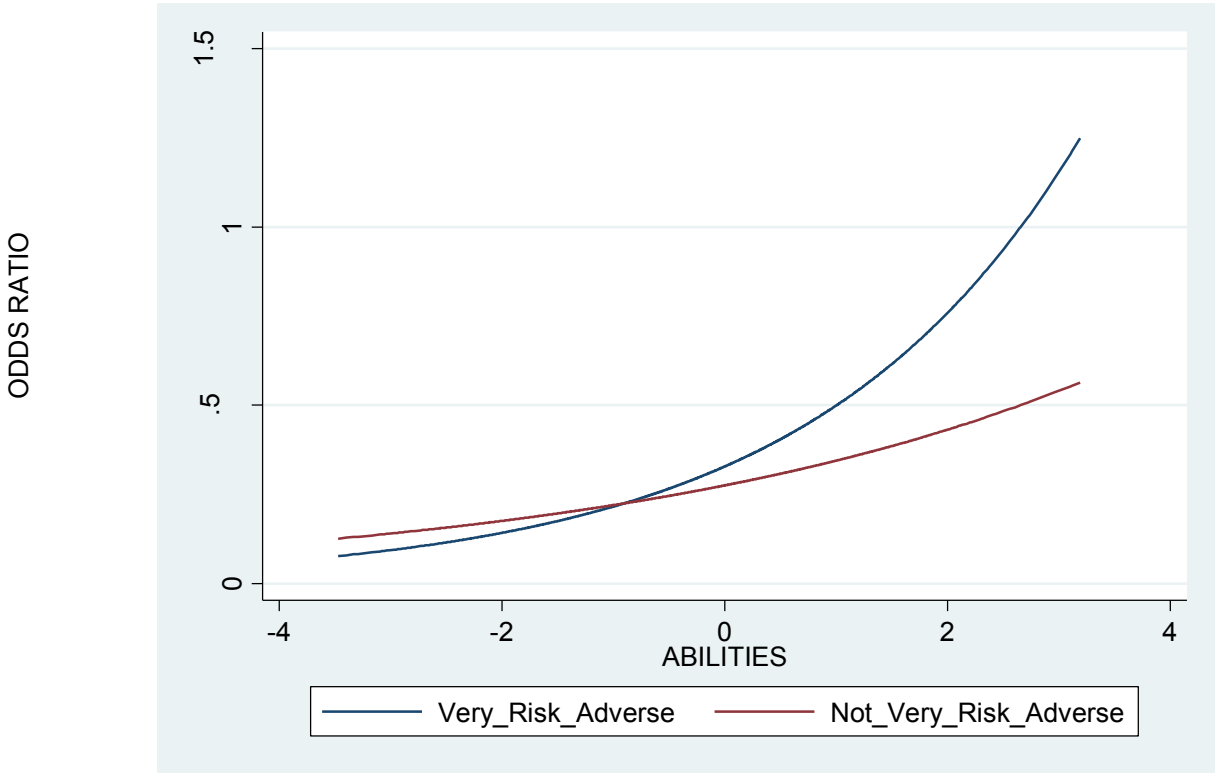

Figure 1. Students probability of choosing Engineering compared to Social Sciences in relation to their Abilities and Risk Aversion

On the other hand, very risk adverse students characterized by high ability are less likely to enrol in Humanities. In Figure 2 the ratio between the estimated probability (for an average student) of

[14] As in multinominal logit models the interaction terms cannot be interpreted straightforwardly, to investigate the effect of *Abilities* on the probability of risk adverse student of choosing each field with respect to the probability of choosing Social Sciences we have used the Stata command *predictnl*.

choosing Humanities and the estimated probability of choosing Social Sciences is graphed against *Abilities*, respectively, for *Very Risk Adverse* students and for students who are not very risk adverse. While for the latter group of students abilities tend to produce a positive impact on the probability of choosing Humanities (the effect is not statistically significant), for *Very Risk Adverse* students a negative relationship emerges: an increase in student abilities substantially reduces the probability of choosing Humanities over Social Sciences. More precisely an increase of one standard deviation in *Abilities* leads a reduction in the probability of a very risk adverse student of choosing Humanities of about 6% .

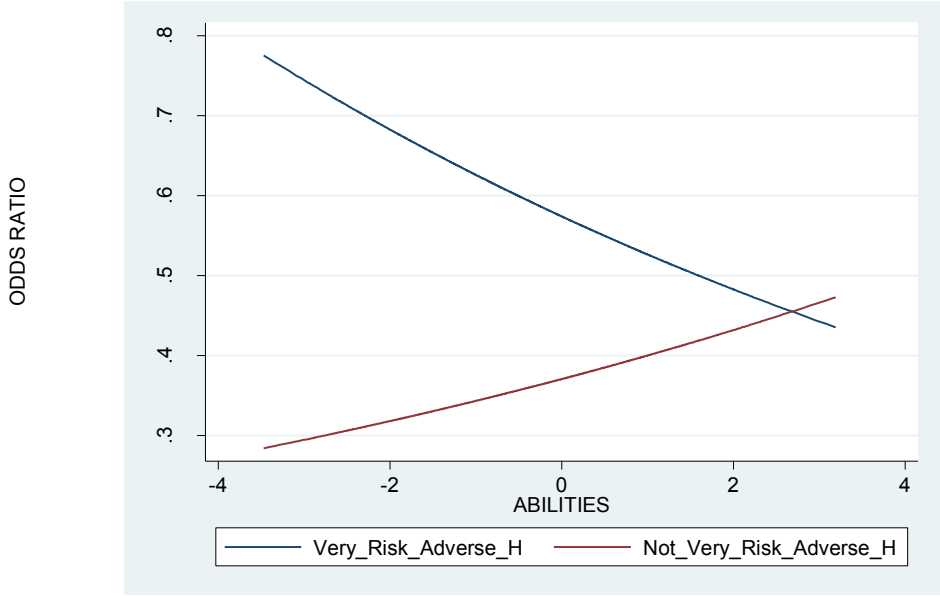

Figure 2. Students probability of choosing Humanities compared to Social Sciences in relation to their Abilities and Risk Aversion

6. Concluding Remarks

Students who decide to continue their educational career up to university face an important decision about the major in which to enrol. There are many elements entering this choice: students from poor families may prefer majors that lead to good employment prospects; more skilled students may choose more challenging majors, etc. An important role in this choice is probably played by individual attitudes towards risk. In fact, when students choose the field of study they face risks deriving from the unknown probability of succeeding in taking the final degree and from the uncertainty about the chance of finding a suitable employment with a satisfactory wage when they enter the labour market.

This paper has been aimed at investigating the effects that risk aversion produces on students' college major choices. We have used a rich data set on a sample of 3661 first-year undergraduate students enrolled to the University of Calabria and have obtained our indicators of risk aversion using student answers to a question on the willingness to invest in a risky asset.

To explain the probability of choosing a particular college field we have estimated a Multinomial Logit model considering as explanatory variables individual risk attitudes, cognitive abilities, a number of personality traits and family characteristics. It emerges that risk aversion is relevant for student major choice. We find that risk adverse students are more likely to enrol in Engineering, Sciences and Humanities than in Social Sciences. Students take into account the probability of obtaining the degree, so the most risk adverse of them are more likely to enrol in the least demanding majors (Humanities) to minimize the risk of dropping out; but students also worry about employment perspectives so afterwards, increasing risk aversion, they choose more challenging fields (Engineering and Sciences) because these fields allow to quickly find a job and to earn a higher wage on the labour market.

To explain what leads risk adverse students to choose whether to minimize the risk of dropping out or the risk faced on the labour market we have introduced among our regressors an interaction term between risk aversion and student ability. We found that risk adverse students characterized by an ability higher than the average level are more concerned about the risk of unemployment, so they are more likely to choose Engineering , while low ability students tend to prefer Humanities because they prefer to minimize the risk of not being able to get the final degree.

Clearly these findings refer to just one university and it is not possible to derive general conclusions. Additional research is necessary to effectively understand the role of individual risk attitudes on educational choices.

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Appendix

In this appendix we provide evidence on the labour market prospects of students graduated from the University of Calabria and on their probability of accomplishing the educational process and getting the degree. Students' labour market performance are analysed using data from ALMALUREA Interuniversity Consortium (a sample of 1205 students graduated in 2004 and interviewed three years after graduation). In Table 1A are reported estimation results for the probability of being employed and for the wage gained by employed subjects. As far as the field Sciences is concerned it is worthwhile to notice that ALMALUREA data does not include students graduating in Pharmacy (this major has been introduced only recently among those offered by the University of Calabria).

Table 1A. Employment probability and wages three years after graduation. Probit and Ordered Probit Estimates.

	Probit	Ordered Probit
	Employed	*Wage*
Female	-0.109***	-0.578***
	(0.028)	(0.102)
Final Grade	0.007***	0.012*
	(0.002)	(0.007)
Engineering	0.146***	0.219*
	(0.035)	(0.133)
Sciences	-0.043	0.239
	(0.044)	(0.157)
Humanities	-0.148***	-0.137
	(0.034)	(0.114)
Observations	1205	783
Pseudo R-squared	0.073	0.095

Notes: In the Probit estimate we control for age and for two variables indicating if the individual has followed after the degree or is following training activities. In the Ordered Probit model we control for age and for the type of employment. Standard errors (corrected for heteroskedasticity) and incorporating clustering grouped by Field are reported in parentheses. The symbols ***, **, * indicate that coefficients are statistically significant at the 1, 5, and 10 percent levels respectively.

In Table 2A we analyse whether students enrolled at the University of Calabria face different degree of risk in terms of drop-out rate according to the major chosen. For our sample students we observe both the drop-out behaviour[15] and grades obtained at exams undertaken during the first two years of their academic career.

Table 2A. Drop-out probability and Grading standards among majors. Probit and OLS estimates.

	Probit	OLS
	Drop-out	*Average Grade at exams*
Female	-0.039***	0.269***
	(0.004)	(0.030)
Lyceum	-0.059***	0.945***
	(0.004)	(0.028)
High_school Grade	-0.005***	0.091***
	(0.000)	(0.001)
Engineering	0.043***	-1.221***
	(0.006)	(0.039)
Sciences	0.035***	-0.257***
	(0.006)	(0.038)
Humanities	-0.019***	2.542***
	(0.005)	(0.032)
Constant		15.220***
		(0.118)
Observations	35,378	29,981
Pseudo R-squared, R-squared	0.0590	0.398

Notes: Dummies for year of enrolment and dummies for province of residence and for year of enrolment are included in all regressions. Standard errors (corrected for heteroskedasticity) and incorporating clustering grouped by Field are reported in parentheses. The symbols ***, **, * indicate that coefficients are statistically significant at the 1, 5, and 10 percent levels respectively.

[15] More precisely for the first five cohorts of students we observe whether students successfully undertook exams during the second year and third year after enrolment and since students who did not pass at least one exam during the second and the third year of their degree course are likely to be students who have decided to drop out, we use this information to measure drop-out behaviour. On the other hand, for the last two cohorts of students (2006-2007 and 2007-2008) we directly observe whether students have decided to drop out from administrative data.