Choosing a career in Science and Technology[*]

Ezequiel Tacsir

UNU-MERIT,
University of Maastricht,
P.O. Box 616, 6200 MD Maastricht,
The Netherlands.

September 24, 2009

Abstract

Student choice is the center of many discussions about higher education policy. At the same time, and regardless of the emphasis put on achieving an important endowment of graduates trained in science and engineering, participation in these fields is stagnated or declining. Evidence suggests that the provision of additional scholarships for science and engineering students or abolishing the tuition fees will have practically no impact. The major problem seems to be that science and engineering programs suffer from a poor image, including as being difficult, leading to lower earning potentials than other specializations. The present study contributes to our understanding of the student choice process by highlighting by means of a probit model with selection the factors and dimensions that influence the choice of field of study. Specifically, we will show the role that non-pecuniary rewards play in the selection process. Using results from a self-designed survey to young individuals finishing high school in Argentina, we show that when factors as the social respect and expected labour demand are considered, the income expectations become irrelevant for the decision about what type of career to follow at the university. Specifically, those inclined towards science, technology and engineering fields are motivated by the belief of obtaining important rewards in the form of social rewards (i.e., reputation) and the expectation of graduating from a highly demanded university career.

1 Introduction

Student choice is an important topic in higher education policy. It is also often a subject of heated policy debates, particularly when financial issues like tuition fees and student support are concerned. Regardless of the worldwide emphasis of public opinion on the importance of science and engineering for the knowledge society, participation in most traditional science and engineering programs is declining and the growing participation in new science and engineering programs cannot make up for that decline. Providing additional scholarships for science and engineering students is shown to have practically no impact . The universities of technology experimented with giving students additional scholarships and financial guarantees in cases of dropout but this did not attract extra students. Simulation studies show that abolishing tuition fees might increase enrolments in science and engineering programs by 7% at most (Vossensteyn, 2005).

The literature on social exclusion is full of testimony from students who admit that they made the wrong decisions in their earlier years, partly because they did not know the consequences of their decisions, or did not heed the warnings of teachers and counselors to develop clearer plans. In some of these cases, the problem is not simply that they were uninformed abut career alternatives and schooling prerequisites; they were also unaware that they needed to know this information in order to make well-informed decisions. Here, we take as our starting point that choosing an occupation requires to combine different sources and types of information. This information will be acquired and transformed differently depending the identity and background of the concerned individual. In this sense, the present study will try to fill the gap in our understanding of the student choice process by highlighting the factors and dimensions that influence the choice of field of study. Specifically, we will highlight the role that non-pecuniary rewards have in the selection process.

Many public policies, and many providers of counseling and career guidance services seem to assume that information about careers and about educational pathways into careers is sufficient for individuals to make considered decisions. But decision-making is a much more complex process. Even in the model of rational decision-making that economists use, the requirements for rational decision-making are substantial: (1) Individuals need to have stable preferences, which for young people who are unfamiliar with the world is a substantial barrier. (2) Individuals need to know their preferences about an enormous range of options including those that are completely unfamiliar to them. (3) Individuals need to have a sense of time, of trading current costs against future benefits. (4) Individuals must be able to think probabilistically, about the differences between high-probability and low-probability events including low-probability events with high payoffs (like becoming a football star). (5) Individuals need to be able to judge the reliability of information they receive. In this setting, the provision of information may be necessary but not sufficient for self-interested decisions.

2 Student choice models

Literature on student choice recognises that choices to attend higher education are complex multistage processes involving a series of successive decisions that result in the decision to

attend or not attend higher education (Hossler et al., 1989). Generally, the student choice process is divided into three broad stages:

1. attending higher education or taking up other activities like work (predisposition);

2. learning about specific institutions and their characteristics (search);

3. choosing a particular higher education program, institution or mode of study, and once enrolled, choosing whether or not to persist (choice).

Three categories of theoretical models can be distinguished in the realm of student choice (Hossler et al., 1999):

Status-attainment models   (also called sociological models), are based on sociological theory that students choose according to what they think is expected from them. These models focus on the socialisation processes that shape the possibilities and ambitions of students since they were born, including family conditions, peer interactions, and school environments. Different variables may have interactive effects at different stages in the college choice process and the influence of such variables may change over time. The sociological models generally leave financial factors out of the analysis and instead utilise the following groups of independent variables to explain student choice:

1. Behavioural variables: students academic performance, students aspirations, spending of leisure time, motivation;

2. Background variables: family background characteristics (parental encouragement, parents income, education and occupation), gender, ethnicity, and influence of peers (e.g. teachers, friends).

Economic college choice models   are rooted in the assumptions that prospective students are rational actors who make careful cost-benefit analyses. These models, in turn, argue that students choose to attend higher education and select particular institutions or programs if and only if the perceived benefits of that choice outweigh the perceived benefits of other alternatives (opportunity costs). Economic college choice models focus on how individuals with certain characteristics (e.g. gender, ability and parental socio-economic status) differ in the extent to which financial variables are deemed important in choosing post-secondary education. In the process of decision-making, individuals face trade-offs and value (the costs and benefits of) various college characteristics (Hossler et al., 1999). Although economic models use many variables that are sociologically based, the models are focused on financial incentives and thus concentrate on the monetary costs and benefits of higher education. The major explanatory variables used in economic models include (Hossler et al., 1989):

- Monetary costs: tuition fees, net tuition fees (tuition fees minus financial support), other study costs (e.g. books and equipment), costs of living, and foregone earnings (opportunity costs);

- Monetary benefits: expected or future earnings, grants/scholarships;

- Intervening non-financial factors

Information-processing models are a third class of college choice models. Neither status-attainment nor economic models provide satisfactory explanations for enrolment decisions in the sense that they each focused on a limited range of explanatory variables. Therefore, the most powerful indicators in the different stages of the decision-making process have been combined in the information processing models. Such combined models have also been developed to better explain the effects of institutional recruitment efforts and policy interventions. The combined models have been extended by the idea of information-processing. In this perspective, college choice is regarded as a continuous cyclical process of uncertainty reduction in which prospective students make successive decisions, based on incomplete information, and then treat the outcomes of one stage as inputs to the next stage. The starting point in the information-processing model is the students particular social setting. The model introduces the (long-run) dynamic roles of parents, peers and schools in collecting and using information about college choice (Hossler et al., 1999). Prospective students social capital is believed to be influenced by background characteristics (e.g., ability) and family factors (e.g., parents income and education), but also by the preferences and attitudes transmitted to children, and the way in which parents motivate their children, such as through encouragement of reading, critical thinking and college attendance. As a result, college choice is seen as a process that starts early and requires different sets of information at different times. Collecting and processing information enables students to reduce uncertainty about colleges and programs considered and applied to.
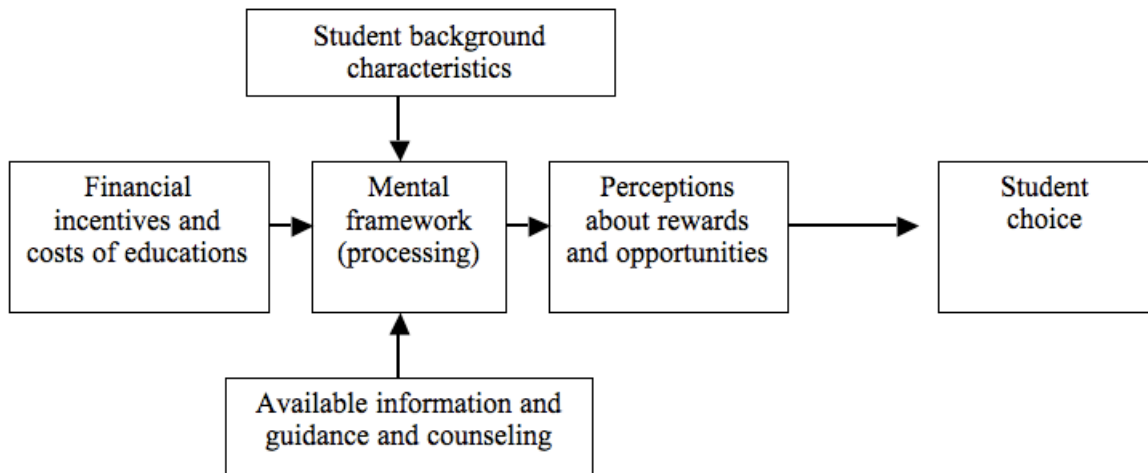
Figure 1: A simple perceptions model of rewards conditioning student choice

Altogether, the information-processing (or combined) models are the most extensive student choice frameworks, including various choice stages and an extensive set of explanatory variables that are deemed important in the various stages of the student college decision-making process.
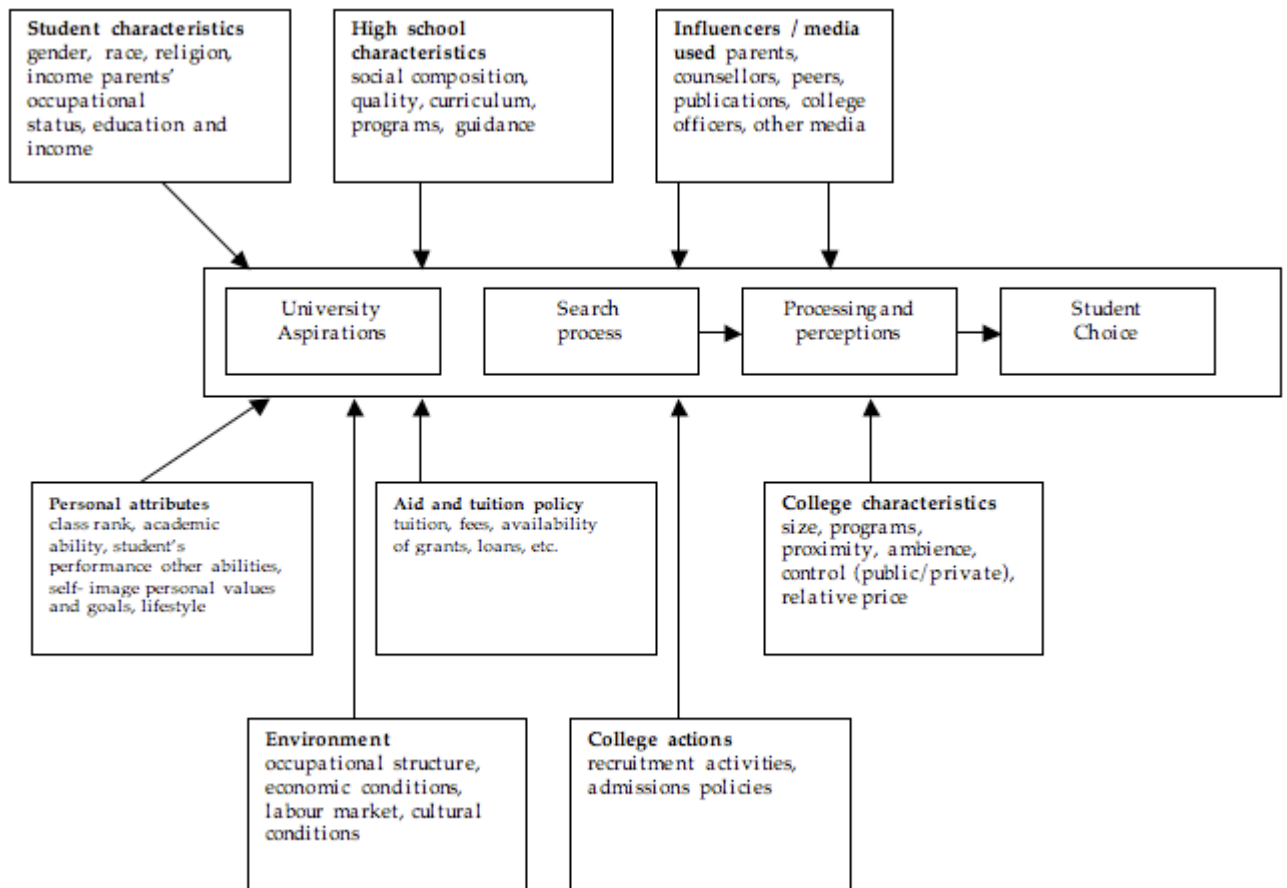
Figure 2: Student choice model and its determinants variables and dimensions. Adapted from Vossensteyn (2005).

3 Received literature

Traditionally, the literature has focused mostly on the study of educational attainment by recurring to either cross-section or longitudinal micro data. Most of these studies were able to show the existence of a correlation between parents and childrens incomes and education. However, there is much less empirical evidence on the effect of family and social background on the choice of subject at tertiary level. Specifically, there are only a few studies that addressed the effects that social class might have on the choice by recurring to individual-level information. Oosterbeek and Webbink (1997) found for the Dutch case that children from high income families were less likely to enroll in technical fields, but more likely to persist in their choice once they had undertaken a technical education. Similar results are presented by Van de Werfhorst et al. (2001) who found, again for the Netherlands that children of the cultural elite were more inclined enrolle in fields elds where they could acquire cultural capital (i.e., non technical elds), while students from the economic elite were under-represented in cultural fields (such as arts and humanities). By contrast, low social class individuals were over-represented in economics and engineering. In relation to this point, Davies and Guppy (1997) analysed US micro data to find that high ability and low social class individuals were more likely to enter high-return fields. Van de Werfhorst et al. (2003) estimated for the 1958 cohort in the UK a multinomial logit model of subject of graduation considering six broad subject categories and including among the explanatory variables family background variables (such as parental social class and measures of economic and cultural capital), ability, and measures of comparative advantage. The authors found that children from professional backgrounds preferred faculties of medicine and law, even after controlling for ability. However, they did not nd other social class differences, which the authors themselves stated were due to the specic characteristics of the cohort studied. In fact, at the time of the study only a very small minority of the working class entered higher education. For the same country, Bratti (2006) did not find statistically signicant differences among social classes in the probability of enrolling in different subjects. Boudarbat (2004) find using Canadian data that fathers favour studies in Sciences while mothers favour studies in Health.

In relation to earnings expectations, Kelsall et al. (1972) showed that lower social class students may be more inclined to choose subjects that offer better labour market prospects, being this confirmed by Hansen (2001). Boudarbat (2004) found for the case of Canada that expected earnings significantly influence the choice of the college field, a fact which agrees with previous studies in the country such as Berger (1988), and Montmarquette, Cannings and Mahseredjian, (2002). Similar evidence is presented by Arcidiacono (2004 and 2005). Specifically to gender, the same author finds that women -similar to Montmarquette, Cannings and Mahseredjian (2002)- are less influenced by earnings relative to men. Berger (1988) argue that students are likely to select fields of study associated with greater streams of future earnings rather than fields with higher beginning earnings. Yet, other studies support that starting wages are important in students choices.

Of course, pecuniary variables are not the unique variables that drive students choices. Nonmarket variables such as interests and abilities also exert a significant impact on those choices (see for example Fiorito and Dauffenbach, 1982), but data availability does not make it possible to control for these variables. Beffy, Fougere and Maurel (2009) assess the sensitivity of students major choices to expected earnings by estimating a semi-structural

model of post-secondary educational choices in the case of France. These authors state that the choice of a major of study is mainly driven by the consumption value of schooling which is related both to schooling preferences and abilities, rather than by its investment value. That paper provides strong evidence that nonpecuniary factors are a key determinant of schooling choices. From a policy point of view, this paper suggests that the solution to the shortage for some skills, mainly scientic in the European context, does not lie principally in financial incentives. The solution probably lies upstream, within formation of preferences and abilities at school.

4   Data description

The data used in this paper comes from a specially designed survey that was conducted during the first week of November 2008 to individuals enrolled in their last year of secondary school in the province of Río Negro, Argentina. Taking into consideration that the academic year finishes in the country in mid-November, the surveyed individuals were already confronted with the need to decide about their future plans. In this sense, it is expected that they have arrived to a quite robust decision and were involved in activities aimed at collecting information and suggestions. Taking in consideration that the sample was constructed after the distribution of students by type of school and regional location, the institutions became the locus for the interviews.

4.1   Main characteristics of the interviewed population

Located in the Patagonian region of Argentina, Río Negro province concentrates 1.5 % of the country's total population and 1.9% of the secondary high school students. Specifically, the secondary level students represents 35.7% of the total student population living in the province and 11.9% of the total inhabitants. According to the latest information available, the province of Río Negro presented slightly more than 5,000 students on their last year of secondary education, while the latest population census reported that 53.4% were females and 46.6% males (INDEC, 2001). In this respect, our pool of 741 respondents presents a distribution that matches this information at the provincial level: 55% of our survey respondents were females (411 cases) and the remaining 45% to males. In relation to the sector of education, the province is endowed with 129 secondary schools of which 88 are public (68%) and remaining 41 (32%) are private. The public sector agglutinates 70.4% of the students, being the rest enrolled in private institutions. Our interviewed sample presents an almost identical distribution of students (69% and 30.9% of the students, respectively). Table 1 shows the distribution of our interviewees in respect to their gender and type of high school that they attend.

Being Argentina federally organized, the different provinces[1] have the liberty to set the organization of their education system and their contents. At the same time, there are no final year tests nor a student register where her past performance and grades are recorded. In the particular case of the province of Río Negro, education is organized following the guidelines by the so-called Federal Education Law, that divided the 12 years of compulsory education in four different cycles of identical length. Currently, the final three years of

---

[1]More precisely, 23 provinces and an autonomous federal district.

	Type of school		
Gender	Private	Public	Total
Female	137	274	411
Male	92	238	330
Total	**229**	**512**	**741**

Table 1: Interviewee's distribution by type of school and gender

compulsory education are called "multimodal" and are supposed to provide more specific skills and knowledge oriented towards specific disciplines or careers. Such an innovation produced that the number or specialisations offered to be much wider and many times labeled following some marketing principles. At the same time, this modification implied that some students are not taken courses in some subjects (such as sciences, maths, for example) since they have completed the 9th grade.

The information provided by international tests (such as PISA) allows to characterize the performance of the Argentine education system as a whole in terms of its output and main features. Table 4.1 shows the position that Argentina obtained in the language test for LAB (1997), PISA (2000), PIRLS (2001) and PISA (2006). There we observe that the relative good performance at the regional level, vanishes when a larger set of countries, with a high participation of developed countries, is included.

Ranking	LAB (3rd) (1997)	LAB (4th) (1997)	PISA (2000)	PIRLS (2001)	PISA (2006)
LATAM sub-sample	2 / 11	3 / 11	2 / 4	2 / 2	4/6
Total Sample	2 / 11	3 / 11	34 / 39	31/ 35	51/57

Table 2: Performance of Argentina in International Tests. Ranking ins relation to Latin American countries and the whole pool of participant countries.

A striking figure for Argentina is the difference in performance between high socioeconomic level and low socioeconomic level students. According to PISA 2000, the 25% with highest SES in Argentina has an average score which is 104 points higher than the lowest 25% students. This is the largest difference among the Latin-American countries included in the sample, and well above the difference for OECD countries. Also note that the top 25% is closer to OECD average (62 points below) than to the lowest 25% (84 points). See Table 4.1 for details.

Specifically, the province of Río Negro presents a performance that places it in the group of top performers in the country. Table 4.1 shows the percentage of students that present a performance considered either "medium" or "high" for the province and the national average in three different subjects: language, maths and natural sciences. There, even when the student performance is relatively lower in maths at every level, we can observe that Río Negro outperforms the country performance at every level and subject considered. At the same time, the performance at the provincial level is quite homogeneous. Computing the coefficient of variation at province level (ratio of standard deviation of individual test score at province level to average score at province level), the province presents values of

Countries	0-25%	S.E.	25%-50%	S.E.	50%-75%	S.E.	75%+	S.E.	Top vs. lowest
Argentina	379	(7.1)	393	(9.9)	440	(9.6)	483	(6.3)	104
Brazil	368	(3.9)	387	(3.8)	413	(4.0)	435	(4.5)	67
Chile	373	(3.8)	388	(4.3)	420	(4.6)	466	(3.5)	93
Mexico	385	(4.1)	408	(3.7)	435	(4.0)	471	(5.9)	86
Peru	283	(5.9)	317	(4.3)	338	(4.7)	383	(5.8)	100
Avg. OECD	463	(0.9)	491	(0.8)	515	(0.7)	545	(0.9)	82

Table 3: Performance in PISA 2000 according the SES quantiles. Source: Auguste et al. (2008) based on PISA, Argentina country report.

17.5% and 17.8% for maths and languages tests, respectively. In both cases the city of Buenos Aires presents the smaller variation (17.1% and 15.8%), ranking Río Negro on the second and fifth places, respectively.

	Language		Maths		Natural sciences	
	Country Avg.	Río Negro	Country Avg.	Río Negro	Country Avg.	Río Negro
3rd grade	68.9	81.1	61.3	73.7	74.4	83.4
6th grade	70.3	73.1	59.6	66.0	63.0	68.5
9th grade	46.5	52.3	45.2	51.4	65.1	78.1
12th grade	61.6	73.6	48.3	62.2	53.0	63.5

Table 4: Percentage of students that presented a medium or high performance on language, maths and natural sciences tests. National evaluation (2005). For the country and province of Río Negro.

In general, almost two thirds of the total interviewees (61.3%) claimed that they have passed math courses on the previous year without difficulties. This figure reaches 76.2% when they were consulted about language and literature courses.[2] However, these important groups as a proportion of the total respondents are distributed unevenly among their future career aspirations. In this sense, and in sintony by the evidence just presented for the OECD countries, those who informed that will follow natural and physical sciences and engineering stand out for their good performance at maths, presenting the higher figures for the option "passing without difficulties": 72.0% and 67.4%, respectively.[3] However, these two groups of students are exactly those that inform the relatively poorest performances in languages (70.0% and 69.9%, respectively). Specifically, are the aspirants of architecture and economics those that present the bigger proportions of individuals that pass this subject without complications. Table 4.1 presents these results.

---

[2]The comparison of these proportions with the percentages of individuals presenting medium or high levels of performance in the national evaluation just presented present percentages that are almost identical (62.2% and 73.6%, respectively). This makes us confident about the robustness of our responses. Unfortunately, our survey did not asked about their performance on natural sciences since not every student in the sample took courses on the subject on the field on 11th grade.

[3]In both cases, these proportions result significantly different from the mean at the 1% level.

Field of Science	Passed math without difficulties (in %)	Passed language without difficulties (in %)
Econ. & Business Adm.	62.7	80.0
Medical Scs.	62.5.	78.6
Law	55.0	76.7
Human & Social Scs.	57.5	77.5
Engineering	67.4*	69.9
Architecture	55.0	81.0
Education	52.1	77.1
Nat. & Physical Scs.	72.0*	70.0
Total	**61.3**	**76.2**

Table 5: Previous performance at maths and languague by field of science. On percentages. Significance: *: 10%.

4.2 Family background

Río Negro presents a smaller proportion of inhabitants that attended higher education (13.8%) that the national average (15.6%). Since parental background is believed to affect the education decisions (both in terms of level and orientation), we are interested in characterizing the education background of the parents of those youngsters finishing high school. However, in respect to their parents' education, our respondents indicate that the proportion of parents with education beyond the compulsory post-secondary levels is higher than both the provincial and national averages. Specifically, 37.3% of our interviewees declare that their fathers have attend (either completed or not) post secondary studies. Those who specifically attended university reaches 27% with 16% informing that their fathers obtained an university degree. Again, the percentages are higher for the mothers case. In this case, 41% have attended tertiary education, with 29% of the total pool were enrolled in university studies. In total 18.1% obtained a degree, and almost one quarter of this group followed postgraduate studies.

Conducted at the same time that our survey, the Labour Survey (EPH) reported for the urban population of the province of Río Negro an unemployment rate of 3.1% for males and 9.0% for females aged between 30 and 64 years. At this respect, when consulted about their parents' employment status, our interviewees indicated that 2.2% of their fathers and 1.6% of their mothers were unemployed. In relation to the household monthly income, the average reported by the interviewees reached AR$ 4,191 (equivalent to US$ 1,360 at the time).[4] This average value is slightly inferior that the one resulting from multiplying by two the average wage obtained by the employees working at the private sector in the province (AR$ 2,160).[5]

---

[4]It should be noted that only 44% of the interviewed individuals provided this information. Also, it is interesting to mention that male interviewees reported household incomes that on average were 40% higher than those reported by the female counterparts.

[5]Source: EPH, net average wage at the private sector. Third quarter 2008.

4.3 Future plans

Traditionally, access to university in the country is equated with social mobility. Two factors have a fundamental importance in this respect: studying has no costs and admissions in most of the cases only require to have finished the secondary studies. Then, at the national level, we observe that an important proportion of those that have finished high school have started university studies (34.5%), this figure rocketing to (63.2%) for the younger population (20 to 30 years old). Similarly, Río Negro presents proportions that reach 39.6% and 53.6%, respectively.[6]

Then, when the interviewees were asked about their future plans, it is not surprising to find that an important proportion (69.7%) declares that will continue its studies at the university level. This percentage matches quite well the observed reality at both the provincial and national levels. Those interested in continuing their education at non-university institution reach 10.6%. Interestingly, 11% informs that they are undecided about their future plans, while the remaining 7.9% is inclined to enter the labour market without further education. When we analyze further this data, we observe that there are no substantial differences in respect to their future plans with respect with the interviewees' gender or location. As might be expected, males present a bigger proportion of individuals declaring their intentions to work right away. As the other side of the coin, and in agreement with the received literature, we find bigger percentages of females both undecided and inclined towards tertiary non-university studies.

	Future plans (%)			
Gender	Tertiary studies	University	Working	Undecided
Female	13.0	69.0	6.0	12.0
Male	8.0	71.0	11.0	10.0
Total	**11.0**	**70.0**	**8.0**	**11.0**

Table 6: Distribution by future plans and gender

We should mention that the decision to attend university is the preferred option for the interviewed youngsters no matter their parents education level (Table 7). As expected, those individuals whose fathers completed university studies, are almost unanimously inclined to reach the same level of education, in coincidence with the assumptions from inter-generational mobility studies. With an important proportion, those whose fathers attended but not obtained their university diploma are closely behind these previously mentioned levels. Additionally, the individuals coming from low-education backgrounds are primarily inclined to attend university, reaching similar levels of interest (59% and 52.2%) to the percentage of individuals that make this transition at the aggregate levels. Evidently, the personal plans are heavily influenced by the dominant perception about prerequisites for individual success and existing opportunities.[7]

---

[6]Nevertheless, previous studies show that the population that attends university are, generally speaking, those belonging to more privileged backgrounds. Unfortunately, these studies only provide partial pictures since there is no updated university censuses or nationwide surveys oriented towards producing such characterization.

[7]It is worth mention that when we asked the interviewed individuals to indicate in terms of relevance different factors that might be considered drivers or individual success, two main factors stand as the

Father Education Level	Future plans			
	Tertiary studies	University	Working	Undecided
Uncomplete primary school	13.0	59.0	13.0	15.0
Completed primary school	17.0	52.0	10.0	20.0
Uncompleted secondary school	9.0	70.0	7.0	15.0
Complete secondary school	9.0	76.0	10.0	5.0
Uncomplete Tertiary	**17.0**	67.0	0.0	17.0
Complete Tertiary	**7.0**	74.0	2.0	14.0
Uncomplete University	14.0	**78.0**	1.0	7.0
Complete University	1.0	**93.0**	3.0	3.0
Postgraduate studies	6.0	**94.0**	0.0	0.0
Total	**11.0**	**70.0**	**8.0**	**11.0**

Table 7: Distribution by future plans and father education level

5   Attractive careers

As mentioned elsewhere, the main driver for this study is understanding the reasons behind the concentration of university students in a few careers. Despite its importance, only very few studies have focused on studying the factors influencing this decision or the perception that youngsters have about the different options.[8] Understanding such a complex phenomenon requires to conduct a self designed study that will represent the young population of the country. At this respect, a fundamental issue that we asked our interviewees was to name two careers that they considered attractive. Taking into account the national classifications we observe that the distribution of answers by broad group of disciplines obtained in the Province of Río Negro are almost identical to the one observed for new enrollments at the national system. (Table 8.) Again, we are confident that the results and evidence presented here can be extrapolated easily to the country as a whole.

Broad groups	Survey (on %)	New enrollments (on %)
Health sciences	10.9	12.9
Applied & Basic sciences	26.7	29.9
Humanities & Social sciences	62.4	57.2
Total	100.0	100.0

Table 8: Distribution of new enrollments at the university system and of attractive careers. On percentages. Own elaboration using survey's results and University Statistical Yearbook(2007).

---

most important determinants: chosen profession and attending university. Also, and providing some indications that the individuals believe that specific occupations provide access to specific rewards, the professional orientation is considered even more important than the individual ability. At the same time, the expectations about social mobility and a meritocratic society are palpable when we observed that neither social origin nor access to contacts are considered determinant of the individual performance.

[8]Two endeavors aiming at addressing this issue are the National Survey of Perception for Science and Technology and the just finished studies about the Science as a Carreer in teenager population.

Specifically, and taking into account the two disciplines informed by each respondent, we observe that the list of most attractive careers presents a combination of "traditional" careers (i.e., medicine, law, psychology and accountancy) with others recently highlighted in both the political and academic discourses (such as engineering and informatics). Nevertheless, those that belong to the first group are those that lead the ranking in terms of mentions, concentrating an important percentage of the intentions. Table 9 presents the list of the ten most attractive careers.

Order	Career	Number of mentions	Percentage
1	Medicine	104	8.0
2	Law	88	6.9
3	Psychology	83	6.4
4	Accountant	64	4.9
5	Architecture	57	4.4
6	Business Administration	47	3.6
7	Tourism administration	43	3.3
8	Mechanical Engineering	43	3.3
9	Physical Education	42	3.2
10	Informatics	41	3.2

Table 9: List of more attractive professions

It is worth mentioning that these traditional careers are considered to be included among the most attractive for the individuals from both genders. In Table 10 we can see that the list of most preferred careers in the case of males interviewees includes a higher proportion of technical disciplines (such as informatics, mechanical, electronic and civil engineering), being the fist two careers leading the ranking. In the case of females, it is patent their inclination towards traditional careers and those in the social and humanities fields.

	Males				Females		
	Career	%	Cumulated		Career	%	Cumulated
1	Informatics	7.1	7.1	1	Medicine	9.7	9.7
2	Mechanical eng.	6.9	14.0	2	Psychology	8.9	18.6
3	Medicine	5.5	19.4	3	Law	8.2	26.9
4	Architecture	5.3	24.7	4	Accountant	5.8	32.7
5	Law	4.8	29.5	5	Tourism adm.	4.3	37.0
6	Electronic eng.	3.9	33.4	6	Business adm.	4.0	41.0
7	Accountant	3.7	37.1	7	Architecture	3.6	44.7
8	Physical ed.	3.4	40.5	8	Physical ed.	3.0	47.6
9	Psychology	3.2	43.6	9	Education	2.2	49.8
10	Civil eng.	3.2	46.8	10	Journalism	1.8	51.6

Table 10: List of more attractive professions by interviewees' gender. On percentage and cumulated percentages.

5.1 Influences in the decision

When confronted with the decision about whether to continue studying or not and what to study, youngsters are supposed to compile and process numerous sources of informations, while taking into account suggestions from teachers, friends, counselors and family members. It is this combination of information and personal experiences that shapes the individuals perceptions about the cost, opportunities and expected advantages of different options. Resulting from this particular set of information, a decision is made.

In the literature on career development, parents and other family members are among the most important influences, sometimes the most important (Grubb, 2002). Sometimes these influences are beneficial, for example when sophisticated parents can provide their children with perspectives on a wide variety of employment and on educational prerequisites, and when their own lives provide models. In other cases, the influences are surely negative in the sense of constraining the options to which a child can aspire.[9] In other cases parents lack the knowledge that might benefit their children.

Family background   In relation to family background, the comparison between the parents training and the most attractive career to our interviewees shows important similarities. The distribution of the specialization of the previous generation across broad groups is quite similar to the one informed by our respondents, being the proportion of parents inclined towards human and social sciences bigger than in the younger generation. Our interviewees are, on the opposite, slightly more oriented towards applied and basic sciences.

It is important to mention that the distribution across these groups of sciences is different in relation to the gender, both for our interviewees and their parents. In fact, females high school students present an almost identical distribution than the one presented by the interviewees' mothers. At the same time, male respondents are a close match for father's distribution across fields. it is interesting to note that our male respondents are those that incline our aggregate distribution to be more biased toward technical fields, being less interested in health-related careers or in human and social disciplines. Table 11 presents these distributions for our interviewees and their parents, distinguishing in both cases by gender.

Broad groups	Mothers (%)	Females (%)	Fathers (%)	Males (%)	Parents (%)	Respondents (%)
Humanities & Social	65.0	60.5	42.0	33.2	54.9	48.5
Applied & Basic	20.3	23.8	42.8	56.8	30.2	38.3
Health sciences	14.7	15.7	15.2	10.0	14.9	13.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 11: Distribution of interviewees' most attractive career and parents university specialization by broad group of science and gender. On percentages.

---

[9]Constraints on aspirations occur in both high-status families for example, when fathers pressure their sons to follow in their footsteps and in low-status families, for example when parents pressure their children to remain in their culture of birth.

Suggestions and parents' recomendations   In this latter aspect, we asked the interviewees to indicate their parents (both mother and father) preferred career and whether they have received or not some suggestion from teachers. As Table 12 shows there are strong similarities between the most frequently received suggestions by their parents and professors. More interestingly for our purposes, we observe that these suggestions are also quite similar to the interviewees' preferences presented just before.

Order	Suggested by parents	Suggested by teachers
1	Law	Accountant
2	Medicine	Law
3	Engineering	Medicine
4	Accountant	Engineering
5	Architecture	Tourism administration
6	Psychology	Psychology
7	Informatics	Informatics
8	Physical Education	Mechanical Engineering
9	Foreign trade	Physical Education
10	Business Administration	Business Administration

Table 12: List of 10 most suggested careers by Parents and Teachers. On percentages and cumulated percentages.

Again, careers like Law, Accountancy, Medicine and Psychology are frequently mentioned. It is interesting to mention that the suggestions received from either mothers or fathers are strongly similar. In fact, the first six suggestions are identical and concentrate almost 70% and 68% of the total mentions, respectively (Table 13). This together with what was mentioned about the professors' suggestions give us room to think that there is an important social consensus about what careers should be followed.

	Suggestions from fathers				Suggestions from mothers		
No.	Career	%	Cumulated	No.	Career	%	Cumulated
1	Law	18.0	18.0	1	Law	18.0	18.0
2	Medicine	13.6	31.6	2	Medicine	16.9	34.9
3	Engineering	11.2	42.8	3	Engineering	7.9	42.8
4	Accountant	7.6	50.4	4	Accountant	5.8	48.6
5	Architecture	4.8	55.2	5	Architecture	4.7	53.2
6	Psychology	4.0	59.2	6	Psychology	3.6	56.8
7	Informatics	2.8	62.0	7	Physical ed.	3.2	60.1
8	Civil engineering	2.8	64.8	8	Business admin.	2.9	62.9
9	Veterinary	2.4	67.2	9	Tourism	2.5	65.5
10	Oil engineering	2.4	69.6	10	Informatics	2.5	68.0

Table 13: List of 10 most suggested careers by fathers and mothers. On percentages and cumulated percentages.

Again, while the most traditional careers lead the list of suggestions received, males tend to receive more suggestions oriented towards technical fields. In fact, four different

engineering specializations and informatics are included among the ten most mentioned. In the case of females, the suggestions received match perfectly the distribution of new enrollments at the university level as a whole. Instead of such an emphasis on engineering, there is a recurrent suggestion to go for traditional careers, psychology and education related fields.

One interesting aspect to analyze is whether the individuals parents suggest to follow the same fields of study that they have or not. In this respect, we observe that those parents who have followed university studies in oriented towards applied or exact sciences are particularly those who are more keen about their offspring being enrolled in the same type of career. Here, even when previous generations trained in these technical fields would orient and suggest younger aspirants to enroll in these careers, the small proportion of parents' specialized in these fields implies an information barrier that shows difficult to overcome. This is more evident when we classify the careers in either priority or non-priority fields.

Coincidence with other's opinions As we mentioned previously, there is a strong coincidence between the list of careers that the interviewees consider as attractive and the list of recommendations and preferences by teachers and parents. At the aggregate level, the choices of our respondents are equivalent to their mother preferences on 69.8% of the cases, 67.1% for their fathers and 61.2% for those who received suggestions by teachers. When we analyze further this information by careers, we observe that the maximum level of coincidence with the mothers' opinion is with Law studies (being this percentage significant at the 1% level), while in the case of fathers' suggestions the higher similarities are found on engineering and medical sciences (both significant at the 1% level). At the same time, teachers suggestions have important level of coincidence for economics and engineering. Natural and Exact sciences and Informatics present small levels of agreement with either parents or professors preferences and suggestions, without reaching 50% in any of the cases. This, again, is a dimension that should be taken into account when exploring the occupation choice. The following table summarizes these results.

6 Perspectives about different careers

University careers present an interesting feature: we all know professionals from different specializations but, nevertheless, very few people would be able to know exactly the income or the main characteristics of the jobs of many professions. Necessary, we all build perceptions about them. In most of the cases, these perceptions or incomplete information sets guide the decisions about what to choose. This chapter is exactly about this. About the perceptions that individuals have about the different careers.

There is a widely held perception that careers in SET very unattractive and hold little appeal for young people. This perception covers remuneration, career structure, work environment, status and marketing (Europe needs more scientists, 2004). This tendency occur despite some important characteristics of such careers. First, remuneration of SET workers is in the upper quartile of professions. Second, unemployment amongst holders of SET tertiary education qualifications is lower than that of the population at large. Third, the diversity of careers for people with an SET background is shown to be great and

Field of Science	Agreement with mother's preferences (in %)	Agreement with father's preferences (in %)	Agreement with Teacher's suggestions (in %)
Econ. & Business Adm.	72.7	72.2	74.5***
Medical Scs.	76.3	83.6***	49.1
Law	84.6*	63.6	69.2
Human & Social Scs.	53.2	42.6	56.9
Engineering	72.1	89.6***	69.3***
Architecture	78.9	76.2	63.0
Education	66.7	29.4	50.0
Nat. & Physical Scs.	50.0	46.7	42.9
Total	**69.8**	**67.1**	**61.2**

Table 14: Degree of agreement with parents and teacher's preferences. On percentages. Significance levels: ***, **, * stand for 1%, 5% and 10%, respectively.

probably far more varied than in any other sector. Then, we have reasons to believe that industry and the profession are not selling careers in SET in the most attractive fashion.

For all this, we believe is fundamental to understand the perception that the prospective students have about these disciplines, their expectations about the future. Then, we asked our interviewed individuals to provide their opinion about income, individual valoration, social reputation and labor market demand for the most demanded fields. The eleven careers presented in the survey concentrates 71.8% of the total enrollments at the university system in 2007, while presented a rate of growth in their enrollments that reaches 17.4%, just below the 21.0% exhibited by the system as a whole.

6.1 Income

The first dimension that we asked about the list of most frequently demanded careers is income for a graduate.[10] Seems plausible to expect that among the careers believed to have the higher incomes will coincide with those indicated as the most attractive previously (section 5). When consulted about it, the interviewees indicated architecture, engineering, medicine and law as the careers with the higher wages. Interestingly, and in strong contradiction with every statistical evidence, informatics is listed among the careers with the lowest income, slightly over physics.

6.2 Social reputation and individual consideration

Interested in understanding the role that "social rewards" might play in the occupation choice, we asked our interviewees to indicate using a 5-point scale how much they respect and how much they believe society values each of the professionals listed. In relation to

---

[10]The literature agrees that expectations about more distant periods become more difficult for young individuals. Then, we inclined to obtain information about a recently graduated professional. We realize that the income profile are certainly different across time and we are not able to control for this fact.

Professions	Monthly income (Argentinean pesos)
Physics	2,357
Law	3,906
Informatics	2,486
Business Administration	3,381
Engineering	4,626
Sociology	2,396
Psychology	2,826
Medicine	4,429
Designs	2,844
Architecture	4,784
Communication	2,393

Table 15: Monthly income of a list of careers in Argentine pesos.

their opinion about social consideration, medicine, law and engineering occupy the first places. Medicine and engineering are on the top of the rankings in terms of individual respect, followed by architecture and law. It should be noted that the careers in the field of applied sciences such as architecture and engineering are well respected personally but believed to be more punished socially. Designs and physics show an important difference between personal and social rankings but still are considered quite poorly.

Professions	Social Perception 1= Very high... 5=Very low	Individual Perception 1= Very high... 5=Very low
Physics	3.15	2.37
Law	2.02	2.27
Informatics	2.48	2.42
Business Administration	2.27	2.39
Engineering	2.06	1.63
Sociology	3.08	2.71
Psychology	2.69	2.44
Medicine	1.62	1.54
Design	3.20	2.85
Architecture	2.21	2.00
Communication	2.98	2.78

Table 16: Social and individual perception of a list of careers

6.3 Demand in the labour market

In respect to the opinion about the careers with the higher demand for their graduates, the list is lead by engineering, law and informatics. While the first two careers were included among those with the higher expect incomes and better standing in both social reputation and individual respect, informatics is an interesting case. This career, focus of multiple

specific studies, even when is perceived as career with an important demand, its wages are believed to be relatively lower. This, combined with the bad performance in terms of social rewards might explain the reasons between the recent incapacity to attract enough individuals to satisfy the rampant demand expressed by the growing number of companies in the country.

Professions	Labour demand 1= Very high... 5=Very low
Physics	2.24
Law	1.73
Informatics	1.94
Business Administration	2.12
Engineering	1.62
Sociology	2.48
Psychology	2.43
Medicine	2.06
Design	2.17
Architecture	2.43
Communication	2.70

Table 17: Demand of the graduates from a list of careers

6.4 Synthesis

With the intention of providing a summary of the considered dimensions, Table 18 presents the relative position for each of the professions listed in comparison with the average for each of dimension. Hence, a (+) indicates that the career presents an average that exceeds the aggregate average, while (-) refers to the opposite situation.

There, we can observe different situations. Careers such as law, medicine and engineering present positive values for every dimension. While the university statistics seems to agree with the results offered by the first two disciplines, the opinions about engineering and its characteristics does not seem to be reflected on the enrollment evolution. Similar questions pose careers such as sociology, psychology, communication and designs specialisations. However, in these cases the incongruence is patent since all of these careers obtained negative values for every dimension while the enrollments figures show a traditionally high level of new enrollments for the first three cases and a rocketing performance in the case of the different designs specialisations. Architecture only receives a negative assessment in relation to the labor demand, while business administration obtained half of positive considerations and half of negative ones. Physics, as an example of natural and physical sciences, only obtained negative values.

Taking this as a starting point, Table 19 presents the information about the share of enrollments and its rate of variation in the last decade for the different groups formed by the type of assessment offered by our interviewees. Generally speaking, the group that receives the positive assessment not only presents an important share of the new enrollments but presented an evolution that was higher than the one presented by the system as a

Professions	Income	Social Perception	Individual Perception	Labour demand
Physics	-	-	-	-
Law	+	+	+	+
Informatics	-	+	-	+
Business Administration	-	+	-	+
Engineering	+	+	+	+
Sociology	-	-	-	-
Psychology	-	-	-	-
Medicine	+	+	+	+
Design	-	-	-	-
Architecture	+	+	+	-
Communication	-	-	-	-

Table 18: Summary of characteristics for a list of careers.

whole. The second group can be characterized by presenting an important share of the present figure of enrollments but a slower growing trend than the one experienced by total enrollments. Even the career that presents the most dynamic performance of those in these group –informatics- exhibits a rate than only reaches half of the average change. Finally, the bottom group concentrates a relatively smaller group but with important growth rates. Specifically, these rates are fostered by the rocketing behavior of both psychology and sociology. Recently newly established careers -such as those in design- present an important share but not such a dynamic behavior. While physics stands out for its almost negligible level, communication is the only career presenting a negative trend in the last decade.

Professions by group	Share (2007)	Variation (1997-2007)
Positive assessment	**29.3**	**24.9**
Law	13.5	10.2
Medicine & paramedics	10.4	42.5
Engineering	5.4	10.1
Mixed assessment	**25.6**	**6.6**
Business Administration	17.6	3.5
Informatics	5.4	10.1
Architecture	2.6	3.6
Negative assessment	**14.7**	**24.6**
Psychology	4.8	30.0
Sociology	3.6	121.7
Communication	3.1	-15.1
Design	3.0	12.5
Physics	0.2	10.1

Table 19: New enrollments, share and rate of variation for a list of selected careers by assessment group. On percentages.

7 Priority fields

Distribution of students, new enrollments and graduates are biased against the natural and physical sciences, engineering and those careers related with software and informatics. While law concentrates more than 13% of the students at the national universities, and accountancy and business administration reach almost 20%, all engineering fields concentrates (6.1%) and informatics (4.1%) have slightly more students than psychology and communication. In relation to graduates, the tiny 2% of total graduates at national universities reached by informatics is smaller than the one produced by odontology, less than half the one referred to architecture and approximately one fourth of the figure for medicine.

Career	New enrollments	Students	Graduates
Architecture & Design	5.4	6.0	5.7
Informatics	4.9	4.3	2.2
Engineering	6.4	6.1	5.8
Medicine	3.9	5.2	8.5
Psychology	4.8	4.6	4.8
Communication	3.8	3.8	2.8
Law	10.2	13.1	14.3
Economics, B.A & C.P.A	17.3	19.7	17.1
Sociology	3.5	3.2	3.2

Table 20: New enrollments, students and graduates for selected university disciplines. On percentage of total figures for the university system. Source: SPU Statistical Yearbook (2007)

With the intention of promoting those areas considered strategic for the development and growth of the economy, the Argentine federal government established at the beginning of the decade several sectoral fora. One of the most recurrent restriction presented in these fora was the lack of suitable human resources in technical areas and for specific industry needs. The list of these required professions forms what the Ministry of Education called "Priority fields".Nowadays, the federal government implemented several initiatives –Bicentenary Scholarships, ICT Scholarships, IT Generation and Control+F– oriented towards promoting the enrollment and graduation in SET disciplines. Anyhow, centered in offering financial means, these schemes don't try to modify issues related with the youngsters' vocation or the image that the different careers represent.

7.1 Priority fields: characterization of prospective students

The prospective students of these "priority fields" represent a 20.5% of the total interviewees and 21.2% of those planning to continue their studies at the university. The main characteristics of this group are:

- 65.0% followed a technical orientation or track at their secondary school. This figure more than doubles the 24.9% in the case of non-priority fields (35.8% for the total sample);

- 37.6% have fathers with tertiary studies (either non university or university, completed or uncompleted) and 46.1% when their mothers are considered. This figures for those in non-priority fields 37.8% and 40.6%, respectively

- 26.9% studied at private schools in comparison to 29.6% that attended these institutions and are planning to enroll in non-priority fields;

- 27.4% of those following priority fields are women while this figure rockets to 63.3% in non-priority fields;

The comparison between the family monthly income of those students that are planning to follow priority fields (after declaring their intentions to study at the university) and those opting for non-priority fields reveal that the first group presents an income 20.5% higher than the second group, being this difference statistically significant (at the 10% level). For details see Table 21.

	Monthly family income
Type of career	Argentine pesos
Non priority	3,650
Priority	4,398
Total	3,804

Table 21: Family monthly income by type of career. On Argentine Pesos.

As Table 22 shows, those students decided to enroll in priority fields exhibit a significantly bigger proportion of students in the top tier of performance in maths (being this difference significant at the 1% level) in comparison to those in non-priority fields. Differently. the performance of the two groups of students is similar in reference to language.

	Percentage of higher performers on...	
Type of career	**Maths**	**Language**
Non Priority	58.4	76.9
Priority	68.6***	76.6
Total	61.3	76.5

Table 22: Higher performers in maths and language by type of career. On percentages.

In relation to the individuals opinion about the school, its quality and characteristics, the students aiming to enroll in priority fields results more demanding than their counterparts in non-priority fields. Generally, they tend to be more critical about the school quality than (being this difference significant at the 1% level). This behavior is also present in relation to the infrastructure and the services related with the career counseling and information. We should stress that this latter aspect is, together with the infrastructure, the dimension presenting the worst evaluation by the whole pool of interviewees. However, they seem to be more satisfied (maybe because of a higher degree of exigence) with the academic aspects such as the content of the classes, the type of evaluation and the pedagogical devices and means applied. These evidences forces to think whether the school system is providing the necessary means to induce students to opt for SET careers (see Table 23).

Type of career	Percentage of individuals with good assessment about...			
	School quality	Academic aspects	Infrastructure	Career information
Non priority	30.3***	25.6	9.8	9.6
Priority	24.8	27.4	9.6	8.3
Total	**30.7**	**26.6**	**9.3**	**9.3**

Table 23: Assessment on schools and their characteristics by type of career

Again, the major level of criticism expressed by the aspirants to priority fields is exhibited in their self-assesment about the level of preparation and the likelihood of finishing their university studies (Table 24). Despite not presenting statistically significant differences, our focus group stress their lack of confidence arising from a poor evaluation of their skills and preparation provided by the educational system.

Type of career	Higher level of preparation	Higher likelihood of finishing
Non priority	8.5	55.5
Priority	6.3	53.2
Total	**7.9**	**54.9**

Table 24: Percentage of interviewees indicating a higher level of preparation and likelihood of finishing by type of career.

7.2 Perceptions about priority fields

When consulted about the characteristics that they believe their careers have in terms of income, social rewards and labor demand, those enrolled in priority fields express more optimistic perceptions than their counterparts. Specifically, they expect to obtain an income that exceeds that expected by those in non priority fields in 45.5%, reaching an income that is 23% higher than the one declared as the household monthly income, perceiving the career as a potential source of upward mobility. In the case of the aspirants to non-priority fields, there are almost no difference (2%) between their wages expectation and their declared household income. While there are no differences in relation to social perception there are significant differences in the way each group considers the professionals of their own fields: those in priority fields are more supportive and pay more respect to their prospective colleagues than the future students in non-priority fields. Finally, those inclined for priority fields are more likely to indicate that they career is among the most demanded, being this expressed on 72% of the cases. Table 25 presents this information.

However, and considering as a factor that operates in the opposite sense, the aspirants to priority fields result more inclined to consider themselves as prepared to perform only one type of occupation. Those interested in non-priority fields believe, instead, that the skills that will obtain during their studies will allow them to be flexible to work on a wide range of occupations. This perceived lack of flexibility might hinder the attraction represented by the priority fields in view of the recurrent changes and volatile economic regime. Table 26 compare the expectations for the two different groups of individuals.

Type of career	Monthly Income Argentinean pesos	Social Perception 1= High...5= Low	Individual Perception 1= High...5= Low	High Demand in %
Non priority	3,725	2.29	1.59	41%
Priority	5,420***	2.30	1.38***	72%***
Total	4,201	2,30	1.53	49.3%

Table 25: Perceptions about selected dimensions by type of career.

Type of career	Obtaining skills for...		
	only one occupation	a range of occupations	general for every occupation
Non priority	15.5	60.2***	24.3
Priority	31.1***	47.6	21.4
Total	18.7	57.2	24.1

Table 26: Skills believed to acquire by type of career. On percentages.

7.3 Family influences

When we analyze the distribution of both prospective students and family members in a two-dimensional space (priority and non-priority fields) we observe that of those planning to enroll in priority fields, 56% have parents with university studies on these same type of careers. This percentage fall to 34% for those students in non-priority fields, where the majority of fathers are specialized in, also, non-priority disciplines. While in the case of mothers we don't find a statistically significant difference, the information shows that those students inclined for priority fields present a higher percentage of mothers with this same specialization, almost doubling the figure reached by their counterparts aiming for non-priority disciplines. In the same direction that in the case of the interviewees' parents, we find statistically significant the presence of the older sibling on a priority field. Here, one third of the students in the required disciplines declare to have their older sibling enrolled or graduated from the same type of career. In the case of those aspiring for non-priority careers, a huge majority (81.9%) are oriented toward these same disciplines (see Table 27).

8 Econometrical analysis

Our interest resides in being capable of identifying what factors have an influence (and to what extent) in the election of a priority field. With this intention in mind, we will characterize the election choice as a sequential process –see Hossler et al. (1989) for details. Hence, the individual should decide first, whether she will continue studying at the university or not. Only those who would follow this stage, will be capable of inclining for a priority field.[11]

---

[11]As becomes evident, this is a stylized depiction of the process. Naturally, the expectations of rewards likely to be obtain at different fields will be compared and used for deciding whether to study at the university or not.

| | A.Father's type of career | |
Type of career	Non priority	Priority
Non priority	66.0***	34.0
Priority	44.1	55.9***
	B.Mother's type of career	
Type of career	Non priority	Priority
Non priority	87.0	13.0
Priority	77.3	22.7
	C.Older sibling's type of career	
Type of career	Non priority	Priority
Non priority	81.9***	18.1
Priority	66.7	33.3**

Table 27: Type of career of the interviewed by type of career of selected members of the family. On percentages.

As a strategy to explain the decision to enroll in priority career we applied a binomial probit with selection model (Van den Ven and Van Praag, 1981). Specifically this model consists on a sequence of two probit models linked by correlated errors, being the first stage a selection equation that determines the likelihood of continuing to attend the university and the second (outcome equation) the likelihood of choosing a priority carrer ($y = 1$) or not.

In its simplest form, the model can be written as:

$$y_1^*(outcome) = x_1\beta_1 + u_1$$
$$y_2^*(selection) = x_2\beta_2 + u_2$$

where

$$\begin{pmatrix} u_1 \\ u_2 \end{pmatrix} \sim N \left\{ \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix} \right\}$$

The observable counterparts to the two latent variables y_1^*, y_2^* are y_1 and y_2. These variables are observed as 1 if their respective latent variables are positive and zero otherwise. The latent variable y_1^* depends on factors X, and the binary outcome $y_1 = 1$ arises when $y_1^* > 0$. However, y_{1j} is observed only when $y_{2j} = (x_2\gamma + u_{2j} > 0)$ that is, when the selection equation generates a value of 1.

Here, we are aware that there is a possible correlation (ρ) between the errors of the two equations. If that correlation is nonzero, estimates of the selection equation will be biased unless we account for the selection. In this type of model we explicity consider x_1 different of x_2, being the factors influencing the selection and those the outcome different to successfully identify the model. By doing this, we are saying that a different set of variables and coefficients determine the probability of censoring (selection equation) and the value of the dependent variable given that it is observed. These variables may overlap, to a point, or may be completely different.

Hence, we have three possible outcomes:

1. No university

2. University-non priority

3. University-priority

Taking this as a starting point our strategy consists on estimating the probability of an individual choosing a priority career given that she have already indicated her intention to attending university. Here, we will proceed on a sequential fashion. First, we will present the results by considering in the outcome equation individual variables (such as gender, age, educational track, type of school that attended, performance at school) and family background factors (parents' education specialization, family income). On a second stage, we will add to this explanatory factors, each of the dimensions related with expectations and perceptions about the chosen career (expected income, labor demand, social value and reputation) individually. This will permit to show their relevance and influence in the choice decision. Finally, and as a third stage, we will present different combinations of these rewards (income and social value; income, social value and demand and, finally, the four dimensions together). For each of these estimations we will consider two different definitions of family income: one considering the monthly income informed and second a binary variable that takes a value of one if the household is in the top of the income distribution. In each of these three stages we will use the same explanatory factors in the selection equation, being the reader get more information about this at Appendix A.

Stage 1: Individual factors and family background The first estimations that we present refer to trying to assess the influence that different personal and family background factors have on the probability of choosing a priority field. First, and as shown on Table 28, the probability of deciding to enroll on university studies is positively affected by presenting a higher performance on maths and language (each subject individually), have attended a private school and to have followed a technical orientation on the secondary level. Family income (either measured in monthly income or in the membership to the group of high income families) positively influences this probability, the same with having a mother that attended high education. Older age negatively affects the decision to continue with university studies. Both gender and the education attained by the fathers do not play a role in this decision.

Once the individuals have decided to continue their studies, we find that educational performance and family background are fundamental factors influencing the decision to what type of career to follow. Specifically, those individuals with better performance at maths and those that were oriented towards technical fields in their secondary education, are more likely to opt for priority fields. Family income influence runs in the opposite direction: those individual that belong to those top of the distribution income are less likely to incline for these required fields. Similarly, women are less likely to go for these fields. All these results, coincide with the evidence summarized earlier on section 3.

Personal and Family factors			
Family income 1		**Family income 2**	
Factors	Sign & significance	Factors	Sign & significance
Outcome equation		Outcome equation	
Gender	−0.907***	Gender	−0.764***
Age	0.169	Age	0.219
Technical track	0.707***	Technical track	0.357**
Private education	0.059	Private education	-0.108
Maths performance	0.328*	Maths performance	0.148*
Language Performance	0.246	Language Performance	-0.106
Family income	0.001	Rich Households	−0.395**
Priority father	0.01	Priority father	-0.07
Priority mother	0.171	Priority mother	−3.725*
Selection equation		Selection equation	
Gender	-0.251	Gender	-0.226
Age	−0.336***	Age	−0.297***
Technical track	0.566***	Technical track	0.641***
Private education	0.423**	Private education	0.409**
Maths performance	0.326**	Maths performance	0.313**
Language Performance	0.519***	Language Performance	0.551***
Family income	0.00011***	Family income	0.00011***
Higher ed. father	-0.108	Higher ed. father	-0.192
Higher ed. mother	0.369*	Higher ed. mother	0.404**
Test Independence	0.08*	Test Independence	0.291
Prob. LR	***	Prob. LR	***
Observations	363	Observations	363

Table 28: Sign and significance levels for the explanatory factors of the probability of choosing a priority field (stage 1).

Stage 2: Individual factors, family background and expectations This second stage of the estimation strategy includes as explanatory factor each of the four different expectations asked about during the survey: expected income, labor demand, social value and individual consideration. In each of the estimations presented here (see Tables 29 and 30) the factors included in the selection equation (i.e., the decision to follow university studies) present the same sign that the one presented on the first stage. In relation to the factors influencing the decision to opt for a priority fields, all estimations presented in this stage are robust in signaling that both family income and gender (i.e., being female) have a negative influence on this probability. In addition, and fundamental for our objectives, the role of perceptions positively influences (except in the case of individual consideration) the probability of inclining for a priority field.

Specifically, we find that the higher the expect income expected, the higher the value that the individuals considers society attaches to these professionals and the more demand in the labor market is perceived, more likely is that our respondents will incline towards SET fields. It is interesting to see that in the case of the estimation including the expect income (left panel Table 29), neither the track of secondary school or the performance at maths play a role in the decision about fields. In all other estimations, both technical track and past performance in maths positively influences the election when considered monthly family income. This significance disappears when we included the membership to top income families as an explanatory factor.

In relation to the non-pecuniary rewards, we observe that while the perception of a socially valuable discipline helps individuals to incline for SET fields, the individual consideration has no effect. Then, those initiatives aimed at changing the consideration that individuals have about different occupation professionals might prove to be a useful mean in promoting higher levels of enrollment on priority fields. Of course, these initiatives should not be only centered on affecting the perception. We believe that providing accurate and free information that stresses the importance, demand and potential contributions of these professionals will certainly help to surmount the current bottlenecks.

Stage 3: Combining expectations: the role of non-pecuniary rewards Now, we will present estimations that go beyond of the validity of using the expectations as explanatory factors. Here, we will present estimations that will try to reproduce as much as possible, the decision that the individuals are confronted with. After deciding to attend university, the young individuals have to "mix" information and expectations about the different characteristics that the existing alternatives present. To make our point clearer, we present three successive estimations that will combine these expectations. On the first case, we will include as explanatory factors both the expected income and the personal opinion about the social value. On a second step, we will add to these mentioned factors, the perceptions about labor demand. Finally, we will add individual consideration to the outcome equation.

Table 31 presents the results for these three estimations using the family income as an explanatory factor. There, we find (in the same line that the results presented in the second

Personal, Family factors and Perceptions about careers

	Including Expected income			Including Labor demand	
	Income 1	Income 2		Income 1	Income 2
Factors	Sign & significance	Sign & significance	Factors	Sign & significance	Sign & significance
Outcome equation			**Outcome equation**		
Gender	−0.456***	−0.622***	Gender	−0.760***	−0.811***
Age	0.268***	0.221**	Age	−0.034	0.143
Technical track	0.275	0.277	Technical track	0.764***	0.483*
Private education	−0.172	−0.192	Private education	0.13	−0.004
Maths performance	0.075	0.136	Maths performance	0.347*	0.217
Language Performance	−0.23	−0.193	Language Performance	0.221	−0.037
Family income	−0.0001**	−0.655***	Family income	−0.0001*	−0.365*
Priority father	−0.187	−0.321	Priority father	−0.156	−0.298
Priority mother	0.493	0.732	Priority mother	0.266	0.207
Expected income	0.001*	0.0001***	Demand	0.705***	0.763***
Selection equation			**Selection equation**		
Gender	−0.137	−0.103	Gender	−0.196	−0.149
Age	−0.232***	−0.233***	Age	−0.338***	−0.313***
Technical track	0.457***	0.427**	Technical track	0.599***	0.702***
Private education	0.761***	0.76***	Private education	0.346*	0.373*
Maths performance	0.236**	0.242*	Maths performance	0.359**	0.372**
Language Performance	0.672***	0.668***	Language Performance	0.513***	0.543***
Family income	0.0001***	0.0001***	Family income	0.0001***	0.0001***
Higher ed. father	−0.255	−0.226	Higher ed. father	−0.180	−0.148
Higher ed. mother	0.277***	0.238	Higher ed. mother	0.404***	0.371*
Test Independence	0.02**	0.0008***	Test Independence	0.122	0.521
Prob LR	***	***	Prob LR	***	***
Observations	289	289	Observations	340	340

Table 29: Sign and significance levels for the explanatory factors of the probability of choosing a priority field including expected income and high labor demand (stage 2).

Personal, Family factors and Perceptions about careers

	Including Social valoration		Including Individual reputation	
	Income 1	Income 2	Income 1	Income 2
Factors	Sign & significance	Sign & significance	Sign & significance	Sign & significance
Outcome equation				
Gender	−0.873***	−0.825***	−0.908***	−0.771***
Age	-0.046	0.159	0.169	0.218**
Technical track	0.736***	0.364	0.707***	0.358
Private education	0.106	-0.032	0.062	-0.105
Maths performance	0.374*	0.232	0.325*	0.148
Language Performance	0.296	-0.03	0.252	-0.095
Family income	−0.0001***	−0.396*	−0.0001***	−0.398**
Priority father	-0.11	-0.097	0.172	0.212
Priority mother	0.282	0.256	0.013	-0.071
Social Value / Individual respect	0.337**	0.368*	0.044	0.06
Selection equation				
Gender	-0.214	-0.144	-0.253	-0.227
Age	−0.342***	−0.306***	−0.336***	−0.297***
Technical track	0.613***	0.712***	0.564***	0.639***
Private education	0.360*	0.361*	0.421**	0.409**
Maths performance	0.363**	0.350**	0.327**	0.314**
Language Performance	0.482***	0.532***	0.519***	0.55***
Family income	0.0001***	0.0001***	0.0001***	0.0001***
Higher ed. father	-0.02	-0.108	-0.108	-0.187
Higher ed. mother	0.351*	0.369*	0.368**	0.402**
Test Independence	0.176	0.385	0.08*	0.31
Prob LR	***	***	***	***
Observations	334	334	363	363

Table 30: Sign and significance levels for the explanatory factors of the probability of choosing a priority field including social value and reputation (stage 2).

stage) that both being a female and belonging to a family with higher income negatively affects the probability of choosing a priority field. In relation to the expectations, we observe that the expectations build about future wages (when presented together with other factors as demand and non-pecuniary rewards) don't have an influence on the orientation of the students. Differently, social value and demand (either included alone or together) positively influence decisions towards SET careers.

The role of the expectations about expected income does change if we use an alternative measure for family income. Table 32 includes as an explanatory factor the membership to a "rich househould". While the negative influence of family background persists, we observe that expected income results a positive factor influencing the occupation choice decision described here. Again, factors such as demand and social value both still (positively) affect the decision to enroll on a priority field. Hence, and a preliminary conclusion, we believe we have shown that occupation choice is a complex factors where individual characteristics, perceptions and family background all have an influence. Specifically, and using expectations about pecuniary rewards, labor demand and non-pecuniary rewards, we show that is the combination of these different dimensions what drives the occupation choice and, eventually, the enrollment evolution.

9   Conclusions

Despite the importance that student choice has a policy issue, the factors influencing the individuals decisions have not been fully understood. This gap has become specially important in the light of the increasing importance attached to science and engineering university graduates. At the same time, evidence suggests that the provision of additional scholarships for science and engineering students or abolishing the tuition fees will have practically no impact. The major problem seems to be that science and engineering programs suffer from a poor image.

The present study contributed to our understanding of the student choice process, by focusing in the reality of developing country and its problems attracting the brightest minds to the more priority fields. Specifically, we included factors not generally taken into account, allowing us to pay special attention to the role that expectations about the different sources of rewards (both pecuniary and non-pecuniary). Taking in consideration the laxk of information, we designed and conducted a survey oriented to characterize the perceptions and expectations held by young individuals finishing high school in Argentina.

Specifically, and by means of a probit model with selection, we showed that the expectations build about future wages (when presented together with other factors as demand and non-pecuniary rewards) don't have an influence on the orientation of the students. Differently, social value and demand (either included alone or together) positively influence decisions towards SET careers. These results are robust to different specifications of the family income (either absolute or relative).

The results presented here support the characterization of the choice of an university career as a complex phenomenon, not only related to financial matters. In this sense, differential access to information and social consideration of the different disciplines play a role. In this sense, it is a prerequisite for an effective policy intervention to act in two

Personal, Family factors and Perceptions about careers

Factors	Income & social value Sign & significance	Income, social value & demand Sign & significance	All factors Sign & significance
Outcome equation			
Gender	-0.516**	-0.521***	-0.511***
Age	0.264**	0.298***	0.314***
Technical track	0.226	0.232	0.234
Private education	-0.18	-0.1508	-0.138
Maths performance	0.044	-0.054	-0.05
Language Performance	-0.307	-0.2755	-0.267***
Family income	-0.001**	-0.0001***	-0.001***
Priority father	-0.261	-0.316	-0.345
Priority mother	0.518	0.598	0.636
Expected income	0.0001	0.0001	0.0001
Social Value	0.464**	0.421**	0.495***
Demand	—	0.506***	0.602***
Individual respect	—	—	-0.294
Selection equation			
Gender	-0.126	-0.172	-0.165
Age	-0.24***	-0.235***	-0.231***
Technical track	0.76***	0.716***	0.706***
Private education	0.428**	0.425***	0.422***
Maths performance	0.275*	0.271**	0.266***
Language Performance	0.628***	0.604***	0.626***
Family income	0.0001***	0.0001***	0.0001***
Higher ed. father	-0.094	-0.163	-0.175
Higher ed. mother	0.218	0.331*	0.331**
Test Independence	0.009***	0.02**	0.02**
Prob LR	***	***	***
Observations	284	283	283

Table 31: Sign and significance levels for the explanatory factors of the probability of choosing a priority field including expectations (stage 3). Estimations using family monthly income.

Personal, Family factors and Perceptions about careers

Factors	Income & social value Sign & significance	Income, social value & demand Sign & significance	All factors Sign & significance
Outcome equation			
Gender	−0.718***	−0.69***	−0.689***
Age	0.232***	0.252**	0.257**
Technical track	0.236	0.261	0.269
Private education	-0.196	-0.161	-0.166
Maths performance	0.093	-0.009	-0.007
Language Performance	-0.312	-0.292	-0.295
Rich Households	−0.648***	−0.62***	−0.606***
Priority father	-0.467	-0.501	-0.524
Priority mother	0.716*	0.797	0.840
Expected income	0.0002**	0.0001	0.0001
Social value	0.479***	0.426**	0.503**
Demand	—	0.441**	0.529**
Individual respect	—	—	-0.286
Selection equation			
Gender	-0.121	-0.144	-0.14
Age	−0.233***	−0.236***	−0.238***
Technical track	0.422***	0.721***	0.715***
Private education	0.738***	0.403**	0.398*
Maths performance	0.272**	0.264*	0.259*
Language Performance	0.600***	0.600***	0.614***
Family income	0.0001***	0.0001***	0.0001***
Higher ed. father	-0.103	-0.159	-0.173
Higher ed. mother	0.263	0.309*	0.312
Test Independence	0.001***	0.003***	0.003***
Prob LR	***	***	***
Observations	284	283	283

Table 32: Sign and significance levels for the explanatory factors of the probability of choosing a priority field including expectations (stage 3). Estimations using rich households as family income.

complementary dimensions: (a) public provision of information and (b) improving the "public image" that priority fields have.

References

[1] Arcidiacono, P. (2004), "Ability Sorting and the Returns to College Major", *Journal of Econometrics*,121, 343375.

[2] Auguste, S., Echart, M. and Franchetti, F. (2008), "The Quality of Education in Argentina", *IDB Research Project*, January.

[3] Beffy, M., Fougere, D., Maurel, A., (2009), "Choosing the Field of Study in Post-Secondary Education: Do Expected Earnings Matter?, IZA DP No. 4127.

[4] Berger, M.C. (1988), "Predicted Future Earnings and Choice of College Major", *Industrial and Labour Relations Review*, 41, $418 - 429$.

[5] Boudarbat, B (2004), "Earnings and Community College Field of Study Choice in Canada", *forthcoming in Economics of Education Review*.

[6] Bratti, M., (2006), "Social Class and Undergraduate Degree Subject in the UK", IZA DP No. 1979

[7] Davies, S. and Guppy, N. (1997), "Fields of study, college selectivity, and student inequalities in higher education", *Social Forces*, 75: $1417 - 1438$.

[8] Fiorito, J. and Dauffenbach, R. C. (1982), "Market and Nonmarket Influences on Curriculum Choice by College Students", *Industrial and Labor Relations Review*, 36, $88 - 101$.

[9] Grubb, W. N. (2002a), "Who am I: The inadequacy of career information in the Information Age", OECD, August.

[10] Hossler, D., Braxton, J.M. and Coopersmith, G. (1989), "Understanding student college choice", in: J.C. Smart (ed.), Higher education: Handbook of theory and research, Volume V, New York: Agathon Press.

[11] Hossler, D., Schmit, J and Vesper, N. (1999), "Going to college, How social, economic and educational factors influence the decisions students make", Baltimore: The Johns Hopkins University Press.

[12] Kelsall, R. K., Poole, A. and Kuhn, A. (1972), Graduates: The sociology of an elite. London: Methuen.

[13] Montmarquette, C., Cannings,K., and Mahseredjian, S., (2002), "How do Young People Choose College Majors?", *Economics of Education Review*, 21(6), $543 - 556$.

[14] Oosterbeek, H. and Webbink, H. D. (1997), ' Is there a hidden technical potential?", *De Economist*, 145, 159177.

[15] RAND Corporation (2004), *Is the Federal Government Facing a Shortage of Scientific and Technical Personnel?*, Santa Monica.

[16] U.S. Department of Education (2006), *Answering the Challenge of a Changing World. Strengthening Education for the 21st Century.*

[17] U.S. National Science Board (2004), *An Emerging and Critical Problem of the Science and Engineering Labor Force*, Arlington, Virginia

[18] Van de Ven, W. P. M. M. and B. M. S. Van Pragg (1981), "The demand for deductibles in private health insurance: A probit model with sample selection", *Journal of Econometrics* 17, $229 - 252$.

[19] Vossensteyn, J. J., (2005), Perceptions of Student Price-Responsiveness, PhD-Thesis, University of Twente, The Netherlands

[20] van de Werfhorst, H. G., de Graaf, N. D. and Kraaykamp, G. (2001), "Intergenerational resemblence in eld of study in the Netherlands", *European Sociological Review*, 17, $275 - 293$.

[21] van de Werfhorst, H. G., Sullivan, A. and Cheung, S. Y., (2003), "Social class, ability and choice of sub ject in secondary and tertiary education in Britain", *British Educational Research Journal*, 29, $41 - 62$.

A Determining the Selection equation

The results presented in Section 8 require specifying a selection equation. In this case, our selection equation refers to the explanatory factors behind the decision to continue studying at the university. This decision made by individuals is expected will be positively affected by individual abilities and past performance, the family income and parents' attendance to higher education. It seems plausible that high school on a private school will have a positive effect on the decision to pursue this type of studies. Additionally, and as control variables, we included in our explorations factors related to age, gender. Table 33 present the results of three specifications of the selection equation that include personal and background factors.

	Selection equation: 3 specifications		
	Model family 1	Model family 2	Model family 3
Explanatory factors	Sign & significance	Sign & significance	Sign & significance
Gender^a	-0.289**	$-$	-0.264*
Age	-0.348***	-0.298***	-0.326***
Private education	0.374***	0.433***	0.400**
Technical track	0.278**	0.533***	0.609***
Good math performance^b	0.248**	0.278**	0.305**
Good language performance^b	0.237*	0.516***	0.538***
Family income		0.001***	0.001***
Father's higher education			$-$
Mother's higher education			0.394**
Prob. LR	*******	*******	*******

Table 33: Sign, significance levels and marginal effects for the explanatory factors of the probability of choosing a priority field.
Notes: a: 0-Male & 1-Female; b: 0-Regular and bad performance &1-Passed without problems. Significance: "–" not significant, * 10%, ** 5%, *** 1%.

Additionally, we estimated a set of different equations including the level of self-reported level or preparation, their expectation about reaching post-graduate studies, receiving scholarships and nationality. None of these specifications added explanatory power, being these factors not statistically significant. Similar results produced the inclusion of their perception about average income expectations from the graduates.