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Risk Aversion and College Subject

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Abstract

We investigate whether individual attitudes toward risk may explain why, though there exist huge differences in the employment returns of graduates by fields of study, the most demanded subjects by the economy are less frequently chosen. The econometric methodology is based on a three step procedure which controls for selectivity bias in the first stage (Heckman, 1979; Lee, 1983; Trost and Lee, 1984). Using a large data set from a survey on the 2001 Italian high school graduates, the main results indicate that students take into account the a priori probability of unsuccess when choosing the college subject. Moreover, students coming from a lower socio-economic background display more risk aversion.

Key words: Risk aversion, College subject, Self-selection.
JEL Classification: C34, J24, I21

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1 Introduction

Are college students irrational? Recent statistics both at the European and the Italian level indicate that, even if there exist huge differences in the employment returns of graduates by fields of study, the most demanded subjects (such as engineering, economics, business and statistics) by the economy are less frequently chosen than humanities and social sciences.

The last annual report of the Bank of Italy (2006) indicates that a large amount of university graduates do not actively participate to the labour market. In 2006 around 30% of Italian graduates between 25 and 34 years old were unemployed, more than double if compared to the EU average. The graduate unemployment rate is widely heterogeneous by college subject: only 15% of Italian engineering graduates were unemployed, while the unemployment rate for humanities and social sciences graduates was more than 45%. Despite that, the labour supply does not seem to adequate rapidly to the labour demand. Indeed, over the last 50 years the distribution of Italian university graduates by fields of study has been almost stable with more than 60% of graduates from Humanities and Social Sciences and only one fourth from the "quantitative" subjects.

In this paper we investigate whether individual attitude toward risk may explain this apparent irrational behaviour and to what extent parents' background (i.e. parents' education and father's occupation) affects individual risk aversion. "Quantitative" fields offer a higher rate of return, but are also more difficult and successful grade achievement is an uncertain outcome. Risk-averse individuals may avoid more

rewarding fields because they expect lower chances of success in such subjects. Recent important contributions (e.g., Altonji, 1993) suggest that individuals from low-income families may be more risk-averse because of liquidity constraints and that the latter could explain their reluctance to attend the more academically demanding disciplines.

Empirical works on risk aversion and schooling remain scarce, although the issue is starting to raise a significant level of interest. Recently, Belzil and Leonardi (2007) and Rochat and Demeulemeester (2001) investigate how risk aversion can explain differences in schooling attainments. In particular, Belzil and Leonardi (2007), formulating the schooling decision process as a dynamic discrete choice model, analyze how grade transition from high school to university varies with risk aversion. In particular, their investigation pays particular attention to the importance of parental human capital and socioeconomic background. Hartog et al. (2007), stressing that the risk of investment in schooling has largely been ignored, mimic the investment decision facing a student and simulate risky earnings profiles in alternative options. They found that individual risk is an important component in the investment in education and that risk attitudes varies by parental background. Differently, Christiansen et al. (2007) and Palacios-Huerta (2003) analyze investment in human capital similarly to the analysis of risky financial assets.

Our findings suggest that students take into account the *a priori* probability of unsuccess when choosing the college subject. Parental human capital and socioeconomic background appear to be important determinants in the college subject choice. Indeed, students coming from a lower socioeconomic background display more risk aversion.

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The rest of the paper proceeds as follows. Section 2 describes the empirical methodology. Data as well as model specification are presented in Section 3. Section 4 provides the empirical results. Section 5 concludes.

2 Empirical Methodology

In this section we concisely describe the empirical methodology utilised in this paper. Our strategy is to model the college subject choice process and to test whether the perceived probability of unsuccess in a major is a relevant determinant in the choice of a major.[1] The estimation procedure is a three-step methodology (e.g., Heckman, 1979; Lee, 1983; Trost and Lee, 1984). In the first step, in order to account for a potential self-selection problem associated with the fact that the probability of unsuccess can depend on the major chosen, we estimate the choice probability of college subject using a multinomial logit.[2] The probability that the individual i, with the set of characteristics X_i choose the college major j is given by the following expression:

$$P_{ij} = \frac{\exp\left(\alpha_j X_i\right)}{\sum_{k=1}^{m} \exp\left(\alpha_j X_i\right)} j = 1...m \tag{1}$$

where the variables X_i are the exogenous pre-treatment characteristics affecting the college major choice. They are in particular related to demographic characteristics (sex, age cohort and region of residence), high school curriculum (type of high school degree and private high school), family background (parents' education and father's occupation), parents' interest in child education and to individual ability (high school

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[1] We define the probability of unsuccess in the sext section

[2] We present the composition of each university group in the following section.

final mark).

Following Lee (1983), we calculate the correction terms obtained from the first step to control for potential self-selection associated with the choice of the college subject:

$$\lambda_{ij} = \frac{\phi\left(\Phi^{-1}\left(\widehat{P}_{ij}\right)\right)}{\widehat{P}_{ij}} \tag{2}$$

where $\widehat{P}_{ij}$ is the estimated probability that an individual i with characteristics X_{ij} chooses the orientation j; ϕ and Φ are respectively the standard normal density function and the standard normal cumulative function. We add these control functions among the regressors of the binary probit model to estimate the determinants of the probability of unsuccess in each major. In the binary probit model, we also consider as explanatory variables the demographic characteristics and the family background. However for identification requirements we exclude two variables (the high school types and parents' interest in child education) and we add the information on whether the individual repeat one year while in high school.

Finally, in the third step we run a conditional fixed effects logit model to estimate the probability a student chooses one of the college major including, as explanatory variable, the expected probability of unsuccess estimated in the second step. The idea is to proxy the risk component associated to the degree subject choice process with the estimated probability of unsuccess and to test whether this variable affects the choice of college major. In this step, the probability a student i chooses major j is given by the following expressions:

$$P_{ij} = \frac{\exp\left(\beta U_{ij} + \delta_j\right)}{\sum_{k=1}^{m}\exp\left(\beta U_{ij} + \delta_j\right)} j = 1...m \tag{3}$$

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where U_{ij} is the predicted probability of unsucess in the j-*th* orientation (j=1,...m) for student i and j are the major fixed effects.[3] We expect a negative impact of variable U_{ij}: an individual should choose the discipline where she has the lowest probability of unsuccess, given all the individual and socio-economic characteristics. A similar specification has been used by Rochat and Demeulemeester (2001).

3 Data description and model specification

Our data originate from the 2004 High School Graduates Survey conducted by the Italian Statistical Institute (ISTAT). The sample approximately represents 5 percent of the population of Italian high school graduates in 2001. The survey collects a wide range of information on high school curriculum, university curriculum, personal characteristics and family background for a representative sample of 18,548 Italian high school graduates. The data allows in particular tracking the whole educational history of each individual, and provides a full description of college performance during the three years after their high school graduation. For the present analysis, the sample of 18,548 records has been reduced by eliminating those who never enrolled at the university. Moreover, following the approach of Becker (2001) and Di Pietro and Cutillo (2007), those individulas who enrolled at university one or more years after high school graduation, are excluded from our final samples. This choice is made in order to ensure comparability in the analysis of unsuccess probability.[4] The final sample comprises

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[3]The fixed effects could be interpreted as the idiosyncratic characteristics of each major.

[4]We also dropped those individuals who had more than one university degree or high school degree at the date of interview. However they consist in a very small group of individuals.

7,168 individuals who enrolled at university after having successfully completed high school. We consider as unsuccessful students either those who dropped out of university or those who changed major during their academic career.

In our empirical analysis we exploit the following information contained in the survey. Individual characteristics include sex, age cohort and region of residence.[5] Indicators of past educational choices and performance are the type of high school degree obtained and the high school final mark.[6] Family background variables include both parents' education and father's occupation (with a breakdown in entrepreneur, professional, other independent, white collar, office worker and blue collar).[7] In addition, we have information on parents' interest in child education represented by a dummy variable equal to 1 if parents' had a major role when their child had to choose the high school type.

The list and the definition of the variables, together with summary statistics, are presented in Table 1. The university groups have been classified into 5 main categories: Engineering (including Architecture), Economics (including Statistics and Business), Political Sciences (including Sociology), Law and a residual group on the basis of the information available from the 2004 High School Graduates Survey. As far as the distribution of college major is concerned, students enrolled at Engineering represent 14.7% of the whole sample, while students enrolled at Economics and Political Sciences

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[5]Age has been grouped into the following categorical variables: born before 1982, born in 1982 and born after 1982. We choose this specification because the huge majority of interviewed students born in 1982.

[6]The high school types are: General (liceo), Vocational, Technical and Other high school. We also add information on whether high school is private or not.

[7]We have one dummy each for the level of education attained by the individual's father and mother (less than college=0, college or more=1).

constitute respectively 16% and 13%. With regard to their academic curriculum up to high school graduation, half of individuals graduated from a general high school (liceo), only 5% come from vocational high school and a very small fraction of individuals attended a private high school. Concerning the family background, our data show that 17% of individuals entering university have a father holding university degree and about 15% have a mother holding the same level of education. Only 6-7% of students comes from an high socio-economic group (i.e. those individuals with a father either entrepreneur, professional or manager), while about a quarter have a father blue collar. Coming to the variable we are more directly interested, descriptive statistics show that the average unsuccess rate for the sample considered is about 22%.

4 Results

This section provides the results from the three step model discussed in section 2. In the first subsection we discuss the multinomial logit results (first step) and the binary probit models estimates (second step), while subsection 4.2 presents the results of the conditional logit estimates where we test for the effect of the estimated probability of unsuccess on the college subject choice controlling for parental human capital and socioeconomic background.

4.1 Main results

Table 1 presents the results of the first step of the empirical procedure (multinomial logit for the determinants of college subject choice). All the coefficients must be in-

terpreted with respect to the "residual" major. Males are significantly more likely to choose Engineering and Economics rather than the "residual" group. This is also true for individuals with a higher high school final mark and graduating from either a General or a Technical high school. The latter result indicates that the type of curriculum followed while in high school influences the choice orientation. Regarding the socio-economic background, only father's occupation exhibits a high explanatory power: having a father holding an elite occupation (as entrepreneur, professional, white collar) influences positively the decision to enrol at Economics rather than the residual group. These effects seem to be consistent with the role/models approach developed by development psychologists, but also with the results obtained in the main literature on the impact of family background on educational choices (Haveman and Wolfe 1995; Figlio, 2000; Checchi and Flabbi, 2005; Dustmann 2004).

Table 2 reports the results of the probit models estimating the probabilities of unsuccess in each of the five college majors, after a correction for the potential selection bias. Some variables are significant in Engineering and Economics majors only. This is the case for the high school type. Graduating from a private high school increases the probability of unsuccess in Economics and Engeneering. This result suggests the higher quality of education provided by public school as it has been found by other empirical works applied to the Italian context (Cappellari 2004, Checchi and Bertola, 2002). Females and individuals with higher high school final mark are less likely to drop-out in each college major.

Table 3 reports the results of the conditional fixed logit model where we test for

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the effect of the estimated probability of unsuccess on the college subject choice. Our findings show that individuals take into account the probability of unsuccess when choosing college subject. Our estimates control for fixed effects at subject degree level. These effects could be interpreted as all the characteristics related to each fields of studies, such as the length of study or the economic returns (the wage at entry-level, the employment probability).

The regression coefficient associated to the (*a priori*) probability of unsuccess on the college major is negative and statistically significant. This suggest that prospective students tend to choose disciplines where they have the lowest probabilities of unsuccess given their socio-demographic and personal characteristics and controlling for the idiosyncratic characteristics of each college major. Hence individuals pay attention not only to expected economic benefits and to the length of studies but also to the *a priori* probability of succeeding in the chosen college major.

4.2   The role of family background

As documented in many empirical works (Cappellari 2004; Checchi and Flabbi, 2005; Dustmann 2004, Leonardi and Belzil 2007), there is a strong and positive relationship between parental background and their children's probability to be successful at university. There can be alternative explanations to this situation. One is referred to preferences, as long as more educated parents give higher value to education and encourage their children to continue with higher education. Secondly parental background might influence children studying abilities, and finally both parental education

and occupation are positively correlated with incomes suggesting larger financial endowments of families from the higher socio-economic groups which can afford to support their children during university.

Bearing all these considerations in mind, we now try to take family background into account as a potential source of risk-averse behaviour by analysing the behaviour of both the most and least privileged students, in order to check whether the former (the latter) are indeed less (more) responsive to their expected probability of unsuccess when choosing a discipline.

As it appears from table 4, we find evidence that the poorest students (i.e. those individuals with a father blue collar or office worker) are sensitive to the expected probability of unsuccess, while this is not the case for students with father professional or entrepreneur. Our findings indicate that students coming from low-income families take into account the probability of unsuccess when choosing a college subject and are more risk adverse in the major choice than their counterparts from higher socio-economic groups. This is more evident when we consider the regression results separated by parental education: individuals having both parents with university degree are not influenced by the expected probability of unsuccess, whereas those with both parents with lower educational levels are more responsive to the expected chances of success when choosing a major. All in all, our findings suggest that student parental human capital and socioeconomic background (i.e. father's occupation) play an important role in affecting her choice of college subject. Our findings are in line with those of Leonardi and Belzil (2007) with respect to the role of parental human capital as a

relevant determinant of schooling decisions. In their analysis they investigate if and to what extent risk aversion can explain differences in schooling attainments, finding that differences in attitudes toward risk do not appear to be an important determinant of transition from high school to university. Complementary to their results, we show that individual attitude toward risk aversion may be a relevant determinant for the choice of college major.

Our analysis supports Altonji (1993) theoretical implications and Rochat and Demeulemeester (2001) empirical results, namely the fact that students do take into account the *a priori* chances of unsuccess and that less advantaged students give a heavier weight to the risk component.

5 Conclusions

The choice of college major is affected by many elements, such as individual ability and preferences, family socioeconomic background, gender and expected economic returns, as documented in this analysis and in the previous literature on this topic. However it is also important to note that choosing a major is a decision made under uncertainty. Indeed, successful grade achievement at college is an uncertain outcome.

This paper investigates if (and to what extent) individual risk-aversion may explain the choice of the college major, besides other factors. Using individual data from a survey on Italian high school graduates enrolled at university, we find that individual risk-aversion is related to the choice of college subject. Risk-averse students avoid more difficult fields because they expect lower chances of success in such subjects. In par-

ticular, we show that less wealthy students give a heavier weight to risk, while richest students are not sensitive to the expected chance of unsuccess. A direct policy implication of our results is that a wise state intervention has to limit as much as possible the impact of the socio-economic background on the discipline choice process at the individual level. This could be reached designing appropriate corrective measures (such as scholarships or facilitated loans) targeting the students from poorer background.

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Table 1: Summary Statistics

Variables	Obs	Mean	Std.Dev.	Min	Max
Unsuccess rate	7,168	0.220	0.415	0	1
College major					
Engineering	7,168	0.148	0.355	0	1
Economics	7,168	0.162	0.368	0	1
Political Sciences	7,156	0.134	0.341	0	1
Law	7,168	0.108	0.310	0	1
Other	7,168	0.449	0.497	0	1
High School types					
Vocational	7,168	0.053	0.223	0	1
Technical	7,168	0.329	0.470	0	1
General	7,168	0.509	0.499	0	1
Other	7,168	0.110	0.313	0	1
Private	7,168	0.054	0.225	0	1
Parents' education					
Father with a college	7,168	0.172	0.377	0	1
Mother with a college	7,168	0.144	0.351	0	1
Father's education					
Entrepreneur	7,168	0.074	0.262	0	1
Professional	7,168	0.076	0.265	0	1
Independent	7,168	0.144	0.352	0	1
Manager	7,168	0.067	0.249	0	1
Office worker	7,168	0.405	0.491	0	1
Blue collar	7,168	0.234	0.423	0	1
Age at the date of interview					
Born before 1982	7,168	0.151	0.358	0	1
Born in 1982	7,168	0.757	0.429	0	1
Born after 1982	7,168	0.092	0.289	0	1
Other Personal Characteristics					
Female	7,168	0.545	0.498	0	1
High school final mark	7168	2.564	1.121	1	4
Repetition	7,168	0.154	0.361	0	1
Parents'interest in child education	7,168	0.443	0.497	0	1

Table 2: Determinants of college subject: MNL estimates

	(1)	(2)	(3)	(4)
	Engineering	Economics	Political Science	Law
Gender	-2.511	-0.469	-0.079	-0.133
	[0.152]***	[0.106]***	[0.117]	[0.124]
Born in 1982	0.654	0.177	0.029	-0.037
	[0.184]***	[0.148]	[0.143]	[0.166]
Born after 1982	0.947	0.117	-0.22	0.077
	[0.297]***	[0.257]	[0.256]	[0.263]
High school mark	0.664	0.236	0.016	0.108
	[0.057]***	[0.048]***	[0.049]	[0.055]**
General High School (Liceo)	2.964	2.298	0.321	1.691
	[0.433]***	[0.371]***	[0.163]**	[0.268]***
Vocational High School	1.57	2.462	0.1	0.928
	[0.473]***	[0.378]***	[0.193]	[0.313]***
Technical High School	3.024	3.125	0.187	1.661
	[0.436]***	[0.371]***	[0.174]	[0.281]***
Private High School	-0.242	-0.051	0.299	0.019
	[0.294]	[0.219]	[0.216]	[0.251]
Parent's interest in child education	-0.039	0.137	0.139	0.036
	[0.120]	[0.102]	[0.105]	[0.119]
Father's education	-0.041	0.031	-0.006	0.12
	[0.187]	[0.169]	[0.192]	[0.176]
Mother's education	-0.067	-0.027	-0.086	-0.122
	[0.184]	[0.169]	[0.176]	[0.176]
Entrepreneur	-0.148	0.486	0.705	0.438
	[0.274]	[0.191]**	[0.202]***	[0.250]*
Professional	0.208	0.457	0.355	0.653
	[0.259]	[0.217]**	[0.238]	[0.230]***
Other independent	0.053	0.037	0.17	-0.066
	[0.192]	[0.167]	[0.167]	[0.206]
White Collar	0.119	0.741	0.315	0.608
	[0.264]	[0.228]***	[0.241]	[0.258]**
Office Worker	-0.193	0.088	0.182	0.037
	[0.159]	[0.136]	[0.140]	[0.163]
Observations	6,794	6,794	6,794	6,794

Notes: Robust standard errors are reported in parentheses. ***, ** and * indicate coefficient significant at the 1%, 5% and 10% levels, respectively. All regressions include regional dummies. The base category for fathers occupation is: blue collar. The base category for the age dummy is: born before 1982 and finally for high school type is: other high schools. All the results of the multinomial logit model should be interpreted with respect to college major other. Father's and mother's education are dummies=1 if highest education attained is college or more. Entrepreneur, professional, other independent, white collar and office worker are referred to father's occupation.

Table 3: Determinants of unsuccess by college subject

	(1)	(2)	(3)	(4)	(5)
	Engineering	Economics	Political Science	Law	Other
Gender	-1.571	-0.105	-0.418	-0.272	-0.214
	[0.402]***	[0.117]	[0.182]**	[0.154]*	[0.100]**
Born in 1982	0.384	-0.345	-0.38	-0.471	-0.21
	[0.400]	[0.326]	[0.316]	[0.396]	[0.147]
Born after 1982	0.76	-0.34	-0.66	-0.34	-0.301
	[0.558]	[0.408]	[0.470]	[0.466]	[0.203]
High school mark	-0.086	-0.225	-0.145	-0.133	-0.157
	[0.109]	[0.053]***	[0.069]**	[0.072]*	[0.034]***
Repetition during high school	0.387	0.063	-0.052	-0.189	-0.23
	[0.373]	[0.337]	[0.320]	[0.389]	[0.155]
Private high school	0.583	0.73	0.04	-0.227	0.088
	[0.295]**	[0.295]**	[0.269]	[0.341]	[0.141]
Father's education	0.021	-0.092	0.297	-0.045	-0.147
	[0.278]	[0.200]	[0.210]	[0.238]	[0.112]
Mother's education	-0.326	-0.057	-0.38	-0.38	0.086
	[0.204]	[0.212]	[0.203]*	[0.265]	[0.122]
Entrepreneur	-0.421	-0.215	-0.616	-0.133	0.092
	[0.277]	[0.205]	[0.290]**	[0.285]	[0.151]
Professional	-0.736	-0.243	-0.318	-0.062	0.311
	[0.291]**	[0.277]	[0.255]	[0.349]	[0.158]**
Other independent	-0.153	0.176	-0.14	0.043	-0.03
	[0.191]	[0.182]	[0.205]	[0.241]	[0.105]
White Collar	-0.684	-0.56	0.029	-0.225	0.191
	[0.376]*	[0.245]**	[0.294]	[0.342]	[0.164]
Office Worker	-0.138	0.006	-0.148	-0.271	0.01
	[0.160]	[0.154]	[0.175]	[0.211]	[0.087]
Correction term	1.24	-0.687	-0.423	1.169	-0.19
	[0.359]***	[0.275]**	[0.694]	[0.478]**	[0.187]
Observations	780	998	991	600	3,399

Notes: Robust standard errors are reported in parentheses. ***, ** and * indicate coefficient significant at the 1%, 5% and 10% levels, respectively. All regressions include regional dummies. The base category for fathers occupation is: blue collar. The base category for the age dummy is: born before 1982 and finally for high school type is: other high schools. Father's and mother's education are dummies=1 if highest education attained is college or more. Entrepreneur, professional, other independent, white collar and office worker are referred to father's occupation.

Table 4: Effect of expected unsuccess rate by father's occupation: conditional logit estimates

	(1) Full sample	(2) Entrepreneur	(3) Professional	(4) Other independent	(5) White Collar	(6) Office worker	(7) Blue Collar
Unsuccess probability	-0.838	0.144	-0.335	0.012	-0.507	-1.149	-0.836
	[0.131]***	[0.476]	[0.498]	[0.364]	[0.583]	[0.231]***	[0.275]***
Econ FE	0.246	0.929	0.388	0.266	0.379	0.065	0.132
	[0.048]***	[0.174]***	[0.170]**	[0.121]**	[0.190]**	[0.076]	[0.095]
Engin FE	0.24	0.839	0.463	0.279	0.377	0.171	0.025
	[0.047]***	[0.191]***	[0.169]***	[0.122]**	[0.199]*	[0.079]**	[0.096]
Pol. Sc. FE	-0.244	0.026	0.155	-0.356	-0.004	-0.352	-0.363
	[0.055]***	[0.210]	[0.182]	[0.147]**	[0.207]	[0.087]***	[0.111]***
Other FE	1.467	1.802	1.338	1.526	1.367	1.369	1.484
	[0.039]***	[0.161]***	[0.158]***	[0.105]***	[0.173]***	[0.063]***	[0.075]***
Observations	6,717	582	483	1,059	428	2,433	1,732

Notes: Robust standard errors are reported in parentheses. ***, ** and * indicate coefficient significant at the 1%, 5% and 10% levels, respectively. Standard errors are bootstrapped using 1,000 replications. Entrepreneur, professional, other independent, white collar, office worker and blue collar are referred to father's occupation.

Table 5: Effect of expected unsuccess rate by parent's education: conditional logit estimates

Unsuccess probability	(1) Both parents less than College	(2) At least one parents with College	(3) Both parents with College
	-0.79	-0.605	-0.39
	[0.149]***	[0.302]**	[0.561]
Econ FE	0.264	0.171	0.295
	[0.055]***	[0.104]	[0.182]
Engin FE	0.255	0.175	0.177
	[0.056]***	[0.108]	[0.187]
Pol.Sc. FE	-0.284	-0.103	-0.015
	[0.064]***	[0.114]	[0.198]
Other FE	1.497	1.326	1.354
	[0.044]***	[0.085]***	[0.160]***
Observations	27,191	6,388	2,244

Notes: Robust standard errors are reported in parentheses. ***, ** and * indicate coefficient significant at the 1%, 5% and 10% levels, respectively. Standard errors are bootstrapped using 1,000 replications.