
# FERTILITY AND SCHOOLING: HOW THIS RELATIONSHIP CHANGED BETWEEN 1995 AND 2005 IN COLOMBIA

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# Fertility and Schooling: How this relation changed between 1995 and 2005 in Colombia

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**Abstract**

We test the existence of changes in the relationship between fertility and schooling in Colombia for women from 30 to 40 years old between 1995 and 2005. For our purpose, we use Poisson Regression Models. Our database is the Demographic and Health Survey from 1995 and 2005. We find a reduction in the fertility during this period and an increase in the educative level of the population. According to our results the total number of children a woman has, keeps an inverse relationship with her educative level, which may be explained by the effects of education on the knowledge of birth control methods. We also find that the effect of having finished an educative level in 2005 is higher than in 1995. Besides, we also find that there are significant rural-urban differences in the determinants on fertility for Colombia's women in the last decade.

**Resumen**

En este trabajo se pretende evaluar la existencia de cambios en la relación entre fecundidad y escolaridad en Colombia para mujeres de 30 a 40 años de edad entre 1995 y 2005. Para tal efecto se utilizan modelos de Poisson sobre la Encuesta Nacional de Demografía y Salud 1995 y 2005. Se encuentra una reducción en la fecundidad durante el periodo y su relación inversa con la escolaridad, que puede ser explicada por el efecto de la educación sobre otras variables como el incremento en el conocimiento sobre los programas de control natal. Se encuentra además que el efecto de culminar un nivel educativo sobre la fecundidad es mayor en 2005 que en 1995. De otro lado, se encuentra que las diferencias entre zonas urbanas y rurales son significativas en la explicación de la fecundidad en Colombia durante la última década.

**Keywords**: Fertility, Schooling, Colombia, Poisson Regression Model, Protogenetic Interval.

**JEL**: I22, J13, C25

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## 1. Introduction

During the last past decades there have been several efforts to understand the link between fertility and schooling. It is widely accepted and frequently observed the negative correlation across households between parent's education and completed fertility in the empirical literature on human fertility behaviour. Some authors as Sander (1992), study the effect of women's schooling on fertility and analyzes the possibility of treating women's schooling as an exogenous determinant of fertility in the United States. As Sander cites, some of the explanations for this effect are: first, women's schooling increasing the value of time in market work for opportunity cost of allocating time to child rearing; second, women's schooling increases the effects of the public programs of contraception and, finally, its influence on the preferences for children (See Becker, 1991; Michael, 1973; Cleland and Wilson, 1987 and Easterlin, 1989 for details). More recently, many empirical works show that fertility has decreased and schooling goes in the inverse direction. Shultz (1997) shows that in low income countries as Latin American, the total fertility rate varied from 5.87 to 2.81 between 1950 and 2000. During the same time, infant mortality changed from 126 to 37 in the region. Nevertheless, this is similar in different countries around the world.

In developed countries, according to United Nations (2001), fertility is below replacement level. In fact, "for the more developed regions as a whole, total fertility is expected to decline from 1.57 children per woman in 1995-2000 to 1.5 children per woman in 2005-2010 (...) and to rise to 1.92 in 2045-2050". In the case of less developed regions, we observe high levels of heterogeneity in fertility rates. According to United Nations (2001) less developed regions include extreme cases such as China (with low fertility rates) and countries like Niger or Afghanistan, with higher fertility rates. On average, fertility rates in less developed regions are above replacement levels (3.1 children per woman in 1995-2000) and are expected to fall to 2.17 children per woman for the period 2045-2050. Finally, the total fertility rate for the 48 least developed countries in 1995-2000 is 5.74 children per woman and this value is projected to reach a level of 2.1 in 2045-2050.

In summary, these data may suggest a negative relationship between fertility rates and level of income among different countries and a general reduction in fertility rates for countries with different levels of development. There are different channels in which fertility and schooling are related. Some of them are not direct but through other variables. Cochrane (1979) says fertility is determined by the biological supply of children, by the demand for children in marriage and by the regulation of fertility. The effect of education on fertility could be ambiguous. On the one hand, more education is associated to a higher probability of conceiving due to better health in women. But, on the other hand, increases in education require spend more time studying which reduces the years of exposure to pregnancy and it also could explain marriages at older ages.

From the demand of children's point of view, another way education and fertility could be related is by means of productivity and income. According to the human capital theory, more education is associated with more productivity and income. This increasing in productivity, as Hicks and Martinez (1985) affirm, enhances the cost in time needed to bring children up and reduces the desired quantity of children. In this sense, education decreases the desired family size because of the perceived benefits and cost of children. From this perspective, opportunity cost for women with high education levels is higher than the cost for women with no education. Besides, education also lets people to regulate fertility by means of the knowledge of contraception methods and it can also reduce unexpected pregnancy events.

Nevertheless, the education could also have a positive effect on the demand of children: Hicks and Martinez (1985) suggest that since higher levels of education achieved are related to better levels of income, and taking into account that children are *normal goods*, the effect of education could be an increase on the number of children. Although both effects act in the opposite direction, we could reasonably expect the total effect to be negative which is the fact literature has widely documented.

As it can be seen, all these effects come from the fact that education is a process in which the people get literacy, skills, productivity, socialization and higher levels of income. But it also generates spillover effects on the choices taken by

people and their preferences. Then, there are many ways in which politicians can alter fertility rates in the population.

There are several empirical works on the relationship between fertility and schooling as Cochrane (1979), Ainsworth *et al.* (1996), Shultz (1998), Okonkwo and Terry (2008), Handa (2000), and Josipovic (2007) among others. For some sub-Saharan countries, Ainsworth *et al.* (1996) find that one additional year of education generates a reduction of 0.06 to 0.13 in the number of children per woman. In a similar way, Schultz (1998) estimates the reduction in around 13% (0.5 children per woman) using a cross-country panel data. For Nigeria, Okonkwo and Terry (2008) estimate that the impact of one additional year of women's education on fertility is a reduction of approximately 11 to 19% for women under 25.

Handa (2000), finds that not only education but also income has a negative influence on fertility in Jamaica. In fact, the estimations for income and education birth elasticities are -0.15 and -0.45 which show a higher impact of education on women's fertility rates. In this case the evidence does not support the idea of Hicks and Martinez (1985) who state that we could expect children to be normal goods. Besides, the impact of education seems to operate through the increase in the value of time, instead of its effect on preferences. For some Arab countries, Al-Qudsi (2000) finds that income and education birth elasticities are 0.03 and -0.06 which would indicate that for the sample used, children are normal goods and that the effect on education remains negative and higher in magnitude, as other studies have documented. Josipovic (2007) also finds a negative relationship between education and fertility for the case of Slovenia, although according to his findings fertility rates in this country are still in high levels for some groups of people with high levels of education. This work explains another mechanism through which education relates to fertility: the protogenetic interval (PGI) or the age of women at the time of the first childbirth. We could expect that higher educative levels delay the PGI and hence, we could expect women to have fewer children.

In the Latin-American context, Florez and Soto (2007) describe fertility patterns among high (Haití and Guatemala) medium (Bolivia and Dominic Republic) and low fertility (Perú and Colombia) countries. They find a higher decrease in the fertility in women with low education level in Perú and Colombia;

meanwhile in countries such as Bolivia they note a raise in educative differentials. As a result, they conclude that contraceptive programs have been relatively successful in these countries.

From the economic approach, fertility choice is based on several models. From the microeconomic perspective we find a time budget constraint that endogenize the allocation of time between market labour supply and nonmarket, because for women some of their labour market activities cannot be readily combined with child care and do not generate income as others do. From the human capital point of view, demographic and economic behaviour depends on the household stocks of human and physical capital. In this sense, past investments are focused in seeking a better standard of living. Finally, labour market training, marriage and children, are immerse in the life-cycle which are different between men and women. After pregnancy periods women gain a licence that let them to care of children, but it is not the case of men (although in Colombia the 'Ley María' lets the father to take off 5 working days).

In this document we want to study how much the relationship between fertility and education has changed in Colombia from 1995 to 2005 for women from 30 to 40 years old by means of count data models. We choose this age range, because it is common among women to have finished studies previous to 30 years old. We think our work is important for two reasons. First, it is an application for a developing country where exists a very specific socioeconomic situation: in the middle of the period analyzed (1999), a deep economic recession took place, although there have been important advances in education enrollment rates. Indeed, in the case of primary and secondary education this indicator has increased from 79% in 2001 to 88% in 2005. For higher education this indicator increased from 14.9% in 1995 to 24.6% in 2005. Besides, Colombia has serious problems of violence, poverty and income concentration.

Second, there are no other works that assess changes in the relationship between fertility and schooling in Colombia and it is important to know population dynamics related to fertility and its determinants, since it is a key factor explaining population growth in the long run and, hence, the evolution of population at age of working and other factors affecting labour market indicators.

For our purpose, we use count data models especially designed for the study discrete and positive variables. This kind of models (Poisson Regression Models and Negative Binomial Models) let us to analyze cases where the dependent variable is discrete and it takes few values. The document is divided as follows: the next section shows the socioeconomic situation of the country and some summary descriptive statistics and then, in the third section we explain our methodology and in the fourth we show our findings. Finally, we present some conclusions.

## 2. Background

At the beginning of the XX century, Colombia had about 5 million of inhabitants and 90 percent lived in rural areas. Today, Colombia is a country with a population of 45 million people in 2005 in which most of the 90 percent of the population live in less than the five percent of its territory. The population's growth rate before the sixties was above the 3 percent per year and since then, there has been a decrease in that rate. During most of the XX century Colombia there was a centralistic political system but the regional development generated different conditions into the regions. The geographic conditions have splitted the country into regions as: Atlantic, Pacific, Central, Western and Bogotá. These regions have different cultural, economic, and topographic conditions, among others. While Atlantic region is characterized by being a plain territory in front of the Caribbean Sea, Central region is very mountainous where are located the two biggest and most populated cities of the country (Bogotá and Medellín). However for statistical reasons and for its own conditions, Bogotá is analyzed as a particular region.

The geographic distribution of the population has been influenced for many reasons. One of them is the result of the economic activity. Colombia had in the production of coffee one of the most important source of its income. As a result, most of the people lived near to the production of this good[1]. Other possible explanation emerges from the political disorders from the end of the forties. In the same line, Colombia witnessed a demographic transition from rural to urban areas: while in 1951 30% of the population lived in the cities, that value has reached a level

[1] Today, about 65% of the population lives in the central region that is the region in which coffee is sowed.

of approximately 70% in recent years. Some facts are influencing these migrations: economic progress, the absence of services as health and education in small towns, public health contraception programs and, in the last two decades, the increase in the violence conditions in the rural areas.

From a demographic point of view, Colombia has a continuous decrease in the fertility rate, but most of this reduction was at the end of the sixties and the seventies. During this period, fertility rates varied considerably. It could be a consequence of several facts such as urbanization process, the reduction in illiteracy rates and the creation of programs specially designed for natal purposes. Some findings from Elkins (1973) show that differences in fertility were notorious among groups from distinct educative levels. Between 1960 and 1964, the population with high education had a fertility rate of 6.2, two children less than women with a basic or no education (8.27). At the end of sixties, that difference increased because of the higher reduction in the urban fertility in comparison with the rural situation. As a consequence, after this decade fertility rate decreased continuously. Some governmental programs in posterior years (1970-1974, 1974-1978, 1978-1982, 1982-1986) included aspects that affected demographic variables such as the extension of the familiar contraception programs and the reduction in the child morbidity and mortality.

Population differences among these regions are notorious. Wills (1976) describes regional differences in fertility and she found that socioeconomic conditions in households are very distinct among regions and she also argues that the ideal family size is affected by feeding and living costs and the marginal benefit of the infant work, especially in rural areas. Most of the reduction was in the Central region, and others as Atlantic have a number of children above the national average. Besides fertility differences, we also found differentials related to levels of education among women: from the Demographic survey it was found that in 1976 21% of Atlantic's women did not have education versus 6.8% in Bogotá. In 2005, these values are 4.8% and 1.3% respectively.

Some calculations made in 1986 show that during this period there were a differential of two children between women from urban and rural areas. It also shows that the transition in the fertility rate started in urban areas as Bogotá and

especially in women with higher education and then, other women groups followed this trend.

Low income teenagers start sexual relations and have children before their counterparts in the top of the income distribution. Total fertility changed from 3.2 to 1.65 between 1986 and 2005 in Colombia. Most of this change is a consequence of the considerable reduction in the fertility among high income people.

Various demographic surveys tell us that in less than three decades, people in urban areas increased in more than 10% and that there are no differences by gender. It is also found a reduction in the proportion of women in the 15-24 age range between 1976 and 2005. This is an expected result taking into account the reduction in fertility rates in previous years (see Table 1).

**Table 1. Distribution of Women in Colombia, 1976-2005**

| | 1976 | 1986 | 1990 | 2000 | 2005 |
|---|---|---|---|---|---|
| **Age** | | | | | |
| 15-19 | 26.5 | 22.7 | 21.0 | 19.5 | 18.0 |
| 20-24 | 19.5 | 20.2 | 19.8 | 17.2 | 16.5 |
| 25-29 | 15.1 | 17.1 | 17.3 | 14.9 | 14.7 |
| 30-34 | 11.1 | 13.7 | 14.1 | 14.0 | 13.3 |
| 35-39 | 10.8 | 11.2 | 11.2 | 13.5 | 13.5 |
| 40-44 | 8.8 | 8.0 | 8.7 | 11.5 | 12.4 |
| 45-49 | 7.6 | 7.1 | 7.9 | 9.3 | 11.4 |
| **Region** | | | | | |
| Atlantic | 18.1 | 18.2 | 19.3 | 21.8 | 21.1 |
| Pacific | 18.3 | 18.6 | 17.4 | 18.8 | 17.6 |
| Central | 30.3 | 30.7 | 27.9 | 27.1 | 25.4 |
| Western | 19.3 | 15.7 | 18.1 | 16.7 | 17.2 |
| Bogotá | 14.0 | 16.8 | 17.2 | 15.6 | 17.4 |
| | | | | | |
| **Area of Residence** | | | | | |
| Urban | 68 | 72 | 74.4 | 77.4 | 77.9 |
| Rural | 32 | 28 | 25.6 | 22.6 | 22.1 |

Source. DHS Macro International. Various years.

Since 1970, there has been a slow reduction in poverty (incidence and severity), but the concentration of income is still at undesirable levels. The lowest 20% of the people only has a share of 3% of income. At the same time, local majors have focused their efforts in education and health provision and it has increased schooling levels and reduced infantile mortality.

In the middle of the nineties Colombia had some economic problems as high inflation rate, a decreasing in the growth rate, among others. But the increase in the forced migration as a consequence of the pressing of the subversive armed groups is one of the most important characteristic of Colombian history in the last twelve years. This situation has its own effects on the fertility choice in women. Camacho (2007) estimates the impact of terrorist attacks in Colombia on the health of babies that were born between 1998 and 2003. The results suggest that these types of violence have a negative and significant impact on child health (i.e. on birth weight and preterm deliveries).

Nevertheless, the reduction in fertility rates can be observed even for shorter periods, as the one we are interested to focus on. Between 1995 and 2005 we can also affirm that the number of children per women in Colombia has decreased (Table 2). As it can be seen, both in 1995 and 2005, women in rural areas have more children than urban but the difference between those is still important. Note that women above 40 years have more than 5 children on average. If we take jointly schooling and place of residence, the differences among people from rural to urban areas with no education are higher than people with high education. From the regional point of view, Atlantic and Central are the regions with the highest number of children during this decade, and this number is higher in urban areas.

When we take into account the relationship between the number of children and schooling, the results are very interesting. Moreover, as Figure 1 shows for the Colombian case, on average there is an inverse relationship between years of schooling and the number of children a woman has. The figure shows that the relationship is monotonic for 1995, but it is not the case for 2005. In this last case, the relationship is negative until 16 years of education and after this level, the relationship changes. One possible reason can be found in the opportunity cost of education and the increase in the available services for child care that let the women to work and study. Although in both years there is evidence that let us affirm that the more educated a woman is, fewer children she has, in 2005 we observe that this is true up to 16 years of schooling. Specifically in 2005, the fact of having achieved more than 16 years of education has a positive relationship with the presence of children. This fact could be explained by taking into account that women with

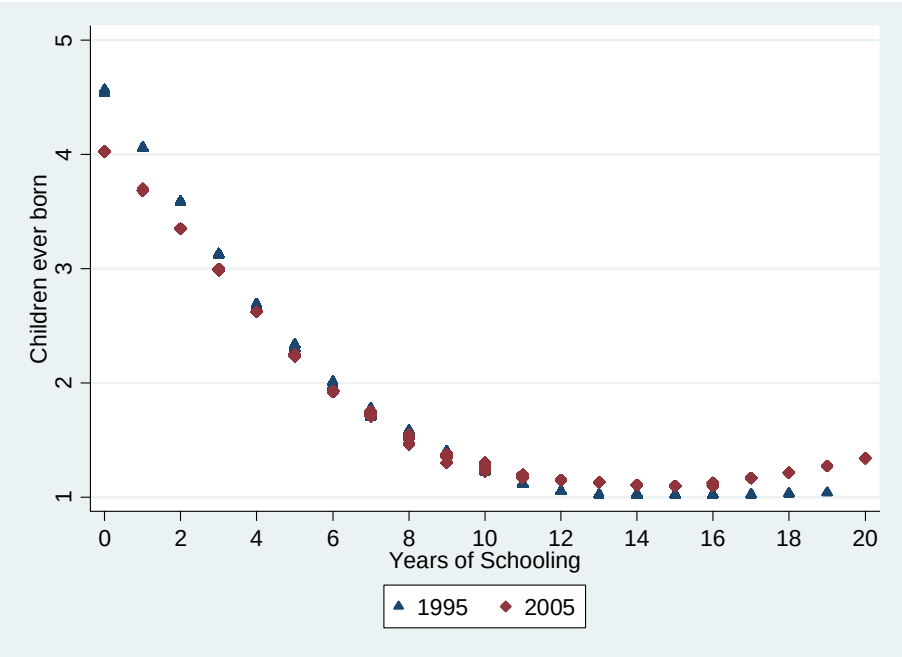
higher educative levels decide to postpone having children, so their PGI starts later in comparison to women with less education achievement. In this sense, once a woman has reached a specific educative level, she decides to have children. As a consequence of the delay in the decision of becoming a mother, we could expect those women to have a lower total fertility rate (i.e. the total number of children at the end of the fertile age).

**Table 2. Mean of children ever born**

| | 1995 | | | | 2005 | | | |
|---|---|---|---|---|---|---|---|---|
| | Rural | Urban | Total | % Population | Rural | Urban | Total | % Population |
| **Age** | | | | | | | | |
| 15-19 | 0.24 | 0.14 | 0.16 | 19.44 | 0.27 | 0.18 | 0.20 | 16.7 |
| 20-24 | 1.38 | 0.78 | 0.93 | 17.4 | 1.27 | 0.70 | 0.82 | 15.35 |
| 25-29 | 2.37 | 1.46 | 1.67 | 16.29 | 2.2 | 1.34 | 1.52 | 13.67 |
| 30-34 | 3.22 | 2.02 | 2.31 | 14.69 | 2.96 | 1.96 | 2.19 | 12.38 |
| 35-39 | 4.11 | 2.61 | 3.01 | 12.515 | 3.6 | 2.34 | 2.63 | 12.57 |
| 40-44 | 4.96 | 3.11 | 3.63 | 10.98 | 4.06 | 2.58 | 2.89 | 11.51 |
| 45-49 | 5.36 | 3.52 | 4.02 | 8.69 | 4.45 | 2.94 | 3.24 | 10.59 |
| **Educative Level** | | | | | | | | |
| No education | 4.92 | 3.83 | 4.52 | 3.80 | 4.29 | 3.51 | 3.93 | 2.59 |
| Incomplete Primary | 3.39 | 3.00 | 3.21 | 20.46 | 3.16 | 2.74 | 2.96 | 12.92 |
| Complete Primary | 2.15 | 2.25 | 2.22 | 16.03 | 2.31 | 2.38 | 2.35 | 13.80 |
| Incomplete Secondary | 1.4 | 1.36 | 1.37 | 32.65 | 1.16 | 1.31 | 1.28 | 31.54 |
| Complete Secundary | 1.1 | 1.16 | 1.16 | 16.58 | 1.27 | 1.3 | 1.29 | 21.10 |
| Higher | 1.14 | 1.00 | 1.00 | 10.48 | 1.05 | 0.89 | 0.90 | 18.05 |
| **Region** | | | | | | | | |
| Atlántica | 2.91 | 1.8 | 2.1 | 23.86 | 2.31 | 1.52 | 1.72 | 21.2 |
| Oriental | 2.66 | 1.68 | 2.07 | 17.28 | 2.21 | 1.59 | 1.79 | 17.22 |
| Central | 2.61 | 1.62 | 1.89 | 25.27 | 2.21 | 1.45 | 1.65 | 25.36 |
| Pacífica | 2.77 | 1.71 | 2.01 | 17.44 | 2.09 | 1.40 | 1.60 | 17.71 |
| Bogotá | - | 1.50 | 1.50 | 16.15 | - | 1.45 | 1.46 | 17.25 |
| Territorios Nacionales | - | - | - | - | - | 1.62 | 1.62 | 1.26 |
| **Socioeconomic Estrata** | | | | | | | | |
| No electricity | n.a. | n.a. | n.a. | n.a. | - | - | 2.21 | 5.14 |
| 1 | n.a. | n.a. | n.a. | n.a. | - | - | 1.97 | 20.27 |
| 2 | n.a. | n.a. | n.a. | n.a. | - | - | 1.67 | 42.20 |
| 3 | n.a. | n.a. | n.a. | n.a. | - | - | 1.29 | 26.52 |
| 4 | n.a. | n.a. | n.a. | n.a. | - | - | 0.99 | 3.96 |
| 5 | n.a. | n.a. | n.a. | n.a. | - | - | 0.84 | 1.05 |
| 6 | n.a. | n.a. | n.a. | n.a. | - | - | 1.00 | 0.87 |
| **Total** | 2.73 | 1.66 | 1.93 | 100% | | | 1.65 | 100% |

Source : DHS- Macro International. * Bogotá is the capital and it does not have a statistically significative rural population.

**Figure 1. Children and years of education**




Source : DHS- Macro International.

## 3. The model

As we mentioned above, our purpose is assessing the existence of changes in the relationship between fertility and schooling during a period of ten years (1995 – 2005) in women from 30 to 40 years old. We choose this age range because we are interested in women that just finished their schooling. Our data comes from the Demographic and Health Survey (DHS) carry out by Profamilia for the case of Colombia. DHS includes information about socioeconomic status, fertility and migration choices, anthropometry and food habits, among other characteristics. This survey is available for years 1995, 2000 and 2005, but we only analyze two of them in order to capture demographic and schooling changes over a decade.

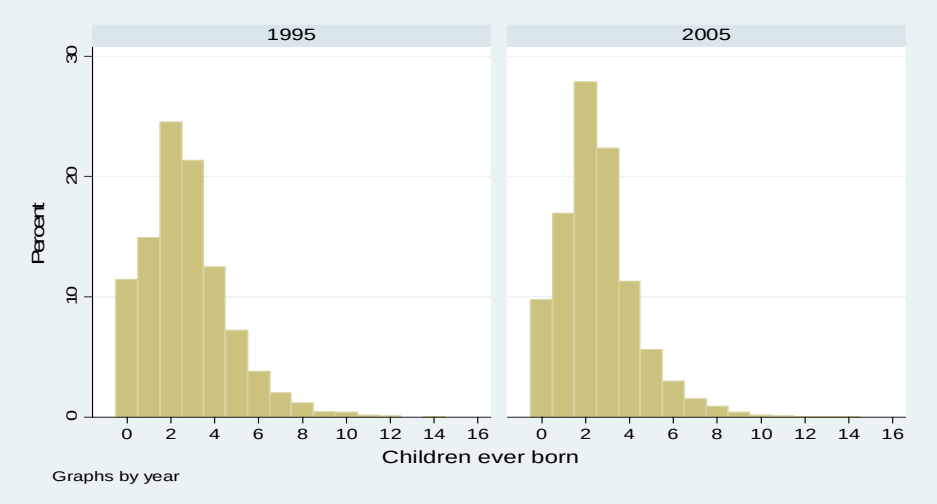
Our dependent variable is the number of children ever born. We use Poisson Regression Model (PRM) due to our dependent variable is discrete and only takes

few values. Linear models as Ordinary Least squares (OLS) have shortcomings from those estimators in which we get negative values. PRM assumes that mean and variance are the same, as the Poisson distribution function. As the mean (variance) increases, the probability of zero count decreases. Then it is possible there are more zeros than those predicted by the Poisson distribution. PRM has problems in the presence of overdispersion. Despite of the existence of other methodologies, PRM has some virtues as attribute a positive probability to the outcome 'zero', it allows inferences on particular outcomes and it also accounts for the heterokedasticity and skewed distributions associated with non-negative variables. For more details of this methodology see Cameron and Trivedi (2005) and Winkelman (2008).

The distribution of the dependent variable for each year is shown in Figure 2. During this decade, the proportion of women with two and three children increased as a consequence of a reduction in women with no children and women with more than three. This effect is more notorious if we only take into account children that were born during this period.

From the survey, we exclude those cases in which women has two or more children at the same time (twins, non-identical twins and so on). As explanatory variables we include schooling, gender, age, area of residence and a proxy of wealth. Our schooling variable is included in two ways: as a categorical variable that tells us the level of education, and a discrete variable of years of schooling. Table 3 summarizes and defines our variables. Some of them are included for controlling additional effects. Although we could expect some other variables to determine fertility levels, the source of data used does not include them. For instance, religion is a factor widely used in fertility literature to explain the number of children a woman has (Hicks and Martinez, 1988; Al-Qudsi, 1998). Nevertheless, the Colombian DHS does not ask about religious practices or preferences.

**Figure 2. Distribution of the number of Children in 1995 and 2005.**




Source: DHS- 95, DHS-05

Table 4 summarizes some complementary information about the sample used in the estimations. As it can be seen, the age of the first and the last child does not change during the period, so it seems to be no significant effects of the increase in schooling years (which presents a small but significant change) on the PGI, at least for the sample used. It is important to take into account that since we only refer to women between 30 and 40 years old, the age at the last child may be underestimated, since for this group of women there is still a period of fertile time. Besides, this would mean that those women only have approximately six years of fertile activity. Instead, we could think about this period as the interval of time between the first and the last child the woman has at the moment of the survey, with the possibility that she decides to have more kids. The number of children also has an increase between the period analyzed. From this statistics we can also say that the urbanization also presented an increase.

## Table 3. Definition of Variables used

| Variable | Description |
|---|---|
| *Dependent Variable* | |
| Total Children Ever Born | It includes those sons who have died. |
| *Independent Variables* | |
| Age | We use age in years and the squared of the age in years. |
| Area of Residence | Urban (1) or Rural (0). |
| Region of Residence | We use dummies for each region. Atlantic, Western, Central, Pacific and Bogotá (reference region). |
| Education | We use either years of schooling (and its squared) or dummies for each level (Primary, Secondary and Higher). The reference is "No education". |
| Active Index | It is a dummy that takes the value of one if the woman has a proportion of actives that is higher to the average proportion in the area she lives in, and zero otherwise. |
| Socioeconomic Strata | This variable is only available for 2005. It refers to a socioeconomic classification used in Colombia to assign subsidies in different way public services. Is a variable ranked from one (the poorest) to six (the richest). |
| Partner's Age | Age in years, of the woman's partner. |
| Age of the first Marriage | Age in years, of the first marriage of the woman. |
| Marital duration | Categorical variable that refers to the time the woman has been married. The exact value is not available from the data source we use. |

## Table 4. Summary Statistics

| | 1995 | 2005 |
|---|---|---|
| Number of children | 2.65 | 2.39 |
| | (1.88) | 1.66 |
| Age at the first son | 22.08 | 21.89 |
| | (4.53) | (4.45) |
| Age at the last son | 28.59 | 28.19 |
| | (4.65) | (4.75) |
| Years of Schooling | 7.41 | 8.41 |
| | (4.34) | (4.42) |
| Observations | 3223 | 11005 |
| % Urban people | 74.30% | 77.19% |

Standard deviation in parentheses
Source: DHS- 95, DHS-05

## 4. Results

Table 5 summarizes the results of the estimated models. The first model includes dummy variables for educative levels and the second specification includes the years of schooling. Since the information about socioeconomic strata is only available for 2005, the third specification –which incorporates this variable–, is estimated only for 2005.

**Table 5. Results.**

| | 1995 | | 2005 | | |
|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 1 | Model 2 | Model 3 |
| Age | 0.205** | -0.003 | 0.1651*** | -0.0072** | 0.0964* |
| Age2 | -0.0023* | - | -0.0019** | - | -0.0015* |
| Atlantic | 0.000 | 0.0838** | -0.0325* | -0.0296 | -0.0364* |
| Western | 0.052 | 0.0881** | -0.0515** | -0.0744*** | -0.0129 |
| Central | -0.040 | -0.005 | -0.1118*** | -0.1424*** | -0.0962*** |
| Pacific | 0.007 | 0.0621 | -0.0957*** | -0.1140*** | -0.0976*** |
| Urban | -0.2534*** | -0.1569*** | -0.1720*** | -0.1448*** | -0.1616*** |
| Primary | -0.1353** | - | -0.1554*** | - | - |
| Secondary | -0.2998*** | - | -0.3164*** | - | - |
| Higher | -0.4385*** | - | -0.4843*** | - | - |
| Actives | -0.1851*** | - | -0.1460*** | - | - |
| Age at 1st marriage | -0.0486*** | - | -0.0447*** | - | - |
| Partner's age | -0.0026 | -0.0032 | -0.0011 | -0.0015 | 0.0003 |
| Years of Schoolling | - | -0.0607*** | - | -0.0520*** | - |
| Years of Schoolling2 | - | 0.0013* | - | 0.0007* | - |
| Marital duration | - | 0.2071*** | - | 0.1895*** | 0.2285 |
| Socioeconomic Strata | | | - | - | -0.1025*** |
| Constant | -16.341 | 10.006 | -0.999 | 1.184 | -0.905 |

*p<0.05; ** p<0.01; *** p<0.001 Source: DHS- 95, DHS-05

As it can be seen, in 1995 we find that women's age has a positive but decreasing relationship with the number of children ever born. Moreover, we can affirm that the effect is statistically significant. This relationship probably reflects the fact that youngest women prefer to postpone the decision of motherhood, maybe

because of their preferences related to accumulation of human capital through years of schooling at this stage. Nevertheless, women's partner's age does not seem to have a significant effect on the number of children ever born.

The results for 1995 show that region seems to have no significant impact on the number of children a woman has, while for 2005 we could affirm that women who live in Bogotá -controlling for the rest of variables- tend to have more kids. Since in Bogotá we find a higher proportion of more educated women (80% of the sample in Bogotá, has secondary or higher education level), we could state that this result may be the consequence of the migration of big families to Colombia's capital city. In general, these are families of the lowest level of income in which it is common to see higher number of children per woman.

Nevertheless, the area where the woman lives is an important determinant of fertility: as descriptive statistics had shown, the statistical results also indicate that living in urban zones has a negative association with the number of children a woman has. According to the semielasticities obtained, living in urban areas decreases the expected number of kids by 18.45% in 1995, and by 15.35% in 2005.[2] In Colombia this is an expected result since educative levels are lower in rural areas; besides, family income is lower in these areas and, especially in these zones children might be seen as a production factor since jobs are usually more intensive in the use of labor, than in more populated areas. In addition, for the sample analyzed, age at first marriage is lower in rural areas than in urban ones (both in 1995 and 2005) which explains that the PGI may start earlier for women living in rural areas. The effect of age at first marriage could be related to the PGI: we could expect that women who get married when they are very young, have more children with respect to women who get married later. The percent change obtained, indicates that for every additional year the woman postpones her marriage, the number of children ever born decreases by 4.7% (1995) or 4.4% (2005). Therefore, the results confirm that the later a woman gets married, the fewer children she has.

In fact, this could be associated to education, since more educated women tend to get married later. In this sense, education could affect the number of children through its impact on marriage decisions. Equally important, marital

[2] This is an average obtained from the different models estimated in each year.

duration is positively correlated with the total children ever born, which could be explained taking into account two facts: on the one hand, that the longer a marriage lasts, reflects more stability and makes it a proper environment to bring children up; on the other hand, higher durations of marriages may reflect the fact of having gotten married earlier (since the sample used only includes women between 30 and 40), which could also be associated to the PGI.

According to the results, socioeconomic variables related to education -either dummy variables for different levels of education or years of schooling- seem to be significant determinants of fertility in Colombia. In comparison to women with the lowest level of education, more educated women appear to have fewer children. Moreover, the biggest marginal effect (among the dummy variables that refer to different levels of education), is the impact of higher education. The elasticities obtained show results in the same direction: in 1995 having a primary, secondary or higher education degree, reduces the expected number of kids by 12.7%, 25.9% and 35.5%, with respect to the fact of having no education. These values in the case of 2005 are 14.4%, 27.1% and 38.4% respectively. Hence, the effect of having finished an educative level in 2005 is higher than in 1995. Besides, the results related to the impact of years of schooling, reflect the relationship of these two variables – education and number of kids-, shown in Figure 1: by using marginal effects (instead off the summary statistics), we found a negative but increasing effect of years of schooling.

The variable associated to the *relative* socioeconomic position of the woman (A*ctives*) indicates both in 1995 and 2005 that a higher socioeconomic position tends to be linked to the fact of having fewer children and its effect is statistically significant. Finally, the effect of Socioeconomic estrata shows that a higher socioeconomic position has an inverse relationship with the number of children a woman has, and its effect is significant.

## 5. Conclusions

The inverse relationship between fertility and schooling is widely accepted around the world -fertility rates are lower for countries with a higher level of

income-. Our findings show that women in Colombia increased their schooling and one of its effects is the reduction in the number of the children they have. The effect of education on fertility is higher in 2005 than in 1995 and some possible explanation for that can be related to the messages coming from the mass media and the public health programs. In this work, we estimate how the relation between these two variables has changed in the last decade, for the case of Colombia. We find that there are no stronger regional effects but the place of residence (urban or rural) has distinct results.

According to the results of the PRM, education and fertility are negatively associated in Colombia. In fact, the number of years of schooling has a negative but increasing effect on the number of children a woman has, for the sample analyzed (women between 30 and 40 years old). In other words, higher educative levels reduce the number of kids, in comparison to not having any level of education. This could be a consequence of the advances in enrollment rates that have taken place in recent years. Besides, we should take into account the potential externalities education has on other variables related to fertility rates. Thus, education affects fertility decisions through different channels and public policies that look for natal controls on population may have in education an important tool.

From a policy point of view, it is important to highlight the differences into rural and urban women. We found that although urban-rural differences in the average number of kids per woman has narrowed in recent years, the zone where the woman lives is still an important determinant of the number of children ever born. This could be explained by the differences related to level of income, years of education and even cultural differences. Moreover, due to geographical conditions, many of the contraceptive programs are concentrated only in urban areas. However, internal migration still continues in Colombia for reasons as violence, absence of opportunities among others, and this fact reduce the efficiency of programs designed for fertility and contraception. In this sense, policy-makers should differentiate the decisions related with fertility goals, between urban and rural areas.

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