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***A dynamic analysis of household decision making in  
urban Colombia, 1976-1998***  
***Changes in household structure, human capital and its returns, and  
female labor force participation***

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# A dynamic analysis of household decision making In urban Colombia, 1976-1998

Changes in Household Structure, Human Capital and its Returns,  
and Female Labor Force Participation

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## Abstract

The objective of this research paper is to examine the changes and dynamics of household structure, human capital and the returns to education, labor earnings, women labor force participation and investment in human capital. The approach used in the analysis is the so-called “cohort technique”, which consists in following across time men and women born in the same year or year spell. The main sources of information for this work are the quarterly Household Surveys beginning in 1976. With such information a database of more than 6.0 millions observations (workers, parents, children, etc) was constructed. The research results show that the number of children of the younger parents has drastically decreased. This process has come together with a significant increase in women’s labor force participation and higher women’s school attainment. The study also points out that the school attainment of the younger generation of women is higher than men’s and that the income gap between men and women of the new generation, after controlling by education, is lower than such gap in the old generations. Finally, the study indicates that the human capital accumulation has been very unequal for the different income groups. The children of low educated parents achieve low levels of education both in the old and new generations. Thus, the escaping from the poverty trap is as difficult today as in the past. The education opportunities are concentrated in the middle and high-income groups.

Key words: human capital, cohort analysis, return to education.

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# A dynamic analysis of household decision making

## In urban Colombia, 1976-1998

### Changes in Household Structure, Human Capital and its Returns, and Female Labor Force Participation<sup>1</sup>

(Revised Final Version)

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#### 1. Introduction

The objective of this study is to examine by using the cohort technique the changes and dynamics of the structure of household, human capital and returns to education, labor force participation and investment in human capital for the period 1976-1998. In the last quarter of 20<sup>th</sup> century Colombia has experienced deep changes in its economic and social structure. Among them, the acceleration of urbanization process, the massive incorporation of women to the labor force, a greater stocks of human capital for men and, in particular women, and the sharp decrease in fertility rates. At the same time, there have been important changes both in the structure and composition of families, such as an increase in the percentage of single parent families, and in the children's the accumulation of human capital. How fast have these changes been? What has been the evolution of returns to education? What have the main determinants of women participation changes been? Has the labor income gap between men and women diminished? Has the accumulation of human capital been similar among children with parents belonging to different socioeconomic backgrounds?

The answers to the above questions are all interrelated and may be described as follows. Thus, higher stock of human capital and school attainment of women are associated to a

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<sup>1</sup> We thank the insights and comments by Orazio Attanasio, Miguel Szekely and others participants in the Seminar held in Mexico City in March 1999. This paper is part of a wider project on the topic for Latin America sponsored by the Inter American Development Bank.

greater labor participation of women and to a higher opportunity cost of children, which leads, at the same time, to lower number of children and smaller families. Additionally, more educated mothers raise less children, invest more in them and, given the case, are more able to run and maintain a household without the presence, and sometimes without the help, of the husband.

The objective of this document is to answer these questions based on the evidence extracted from the Colombian urban household surveys of the last quarter of century. The trends found will tell us how the households of the Colombian urban society have evolved and what we may expect for the next century. To undertake the present study we construct a large database with information on personal and household characteristics of men, women and their families for the period 1976-1998. The information allows to examine the changes of family structure, analyze the accumulation of human capital of men, women and children, measure both the evolution of labor earnings and the changes in the returns to education and explain the patterns of female labor force participation.

Thus, according to the findings the story presented in detail below is as follows. The returns to education and expected earning of women have increased for most of the education levels, which may have contributed together with more educated parents (in each new generation) to raise the level of education among women. At the same time, higher levels of women's education in urban Colombia have prompted an increase in their labor participation rates and the quality of children, and a decrease of the family size and of the expected quantity of children. The present document will present each part of the story and is divided in five sections, being the first one this introduction. The second section examines the evolution by cohorts of the family structure and its composition. The results will show that the younger generations of household head are more likely to command extended families and less likely to command nuclear families. It is found, additionally, that single parents families are also more common in the younger generations. The empirical evidence will show as well that family size is smaller in the younger households. We also analyze the mating decisions in three points of time and find that the men and women tend to wed people of the same education level. Section three examines the stock of human

capital, the returns to education, the earnings and the earning differentials by cohort. It is found that the stock of human capital is larger in the new generations and that woman's stock has grown faster than man's has. It is also found that although returns to education of the younger cohorts are lower than the older cohorts' returns, there is a significant premium in the returns to education for the workers with college education. Section four presents the changes in labor force participation of women. The evidence shows that the younger cohorts of women have experienced a remarkable increase in labor participation basically explained by their higher school attainment. Section five analyzes the dynamics of children's investment in human capital and children's school enrollment rates by cohort and education of their parents. It is observed that, for any parent cohort, the children of the more educated parents have greater enrollment rates and, in consequence, have a higher school attainment. Moreover, for the younger parents cohorts, the school attainment gap between the children of the more educated and the children of the less educated seem to have increased. Finally, section six is dedicated to conclusions.

## 2. Family Structure

### **2.1 Family type and composition**

This section presents the evolution of the family type and family composition according to the cohort (year of birth) of the household head. The data was compiled from quarterly household surveys from 1976 to 1998. We put together in a single file all the information regarding the characteristics of the household (number of household members, and marital status, age, gender and education of the household head) and divided the sample by the year of birth of the household head, in five-year spells beginning 1910-1914. Then, we calculate for each household head cohort at each (average) observable age the mean value of the variable to examine. For instance, we are able to observe in the 1976 household surveys the men and women of the 1910-1914 cohort when they were (in average) 64 years old, in the 1977 household surveys when they were 65 and so on. At each (average) age of the household head cohort we can then compute the mean value of the variable to examine (number of household member, percentage of lonely couples, etc). At the same time, we are able to observe, let us say, the men and women of the 1945-1949 cohort in the 1976

household surveys when they were (in average) 29 years old, in the 1985 household surveys when they were 38 years old and so on.

Given the data and the methodology described above we calculate for each cohort the percentage of men and women either single or married. In addition, we characterize for each observable age and cohort the percentage of different types and composition of households.

Graphs 1 and 2 depict the percentage of married men and married women. We can see, as expected, that the percentage of married men and married women increases with age. However, there are two differences between the patterns of men and women. First, while most men (around 90%) remain married until death the percentage of married women reaches a peak at age 40 and diminishes afterwards. This may be due to higher life expectancy of women. Second, the percentage of married women is higher than men's percentage until at about age 32, when such percentage turns lower. Thus, at 44 the percentage of married men reaches 90% (for the older cohorts) while the percentage of married women barely arrives to 70% (also for the older cohorts). For the younger cohorts, the percentage of married men and women is lower, as observed in graphs  $x$  and  $x^2$ . This is clearly the result of a rise in the percentage of the separations and divorces reflected in the increase of single parent families, as it will be seen below<sup>3</sup>.

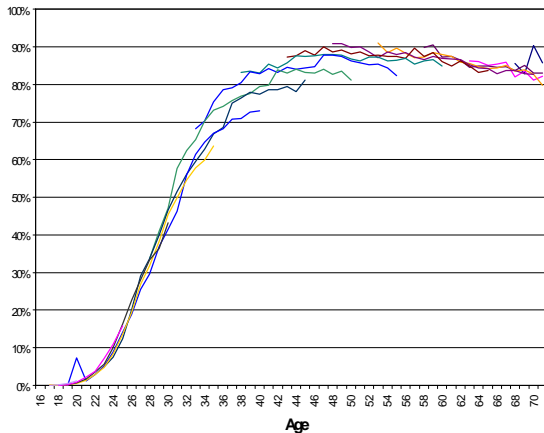
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<sup>2</sup> T We also established the mating decisions of men for the year of 1976, 1987 and 1998. In 1976 the most educated married men had spouses belonging to both the most educated women groups and to the non-educated groups, while the non-educated men married mostly non-educated women (see appendix 1). Such mating pattern may be due low proportion (in relation to men) of educated women 1976. However, such pattern has drastically changed over time, mainly for educated men. In fact, married men with college education in 1985 and in 1998 have spouses belonging in higher proportion to that education level group. Thus, 29% and 43% of married men with college education had, in 1987 and 1998 respectively, wives with that education level. In contrast, in 1985 and 1998 married men with less than 10 years of schooling had wives mostly with 10 or less years of schooling as observed in the diagonal of the Appendix 1.

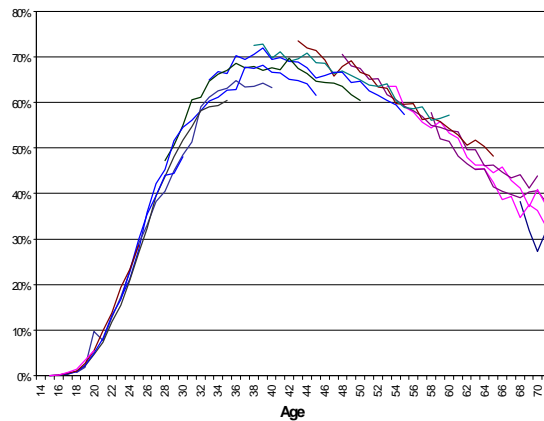
<sup>3</sup> We carried out the a similar exercise for the percentage of households composed of single males and females. The results obtained were practically a mirror of the graphs 1 and 2. We could observe that the percentage of single male households decreases rapidly from 16% to 2% between ages 20 to mid-thirties. The percentage of single male household remains low, even for men at very old age. The pattern of single female household looked different. First of all, while the percentage of household of 20 years old female is 12%, the percentage of 30 years old single women is 2%. However, the pattern reverses at around age 50. Thus, the percentage of household of fifty years old single women is 2% but the percentage of 60 year old women is 4% and it rises to 10% for women at 80, which shows that men generally died at an earlier age than women. Although, it was possible to observe in the graphs some cohort's differences, apparently they were quite small.

Graphs 3 and 4 depict respectively the percentage of nuclear (husband, wife and children younger than 30) households and extended families (defined as families whose members are children 30 years old or more or have additional adults) by the age and cohort of the household head. According to the graph 3, 30% of the households with head at around age 20 are nuclear families. This percentage increases with the age of the head until age 38, at which the percentage of nuclear families reaches its peak. Thus, 68% of 38 years old household heads command nuclear families. However, for household heads at age above 38 the percentage of nuclear families decreases and, as observed in graph 4, the percentage of extended families increases. This pattern is mainly due, of course, to aging of children. However, the decreasing pace is quite slow until about age 50 of the household head. Thus, less than 20% of the households directed by heads younger than 50 years are family extended households. However, this percentage increases sharply for household head older

**Graph 1**  
**Married Men Households by head Cohort**  
**(Percentage of Households)**

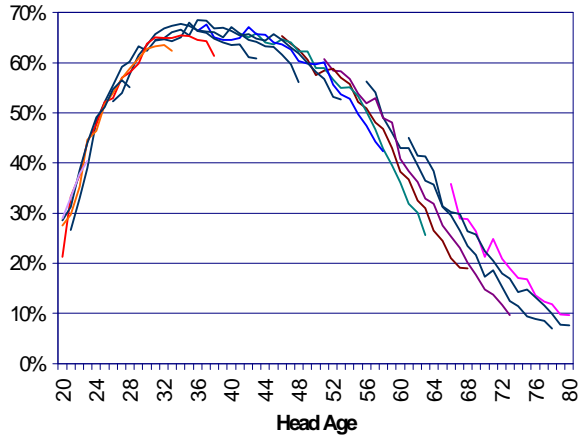


**Graph 2**  
**Married Women Households by Head Cohort**  
**(Percentage of Households)**

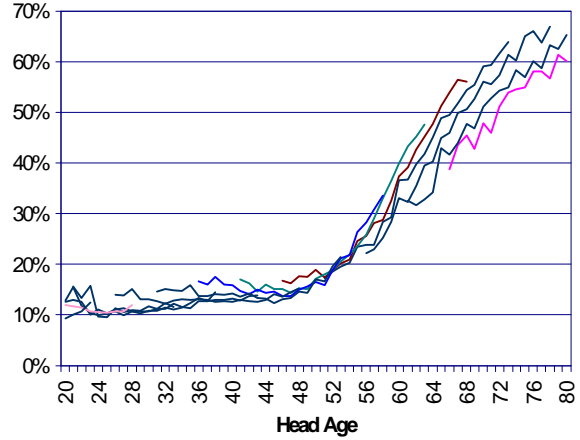




**Graph 3**  
**Nuclear Families by Head Cohort**  
**(Percentage of Household)**

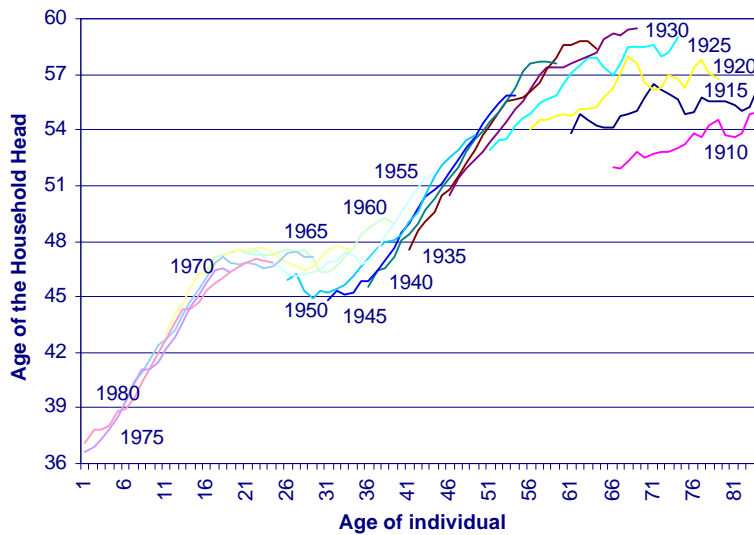


**Graph 4**  
**Extended Families by Head Cohort**  
**(Percentage of Households)**



than 50 years. For instance, around 60% of the household with 70 years old heads are family extended. The mentioned pattern clearly illustrates the natural result of aging of young children and parents. Thus, the older the parents (and the children) the greater the percentage of extended families.

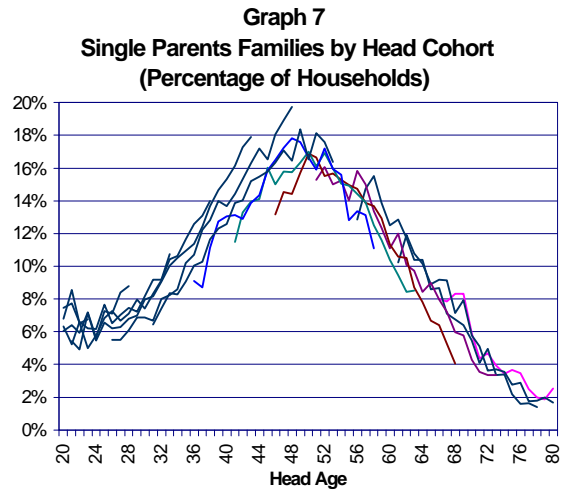
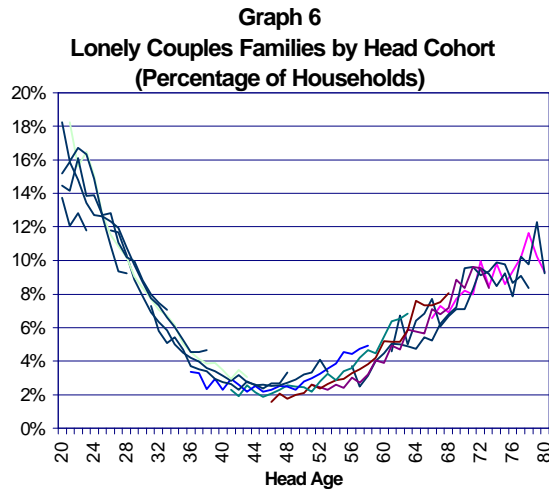
**Graph 5**  
**Age of the Household Head**



Finally, there are apparently some cohort's effects in the trends of percentage of nuclear and family extended. According to the graphs, household heads belonging to the younger cohorts are more likely to command family extended households.

**Graph 6** shows the percentage of households by age and cohort of the head composed by couples without children. The percentage of households whose head is 25 years old composed by couples without children is around 12% and decreases with the age of the head being only 2% for households headed by 50 years old people. However, the trend reverses for heads older than fifty years. **Graph 7** presents by cohort and age the percentage of households whose head is a single parent. It is clear from graph that the older the household head (until 45) higher the probability to head a single parent household. However, as long as the household head becomes older than 45 the probability of commanding a single parent household decreases. It is also quite apparent from graph 7 that there is a strong cohort effect in single parenthood. Thus, at the same household head age, the percentage of single parent families among the younger generations is higher.

Finally, graph 7 relates the age of the individual (excluding the household head) with the age of the household head by cohort. The graph indicates that the patterns in family formation have varied significantly among cohorts, particularly between the old and young cohorts. In fact, the graph 7 shows that household head belonging to the old cohorts were much younger than today's household head. However, the big changes in family formation seemed to have occurred for the cohorts born after 1965. These changes may be related to the significant increases school attainment among the new generations of men and women (as shown below) that have delayed their mating decisions.

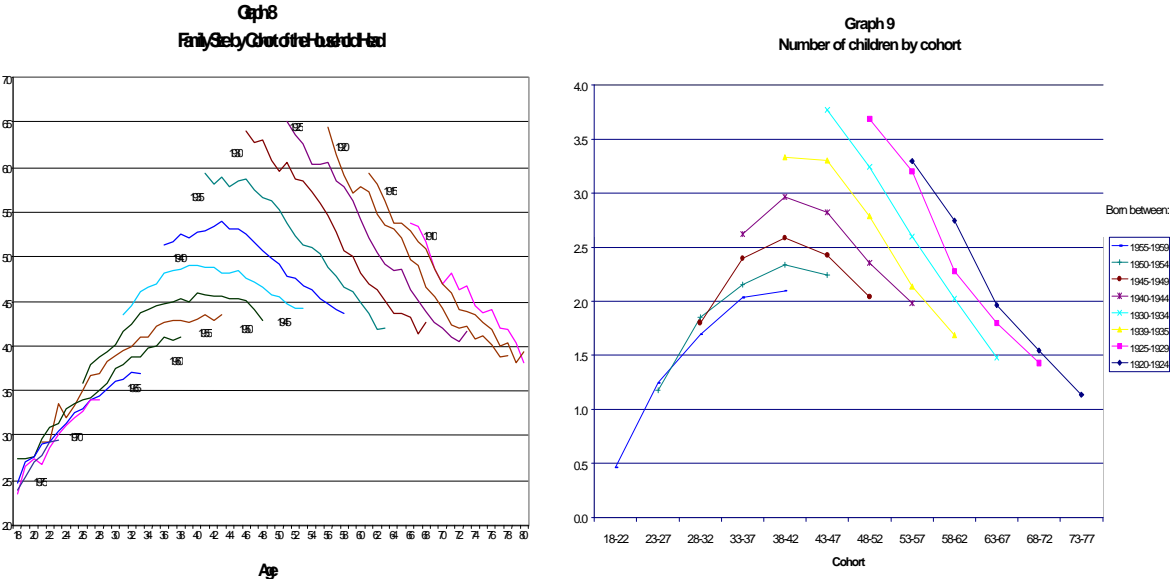


## 2.2 Family size

**Graph 8** contains the family size by cohort of the household head at each age. We can observe from the **graph 8** and graphs A.1 to A.6, that there is a strong cohort effect in family size regardless the education level of the household head. Thus, the family size of the 1935 cohort household head at age 40 amounted about seven people, while the 1955 cohort– family size amounts 4.8 people.

The family sizes of the older generations of household heads are quite similar regardless of head the education level. However, the reduction in family sizes seems to be stronger, in the younger cohorts, among the families of the most educated household heads. This may be explained for the higher opportunity cost of raising a child for the most educated women. In fact, according to appendixes A.1 and A.2, the percentage of women born before 1930 with 11 years of education or more was about 8% (and about 15% for men) and the percentage with college was less than 1.5% (and about 7% for men). However, the percentage of women born between 1950 and 1970 with 11 years of education or more is about 40% (and about 36% for men) and the percentage with college around 10% (and less than 9% for men). Clearly the younger generations of women have, in average, higher school attainment, which may explain both the reduction in family size (graph 8) and in number of children (graph 9) that have occurred over time. In fact, as shown in graph 9, the

number of children fell almost by 50% in a twenty years span. Thus, the cohorts born in 1935-39 had about four children compared with the two children of the cohorts born in 1955-59.



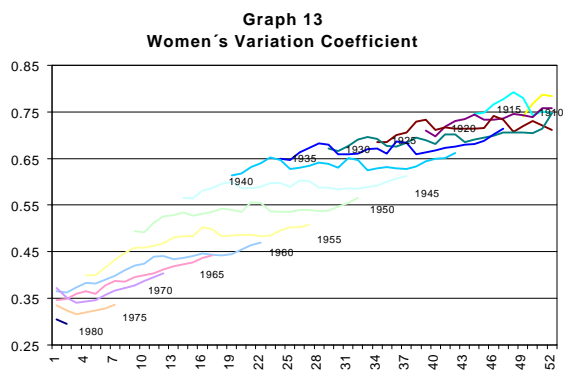
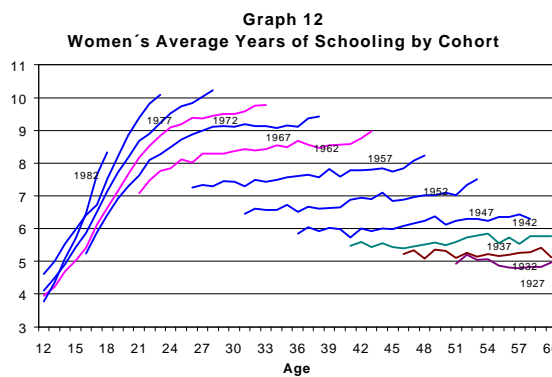
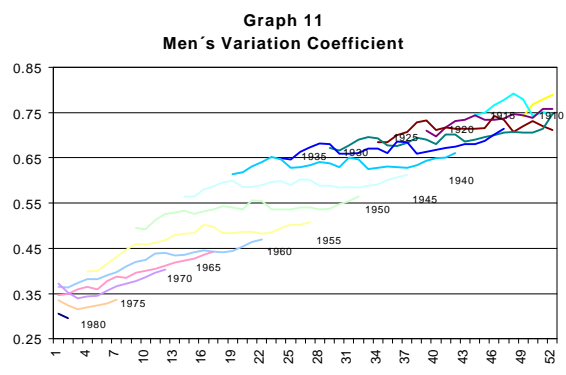
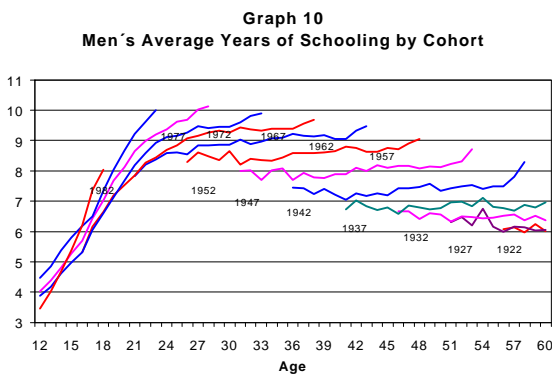
### 3. The Stock of Human Capital and Its Returns

#### 3.1 Stock and Accumulation of Human Capital

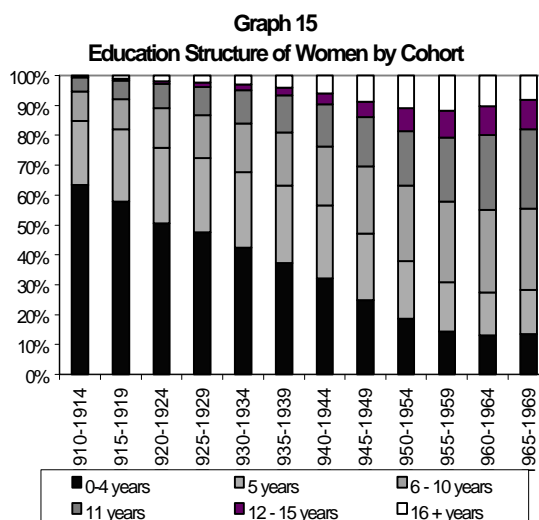
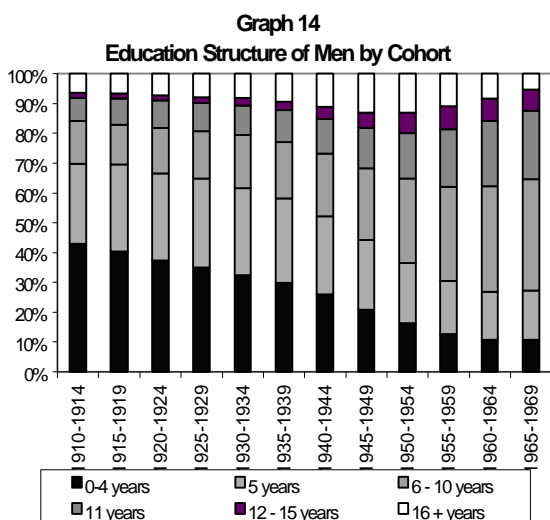
In this section we will examine the stock and coefficient of variation of human capital for men and women by cohorts. Graph 10 depicts the stock of human capital of men’s cohorts since 1927. Until the 1947 cohort the accumulation of human capital was quite slow. The difference in years of schooling from one cohort to the next five years younger was of 0.25 years. However, the stock grew a little faster for the 1952 and 1957 cohort, slowed down for the 1962 and 1967 cohorts but apparently accelerated for the cohort born after 1970. The increase in years of schooling of men has gone together with an important change in the profile of degree completion. Thus, around 7% of the men born before 1930 completed college degree and more than 65% had primary or less than primary education (Graph 14 and appendix A.1). The percentage of men born between 1930 and 1960 with primary

education or less decreased from 60% to 30%, the percentage with complete and incomplete secondary school increased from 27% to 55% while the percentage with college education only reached 10%. The coefficient of variation of the men's stock of human capital is presented in graph 11. It shows that it is lower the younger the cohort. This implies a significant reduction in the dispersion of human capital among men as the coefficient of variation depends on the differences in inter-cohort education attainment. The coefficient of variation also increases overtime for the same cohort. Thus, at an early age of the cohort the education attainment gap is not so wide. However, as long as some people drop out from the school system the intra-cohort education coefficient of variation rises, reflecting the differences in education opportunities. Among the new generations of men, as shown in graph 11, such the "slope" of the coefficient of variation does not seem to be lower.

Graph 12 contains the stock of women human capital by cohort, measured as their average



years of schooling. It is pretty clear from the graph that there has been a significant increase in women’s human capital. For instance, the average years of schooling of the 1927 cohort were about five while the 1947 cohort was about 6.5. However, the accumulation of human capital accelerated for the cohorts 1947 to 1962 at a rate close to one additional year by cohort, slows down a bit for the 1967 cohort and has gone quite fast for the younger cohorts. Thus, the average years of schooling at 30 were 7.2 for the 1952 cohort, 8.2 for the 1957 cohort and 9.5 for the 1967 cohort. As in men, the increase in years



of schooling of women has gone together with an important change in the profile of degree

completion. Thus, only around 1.5% of women born before 1930 completed college degree and more than 75% had primary or less than primary education (Graph 15 and appendix A.2). The percentage of women born between 1930 and 1960 with primary education less decreased from 65% to 27% (more rapidly than men), the percentage with complete and incomplete secondary school increased from 27% to 53% while the percentage with college education only reached 11% (graph 15). The coefficient of variation of the stock of women human capital has the same pattern than men’s does. It was as high among the old generations of women as it was among the old generations of men. It has decreased as well among the new generations of women reflecting the inter cohort expansion education opportunities. However, as in men, the “slope” of the coefficient of variation for the same cohort also rises.

### 3.3 Returns to Human Capital

#### 3.3.1 Data and Methodology

The data utilized in this section are primarily from the 93 quarterly Household Surveys for the main seven Colombian cities, from March 1976 to June 1998. The sample is limited to individuals from 12 to 60 years perceiving labor earnings. The top coded earning data (on monthly basis) and missing and not reported earning data (on monthly basis) have been corrected by using the methodology described in Núñez y Jiménez (1998) and Núñez y Sanchez (1999), respectively.

From 1977 to 1981, around 9.000 people were interviewed in each quarterly Survey, which

**Table 2.**  
**Sample Size**

| <b>Year</b>  | <b>Frequency</b> | <b>Share</b>   | <b>Accumulated</b> |
|--------------|------------------|----------------|--------------------|
| 1976         | 41,761           | 2.07%          | 2.07%              |
| 1977         | 38,344           | 1.90%          | 3.98%              |
| 1978         | 23,621           | 1.17%          | 5.15%              |
| 1979         | 38,428           | 1.91%          | 7.06%              |
| 1980         | 33,363           | 1.66%          | 8.72%              |
| 1981         | 44,871           | 2.23%          | 10.95%             |
| 1982         | 103,255          | 5.13%          | 16.08%             |
| 1983         | 123,730          | 6.15%          | 22.22%             |
| 1984         | 128,941          | 6.41%          | 28.63%             |
| 1985         | 100,818          | 5.01%          | 33.64%             |
| 1986         | 106,294          | 5.28%          | 38.92%             |
| 1987         | 112,702          | 5.60%          | 44.52%             |
| 1988         | 113,772          | 5.65%          | 50.17%             |
| 1989         | 114,784          | 5.70%          | 55.87%             |
| 1990         | 97,090           | 4.82%          | 60.69%             |
| 1991         | 100,869          | 5.01%          | 65.70%             |
| 1992         | 104,601          | 5.20%          | 70.90%             |
| 1993         | 107,988          | 5.36%          | 76.26%             |
| 1994         | 112,157          | 5.57%          | 81.83%             |
| 1995         | 107,491          | 5.34%          | 87.17%             |
| 1996         | 105,897          | 5.26%          | 92.43%             |
| 1997         | 99,838           | 4.96%          | 97.39%             |
| 1998         | 52,456           | 2.61%          | 100.00%            |
| <b>Total</b> | <b>2,013,171</b> | <b>100.00%</b> |                    |

means that the annual sample during this period was around 36.000 people. Since 1982 the number of people interviewed was tripled and has been around 110.000 per year. In order to obtain a large sample we put together the 93 quarterly Surveys in a single file and got a database with more than 2.0 millions observations. (Table 2) The objective of study is to

examine the changes in the behavior of labor income and returns to education for education groups, gender and cohorts.

One of the main sample problems is whether the characteristics of the migrant labor force differs from the urban “historical population”. If their socioeconomic characteristics were different, the results found may be biased. The solution to that problem could have been to exclude from the sample the migrant population. However, we were not able to do so mainly for two reasons. 1) The questions about the person’s geographic origin and number of years living in the city (where the Household Survey is conducted) were not always asked every quarter. 2) The computation of the migration variable (percentage of workers who have lived less than 5 years in the city) shows from one survey to the next bizarre jumps. Calculations based on the household survey show, however, that the percentage of migrants has been around 11% of the labor force. In order to determine whether the migrant’s characteristics and behavior differ from the non-migrants’ characteristics we estimate both the average years of education of migrant and the migrant’s participation rate. The calculations are presented in graphs A.7 and A.8. Graph A.7 shows that the years of education of migrant and non-migrant are quite similar. In fact, there exists a small difference in favor the non-migrants workers (around 0.1 years). The participation rate of migrant and non-migrant workers is also very similar (graph A.8). These two results leads us to conclude that the utilization of the whole sample (without excluding migrants) does not introduce a significant bias (not even a small bias) in the estimations we will carry on.

In order to determine the education groups, in which the cohorts are to be divided, we calculated for the whole sample the person’s average monthly labor earnings by years of education. The results of the calculation are presented in graph 16 and in appendix A.7, which shows that there are significant increases in the average income once a school degree is achieved (primary, secondary and college). However, an enormous jump in income occurs once a college degree<sup>4</sup> is obtained (almost 100% for men and 71% for women). From graph 16 it is clear that the labor earnings exhibits “jumps” at five, eleven and sixteen years of schooling. According to this pattern, we defined six educational groups: workers

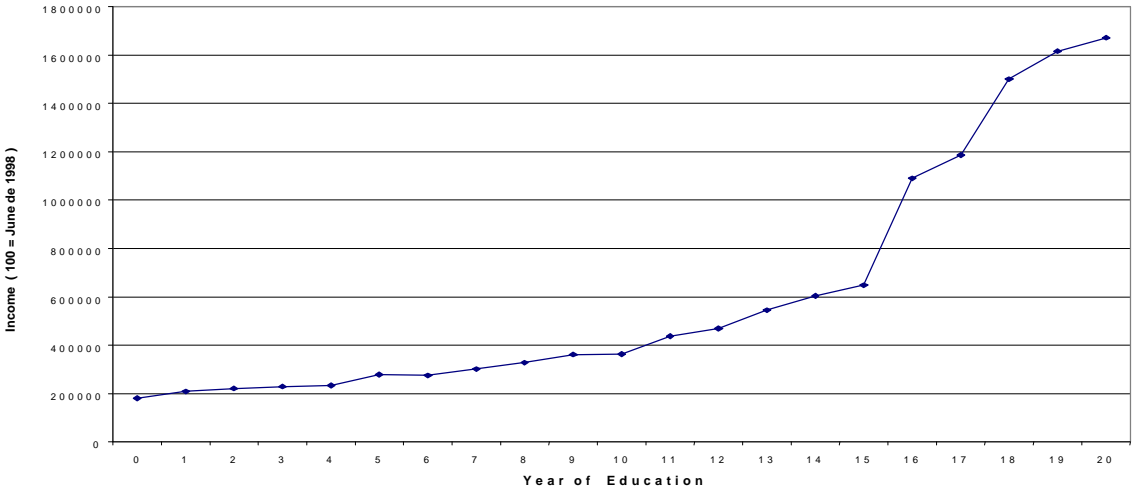
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<sup>4</sup> In fact, significant jumps occur after each year of education achieved after college, as shown in graph 1.



between 0 and 4 years of schooling (incomplete primary), 5 years (complete primary), between 6 and 10 (incomplete secondary), eleven (complete secondary), between 12 and 15 (incomplete college and technical education) and more than sixteen (complete college and more). The returns to education of each group is presented in table A.9.

**Graph 16**  
**Average Income by Year of Education**



**3.3.2 Cohort Analysis**

This section presents the estimates of the returns to education by cohort. The returns to education are different not only between education levels but also between generations and over time. These differences can be grasped by using techniques of cohort analysis, which basically consist in following across time a sample of individuals born in a determined year or time span. By using such technique it is possible to capture the earning profile and other variables along the life cycle for the same group of people. It also allows comparing different generations at the same age and observing changes in patterns of income, relative income, savings, expenditures, number of children, participation rates, etc. One way of capturing the cohort effects on income is by introducing into a Mincer’s equation cohort dummy variables interacting with schooling in order to isolate the changes in the returns to education by generation, as shown in the following equation:

$$\ln Y_i = b_0 + b_1 S_i + b_2 A_i + b_3 A_i^2 + \sum_{j=1}^{J-1} x_j d_j + \sum_{k=1}^{K-1} y_k d_k + \sum_{j=1}^{J-1} a_j d_j S_i + \sum_{k=1}^{K-1} z_k d_k S_i + \eta_i \quad (3)$$

Where  $d_k$  are year dummies and  $d_j$  are cohort dummies. We avoid the multicollinearity problem that may arise between age and cohort by defining a cohort as a group of individuals born within a five-year spell and not in a single year. The specification of the equation (3) captures not only the cohort shift of the intercept but also the changes in the slope of the return to education ( $d_j * S_j$ ). The coefficients obtained are presented in table 3<sup>5</sup>. The coefficients in the left side of the table 3 (year effects interacting with schooling) suggest that the average return to education had important fluctuations during the time period under study. It decreased between 1976 to 1981 from 0.12 to 0.09 and remained constant until 1992 to rise sharply to 0.11 between 1992 to 1998. The right side of the table 3 suggests that the average return to education by cohort has been decreasing. Thus, the rate of return to education for the generation born between 1910-1914 has been in average 0.12 while the rate for the generation born between 1970-1974 has been 0.08.

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<sup>5</sup> The identification problems of the age variable when cohorts effects are introduced are well known. We think we avoid such problem by defining cohorts with individual born in a five year time span. However just to be sure of our procedure we ran the Mincer's equation model without the age variable but leaving in the regression the cohorts and time effects. *The estimates of the return to education either by cohort or year do not change at all* as shown in graph A.12 and 13.

**Table 3**

| <b>Changes in the Return to Education by Year and Cohort</b> |                    |                |                                      |                    |                |
|--|--------------------|----------------|--------------------------------------|--------------------|----------------|
| <b>Changes by Year<sup>1</sup></b>                           |                    |                | <b>Changes by Cohort<sup>1</sup></b> |                    |                |
| <b>Year</b>  | <b>Coefficient</b> | <b>Returns</b> | <b>Cohort</b>                        | <b>Coefficient</b> | <b>Returns</b> |
| 1976   | 0.0285             | 0.1169         | 1910-1914                            | 0.0328             | 0.1212         |
| 1977   | 0.0226             | 0.1110         | 1915-1919                            | 0.0325             | 0.1209         |
| 1978   | 0.0178             | 0.1062         | 1920-1924                            | 0.0288             | 0.1172         |
| 1979   | 0.0110             | 0.0994         | 1925-1929                            | 0.0250             | 0.1134         |
| 1980   | 0.0069             | 0.0953         | 1930-1934                            | 0.0228             | 0.1113         |
| 1981   | -0.0001            | 0.0883         | 1935-1939                            | 0.0219             | 0.1103         |
| 1982   | 0.0027             | 0.0911         | 1940-1944                            | 0.0206             | 0.1090         |
| 1983   | 0.0042             | 0.0927         | 1945-1949                            | 0.0183             | 0.1067         |
| 1984   | 0.0043             | 0.0927         | 1950-1954                            | 0.0132             | 0.1016         |
| 1985   | 0.0034             | 0.0918         | 1955-1959                            | 0.0061             | 0.0945         |
| 1986   | 0.0002             | 0.0886         | 1960-1964                            | 0.0000             | 0.0884         |
| 1987   | 0.0000             | 0.0884         | 1965-1969                            | -0.0040            | 0.0845         |
| 1988   | 0.0003             | 0.0887         | 1970-1974                            | -0.0095            | 0.0789         |
| 1989   | 0.0014             | 0.0899         | 1975-1979                            | -0.0282            | 0.0602         |
| 1990   | 0.0024             | 0.0908         | 1980-1984                            | -0.0482            | 0.0402         |
| 1991   | 0.0032             | 0.0916         |                                      |                    |                |
| 1992   | 0.0061             | 0.0946         |                                      |                    |                |
| 1993   | 0.0047             | 0.0931         |                                      |                    |                |
| 1994   | 0.0038             | 0.0922         |                                      |                    |                |
| 1995   | 0.0062             | 0.0947         |                                      |                    |                |
| 1996   | 0.0113             | 0.0997         |                                      |                    |                |
| 1997   | 0.0176             | 0.1060         |                                      |                    |                |
| 1998   | 0.0252             | 0.1136         |                                      |                    |                |

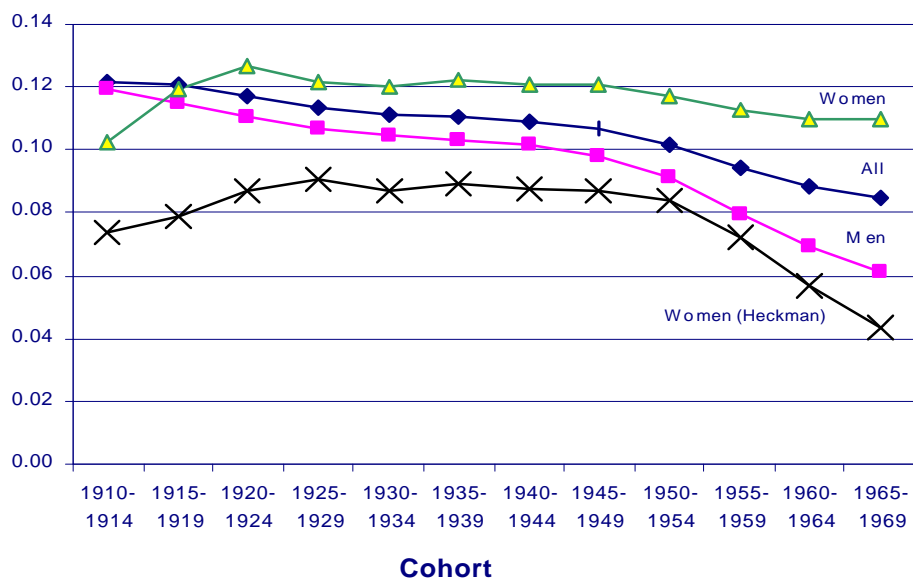
<sup>1</sup> The Return to Education by year or cohort is the sum of the average return (0.0884) and the specific coefficient by year and cohort

The estimations for men and women of the returns to education both by cohort and by year are depicted in graphs 17 and 18. The men's returns to educations have been falling steadily for each cohort, although this process has been more pronounced for the cohorts born after 1950. In fact, men's returns to education fell from 0.12 for the cohorts born in the 1910's to 0.085 for the cohorts born in the 1960's. The women's returns to education exhibit a different pattern. They remained more or less constant for the cohorts born between the 1910's and the 1950's and fell just a little (to about 0.11) for the younger cohorts.

The results change, however, dramatically when we correct for participation bias by using Heckman's methodology (see appendix A.3 and A.4 for the estimated equation). In order to avoid identification problems the following variables entered in the participation equation and did not enter in the wage equation: number of children under 6, between 6 and 11, 12 and 17, 18, etc., non labor income, average age of the household, average education of household and city dummies. According to the graph 17, the women's returns of education are much lower if the equations are corrected. In addition, the decrease in the returns to education that is observed in the younger men's cohort is even sharper in younger

women (see appendix A.5 and A.6). This might be the result of more idle labor force of the young women due to their child-raising activities.

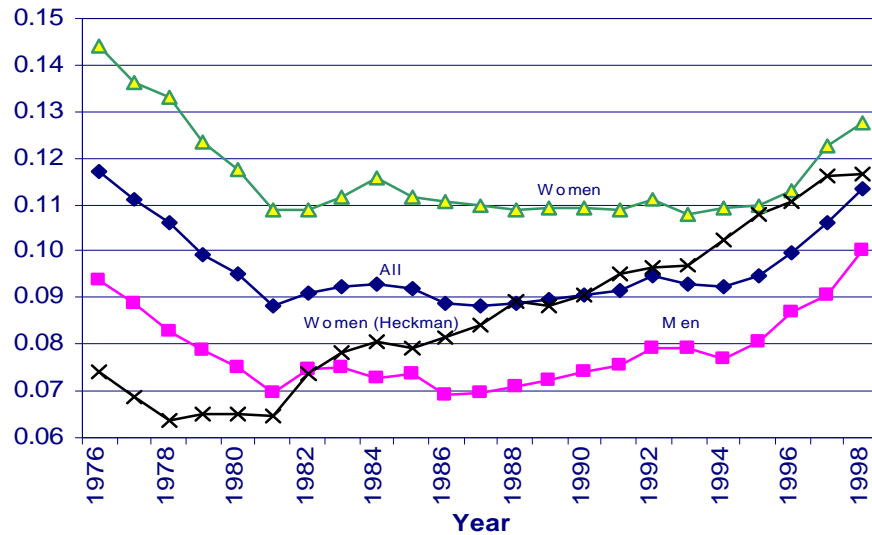
**Graph 17**  
**Return to Education by Cohort**



Graph 18 contains the yearly to education for men and women from 1976 to 1998. As observed, women’s returns (without Heckman’s correction) have been higher than men’s (in about 0.04 points), although have had the same trend. In fact, returns to education fell between 1976 and 1981, remained more or less constant during the 1980’s and increased during the 1990’s. Women’s returns to education corrected by participation were lower than men’s at the end of the 1970’s, but grew steadily during the 1980’s and 1990’s, according to graph 18.

The econometric results gives us the evolution of the returns to education by cohort and gender. Nevertheless, the above approach shows only the general trends. A complete picture of the evolution of earnings and returns to education and experience, relative earnings, relative returns to education and relative returns to experience by education groups, cohorts and gender will be presented in the following section.

**Graph 18**  
**Returns to Education**



### 3.3.3 Income Profile by Cohort, Gender, and Education

The objective of this section is to present the income profile of the individuals of sample by cohort, education level and gender. The sample is divided in fifteen five years cohorts, starting with the cohort born between 1910 and 1914 and ending with the one born between 1980 and 1984. Each cohort was divided by gender and by six educational groups. Thus, we divide the sample in 180 groups that are tracked down through each year of the sample. Then, we calculated for every cohort, educational group and gender group the average labor earnings (deflated at 1998 prices) at each year of the sample<sup>6</sup>.

In order to have a neat and clear pictures of the earning profile of the different cohorts we smoothed the data by following Deaton's (1997) and Attanasio's (1994) technique. The smooth process consists in running a fifth order polynomial in age, cohort specific intercept

<sup>6</sup> The size of each cohort–gender–education cell is presented in tables A.1 and A.2.

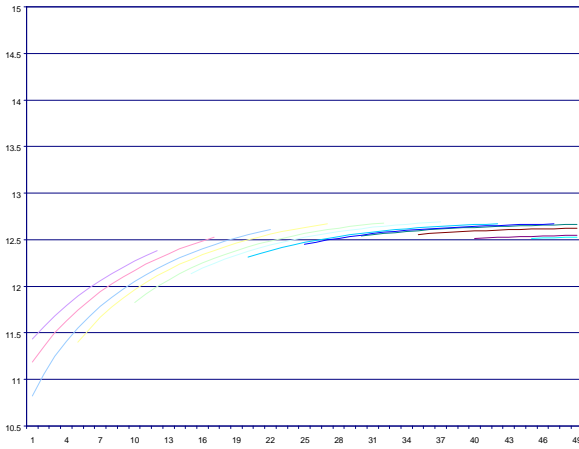
and year dummies whose coefficients are constrained to sum zero<sup>7</sup>. The smooth profiles are given by the polynomial in age with the cohort-specific intercepts. The smooth income profiles of men are presented in graphs 19 to 24 and of women in graphs 25 to 30.

The labor earning profiles show that the average labor earnings are not similar either by education or by gender. From graphs 19 and 20 we can see that the average earnings of men with incomplete and complete primary school has increased for every cohort and, as expected, the average earnings of the former have always been lower than the latter's. Thus the younger the generation of the men with incomplete and complete primary the higher their average income. It appears then that the returns to education of the mentioned school group has increased for the younger generations. Let us see men with incomplete and complete secondary school. As observed in graphs 21 and 22, younger men with incomplete and complete secondary school earn less at the same age than older men with the same schooling did. Unlike the men with primary school, the returns to educations of men with incomplete and complete secondary school have sharply decreased. The same pattern is observed in men with incomplete and complete college. According to the graphs 23 and 24 each new generations of men with college education earned less than the previous generation at the same age. The earning patterns by men's cohorts may as well reflect the observed changes in the relative supply by education. As shown in the first part of document (graph 14) the relative supply of men with incomplete and complete primary school among has sharply dropped among the new generations, which may had lead to an increase in their labor earnings.

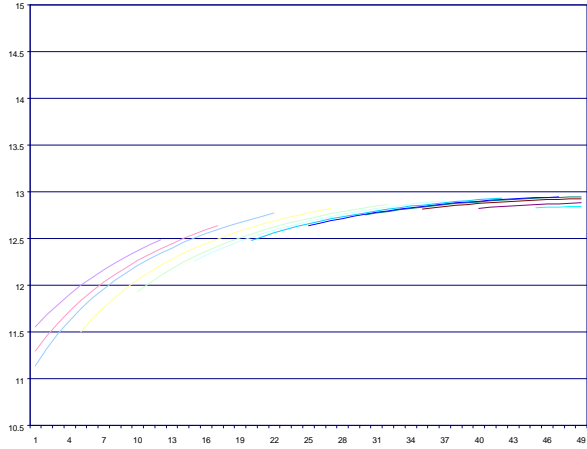
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<sup>7</sup> The men's and women's earnings were calculated using Attanasio's (1994) methodology. The graphs obtained were little messy making difficult to distinguish patterns of income among the different cohorts. Furthermore, towards the end of the graphs (at older age) all the cohorts jumped up and down, maybe due to the sample size of the older cohorts, which are divided in addition by education groups.

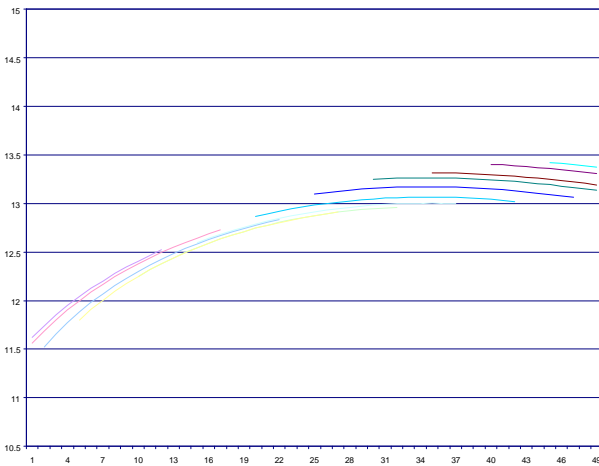
## Smooth Income Profiles of Men by Cohort and Education



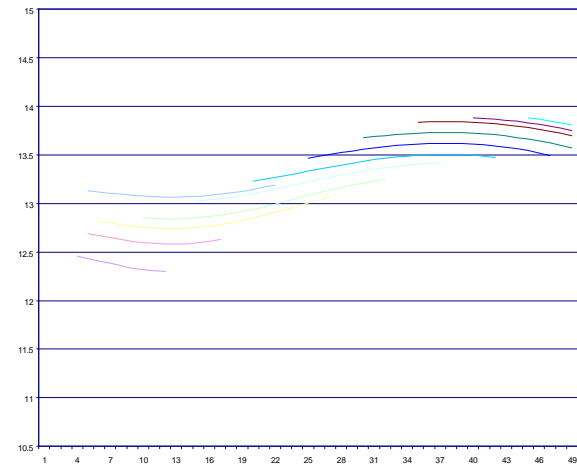
Graph 19 0-4 years



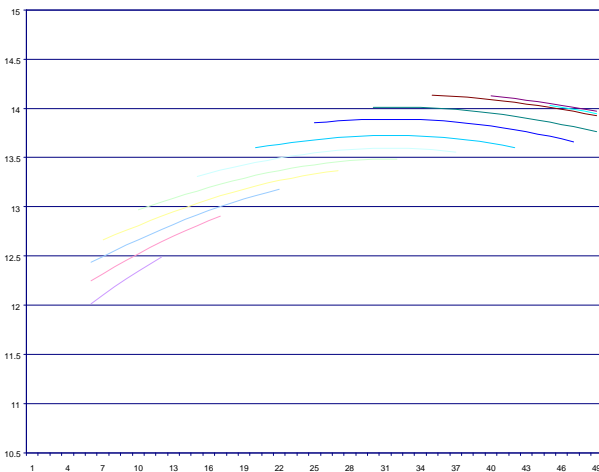
Graph 20 5 years



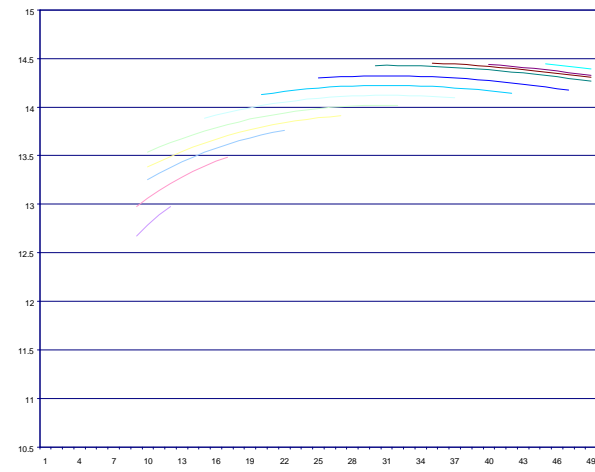
Graph 21 6-10 years



Graph 22 11 years

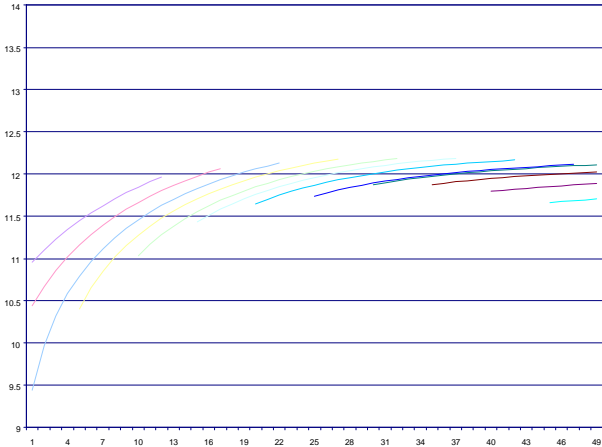


Graph 23 12-15 years

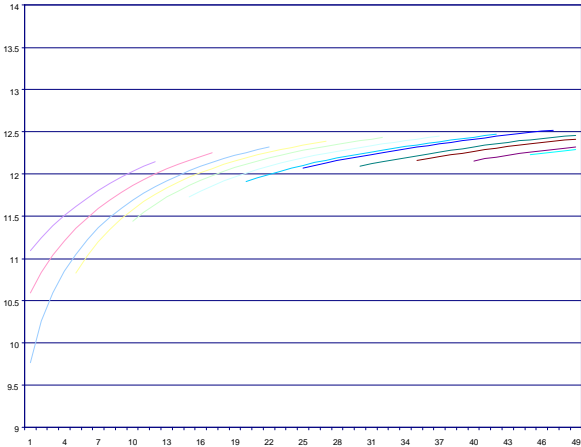


Graph 24 16+ years

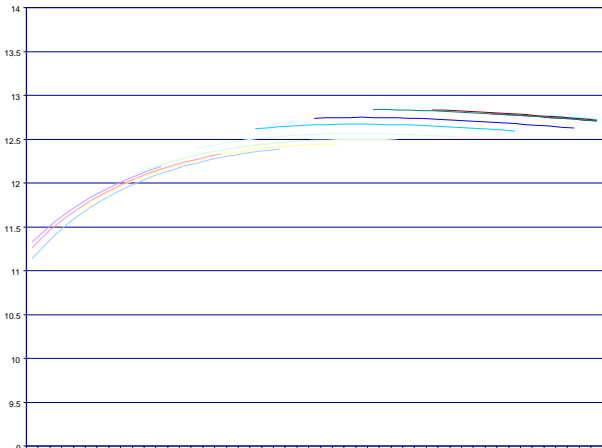
# Smooth Income Profiles of Women by Cohort and Education



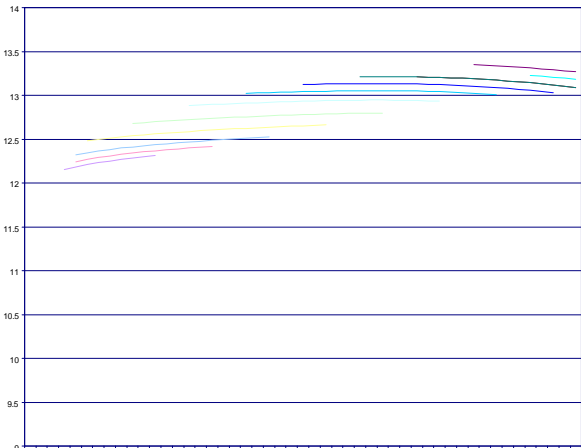
**Graph 25 0-4 years**



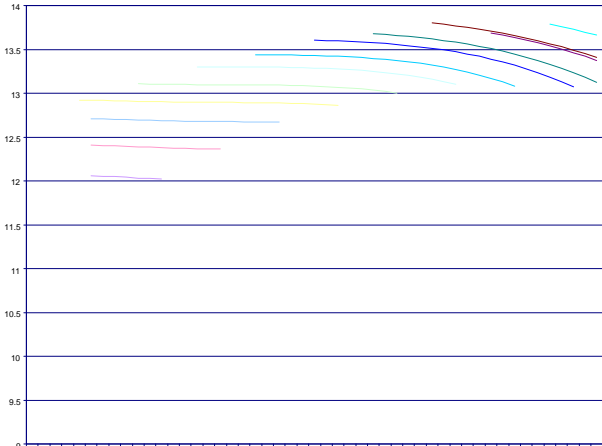
**Graph 26 5 years**



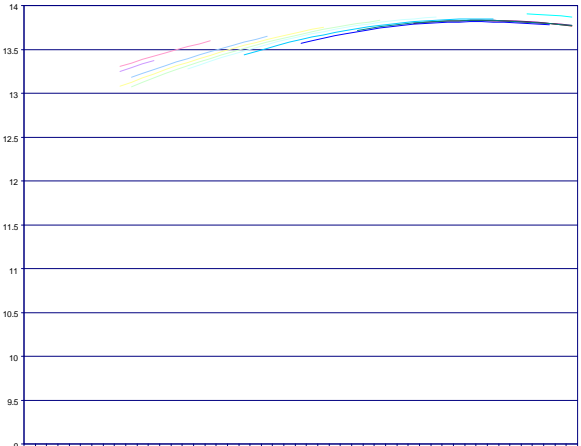
**Graph 27 6-10 years**



**Graph 28 11 years**



**Graph 29 12-15 years**



**Graph 30 16+ years**



The women's earnings profile by cohort is not always similar to men's. Thus, similarly to men, younger generations of women with incomplete and complete primary education earned more than older generations at the same age, as observed in graph 25 and 26. Nevertheless, the labor earnings differences between generations seem to be larger among women than among men. According to graph 25 and 26, women with incomplete and complete primary school at determined age earned around 20% more than women five years older at the same age. The income pattern of women with incomplete and complete secondary school is presented in graphs 27 and 28.

According to the graphs, younger women with incomplete and complete secondary school earned less than older women with the same education level did, at the same age. This implies that, like men, the returns to education for secondary school of the younger cohorts has decreased. The same behavior is observed among women cohorts with incomplete college (graph 29). Thus, older generations of women earned more than younger generations at the same age. Nevertheless, the earning gap between cohorts is wider in women with such level of education compared with other levels. Finally, graph 30 presents the earning profiles of women with college education by cohort. It is noticed that earning differences between cohorts are not very large and that the earnings of the younger generations of women are higher than the earnings of the older. It seems, then, that the returns to college education for women has increased over time, despite the fact that the relative supply of women with college degree has also increased as observed in graph 15.

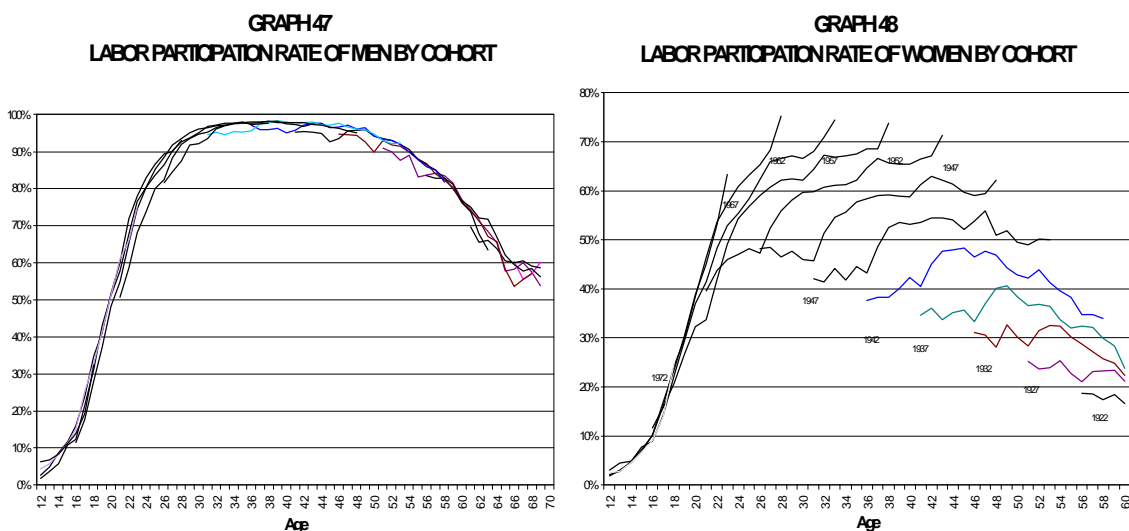
## 4. Labor Supply

### **4.1 Trends in the labor participation rate**

In the previous sections we analyzed the trends in composition and family size, returns to education of men and women, and relative earnings of men to women. These variables, as shown in diagram 1, are closely related to the labor participation of men and particularly of

women. The purpose of this section is to determine the impact of these variables on women's participation<sup>8</sup>.

Graph 47 depicts men's participation rate by cohort and age. It is clear from the graph that at age 25 more than 90% of men participate in the labor market regardless of the cohort and remains around 95% until age 50 at which the men's participation rate begins to decrease smoothly. Thus, at age 70 around 40% of men are still participating in the labor market.



Women labor force participation rate by cohort is depicted in graph 48. It is pretty clear that the changes in women's participation rate by cohorts have been significant. For instance, at age 40 about 35% of women belonging to the cohort born around 1937 participated in the labor market. This percentage reaches 65% for the generation born around 1957 and it would be much higher for the generation born around 1962. In the next section, we will estimate a model to explain the changes in women's participation. ¿Why these trends? ¿How are they related to the previous findings on returns to education and family size?

<sup>8</sup> Graph A.9 presents the behavior of labor force participation rate for men and women from 1976 to 1998. While men's participation rate has increased from 65% to 77% in the period under consideration, women's participation rate has increased quite significantly from 30% to 50%. The jump in women's participation rate occurred in 1982, associated with changes in the minimum wage legislation, which fixed it for women.

## 4.2 Determinants of women's labor force participation

In this section we will examine the determinants of women's labor force participation. From the literature, it is known that the participation rate of women depends on variables related to women's human capital and returns to education, demographic variables such as number of children and business cycles variables such as unemployment rates, men wages, etc. The traditional approach to analyze the determinants of women's participation is by estimating probit or logit models with cross sectional data<sup>9</sup>. However, this approach ignores both cohort and time effects that may influence women's participation.

Following Goldin (1983), we estimate an equation to explain the observed trends in women's labor participation rate as depicted in graph 48. As explicative variables we use a) cohort variables. Among them cohort average (expected) number of children<sup>10</sup>, cohort average years of schooling (graph 12), cohort expected labor earnings<sup>11</sup>, and b) time variables such as men's wages, women's wages, and unemployment rate. Since we use as explanatory variables the expected number of children of the women's cohort and the expected labor earning, *we avoid the simultaneity*<sup>12</sup> *problems* between number of children and labor participation, and between labor earnings and labor participation. The results of

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<sup>9</sup> Ribero y Meza (1996) and Tenjo (1997) have used this methodology for the Colombian case.

<sup>10</sup> We are not able to observe the total number of children of every women's cohort and each year. Moreover, and in order to correct the possibility that number of children may be an endogenous variable we estimated it through a five degree polynomial in age and cohort.

<sup>11</sup> We use the women's expected earning without correcting by selectivity bias. Such earnings are the observed one and women base on them the decisions of participation.

<sup>12</sup> This point is developed by Becker (1991).

**Table 4. Variations in the Participation of Women <sup>a</sup>**

|   | <b>Model 1</b>     | <b>Model 2</b>     | <b>Model 3</b>     |
|---|--------------------|--------------------|--------------------|
| <b>Female Wage <sub>t</sub></b>             | 0.365<br>(4.93)    | 0.330<br>(9.51)    |                    |
| <b>Male Wage <sub>t</sub></b>               | -0.550<br>(-2.506) | -0.999<br>(-7.46)  |                    |
| <b>Unemployment <sub>t</sub></b>            | -0.113<br>(-3.17)  | -0.192<br>(-7.29)  | -0.332<br>(-16.76) |
| <b>Female Potencial Wage <sub>i,t</sub></b> |                    |                    | 0.544<br>(26.41)   |
| <b>Schooling <sub>i</sub></b>               | 0.377<br>(6.03)    |                    |                    |
| <b>Schooling <sub>i,t</sub></b>             |                    | 0.566<br>(14.51)   |                    |
| <b>Fertility <sub>i</sub></b>               | -0.045<br>(-3.85)  | -0.115<br>(-15.25) | -0.134<br>(-8.27)  |
| <b>Young * Fertility <sub>i</sub></b>       | 0.015<br>(3.29)    | -0.045<br>(-4.09)  |                    |
| <b>Old Dummy</b>                            | 0.014<br>(0.72)    |                    |                    |
| <b>Constant</b>                             | 2.044<br>(0.92)    | 7.916<br>(4.77)    | -6.794<br>(-24.57) |
| <b>R<sup>2</sup></b>                        | 0.32               | 0.58               | 0.73               |
| <b>Observations</b>                         | 265                | 265                | 265                |

<sup>a</sup> Dependent Variable = Labor Force Participation for Cohort *i* at Time *t*.

The regression's coefficients were obtain by the method of Principal Components.

and the regression using three models are presented in table 4. In models 1 and 2, female wage cohort average years of schooling coefficients have positive sign, as expected. On the other side, male wage, unemployment and number of children (fertility) coefficients have negative sign.

Model 3 is simpler but has higher explanatory power. We use only unemployment rate, number of children (fertility) and female potential wage. The latter variable was calculated by using the coefficients of returns to women's education and experience of table 4, and the year and cohorts effects of table A.6, according to the following equation:

$$Y_{it}^{EW} = b_0 + b_1 * S_{it} + b_2 * Exp_{it} + DYear + Dcohort$$

Where  $Y_{it}^{EW}$  represents the average expected women's labor income of cohort *i* at year *t*,  $b_1$  represents the women's return to education,  $b_2$  the returns to experience,  $S_{it}$  the average years of schooling of cohort *i* at year *t* and  $Exp_{it}$  the average years of experience of cohort *i* at year *t*.  $Dyear$  and  $Dcohort$  represent the year and cohort dummy values of table 3.

According to the results the potential or expected female labor income is very significant (t statistics of 26.1) and explains a great deal of the participation rate variance by cohort. Since the potential wage contains schooling by cohort we eliminated that variable from model 3.

Finally, by using the obtained coefficients, we calculated the how much of the change in participation rate of women at 40 between 1977 and 1997 is explained by each variable. The participation rate of women at 40 change 31 percentage points between 1977 and 1997. The cohort effects (years of schooling of the cohort and number of children) explained 31 percentage points. The time effects (male and females wages and unemployment rates) explained -4.4 percentage points of the change. Although the effects of male and female wages are high they cancel out (table 5). Model 3, although performs well in econometrically, does not in the decomposition of the changes in women's participation rate.

**TABLE 5. DECOMPOSITION OF THE CHANGES IN THE LABOR PARTICIPATION RATE OF WOMEN**

|                                   | Model 1      | Model 2      | Model 3      | Model 1      | Model 2      | Model 3      |
|-----------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Age Groups                        | 40 years     | 40 years     | 40 years     | 25 years     | 25 years     | 25 years     |
| Time Interval                     | 1977-1997    | 1977-1997    | 1977-1997    | 1982-1997    | 1982-1997    | 1982-1997    |
| <b>Observed Change</b>            | 0.311        | 0.311        | 0.311        | 0.159        | 0.159        | 0.159        |
| <b>Explained by:</b>              |              |              |              |              |              |              |
| Men labor Income                  | -0.161       | -0.089       |              | 0.049        | 0.027        |              |
| Women Labor Income                | 0.177        | 0.195        |              | 0.017        | 0.046        |              |
| Women Potential Income            |              |              | 0.190        |              |              | 0.107        |
| Unemployment                      | -0.059       | -0.035       | -0.102       | -0.074       | -0.044       | -0.102       |
| Cohort Years of Scholing in t     | 0.254        |              |              | 0.109        |              |              |
| Cohort Average Years of Schooling |              | 0.146        |              |              | -0.004       |              |
| Number of Children                | 0.057        | 0.022        | 0.022        | 0.007        | 0.003        | 0.014        |
| Young Dummy                       |              |              |              | 0.002        | -0.001       |              |
| <b>Explained by:</b>              |              |              |              |              |              |              |
| Cohorts Factors                   | 0.311        | 0.168        | 0.213        | 0.119        | -0.005       | 0.121        |
| Time Factors                      | -0.044       | 0.072        | -0.102       | -0.008       | 0.029        | -0.102       |
| <b>Explained by the model</b>     | <b>0.268</b> | <b>0.240</b> | <b>0.111</b> | <b>0.111</b> | <b>0.024</b> | <b>0.019</b> |

Source: Table 4 and Household Surveys

The results of the exercise are very revealing of the determinants of women's labor participation in urban Colombia and show that higher levels of education (or higher expected income of the cohort) and lower fertility rates are behind the observed participation trends. Thus, the mentioned trends are the result of the deep structural social changes that have occurred in urban Colombia since the middle of the 20<sup>th</sup> century.

## 5. Investment in Human Capital

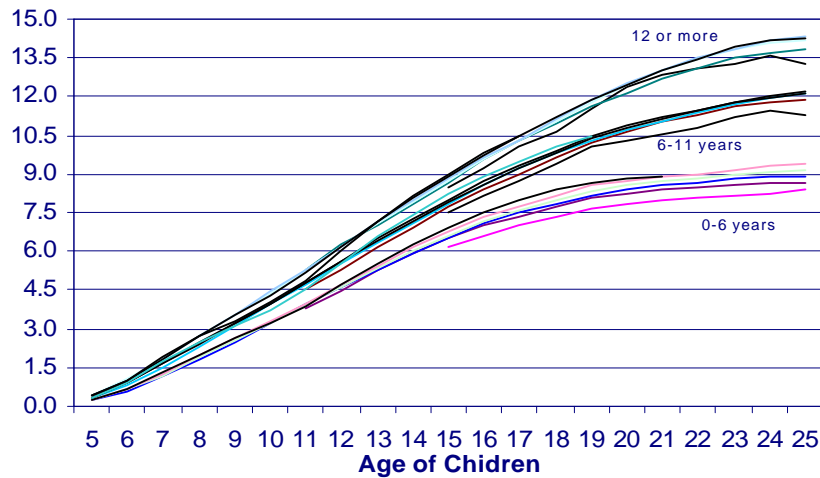
### 5.1 Educational Attainment

This section presents the dynamics of children's human capital accumulation in the Colombian urban households by cohort. We define children's human capital accumulation as the average years of schooling that children attain at certain age. The calculations of human capital accumulation are done for different children's groups. The groups correspond to cohort and level of education of the household's head. Thus, we have 45 children groups resulting from 15 household's head cohorts and 3 levels of education (from 0 to 5, from 6 to 11 and from 12 and above years of schooling). The exercise consists in computing at each age of the children's group the average years of education attained by the group.

The results of the calculations for each one of the groups are shown in graph 49. It is clear from the graphs that there has been some improvement in the accumulation of human capital among the children with parents with low education. In fact, at 24 the children's average years of education of the least educated parents increased from 8.8 to 9.3 (1910 parents' cohort versus 1940 parents' cohort). The education attainment might be even a little higher for the children of 1960 parents' cohort. These figures show, however, that the pace of increase in the educational attainment of the children of the least educated has been very slow. Thus, at 20 years of age, the children of the younger cohort (among the least educated parents) attained only 0.15 years more of schooling than the children (ten year older) with parents ten years older did.

The graph 49 also contains the children's educational attainment (at every age) of the children groups with parents with 6 to 11 and 12 and more years of schooling. The graphs show that the differences in children's educational attainment (at age 25) among cohorts with parents of similar schooling are positive although not very significant. In fact, the children's educational attainment with parents having 6 to 11 years of education belonging to 1942 cohort is only 0.4 years higher than the children's educational attainment with parent's belonging to the 1912 cohort. The education attainment of the different groups of children (at every age) with parents having 12 or more years of education has also increased. Thus, the younger the parent's cohort the higher the educational attainment.

**Graph 49**  
**Children School Attainment by Household Head Education Level and Cohort**

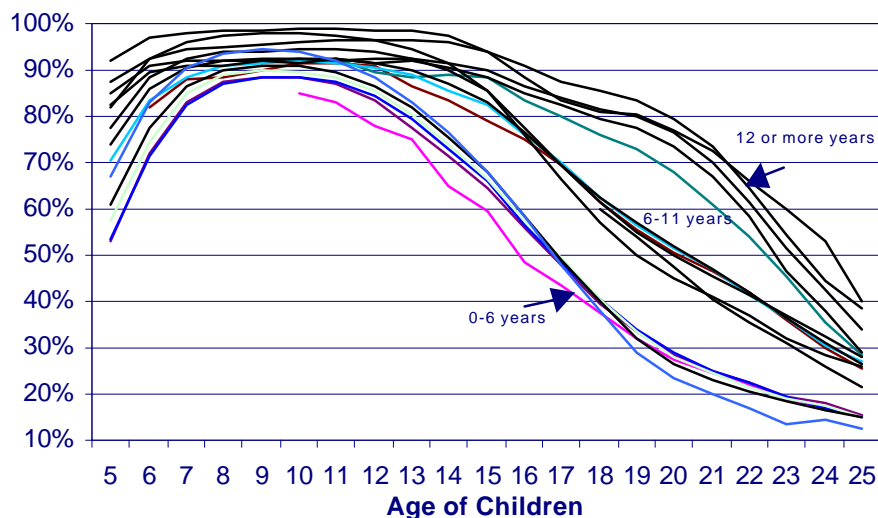


Thus, the differences in children's attainment are clearly related to the parents' schooling. From graph 49, we can then conclude that the cohort effect within the same parent's educational groups has been small and the differences in children's school attainment are determined by the parents' years of schooling. In fact, at 25 the difference in years of education between the children of the most and the least educated parents of the same cohort has always amounted around 5.5 years. However, the graphs also indicate that the average years of schooling of children at age 24 is higher than the parents' average years of schooling. This result might point out a) the existence of some sort of social mobility in urban Colombia; b) the fact that the children of the poor are more educated than their parents.

## 5.2 Enrollment Rates

Graph 50 depicts the children's enrollment rates (percentage of children at certain age attending school) for children groups similar to these described in the above section. At age 10, almost 90% of the children of the least educated parents in the younger cohorts go to school compared to almost 100% of the children of the most educated parents. However, after age 13, the enrollment rate gap among children with parents with different levels of education starts to widen. Thus, at 18, the school attendance rate of the children of the least educated is around 35% (a bit higher for the new generations), around 55% for the children with parents with 6 to 11 years of education and about 80% for the children of the most educated parents. In addition, attendance rate among the children of the least educated differs just a little across cohorts. On the contrary, the children's attendance rate of the most educated parents has increased substantially for the new generations. Thus, at age 18, the attendance rate of the children with educated parents born in the 1910's has been about 75% while the rate of those with parents born in the 1950's has risen to 85%.

**Graph 50**  
**Children's Enrollment Education Rates by**  
**Household Head Education Level and Cohort**



In the second section we present the percentage of men and women by education level in each cohort (graphs 14 and 15). The evidence in the graph show that the percentage of men and women with primary education or less has decreased in every cohort, which indicates



that each new generation has had more educated parents and has attained higher level of schooling. These results indicate that the enhanced education opportunities coming with the expansion of the public system of schools and the education programs have clearly reached the urban poor but not quite enough to close education gap (Sarmiento and Caro, 1997). As shown in the above graphs, most of the children that drop out from the school system belong to households with low educated parents and are probably poor. Raising the enrollment rates of the poor, mainly of teenagers, is one of the most important challenges of Colombian social policy and it is, in addition, the surest way to close the income gap and escape from poverty.

### **5.3 Determinants of child's years of schooling and school enrollment**

In order to complete the graphic analysis of the previous sections we have estimated a model to capture the determinants of schooling and enrollments<sup>13</sup>. The results of the exercise is presented in table 6. As observed, we have divided the explanatory variables in five sets as follows: variables related to the children, parents, household characteristics, labor market and parent's cohorts. We can highlight the following findings:

- The finished years of schooling are a quadratic function of the child's age and has the shape of an inverted U.
- The effect of the parent's schooling on the either child's schooling or child's enrollment probability is picked by the interaction between the household head schooling and the child's age. The shape of such interaction is either a curve with positive and decreasing slope in the case of years of schooling or an inverted U in the case of the enrollment probability.
- The higher the number of children the lower either child's schooling or enrollment probability.
- The child's years of schooling or child's the enrollment probability are lower in single parent households.

- The impact of both spouse labor participation and labor income on the child's schooling or enrollment, after controlling by education and number of children, is negligible. It seems that such variables picked the mother's opportunity cost.
- The child's schooling or enrollment probability is lower if either the household head or his (or her) spouse is unemployed.
- The child's years of schooling are higher, *ceteris paribus*, if the parents belong to cohorts born in the 1930's and 1940's and are lower if the parents belong to the 1910 or 1960 cohorts. In contrast, the child's enrollment probability is higher, *ceteris paribus*, the older the parent's cohort.
- The college/high school relative labor earnings have a strong positive impact on the child's enrollment probability but it is non significant on child's schooling.

We can conclude from this sub section that the child educational attainment and school attendance are strongly associated with the parent's education and household characteristics. The effect on education of the shocks affecting household is picked by the unemployment variables. Thus, macroeconomic conditions that are transmitted to families to the labor market conditions affect as well the accumulation of human capital (Berhman et al, 1999). The time variables picked the impact of other macro variables, among others, the education policies. We found (see appendix A.8) that year dummy coefficients in the estimation of enrollment probability has more or less the same value. In contrast, the such coefficients in the estimation of years of schooling grow over time, increasing quite strongly during the 1990's.

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<sup>13</sup> Similar estimations were done by Robbins (1998). However, Robbins' objective was to estimate the determinants of educational attainment (measured as the finished years of schooling) of people that already stopped attending school.

**Table 6**  
**Determinants of School Enrollment and Years of Schooling**

|  | <b>Schooling</b>        | <b>Enrollment</b>       |
|--|-------------------------|-------------------------|
| <b>Constant</b>                            | -6.282<br>(-183.986)    | -0.663<br>(-12.339)     |
| <b>Child's variables</b>                   |                         |                         |
| Child's age                                | 0.928<br>(603.595)      | 0.454<br>(201.295)      |
| Child's age^2                              | -0.014<br>(-288.335)    | -0.021<br>(201.295)     |
| Gender (men=1)                             | 0.343<br>(113.070)      | 0.185<br>(42.418)       |
| <b>Parents' variables</b>                  |                         |                         |
| Average education of parents               | -0.031<br>(-47.935)     | 0.117<br>(83.658)       |
| Household head education * child's age     | 0.016<br>(356.758)      | 0.004<br>(52.353)       |
| (Household head education * child's age)^2 | -7.45e-06<br>(-363.298) | -4.08e-06<br>(-102.546) |
| <b>Household's variables</b>               |                         |                         |
| Number of children                         | -0.115<br>(-162.109)    | -0.061<br>(-62.158)     |
| Existence of spouse                        | 0.403<br>(95.393)       | 0.305<br>(52.829)       |
| <b>Labor market variables</b>              |                         |                         |
| Spouse labor participation                 | 0.008<br>(0.812)        | 0.027<br>(1.778)        |
| Spouse labor income                        | -0.009<br>(-9.098)      | 0.001<br>(0.778)        |
| Household head unemployment                | -0.302<br>(-35.770)     | -0.301<br>(-26.735)     |
| Spouse unemployment                        | -0.263<br>(-19.073)     | -0.163<br>(-8.004)      |
| Relative labor income (univ/high school)   | 0.624<br>(28.758)       | 0.004<br>(0.319)        |
| <b>Cohort variables</b>                    |                         |                         |
| 1910 cohort                                | 0.099<br>(3.970)        | 0.262<br>(6.789)        |
| 1920 cohort                                | 0.395<br>(30.940)       | 0.177<br>(8.758)        |
| 1930 cohort                                | 0.524<br>(50.827)       | 0.107<br>(6.296)        |
| 1940 cohort                                | 0.520<br>(55.245)       | 0.025<br>(1.572)        |
| 1950 cohort                                | 0.389<br>(44.903)       | -0.029<br>(-1.958)      |
| 1960 cohort                                | 0.159<br>(19.134)       | -0.009<br>(-0.602)      |
| <b>Method of estimation</b>                | OLS                     | Logit                   |
| <b>Number of observations</b>              | 1795180                 | 1578681                 |
| <b>Year dummies</b>                        | Yes                     | Yes                     |
| <b>R<sup>2</sup></b>                       | 0.749                   | -                       |

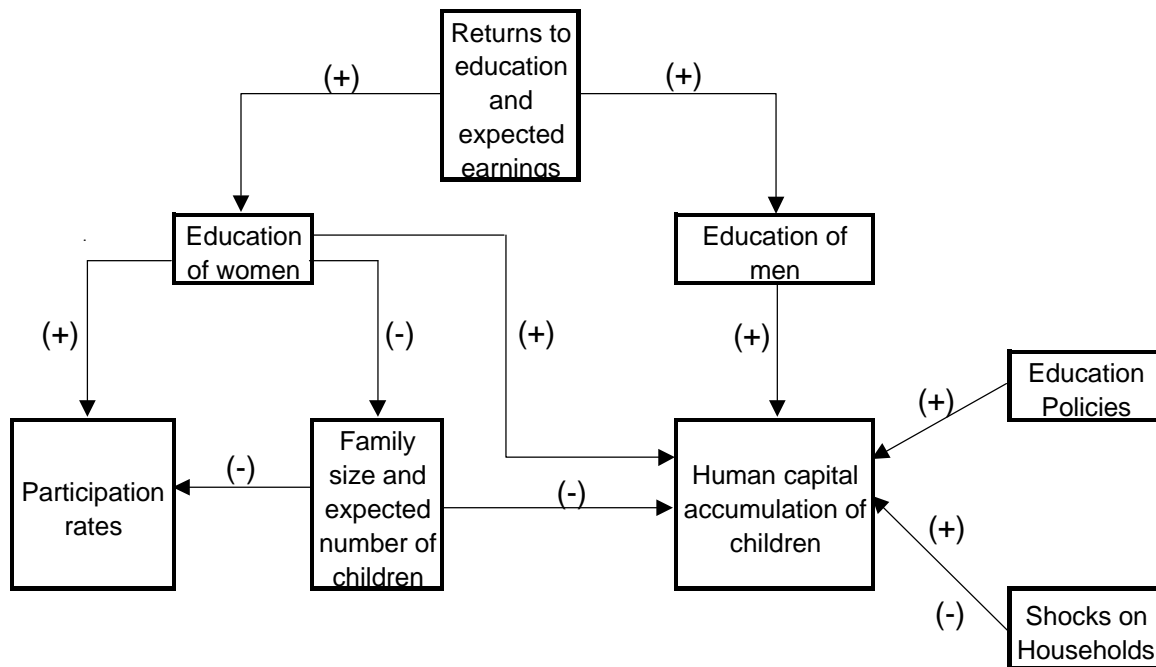
## 6. Conclusions

The results presented in this document are the first attempt to apply the cohort methodology to the Colombian urban household surveys. Thus, we have examined the changes in family structure and size, the returns to education, the labor income dynamics by level of education, the relative labor income, the changes in women's participation rate and its determinants, and the accumulation of human capital. The dynamics and interrelation of these changes are depicted in diagram 1.

The main changes in the urban family structure have been the decreasing share of nuclear families in total households for the new generations in favor basically of extended families and, in less proportion, of lonely couples. There have also been quite significant changes in family size. Thus, the average family size of household heads born in the 1920's and 1930's amounted around seven people. In contrast, the family size of the new generations of household heads is close to four. We observed the same trends for the number of children. The changes in the size of urban families have occurred with a moderate increase of schooling both of men and mainly of women.

**Diagram 1**

**A diagram of returns to education, participation and human capital**



The estimations of returns to education show that they are positively related to the achieved school level or degree. The people with complete college have the highest returns of education (more than 0.20) 80% more than the returns to complete primary and secondary school and three times the returns of incomplete secondary school. The labor income gap of between workers with college degree and the workers with primary schools have decreased across cohort in contrast to the trend across cohorts of increasing income gap between workers with complete college and workers with complete and incomplete secondary school. Thus, recent surge in labor income inequality (Nunez and Sanchez, 1998) maybe due to the widening income differential between skill and unskilled workers that belong to younger cohorts. The gender income gap has been closing for the younger cohorts. The evidence we found shows that the narrowing of differences has occurred at every level of education but more strongly between men and women with complete college degree.

The increase of labor participation rate of women has been remarkably. Its main determinants have been the significant rise of women's human capital, which brought about

both higher expected labor income and opportunity cost, together with lower fertility rates. The estimates reveal that the most important determinant of the changes in female labor participation is women's income or expected women's income.

Finally, the accumulation of human capital among children has been basically associated to the level of education of the household head. The lower his (or her) level of education the lower the school attainment of his (or her) children. Nevertheless, there have been some positive cohort's effects. Thus, the children of the younger cohorts have both higher educational attainment and greater enrollment rates although the parent's background seems to be the most important determinant of the children's accumulation of human capital. We also found that labor market shocks, in particular unemployment, seem to affect as well human capital accumulation.

We have then completed the story presented in diagram 1. Higher returns to education and expected earnings of women determine greater participation rates and a lower number of children. This latter variable affects the quality of children and the accumulation of human capital<sup>14</sup>. Any social policy that increases the education of women will have an impact on their potential earnings and on the probability of joining the labor market. At the same time, a more educated woman will have more incentives to limit her number of children and will dedicate more resources to each of them. In the long run, the greater level of children education would reduce income inequality.

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<sup>14</sup> A wider discussion of these topics is presented in IADB (1998).

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# Appendix 1

Table A.1. Men Statistics

|           | Descriptive Statistics by Cohort and Education Level <sup>a</sup> |                           |                           |                            |                             |                               |                             | Sample Share <sup>b</sup> |                             |                             |                             |                             |                           |                           |                               |
|-----------|---|---------------------------|---------------------------|----------------------------|-----------------------------|-------------------------------|-----------------------------|---------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|---------------------------|---------------------------|-------------------------------|
|           | 0-4 years   | 5 years                   | 6-10 years                | 11 years                   | 12-15 years                 | 16+ years                     | Total                       | 0-4 years                 | 5 years                     | 6-10 years                  | 11 years                    | 12-15 years                 | 16+ years                 | Total                     |                               |
| 1910-1914 | 260,704<br>981<br>1,328   | 361,743<br>708<br>829     | 579,325<br>977<br>442     | 972,308<br>1,320<br>242    | 1,233,633<br>1,166<br>47    | 1,611,786<br>1,424<br>202     | 492,240<br>1,060<br>3,090   | 1910-1914                 | 0.11%<br>42.98%<br>0.60%    | 0.07%<br>26.83%<br>0.32%    | 0.04%<br>14.30%<br>0.12%    | 0.02%<br>7.83%<br>0.11%     | 0.00%<br>1.52%<br>0.06%   | 0.02%<br>6.54%<br>0.18%   | 0.25%<br>100.00%<br>0.25%     |
| 1915-1919 | 268,532<br>723<br>3,823   | 382,204<br>869<br>2,759   | 598,707<br>1,059<br>1,258 | 846,578<br>1,023<br>815    | 1,064,506<br>1,295<br>167   | 1,517,914<br>1,291<br>635     | 493,378<br>970<br>9,457     | 1915-1919                 | 0.31%<br>40.43%<br>1.72%    | 0.22%<br>29.17%<br>1.08%    | 0.10%<br>13.30%<br>0.35%    | 0.07%<br>8.62%<br>0.38%     | 0.01%<br>1.77%<br>0.23%   | 0.05%<br>6.71%<br>0.57%   | 0.77%<br>100.00%<br>0.77%     |
| 1920-1924 | 288,640<br>760<br>7,966   | 391,929<br>766<br>6,209   | 619,683<br>1,188<br>3,226 | 904,271<br>1,156<br>1,931  | 1,143,451<br>1,434<br>413   | 1,597,821<br>1,330<br>1,533   | 535,753<br>1,031<br>21,278  | 1920-1924                 | 0.65%<br>37.44%<br>3.59%    | 0.50%<br>29.18%<br>2.43%    | 0.26%<br>15.16%<br>0.90%    | 0.16%<br>9.08%<br>0.91%     | 0.03%<br>1.94%<br>0.57%   | 0.12%<br>7.20%<br>1.39%   | 1.73%<br>100.00%<br>1.73%     |
| 1925-1929 | 292,333<br>660<br>13,519  | 396,997<br>709<br>11,474  | 597,912<br>997<br>6,156   | 916,785<br>1,198<br>3,592  | 1,170,470<br>1,204<br>785   | 1,651,843<br>1,448<br>3,031   | 555,193<br>1,006<br>38,557  | 1925-1929                 | 1.10%<br>35.06%<br>6.09%    | 0.93%<br>29.76%<br>4.49%    | 0.50%<br>15.97%<br>1.72%    | 0.29%<br>9.32%<br>1.69%     | 0.06%<br>2.04%<br>1.07%   | 0.25%<br>7.86%<br>2.74%   | 3.13%<br>100.00%<br>3.13%     |
| 1930-1934 | 310,018<br>641<br>19,465  | 414,608<br>774<br>17,589  | 569,915<br>904<br>10,639  | 908,483<br>1,147<br>5,980  | 1,194,560<br>1,165<br>1,474 | 1,679,825<br>1,303<br>4,955   | 580,803<br>970<br>60,102    | 1930-1934                 | 1.58%<br>32.39%<br>8.77%    | 1.43%<br>29.27%<br>6.88%    | 0.86%<br>17.70%<br>2.98%    | 0.49%<br>9.95%<br>2.81%     | 0.12%<br>2.45%<br>2.02%   | 0.40%<br>8.24%<br>4.49%   | 4.88%<br>100.00%<br>4.88%     |
| 1935-1939 | 313,379<br>614<br>22,824  | 406,274<br>744<br>21,576  | 560,971<br>924<br>14,527  | 866,973<br>1,107<br>8,121  | 1,103,843<br>1,194<br>2,197 | 1,686,595<br>1,385<br>7,167   | 597,043<br>998<br>76,412    | 1935-1939                 | 1.85%<br>29.87%<br>10.28%   | 1.75%<br>28.24%<br>8.44%    | 1.18%<br>19.01%<br>4.06%    | 0.66%<br>10.63%<br>3.82%    | 0.18%<br>2.88%<br>3.01%   | 0.58%<br>9.38%<br>6.49%   | 6.21%<br>100.00%<br>6.21%     |
| 1940-1944 | 304,881<br>579<br>25,997  | 387,723<br>752<br>26,309  | 517,855<br>867<br>21,095  | 777,974<br>1,062<br>11,710 | 1,029,092<br>1,105<br>3,913 | 1,579,020<br>1,252<br>11,262  | 597,944<br>966<br>100,286   | 1940-1944                 | 2.11%<br>25.92%<br>11.71%   | 2.14%<br>26.23%<br>10.29%   | 1.71%<br>21.03%<br>5.90%    | 0.95%<br>11.68%<br>5.51%    | 0.32%<br>3.90%<br>5.36%   | 0.91%<br>11.23%<br>10.20% | 8.15%<br>100.00%<br>8.15%     |
| 1945-1949 | 290,819<br>524<br>26,064  | 362,250<br>664<br>29,250  | 457,062<br>735<br>30,028  | 682,047<br>973<br>16,742   | 886,130<br>1,022<br>6,401   | 1,461,253<br>1,232<br>16,420  | 584,278<br>931<br>124,905   | 1945-1949                 | 2.12%<br>20.87%<br>11.74%   | 2.38%<br>23.42%<br>11.44%   | 2.44%<br>24.04%<br>8.40%    | 1.36%<br>13.40%<br>7.88%    | 0.52%<br>5.12%<br>8.76%   | 1.33%<br>13.15%<br>14.86% | 10.15%<br>100.00%<br>10.15%   |
| 1950-1954 | 279,105<br>535<br>25,662  | 333,141<br>654<br>31,932  | 403,670<br>688<br>44,532  | 580,065<br>925<br>24,278   | 750,414<br>968<br>10,777    | 1,319,223<br>1,200<br>20,620  | 539,597<br>903<br>157,801   | 1950-1954                 | 2.08%<br>16.26%<br>11.56%   | 2.59%<br>20.24%<br>12.49%   | 3.62%<br>28.22%<br>12.46%   | 1.97%<br>15.39%<br>11.42%   | 0.68%<br>6.83%<br>14.75%  | 1.67%<br>13.07%<br>18.67% | 12.82%<br>100.00%<br>12.82%   |
| 1955-1959 | 252,080<br>516<br>23,401  | 297,346<br>547<br>32,649  | 349,656<br>663<br>57,560  | 471,046<br>757<br>35,483   | 618,679<br>882<br>14,437    | 1,151,995<br>1,201<br>19,957  | 459,812<br>637<br>183,487   | 1955-1959                 | 1.90%<br>12.75%<br>10.54%   | 2.65%<br>17.79%<br>12.77%   | 4.68%<br>31.37%<br>16.10%   | 2.88%<br>19.34%<br>16.70%   | 1.17%<br>7.87%<br>19.76%  | 1.62%<br>10.88%<br>18.07% | 14.90%<br>100.00%<br>14.90%   |
| 1960-1964 | 231,024<br>497<br>21,269  | 268,626<br>569<br>31,685  | 305,100<br>555<br>69,268  | 407,266<br>706<br>43,006   | 531,027<br>792<br>14,895    | 1,025,481<br>1,072<br>14,738  | 385,386<br>729<br>194,861   | 1960-1964                 | 1.73%<br>10.91%<br>9.58%    | 2.57%<br>16.26%<br>12.39%   | 5.63%<br>35.55%<br>19.37%   | 3.49%<br>22.07%<br>20.24%   | 1.21%<br>7.64%<br>20.39%  | 1.20%<br>7.56%<br>13.34%  | 15.83%<br>100.00%<br>15.83%   |
| 1965-1969 | 203,914<br>384<br>15,412  | 245,787<br>581<br>23,545  | 277,564<br>608<br>53,232  | 355,567<br>621<br>33,026   | 470,464<br>755<br>10,180    | 948,165<br>1,078<br>7,504     | 331,369<br>690<br>142,899   | 1965-1969                 | 1.25%<br>10.79%<br>6.94%    | 1.91%<br>16.48%<br>9.21%    | 4.32%<br>37.25%<br>14.89%   | 2.68%<br>23.11%<br>15.54%   | 0.83%<br>7.12%<br>13.94%  | 0.61%<br>5.25%<br>6.79%   | 11.61%<br>100.00%<br>11.61%   |
| 1970-1974 | 185,336<br>407<br>9,041   | 221,716<br>428<br>13,151  | 250,577<br>514<br>29,366  | 315,634<br>548<br>19,803   | 425,984<br>717<br>5,816     | 796,425<br>853<br>2,335       | 283,448<br>567<br>79,512    | 1970-1974                 | 0.73%<br>11.37%<br>4.07%    | 1.07%<br>16.54%<br>5.14%    | 2.39%<br>36.93%<br>8.21%    | 1.61%<br>24.91%<br>9.32%    | 0.47%<br>7.31%<br>7.96%   | 0.19%<br>2.94%<br>2.11%   | 6.46%<br>100.00%<br>6.46%     |
| 1975-1979 | 160,472<br>384<br>4,406   | 192,616<br>365<br>5,398   | 211,762<br>460<br>13,319  | 259,397<br>460<br>7,350    | 321,511<br>512<br>1,531     | 605,546<br>685<br>104         | 218,918<br>449<br>32,108    | 1975-1979                 | 0.36%<br>13.72%<br>1.99%    | 0.44%<br>16.81%<br>2.11%    | 1.08%<br>41.48%<br>3.73%    | 0.60%<br>22.89%<br>3.46%    | 0.12%<br>4.77%<br>2.10%   | 0.01%<br>0.32%<br>0.09%   | 2.61%<br>100.00%<br>2.61%     |
| 1980-1984 | 125,999<br>448<br>1,767   | 144,800<br>377<br>1,340   | 158,985<br>400<br>2,891   | 197,120<br>425<br>422      | 289,871<br>420<br>19        | -                             | 149,866<br>414<br>6,439     | 1980-1984                 | 0.14%<br>27.44%<br>0.80%    | 0.11%<br>20.81%<br>0.52%    | 0.23%<br>44.90%<br>0.81%    | 0.03%<br>6.55%<br>0.20%     | 0.00%<br>0.30%<br>0.03%   | 0.00%<br>0.00%<br>0.00%   | 0.52%<br>100.00%<br>0.52%     |
| Total     | 270,496<br>580<br>221,944   | 328,484<br>666<br>255,695 | 364,169<br>717<br>357,539 | 504,759<br>865<br>212,501  | 659,785<br>937<br>73,052    | 1,315,170<br>1,225<br>110,463 | 466,998<br>866<br>1,231,194 | Total                     | 18.03%<br>18.03%<br>100.00% | 20.77%<br>20.77%<br>100.00% | 29.04%<br>29.04%<br>100.00% | 17.26%<br>17.26%<br>100.00% | 5.93%<br>5.93%<br>100.00% | 8.97%<br>8.97%<br>100.00% | 100.00%<br>100.00%<br>100.00% |

<sup>a</sup> Each cell contains: Average Labor Income, Variance and Frequency.

<sup>b</sup> Each cell contains: Sample Share, Cohort Share and Education Level Share.



**Table A.2. Women Statistics**

| co        | Descriptive Statistics by Cohort and Education Level <sup>a</sup> |                           |                           |                           |                          |                           |                           | Sample Share <sup>b</sup> |                             |                             |                             |                             |                           |                           |                               |
|-----------|---|---------------------------|---------------------------|---------------------------|--------------------------|---------------------------|---------------------------|---------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|---------------------------|---------------------------|-------------------------------|
|           | 0-4 years   | 5 years                   | 6-10 years                | 11 years                  | 12-15 years              | 16+ years                 | Total                     | 0-4 years                 | 5 years                     | 6-10 years                  | 11 years                    | 12-15 years                 | 16+ years                 | Total                     |                               |
| 1910-1914 | 120,614<br>416<br>490   | 197,699<br>519<br>165     | 298,303<br>481<br>75      | 403,110<br>560<br>36      | -                        | 381,407<br>532<br>5       | 169,277<br>475<br>771     | 1910-1914                 | 0.06%<br>63.55%<br>0.32%    | 0.02%<br>21.40%<br>0.12%    | 0.01%<br>9.73%<br>0.04%     | 0.00%<br>4.67%<br>0.02%     | 0.00%<br>0.00%<br>0.00%   | 0.00%<br>0.65%<br>0.01%   | 0.10%<br>100.00%<br>0.10%     |
| 1915-1919 | 122,709<br>352<br>1,511   | 267,907<br>1,194<br>639   | 325,882<br>714<br>262     | 422,947<br>614<br>164     | 880,831<br>990<br>17     | 643,927<br>819<br>25      | 207,189<br>866<br>2,618   | 1915-1919                 | 0.19%<br>57.72%<br>1.00%    | 0.08%<br>24.41%<br>0.45%    | 0.03%<br>10.01%<br>0.13%    | 0.02%<br>6.26%<br>0.10%     | 0.00%<br>0.65%<br>0.03%   | 0.00%<br>0.95%<br>0.04%   | 0.34%<br>100.00%<br>0.34%     |
| 1920-1924 | 135,007<br>398<br>3,016   | 219,516<br>873<br>1,510   | 324,101<br>693<br>782     | 511,194<br>715<br>480     | 755,390<br>959<br>56     | 923,267<br>849<br>112     | 232,233<br>709<br>5,956   | 1920-1924                 | 0.39%<br>50.64%<br>1.99%    | 0.19%<br>25.35%<br>1.06%    | 0.10%<br>13.13%<br>0.40%    | 0.06%<br>8.06%<br>0.29%     | 0.01%<br>0.94%<br>0.09%   | 0.01%<br>1.88%<br>0.17%   | 0.76%<br>100.00%<br>0.76%     |
| 1925-1929 | 148,263<br>498<br>5,683   | 218,167<br>551<br>2,967   | 335,813<br>697<br>1,730   | 523,169<br>851<br>1,123   | 625,206<br>724<br>188    | 908,678<br>867<br>270     | 252,591<br>649<br>11,961  | 1925-1929                 | 0.73%<br>47.51%<br>3.75%    | 0.38%<br>24.81%<br>2.08%    | 0.22%<br>14.46%<br>0.88%    | 0.14%<br>9.39%<br>0.68%     | 0.02%<br>1.57%<br>0.31%   | 0.03%<br>4.53%<br>0.41%   | 1.53%<br>100.00%<br>1.53%     |
| 1930-1934 | 166,122<br>744<br>9,365   | 234,022<br>624<br>5,592   | 348,786<br>678<br>3,614   | 512,574<br>751<br>2,447   | 726,307<br>960<br>426    | 961,380<br>948<br>663     | 286,152<br>745<br>22,107  | 1930-1934                 | 1.20%<br>42.36%<br>6.19%    | 0.72%<br>25.30%<br>3.93%    | 0.46%<br>16.35%<br>1.84%    | 0.31%<br>11.07%<br>1.48%    | 0.05%<br>1.93%<br>0.71%   | 0.08%<br>3.00%<br>1.01%   | 2.83%<br>100.00%<br>2.83%     |
| 1935-1939 | 172,939<br>723<br>12,267  | 234,098<br>566<br>8,613   | 355,862<br>700<br>5,862   | 516,897<br>800<br>4,137   | 701,337<br>871<br>857    | 974,669<br>1,014<br>1,295 | 309,571<br>749<br>33,031  | 1935-1939                 | 1.57%<br>37.14%<br>8.10%    | 1.10%<br>26.08%<br>6.05%    | 0.75%<br>17.75%<br>2.99%    | 0.53%<br>12.52%<br>2.51%    | 0.11%<br>2.55%<br>1.42%   | 0.17%<br>3.92%<br>1.97%   | 4.23%<br>100.00%<br>4.23%     |
| 1940-1944 | 165,496<br>383<br>16,209  | 232,754<br>627<br>12,453  | 336,069<br>653<br>9,970   | 503,309<br>801<br>7,209   | 692,426<br>907<br>1,796  | 945,821<br>984<br>2,977   | 328,354<br>715<br>50,614  | 1940-1944                 | 2.08%<br>32.02%<br>10.71%   | 1.59%<br>24.60%<br>8.75%    | 1.28%<br>19.70%<br>5.08%    | 0.92%<br>14.24%<br>4.37%    | 0.23%<br>3.55%<br>2.98%   | 0.38%<br>5.88%<br>4.53%   | 6.48%<br>100.00%<br>6.48%     |
| 1945-1949 | 166,913<br>458<br>17,878  | 216,315<br>452<br>16,085  | 314,891<br>659<br>16,077  | 470,521<br>754<br>11,874  | 634,739<br>873<br>3,833  | 918,375<br>953<br>6,201   | 350,820<br>717<br>71,948  | 1945-1949                 | 2.29%<br>24.85%<br>11.81%   | 2.06%<br>22.36%<br>11.30%   | 2.06%<br>22.35%<br>8.20%    | 1.52%<br>16.50%<br>7.19%    | 0.49%<br>5.33%<br>6.37%   | 0.79%<br>8.62%<br>9.44%   | 9.21%<br>100.00%<br>9.21%     |
| 1950-1954 | 158,620<br>371<br>19,046  | 203,878<br>439<br>19,575  | 278,956<br>594<br>25,898  | 424,535<br>708<br>18,794  | 567,053<br>818<br>7,716  | 874,816<br>932<br>11,811  | 355,854<br>708<br>102,210 | 1950-1954                 | 2.44%<br>18.63%<br>12.58%   | 2.51%<br>19.15%<br>13.75%   | 3.32%<br>25.34%<br>13.21%   | 2.41%<br>18.39%<br>11.38%   | 0.99%<br>7.55%<br>12.82%  | 1.43%<br>10.94%<br>17.01% | 13.09%<br>100.00%<br>13.09%   |
| 1955-1959 | 139,808<br>356<br>19,032  | 187,481<br>519<br>22,037  | 248,367<br>517<br>35,904  | 361,693<br>644<br>28,675  | 486,184<br>729<br>11,858 | 787,611<br>894<br>15,697  | 331,896<br>676<br>133,203 | 1955-1959                 | 2.44%<br>14.29%<br>12.57%   | 2.82%<br>16.54%<br>15.48%   | 4.60%<br>26.95%<br>18.31%   | 3.67%<br>21.53%<br>17.36%   | 1.52%<br>8.90%<br>19.69%  | 2.01%<br>11.78%<br>23.89% | 17.06%<br>100.00%<br>17.06%   |
| 1960-1964 | 122,770<br>329<br>18,750  | 168,567<br>410<br>20,662  | 220,530<br>438<br>39,786  | 312,694<br>545<br>35,744  | 430,642<br>654<br>14,072 | 729,718<br>902<br>14,626  | 295,641<br>624<br>143,660 | 1960-1964                 | 2.40%<br>13.05%<br>12.39%   | 2.65%<br>14.40%<br>14.53%   | 5.09%<br>27.69%<br>20.29%   | 4.58%<br>24.88%<br>21.64%   | 1.80%<br>9.80%<br>23.37%  | 1.87%<br>10.18%<br>22.26% | 18.40%<br>100.00%<br>18.40%   |
| 1965-1969 | 108,726<br>288<br>14,773  | 145,446<br>364<br>16,498  | 197,221<br>416<br>30,187  | 281,815<br>535<br>29,551  | 385,364<br>602<br>10,752 | 702,822<br>944<br>8,960   | 259,462<br>605<br>110,721 | 1965-1969                 | 1.89%<br>13.34%<br>9.76%    | 2.11%<br>14.90%<br>11.59%   | 3.87%<br>27.26%<br>15.39%   | 3.78%<br>26.69%<br>17.89%   | 1.38%<br>9.71%<br>17.86%  | 1.15%<br>8.09%<br>13.63%  | 14.18%<br>100.00%<br>14.18%   |
| 1970-1974 | 102,280<br>275<br>8,468   | 130,828<br>385<br>10,033  | 184,503<br>426<br>17,071  | 265,304<br>437<br>17,969  | 360,100<br>580<br>6,555  | 665,029<br>913<br>3,455   | 232,156<br>547<br>63,551  | 1970-1974                 | 1.08%<br>13.32%<br>5.59%    | 1.26%<br>15.79%<br>7.05%    | 2.19%<br>26.86%<br>8.70%    | 2.30%<br>28.27%<br>10.88%   | 0.84%<br>10.31%<br>10.89% | 0.44%<br>5.44%<br>5.26%   | 8.14%<br>100.00%<br>8.14%     |
| 1975-1979 | 102,704<br>291<br>3,770   | 125,280<br>304<br>4,486   | 164,536<br>414<br>7,514   | 243,837<br>479<br>6,616   | 303,070<br>511<br>2,044  | 540,807<br>698<br>251     | 184,513<br>444<br>24,681  | 1975-1979                 | 0.48%<br>15.27%<br>2.49%    | 0.57%<br>18.18%<br>3.15%    | 0.96%<br>30.44%<br>3.83%    | 0.85%<br>26.81%<br>4.01%    | 0.26%<br>8.28%<br>3.39%   | 0.03%<br>1.02%<br>0.38%   | 3.16%<br>100.00%<br>3.16%     |
| 1980-1984 | 98,677<br>405<br>1,128  | 112,169<br>305<br>1,019   | 130,634<br>339<br>1,389   | 184,724<br>311<br>328     | 246,163<br>385<br>40     | -                         | 122,309<br>358<br>3,904   | 1980-1984                 | 0.14%<br>28.89%<br>0.75%    | 0.13%<br>26.10%<br>0.72%    | 0.18%<br>35.58%<br>0.71%    | 0.04%<br>8.40%<br>0.20%     | 0.01%<br>1.02%<br>0.07%   | 0.00%<br>0.00%<br>0.00%   | 0.50%<br>100.00%<br>0.50%     |
| Total     | 143,955<br>494<br>151,386   | 188,842<br>520<br>142,354 | 245,453<br>544<br>196,121 | 350,118<br>638<br>165,147 | 466,626<br>725<br>60,210 | 796,203<br>926<br>65,718  | 300,992<br>665<br>780,936 | Total                     | 19.39%<br>19.39%<br>100.00% | 18.23%<br>18.23%<br>100.00% | 25.11%<br>25.11%<br>100.00% | 21.15%<br>21.15%<br>100.00% | 7.71%<br>7.71%<br>100.00% | 8.42%<br>8.42%<br>100.00% | 100.00%<br>100.00%<br>100.00% |

<sup>a</sup> Each cell contains: Average Labor Income, Variance and Frequency.

<sup>b</sup> Each cell contains: Sample Share, Cohort Share and Education Level Share.

**Table A.3. HECKMAN SELECTION MODEL FOR WOMEN**  
(Regression Model with Sample selection)

| Returns to Education by Year |             |             |     | Returns to Education by Cohort |             |             |     |
|------------------------------|-------------|-------------|-----|--------------------------------|-------------|-------------|-----|
| Variable                     | Coefficient | Statistic Z |     | Variable                       | Coefficient | Statistic Z |     |
| Schooling                    | 0.074       | 13.591      | *** | 1915 - 1919                    | -0.126      | -3.593      | *** |
| Age                          | 0.038       | 42.906      | *** | 1920 - 1924                    | -0.199      | -6.050      | *** |
| Age <sup>2</sup>             | 0.000       | -41.131     | *** | 1925 - 1929                    | -0.294      | -9.026      | *** |
| 1977                         | 0.258       | 13.845      | *** | 1930 - 1934                    | -0.336      | -10.126     | *** |
| 1978                         | 0.547       | 26.652      | *** | 1935 - 1939                    | -0.434      | -12.494     | *** |
| 1979                         | 0.849       | 44.502      | *** | 1940 - 1944                    | -0.523      | -14.328     | *** |
| 1980                         | 1.076       | 55.875      | *** | 1945 - 1949                    | -0.589      | -15.267     | *** |
| 1981                         | 1.292       | 69.706      | *** | 1950 - 1954                    | -0.605      | -14.882     | *** |
| 1982                         | 1.410       | 87.557      | *** | 1955 - 1959                    | -0.516      | -12.017     | *** |
| 1983                         | 1.551       | 96.935      | *** | 1960 - 1964                    | -0.306      | -6.771      | *** |
| 1984                         | 1.669       | 103.490     | *** | 1965 - 1969                    | -0.061      | -1.279      |     |
| 1985                         | 1.802       | 105.725     | *** | 1970 - 1974                    | 0.194       | 3.847       | *** |
| 1986                         | 1.948       | 113.665     | *** | 1975 - 1979                    | 0.652       | 12.093      | *** |
| 1987                         | 2.112       | 121.514     | *** | 1980 - 1984                    | 1.307       | 21.767      | *** |
| 1988                         | 2.231       | 127.387     | *** | (1915 - 1919) Schooling        | 0.005       | 0.807       |     |
| 1989                         | 2.466       | 136.756     | *** | (1920 - 1924) Schooling        | 0.019       | 2.208       | **  |
| 1990                         | 2.663       | 140.432     | *** | (1925 - 1929) Schooling        | 0.016       | 2.963       | *** |
| 1991                         | 2.828       | 147.410     | *** | (1930 - 1934) Schooling        | 0.013       | 2.444       | **  |
| 1992                         | 3.001       | 154.684     | *** | (1935 - 1939) Schooling        | 0.015       | 2.842       | *** |
| 1993                         | 3.258       | 163.847     | *** | (1940 - 1944) Schooling        | 0.014       | 2.642       | *** |
| 1994                         | 3.440       | 169.899     | *** | (1945 - 1949) Schooling        | 0.019       | 2.524       | **  |
| 1995                         | 3.543       | 169.692     | *** | (1950 - 1954) Schooling        | 0.019       | 1.839       | *   |
| 1996                         | 3.659       | 174.465     | *** | (1955 - 1959) Schooling        | 0.002       | -0.409      |     |
| 1997                         | 3.704       | 171.458     | *** | (1960 - 1964) Schooling        | 0.017       | -3.244      | *** |
| 1998                         | 3.862       | 176.383     | *** | (1965 - 1969) Schooling        | 0.031       | -5.878      | *** |
| 1999                         | 4.054       | 137.025     | *** | (1970 - 1974) Schooling        | 0.041       | -8.388      | *** |
| 1977*Schooling               | -0.006      | -2.325      | **  | (1975 - 1979) Schooling        | 0.076       | -13.473     | *** |
| 1978*Schooling               | -0.010      | -3.975      | *** | (1980 - 1984) Schooling        | 0.103       | -17.431     | *** |
| 1979*Schooling               | -0.009      | -3.872      | *** | Constant                       | 7.621       | 144.201     | *** |
| 1980*Schooling               | -0.009      | -3.821      | *** |                                |             |             |     |
| 1981*Schooling               | -0.009      | -4.198      | *** |                                |             |             |     |
| 1982*Schooling               | 0.000       | -0.256      |     |                                |             |             |     |
| 1983*Schooling               | 0.004       | 2.267       | **  |                                |             |             |     |
| 1984*Schooling               | 0.007       | 3.476       | *** |                                |             |             |     |
| 1985*Schooling               | 0.005       | 2.731       | *** |                                |             |             |     |
| 1986*Schooling               | 0.008       | 3.934       | *** |                                |             |             |     |
| 1987*Schooling               | 0.010       | 5.226       | *** |                                |             |             |     |
| 1988*Schooling               | 0.015       | 8.074       | *** |                                |             |             |     |
| 1989*Schooling               | 0.015       | 7.587       | *** |                                |             |             |     |
| 1990*Schooling               | 0.017       | 8.566       | *** |                                |             |             |     |
| 1991*Schooling               | 0.021       | 10.999      | *** |                                |             |             |     |
| 1992*Schooling               | 0.022       | 11.610      | *** |                                |             |             |     |
| 1993*Schooling               | 0.023       | 11.789      | *** |                                |             |             |     |
| 1994*Schooling               | 0.028       | 14.728      | *** |                                |             |             |     |
| 1995*Schooling               | 0.034       | 17.575      | *** |                                |             |             |     |
| 1996*Schooling               | 0.037       | 19.115      | *** |                                |             |             |     |
| 1997*Schooling               | 0.042       | 21.945      | *** |                                |             |             |     |
| 1998*Schooling               | 0.043       | 22.405      | *** |                                |             |             |     |
| 1999*Schooling               | 0.037       | 14.262      | *** |                                |             |             |     |

**Number of Observations** 1,363,064  
**Censored Observations** 922,412  
**Uncensored Observations** 440,652  
**Wald chi2(77)** 1,290,000  
**Prob > chi2** 0  
**Log likelihood** -1,211.479

Table A.4.

## PROBIT EQUATION OF WOMEN LABOR FORCE PARTICIPATION

| Variable                    | Coefficient       | Statistic Z     |            |
|-----------------------------|-------------------|-----------------|------------|
| People < 6                  | -0.037            | -27.714         | ***        |
| People (6 -11)              | -0.013            | -10.017         | ***        |
| People (12 - 17)            | -0.073            | -71.240         | ***        |
| People (18 - 29)            | -0.005            | -6.065          | ***        |
| People (30 - 41)            | -0.005            | -3.842          | ***        |
| People (42 - 54)            | -0.034            | -21.252         | ***        |
| People >= 55                | 0.039             | 20.361          | ***        |
| Barranquilla                | 0.093             | 29.355          | ***        |
| Bogota                      | 0.303             | 114.198         | ***        |
| Medellin                    | 0.172             | 62.466          | ***        |
| Cali                        | 0.252             | 78.478          | ***        |
| Average Household Schooling | 0.040             | 108.340         | ***        |
| Average Household Age       | -0.004            | -35.690         | ***        |
| Non-Labor Income            | -0.030            | -85.940         | ***        |
| 1977                        | -0.006            | -0.532          |            |
| 1978                        | -0.011            | -0.873          |            |
| 1979                        | 0.013             | 1.121           |            |
| 1980                        | 0.051             | 4.446           | ***        |
| 1981                        | 0.032             | 2.967           | ***        |
| 1982                        | 0.059             | 6.358           | ***        |
| 1983                        | 0.043             | 4.720           | ***        |
| 1984                        | 0.066             | 7.221           | ***        |
| 1985                        | 0.096             | 10.185          | ***        |
| 1986                        | 0.100             | 10.685          | ***        |
| 1987                        | 0.149             | 15.988          | ***        |
| 1988                        | 0.190             | 20.617          | ***        |
| 1989                        | 0.215             | 23.019          | ***        |
| 1990                        | 0.254             | 26.340          | ***        |
| 1991                        | 0.304             | 31.629          | ***        |
| 1992                        | 0.381             | 39.798          | ***        |
| 1993                        | 0.416             | 43.445          | ***        |
| 1994                        | 0.427             | 44.777          | ***        |
| 1995                        | 0.452             | 47.005          | ***        |
| 1996                        | 0.522             | 54.876          | ***        |
| 1997                        | 0.617             | 63.855          | ***        |
| 1998                        | 0.680             | 70.747          | ***        |
| 1999                        | 0.628             | 44.546          | ***        |
| 1915 - 1919                 | 0.116             | 5.847           | ***        |
| 1920 - 1924                 | 0.280             | 15.426          | ***        |
| 1925 - 1929                 | 0.480             | 27.743          | ***        |
| 1930 - 1934                 | 0.700             | 41.662          | ***        |
| 1935 - 1939                 | 0.913             | 54.963          | ***        |
| 1940 - 1944                 | 1.126             | 68.375          | ***        |
| 1945 - 1949                 | 1.284             | 78.500          | ***        |
| 1950 - 1954                 | 1.368             | 84.227          | ***        |
| 1955 - 1959                 | 1.351             | 83.529          | ***        |
| 1960 - 1964                 | 1.189             | 73.703          | ***        |
| 1965 - 1969                 | 0.972             | 60.077          | ***        |
| 1970 - 1974                 | 0.763             | 46.586          | ***        |
| 1975 - 1979                 | 0.392             | 23.349          | ***        |
| 1980 - 1984                 | -0.241            | -13.018         | ***        |
| Constant                    | -1.849            | -102.812        | ***        |
| <b>athrho</b>               | <b>-1.309992</b>  | <b>-331.248</b> | <b>***</b> |
| <b>rho</b>                  | <b>-0.8642735</b> |                 |            |

**Table A.5 Changes in the Return to Education by Year and Cohort (Men)**

| Changes by Year <sup>1</sup> |             |         | Changes by Cohort <sup>1</sup> |             |         |
|------------------------------|-------------|---------|--------------------------------|-------------|---------|
| Year                         | Coefficient | Returns | Cohort                         | Coefficient | Returns |
| 1976                         | 0.0246      | 0.0940  | 1910-1914                      | 0.0500      | 0.1194  |
| 1977                         | 0.0194      | 0.0888  | 1915-1919                      | 0.0457      | 0.1151  |
| 1978                         | 0.0134      | 0.0828  | 1920-1924                      | 0.0413      | 0.1107  |
| 1979                         | 0.0093      | 0.0788  | 1925-1929                      | 0.0378      | 0.1072  |
| 1980                         | 0.0058      | 0.0753  | 1930-1934                      | 0.0353      | 0.1047  |
| 1981                         | 0.0004      | 0.0698  | 1935-1939                      | 0.0338      | 0.1032  |
| 1982                         | 0.0051      | 0.0745  | 1940-1944                      | 0.0323      | 0.1017  |
| 1983                         | 0.0058      | 0.0753  | 1945-1949                      | 0.0288      | 0.0982  |
| 1984                         | 0.0034      | 0.0728  | 1950-1954                      | 0.0217      | 0.0911  |
| 1985                         | 0.0045      | 0.0739  | 1955-1959                      | 0.0103      | 0.0797  |
| 1986                         | -0.0001     | 0.0693  | 1960-1964                      | 0.0000      | 0.0694  |
| 1987                         | 0.0000      | 0.0694  | 1965-1969                      | -0.0086     | 0.0608  |
| 1988                         | 0.0015      | 0.0710  | 1970-1974                      | -0.0187     | 0.0507  |
| 1989                         | 0.0030      | 0.0725  | 1975-1979                      | -0.0370     | 0.0324  |
| 1990                         | 0.0049      | 0.0743  | 1980-1984                      | -0.0399     | 0.0296  |
| 1991                         | 0.0063      | 0.0757  |                                |             |         |
| 1992                         | 0.0097      | 0.0791  |                                |             |         |
| 1993                         | 0.0095      | 0.0790  |                                |             |         |
| 1994                         | 0.0073      | 0.0767  |                                |             |         |
| 1995                         | 0.0111      | 0.0805  |                                |             |         |
| 1996                         | 0.0174      | 0.0868  |                                |             |         |
| 1997                         | 0.0214      | 0.0908  |                                |             |         |
| 1998                         | 0.0308      | 0.1002  |                                |             |         |

<sup>1</sup> The Return to Education by year or cohort is the sum of the average return (0.06942) and the specific coefficient by year and cohort

**Table A.6 Changes in the Return to Education by Year and Cohort (Women)**

| Changes by Year <sup>1</sup> |             |         | Changes by Cohort <sup>1</sup> |             |         |
|------------------------------|-------------|---------|--------------------------------|-------------|---------|
| Year                         | Coefficient | Returns | Cohort                         | Coefficient | Returns |
| 1976                         | 0.0342      | 0.1442  | 1910-1914                      | -0.0076     | 0.1024  |
| 1977                         | 0.0260      | 0.1361  | 1915-1919                      | 0.0095      | 0.1195  |
| 1978                         | 0.0233      | 0.1333  | 1920-1924                      | 0.0164      | 0.1264  |
| 1979                         | 0.0134      | 0.1234  | 1925-1929                      | 0.0117      | 0.1217  |
| 1980                         | 0.0074      | 0.1174  | 1930-1934                      | 0.0104      | 0.1205  |
| 1981                         | -0.0009     | 0.1091  | 1935-1939                      | 0.0120      | 0.1220  |
| 1982                         | -0.0012     | 0.1089  | 1940-1944                      | 0.0109      | 0.1209  |
| 1983                         | 0.0017      | 0.1117  | 1945-1949                      | 0.0107      | 0.1207  |
| 1984                         | 0.0056      | 0.1156  | 1950-1954                      | 0.0072      | 0.1173  |
| 1985                         | 0.0015      | 0.1115  | 1955-1959                      | 0.0031      | 0.1131  |
| 1986                         | 0.0006      | 0.1106  | 1960-1964                      | 0.0000      | 0.1100  |
| 1987                         | 0.0000      | 0.1100  | 1965-1969                      | -0.0004     | 0.1096  |
| 1988                         | -0.0013     | 0.1087  | 1970-1974                      | -0.0029     | 0.1071  |
| 1989                         | -0.0007     | 0.1093  | 1975-1979                      | -0.0211     | 0.0890  |
| 1990                         | -0.0009     | 0.1092  | 1980-1984                      | -0.0551     | 0.0549  |
| 1991                         | -0.0013     | 0.1087  |                                |             |         |
| 1992                         | 0.0011      | 0.1111  |                                |             |         |
| 1993                         | -0.0021     | 0.1079  |                                |             |         |
| 1994                         | -0.0007     | 0.1093  |                                |             |         |
| 1995                         | -0.0001     | 0.1099  |                                |             |         |
| 1996                         | 0.0031      | 0.1131  |                                |             |         |
| 1997                         | 0.0126      | 0.1226  |                                |             |         |
| 1998                         | 0.0175      | 0.1275  |                                |             |         |

<sup>1</sup> The Return to Education by year or cohort is the sum of the average return (0.1100) and the specific coefficient by year and cohort

**Table A.7**

**Average Income and Differential by Gender and Educational Level**

| Level                     | Years of Schooling | Men       | Increase <sup>a</sup> | Women   | Increase <sup>a</sup> | Increase <sup>b</sup> |
|---------------------------|--------------------|-----------|-----------------------|---------|-----------------------|-----------------------|
| Incomplete Primary        | 0-4 años           | 270,496   |                       | 143,955 |                       | 87.9%                 |
| Complete Primary          | 5 años             | 328,484   | <b>21.4%</b>          | 188,842 | <b>31.2%</b>          | 73.9%                 |
| Incomplete Secondary      | 6-10 años          | 364,159   | <b>10.9%</b>          | 245,453 | <b>30.0%</b>          | 48.4%                 |
| Complete Secondary        | 11 años            | 504,759   | <b>38.6%</b>          | 350,118 | <b>42.6%</b>          | 44.2%                 |
| Incomplete College        | 12-15 años         | 659,785   | <b>30.7%</b>          | 466,626 | <b>33.3%</b>          | 41.4%                 |
| Complete College and more | 16+ años           | 1,315,170 | <b>99.3%</b>          | 796,203 | <b>70.6%</b>          | 65.2%                 |
|                           | Total              | 466,998   |                       | 300,992 |                       | 55.2%                 |

Source: DANE, Household Surveys. Authors' Estimates.

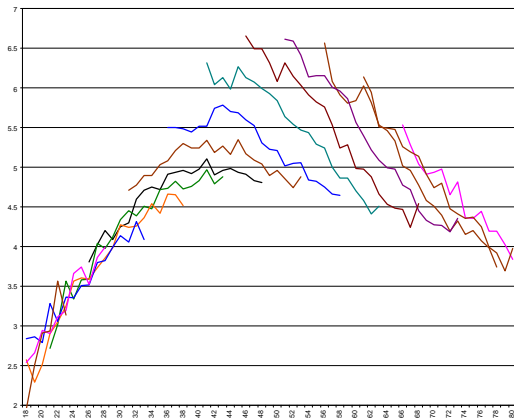
<sup>a</sup> Calculated as the percentage increase between on level and the next.

<sup>b</sup> Calculated as the percentage difference between the labor income of men and women.

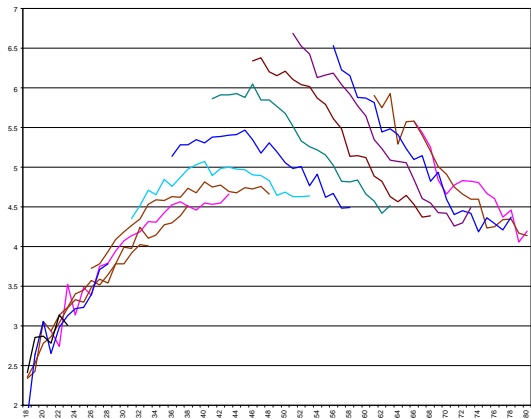
**Table A.8**  
**Time Dummies of the Determinants of School**  
**Enrollment and Years of Schooling**

|             | <b>Schooling</b> | <b>Enrollment</b> |
|-------------|------------------|-------------------|
| <b>1977</b> |                  | 0.054             |
| <b>1978</b> |                  | 0.038             |
| <b>1979</b> |                  | 0.082             |
| <b>1980</b> | -1.771           | 0.114             |
| <b>1981</b> | -4.999           | 0.164             |
| <b>1982</b> | -1.594           | 0.169             |
| <b>1983</b> | -1.938           | 0.170             |
| <b>1984</b> | -1.915           | 0.199             |
| <b>1985</b> | -1.941           | 0.289             |
| <b>1986</b> | -1.955           | 0.313             |
| <b>1987</b> | -1.960           | 0.352             |
| <b>1988</b> | -1.944           | 0.398             |
| <b>1989</b> | -1.914           | 0.462             |
| <b>1990</b> | -1.838           | 0.511             |
| <b>1991</b> | -1.987           | 0.587             |
| <b>1992</b> | -2.113           | 0.322             |
| <b>1993</b> | -2.011           | 0.372             |
| <b>1994</b> | -1.922           | 0.454             |
| <b>1995</b> | -2.025           | 0.515             |
| <b>1996</b> | -0.775           | 0.683             |
| <b>1997</b> |                  | 0.934             |
| <b>1998</b> |                  | 1.032             |

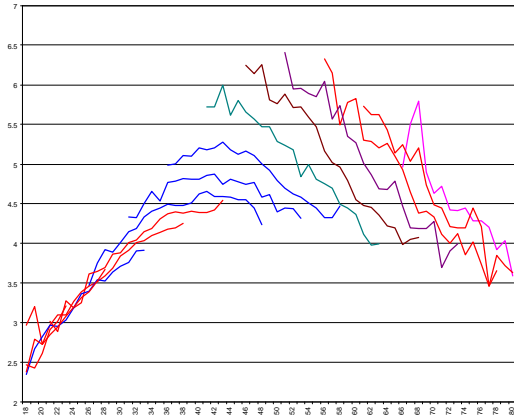
## Family Size by Cohort and Schooling of the Household Head



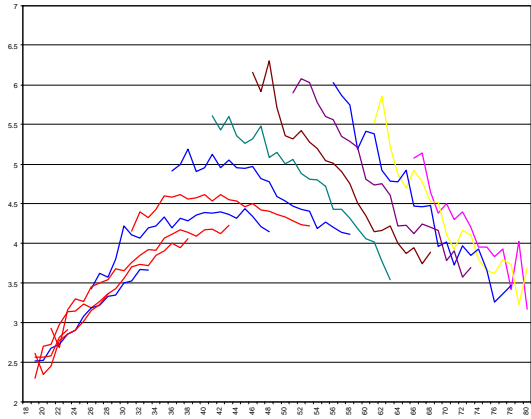
Graph A.1. 0-4 years



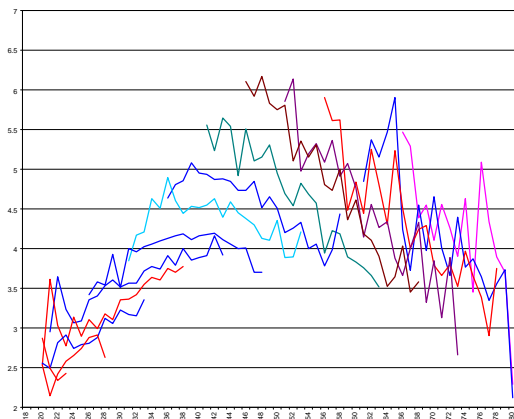
Graph A.2. 5 years



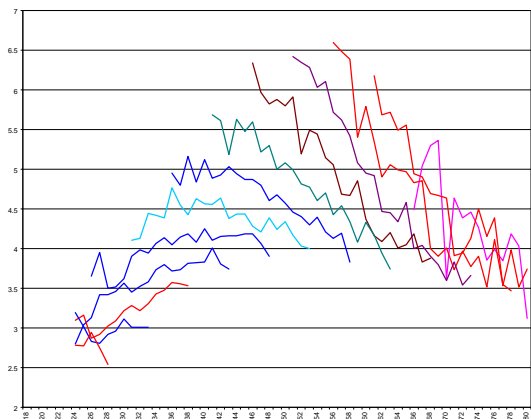
Graph A.3. 6-10 years



Graph A.4. 11 years



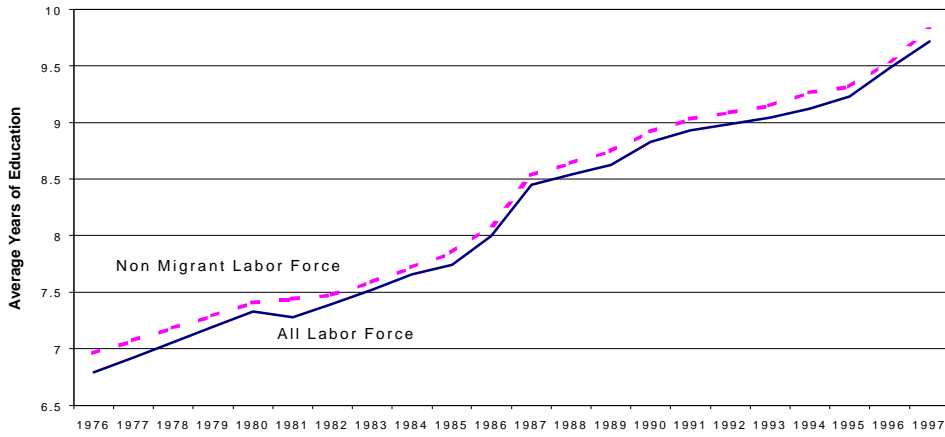
Graph A.5. 12-15 years



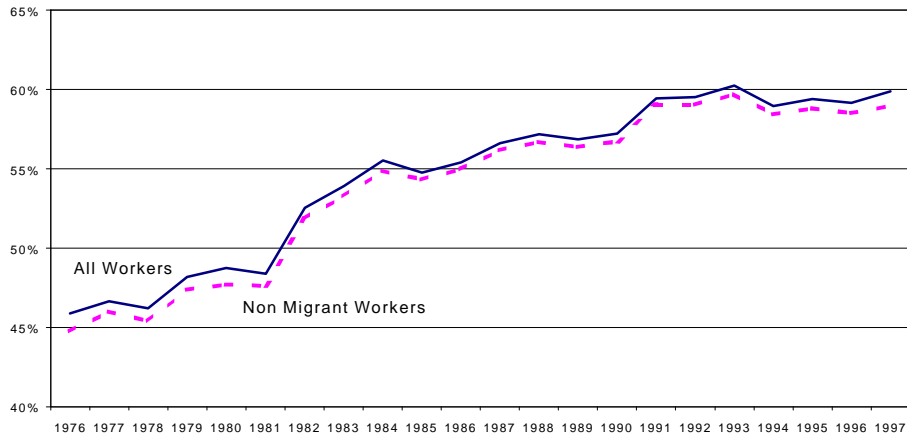
Graph A.6. 16+ years



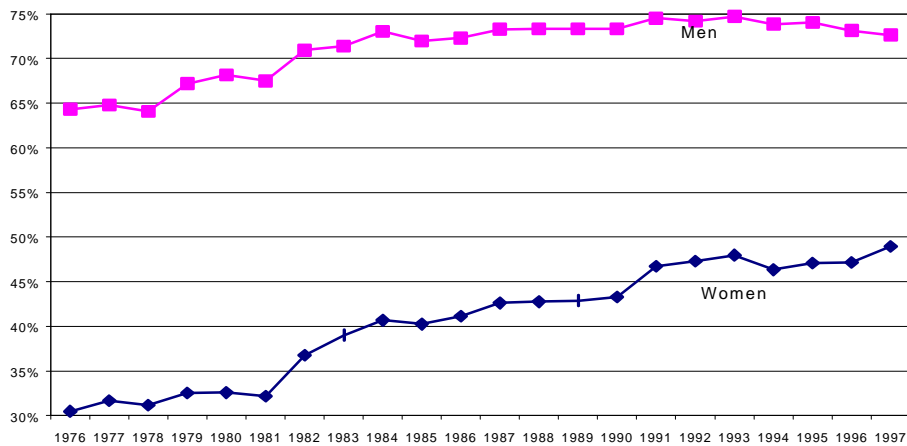
**Graph A.7**  
**Years of Education for Migrant and non Migrant Workers**



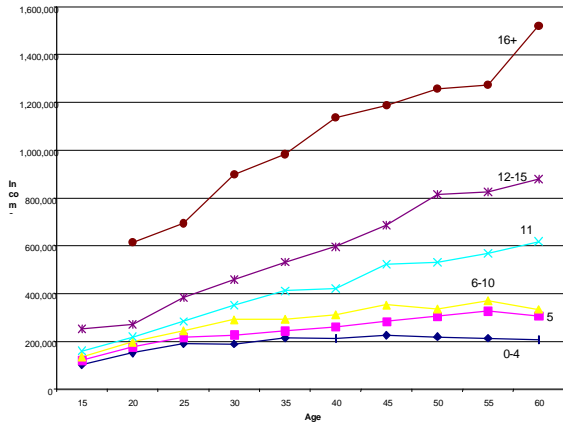
**Graph A.8**  
**Labor Force Participation for Migrant and non Migrant Workers**



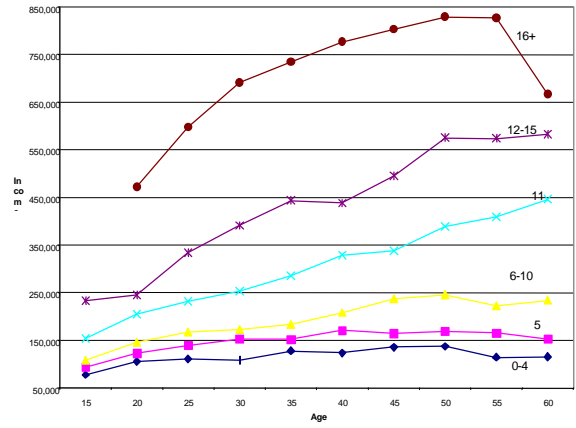
**Graph A.9**  
**Labor Force Participation**



**Graph A.10**  
**Men Income Profile by Educational Level**



**Graph A.11**  
**Women Income Profile by Education Level**



## Appendix 2

### Mincer's Approach to the Returns to Education

In this section we will present some estimates of the Mincer's equation of returns to education<sup>15</sup> using the entire database. The equation to estimate is as follows:

$$\ln Y_i = b_0 + b_1 S_i + b_2 A_i + b_3 A_i^2 + \eta_i \quad (1)$$

Where Y is income, S years of schooling and A is the individual's age. Age has a quadratic form to account for the "hump shape" income profile over the life cycle. According to Mincer (1974) the  $b_1$  coefficients is an estimate of the rate of return to education (table A.8). The results show that the average rate has been 10% (9% for women and 11.5% for men).

*Table A.8*

#### **Earnings Function**

|                  | All                   | Men                   | Women                 |
|------------------|-----------------------|-----------------------|-----------------------|
| Education        | 0.1020<br>(922.252)   | 0.0923<br>(663.502)   | 0.1152<br>(639.422)   |
| Age              | 0.0757<br>(359.653)   | 0.0831<br>(321.222)   | 0.0704<br>(192.904)   |
| Age <sup>2</sup> | -0.0008<br>(-286.595) | -0.0008<br>(-256.331) | -0.0008<br>(-158.364) |
| Gender Dummie    | 0.4211<br>(442.708)   |                       |                       |
| Constant         | 9.8370<br>(2619.022)  | 10.2090<br>(2178.755) | 9.9450<br>(1602.323)  |
| R <sup>2</sup>   | 0.4047                | 0.3519                | 0.3969                |
| No. Observations | 2,013,071             | 1,231,893             | 781,172               |

Source: DANE, Household Surveys. Authors' Estimates.

<sup>15</sup> Becker (1964), Mincer (1974).

In order to have a more precise indication of the differences in labor earnings by education group we calculate the rate of return for each education level. The rates of returns were estimated using the so-called spline function that allows calculating coefficients for each education level. The spline function coefficients could be interpreted as the change in the slope of the return once a level of education is complete. The equation to estimate is as follows:

$$\ln Y_i = b_0 + b_1 S_i + b_2 A_i + b_3 A_i^2 + b_4 (S_i - 4)d_1 + b_5 (S_i - 5)d_2 + b_6 (S_i - 10)d_3 + b_7 (S_i - 11)d_4 + b_8 (S_i - 15)d_5 + \eta \quad (2)$$

Where  $d1=1$  if  $S>4$ ,  $d2=1$  if  $S>5$ ,  $d3=1$  if  $S>10$ ,  $d4=1$  if  $S>11$  and  $d5=1$  if  $S>15$ . The results of the estimation are shown in table A.9. The coefficients indicate that during the time period covered by the sample (1976-1998) the lowest returns to education were obtained by the workers with incomplete primary education (0.085) and with incomplete secondary education (0.076). Similar results are obtained for men and women, although the women returns to education for the considered levels are slightly lower. The returns to education for complete secondary school are much higher, 0.139 (and even higher for women 0.16). However, workers with college degree have the highest returns to education, 0.215, and in particular men, 0.23.

Table A.9

**Spline Model for Returns of Education**

|         |   | TOTAL  | HOMBRES | MUJERES |
|---------|---|--------|---------|---------|
| 0-4     | $\beta_1$   | 0.0853 | 0.0763  | 0.0830  |
| 5       | $\beta_1+\beta_4$                                 | 0.1214 | 0.1029  | 0.1576  |
| 6-10    | $\beta_1+\beta_4+\beta_5$                         | 0.0761 | 0.0618  | 0.1021  |
| 11      | $\beta_1+\beta_4+\beta_5+\beta_6$                 | 0.1369 | 0.1018  | 0.1595  |
| 12-15   | $\beta_1+\beta_4+\beta_5+\beta_6+\beta_7$         | 0.1201 | 0.1238  | 0.1127  |
| 16+     | $\beta_1+\beta_4+\beta_5+\beta_6+\beta_7+\beta_8$ | 0.2158 | 0.2320  | 0.2026  |
| Average |   | 0.1020 | 0.0923  | 0.1152  |

Fuente: DANE, Encuestas de Hogares. Cálculo de los autores.

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