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"LA NOCTURNA": STUDY OF EDUCATIONAL CHOICE IN COLOMBIA

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Abstract

T his study uses data from Colombia's 2003 Encuesta de Calidad de Vida to examine how well do electricity strata (proxy for socioeconomic status) explain the choice decision for type of institution and session attended. In the model of choice by type – private vs. public universities – I find that as the electricity strata increases, the marginal probability of enrolling in a public university decreases up to stratum five after which the decreasing trend reverts. In the case of session attendance, the working variable plays an important role in the decision. As expected, if students work and study at the same time, it is difficult to be enrolled as a full-time student.

Key words: College choice; College decision-making; Colombia; Higher education.
Classification JEL: I2; C2; J3.

Introduction

H igher education in low income and developing countries is a luxury few people can access. In Colombia, during most of the twentieth century, access to tertiary education was mainly available to individuals coming from high income households. In order to promote the entrance of a larger cohort of students to higher education institutions, during the 1990's several reforms were advanced. The reforms had a positive outcome showing an increase of more than twice the supply of seats from 1990 to 1998. Conversely, the demand of seats did not react at the same level, "despite the system's expansion during the 1990's the number of new entrants to tertiary education began declining in 1998" (World Bank, 1995: 25). Thus, two factors that play an important role in the decision of pursuing a tertiary degree in these countries are having availability to enough resources in order to continue studying combined with perception of a higher utility level.

The determinants of choice in higher education can be approached from multiple perspectives. The decision of attending a higher education institution is affected by many factors that need to fall in place at the right moment. Thus, trying to explain the determinants of choice from a single perspective gives partial information on the aspects that come in to play. Among the studies that analyze choice the factors considered are, household/family characteristics, the options given by society (represented by both the government policies and private sector aid), the quality of previous

education, the quality of higher education, the perception of the benefits of an additional year of schooling – as measured by the returns to education, the availability of scholarship and loans, and issues of equity and equality in the access to higher education.

The evidence has shown that an additional year of education increases the returns to education for people and thus for society which translates into a higher utility level. The utility maximization approach predicts that the optimal demand for education will be attained when the marginal utility of additional knowledge is equal to the marginal disutility of an alternative choice (Checchi, 2006: 18). Furthermore, not only people obtain a higher utility but society as a whole is benefiting from an educated society. Therefore, if families assume that only children coming from high income and educated families have access to good quality education the implications are not encouraging for the rest of the population (Gaviria and Barrientos, 2001: 3). On the other hand, if policies aimed at improving both quality and access to higher education are established, families who previously believed their children would never enroll in college will now have options.

Even though there was an expansion in the supply of seats in higher education institutions during the 1990's in Colombia, the access remains restricted to people from higher income families as the costs of tertiary education increases significantly when compared to secondary education (Checchi, 2006: 19). In this paper I will approach the issue of choice in higher education in Colombia from the individual's perspective. In other words, I am interested in looking at the effect of individual's characteristics on their schooling choice decision. Furthermore, I am interested in finding what aspects influence the decision for students and their families when choosing the type of higher education institution and session to attend. Moreover, what are the burdens or constraints faced by the families? Given that Colombia is a country with an unequal income distribution, how well does the electric strata variable (socioeconomic variable) explain the choice decision both for type of institution and session attended. Finally, I would like to see if gender plays an important role in the decision.

1. Background

Investment in tertiary education is one of the cornerstones in the ongoing debate on how to promote economic growth via education. More specifically, according to Checchi, "income inequality tends to be lower in countries where average educational achievement is higher" (Checchi, 2006: 5). Given the lower percentage of investment in education in developing countries compared to industrialized countries, the situation can be defined as "la guerra del centavo" (dispute over a cent), a Colombian expression that explains how people dispute over the limited amount of funds available in the country. In 2003, the World Bank estimated that spending on higher education equals approximately 4% of GNP or 15% of the total education budget (Orozco, 2005: 39).

Public spending on education shifts between two positions, investment in primary and secondary schooling or in higher education. Supporters for investment in higher education argue that as the pool of skilled people increases technological advancement is promoted. On the other hand, opponents argue in favor of investment in primary and secondary education in order to prevent low poverty levels (World Bank, 1995:22). Public sector spending for higher education is particularly inequitable because the subsidy per student is higher than that for basic education, even though higher education students come disproportionately from richer families (World Bank

– Priorities and Strategies for Education, 1995: 4). Beginning the 1990's education in Colombia emerged as a factor that allowed social mobility which is a key element in economic growth and development (Iregui, Melo, and Ramos, 2006: 6). Thus, it is fundamental for the government to find an adequate investment level.

Access to higher education in Colombia during most of the twentieth century was mainly available to the elite classes. In 1960, there were 29 higher education institutions in Colombia[1] of which 12 were located in Bogotá, the capital city (Ministry of Education Statistics, 2002). This inequality in access to higher education was and still is driven by two factors. First, primary and secondary public schools which are mostly attended by low income people provide poor quality education mainly due to the insufficient amount of funds allocated by the government. Second, there is an insufficient supply of seats in public higher education institutions. The difficulty in accessing higher education has restricted social mobility in the country, thus accentuating the polarization between high and low income people.

In 1992 several law reforms were put in place to foster the entrance of a larger cohort of students into tertiary education. The supply of seats in tertiary education increased markedly in the 1990's. "Starting from a supply of 180,000 seats in 1990, the system expanded considerably and offered, at its peak in 1998, 415,000 seats"[2] (Blom and Hansen, 2003: 174).[3] This expansion was primarily driven by the increase of private establishments. Furthermore, the private sector has lower costs per student on average but this generates lower quality education[3]. On the other hand, public institutions face a capacity constraint caused by higher costs per pupil in public education institutions. Public expenditures on education are mainly assigned to teacher salaries and their benefits, and the subsidies given to students who are admitted to public institutions. From 1993- 2001 79.2% of total expenditures in education were for operational expenses and 20.8% for investment. From 2002-2004 operational expenses increased to 96.1% of total expenditures in education (Iregui, Melo, and Ramos, 2006: 28). In other words, students who are admitted to public universities pay lower tuition costs which are the main source of financial aid available in Colombia. These conditions explain why the tertiary education sector had an influx of low quality private institutions to serve a segment of the population that did not have access to tertiary education before.

On the demand side of education, families did not react as anticipated to the increase in supply driven by the private sector during the 1990's. For example, in 1999 of the 568,000 students who graduated from secondary education institutions,[4] only 367,000 enrolled in higher education institutions (Blom and Hansen, 2003: 174). This unfilled capacity could be driven by several factors such as: economic recession in Colombia at the en of the 1990's, the households' perception of low returns to higher education, and the higher tuition levels charged by private institutions.

From the individuals' perspective, those who want to attain a higher utility level and come from low income households are compelled to work full time in order to pay for their education

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[1] By 2000 there were 309 institutions. In 1950 60% of higher education enrollment was in public institutions, by 1999 66.5% of enrollment was in private institutions.

[2] Furthermore, the oversupply of tertiary education reached a peak during the beginning of the 1990's but it decreased at the end of the decade driven by the economic recession the country faced during this period.

[3] Public institutions per pupil expenditures (PPE) in 2000 were approximately USD $2,100 vs. USD$1,650 in private institutions.

[4] Potential demand measured as the number of people who took the ICFES exam, does not include delayed enrollees but it may include people who were repeating the ICFES exam.

costs. Thus, approximately 30% of students are enrolled in evening session classes which are "(…) less expensive than full time day enrollment. While evening classes allow working individuals to attend tertiary studies, it also results in reduced effort and time devoted to learning, leading to lower quality and value added of the human capital generated" (World Bank Country Study, 2003: 26). Additionally, most of the programs offered during evening sessions are inclined towards disciplines such as business, law, finance and economics; hence, the education in engineering and sciences, which have a stronger impact on development, have a lower participation in the education sector (Natalia Agapitova, Lauritz B. Holm-Nielsen and Goga Vukmirovic, 2003: 141). Consequently, the disparities in tertiary education are not only driven by insufficient supply of seats but, both by financial constraints faced by the households and the quality of secondary education.

Additionally, the rapid growth in the private education sector has brought up issues of quality. The Ministry of Education does not have a proper infrastructure in place to ensure the quality of education. Although the Ministry of Education has implemented several initiatives to ensure the quality of education, results are not satisfactory. Additionally, the problem exacerbated once the Ministry of Education decided to create several institutions whose objectives involved the evaluation education quality, the administration of loans for education, policy analysis, research on quality, and administration of financial support to institutions. Some of these have overlapping functions which is affecting the development of this sector negatively (World Bank Country Study, 2003: 32).

The benefits of holding a degree beyond high school are significant as measured by the returns to education despite the aforementioned issues.[5] Provided that families are price sensitive when choosing both the type of institution and the session to attend, using the *Encuesta de Calidad de Vida 2003* (ECV), the main objective of the paper is to observe the determinants of school choice in higher education. The paper has two sections. On the first section, based on a random utility framework, I look at the probability of enrollment in public institution using a probit model. In the second section, using a multinomial logit model, I observe the factors that determine how people choose among full-time schooling, part-time schooling, night school (la nocturna), and distance education.

2. Literature Review

The study of choice in higher education is extensive in the United States. Choice has been approached from different angles such as the effect of financial aid via scholarships of loans, the decision to enroll in private or public universities, the effects of enrolling in community colleges versus four year colleges, how the increase of tuition expenses affect the enrollment decision, among others. This literature has helped scholars, students, families, schools and the government to understand the effects of choice on the individuals and to design different alternatives in order to provide the best education to the maximum amount of the population.

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[5] In Annex one of this paper I use the ECV database to analyze the returns to education using a Mincerian model.

Manski and Wise in 1983 designed an econometric model of student behavior by following the sequence of decisions pursued by students and the impact of policy in the decision. The importance of this study is that it depicts all the variables that are taken into consideration by the families and the students.

Long in 2003 used a conditional logistic choice model to study how college decisions changed over time. She used longitudinal databases (NLS 1972 and NELS 1988) and found that the impact of college costs in the enrollment decision have decreased over the 1972-1992 period. The 1992 results show that other factors affect the enrollment decision such as labor market conditions, county unemployment rate, high-school preparation and academic performance.

Cecilia Rouse in 1994 wrote a paper on the Two-Year versus Four-Year enrollment decision using the National Longitudinal Survey, Youth Cohort (NSLY), the High School and Beyond (HSB) and the Current Population Survey (CPS). She was interested in the effects of college tuition and the proximity to school. The results show that an 8 percent increase in two-year and four-year tuition will decrease the probability of college enrollment by one. Additionally, conditional on other factors, "parents' income is not a crucial determinant of college attendance" (Rouse, 1994: 74). Using the HSB she found that as the distance to school decreases, "the likelihood that a student is diverted from four-year college increases, but so does the likelihood that someone who was not considering college will now attend a two-year school" (Rouse, 1994: 79).

3. Theoretical Framework

3.1 Public vs. private school choice

A random utility model fits well the school choice decision (Rouse, 1994: 61). Decisions in this model can only be determined probabilistically and not with average returns as with OLS. This model represents individuals who are trying to maximize their level of schooling according to their individual characteristics. An individual can choose his/her utility level among several alternatives. In this model I look at choice between private and public higher education institutions in Colombia which can be represented in the following way:

$$U_{i,\mathrm{Pr}} = \overline{U}_{i,\mathrm{Pr}} + \varepsilon_{i,\mathrm{Pr}}$$
$$U_{i,Pub} = \overline{U}_{i,Pub} + \varepsilon_{i,Pub}$$

Each individual i receives utility from each alternative j (private or public university), and ε represents a random error term. X is a matrix of individual-specific characteristics.

$$U_{ij} = \beta_{ij} X_i + \varepsilon_{ij}$$

An individual will choose the alternative that maximizes his/her utility. In a random utility model the information on the errors (ε) distribution is "to form choice probabilities and then select parameter estimates that make the choice probabilities and the observed choices of individuals most closely correspond" (Manski and Wise, 1983: 33). "Individuals with identical measured characteristics can have quite different unmeasured characteristics, and so have quite different utilities associated with an alternative" (Kennedy, 2003: 261). Therefore, the probability of student i to choose a public instead of a private institution, is the probability that $\varepsilon_{i,Pr} < \varepsilon_{i,Pub}$.

$$prob(U = 1) = prob(X\beta + \varepsilon > 0) = prob(\varepsilon > -X\beta)$$

Probit models use normality assumptions for ε which makes the interpretation easier but drawbacks have to be considered in the analysis. For example, a drawback of using a probit model (Daganzo, 1979) is "ε has heteroskedasticity depending on X, and then $X\beta/\sigma$ is no longer a linear function of X" (Kennedy, 2003: 266). Another drawback of probit models is their sensitiveness to misspecification making estimators inconsistent if an explanatory variable is missing for which Lee and Marsh (2000) suggest a multinomial logit approach for correction. Finally, the non-randomness of samples can have an effect on the results, such as oversampling of minority groups in order to have a representative sample. Manski and Lerman (1977) suggest a weighted log-likelihood function for correction.

3.2 Session attendance choice

A random utility model also fits the session attendance choice decision but instead of using a dichotomous dependent variable – and thus a probit model – the dependent variable is polychotomous and the model to use is a multinomial logit (McFadden, 1974). Again, the utility of the student is set as a linear function plus an error term, with a different set of parameters (and a different individual specific error) for each alternative. Therefore, the probability that a student will select to attend college in a specific session is given by the probability that the utility of the selected session is greater than the utility of all other sessions. Once more, the choice made by the student depends on the non-error terms and the error terms associated with the utilities for the student. Utilities can be represented as

$$U_{i,FTD} = \overline{U}_{i,FTD} + \varepsilon_{i,FTD}$$
$$U_{i,PTD} = \overline{U}_{i,PTD} + \varepsilon_{i,PTD}$$
$$U_{i,E} = \overline{U}_{i,E} + \varepsilon_{i,E}$$
$$U_{i,D} = \overline{U}_{i,D} + \varepsilon_{i,D}$$

where ε represents a random error. An individual receives utility from each alternative (j) and thus

$$U_{i,j} = \beta_{i,j} X_{i,j} + \varepsilon_{i,j}$$

where X represents a matrix of individual characteristics, such as, age, gender, parent's education, and SES. Individuals will choose an alternative that maximizes his/her utility. Therefore, if he/she chooses $U(FTD)_i > U(E)_i$, $U(FTD)_i > U(PTD)_i$, and $U(FTD)_i > U(D)_i$, the probability that he/she will attend that session is:

$$\Pr(U_{i,FTD} > U_{i,PTD}, U_{i,FTD} > U_{i,E}, U_{i,FTD} > U_{i,D}) = \Pr(\varepsilon_{i,PTD} - \varepsilon_{i,FTD} < \overline{U}_{i,FTD} - \overline{U}_{i,PTD}; \varepsilon_{i,E} - \varepsilon_{i,FTD} < \overline{U}_{i,FTD} - \overline{U}_{i,E}; \varepsilon_{i,E} - \varepsilon_{i,FTD} < \overline{U}_{i,FTD} - \overline{U}_{i,E})$$

replacing $\eta_{kk'} \equiv \varepsilon_k - \varepsilon_{k'}$ and $\bar{U}_{kk'} \equiv \bar{U}_k - \bar{U}_{k'}$ (and dropping the subscript i for simplicity):

$$P_{FTD} = \int_{-\infty}^{\overline{U}_{FTD,PTD}} \int_{-\infty}^{\overline{U}_{FTD,E}} \int_{-\infty}^{\overline{U}_{FTD,D}} g_{FTD}(\eta_{FTD,PTD}, \eta_{FTD,E}, \eta_{FTD,D}) d\eta_{FTD,PTD}, d\eta_{FTD,E}, d\eta_{FTD,D}$$

where g_{FTD} is the joint density function of the variable for the FTD session attendance.

The underlying assumption to use the multinomial logit model is that the random utility error terms are assumed to be independently and identically distributed. On the other hand the disadvantage of this model is denominated the independence of irrelevant alternatives property (IIA). Kennedy explains how one could assume that if a new alternative – very similar to an existing one – is included to the set of choices, the probability of the pre-existing alternative is cut in half therefore leaving the other alternatives unaffected. "Unfortunately this is not the case, implying that the multinomial logit model will be inappropriate whenever two or more of the alternatives are close substitutes" (Kennedy, 2003: 262). In order to test the validity of independent and homoscedastic disturbances assumption, Greene suggests the use of a test developed by Hausman and McFadden (1984). "If a subset of the choice set is truly irrelevant, omitting it from the model altogether will not change the parameter estimates systematically" (Greene, 2003: 725). I use the Hausman test in order to observe if eliminating any of the choices does not change the remaining parameters' estimates.

4. Methodology and Principal Features of the Data

I used the Encuesta de Calidad de Vida (ECV) carried out during 2003 as the basis for this paper.[6] The ECV is performed every three years and the methodology used is personal interviews of Colombian households conducted by the *Departamento Administrativo Nacional de Estadistica (DANE)*. The 2003 ECV has a sample of 22,949 households. The 2003 sample selection process is chosen in two major stages. The households are selected using a probabilistic, stratified and multi stage model. It is stratified between rural and urban municipalities. In the first stage, blocks are randomly selected and within the blocks, houses in groups of ten are selected and all of them are

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[6] This survey is similar to the Current Population Survey (CPS) that is performed in the United States.

interviewed (Manual Operativo: 2003). The unit of analysis of the ECV is the household; in this paper I employ the information from the ECV to study how individuals choose higher education institutions by type – public and private. Additionally, I evaluate how individuals choose the session they attend – full-time day, part-time day, evening (la nocturna), or distance.

The dataset has information on the type of higher education institution (public or private) or the session students attend (full-time day, part-time day, evening, or distance) for those who were enrolled in one at the time of the survey. Therefore, the dataset contains 3,667 individuals who at least have a high school degree (see Table 1). The average age of the sample is 23 years which highlights the importance of alternative attendance sessions in Colombia. The average age is high because people who attend part-time or evening sessions are older either due to delayed enrollment or longer time for degree attainment.

Gender is evenly distributed as follows, 46% of the sample is male. The parents' education variables are measured by highest level attained, not in years of schooling.[7] Parents' education as in the previous dataset is constructed in an ordinal scale (no schooling – 0, some elementary – 1, elementary – 2, some high school – 3, high school – 4, some technical or technical – 5, some college or college – 6). Both parents average level of education is high school.

Household monthly income is US$590 on average which is more than twice the minimum wage in the country (US$314). Approximately 39% of the respondents are both working and studying simultaneously. This situation is very common in Colombia, especially for people who are enrolled part-time in school or attend evening sessions. The percentage can also help explain the average age of the sample.

The electricity stratum is a proxy for socioeconomic status (SES). Neighborhoods in Colombia are classified according to the households' income level ranging from 0 to 6.[8] Households belonging to the lower strata are usually low income families who are subsidized by higher income households and the government. This measure is commonly used in Colombia as a proxy for SES. The sample average is stratum three, which reflects that a higher percentage of the sample belongs to lower income households. In the regressions I used dummy variables for each stratum in order to observe the effect of the SES variable.

Either having a scholarship or a loan can increase the chances of attending higher education institutions. Financial aid in the form of scholarships is not granted by public institutions[9] but by private ones or by non-educational institutions. 73% of the students who reported having a scholarship attend private institutions. In the case of loans, conditions for obtaining credit in Colombia are stringent and people have to prove economic stability in order to be granted credit.[10] 90% of the people who reported having a loan belong to electricity strata 2 to 4. This indicates that people who are able to demonstrate financial stability (i.e. are employed) obtain the loans and people belonging to higher strata (5 or 6) do not need loans to finance education costs.

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[7] I used an ordinal scale for level of schooling in order to minimize measurement error.
[8] I observed some inconsistencies with the households classified as stratum zero therefore I used stratum 1 as base category.
[9] Public institutions subsidize the cost of education via lower tuition and this is not perceived as a scholarship.
[10] In Colombia it is not easy to demonstrate a stable source of income given the prevalence of informal employment.

Table 1
Individual and Household Characteristics
(sample means)

Characteristic	Choice
Observations	3,667
Average Age	23
Percent Males	46%
Father's Education (highest level)	HS
Mother's Education (highest level)	HS
Household Income	US$590
SES variable (Electricity strata)	3
- Percent in electricity stratum 1	5%
- Percent in electricity stratum 2	24%
- Percent in electricity stratum 3	48%
- Percent in electricity stratum 4	17%
- Percent in electricity stratum 5	4%
- Percent in electricity stratum 6	3%
Percent attend Private institutions	69%
Percent attending FTD session	32%
Percent attending PTD session	31%
Percent attending E session	28%
Percent attending D session	8%
Percent w/ Scholarship	9%
Percent w/ Loan	14%
Percent working	38%

Finally, the public vs. private outcome variable will be measured by a dummy variable that is equal to zero when the institution is private and one when the institution is public. The results, which can be seen in Table 2, show the enrollment distribution by type of institution. In this dataset 69% of the individuals are attending private institutions.

Table 2
Enrollment by Institution Type and Gender

Type	Gender		Total
	Female	Male	
Private	1,386	1,134	2,520
	70%	67%	69%
Public	583	564	1,147
	30%	33%	31%
Total	1,969	1,698	3,667
	100%	100%	100%

Table 3 shows enrollment by session attended at the institutions, namely full-time day, part-time day, evening or distance. Students attend in descending order full-time day (FTD), part-time day (PTD), evening (E) and distance (D). Additionally, the only category where males outnumber females is in the FTD category.

Table 3
Enrollment by Session Attended and Gender

Type	Gender		Total
	Female	Male	
FTD	572	609	1,181
	29%	36%	32%
PTD	692	464	1,156
	35%	27%	32%
E	530	518	1,048
	27%	31%	29%
D	175	107	282
	9%	6%	7%
Total	1,969	1,698	3,667
	100%	100%	100%

4.1 Limitations of the dataset

Unfortunately, because the dataset is a household survey, there is no information on variables that are commonly used in studies on educational choice such as tuition level, financial aid, distance to school, or measure of ability. Conversely, although this variables have proven to be important in the American literature on choice, in the Colombian case there are some differences such as the high concentration of tertiary education institutions in the cities which implies that a person interested in pursuing a higher education degree usually moves to urban areas. This could be an issue in places where the population is distributed among rural and urban areas.[11] Financial aid in Colombia is inadequate since "funding represents less than one percent of total government funding for tertiary education" (World Bank Country Study, 2003: 55). Student loans are supplied and administered by the Colombian Institute for Education Credit and Advanced Studies Abroad (ICETEX) and the coverage is "only five percent of the student population" including graduate students and students abroad (World Bank Country Study, 2003: 55). The household survey has a question on financial aid – scholarship or loan – but not on the amount. Tuition level variables could provide useful information on the burden faced by families or people when considering the

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[11] Given that approximately 70% of the population in Colombia lives in the major cities the effect is minimized (DANE: 2005).

school choice decision. Finally, the GPA or ICFES[12] (state administered national exam) are two variables commonly used to proxy student's ability that were not included in the survey.

5. Estimation Methods and Empirical Tests

In section 5.1 I ran a probit regression to test the probability of a high school graduate to enroll in a public or private university. In section 5.2 I ran a multinomial logit type regression in order to test the odds that a person has of choosing among different attendance sessions, full-time day (FTD), part-time day (PTD), evening (E) (la nocturna) and distance learning (D). This sample is comprised of people who were enrolled in a higher education institution at the time of the survey.

5.1 Public vs. private school choice

Table 4 shows the results for the probability of an individual to attend a public higher education institution. The coefficients show the marginal effects of the probit regression. Model 1 does not include the working variable because of possible endogeneity. I ran a likelihood ratio test in order to analyze the effect of the additional variable and the results were as follows: LR chi2(1) = 10.42; Prob > chi2 = 0.0012.

The results on Table 4 show that age (for males) and gender (males) are variables affecting the schooling decision. Males have a 0.054 higher chance of enrolling in a public university than females. Age increases the probability of attending a public university for males. An infinitesimal change in age increases the probability of enrolling in a public university by 0.006.

Conversely, all other variables favor the chances of enrolling in private higher education institutions – in other words, an infinitesimal change in the dependent variables decreases the predicted probability of enrolling in a public university. This is the case for males who are working where the marginal probability of attending a public institution decrease by 0.13. The results for women are negligible and not statistically significant. Given that this variable has a value of one for people who are receiving some kind of remuneration for their job, the effect for women can be affected because the variable does not include non-remunerated jobs. Thus, relaxing this condition (positive wages) and including non-remunerated jobs could show the expected result, as for men.

Fathers' education increases the chance of enrolling in a private institution by 0.02. There is an inverse relationship between father's education and students who are working. As fathers' education increases less people have to work.

The electricity variable effects are substantial in the regressions. As the electricity stratum increases, the probability of attending private schools increases in an ascending monotonic trend up to stratum five where individuals' probability of being enrolled in a public institution decreases by 0.26 compared to a person who lives in an stratum one household. The increasing trend reverts in stratum six households where the chance of enrolling in a private institution is 0.21 compared to

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[12] Similar to the SAT in the United States.

Table 4
Probability of a Person to enter a Public University

Dependent variable (Private = 0 and Public = 1)

Marginal effects	1			2		
Variable	Male	Female	Total	Male	Female	Total
Age	0.002	-0.001	0.000	**0.006**	-0.001	0.002
	(0.357)	(0.553)	(0.903)	(0.004)	(0.526)	(0.202)
Male			**0.055**			**0.053**
			(0.000)			(0.001)
Father's education	**-0.020**	**-0.025**	**-0.022**	**-0.023**	**-0.025**	**-0.024**
	(0.007)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)
Electricity 2 (SES)	-0.019	-0.086	-0.062	-0.024	**-0.086**	-0.062
	(0.755)	(0.051)	(0.084)	(0.689)	(0.051)	(0.084)
Electricity 3 (SES)	**-0.174**	**-0.139**	**-0.158**	**-0.178**	**-0.139**	**-0.161**
	(0.003)	(0.002)	(0.000)	(0.002)	(0.002)	(0.000)
Electricity 4 (SES)	**-0.221**	**-0.179**	**-0.202**	**-0.230**	**-0.179**	**-0.206**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Electricity 5 (SES)	**-0.276**	**-0.253**	**-0.264**	**-0.285**	**-0.252**	**-0.268**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Electricity 6 (SES)	**-0.202**	**-0.211**	**-0.209**	**-0.217**	**-0.211**	**-0.213**
	(0.008)	(0.008)	(0.000)	(0.003)	(0.001)	(0.000)
Working				**-0.133**	0.005	**-0.056**
				(0.000)	(0.822)	(0.001)
Predicted probability	0.324	0.288	0.304	0.322	0.288	0.304
Wald ^{2}	96.59	79.83	173.72	119.2	79.87	183.11
pseudo R^2	0.0467	0.0354	0.0401	0.0583	0.0354	0.0424

* statistically significant at 5% in bold; p-values in parenthesis.

a person who lives in a stratum one household. Although the result still favors enrollment in a private institution, the change in the trend indicates how elite classes still benefit from the subsidized public higher education.

5.2 Session attendance choice

A multinomial logit (MNL) model was used to calculate the relative probability of an individual to choose among four session attendance choices. FTD session was set as base category for the model and electricity stratum one for the dummy variables. Results are presented on Table 5.

The relative probability coefficients for age and father's education are virtually 0.50 which indicates indifference between each alternative session. Another interpretation is that the variables are not determinants of session choice.

Session attendance choice results on Table 5 show that the working variable plays an important role in making the decision. As expected, if students work and study at the same time, it is difficult to be enrolled as a FTD student, thus the results are obvious. Interesting results show that students who attend the PTD session have a 0.64 probability of being employed while students who are enrolled in E or D sessions have 0.91 and 0.92 probabilities of being employed.

Alternatively, as electricity stratum (SES) increases the relative probability of enrolling in each alternative session compared to FTD decreases. The relative probability of attending the evening session for people from electricity stratum two is 0.67 indicating that low-income people have a complementary activity to studying. Conversely, the probability of attending each session

Table 5
Multinomial Logit - Session Attendance Choice

Base category FTD - relative probability of attendance

Variable	Males			Total			Males			Total		
	PTD	E	D	PTD	E	D	PTD	E	D	PTD	E	D
Age	**0.515**	**0.550**	**0.565**	**0.518**	**0.542**	**0.554**	**0.511**	**0.530**	**0.545**	**0.512**	**0.525**	**0.538**
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.011)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Gender				**0.390**	0.480	**0.399**				**0.394**	0.498	**0.418**
				(0.000)	(0.401)	(0.007)				(0.000)	(0.940)	(0.036)
Father's education	**0.479**	**0.447**	**0.418**	**0.475**	**0.451**	**0.407**	**0.480**	**0.453**	**0.426**	**0.478**	**0.461**	**0.418**
	(0.043)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.053)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Electricity 2 (SES)	0.566	0.623	0.352	0.551	**0.670**	**0.347**	0.566	0.634	0.370	0.550	**0.662**	**0.340**
	(0.490)	(0.231)	(0.197)	(0.403)	(0.001)	(0.025)	(0.495)	(0.236)	(0.306)	(0.410)	(0.022)	(0.029)
Electricity 3 (SES)	0.424	0.543	**0.139**	0.421	0.559	**0.121**	0.416	0.524	**0.136**	0.416	0.549	**0.119**
	(0.405)	(0.664)	(0.000)	(0.169)	(0.367)	(0.000)	(0.358)	(0.824)	(0.000)	(0.144)	(0.484)	(0.000)
Electricity 4 (SES)	0.400	0.410	**0.064**	**0.343**	0.374	**0.086**	0.393	0.402	**0.066**	**0.338**	0.376	**0.091**
	(0.288)	(0.387)	(0.000)	(0.008)	(0.070)	(0.000)	(0.254)	(0.392)	(0.000)	(0.007)	(0.097)	(0.000)
Electricity 5 (SES)	0.345	0.287	0.194	**0.285**	**0.283**	**0.075**	0.346	0.334	0.240	**0.288**	0.323	**0.090**
	(0.163)	(0.106)	(0.062)	(0.003)	(0.014)	(0.000)	(0.166)	(0.260)	(0.157)	(0.003)	(0.068)	(0.000)
Electricity 6 (SES)	0.301	**0.159**	**0.101**	**0.306**	**0.143**	**0.221**	0.303	0.206	0.152	**0.309**	**0.162**	**0.237**
	(0.089)	(0.023)	(0.052)	(0.001)	(0.001)	(0.015)	(0.094)	(0.082)	(0.140)	(0.012)	(0.003)	(0.035)
Working							**0.613**	**0.915**	**0.938**	**0.645**	**0.908**	**0.924**
							(0.009)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
χ^2 statistic	525.54			1084.39			823.18			1666.53		
pseudo R^2	0.1230			0.1152			0.1926			0.177		

by strata does not have a specific trend (this is not an ordered logit regression). For instance, the relative probability of being enrolled in distance education for people living in electricity stratum two households is lower (0.34).

People's relative probability of being enrolled in distance education is less when comparing each electricity stratum to its equal in the FTD category, and as electricity stratum increases within D the probability of being enrolled decreases, with the exception of electricity stratum six. This result denotes that distance education is preferred by low income people because of lower tuition and transportation costs, but it is also preferred by high income people (living in stratum six households) most likely because of the different types of distance education courses offered (internet courses vs. radio or TV courses) and because the distance education variable includes courses that people have to attend once every period of time which sometimes are graduate programs.

6. Conclusions

• As in other studies on education, results for males are consistent when compared to females. In the model of choice between private vs. public universities, males have a higher probability of attending a public university (0.055) compared to females. Males perceive a higher utility in attending a public institution.

• The electricity strata variable plays an important role in the choice decision for individuals. For males, as the electricity stratum increases, the probability of attending a private school increases up to stratum five after which the increasing trend reverts. Although the result still favors enrollment in a private institution, the change in the trend indicates how elite classes still benefit from the subsidized public higher education.

• For session attendance as electricity stratum (SES) increases the relative probability of enrolling in any of the alternative sessions compared to FTD decreases.

• In the case of session attendance the working variable plays an important role in the decision. As expected, if students work and study at the same time, it is difficult to be enrolled as a FTD student.

• The relative probability of being enrolled in distance education decreases as electricity stratum increases with the exception of electricity stratum six.

• Having a scholarship or a loan increases the chances of attending private institutions. This does not mean that public institutions do not provide financial aid. Financial aid in public institutions is reflected in lower tuition costs that are not perceived by individuals as financial aid.

• In the case of loans, conditions for obtaining credit in Colombia are stringent and people have to prove economic stability in order to be granted credit. 90% of the people who reported having a loan belong to electricity strata 2 to 4. This indicates that people who are able to demonstrate financial stability (i.e. are employed) obtain the loans and people belonging to higher strata (5 or 6) do not need loans to finance education costs.

• Higher education quality control is fundamental in order to ensure the positive impact on economic development. Although the ministry of education has advanced in the design of mechanisms for quality control there are still some issues that should addressed such as problems of information

exchange, offering more incentives for improvement, creating a strong sense of accountability and evaluation, and strengthening government programs and institutions (Orozco, 2005: 43).

• The government should take advantage of the growth of the private education sector and its unfilled capacity via subsidization in order to promote the entrance of larger cohorts of students to tertiary education.

• Technical and technological degrees are undermined in Colombia thus people do not enroll in these programs but rather pursue poor quality college degrees because of the lower tuition costs and the possibility of attending evening sessions. The private and pubic sector should promote technical and technological education.

• Transfer between institutions should be allowed for students interested in pursuing a higher education degree. This also includes a homogenization in college credits to make them valid across institutions and the public and private sector.

Annex 1 – Returns to education in Colombia

In this section I study the degree effects on returns to education. The objective is to observe the effect of an additional degree or more years of education represented by the percentage increase on log-wage. The Mincerian wage equation (Mincer, 1974) remains a useful tool for the analysis of returns to education. This equation allows researchers to find if there is an effect on wages controlling for variables such as education, experience, and individual characteristics (socioeconomic background, race/ethnicity, gender, and parents' education among others). The following equation follows Mincer's human capital earnings function in a semi-logarithmic form:

$$\ln w = \beta_0 + \beta_1' X_{1i} + \beta_2 X_{2i} + \varepsilon_i$$

where X_{1i} is a vector of individual characteristics of individual i that include race/ethnicity, gender, a socioeconomic status (SES) variable (electricity strata), parents' education, age and age squared. X_{2i} is a vector that includes the number of years of schooling and degree attained.[13]

Sources of bias in the ordinary least squares (OLS) estimates due to regressor endogeneity have to be considered in the results. Griliches (1977) and Card (1999) explained how "endogeneity comes from three potential sources: omitted variables, measurement error, and heterogeneity of returns in the population" (Checchi, 2006: 200). For this reason, when explaining the model I will address these issues.

Measurement error is common in survey data because "respondents give faulty answers to the questions posed to them" (Angrist and Krueger, 1999: 1339). Given that survey respondents may intentionally report differences in years of schooling, in order to minimize this error I use categorical variables for each degree obtained instead of years of schooling.

Heteroskedasticity is usually present in cross-sectional data because of the "regression disturbances whose variances are not constant across observations" (Greene, 2002: 215). This is due to difference across segments of the population. For example, "families with higher levels of innate ability or more enriching learning environments for their children benefit more from schooling" (Ashenfelter and Rouse, 1998: 258) or students who come from higher income families receive better quality education because they have access to better schools. These two examples imply that returns to schooling vary depending of factors that are not captured by the coefficients. To test for heteroskedasticity I will run the OLS regression using White's robust standard errors (Kennedy, 2003: 154).

The dataset contain 12,923 individuals between 18 and 64 years of age who have earned a high school degree or higher and reported a positive wage. The purpose of this dataset is to confirm if a degree effect is reflected on the individuals' wages who participated in the survey.

There are 6,305 or 49% females in the sample and 6,618 or 51 % males, which make it fairly equal in its gender composition. The data reveals that all individuals were earning a wage at the time of the survey. The income ranged from as low as US$1 to US$12,000 a month. I constructed the

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[13] It is worth mentioning that I do not to use the potential experience variable that is commonly used in the literature because, as I mentioned above, students in Colombia are enrolled full time and work thus the experience variable could be biased downward, whereas by using age, this source of bias is eliminated.

wage variable by combining different sources of income because there are cases in which people are paid *'en especie'* which means that they receive food, education, or transportation in exchange for their work. Table A.1 shows the main features of the data.

Table A.1
Individual and Household Characteristics
(sample means)

Characteristic	Degree
Observations	12,923
Average Age	36
Percent Males	51%
Father's Education (highest level)	Some HS
Mother's Education (highest level)	Some HS
SES variable (Electricity strata)	3
Average monthly wage	US$392
Log monthly wage	5.40
Average years of schooling	13
Percent w/ HS	45%
Percent w/ Technological	2%
Percent w/ Bachelor's	21%
Percent w/ Post-Bac	9%

The average age of the sample is 36 years with a standard deviation of 11 years. As mentioned in the theoretical framework, I used age and age squared variables in the model instead of the potential experience variable. Given that a fraction of students in Colombia are both enrolled full time at school and work, the potential experience variable could be biased downward if using the CPS suggested methodology.

The sample has an average father's education of some high school. The result is the same as the mother's education average which is some high school.

The electricity stratum variable of the households is three meaning that the sample follows Colombia's income distribution.

Average monthly wage is US$392. Considering that minimum monthly wage in Colombia is US$157 this figure suggests that people who have at least high school degree earn on average more than minimum wage. This can be seen as a preliminary result of the benefit of earning a higher degree.

Finally, as mentioned above, individuals in the sample hold at least a high school degree. The table shows that 45% of the sample only holds a HS degree. People holding technical degrees are 2% of the sample. People holding bachelor's degrees are 21% of the sample. People who attained a post-baccalaureate degree are 9% of the sample. By difference 23% of the sample attended a tertiary education institution but did not receive a degree. These figures reflect a low drop out rate from higher education institutions. This indicates that given the difficulties of having access to tertiary education in Colombia, once enrolled the chances of dropping out are low. This can be due to the fact that individuals who enroll in higher education institutions are very motivated.

The results of the estimation of returns to education by degree model are presented in the following Table A.2. The estimated wage equations are calculated by gender. Individuals who live in a stratum one household and graduated from high school (HS) are the base category. The variables some years of college, Technical, Bachelor's, and Post-Baccalaureate are dummies constructed according to the obtained degree reported by respondents.

As expected, all results are positive with the exception of the Technical degree effect for males. For instance, the Bachelor's (BA) degree coefficient for males was 0.368, which implies that having a BA degree increases earnings by approximately 37% in relation to the average wage of males who have completed their HS degree. For women, the BA coefficient was 0.392, denoting that having a BA degree increases average earnings by approximately 39% relative to the average wage of females with a HS degree.

Furthermore, the Post-baccalaureate (post-bac) coefficient for both genders was of 0.70. This result represents an increase in earnings of more than 70% for people who hold a post-bac degree in relation to the average wage of people who have earned a HS in the sample.

The Technical (T) degree coefficients have mixed results for males and females. For males, the coefficient was of -0.05 or 5.1% decrease in earnings in relation to a male holding a HS degree. On the other hand, for females the coefficient was 0.078 or 7.8% increase in earnings relative to a female holding a HS degree. These results could be influenced by two factors, first, technical and technological studies are undervalued in Colombia. In other words, people do not perceived the aggregated value of having a technical or technological degree and thus prefer to pursue a BA. This could be driven by a low demand of people with this degree in favor of sub-employed BA degree holders. Second, because only 2% of the sample holds a T degree, the observations are not providing reliable information. Both factors explain why these coefficients did not provide convincing results.

Finally, other coefficients that reveal important results are male, which indicates that the gender gap between males and females who hold at least a HS degree is 0.396 or more than 40% increase in average wage for males. The electricity strata (SES) variable also plays an important role in the returns by higher education degree. As the electricity strata increases, the returns to an additional degree increase showing a positive relationship between SES and wages. For example, the wage of a male's that lives in electricity stratum 6 household increases by more than 131% compared to a male who lives in an electricity stratum 1 household, holding everything else constant. Furthermore, female wages living in electricity stratum 6 household increases by more than 109% compared to females living in stratum 1 households.

Table A.2
Mincerian Log-Wage Equation - Degree Effects

Variable	Coefficient Estimate		
	Male	**Female**	**Total**
Intercept	**2.031**	**1.790**	**1.736**
	(0.000)	(0.000)	(0.000)
Age	**0.103**	**0.070**	**0.086**
	(0.000)	(0.000)	(0.000)
Age^2	**-0.001**	**-0.001**	**-0.001**
	(0.000)	(0.000)	(0.000)
Gender (Male=1)			**0.396**
			(0.000)
Mother's education (level)	**0.038**	**0.037**	**0.037**
	(0.000)	(0.000)	(0.000)
Electricity 2 (SES)	**0.166**	**0.149**	**0.160**
	(0.000)	(0.007)	(0.000)
Electricity 3 (SES)	**0.296**	**0.353**	**0.325**
	(0.000)	(0.000)	(0.000)
Electricity 4 (SES)	**0.659**	**0.577**	**0.613**
	(0.000)	(0.000)	(0.000)
Electricity 5 (SES)	**0.946**	**0.709**	**0.819**
	(0.000)	(0.000)	(0.000)
Electricity 6 (SES)	**1.313**	**1.099**	**1.190**
	(0.000)	(0.000)	(0.000)
Electricity 0 (SES)	0.132	**0.397**	**0.241**
	(0.323)	(0.008)	(0.017)
Years of schooling	**0.061**	**0.102**	**0.081**
	(0.000)	(0.000)	(0.000)
Some years of higher education	**0.102**	**0.130**	**0.119**
	(0.029)	(0.012)	(0.001)
Technical	-0.051	0.078	0.020
	(0.594)	(0.451)	(0.780)
Bachelor's	**0.368**	**0.392**	**0.389**
	(0.000)	(0.000)	(0.000)
Post-Baccalaureate	**0.674**	**0.698**	**0.700**
	(0.000)	(0.000)	(0.000)
F - statistic	326.43	285.34	578.92
R^2	0.4038	0.3598	0.3950

* statistically significant at 5% in bold; p-values in parenthesis.

References

Angrist, Joshua, and Alan Krueger. "Empirical strategies in labor economics." Chapter 23 in *Handbook of Labor Economics* 3, edited by: Orley Ashenfelter, and David Card. Oxford: North-Holland, 1999.

Ashenfelter, Orley, and David E. Card. *Handbook of Labor Economics*. Oxford: North-Holland, 1999.

Ashenfelter, Orley, and Cecilia Rouse. "Income, Schooling and Ability: Evidence From a New Sample of Identical Twins." *The Quarterly Journal of Economics* 113, no. 1 (February 1998): 253-84.

Card, David. "The causal effect of education on earnings." Chapter 30 in *Handbook of Labor Economics* 3, edited by: Orley Ashenfelter, and David Card. Oxford: North-Holland, 1999.

Checchi, Daniele. *The Economics of Education: Human Capital, Family Background and Inequality*. Cambridge: Cambridge University Press, 2006.

Cohn, Elchanan, and Terry Geske. *The Economics of Education*. Boston: Butterworth-Heinemann, 1990.

Daganzo, Carlos F. *Multinomial Probit: The Theory and its Applications to Travel Demand Forecasting*. New York: Academic Press, 1979.

Departamento Administrativo Nacional de Estadística (DANE). Censo General. 2005.

Easterly, William, and Ross Levine. "It's not factor accumulation: Stylized facts and growth models." *The World Bank Economic Review* 15, no. 2 (August 2001):177-219.

Gaviria, Alejandro, and Jorge Barrientos. "Determinantes de la calidad de la educación en Colombia." Archivos de Economía 159. Bogotá: Dirección de Estudios Económicos, Departamento Nacional de Planeación, 2001.

Greene, William H. *Econometric Analysis*. Upper Saddle River, N.J.: Prentice Hall, 2003.

Griliches, Zvi. "Estimating the Returns to Schooling: Some Econometric Problems." *Econometrica* 45, no. 1 (January 1977): 1-22.

Iregui, Ana María, Ligia Melo, and Jorge Ramos. "Evaluación y análisis de eficiencia de la educación en Colombia." Borradores de Economía 381. Bogotá: Banco de la República Colombia, 2006.

Kennedy, Peter. *A Guide to Econometrics*. Cambridge: The MIT Press, 2003.

Lee, Byung-Joo, and Lawrence C. Marsh. "Sample Selection Bias Correction for Missing Response Observations." *Oxford Bulletin of Economics and Statistics* 62, no. 2 (May 2000): 305-22.

Manski, Charles, and Steven Lerman. "The Estimation of Choice Probabilities from Choice-Based Samples." *Econometrica* 45, no. 8 (November 1977): 1977-88.

McFadden, Daniel. "Conditional Logit Analysis of Qualitative Choice Behavior." Chapter in *Frontiers in Econometrics*, edited by Paul Zarembka. New York: Academic Press, 1974.

Manski, Charles, and David A. Wise. *College Choice in America*. Cambridge: Harvard University Press, 1983.

Mincer, Jacob. *Schooling, experience, and earnings*. New York: Columbia University Press, 1974

Ministry of Education. Ministry of Education Statistics. 2002.

Orozco, María Otilia. "Colombia's Higher Education Quality Control System and Potential for Further Development." Archivos de Economía 290. Bogotá: Dirección de Estudios Económicos, Departamento Nacional de Planeación, 2005.

Pritchett, Lant. "Where has all the Education Gone?." *The World Bank Economic Review* 15, no. 3 (October 2001): 367-91.

Rouse, Cecilia Elena. "What to do after high school: The two-year versus four-year college enrollment decision." Chapter 3 in *Choices and Consequences: Contemporary Policy Issues in Education*, edited by: Ronald Ehrenberg. Ithaca: ILR Press, 1994.

Wooldridge, Jeffrey M. *Introductory Econometrics: A Modern Approach*. Michigan: Thomson-South-Western College Publishing, 2006.

World Bank. *Priorities and strategies for education: a World Bank review*. Washington, D.C.: The World Bank, 1995.

World Bank. *Tertiary Education in Colombia. Paving the Way for Reform*. Washington, D.C.: The World Bank, 2003.