College choice and academic performance[†]

Daniele Checchi
(University of Milano-Bicocca)
Francesco Franzoni
(MIT and Università Bocconi)
Andrea Ichino
(Istituto Universitario Europeo, IGIER and CEPR)
Aldo Rustichini
(CeNTER, Tilburg University)

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Abstract

We present a formal model predicting that families invest more in their children the higher are the family income and the (expectation on) child talent. Once the investment is undertaken, a student performs better the higher is the family income, because of networking and/or cultural inheritance reasons. When the family is liquidity constrained and/or the child is insufficiently endowed, we expect a zero investment in education.
Our empirical analysis does not contradict this theoretical model. Using a representative sample of the Italian population, we observe that family income does not prevent enrolment to the university, whereas cultural family background is more relevant, especially because it shapes the secondary education choices. Using administrative data on students enrolled in private and public universities, we show that family income become relevant whenever the amount of money invested raises significantly; even a poor family invests, provided that her child is sufficiently endowed. Finally, students' performance is positively correlated with family income, and we take this evidence as supporting the idea of family networking: students from richer families tend to go quicker because they have better prospects when they exit the university.
On the whole, we claim that liquidity constraints do not play a significant role in preventing the enrolment in Italian public universities, whereas cultural constraints do. Students from better educated families probably receive stronger pressure to complete their academic career, and this leads them to perform better and not to drop out during initial years.

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2. A formal model of educational investment

We introduce a simple model to study the interaction between the investment in children education by parents and schooling performance by children. The model is applicable to the later stages of higher education, where individual students bear some responsibility in their performance. We cast the choice in a single period framework, but extensions to overlapping generation contexts are straightforward. Consider an altruistic parent that has to allocate part of his current income between consumption and investment in her child education. Raising the investment reduces her own consumption but improve the income opportunity of her child. The parent choice solves the following problem

$$\max_S U(C, Y_c) = \max_S U(Y_f - S, Y_c), U_i' > 0, U_{ii}'' < 0, i = C, Y_c; U_{ij}'' > 0, i \neq j \tag{1}$$

where U is the parent utility, C is parent consumption, Y_f is the family income, S is the amount invested to finance the child education (i.e. payment of admission fees, purchase of textbook, etc.), Y_c is the child future income. The income of the child depends on academic performance P achieved during university career and (possibly) on family networking, here proxied by the effect of family income: children from richer families have access to better jobs, both in terms of earnings and quality of the job.[1] The academic performance can be thought as the amount of human capital obtained during the university career, which include both elements of quantity (how many courses attended) and quality (which marks obtained in passing the exams).

$$Y_c = Y(P, Y_f), Y_P' > 0, Y_{Y_f}' \geq 0, Y_{ii}'' < 0, i = P, Y_c; Y_{ij}'' > 0, i \neq j \tag{2}$$

The academic performance depends on several factors. First, it depends on student talent A that is assumed to be perfectly observable at the moment of undertaking the decision to proceed to tertiary education: other things held constant, abler students exhibit better performance. But performance is also dependent on student effort E, which is optimally chosen by the student her-self, taking into account the disutility of effort and the benefit of greater future earnings. The presence of S capture the positive effect of the resources invested in education, whereas Y_f has to be considered if one wants to take into account the family background (where family income proxies family education).

$$P = P(A, E, S, Y_f) \tag{3}$$
$$P_A' > 0, \quad P_E' > 0, \quad P_S' > 0, \quad P_{Y_f}' \geq 0, \quad P_{ii}'' < 0, \quad i = A, E, S, Y_f; \quad P_{ij}'' > 0, \quad i \neq j$$

Each student maximises her own utility defined over effort E and future income Y_c subject to the constraint described by equation (3)

$$\max_E V(E, Y_c) = \max_E V(E, Y_c(P, Y_f)) = \max_E V[E, Y_c(P(A, E, S, Y_f), Y_f)] \tag{4}$$
$$V_E' < 0, \quad V_Y' > 0, \quad V_{EE}'' \geq 0, \quad V_{YY}'' < 0, \quad V_{EY}'' < 0$$

The sequence of choices in the present model resembles a Stackelberg game, where the parent acts as a leader, choosing the optimal amount of investment S^* under the rational expectation of children behaviour in determining the optimal amount of effort E^*. Notice that when the parent makes her choice, her income is taken as predetermined, so that she links her investment on the talent of the child only. Once this choice has been undertaken (that is, when a university has been chosen), the child take the parent investment as predetermined, and in her turn she bases the optimal amount of effort onto the level of talent. To study the sequence of optimal choices we have to start from the end, and we move to the solution of the problem described by equation (4).

[1] See for example Montgomery 1991.

Since we want to take into account the possibility of imperfections in financial markets, we could proceed in two ways: either we introduce a (possibly binding) constraint on the optimal amount of investment S^*, or we consider that students from poorer families are subject to stronger pressure to complete their curricula. In this case this constraint takes the following form

$$P \geq \overline{P}\left(Y_f\right), \overline{P}' < 0 \tag{5}$$

where $\overline{P}$ represent the minimum level of performance a student has to achieve in order to fulfil parents' expectations. Obviously, the richer is the family, the lighter is this type of pressure.[2] If we solve problem (4) under the constraint represented by equation (3) and (5) we obtain

$$\begin{cases} \hat{E} = \hat{E}\left(A, S, Y_f\right) if\ P\left(A, \hat{E}, S, Y_f\right) \geq \overline{P}\left(Y_f\right) \\ \tilde{E} = P^{-1}\left(\overline{P}\left(Y_f\right)\right) if\ P\left(A, \hat{E}, S, Y_f\right) < \overline{P}\left(Y_f\right) \end{cases} \tag{6}$$

The signs of the partial derivatives can be studied using the implicit function theorem. For example, it is possible to show that

$$\frac{\partial E^*}{\partial A} > 0 \qquad if \qquad V''_{EY} P'_A + V'_Y P''_{EA} > -P'_E \left(V''_{YY} + V'_Y \frac{Y''_{PP}}{Y'_P} \right)$$

Thus in general it is impossible to sign these derivatives with certainty, unless choosing specific functional forms. Equation (6) can be re-expressed in a more compact form as

$$E^* = \max\left[\hat{E}, \tilde{E}\right] = E^*\left(A, S, Y_f\right) \tag{7}$$

Given the fact that students' effort is unobservable, if we reinsert equation (7) into equation (3) we obtain a version that can be tested on the data

$$P^* = P^*\left(A, E^*, S, Y_f\right) = P^*\left(A, S, Y_f\right) \tag{8}$$

Equation (7) can be taken as the reaction function of the follower (the child), and is taken into full account by the leader (the parent), when choosing the optimal amount of investment in education

$$\max_S U\left[Y_f - S, Y\left(P^*\left(A, S, Y_f\right), Y_f\right)\right] \tag{9}$$

Her optimal choice is therefore given by

$$S^* = S^*\left(A, Y_f\right) \tag{10}$$

A model example

In order to see how the present model works, let us consider specific functional forms. We express equation (3) as

[2] It is worth recalling that in Italy student grants (*assegno di studio*) and fee exemption are conditional on a similar requirement (a minimum of passed exams per year and a minimum in the average marks obtained).

$$P = A^{\alpha} S^{\sigma} E^{\varepsilon} Y_f^{\beta} \tag{11}$$

where β measures the intensity of cultural transmission within the family (or the "genetic" effect, if one wants to believe in it). Notice that this formulation considers ability, educational resources and family background as partial substitutes. Equation (2) is re-expressed as

$$Y_c = \pi P Y_f^{\theta} = \pi A^{\alpha} S^{\sigma} E^{\varepsilon} Y_f^{\beta+\theta} \tag{12}$$

where θ measures the intensity of the networking effect. Taking a linear utility function for the child yields

$$\max_E V(E, Y_c) = \max_E Y_c - \eta E = \max_E \pi A^{\alpha} S^{\sigma} E^{\varepsilon} Y_f^{\beta+\theta} - \eta E \tag{13}$$

under the following constraint

$$P \geq \overline{P}(Y_f) = Y_f^{-\delta} \tag{14}$$

Solving the problem (13) yields the following result

$$E^* = \max\left[\hat{E}, \tilde{E}\right] = \max\left[\left(\frac{\pi\varepsilon}{\eta} A^{\alpha} S^{\sigma} Y_f^{\beta+\theta}\right)^{\frac{1}{1-\varepsilon}}, \left(A^{-\alpha} S^{-\sigma} Y_f^{-\delta-\beta}\right)^{\frac{1}{\varepsilon}}\right] = E^*\underset{+\ +\ \pm}{\left(A, S, Y_f\right)} \tag{15}$$

By equating $\hat{E}$ and $\tilde{E}$ we obtain the family income threshold $\hat{Y}_f$ above which the performance constraint is not any more binding

$$\hat{Y}_f = \left(\frac{\eta}{\pi\varepsilon A^{\alpha} S^{\sigma}}\right)^{\frac{1}{\beta+\theta\varepsilon+\delta(1-\varepsilon)}} = \hat{Y}_f\underset{-\ -}{\left(A, S\right)} \tag{16}$$

This threshold becomes lower the higher is the student talent and the investment in student ability, which is to be determined at the first stage of the model. By replacing equation (15) in equation (11), we obtain an observable behaviour

$$P = \begin{cases} \left(A^{\alpha} S^{\sigma} Y_f^{\beta+\theta\varepsilon}\left(\frac{\pi\varepsilon}{\eta}\right)^{\varepsilon}\right)^{\frac{1}{1-\varepsilon}} & \text{if} \quad Y_f \geq \hat{Y}_f \\ Y_f^{-\delta} & \text{if} \quad Y_f \leq \hat{Y}_f \end{cases} \tag{17}$$

which can be represented in figure 1. Moving now to the parent choice, we make use of a Cobb-Douglas utility function

$$\max_S U(C, Y_c) = \max_S (Y_f - S)^{\omega} (Y_c)^{1-\omega} \tag{18}$$

When the performance constraint is binding $\left(Y_f \leq \hat{Y}_f\right)$, we get

$$\arg\max_{S}\left(Y_f - S\right)^{\omega}\left(\pi Y_f^{-\delta}Y_f^{\theta}\right)^{1-\omega} = \tilde{S} = 0 \tag{19}$$

whereas when it is not binding $\left(Y_f \geq \hat{Y}_f\right)$ we obtain

$$\arg\max_{S}\left(Y_f - S\right)^{\omega}\left(\pi\left(A^{\alpha}S^{\sigma}Y_f^{\beta+\theta\varepsilon}\left(\frac{\pi\varepsilon}{\eta}\right)^{\varepsilon}\right)^{\frac{1}{1-\varepsilon}}Y_f^{\theta}\right)^{1-\omega} = \hat{S} = \frac{\sigma(1-\omega)}{(1-\varepsilon)\omega+\sigma(1-\omega)}Y_f = \Omega Y_f \tag{20}$$

The optimal amount of investment in child education is therefore zero if the family income is lower than a given threshold and/or the student talent is sufficiently low; otherwise it is a constant fraction of family income. By taking into account that the income threshold is conditional upon the optimal amount of education, if we replace equation (20) into equation (16) we obtain

$$\hat{Y}_f = \left(\frac{\eta}{\pi\varepsilon A^{\alpha}\Omega^{\sigma}}\right)^{\frac{1}{\beta+\theta\varepsilon+\delta(1-\varepsilon)+\sigma}} \tag{21}$$

This result tells us that as long as a student is sufficiently endowed in terms of talent, her family will always invest a fraction of income in her education. Otherwise, they will not invest any amount because the student performance will be insufficient to overcome the performance constraint. This situation is depicted in figure 2. Notice that the optimal amount of education obtained in equation (20) is independent of student ability. This is strictly due to the specific technology assumed for student performance; however if one takes into account that the income threshold is negatively related to student talent by means of equation (21), the final result confirms the general formulation indicated in equation (10).

Notice that when we replace the results of equation (19) into equation (17) we do not observe university performance for students insufficiently endowed with talent, because their parents anticipate that they will be unable to over-perform the threshold, and consequently do not invest on them (i.e. they to not pay for their enrolment to the university). Thus our model offers two testable predictions:
i) families invest more resources in the education of their children the higher is their income, provided that their children are sufficiently endowed with talent;
ii) children perform better at the university the higher are their talent, the quality/quantity of resources invested in their education and their family income (for cultural inheritance and/or networking reasons).
These predictions are not rejected by our empirical analysis, where we now move.

3. The college choice

We can study the choice of higher education as a sequential process, characterised by at least three steps:
i) enrolling or not the university;
ii) the choice of the university faculty;
iii) the choice between private of public universities, when available.

We do not have explicit information on the people that did not enrol the university. However we can resort to a representative sample of the Italian population provided by the Survey on Household Incomes and Wealth (SHIW) conducted biannually by the Bank of Italy. Using the most recent wave available (referred to 1995) we can trace out families with children aged between 19 and 26, among

which some are enrolled at the university. Studying the differences between the two sub-samples, we are able to identify some conditioning variables in the college choice.

The 1995 survey contains information regarding 23924 individuals and 8135 families. 4907 families have cohabiting children, whereas we do not have information about children that live elsewhere. Our analysis will be biased whenever the individuals that left cohabitation are significantly different from remaining ones with respect to the process under analysis. However we know from other sources that Italy is characterised by late leaving of family cohabitation,[3] due to high costs of settlements and absence of unemployment benefits. Looking at our data, we can infer information by looking at family composition. In a constant population with children not leaving family cohabitation we should observe a constant number of children at any (average) age of children themselves. Under this assumption when we record a sharp decline, we can take it as evidence of the (average) family leaving age. By observing figure 3, we notice that this sharp decline occurs in our data set around an average age of children of 29. Therefore we feel justified in restricting our analysis to families with children in an age comprised between 19 and 26, extremes included, and we expect a reduced bias in the sample of these children.

We have 2022 families that include 2748 individuals aged 19-26, 907 of which are recorded as "student" and have completed a secondary school, and can plausibly be taken as university students; among the remaining 1841 youngsters, 1041 did not achieve a secondary school degree, and therefore have already dropped out the educational system. Thus we are left with 1707 people that potentially could enrol the university (they have the right educational credentials), but only a fraction (corresponding to 53.1%) actually did it. In addition to demographic variables (age, gender, number of siblings, region of residence), we know the type of attained secondary school (but unfortunately not the final marks obtained at exit), and we also have some information on the family background (education and occupation of both parents, family income). Table 1 reports the maximum likelihood probit estimates of the relative contribution of each of these factors (evaluated at sample means).

Let us notice that the most relevant variable seems to be the secondary school of origin. In the Italian system, where the secondary school is organised according to parallel and non-communicating tracks, this suggests that the university career of the children be planned by the family much in advance (at the age of 14). Thus sending a child to the high school, if successful almost ensure the continuation to the university level (contribution in probability between 0.358 and 0.405). Quite surprisingly, there is no evidence of gender discrimination, even if belonging to a numerous families reduces the probability of access (probably because of limited resources). Finally Northeastern and central regions seem characterised by lower enrolment rates.[4]

When we introduce variables measuring the family background, we find that family total (gross) income exerts a statistically significant positive effect only when we omit any variable measuring the human capital available within the family. When we add the educational attainment of both parents (3rd column of table 1), we find that having parents that went beyond compulsory education (lower secondary since 1962) helps in accessing the university. As already found with respect to other countries, having a graduated mother provides a great pressure in the children to repeat the university experience. This obviously translates into higher persistence in intergenerational transmission of education.[5]

[3] In 1996 the 98.1% of young people aged 18-19 was cohabiting with the family of origin. The same percentage declines to 88.4% for people aged 20-24, 54.1% for people aged 25-29 and 21.6% for people aged 30-34. See Istat 1997, pg.224 ss.

[4] This is not confirmed by aggregate data: in 1995-96 the percentage of enrolment on student ending the secondary school the previous year was 65.0% in Northwest, 74.3% in Northeast, 84.5% in Centre and 59.7% in South and Islands. See Istat 1997, p.181.

[5] See the regressions reported in Checchi, Ichino and Rustichini 1996.

However this reduces the explanatory power of family income. How can we interpret this result ? We are tempted to take this as evidence that liquidity constraints do not prevent access to university education; but this conclusion seems contradicted by the significant (negative) effect of the number of siblings and by the similarly negative effect of having a father and/or a mother unemployed (5th column of table 1). However the negative effect of family income is even strengthened when we control for parents' occupations:[6] having a household head holding a managerial or entrepreneurial job ensures the highest probability to enrol the university; a less powerful effect is also played by having parents with clerical jobs.

On the whole, it seems as if attending a university in Italy were more a matter of social status than an economic investment. Since the wage premium of a university degree is positive (see below), the theory would predict that the richer the family, the easier would be university attendance. Since this does not occur in our data, we suspect that young people enrol the university on the wave of family pressures, mainly stemming from having educated parents and/or parents holding prestigious jobs. This is confirmed when we analyse the choice of secondary school attended by children (see table 2). Using the same data set, we use multinomial logit analysis to ascertain which are the determinants among the different types of secondary school. Notice that the sample is biased, because we are considering only students that completed the secondary school, whereas it is common knowledge that dropout rates vary considerably among different type of schools.[7] The only significant evidence we find relates to family educational background: having both parents with a secondary school diploma raises the probability to enrol a high school, which in turn raises the probability to enrol the university. Once more we are unable to detect any significance of family income and occupations[8] in conditioning the educational choices of children.

[6] The 5th column of table 1 reports the coefficients on father and mother occupations that survive a stepwise elimination with a p-value threshold of 0.20.

[7] In 1992-93 the percentage of boys (girls) failing during the secondary school was 27.8% (17.3%) in vocational schools, 21.5% (13.0%) in technical schools, 25.3% (12.3%) in teacher training school and 12.5% (6.7%) in high schools. See Gasperoni 1997.

[8] In estimating table 2, we also tested the significance of father and mother occupations, but none of them resulted significant, and therefore we have not reported them.

Table 1 - Determinants of enrolment at the university

(t-statistics in parentheses - constant included - coefficients report the probability effect a discrete change of a dummy variable from 0 to 1 or one point increase in a continuous variable)

# obs :	1707	1707	1707	1707	1707
Depvar:	sonuni	sonuni	sonuni	sonuni	sonuni
gender	-0.030	-0.030	-0.014	-0.018	-0.008
female=1	(-1.07)	(-1.07)	(-0.51)	(-0.64)	(-0.28)
age	-0.052	-0.054	-0.052	-0.051	-0.050
	(-8.19)	(-8.51)	(-8.01)	(-7.71)	(-7.41)
regio2	-0.077	-0.077	-0.058	-0.045	-0.054
North-east	(-1.79)	(-1.80)	(-1.32)	(-1.01)	(-1.21)
regio3	-0.100	-0.092	-0.096	-0.097	-0.096
Centre	(-2.43)	(-2.23)	(-2.26)	(-2.27)	(-2.24)
regio4	-0.047	-0.002	-0.020	-0.027	-0.022
South	(-1.22)	(-0.06)	(-0.49)	(-0.64)	(-0.50)
regio5	0.012	0.048	0.022	0.020	0.020
Islands	(0.25)	(0.92)	(0.42)	(0.38)	(0.37)
Secondary school degree					
vocational	-0.303	-0.293	-0.198	-0.205	-0.177
	(-4.38)	(-4.20)	(-2.67)	(-2.74)	(-2.32)
technical	-0.168	-0.161	-0.081	-0.081	-0.057
	(-2.87)	(-2.72)	(-1.32)	(-1.29)	(-0.92)
hgh school	0.358	0.359	0.382	0.385	0.405
(liceo)	(6.28)	(6.28)	(6.66)	(6.57)	(6.98)
art school	0.000	0.006	0.068	0.071	0.077
(lic.art.)	(0.00)	(0.07)	(0.79)	(0.80)	(0.87)
teach.trng	-0.098	-0.095	-0.029	-0.026	-0.030
(magistr)	(-1.35)	(-1.29)	(-0.39)	(-0.34)	(-0.40)
other	-0.221	-0.209	-0.129	-0.136	-0.104
	(-2.30)	(-2.16)	(-1.30)	(-1.35)	(-1.04)
family background					
log family		0.035	-0.031	-0.027	-0.066
income		(1.77)	(-1.40)	(-1.21)	(-2.75)
n.children		-0.046	-0.049	-0.052	-0.047
		(-2.88)	(-3.07)	(-3.17)	(-2.85)
single parent		0.016	0.049	0.058	-0.017
		(0.38)	(1.05)	(1.22)	(-0.30)
father lwr.			-0.007	-0.002	-0.001
sec./vocat.			(-0.20)	(-0.08)	(-0.02)
father high			0.115	0.126	0.117
sec./shrt dgr			(2.78)	(3.02)	(2.61)
father college			0.043	0.050	0.015
			(0.67)	(0.78)	(0.21)
mother lwr.			0.018	0.015	0.003
sec./vocat.			(0.52)	(0.42)	(0.09)
mother high			0.173	0.162	0.125
sec./shrt dgr			(3.83)	(3.54)	(2.53)
mother college			0.327	0.326	0.269
			(4.81)	(4.68)	(3.34)

household head			-0.491		
selfemployed			(-5.29)		
fth white					0.065
collar low					(1.56)
fth teacher					0.096
					(1.20)
fth manager					0.304
					(3.41)
fth entrepr					0.310
					(2.87)
fth selfempl					0.128
					(2.72)
fth rentier					0.078
					(1.23)
fth unemployed					-0.201
					(-2.07)
fth retired					0.083
but working					(2.20)
mth white					0.094
collar low					(1.24)
mth unemployed					-0.245
					(-1.91)
mth housewife					-0.109
					(-2.96)
mth retired					-0.101
but working					(-1.87)
mth retired					-0.171
no working					(-1.35)
R^2	0.194	0.198	0.228	0.245	0.249

Table 2 - Choice among different secondary schools - family with a student aged 19-26 in 1995 who completed a secondary school

	vocational	technical	high school	art school	teacher train.
gender (1=female)	0.458**	0.332***	0.676	1.776	9.084***
age	0.833**	0.841**	0.814***	0.827*	0.926
resident Northeast	0.236***	1.089	0.888	0.977	0.65
resident Centre	0.565	0.726	0.657	0.719	0.593
resident South	0.801	1.616	1.486	0.949	2.345
family background					
(log) family income	1.289	1.257	1.253	1.336	1.155
(log) family income	1.289	1.257	1.253	1.336	1.155
number of children	1.016	0.957	0.858	0.956	0.777
single parent family	0.97	1.393	1.806	0.88	1.954
father with compl.lower secondary/vocational	1.545	1.642	2.244**	1.026	1.521
father with compl.higher secondary	0.987	1.285	3.266**	1.403	1.377
father with university degree	0.226*	0.33	1.690	0.363	0.112**
mother with compl.lower secondary/vocational	0.523	1.021	1.078	0.487	1.328
mother with compl.higher secondary	0.753	1.920	3.602**	1.182	3.210*
mother with university degree	0.334	1.593	6.626*	4.567	2.125
head of household self-employed	0.924	1.982	0.887	1.491	2.107
Pseudo R^2			0.12		
Chi^2			517.46		
Number of cases			1615		

Estimated coefficients are transformed to relative risk ratios.
*** 99% significance ** 95% significance * 90% significance.
Comparison group: other type of diploma.

However we are unable to control for unobservable characteristics of the children, and we suspect that these variables may be relevant in deciding whether enrolling the university or not. In addition to the attained secondary school, which is observable and plays a significant role in determining future choices,[9] the sorting may be based on the final marks obtained at exit, which can proxy unobservable ability. Unfortunately we do not have representative data sets of individual data containing this piece of information. An indirect evidence of this potential effect can be grasped by comparing family incomes and grades obtained by the students at the exit of secondary school, as it is done in Table 3. These data suggest us that students enrolled in a state university (at least in the faculties under consideration) are indistinguishable from the rest of the population, whereas entering a private university is associated with higher income and/or better secondary school performance. Before analysing this question in greater details, let us consider the problem of choosing the university faculty.

[9] In addition to the significant coefficient obtained in table 1, one may consider that the transition rates from secondary schools to university in 1995-96 were above 100% for high schools (*liceo classico* and *liceo scientifico*), 49.6% for technical schools (*istituti tecnici*) and 27.0% for vocational schools (*istituti professionali*). See Istat 1997, table 4.3.

Table 3 - Income and marks comparisons between entire population and university samples

	Italian population *	Italian population with a son enrolled at the University **	Enrolled at State University of Milan***	Enrolled at Bocconi University in Milan (private)***
gross family income (1995 millions)				
average family income (1995 millions)	63.034	76.664	71.572	119.430
median family income (1995 millions)	52.340	62.774	62.465	96.173
standard deviation	55.115	74.873	69.576	70.150
final marks at exit of secondary school				
average marks (max 60)	44.52	n.a.	43.93	50.73
standard deviation	7.16	n.a.	6.55	7.37

* Data on incomes from Bank of Italy sample (1995), referred to the population with at least one child in the age between 19 and 26. Data on marks from Gasperoni 1997, tab.4; they are referred to the academic year 1994-95.

** Data from Bank of Italy sample (1995), referred to the population with at least one child in the age between 19 and 26 recorded as student.

*** Data from administrative sources, referred to the faculties of Economics, Law, political Sciences and Mathematics only: see the Appendix. For comparability, data on marks are restricted to students firstly matriculated in 1995-96.

Once a family has reached the decision to send a child to the university, the next step is to choose among available faculties and universities.[10] Students' families can form expectations about future earnings attached to a specific degree by looking at actual returns in the labour market. If we look at table 4, we notice that completing a generalist secondary school (*liceo)* without going on with enrolment at the university yields a very limited return. This suggests that whenever a child completes a secondary school, it is almost sure to continue in his/her educational career; on the contrary, vocational training provides an extra return in the order of 20% above people without formal education. When looking at returns to university degree, the ranking in terms of returns of different faculties is the following: Medicine and Law, giving access to professional jobs, come first; Economics and Statistics comes second; Political Science and Engineering are approximately third; and finally Mathematics with other degrees close the list.

[10] The reader has to keep in mind that each university does not contain all faculties, and sometimes to choose a specific university implies to move (or to commute) to a different city. We do not have aggregate information about this phenomenon, but we believe that the local availability of given faculties may condition the final choice of faculty.

Table 4 - Differentials in (gross) return for different educational degrees (secondary school and university) - percentage increase

Completed secondary school:			
High school (*liceo classico* or *scientifico*)	0.281 (4.75)	0.176 (3.08)	0.094 (1.68)
High school (*liceo artistico*)	0.133 (1.35)	0.066 (0.69)	0.020 (0.21)
Teacher training (*istituto magistrale*)	0.320 (5.82)	0.184 (3.46)	0.102 (1.93)
Professional (*istituto tecnico*)	0.342 (7.35)	0.257 (5.75)	0.170 (3.87)
Vocational (*istituto professionale*)	0.328 (5.53)	0.237 (4.18)	0.203 (3.66)
University degree (BA/BS):			
Economics and statistics	0.746 (9.10)	0.596 (7.54)	0.372 (4.78)
Law	0.924 (10.5)	0.752 (8.85)	0.542 (6.47)
Political Sciences	0.740 (5.90)	0.520 (4.35)	0.291 (2.49)
Mathematics	0.573 (7.78)	0.429 (6.09)	0.264 (3.78)
Agriculture and veterinary science	0.603 (4.15)	0.547 (3.96)	0.279 (2.06)
Medicine and surgery	0.972 (11.1)	0.785 (9.39)	0.481 (5.68)
Engineering	0.627 (7.34)	0.576 (7.00)	0.320 (3.95)
Architecture and planning	0.475 (3.68)	0.461 (3.65)	0.161 (1.29)
Literature and philosophy	0.426 (6.90)	0.247 (4.14)	0.108 (1.77)
for comparison: return to one year of education	0.074 (34.76)	0.059 (25.27)	0.030 (10.68)
Sector of activity	no	yes	yes
Job position	no	no	yes
R^2	0.28	0.32	0.35

Controls: experience, experience squared, gender, region of residence, self-employment, educational dummies for less than secondary education. Excluded case: male, blue collar, without formal education, working in agriculture, resident in islands. T-statistics in brackets.

It is not clear the criterion according to which students are sorted to more profitable degrees. Even without information on the entire university population, we try to infer some information from available data. We start with noticing that, according to the marks obtained at the completion of the secondary school taken as a proxy of unobserved ability, the "above the average marks" students enrol the faculties of Economics and Mathematics, whereas the "below the average marks" student tend to attend the Faculty of Political Science (see table 5).[11] If we resort to multinomial logit analysis and take our data set as the universe of available choices within a State University (table 6), we discover that family background (as measured by total income and self-employment of household head) is almost irrelevant in the faculty choice. Previous academic performance seems more important: as already remarked, students with better marks tend to go to the faculties of Economics and Mathematics; there is also a clear preference from students exiting the high school (*liceo classico*) for the faculty of Law. Age does not seem to identify a precise pattern of choice, whereas women tend to go to the faculty of Law. However this evidence is rather incomplete, since we are not including other choices available within the city of Milan;[12] nevertheless it strengthen the previous result that family income does not represent neither a financial obstacle to enrol the university nor a guiding criterion in choosing among some faculties. On the contrary, previous educational choices at the stage of secondary school and subsequent performance seem to provide some clue in understanding future educational choices.

[11] The reader has to keep in mind that students enrolled at the Bocconi University and the Faculty of Economics of State University could represent a self-selected sample, because of the existence of admission tests partially based on the marks obtained at the completion of the secondary school. To give an idea of the incidence of this phenomenon, the average marks of students applying to Bocconi University in 1996-97 was 49.85; the average marks of accepted students was 51.35, but the average marks of those who effectively enrolled was 51.20. Comparable figures for State University were not available.

[12] In 1996-97 the State University of Milan comprises the additional Faculties of Medicine (4681 students), Literature and Philosophy (17963 students), Natural Sciences and Physics (18017 students), Pharmacy (3922 students), Agriculture (3057 students) and Veterinary Science (2251 students). In addition to public universities, there were three private universities (Bocconi University, Catholic University and IULM).

Table 5 - Marks comparisons according to the secondary school attained

Average final marks at exit of secondary school (max 60)	Italian population	Bocconi Univ. (economics)	State Univ. (economics)	State Univ. (law)	State Univ. (pol.sciences)	State Univ. (mathematics)
Secondary school type:						
High school (*liceo classico*)	46.91	51.95	44.35	44.20	42.00	50.00
High school (*liceo scientifico*)	45.90	49.31	43.92	42.48	41.33	50.40
Accounting (*ragioneria*)	44.10	53.36	49.67	44.64	43.73	44.88
Vocational (*tecnico/profess.*)	43.21	52.14	48.61	43.90	44.66	46.21
Total	44.52	50.73	47.46	43.67	43.24	48.81
Ratio to population average						
Secondary school type:						
High school (*liceo classico*)	1.00	1.11	0.95	0.94	0.90	1.07
High school (*liceo scientifico*)	1.00	1.07	0.96	0.93	0.90	1.10
Accounting (*ragioneria*)	1.00	1.21	1.13	1.01	0.99	1.02
Vocational (*tecnico/profess.*)	1.00	1.21	1.12	1.02	1.03	1.07
Total	1.00	1.14	1.07	0.98	0.97	1.10

Data from administrative sources: see the Appendix. Data on marks are restricted to students firstly matriculated in 1995-96.

Table 6 - Choice among some faculties within a state university - first enrolment in 1996-97

	State Univ. (economics)	State Univ. (law)	State Univ. (mathematics)
gender (1=female)	-0.185**	0.177***	-0.036
age	-0.079***	-0.012**	-0.054*
resident Northwest	0.323	-0.215	-0.443
resident Northeast	-0.740	-0.740**	-0.353
resident Centre	-0.435	-0.782	-30.137
Secondary school degree			
Completed high school (*liceo classico*)	-2.456***	0.572*	-1.219*
Completed high school (*liceo scientifico*)	-1.728***	-0.183	-0.305
Completed accounting school (*ragioneria*)	-1.000***	-0.325	2.201***
Completed vocational school (*tecnico/profess.*)	-2.092***	-0.493	-1.243**
final mark at exit secondary school	0.102***	0.015***	0.107***
family background			
(log) family income	0.044	-0.073*	-0.172*
head of household self-employed	0.245	-0.197	-0.608
(log) family income*household head self-employed	-0.061	-0.083*	0.125
Pseudo R^2		0.0634	
Chi^2		1049.83	
Number of cases		7750	

Estimated coefficients are transformed to relative risk ratios.
*** 99% significance ** 95% significance * 90% significance.
Comparison group: Political Sciences.

Let now assume that a student and her family have agreed on attending the courses of a Faculty of Economics. The last choice left open is whether enrolling a private or a public university, when both offer the possibility to achieve an identical degree (BA in economics - *laurea in Economia*). The two certificates are identical from a formal point of view (for example, they provide access to the same opportunities within the Public Administration), but may be perceived as different from the future employer. If this is the case, students and their families will not consider the two alternatives alike. Here again we do not have comparable evidence of the labour market performance of the two titles, but indirect evidence can be obtained from aggregate data on labour market experience of newly graduated people. Even if strictly not comparable on a temporal basis, table 7 should make clear that a degree from a private university significantly lowers the unemployment spell of a student.[13] However, if

[13] The unemployment spell for graduate people exhibits a declining trend, and therefore the differential among the two types of institution could be lower. In facts Eurisko 1999 quotes an average search time of 5.5 months for people graduated in 1993, which is higher than the recorded 3.38 for 1996-97.

we judge the relative convenience only on the base of forgone income due to longer waiting for a job, the direct cost of attending a private university exceeds the benefit of reduced forgone income: in 1996-97 the admission fees were comprised between 1.330.000 Italian lire (lowest family income) and 3.650.000 lire (highest family income) for the State University, and between 1.165.000 lire and 10.625.000 lire for the Bocconi University.[14]

Table 7 - Search time for first job - degree in economics

	already employed	1 month or less	2 months	3 months	4-12 months	more than 12 months	months on average
Italy - degree in economics obtained in 1992 - interviewed in 1995	25.2	10.10	5.83	5.91	31.42	21.47	7.41
Bocconi - degree in 1995-96 - interviewed in 1998	14.0	33.0	14.0	9.0	29.0	1.0	3.38

Source: Istat 1996 and Eurisko 1999

Therefore we think that there must be additional value attached to attending a private university. An additional explanation makes reference to an extra return to private education in terms of future earnings. Using human capital jargon, one could say that human capital accumulation per unit of time in a private university is higher than in a corresponding public one, because of better teachers, less crowding in rooms, better libraries, and so on. Then higher incomes would be the mere reflection of higher human capital endowment. Even if we do not have direct evidence on future earnings of graduates in economics from different universities, we can infer something from opinion surveys. Half of the graduates from Bocconi University during academic year 1995-96 self-reports to be "very satisfied" of the current job position (2 years later the graduation), and an additional 44% self-declares "rather satisfied" (Eurisko 1999). Unfortunately, we do not have comparable questions from the Istat survey: however we notice that 33.1% of the Italian graduates in Economics during the academic year 1991-92 report the degree "unnecessary for their subsequent work experience", and an additional 15.4% considers it "of limited importance" (Istat 1996). Even if not directly comparable, these two pieces of information tells us that job satisfaction could be rather different in the two samples.

If we should generalise the perception that a private university provides better quality of training, we would expect a private university to be the first choice for all the families and students that have decided to enrol the university for an economics degree. This could effectively be the case, since both private and public faculties of economics were holding admission tests, and it is common perception that many students applied to more than one university.[15] Since the rank of admission was based on both the marks obtained at the exit of secondary school and the test scores, if the former can be taken as a proxy for the ability and ability affects positively the performance when sitting for test answering, we do expect the marks to be the most relevant variable in explaining the choice to enrol in a private university. However, when we run a probit analysis in the sub-sample constituted by students attending an Economics faculty, family background surfaces again. Table 8 reports an estimated probit model for the choice of attending a private university (Bocconi) when choosing an economics faculty: the first three columns estimates the model for first year enrolment in 1996-97, while the other three shows the estimated coefficient for total enrolment for the same year (i.e. they also include enrolment to all years). It comes out that families are more likely to afford higher cost of enrolling a child to a private university when he is a (younger) man, coming out from a high school (*liceo classico* or *liceo scientifico*)

[14] In Euros, the admission fees were comprised between 687 and 1885 for the State University, and between 601 and 5487 for the private university.

[15] In the city of Milan there are two private universities offering BA courses in economics, Bocconi University and Catholic University. Admission fees for the latter are lower than the former, but higher than public ones. Both universities held admission tests. In the case of Bocconi University, in 1996-97 there were 3351 applications for 2580 potential admissions, but eventually there were only 2156 effective enrolments. In the same year we record 1026 enrolments to the Faculty of Economics of the State University: summing these figures up with enrolment at Bocconi University seems to confirm the idea that potential applicants for a degree in economics ranged around 3000-3500 for that year.

with a high final mark.[16] Bocconi also attracts students from other regions, as witnessed by the highest and significant coefficient associated with a student residence in the South of the country. One can also notice that family background matters, because this probability increases with family total income;[17] in addition, when we interact family income with the condition of self-employment of the household head, we find a higher marginal effect of family income in case of self-employment.[18] This may be the reflection of high professional families putting more pressure on their children to aspire to family status. If we compare the distribution of household head occupations between the population of Bocconi students and a representative sample of the Italian population with a child enrolled at the university (see table 9 - unfortunately we do not have comparable information for students from State university), we discover that high prestige and high income father occupations are significantly over-represented within the Bocconi sample. Notice that there is a partial compensation of individual talent with family income: along an iso-probability curve (i.e. a locus obtained by keeping constant the probability of going to a private university), an increase of income by 10% would compensate 1.13 points in final marks.[19]

[16] In order to reduced the potential measurement error due to possible differences in marking policies by different types of secondary schools, we have also run probit regression using normalising this variable according to mean and standard deviation for each type of school. But results are almost identical, so we have reported them (available from the authors).

[17] Since family incomes for the Bocconi sample was estimated using income brackets for admission fees, we have also estimated family incomes for the State University sample with identical procedure, in order to see whether this procedure could affect the results. Since the estimated model is almost identical, we have reported estimates using actual incomes. Alternative estimates are available upon request.

[18] Since having a household head self-employed lower the intercept and raises the slope of the predicted probability, it is possible to compute the income level above which it self-employment income becomes more compelling: it is 78.33 millions It.liras in column 3 of table 8 and 140.65 millions in column 6. The two results are mutually compatible when one considers that dropout rates are inversely related with family incomes (see below).

[19] Obtained as a result of 0.159/0.014. Given the fact that this measure is a semi-elasticity (because family income is measured in logs), it implies that compensating money has declining marginal effectiveness, i.e. rich families need more money to compensate the same gap.

Table 8 - Probability to choose a faculty of Economics in a private university

(t-statistics in parentheses - constant included - coefficients report the probability effect a discrete change of a dummy variable from 0 to 1 or one point increase in a continuous variable)

	enrolment in 1996-97			enrolment since 1992-93 on		
# obs :	3208	3208	3208	10891	10891	10891
Depvar:	univer	univer	univer	univer	univer	univer
gender	-0.114	-0.102	-0.103	-0.053	-0.042	-0.042
female=1	(-6.37)	(-5.76)	(-5.79)	(-7.92)	(-6.76)	(-6.75)
age	-0.063	-0.058	-0.059	-0.027	-0.022	-0.022
	(-9.20)	(-8.71)	(-8.75)	(-13.17)	(-11.51)	(-11.60)
regio2	0.229	0.208	0.210	0.132	0.112	0.113
North-east	(6.80)	(6.14)	(6.11)	(11.58)	(10.66)	(10.65)
regio3	0.242	0.232	0.233	0.126	0.111	0.111
Centre	(5.39)	(4.97)	(5.00)	(7.02)	(6.62)	(6.65)
regio4-5	0.254	0.264	0.264	0.144	0.139	0.139
South isld	(8.96)	(9.93)	(9.86)	(13.33)	(14.74)	(14.62)
Secondary school degree						
hgh school	0.240	0.199	0.201	0.131	0.097	0.097
(lic.class)	(10.37)	(7.99)	(8.02)	(15.28)	(11.15)	(11.16)
hgh school	0.273	0.222	0.224	0.151	0.108	0.109
(lic.scien)	(12.39)	(9.85)	(9.86)	(16.96)	(12.93)	(12.94)
technical	-0.040	-0.036	-0.037	-0.034	-0.027	-0.028
(ragion.)	(-1.75)	(-1.56)	(-1.61)	(-3.62)	(-3.17)	(-3.21)
fnl marks	0.014	0.014	0.014	0.009	0.009	0.009
exit scnd	(10.92)	(11.21)	(11.12)	(19.64)	(20.11)	(19.93)
Family background						
log family		0.159	0.136		0.102	0.093
tot income		(13.05)	(8.77)		(23.75)	(16.64)
household hd			-0.300			-0.141
selfemployed			(-2.51)			(-3.27)
hh self*fm income			0.063			0.025
			(2.53)			(2.93)
R^2	0.323	0.371	0.372	0.253	0.31	0.311

Table 9 - Distribution of household head occupation - private versus public university

Occupations	Italy: household head with a son enrolled at the university in 1995	Household head with a son enrolled at Bocconi University in 1996-97
Blue collar workers	16.82	8.95
(Low) white collar workers	26.70	7.12
(High) white collar workers	9.10	17.10
Teachers	10.03	5.40
Managers	8.80	21.79
Self-employed	12.81	14.21
Professionals	3.86	14.49
Entrepreneurs and family firm partners	9.57	10.94

If we had to summarise what we have found so far, we could say that the choice of investing in tertiary education of their children by Italian families could be only partially interpreted according to the

theory of *human capital investment*.[20] Under this approach, when children are heterogeneous in ability, families invest in their education up to the point where marginal return to education equals the marginal cost. Since brightest individuals have higher returns, they are expected to attract more investment from their families. Under the assumption of perfect capital markets, (expected) ability should be the main explanatory variable in educational choice; when financial markets are imperfect, then family income and/or wealth should matter.
In the empirical analysis we find that sending a child to the university is hardly affected by family income, and this could be taken as indirect evidence of the absence of liquidity constraints for the families. However, when we come to consider the choice of sending the child to a private university (i.e. paying higher admission fees), we find that family income restrict the choice set, and the families are available to spend more only when they expect their offspring to be above the average (as measured by marks at the exit of secondary school). But there are additional factors that do not fit into the present story. We find repeated evidence that both the type of secondary school and the type of parents' occupations affect the probability of attending the university. Both factor can be accounted for in a theory of educational choice based on *status transmission*:[21] in this case parents are not maximising expected future income of their children, but their probability to get a "good" job (whatever "good" may means in terms of satisfaction, schedule, command, social prestige, and so on), when good jobs are rationed.

Before jumping to definite conclusions, we have to consider that enrolling the university is just a part of the story, because anything applies only when a student concludes her academic career obtaining a bachelor degree. We analyse the student performance in the next section.

[20] This approach can be traced back to Becker and Tomes 1979 and 1986, and recently revived by Owen and Weil 1997.

[21] See for example Fershtman, Murphy and Weiss 1996.

4. Academic performance

It is wide known that Italian university is afflicted by two problems: the dropout rates and the excessive duration of student academic career. Table 10 estimates the extent of the first phenomenon in our sample by going back the original number of new enrolment in each year and observing how many student have survived 2, 3 and 4 year later. The difference between original enrolment and actual enrolment can be taken only as a rough measure of drop-out rates, because student could have changed faculty or transfer from other universities to higher years are possible. We cannot go beyond 4 years because this is the minimum official time length to complete each course, and students could disappear from the sample just because they graduate. However this an exception rather than the norm, as it can be seen from table 11, which shows that only one tenth of the students complete their undergraduate studies on time.[22]

Table 10 - Estimated dropout rates for year of enrolment

	Bocconi Univ. (economics)	State Univ. (economics)	State Univ. (law)	State Univ. (pol.sciences)	State Univ. (mathematics)
enrolment to 1° year	5.44%	40.60%	44.63%	53.50%	62.91%
enrolment to 2° year	4.44%	34.85%	35.99%	51.09%	61.56%
enrolment to 3° year	2.68%	34.10%	25.62%	36.72%	53.04%
enrolment to 4° year	1.34%	11.56%	3.89%	3.26%	10.81%

Note: it reports the ratio between students with "active enrolment" status and the first-year enrolment of the corresponding cohort.

Table 11 - Course duration - degree in economics

	4 years	5 years	6 years	7 years	8 years or more	years on average
Italy - degree in economics obtained in 1992 - interviewed in 1995	15.3	23.9	24.1	15.3	21.4	6.25
Bocconi - degree in 1996-97 - interviewed in 1998	12.0	33.0	22.0	15.0	18.0	6.12

Source: Istat 1996 and Eurisko 1999

We notice that more than half of the students enrolled in a public university does not complete their curricula, against a figure of less than 6% in a private university. From data reported in table 10 it is rather clear that while the Bocconi students sample is rather unaffected by drop-out (we could think of frictional turn-over among students), it represents a potential source of bias in the State University sample. The extent of self-selection can be judged by observing representative statistics for year of enrolment, as it is done in table 12. Family income is clearly rising only in the case of the Bocconi sample, and we have already observed that the choice of a private university can be affected by liquidity constraints. On the contrary, no clear pattern emerges within the State University sample with respect to self-selection based on family income. Nor we find clear-cut evidence of best student surviving within the university courses if we measure students' ability with either the final marks at the exit of secondary school or with the average marks obtained during their academic career. Taking individual data on enrolment of two subsequent years, we trace out those students who did not re-enrol, and we can investigate the determinants of this choice. Because of lack of data, this could be done only for the students enrolled in the Faculty of Economics of the State University with reference to students who enrolled in 1995-96 and did or did not in 1996-97. The probit model reported in table 13 indicates that family income, secondary schools (both type and marks) are statistically non-

[22] We do not have comparable figure for the Faculty of Economics of State University, since it opened in 1992-93 and by the time these data were collected (April 1997) no student has yet completed his/her career. Comparable figures for other faculties of the State University (referred to the academic year 1995-96) were 6.8 years for Law, 7.5 for Political Sciences and 6.8 for Mathematics.

significant with respect to this choice, whereas age and academic performance within the university are the only significant variable. When a student is getting older, is unable to pass a sufficient number of exams per year and/or is unsatisfied of the marks obtained, then he or she becomes more likely to dropout from the university. Given the fact that the self-selection of the sample is mainly due to poor performance, we now concentrates on the analysis of the determinants of academic performance, being confident that the estimates for the other regressors should not be distorted.

Table 12 - Descriptive statistics for year of enrolment

	Bocconi Univ. (economics)	State Univ. (economics)	State Univ. (law)	State Univ. (pol.sciences)	State Univ. (mathematics)
family income (millions It.liras 1995)					
enrolment to 1° year	115.71	69.70	79.59	71.08	70.85
enrolment to 2° year	120.57	76.21	72.74	68.30	73.09
enrolment to 3° year	122.83	74.81	71.74	67.60	71.16
enrolment to 4° year	128.20	76.44	73.23	68.97	74.97
final marks at exit scnd school (max 60)					
enrolment to 1° year	51.04	47.27	43.60	42.95	47.63
enrolment to 2° year	50.76	47.46	43.71	43.36	49.39
enrolment to 3° year	50.80	47.52	44.44	43.40	50.62
enrolment to 4° year	51.56	46.01	44.80	43.85	51.40
Average marks at university (max 31)					
enrolment to 1° year	25.09	23.46	24.74	23.17	26.51
enrolment to 2° year	24.73	23.39	24.13	23.49	24.42
enrolment to 3° year	25.20	23.69	24.11	23.73	23.73
enrolment to 4° year	25.63	23.49	24.30	24.22	24.88

Table 13 - Probability of dropout - State University - faculty of Economics

(t-statistics in parentheses - constant included - coefficients report the probability effect a discrete change of a dummy variable from 0 to 1 or one point increase in a continuous variable)

# obs :	2745	2745	2745
Depvar:	dropout	dropout	dropout
gender	-0.012	-0.013	-0.011
female=1	(-1.31)	(-1.33)	(-1.52)
log(age)	0.196	0.196	0.175
	(5.98)	(5.95)	(6.77)
regio2	0.056	0.057	0.034
North-east	(0.85)	(0.87)	(0.69)
regio4-5	0.035	0.031	0.053
South isld	(0.64)	(0.59)	(1.09)
Secondary school degree			
hgh school	-0.015	-0.013	-0.030
(lic.class)	(-0.38)	(-0.31)	(-1.42)
hgh school	0.003	0.006	-0.028
(lic.scien)	(0.09)	(0.16)	(-1.15)
technical	0.014	0.017	-0.024
(ragion.)	(0.37)	(0.43)	(-0.86)
vocational	0.024	0.027	-0.015
(tecnica)	(0.58)	(0.63)	(-0.60)
log(marks)	-0.024	-0.024	-0.028
exit scnd	(-0.71)	(-0.71)	(-1.06)
family background			
log family		-0.002	-0.001
total income		(-0.38)	(-0.32)
academic performance			
log exams			-0.027
per year			(-7.10)
log average			0.005
marks per exam			(8.96)
R^2	0.031	0.031	0.133

The problem is how to define a precise measure of students' performance. According to the Italian tertiary education system, a student obtains a BA degree when he has passed a predetermined number of exams, obtaining in each of them at least a minimum mark of 18 (over 30), and presenting a final dissertation (*tesi di laurea*). There are a minimum number of years of enrolment, which are 4 for most degrees, but not a maximum. If we take the number of exams corresponding to each degree course and we multiply them by either 18 or 31,[23] we obtain respectively the minimum or the maximum result a student can obtain through his academic career. By dividing the latter value with the minimum number of years of university attendance, we obtain the supremum in the range of an indicator of student performance, the infimum being zero (since potentially there is no time limit to complete the academic career).

[23] It is possible to pass an exam with the mark "30 cum laude": we have coded this outcome as 31.

For each student it is therefore possible to define the *performance* by taking the sum over the marks obtained in passed exams and dividing it by the number of enrolment years, that is

$$performance = \frac{\sum_{i=1}^{p} m_i}{n} \tag{22}$$

where p is the number of passed exams, m_i is the mark obtained in the i-th exam and n is the number of years of active enrolment. Let us notice that the performance indicator can be obtained as the product of two other indicators of performance, namely the *average mark* obtained on passed exams and the *speed* at which a student is undertaking the exams. In symbols

$$performance = average\ \ mark \cdot speed = \frac{\sum_{i=1}^{p} m_i}{p} \cdot \frac{p}{n} \tag{23}$$

It is important to distinguish between the two components, because there is an implicit trade-off between the twos. A student can decide to dedicate one year to prepare each exam, obtaining high mark (and consequently cumulating a high value of *average mark*), but this produce a very long stay at the university to complete the career (a very low value in *speed*). At the opposite extreme, a student can decide to devote the minimum amount of time required just to pass an exam with the minimum mark (a very low value in *average mark*), thus being able to get through a higher number of exams (a high value in *speed*).[24] The descriptive statistics for these values are reported in table 14. It can be noticed that students from different faculties exhibit similar values in *average mark*, but considerably different values in *speed*. Students from Bocconi University are characterised by almost double *speed* when compared with student from a state university, and this translates into higher performance. One may wonders how to combine the evidence of table 11 (almost identical duration of course) with the first two columns of table 14 (speed in the private university is higher than the speed in the public one). The answer lies in previous tables: since the public university experiences higher drop-out rates (table 10), and students that drop-out are low-speed students (table 13), the "survivors" are characterised by a speed above the average, since the average is computed over a sample including potential droppers.[25]

Table 14 - Descriptive statistics of student performance

	Bocconi Univ. (economics)	State Univ. (economics)	State Univ. (law)	State Univ. (pol.sciences)	State Univ. (mathematics)
#exams required to complete the career	32	29	22	26	22
minimum # years to complete course	4	4	4	4	4
theoretical maximum of performance	248	224.75	170.5	201.5	170.5
average *performance* (last 5 years)	116.29	43.93	57.13	52.32	44.71
average *mark* (last 5 years)	25.25	23.61	24.33	23.85	24.74
average *speed* (last 5 years)	4.53	1.82	2.29	2.13	1.78

But which are the determinants of students' performance ? In tables 15-16-17 we estimate ordinary least square models predicting performance, average mark and speed in each faculty, basing on previous student achievements and family background.[26]

[24] An alternative way to look at the same concept is to think of *performance* as an index of productivity in the production of a vertically differentiated product, where *average mark* is the quality and *speed* is the quantity.

[25] The average *speed* among students enrolled to the Faculty of Economics of the State University is 0.65 for those enrolled at the first year, 2.01 for second year, 2.44 for third year, 2.59 for fourth year and 2.92 for the first extra-year (*fuori corso*).

[26] We have excluded 566 students attending a degree course in *Discipline Economiche e Sociali* at Bocconi University, since it is mainly academic oriented (students could self-select when enrolling this course) and last five years instead of four. Effectively their average *performance*, *average mark* and *speed* are respectively 123.3, 26.7 and 4.56.

When we look at *performance* we find corroboration of previous evidence: student with better educational record (higher marks at the exit of secondary school, attendance of high school) perform better (in terms of both higher *average mark* and *speed*), whereas they are at some disadvantage when they are resident in a region that is far away. But the most interesting result is the evidence on family background: family income influences positively performance in the case of attending a Faculty of Economics in the private university and a Faculty of Law or Political Sciences in the State University, whereas it is irrelevant in the other cases (Faculty of Economics and Faculty of Mathematics in the State University).[27] In two cases (Economics in private university and Law in State university) this effect is lighter in the case of self-employment of the household head: parents seem to put less pressure on the shoulders of their off-springs when family income exceeds 54.45 and 66.52 millions of Italian liras respectively. Apart from the case of Bocconi University, this effect passes through the effect onto *speed*, indicating that students from richer families tend to go faster in their academic career. We can provide alternative interpretations of this evidence. On one side it seems that liquidity constraints do not bite, because otherwise we should have found that students from poorer families would have had higher speed (even at the cost of a lower average marks).[28] On the other side we could think of family income being correlated with parental education: in this case students would receive more support from their families the higher is the educational achievements of their parents, and the positive correlation with income would be a case of spurious correlation. This interpretation is however contradicted by the evidence on *average grade*, where in no case (but Bocconi, though the effect is negative for family with self-employed head) we find positive effect of family income: had a cultural background played any role, we should have expected a positive effect of family support on the average marks obtained in passing exams.[29] We are therefore left with explanations based on family networking: other conditions being equal, students from richer families face better employment prospects, and therefore afford a higher opportunity costs of protracting their university career. This creates an incentive to reach higher speed in passing exams, independently of the marks obtained. This explanation is not contradicted by the absence of effect within two faculties. In the case of the Faculty of Economics in the State University we can argue that these students represent a self-selected sample (table 8), since students with better prospects have already chosen to attend a private university. In the case of the Faculty of Mathematics, the natural opening for its graduates is teaching, and the access to this occupation is regulated through nation-wide competition, where family networking is (almost) ineffective. Nevertheless, the networking explanation is at odds with the evidence of a differential effect for families with a self-employed head. We would expect a self-employed to engage in wider social networking, holding several personal contacts and having access to greater information.[30] His/her children should benefit more from these opportunities, and this is actually reflected by a

[27] This evidence is robust against alternative definition of family income. When we compute family income within the State University sample with the same procedure utilised for the Bocconi sample, the estimated coefficients are not very different from those reported in table 15: with reference to log of family income they are 0.021 (0.36) for the Faculty of Economics, 0.045 (3.82) for the Faculty of Law, 0.031 (1.76) for the Faculty of Political Sciences and 0.095 (1.84) for the Faculty of Mathematics.

[28] Unfortunately we do not have information on whether the students are full-time or part-time students. Anedoctical evidence tells us this phenomenon could be rather wide-spread: the 33% of graduated students from Bocconi University report to have been working before graduation (no information about working hours - see Eurisko 1999); in a survey conducted among the students of the Faculty of Political Sciences during 1996 (910 cases), 18% of the sample self-declared "full-time worker", 19% "part-time worker" and an additional 34% "occasional worker". Had we had this information for our samples, we could have tested an alternative version of the liquidity constraint model: students from poorer family have to work in order to finance their studies, and therefore less time is devoted to the academic career; on the contrary, students from richer families are implicitly exempted from work and therefore dedicate more time to study activity.

[29] Following this line of reasoning, one could argue that the variable "final mark at exit of secondary school" is endogenous with respect to the variable "family income". Using region of residence as instrumental variables for family income, we obtain very similar results (available upon request).

[30] We have information about the actual occupation of the household head for the Bocconi sample only (table 9). When we insert dummies for each occupation, we find that having an entrepreneur father provides the only significant effect, but the effect is negative when compared to having a blue-collar father.

positive and significant dummy for the condition of "self-employment household head". However we do not find good explanations why this effect should decline with the family income.

Table 15 - Determinants of student performance - last five years of enrolment

(t-statistics in parentheses)

Model :	Bocconi	St.Un.Ec.	St.Un.Law	St.Un.PoSc	St.Un.Math
# obs :	9543	1786	14891	7802	510
Depvar:	lperform	lperform	lperform	lperform	lperform
intcpt	-0.248	-5.317	-4.256	-2.929	-8.190
	(-0.47)	(-6.46)	(-20.01)	(-9.44)	(-6.59)
gender	0.010	0.023	0.017	0.132	-0.083
female=1	(0.81)	(0.64)	(1.42)	(7.55)	(-1.41)
log(age)	-0.612	1.073	0.453	0.243	1.022
	(-3.93)	(5.49)	(10.34)	(3.96)	(3.78)
regio1	===	===	===	===	0.233
North-west					(0.99)
regio2	0.004	-0.285	-0.008	0.039	===
North-east	(0.19)	(-1.31)	(-0.17)	(0.62)	
regio3	-0.068	0.152	-0.087	0.075	===
Centre	(-2.59)	(0.30)	(-0.78)	(0.41)	
regio4-5	-0.105	-0.021	-0.069	-0.213	-0.035
South isld	(-6.33)	(-0.11)	(-1.32)	(-2.28)	(-0.10)
Secondary school degree					
fnl marks	1.598	1.511	1.706	1.540	2.196
exit scnd	(34.59)	(11.41)	(42.47)	(24.31)	(11.17)
hgh school	0.148	0.330	0.408	0.318	0.037
(lic.class)	(5.59)	(3.85)	(24.91)	(10.47)	(0.31)
hgh school	0.227	0.321	0.343	0.247	0.224
(lic.scien)	(9.70)	(6.13)	(21.90)	(11.51)	(2.90)
technical	0.136	0.104	0.099	0.026	-0.133
(ragion.)	(5.54)	(2.20)	(6.08)	(1.15)	(-1.00)
foreign	0.063	0.656	0.137	0.485	0.422
diploma	(1.38)	(3.76)	(1.70)	(5.30)	(1.43)
Family background					
log family	0.061	-0.009	0.042	0.030	0.032
tot income	(5.38)	(-0.32)	(4.25)	(2.13)	(0.80)
househ head	0.173	0.035	0.166	0.017	0.006
selfemploy.	(1.95)	(0.21)	(3.41)	(0.23)	(0.03)
hh self*	-0.043	-0.003	-0.039	-0.015	-0.014
fam income	(-2.31)	(-0.08)	(-3.37)	(-0.84)	(-0.25)
R^2	0.136	0.091	0.147	0.099	0.242

Table 16 - Determinants of student average mark - last five years of enrolment

(t-statistics in parentheses)

Model :	Bocconi	St.Un.Ec.	St.Un.Law	St.Un.PoSc	St.Un.Math
# obs :	9543	1786	14891	7802	510
Depvar:	lmedia	lmedia	lmedia	lmedia	lmedia
intcpt	1.468	2.090	1.877	1.979	1.381
	(19.09)	(18.71)	(63.06)	(48.06)	(6.60)
gender	0.005	0.021	0.012	0.015	-0.040
female=1	(3.09)	(4.33)	(7.59)	(6.54)	(-4.02)
log(age)	0.092	0.011	0.014	0.057	-0.017
	(4.07)	(0.41)	(2.32)	(7.00)	(-0.36)
regio1	===	===	===	===	0.045
North-west					(1.13)
regio2	0.011	-0.068	0.001	0.007	===
North-east	(3.89)	(-2.33)	(0.17)	(0.88)	
regio3	0.015	-0.10	-0.045	-0.004	===
Centre	(3.81)	(-1.47)	(-2.91)	(-0.15)	
regio4-5	0.002	-0.051	-0.024	-0.044	-0.012
South isld	(0.71)	(-1.93)	(-3.24)	(-3.52)	(-0.21)
Secondary school degree					
fnl marks	0.368	0.265	0.323	0.267	0.464
exit scnd	(55.01)	(14.73)	(57.40)	(31.68)	(14.02)
hgh school	0.039	0.040	0.073	0.041	0.023
(lic.class)	(10.24)	(3.41)	(31.84)	(10.16)	(1.13)
hgh school	0.031	0.030	0.047	0.026	0.031
(lic.scien)	(9.21)	(4.17)	(21.50)	(9.20)	(2.37)
technical	0.014	0.003	0.005	-0.009	-0.024
(ragion.)	(4.09)	(0.55)	(2.02)	(-3.06)	(-1.07)
foreign	0.023	0.052	0.050	0.079	0.055
diploma	(3.49)	(2.20)	(4.49)	(6.54)	(1.11)
Family background					
log family	0.003	-0.002	0.001	-0.002	0.003
tot income	(1.74)	(-0.46)	(0.94)	(-0.89)	(0.38)
househ head	0.032	-0.021	0.003	0.002	-0.007
selfemploy.	(2.48)	(-0.93)	(0.41)	(0.25)	(-0.17)
hh self*	-0.007	0.005	-0.001	-0.001	0.001
fam income	(-2.68)	(1.00)	(-0.40)	(-0.39)	(0.11)
R^2	0.29	0.142	0.24	0.144	0.322

Table 17 - Determinants of student speed - last five years of enrolment

(t-statistics in parentheses)

Model :	Bocconi	St.Un.Ec.	St.Un.Law	St.Un.PoSc	St.Un.Math
# obs :	9596	1790	14896	7809	521
Depvar:	lspeed	lspeed	lspeed	lspeed	lspeed
intcpt	-1.511	-6.888	-6.148	-4.915	-10.309
	(-3.01)	(-9.04)	(-30.28)	(-16.67)	(-8.98)
gender	0.006	0.006	0.004	0.118	-0.033
female=1	(0.53)	(0.18)	(0.37)	(7.14)	(-0.59)
log(age)	-0.835	0.919	0.441	0.186	1.215
	(-5.70)	(5.24)	(10.57)	(3.20)	(5.00)
regio1	===	===	===	===	0.315
North-west					(1.52)
regio2	-0.001	-0.212	-0.006	0.032	===
North-east	(-0.05)	(-1.02)	(-0.13)	(0.54)	
regio3	-0.082	0.247	-0.041	0.079	===
Centre	(-3.22)	(0.51)	(-0.39)	(0.45)	
regio4-5	-0.106	0.033	-0.040	-0.170	-0.066
South isld	(-6.57)	(0.18)	(-0.80)	(-1.91)	(-0.22)
Secondary school degree					
fnl marks	1.272	1.223	1.385	1.276	1.734
exit scnd	(28.62)	(9.68)	(36.12)	(21.19)	(9.42)
hgh school	0.115	0.272	0.335	0.278	0.022
(lic.class)	(4.52)	(3.34)	(21.41)	(9.61)	(0.19)
hgh school	0.206	0.282	0.296	0.219	0.217
(lic.scien)	(9.16)	(5.65)	(19.80)	(10.73)	(2.99)
technical	0.126	0.099	0.095	0.035	-0.074
(ragion.)	(5.36)	(2.19)	(6.08)	(1.66)	(-0.59)
foreign	0.015	0.648	0.098	0.423	0.699
diploma	(0.35)	(3.97)	(1.31)	(4.94)	(2.85)
Family background					
log family	0.059	-0.009	0.041	0.031	0.040
tot income	(5.37)	(-0.34)	(4.31)	(2.30)	(1.06)
househ head	0.149	0.051	0.163	0.011	0.123
selfemploy.	(1.74)	(0.32)	(3.50)	(0.16)	(0.55)
hh self*	-0.038	-0.007	-0.039	-0.013	-0.043
fam income	(-2.09)	(-0.19)	(-3.47)	(-0.79)	(-0.82)
R^2	0.103	0.072	0.112	0.08	0.204

We now summarise the main findings of this section with the help of figure 4. In previous work (Checchi, Ichino and Rustichini 1996) we found that Italy is characterised by low intergenerational mobility, especially wen measured in terms of educational achievements. Current findings help us to clarify that statement. Our first finding is that the choice of sending a child to the university is taken well before of the very moment of choice, because the type of secondary school attended is crucial in shaping future educational destiny of the child. Attending and successfully completing a high school raises the probability of enrolling and completing the university. In this choice, children from educated family have advantages over children from uneducated families, and earned income seem to play no (or negative) role. Thus *cultural constraints* seem to be more important than *liquidity constraints* in limiting the access to the university. Money matters in selecting a private university, if available for the preferred faculty. In this case we find that even poor families are available to finance this choice of their offspring provided that they have proved sufficiently endowed in previous schooling. Once students have enrolled faculty, either in private or public institutions, their performance is in accordance with family expectations (better talented students perform better), but family networking represents the strongest incentive to complete their courses. In facts, we find that children from richer families perform better because they are quicker than those from poorer families are. For lack of data, we are unable to discriminate among other competing explanations (students from poorer families could be more likely to be part-time students because of work, family income could capture higher educational achievements of their parents).

5. Conclusions

We have presented a formal model predicting that families invest more in their children the higher are the family income and the (expectation on) child talent. Once the investment is undertaken, the student perform better the higher is the family income, because of networking and/or cultural inheritance reasons. When the family is liquidity constrained and/or the child is insufficiently endowed, we expect a zero investment in education.

Our empirical analysis does not contradict this theoretical model. Using a representative sample of the Italian population, we observe that family income does not prevent enrolment to the university, whereas cultural family background is more relevant, especially because it shapes the secondary education choices. Using administrative data on students enrolled in private and public universities, we show that family income become relevant whenever the amount of money invested raises significantly; even a poor family invests, provided that her child is sufficiently endowed. Finally, students' performance is positively correlated with family income, and we take this evidence as supporting the idea of family networking: students from richer families tend to go quicker because they have better prospects when they exit the university.

On the whole, we claim that liquidity constraints do not play a significant role in preventing the enrolment in Italian public universities, whereas cultural constraints do. Students from better-educated families probably receive stronger pressure to complete their academic career, and this leads them to perform better and not to drop out during initial years.

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Appendix - Data sources

Our data sets come from administrative sources and have been obtained from the Admission Offices of Università Commerciale L.Bocconi and Università degli Studi di Milano. They are referred to students enrolled at these universities during the academic year 1996-97 (including 576 students from Bocconi University that graduated during the year). Bocconi University comprises a unique Faculty (Economics), while in the case of the State University we restrict ourselves to students from the faculties of Economics, Law, Political Sciences and Mathematics. The formal length of each curriculum is four year (excluding the degree in "Discipline Economiche e Sociali" at Bocconi University, which is five years long - but it consists of 703 enrolled students, equal to 4.9% of total enrolment at that university).

Relevant information is contained in the following table.

Table A1. - Sample means for relevant variables - Academic year 1996-97

University: Faculty:		Bocconi Univ. Economics	State Univ. Economics	State Univ. Law	State Univ. Pol.Sciences	State Univ. Mathematics
Variable:	Var.name:					
Female	gender	37.86%	47.32%	56.20%	48.84%	64.60%
Age	age	19.10	19.96	20.25	20.83	19.88
Family income (millions lire)	faminc	119.43	74.44	72.94	68.80	72.11
Father self-employed	auton	37.37%	37.40%	46.30%	43.09%	36.24%
Region of residence:						
North-West	regio1	69.94%	98.44%	97.16%	96.98%	96.48%
northeast	regio2	8.89%	0.53%	1.40%	1.84%	1.58%
Centre	regio3	5.11%	0.15%	0.23%	0.32%	0.09%
South	regio4	16.07%	0.87%	1.21%	0.86%	1.85%
Secondary school type:						
Liceo Classico (high school)	hstype1	16.16%	4.29%	22.56%	10.25%	6.67%
Liceo Scientifico (high school)	hstype2	49.09%	27.75%	28.32%	28.08%	62.65%
Ragioneria (accounting)	hstype3	23.04%	46.07%	22.58%	23.31%	6.86%
Tecnico/profess. (vocational)	hstype4	7.74%	20.52%	25.91%	37.44%	22.15%
Foreign secondary school	hstype5	3.96%	1.37%	0.63%	0.92%	1.67%
Final marks sec.school(max 60)	hsg	51.41	47.11	44.07	43.56	48.93
Effective enrolment *	status1	98.16%	94.68%	96.29%	95.62%	93.14%
Years of enrolment	numanno	3.97	2.39	4.35	4.72	4.74
Number of completed courses	numes	15.64	5.11	9.67	10.20	8.16
Average marks (max 31)**	media	25.43	23.60	24.29	24.16	24.50
Completed courses per year	speed	4.28	1.65	2.14	2.07	1.70
Number of observations	#	14569	2631	24877	15183	1079
If enrolled after 1989:						
Effective enrolment *	status1	98.15%	94.62%	96.51%	95.72%	93.65%
Years of enrolment	numanno	3.18	2.30	3.52	3.63	3.77
Number of completed courses	numes	14.87	5.08	8.88	9.16	7.72
Average marks (max 31)**	media	25.49	23.59	24.31	24.05	24.61
Completed courses per year	speed	4.51	1.66	2.22	2.15	1.78
Number of observations	#	13215	2602	22293	13170	945

* Students that were not effectively enrolled could have either abandoned the university (without formally giving notice to the Admission Office), moved to other university, began the military service, or even died during the current academic year.

** Grades are in thirtieths; the minimum passing grade is 18; grade 31 corresponds to getting the honours.

Some additional information has to be recalled. The Faculty of Economics at the State University begun its activity on November 1st, 1992, and by the time that these data were collected we do not observe any graduation. This may explain why we do observe lower figures in the "years of enrolment" and in the "numbers of completed courses". In addition, when considering that the highest drop out rates are observed during the initial years, composition biases may explain the lower "number of completed courses".

Family income for the students enrolled in the State University comes from fiscal declarations (mod.740) exhibited at the moment of enrolment, and refer to gross labour incomes earned in 1995 by all the family members. Except from building rents, capital incomes are not included. In the case of students from Bocconi University, we only know the income bracket to which students were assigned in each year of enrolment.[31] In the absence of better alternatives, we exploited the income variation induced by the fact that income brackets have been changed from year to year,[32] and we assigned to each student the midpoint value of the corresponding income bracket. After converting all the incomes to a comparable value (1995 prices), we collapsed the income observations on each student for different years into one observation, that describes the average family income over the time the student has been enrolled at the Bocconi University.[33] Since the family income variable has been constructed by the aggregation of class incomes, its distribution is affected by some discreteness.

As a consequence, family incomes in the Bocconi and the State University samples are not perfectly comparable. The former is characterised by (presumably) lower under-reporting for self-employment incomes and its distribution is discretised and truncated from above. In order to increase the comparability between the two samples, in some regression we have also computed the family income in the State University sample applying the same procedure based on income brackets used in the Bocconi sample. Some of these differences can be grasped by observing the following figure A1. While lognormal distribution seem a plausible assumption in the State University sample,[34] in the Bocconi sample income distribution is clearly skewed to the right and truncated from above.

[31] Tuition depends on the income bracket to which students are assigned by the Admission Office, that bases its decision on the assessment of family income (declared for fiscal purposes) and estates. This creates a significant difference in the case of self-employee: since it is widely recognised that self-employment incomes are generally under-reported (at an estimated rate of 70.2% - see Bernardi and Bernasconi 1996), Bocconi Administration assigns students from self-employed parents a the highest income bracket at start, and subsequently reduces it according to the exhibited documentation. Nothing similar applies in the case of State University.

[32] They were five at the beginning of our sample (1978-79), became nine the subsequent year (until 1980-81) and then eleven up to 1991-92; from then on they were set to twelve. However, from year to year the income brackets were raised to take into account price inflation.

[33] Given that the top bracket is by necessity superior unbounded, in this case we used the mean value of the Italian household incomes that exceeded the lower boundary of the top bracket in the year of interest. Data on household incomes were drawn from the Bank of Italy database (SHIW - Survey on Household Incomes and Wealth). Since this survey does not cover all the years of interest, for missing years the variable has been determined adjusting for inflation over the available years.

[34] In drawing figure A1, we have dropped observations with yearly incomes lower than 1 million (359 observations) and bigger than 3 billions (2 observations).

Figure 1

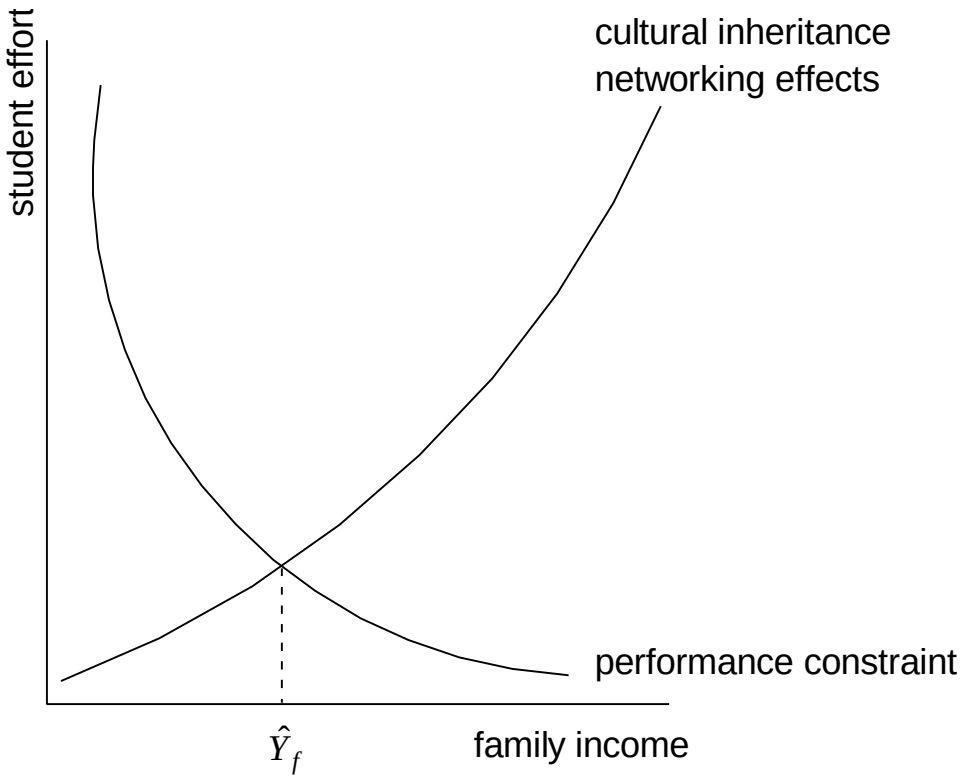

student effort
cultural inheritance
networking effects
performance constraint
$\hat{Y}_f$
family income

Figure 2

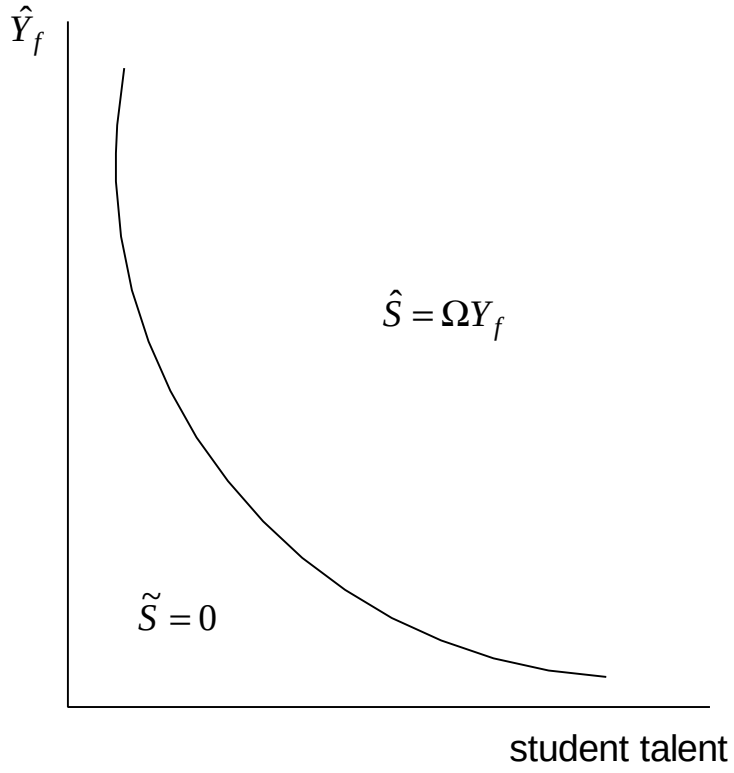


Figure 3

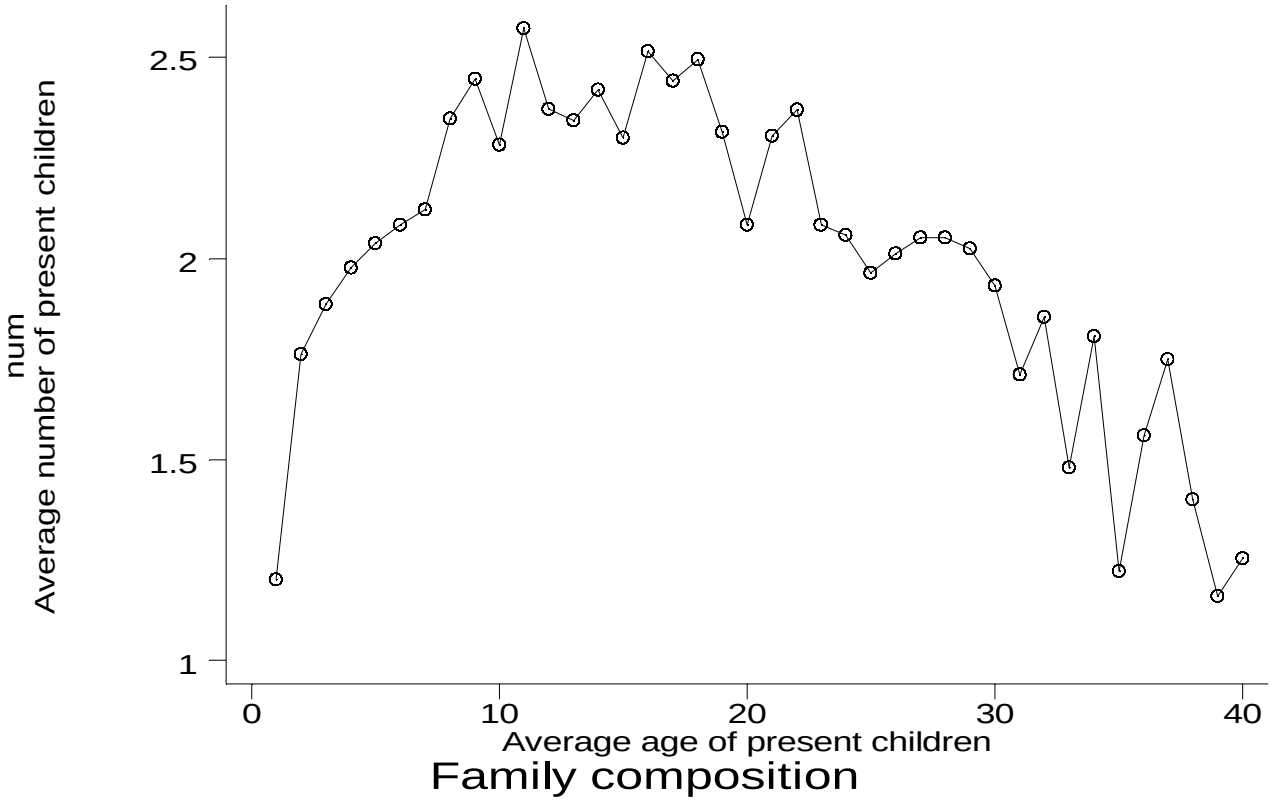

num
Average number of present children
2.5
2
1.5
1
0
10
20
30
40
Average age of present children
Family composition

Figure 4 - The empirical evidence

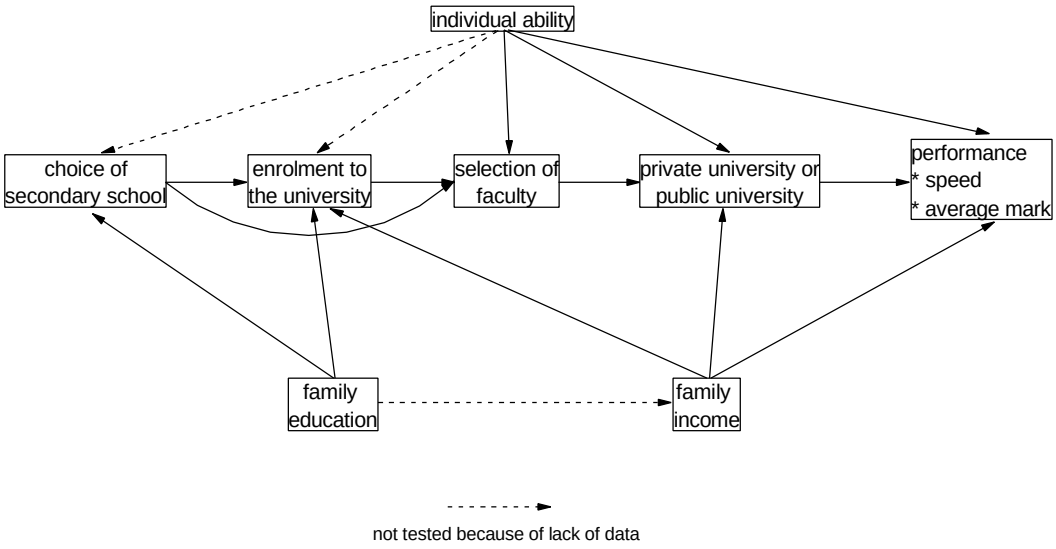
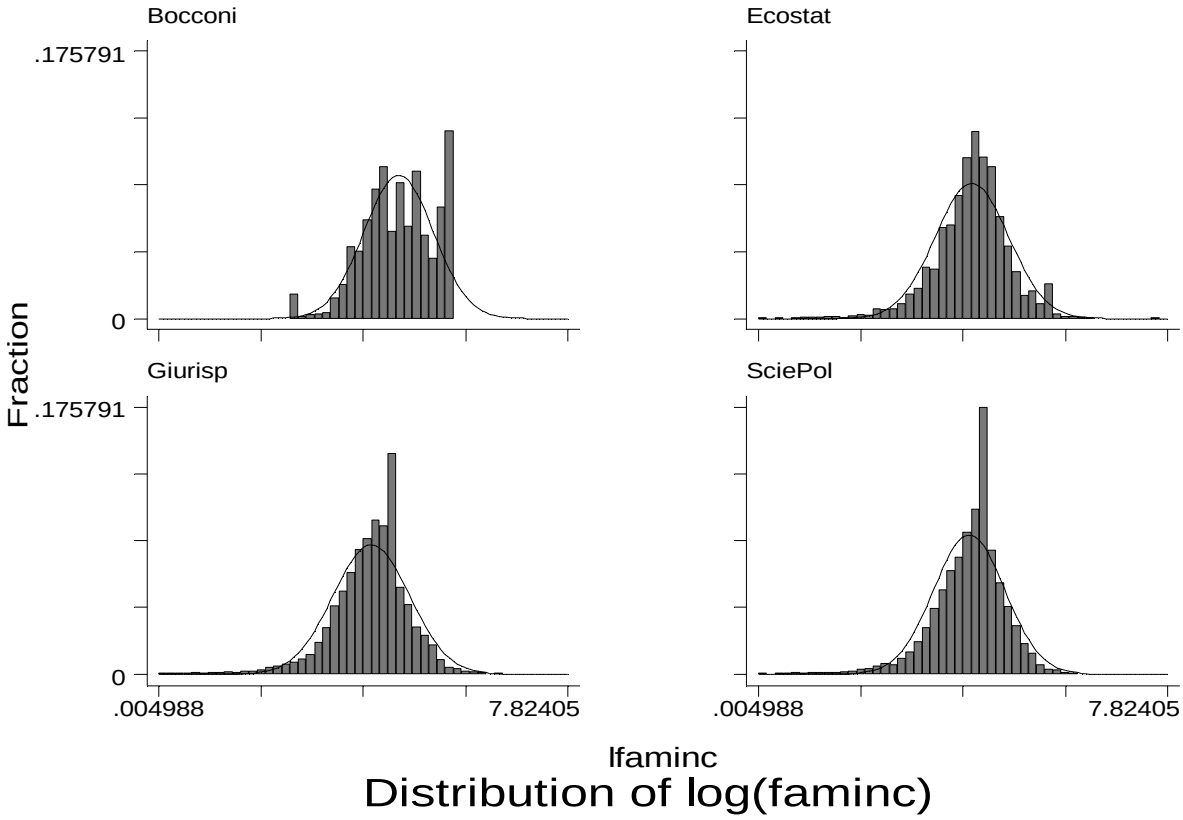


Figure A.1


Bocconi
Ecostat
Giurisp
SciePol
.175791
0
Fraction
.004988
7.82405
lfaminc
Distribution of log(faminc)