LUND UNIVERSITY
School of Economics and Management

Master in Economic Development and Growth

"The relationship between Education and Fertility Rate, an analysis for Andean Countries"

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Abstract: One of the topics that has generated discussions and focuses on demographic theory is undoubtedly the treatment of fertility rates, another important number of studies have incorporated different methods for measuring behaviors in count data, such as Poisson models, also used in the present document. On the other hand, by using panel data, we estimate a random effects model and evaluate the determinants of the behavior of the fertility rate for a specific region of Latin America, the Andean countries such as Venezuela, Colombia, Ecuador, Peru, Bolivia, Argentina and Chile. Given the fact that there are many ways to measure fertility we use a combination of econometric methods, among them, the impulse response functions that will serve to prove through three alternative ways, the effects between education and fertility rate, finding for the region, tested theories.

Key words: *fertility rate, women, education, Andean countries*

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Content

1. Introduction ……4
2. Background……..7

2.1 Fertility in developing countries……..11

3. Andean Countries of Latin America……..13
4. Objective……15

4.1 Research Question……15

5. Data……16

5.1. Data for Macroeconomic Analysis ……16

5.1.1. Descriptive Macroeconomic Analysis……17

5.1.1.1. Fertility Rate……17

5.1.1.2. Fertility rate in adolescents (birth per 1,000 woman age 15 To 19 years old)……18

5.1.1.3. Secondary education, overall students (%female)……..18

5.1.1.4.. Public spending on education, total (% of GDP)……19

5.1.1.5. Enrollment rate – Secondary – Gross……19

5.1.1.6 GDP per capita (Constant 2000 USD)……20

5.1.1.7. Volume of debt……..20

5.1.1.8. Consumer price index (2005=100)……21

5.1.1.9. Gini coefficient……21

5.1.1.10. Health Expenditure (% of GDP)……22

5.1.1.11. Health Expenditure Per capita (current USD)……22

5.1.1.12. Doctors (per 1,000 people)……23

5.1.1.13. Risk of Maternal Mortality (the rate varies by country)……23

5.1.1.14. Unemployment……24

5.2. Microeconomic Data Analysis……24

6. Methodology……25

6.1 Methodology of Macroeconomic Data……26

6.1.1. POOLED OLS……26

6.1.2. RANDOM EFFECTS……26

6.1.3. FIXED EFFECTS……..27

6.2. The Simple Co-integration VAR model……27

6.3 Methodology with micro data……..31

6.3.1. The Poisson Model……31

7. Results……32
7.1. Pretreatment and model selection panel……32
7.1.2. Panel Data Test……33
7.1.2.1. Lagrange Multiplier Test for Random Effects……33
7.1.3. Hausman Test……33
7.1.4. Interpretation of Panel Results……33
7.2. Interpretation of Impulse Response Results……35
7.3. Poisson Models Results……37
8. Conclusions……38
Bibliography……40
ANNEX I……43
ANNEX II……44

1. Introduction

Since it appeared in the discussion of economic development the considerations about the importance of changes in the economy caused by government policies in order to reduce inequality gaps, the inclusion of the concept of human capital, health productivity performance and growth economic, the analysis of demographic events took a great importance.

Talking about the importance in the economic discussion on the processes inherent to population growth and its implications on the economic resources available to sustain the economy, influential reports such as UNESCO appears, which states the evidence that women offer greater social benefits since when increasing their educational level the fertility rate decreases and the child health and nutrition increases, this is one of the reasons why we are interested in studying the relationships of fertility and economic growth.

In the analysis of the literature, these problems have been addressed in a different way with regard to the present document. This section will be developed in the section that analyses the background of this research. However, with different views, it has been found different ways to measure the impact of fertility on economic growth, noting that women's education is a major factor in explaining fluctuations in the fertility rate.

Here it emerges the importance of measuring the evolution of fertility rates since through the years the researchers found evidence showing that policies adopted by governments in education, directly influenced fertility rates and hence it is related to health and production.

Fertility is often presented as one of the indicators that present controversial dialectic clashes since usually in the studies it has been considered a high fertility rate as an indicator of underdevelopment. This idea comes from agrarian societies, which have high rates of infant mortality and in which the labor or family labor resources are considered as a value and a generator of resources.

The developing countries are characterized by greater market integration, rural-urban migration and the diversification of the economy was apparently a common denominator the mismatches between infant mortality and fertility rates, it was given the case that when the mortality rate diminished, the fertility remained high and the population was growing rapidly, creating pressure on resources and social services.

When we asked ourselves about the evaluations and comparisons of inequality or socio-demographic indicators growth in the relevant literature on this topic, rarely the components that bind to these countries are analyzed, beyond growth rates.

If we think about no general terms we can identify slowly similarities between the effects of public policies aimed at reducing inequality gaps between countries, therefore joint efforts trying to implement similar elements to bridge the gap between the citizens of Latin American countries .

In this document we have decided to analyze a group that keeps similarities beyond sharing a continent and it has been decided to look at the Andean Community, as in antiquity in the fifteenth and sixteenth centuries is where the history starts, when Inca culture and its organization ranging from the highlands of Venezuela, Colombia, Ecuador, Peru and Bolivia and also northern Argentina and Chile.

The main column of the Inca Empire[1]were the regions now known as Ecuador, Bolivia and Peru, which developed a single unified culture and co-determined both by the nature of their environment, such as the union of their strengths of rich biodiversity resources and ecological systems that even today remain.

An example of cohesion is the story with Ecuador, Bolivia and Peru who shared and still share many of their customs and ways of life that are still present. For example Ecuador in almost their entirety are descendants of the kingdom of

1 see Annex 1.

Quito that was considered as Quechua, in Bolivia more than 60% are Quechua and Aymara, with a percentage of 25% of mestizos. On the other hand, almost more than half of Peru is or belong to Quechua or Aymara origins. The Inca Empire spanned almost 2 million square kilometers between the Pacific Ocean and the Amazon jungle, from the surroundings of San Juan de Pasto (Colombia) in the north, to the Maule (Chile) river in the south. The Inca Empire was the largest domain in the pre-Columbian America, hence the similarity among these countries are of interest in our study.

We use different sources of data, trying to explain the determinants and the progress that has been given to try to increase education levels and thus affect fertility rate since in the previous documents reviewed, many analysis are engaged in finding differences between the scarce data that can be obtained, the so called count-based models by maximum likelihood, highlighting Poisson models or survival models such as Oaxaca or Hazard, which are very useful with individual data, households surveys or living conditions surveys

But how can we extrapolate micro data to a macro problem? We know that a micro policy tends not to affect the macro directly, but when improving health indicators translate into an improvement in the economy, therefore, it is interesting to see if these programs are efficient and can be analyzed by using macro data.

Therefore, following the literature and trying to apply what we studied in the master program, we decided to use two views in the analysis, first by using macro data from World Bank and constructing an unbalanced panel it was tested if the fertility rate depends on factors that literature studies.

On the other hand, less orthodox in the formulation and its use, we believe it can be useful the theory of the connection in the long term of fertility rate and spending on education, by a vector autoregression analysis to investigate the impulse response effects that occur between these variables. Thus, we can ensure that there exist or not the inverse relationship between these variables.

This alternative is presented as a contribution analysis to traditional models studied previously in the literature.

Finally, by using micro data, as is the Household Survey 2012 for Ecuador, with individual micro data, we make an analysis by maximum likelihood using a Poisson model, which is widely used when analyzing data counting and it is very popular in the studies about fertility.

2. Background

The study of fertility in the beginning was in principle the identification of determinants affecting fertility, getting to find the relationship of social effects, economic environment and the environment (Davis, 1956).

A first relevant classification was the influential work of John Bongaarts who identified effects of a group of variables to the behavior of the total fertility rate (Bongaarts, 1982), using the fertility rate of the population.

- Share of married women in reproductive age
- Use and effectiveness of the contraceptive used.
- Induced abortion.
- Postpartum Infertility.
- The frequency of sexual relations
- The menopause.
- Spontaneous abortions

The analysis about the behaviors at micro level led to a stream that applied assumptions of decision theory, observing individual data and the rationalization of the choice of consumption of goods and services maximizing their satisfaction, are concepts that are used in favor of modeling the motivations for having children.

This marginal stream was applying the relationship between costs and benefits and then infer the opportunity cost of having and raising children, this type of analysis is based on the demand function of children, which as any demand

function has effects (inversely proportional) leading to reduce the fertility, for example children are part of the utility function of parents (that satisfy the need to have children) but children are consumers of resources, such studies usually find positive relationships between income and family size (Schultz T, 1974).

The economic development theory has been promulgating the importance of health on education and human capital formation , which in the early discussion of the different economic trends found in orthodox economists as its detractors and subsequently with the appearance of one of the most influential articles addressing criticism in why the classical economists were not taking into consideration the influence of human capital in the economy (Schultz T. W., 1961). The neoclassical school with G. Becker arises not only to talk about the importance of human capital but also he develops the theoretical framework of the treatment and study on inequalities in income distribution that, in the essential part of the investment in education, had to be done by the worker in order to increase the likelihood of having a better wage (Becker,1975). In this discussion was added that education would be a very good proxy variable to measure the impact of human capital (Schultz P.T., 1992) creating a solid foundation for the marginal theory.

Another influential study that use a proxy for human capital is undoubtedly the work of (Benhabib, 1994) that assume a linear relationship between the years of education and human capital. From here on, the concept of human capital stock appears, which must be deducted from the gross workforce and the years of education in order to determine the wage gap (Pritchett, 2001)

Since then the relationship between education and the economy, relative to the direct results in society, has been included in macroeconomic decision processes as active policies on investment in education. Other studies on the importance of investment in human capital examined the returns of this investment in education on the economy and discussed the economic rate of return to education (Mincer,1974) (Becker,1975). Then the research on the relationship between female education and fertility became and is certainly an

important factor in the returns to education and not a dependent factor of the market (Schultz, 1993).

The theory that states that education is a key determinant of fertility and child health is strongly supported by many researchers, one of them make an analysis of the correlation between education (in fertility) of parents especially of the mother and the health care of the child (Strauss, 1995). Other theories such as that of planned behavior, maintains and orders certain decisions and personal positions when determining a behavior (Ajzen, 1991), which are divided into three categories:

-A purely personal decision, whether postures, for or against the behavior or action to take, for example conceive a son

-pressures from third parties, interest groups, social pressure and

-the emotional and financial security that is controlled by the individual, making the decision of such behavior linked to the availability of housing, income, etc.

A factor of pressure to the behavior of having a second child for example is crucial to the decision to have it. On the other hand a study for Europe has shown that the positive effect on the decision fertility intention is stronger when women have higher education (Testa, 2010).

This assumption was definitely one of the main advantages from the studies of Becker, thus giving to economic policies mechanisms to affect fertility through education, which leads to an individual decision on fertility that may be affected by education of parents, being the maternity an opportunity cost.

It is also evidenced that fertility decisions are influenced by more sexual education and birth control such as the use of contraceptive methods (Rosenzweig, 1989) that demonstrated empirically that there is a positive correlation between the use of contraception and education.

Some authors point out - from the point of view of the needs to satisfy a demand for children by society - that this relationship is linked to wages, incomes and productivity, the productivity that comes from the theory of human

capital (higher education leads to higher income) would increase the opportunity cost of being in gestation since this translates into time devoted to the care of the mother and this would influence the desired number of children (Martinez, 1985); thinking about that statement we can deduce that the authors found evidence that the more education the less the size of the desired family, because it would mean living expenses, care and all the tangible and intangible costs to a large family involved, finding that women with low levels of education have higher opportunity costs than those with higher education levels.

In the case of Latin American countries, samples on the evolution of fertility rates based on demographic movements were extracted. It was evidenced that there are net reproduction rates in individuals with lower incomes, those who are under the poverty line in particular , the case of Guatemala is the one that stands out for strata and strong inequalities, increasing social equity gaps (Hakkert, 2005).

Then there is the idea of the existence of an apparently negative relationship between family size and social class or social strata makes the figure of a trade-off between quantity and quality of children (Bavel, 2005) to appear. It should be clarified that the authors refer to the quality of life that parents can give to their children depending on the resource that they have, since from Becker is defended the theory that decreasing the number of children to invest more and better, this is called quality children, this type of action would lead to a better opportunity for low-income families because what they can invest in one of their children would be as an investment in their future, according to Becker, would be reflected in future wages of better educated children.

The evidence collected by Baez (2006) for Colombia, on the preference of families to have same-sex siblings in families with at least two and / or three children, reinforces the theory of Martínez (1985) and the pressure of external factors or the pergrup[2].

2 group of influence of an individual, usually referred to a peer group.

Following the literature for Latin America and the Caribbean, in the levels of fertility very different patterns were found depending on the country being analyzed (Soto, 2007), for example than in cases of low education in Peru and Colombia the fertility levels decrease considerably, in Bolivia increases in the levels of education, not forgetting that in the region for many years have been implemented sexual education programs, which lead to the authors to conclude that these programs have been highly effective in birth control and fertility.

On the other side, there is evidence that education and schooling of the woman, combined with the employment status on studies for developed countries, women with higher levels of education have access to jobs with better salaries (Kremer, 2000) showing the substitution effect, which may be the case that if incomes are overcome by this effect, women with more education tend to have fewer children, providing to the theory a very interesting relationship, since this implies that the mother's education and fertility are related to each other.

More recent studies of multi level analysis for European countries found results that supported the existence of the positive correlation between education and fertility studies on proportions of women with higher education in European countries (Testa M. R., 2014) in this context the positive effect of women's education has a significant impact on fertility women's plans.

2.1. Fertility in Developing Countries

If we follow the stream of research that analyses the demand for children, we should note here that according to the literature reviewed, the number of children is not the only determinant of this function but also considers the return to parents for services that children can give to parents.

For example, in less developed countries or those even developing, where in families children perform tasks both unpaid and paid is evident the intra-generational transfer, countries such as Latin Americans ones are examples of this situation, where children contribute to the family income, even from an early age (5 years and up) (Partha,1993) in some cases where the home is under the

poverty line the parents offer their children as workers. Some studies find evidence of correlation between the birth rate and child labor data (Pörtner, 2001) (DaVanzo, 1971.).

Moreover in these studies show that the factors determining the decision-making of women to work should be correlated with the costs of motherhood and affordable to their income level. The theoretical position of the opportunity costs of maintenance and raising children from income models of parents through parenting time infer in reducing the demand for children once found that living costs are more but when contrasted against the basic needs of the new children that could come to the family (Eckstein, 1985). On the other side, the opportunity cost of having a child for women following the same effect on their earnings functions, they also find evidence of negative substitution effect on the demand for children against what happens to men (that is the other way around).

This effect on labor markets with higher wages for women influence the rate of marital unions downward and the fertility rate is decreasing, (Schultz., 1997) if we observe this effect is determinant on fertility or the demand for children.

Therefore, the mother's education as a determinant in this type of model not only captures the effect of the potential income that she can earns but also includes the effect of their labor productivity, affecting the child labor downward. In fact, relevant works analyzed that for developing countries maternal education positively influenced the education of children (Hausmann, 2003).

An example of the relationship between fertility and education is evident in Latin America and has a noticeable impact than in other parts of the world, finding a differential in reproductive strategies. Latin America is a pre-transitional society, showing that women with less education have an average of 6 or 7 children, while better educated women on average 2 or 3 children.

Table 1

Total Fertility Rates, Mean Desired Size and Contraceptive Prevalence for 9 Latin American countries

Country	TFR						Mean desired family size*						% contraceptive prevalence†					
	All	0	1–3	4–6	7–9	≥10	All	0	1–3	4–6	7–9	≥10	All	0	1–3	4–6	7–9	≥10
Bolivia	5.1	6.2	6.4	5.3	4.2	2.8	2.8	2.6	2.6	2.9	2.8	3.0	30	12	23	31	43	53
Brazil	3.7	6.7	5.2	3.4	2.8	2.2	3.0	3.0	3.1	2.9	2.9	2.9	66	47	59	71	76	73
Colombia	3.3	5.6	4.5	3.6	2.5	1.8	3.0	3.2	3.1	3.0	2.9	2.9	65	53	61	65	73	73
Dom. Rep.	3.8	5.8	5.0	4.4	3.5	2.6	3.6	3.6	3.7	3.5	3.5	3.5	50	38	47	51	49	57
Ecuador	4.3	6.4	6.3	4.7	3.5	2.6	3.2	3.4	3.4	3.3	3.0	3.1	44	18	37	43	50	61
El Salvador	4.4	6.0	5.2	3.9	3.5	2.5	3.9	4.3	4.0	3.5	3.3	3.3	47	37	42	55	51	64
Guatemala	5.6	6.9	5.6	4.2	2.8	2.7	4.2	4.6	4.0	3.5	3.7	3.4	23	10	24	42	60	60
Mexico	4.1	6.4	6.3	4.0	2.7	2.4	3.3	4.0	3.4	3.2	3.0	2.9	53	25	44	58	70	69
Peru	4.5	7.4	6.1	4.6	3.7	2.5	2.9	3.0	3.1	2.8	2.8	2.8	46	19	33	46	60	67

*Adjusted by woman's age and number of living children. †Among currently married women.

Source: World Bank Data

3. Andean Countries of Latin America

If we talk about the common aspects of the selection of countries we have made, we should indicate that, in demographics aspects, these countries which are also members of the Andean Community[3], have programs to the region to meet the Millennium Goals. Among the main programs of Health and Education, we present:

Table 2
Relation of Social Programs

Country	Name of the Program	Field
Ecuador	"Programa Maternidad Gratuita y Atención a la Infancia"	health
Colombia	"Régimen Subsidiado de Salud"	health
Bolivia	"Seguro de Salud para el Adulto Mayor (SSPAM)"	health
Perú	"Seguro Integral de Salud"	health
Bolivia	"Seguro Universal Materno Infantil (SUMI)"	health

Country	Name of the Program	Field
Colombia	"Programa Crédito Access"	Education
Colombia	"Programa Gratuidad"	Education
Ecuador	"Programa Hilando el Desarrollo"	Economic and Social Inclusion
Bolivia	Programa Nacional de Alfabetización “Yo Si Puedo”•	Education
Perú	"Programa Nacional de Movilización de Alfabetización"	Education
Bolivia	Programa Nacional de Post alfabetización “Yo Si Puedo Seguir”•	Education
Ecuador	"Programa Nutriendo el Desarrollo"	Economic and Social Inclusion
Ecuador	"Programa Textos Escolares"	Education
Ecuador	"Servicio Ecuatoriano de Capacitación Profesional – SECAP"	Education
Ecuador	"Universalización de la Educación Básica"	Education

Source: Own elaboration based on information of CAN

3 http://www.comunidadandina.org/

First we should note that the Andean countries share many socioeconomic characteristics, is known the formation of the Andean Community as a major regional formations sharing ideals and resources to achieve common goals and eventually be closing inequality gaps.

The table shown above refers to joint programs for countries with more risk or more inequality gaps but it is a sign that the Andean countries work together to improve the indicators of development. These programs have been successful in the region through the years.

Regarding life expectancy is now 73.7 years for 2011 which are the latest data, representing an increase of 2.9 years if we compare with 2002 that it is the farthest data since joint policies were implemented.

Looking at the crude birth rate of live births per thousand inhabitants since 2002 begins a reduction of 23.9, decreasing at a rate of 19.8 in 2011.

Another indicator that has improved significantly is the crude death rate, which rose from 5.9 deaths per thousand inhabitants in 2002 to 5.7 deaths per thousand in 2011. According to the reports of CAN[4], these are the main results in the light of improving of health systems in the last decade.

Moreover, and equally important, is the decline in infant mortality rate in the Andean Community, which has been decreasing over the last decade, from 28.5 deaths of infants under one year per thousand live births in 2002 to 21.5 deaths of infants under one year old in 2011.

Inequality gaps are main objective in the region and the programs that are being implemented are reducing gaps and it is thanks in principle to the best health treatment at the time of childbirth and to the best conditions of feeding of the newborns. Here it is worth mentioning that according to official data from the CAN, the 89% percent of births produced in the Andean region in 2012 were attended by trained personnel, this information is very important because it

4 Andean Community of Nations (In spanish: "Comunidad Andina de Naciones").

indicates that for mothers and their children, specialized care has improved, influencing the reduction in mortality risk for complications before, during and after childbirth.

A very important fact of education is that youth Andeans from 15 to 24 years, both in urban and rural areas at national levels, are free of illiteracy with higher data to 96% in 2012.

It is an achievement the progress in educational policies in terms of educational coverage, learning achievements among other things that directly contribute to the economic and social environment in the region decreasing inequality gaps.

Following the progression of education in the Andean population of 15 years and over at the urban level, it is next to be considered free of illiteracy when presenting all its member Countries, a literacy rate greater that 96% in 2012.

Regarding to infrastructure in education in the Andean Community, primary classrooms receive an average of 22.3 students per teacher , that in use of human resources in terms of Andean teachers, is moving towards a more personalized and didactic[5] teaching.

4. Objective

We know that social policies made by governments both in the economic and social matters directly affect the sociological structures of having children. Therefore, our interest is to study the relationship between the fertility rate and education

4.1 Research Question

- If the relationship between education and fertility is evident for the literature reviewed, the macroeconomic data will collect that relationship and therefore it will be reflected in a macroeconomic model.

5 Executive summary, abstract of statistical series of the Andean Community 2013.

- And the relationship between these variables in the long run, will be observed by using a long-term model?

5. Data

For this research we use two important sources of data, which are ordered as follows:

5.1. Data for Macroeconomic Analysis

For our study of the macroeconomic environment, we take information from the database of the World Bank for Latin American countries, specifically from the Andean region, which are presented in alphabetical order, Argentina, Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela, for the period 1990 to 2012.

Table 3

Macroeconomic Data

	ARGENTINA					BOLIVIA				CHILE			
Variable	Obs	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max
Fertility rate, total (births per woman)	43	2.50	0.29	2.05	2.99	4.11	0.51	3.31	4.91	2.17	0.27	1.84	2.62
GDPpc	43	4447.07	481.11	3262.26	5096.39	998.55	120.37	833.86	1259.81	6790.55	1484.98	4121.34	9447.08
Life expectancy at birth, female (years)	43	76.82	3.80	60.56	79.61	65.24	2.65	60.54	69.54	79.59	1.93	76.46	82.27
Primary completion rate, female (% of relevant age group)	43	100.20	6.36	91.66	109.25	85.56	10.47	63.09	98.10	88.80	5.54	83.13	99.06
School enrollment, primary, female (% gross)	43	112.27	3.51	105.87	117.35	105.09	4.37	93.72	110.75	99.58	2.57	95.17	103.92
School enrollment, secondary, female (% gross)	43	89.39	3.95	78.59	96.11	87.47	10.60	67.97	102.90	87.54	5.39	78.84	99.77
School enrollment, tertiary, female (% gross)	43	40.08	39.72	0.00	90.29	1.49	7.17	0.00	34.37	33.22	22.16	0.00	73.91

	COLOMBIA					ECUADOR				PERU				VENEZUELA			
Variable	Obs	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max
Fertility rate, total (births per woman)	43	2.66	0.23	2.35	3.10	3.08	0.34	2.62	3.77	71.67	6.91	42.67	76.98	4.03	5.67	2.44	30.00
GDPpc	43	3337.37	422.97	2832.47	4260.92	2303.46	280.28	2613.35	3568.19	2773.33	674.96	1966.58	4253.62	5617.58	529.32	4322.64	6509.56
Life expectancy at birth, female (years)	43	74.99	1.54	72.38	77.34	75.90	2.32	71.31	78.89	68.03	2.75	63.21	72.55	75.58	1.04	73.90	77.38
Primary completion rate, female (% of relevant age group)	43	97.12	11.95	76.24	116.57	99.14	4.60	94.67	111.85	98.84	3.48	89.77	104.70	93.08	5.50	84.31	100.12
School enrollment, primary, female (% gross)	43	113.74	5.45	100.66	119.55	112.97	3.96	107.91	128.25	115.77	5.31	105.29	123.38	104.93	5.31	98.20	114.86
School enrollment, secondary, female (% gross)	43	81.61	12.42	56.99	101.26	70.51	11.35	56.31	87.56	82.03	8.50	68.76	92.14	75.25	8.60	61.85	89.27
School enrollment, tertiary, female (% gross)	43	24.13	14.03	0.00	47.71	1.81	8.69	0.00	41.69	11.81	16.77	0.00	44.57	9.27	23.51	0.00	98.68

Source: Own elaboration based on World Bank data.

We proceed to perform a descriptive analysis of the countries included in our study, the data come from the database of the World Bank. In order to understand the progress of socio-economic policies that have helped to lower inequality gaps, we will analyze the selected region and will make a preliminary analysis with the most relevant socio-demographic variables in this type of studies about fertility.

Table 4

Socio-demographic variables

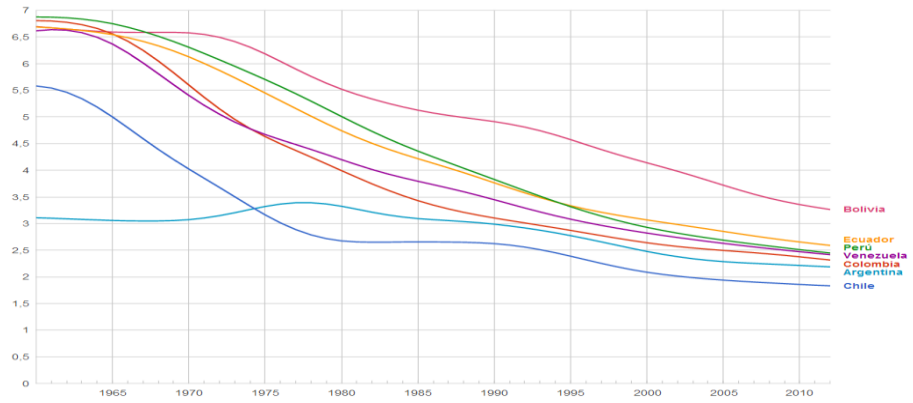
						Maternal Mortality	
	Population 2010 (millions)	women 15-49 (millions)	Fertility rate (children/woman)	Ever born (thousands)	Natality Births *1000 hab.	Deaths (n)	Ratio (100 mil NV)
ARGENTINA	40.7	10.2	2.2	692	16.9	381	55
BOLIVIA	10	2.5	3.3	265.3	26.1	607	229
CHILE	17.1	12.6	2.3	906.2	14.2	42	16.6
COLOMBIA	46.3	12.6	2.3	906.2	19.2	685	75.6
ECUADOR	13.8	3.5	2.4	297.1	20.2	286	96.3
PERU	29.5	7.9	2.4	588.6	19.9	547	93
VENEZUELA	29	7.7	2.4	597.2	20.2	376	62.9

Source: Own elaboration from information of the report of PAHO6 2012

5.1.1 Descriptive Macroeconomic Analysis.

5.1.1.1 Fertility rate

Graph 1: Fertility Rate



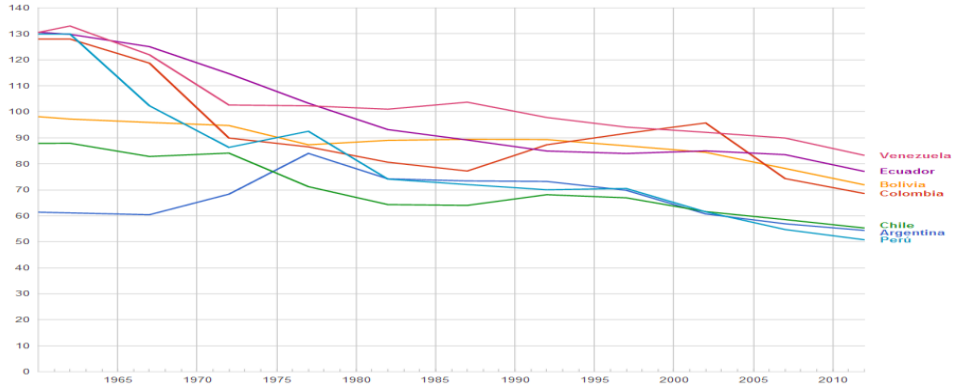
Source: Own elaboration based on World Bank Data

The total fertility rate represents the number of children a woman would have if she lived to the end of their childbearing years and bore children according to the current specific fertility rates by age. In selected countries, the average total fertility rate is 2.6 children per woman. If we compare with previous data, the reduction that has been taking place is due to economic and social changes in recent years; among them, it may be indicated the use of contraception by women.

6 Pan American Health Organization

5.1.1.2. Fertility rate in adolescents (births per 1,000 women aged 15 to 19 years old)

Graph 2: Fertility Rate in adolescents

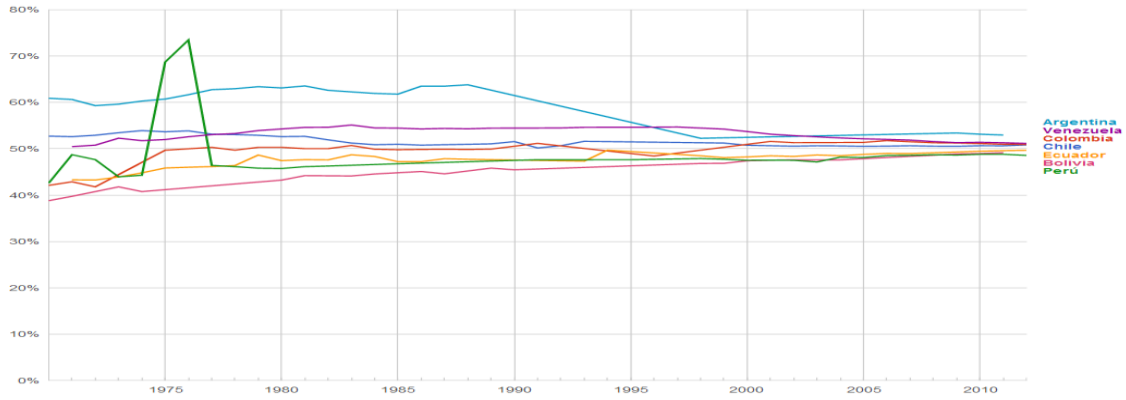


Source: Own elaboration based on World Bank Data

The fertility rate of adolescents has been in sharp decline over the years though Venezuela is the country with the highest rate in this age group.

5.1.1.3. Secondary education, overall students (% female)

Graph 3: Secondary education, overall students

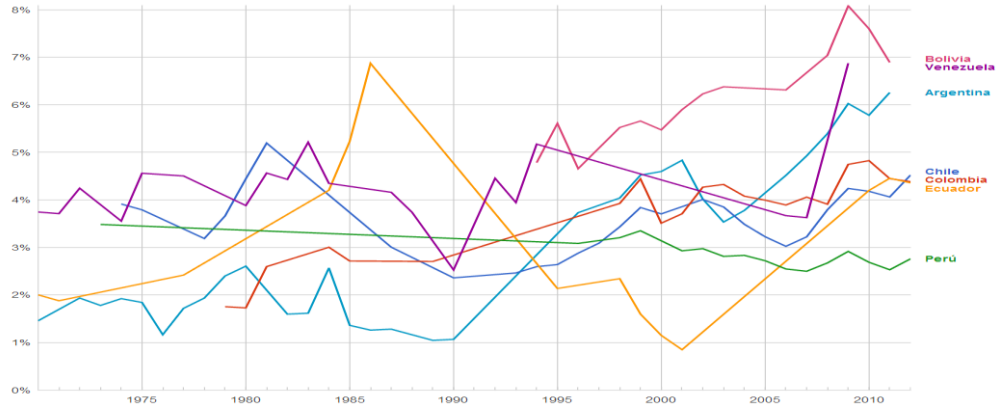


Source: Own elaboration based on World Bank Data

Students in secondary general education programs are the number of secondary students enrolled in general education programs, including teacher training. We can see that the selected countries are on course to homogenization in education rates certainly from the region's efforts to reduce inequality gaps.

5.1.1.4. Public spending on education, total (% of GDP)

Graph 4: Public Spending on Education, Total

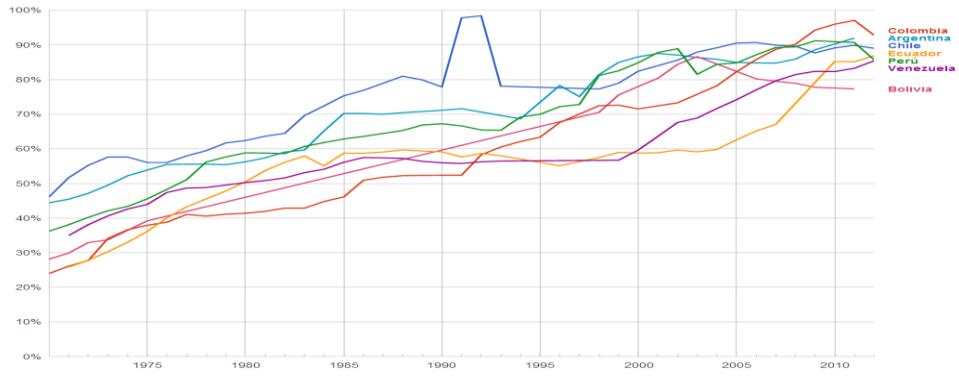


Source: Own elaboration based on World Bank Data

Public expenditure on education consists of current and capital expenditure on education and includes government spending on both public and private educational institutions. It also includes to the educational administration and subsidies for private institutions. We can see that for the region, Bolivia is the country that more resources allocates and Peru is the country with the lower spending but each year the spending is decreasing, while Ecuador is the country that in the last 10 years has been increasing the spending on education.

5.1.1.5. Enrollment rate - Secondary – Gross

Graph 5: Enrollment Rate- Secondary Gross



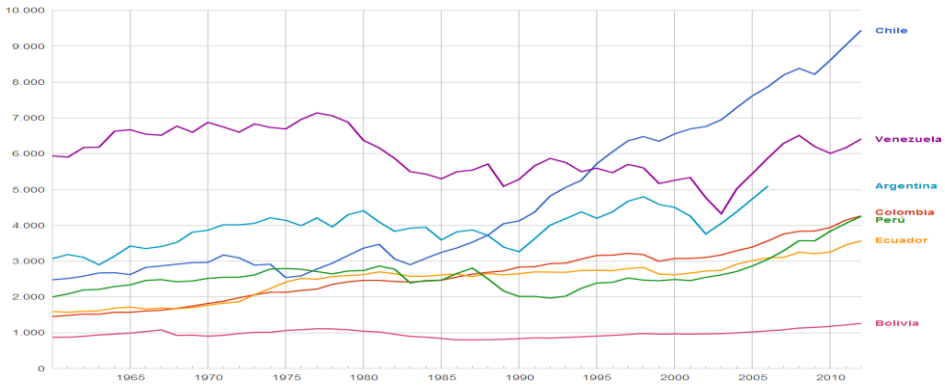
Source: Own elaboration based on World Bank Data

Enrolment rates help in monitoring whether a country is on track to achieve the Millennium Development Goals of universal primary education by 2015, and whether an education system has the capacity to meet the needs of universal

primary education, as it is shown in part in the gross enrollment rates. Therefore, the rates in the region have evolved close to 95%.

5.1.1.6. GDP per capita (constant 2000 USD)

Graph 6: GDP per capita

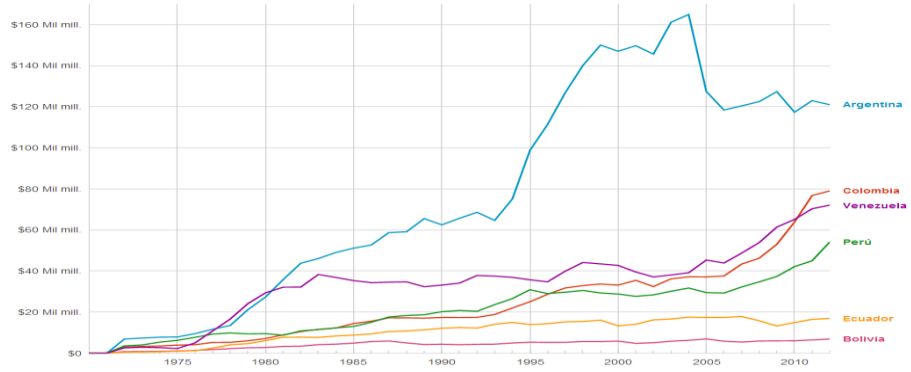


Source: Own elaboration based on World Bank Data

This variable is one of the main determinants in fertility studies. GDP per capita is the product divided by midyear population. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. As we can observe, Bolivia is the only country that has not improved this indicator while countries such as Chile, Colombia and Venezuela had been held in the last decade a growing trend of this variable, which it is an indicator of wellbeing. The interesting thing is that even though the region has suffered greatly with political crises, this indicator has grown through the years.

5.1.1.7. Volume of debt

Graph 7: Volume of debt

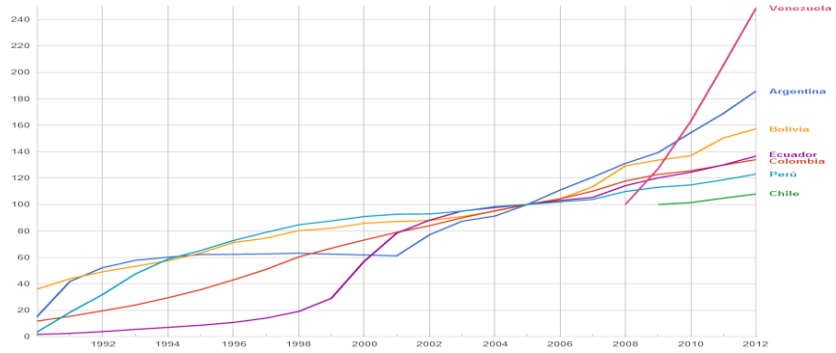


Source: Own elaboration based on World Bank Data

The external debt that is the debt incurred by non-residents to pay in foreign currency goods or services is the sum of long-term public debt, with public and private non-guaranteed warranty, short-term debt and use of credit of IMF. Highly indebted countries of the group such as Argentina, Colombia, Venezuela and Peru are the ones in the table above that had a higher GDP pc, and countries like Ecuador and especially Bolivia who had the lowest rates of GDP pc, have a lower volume of debt. The case of Bolivia is very interesting because its volume of debt is the lowest in the region.

5.1.1.8. Consumer price index (2005 = 100)

Graph 8: Consumer Price Index

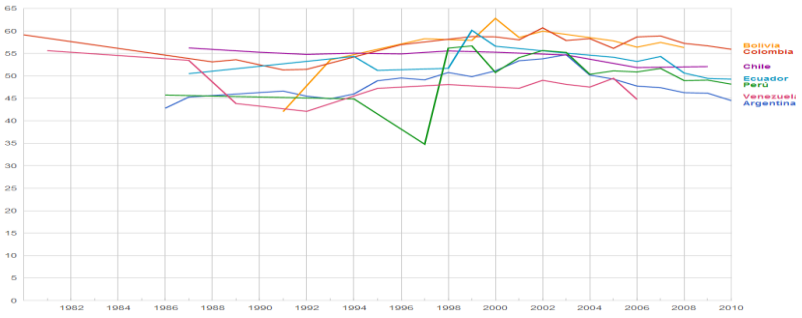


Source: Own elaboration based on World Bank Data

The consumer price index reflects changes in the cost to the average consumer for the purchase of a basket of goods and services, which is usually calculated with the Laspeyres formula. It is interesting to note that the countries that experience a high rate of inflation are Venezuela and Argentina, while Chile would be the country in the region that maintains the lower rate of inflation.

5.1.1.9. Gini coefficient

Graph 9: Gini Coeffcient

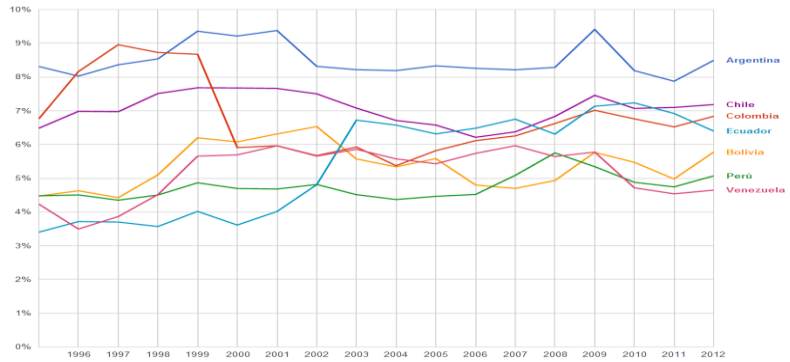


Source: Own elaboration based on World Bank Data

The Gini coefficient measures the degree to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution. The interpretation of the Gini coefficient of 0 represents perfect equality, while a ratio of 100 implies perfect inequality. According to the data the most unequal countries are Bolivia, Colombia and Chile, and the country with less inequality, Argentina. The most interesting case is that of Peru, which has developed the knock-on effect; between 1996 and 1998 Peru suffered major disruptions in its economy, and this caused, that the rate of inequality increase from 35% to 55%. Since that time, Peru was unable to retrieve the lowest rates.

5.1.1.10. Health expenditure (% of GDP)

Graph 10: Health Expenditure



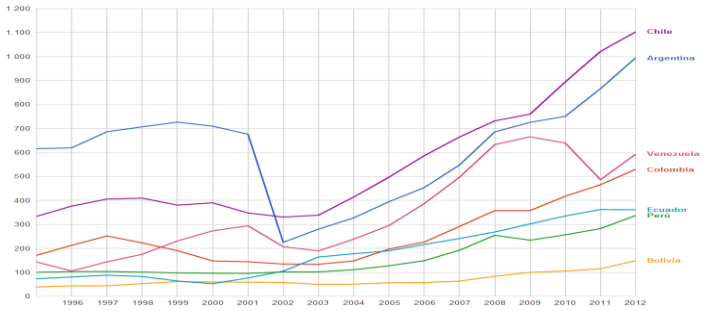
Source: Own elaboration based on World Bank Data

This variable is crucial in the functions that measure fertility, total health expenditure is the sum of public and private expenditure related to health and it is very important because in its calculation includes the provision of preventive and curative health services, activities of nutrition, and family planning, and emergency assistance for health. An important clarification is that it does not include provision of water and sanitation.

Therefore, the country with the lowest spending is Venezuela and the one with the highest spending Argentina. However, Bolivia and Argentina are those who, in the last period, have increased more than the group average.

5.1.1.11. Health expenditure per capita (current USD)

Graph 11: Health Expenditure Per capita

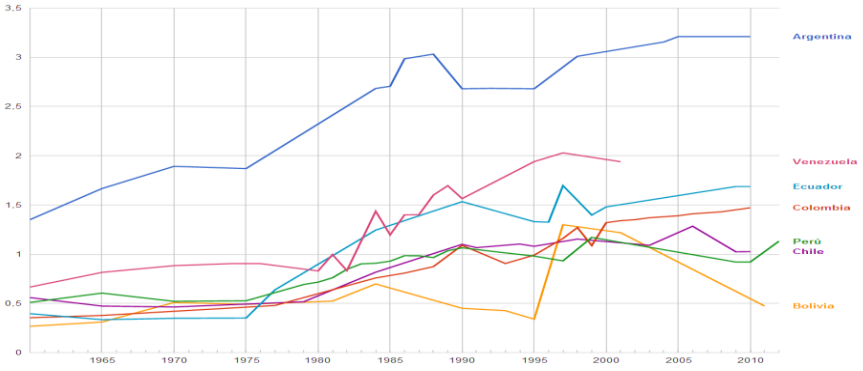


Source: Own elaboration based on World Bank Data

Education expenditure per capita in the region is led by Chile, and the country that goes behind the group is Bolivia. This data is not entirely conclusive as for example Bolivia, is the country with less population and GDP level of the group; However, Venezuela is the country that has experienced a steady progression between the seven countries analyzed.

5.1.1.12. Doctors (per 1,000 people)

Graph 12: Doctors

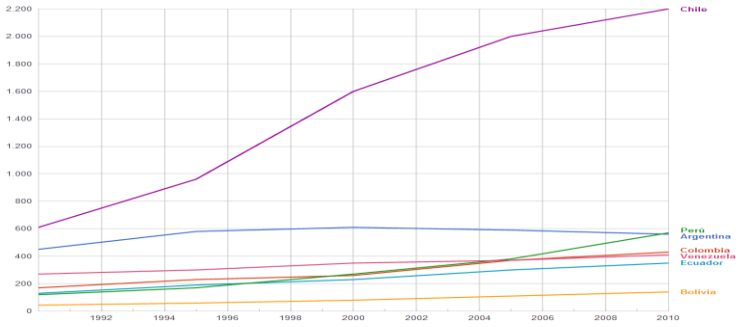


Source: Own elaboration based on World Bank Data

This variable, including general practitioners and specialists, it is important to understand that when more professionals provide medical care to the population is an indicator of well-being and it reduces inequality gaps. In this case, Argentina is leading in the group and Bolivia the country that for ten years has maintained a decrease in this indicator, while the other countries are trying to maintain an upward trend.

5.1.1.13. Risk of maternal mortality (the rate varies by country)

Graph 13: Risk of Maternal Mortality

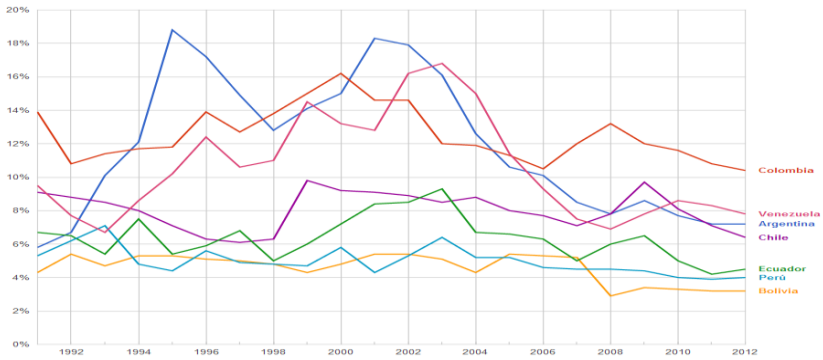


Source: Own elaboration based on World Bank Data

The risk of maternal mortality is the probability that a woman of 15 years old die of causes related to maternity assuming that current levels of fertility and mortality, included the maternal mortality, will not change in the future, taking into account other causes of death. Most shocking is that in Chile, which is the country with better socioeconomic indicators, the risk of mothers is impressively high. Moreover, the country with the worst data was Bolivia, but the mortality rate in this country is the lowest in the group.

5.1.1.14. Unemployment

Graph 14: Unemployment



Source: Own elaboration based on World Bank Data

By using the definition of the International Labor Organization (ILO), it defines the unemployed people to the members of the labor force without jobs but available for and seeking job, including those who have lost their jobs or have abandoned their jobs. It is clearly observed that the region has experienced a lot of volatility, however it can be pointed out that the unemployment is seasonally affected by spikes and fences of the series.

But countries that have undergone drastic changes are Argentina and Colombia; However, it is noted that the region in recent years is experiencing a decline in unemployment mainly by the rise of the economic boom in the region.

5.2. Microeconomic Data Analysis.

When analyzing fertility and its determinants, it is often taking into account individual data, usually in those surveys that address socio-demographic variables, with which we can measure the effects of macroeconomic policies that may affect the micro data, to the individuals, and through of them, an improvement to the economy as a whole.

Therefore, with the information from the survey data of 2012 of household panel of Ecuador containing individual information, we will carry out a Poisson Model (counting model) for Ecuador.

Here it is worth to make a clarification: This elaboration has been done only to Ecuador, since the Andean Countries and in Latin America in general, there are no updates on household surveys or living conditions surveys. Another problem is the complication of getting these databases, either by the limited availability or simply because the methodologies are changing or because of few resources, the surveys are not made with a homogeneous periodicity.

Here are the basic statistics of the variables that we consider relevant and that were statistically significant when calculating the Poisson model that we present in the Results section.

Table 5: Microeconomic Data

Code	Variable	Observations	Mean	Std. Dev.	Min	Max
pf16a	Years worked	9514	1999.227	5.747622	1974	2006
pf14	Children ever born	9820	2.92668	2.108939	0	20
pd13a	Level of studies of the mother	28018	2.69359	1.947562	1	6
pa23a	Salary	3246	27.4561	29.79102	0	360
Edad	Age	55666	27.28957	20.90176	0	98
Sec	Secondary education	55666	0.054845	0.2276794	0	1

Source: Own elaboration based on information of INEC (National Institute of Statistics and Censuses)

6. Methodology

Among the many applications of the models that try to explain the relationship between fertility and education there is a stream between the literature of demographic analysis that tries to explain about the type of relationship between the development and the declining of fertility rates.

About the methodology, there is a diversity of applications, among which highlights in the literature reviewed for this paper[7], the micro-econometric data, by using counting analysis or the so called survival data, dealing with this type of analysis.

We follow two approaches:

• The first approach from the treatment of macroeconomic data, by using two methods, initially by means of panel data and then a simple VAR model to analyze the impulse and response effects.

• The second approach is to perform the micro model with a Poisson model with individual data for Ecuador.

6.1. Methodology of Macroeconomic Data

We will perform the panel data methodology similar to the study that covers 45 years of study from 1960 to 2005 for Latin American countries, where two modeling approaches are used (Macro and Micro analysis) (Adsera & Menendez, 2009).

We will use in this study a database obtained from the World Bank for the period 1990 to 2012 for the countries of Argentina, Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela.

Then we will analyze a Poisson model for Count Data for Ecuador using the household database of 2012.

7 see Annex 2

6.1.1. POOLED OLS

It is the first estimator that is usually estimated to determine causality of the regressors in panel data environment, omitting dimensions of cross section and time, this method is similar to the usual OLS regression.

$$Y_{it} = \alpha + \beta_1 X_{1it} + e_{it} \qquad \text{[i]}$$

Where i means the ith cross-unit and t the time t per each year.

6.1.2. RANDOM EFFECTS

In equation [i] is assumed that the intercept of the regression is the same for all cross units without forgetting that there is the possibility of controlling the individual character of each transverse unit. It should be noted that the random effects model supports the assumption that each cross unit has a different intercept.

$$Y_{it} = \alpha_i + \beta_1 X_{1it} + e_{it} \qquad \text{[ii]}$$

For $\alpha_i = \alpha + u_i$ that means α we do not assumed it as fixed, but as a random variable with mean α and a variance u_i of this value in average

If we substitute $\alpha_i = \alpha + u_i$ in [ii] we will get:

$$Y_{it} = \alpha + \beta_1 X_{1it} + u_i + e_{it} \qquad \text{[iii]}$$

In the equation [iii] is evident that if the variance of u_i is $\sigma_u^2 = 0$, there will be no a significant difference between [i] and [iii].

6.1.3. FIXED EFFECTS

On the other hand there is another way to capture the individual character of cross-unit, and it is by using the fixed effects estimator, this modeling maintains the assumption that the differences between the transverse units to be random but constant or fixed, estimating each intercept u_i. One way of making this is through dummy variables of differential interception.

$$Y_{it} = v_i + \beta_1 X_{1it} + e_{it} \qquad \text{[iv]}$$

Where v_i is a vector of dichotomous variables for each cross unit.

6.2. The Simple Co-integration VAR Model

In our case we will use co-integration models for the Andean community in Latin America by a simplification of sociological and demographic similarities.

It is clear at these moments with scientific evidence the effects of economic policies on fertility and development indicators, which leads us to use one of the econometric techniques that best result offers when interpreting the effects of the relationship of these variables in the long term; this method is known as the co-integration model.

We know that traditional econometric models ignore that most economic series are not stationary, thus invalidating the results corresponding to the distribution of estimators and this creates problems such as the spurious regressions.

Co-integration analysis allows to detect the existence or the possibility of obtaining accurate estimates, i.e., free from spurious results, of the parameters that define the relationships between two or more variables, both short and long-term, but it is in the long term that we are interested in since the long-term is associated with the equilibrium defined by a state in which there is not a tendency to the change (but do not forget about the dynamic equilibriums that may exist).

In econometrics and statistics, talking about equilibrium means the fulfillment of the concept of seasonality, which would represent the steady balance, defined as a balance between two or more variables, provided that the deviation of this relationship is a weak stationary process.

If there is a long-term relationship between a set of variables (y, x1, x2, x3, ... xk) should be given in the same point of time, being the generic formulation as $Y_t = X_t'\beta$, the relation of the exogenous variables over the endogenous ones appear and disappear immediately.

But in the analysis of real series although the relationship can be fulfilled in the long-term, in the short-term there are mismatches that determine that the past values of the variables fulfill an important role in determining the phenomenon at each point in time.

At this point we could use a contrast between economic theory and econometric theory, if we evaluate only the relationship between two variables without expectations, if we check the possible existence of this inverse relationship in the long term between education and fertility we could use a structural VAR model to analyze its impulse response function in order to identify whether or not this property exists.

$$\Delta \text{Fertilityrateto}_t = \alpha_{01} + \sum \phi_{11_j}\ \Delta \text{Schoolenrollmen}_t + \varepsilon_t$$

$$\Delta \text{Schoolenrollmen}_t = \alpha_{01} + \sum \phi_{12_j} \Delta \text{Fertilityrateto}_t\ + \varepsilon_t$$

VAR

At this point, we will perform the following procedure.

•The variables that are thought to interact, are included as a function of the economic system that is modeled.

• greater number of lags is used to capture most of the effects that the variables together.

Using the Akaike, Hannan-Quinn and Schwarz criteria in order to determine the appropriate number of lags, it was not equal to 2.

In this paper we will only see the impulse response graph, which is what we want to analyze as VAR parameters are not always easy to interpret.

The so called impulse response function is accompanied by the analysis of variance decomposition that analyze the dynamic interactions, which are theoretically produced by deterministic effect of time and the influence that characterize the system to be estimated.

If so, this will allow us to identify these sequences and/or relationships with the simulation of a dynamic interaction model and the simulation where it comes to analyzing the effects that in the endogenous variables cause changes of the exogenous variables.

Therefore, the econometric theory provides us Vector Autoregressive (VAR) models, where there is no a closed concept of exogenous variables, therefore, interactions are subject to changes that are included in some of the variables explained.

For these reasons, the VAR methodology captures in its theory, the difficulty of interpreting their coefficients because they use as a way to capture the dynamics among the variables, the use of lags which is not always easy to interpret. Hence, the impulse response function shows the reaction (response) of the explained variable in the system to changes in the errors.

Usually this is known as shocks in a variable in the ith period because it will directly affect the variable itself and then it will be transmitted to the other explained variables through the dynamic structure that represents the VAR model.

This "skill" of the model will help us to find the relationship (if so) between the variables Expenditure on Education and Fertility Rate.

The technical procedure is performed on the errors, which should be orthogonalized by some process of decomposition. The Cholesky procedure uses such procedure that the form given to the covariance matrix of the resulting innovations is diagonal, it is necessary to indicate that the Cholesky decomposition is a method widely used but it is no less arbitrary when it comes to attributing common effects, for this reason there are many procedures that perform this orthogonalization of the errors. But, for the present document we will use the Cholesky methodology.

Furthermore, it should be taking into consideration that when changing the order of the equations, the results of the impulse response functions can vary dramatically.

The VAR models are timeless, i.e., which only collect under the influence over time, but they are not associated with a particular period, as it is the case of the simulations with structural models.

Operationally, performing simulations with VAR models is conducted using the following steps:

• variables are ordered based on higher or less relative exogeneity.

• the model is transformed according to a matrix deduced of the ordination conducted

•The transformed model is re-estimated in its autoregressive form.

•The representation of moving average of the new estimated model is computed.

•A certain value to the random error of an equation, usually equivalent to a standard deviation of the disturbance is incorporated.

•The remaining values of the transformation of such perturbation through the matrix of moving averages are calculated again.

•The values obtained for each variable included in the system are shown.

Given the complexity of all programs that include estimation of VAR models, they have built-in routines for obtaining these impulse response functions automatically. We will use the E-views program and will present the results in the corresponding section.

6.3. Methodology with micro data

These models are often used in the analysis of count data, generally used in areas of analysis of health data, as it is much easier to obtain data on the use of health centers and the expenditure made in them (Cameron and Trivedi, 1998).

The most common way is to use the Poisson regression, although in some studies is somewhat stiff when converge on an adjustment for the rigidities of their assumptions.

6.3.1. The Poisson model

The Poisson regression model is a nonlinear model in which the probability of each count, y_i (i = 1,...,N), is determined from the Poisson distribution, whose mean, λ_i , is function of a set of explanatory variables, x_i , this is:

$$P(Y_i = y_i / x_i) = \frac{e^{-\lambda_i}\ \lambda_i^{y_i}}{y_i!} \quad y_i = 0,1,2,...$$

$$\lambda_i = E[y_i / x_i] = \exp(x_i\ \beta)$$

where β is the parameter vector and xi is the vector that collects the set of explanatory factors. The exponential formulation of the parameter λ_i ensures the positive nature of the mean of the dependent variable.

The unobserved heterogeneity is taken up by introducing a multiplicative error term in the conditional mean of the Poisson regression model, thus giving rise to mixed Poisson models or compounds where:

$$\lambda_i^* = E[y_i / x_i, v_i] = \lambda_i\ v_i = e^{x_i \beta}\ e^{\varepsilon_i}$$

The unobserved heterogeneity term, vi, generally it is supposed to be identically and independently distributed with a known parametric distribution and it is independent of the set of explanatory variables. Additionally, it is often assumed that its mean is the unity and its variance $\sigma^2_{v_i}$.

7. Results

Having two types of analysis, we will present first the results of the macro econometric model, and then to conclude, the results of the micro econometric model.

7.1. Pretreatment and model selection panel.

In this part of the investigation, we should analyze depending on the data we have, what kind of modeling we need. To carry out this procedure, previously we performed the selection panel data model.

And then interpret the results using only the preferred model.

Table 6: Pretreatment and Model Selection Panel

	Pooled			Fixsed Effects			Random Effects		
Fertilityratetotalbirthspe	Coef.	Std. Err.	P-valor	Coef.	Std. Err.	P-valor	Coef.	Std. Err.	P-valor
Employersfemaleofemployme	0.1535248	0.0463291	0.0010	0.1749340	0.0552572	0.0020	0.1535248	0.0463291	0.0010
Employmenttopopulationratio	-0.0140440	0.0045411	0.0020	-0.0136988	0.0047394	0.0040	-0.0140440	0.0045411	0.0020
GDPPPPconstant2005internat	0.0000000	0.0000000	0.0000	0.0000000	0.0000000	0.1330	0.0000000	0.0000000	0.0000
GNIpercapitaconstant2005US	0.0002560	0.0000328	0.0000	0.0000524	0.0000762	0.4930	0.0002560	0.0000328	0.0000
HealthexpenditurepercapitaP	0.0008343	0.0001593	0.0000	0.0009802	0.0001610	0.0000	0.0008343	0.0001593	0.0000
Laborforceparticipationrate	0.0199849	0.0071817	0.0060	0.0146396	0.0082186	0.0770	0.0199849	0.0071817	0.0050
Laborforcewithprimaryeducati	0.0030923	0.0031203	0.3230	0.0026781	0.0030646	0.3840	0.0030923	0.0031203	0.3220
Mortalityrateinfantper100	0.0537181	0.0046522	0.0000	0.0643154	0.0092776	0.0000	0.0537181	0.0046522	0.0000
Numberofinfantdeaths	0.0001308	0.0000754	0.0850	0.0001666	0.0001031	0.1080	0.0001308	0.0000754	0.0830
Numberofneonataldeaths	0.0001173	0.0000514	0.0240	0.0002379	0.0000757	0.0020	0.0001173	0.0000514	0.0220
Numberofunderfivedeaths	-0.0001268	0.0000435	0.0040	-0.0002012	0.0000657	0.0030	-0.0001268	0.0000435	0.0040
Unemploymentwithprimaryeducat	0.0101080	0.0029977	0.0010	0.0073414	0.0033760	0.0310	0.0101080	0.0029977	0.0010
Wageandsalariedworkersfemal	-0.0058843	0.0024731	0.0190	-0.0075529	0.0027251	0.0060	-0.0058843	0.0024731	0.0170
Unemploymentwithsecondaryeduc	-0.0048847	0.0025944	0.0620	-0.0023269	0.0027206	0.3940	-0.0048847	0.0025944	0.0600
Constant	0.0208071	0.1641056	0.8990	0.0229440	0.1593058	0.8860	0.0208071	0.1641056	0.8990

7.1.2. Panel Data Test

7.1.2.1 Lagrange Multiplier Test for Random Effects

In order to identify which model would be more efficient, a test performed by Breusch and Pagan is used and it is known as the Lagrange Multiplier Test for Random Effects (Breusch & Pagan, 1980).

The null hypothesis of this test is that $\sigma_u^2 = 0$. If the test is rejected, yes there is a difference between (1) and (3), and is preferable to use the random effects method.

When testing, this indicates us that we do not reject Ho: $\sigma_u^2 = 0$ therefore it is better to use the estimators of the random effects rather than the Pooled model. The p-value indicates that we can reject Ho; therefore, the random effects u_i are relevant and it is preferable to use the random effects estimation rather than the pooled one.

7.1.3 Hausman Test

If the regressors are correlated with ui, the fixed effects estimator is consistent, but the random effects estimator is not, so if the regressors are uncorrelated with ui the fixed effects estimator is consistent but inefficient, while random effect estimator is consistent and efficient, thus this is the aim of this test.

When testing in our model the null hypothesis H_0 is not rejected, clearly confirming the choice of modeling by random effects, since the individual effects appear to be uncorrelated with the regressors. Since we cannot reject H_0, there is no bias to worry about and we prefer to use random effects that, by not estimating lots of dummies (which should be constructed in order to estimate the individual effects), is a more efficient model.

7.1.4 Interpretation of Panel results

In light of the tests we performed, we interpret the results of the model estimated by random effects.

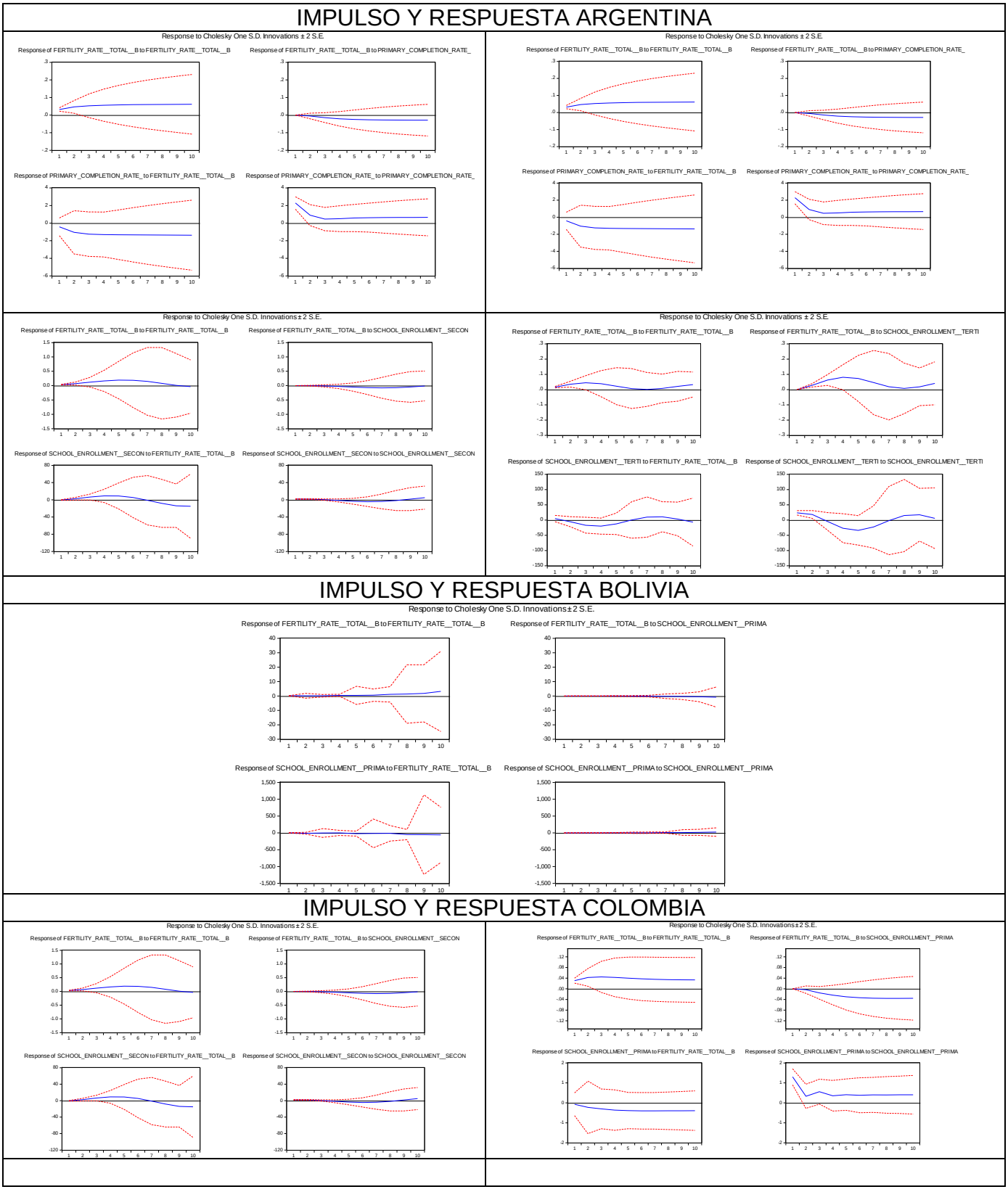
Table 7: Interpretation of Panel Results

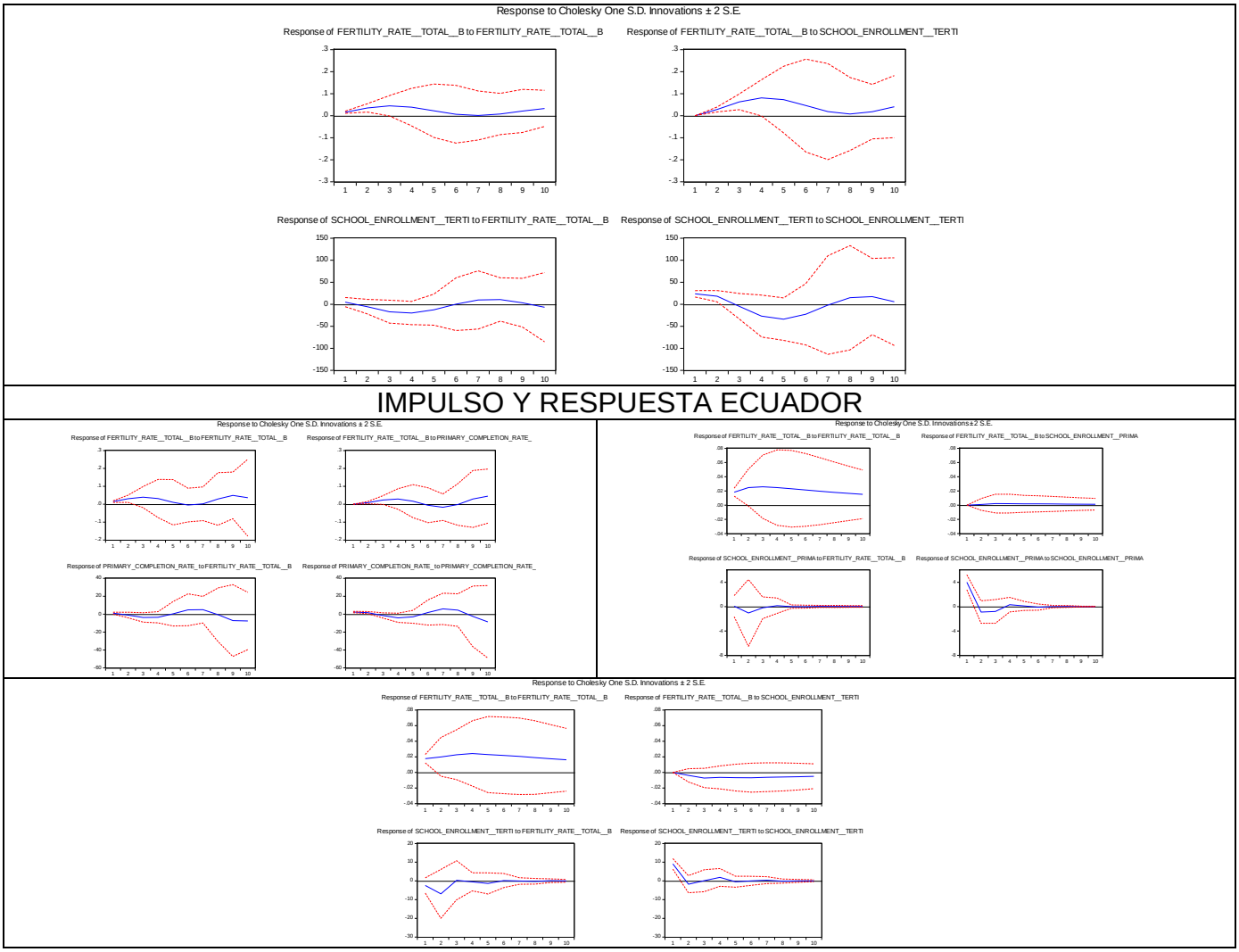
Variable	Analysis and Interpretation of β_k
Employers, female (% of employment)	If there is a change on the rise of the employment rate of women in the labor market is evident that the positive influence towards the fertility rate is relevant to think about that a woman who ensures her own income is determined to have children .
Employment to population ratio, 15+, female (%)	If the employment rate of women over age 15 is increased relative to the total employed population, this will positively influence in the fertility rate negatively.
GDP, PPP (constant 2005 international $)	If the GDP per capita increases, this affects negatively in the fertility rate
GNI per capita (constant 2005 US$)	If the Gini index had a change upwards, this will positively influence fertility.
Health expenditure per capita, PPP (constant 2005	If the per capita health expenditure is increased, the fertility rate would benefit positively from this.

international $)	
Labor force participation rate, female (% of female population ages 15-24)	If the labor force participation of women in young women aged 15 to 24 were increased, the fertility rate would be influenced positively.
Labor force with primary education, female (% of female labor force)	But if the labor force of women with primary education were increased over the total female labor force, the fertility rate would be positively influenced.
Mortality rate, infant (per 1,000 live births)	As long as the infant mortality increases there will be an opposite relation with the fertility rate, we would see an increase in the fertility rate.
Number of infant deaths	If the number of infant deaths were increased, the fertility rate would be positively influenced.
Number of neonatal deaths	If the number of neonatal deaths were increased, the fertility rate would be positively influenced.
Number of under-five deaths	But if the rate of children under five years increases, the fertility rate is negatively affected.
Unemployment with primary education, female (% of female unemployment)	If unemployment in women with primary education increases over the total labor force of employed women, the fertility rate is positively affected.
Wage and salaried workers, female (% of females employed)	If the wage of female workers would be increased in relation to the total labor force in the labor market, the fertility rate would be negatively affected.
Unemployment with secondary education, female (% of female unemployment)	If unemployment of women with secondary education increases over the total female labor force, the fertility rate is negatively affected.

7.2. Interpretation of Impulse Response Results

Graph 15: Impulse Response Results





IMPULSO Y RESPUESTA ECUADOR

In light of the results of impulse response functions, we can identify certain patterns of influence, it is clear that education influences fertility, and depending on the country and whether the rate of education is primary, secondary or some tertiary case. In short, it is found that there is an effect of impulse-response between these variables, that is interpreted as the effects that are produced are of dynamic type where one moves and the other responds, or vice versa.

For countries such as Chile, Peru and Venezuela, the impulse response functions show no patterns that can be interpreted as relevant, which is why we do not include the graphics in the present analysis.

7.3. Poisson Model Results

By performing the Poisson model we have the following result, where the fertility rate is the dependent variable.

Table 8: Poisson Model Results

		Coef.	Std. Err.	P>z
pf14	Children ever born	0.0005985	0.0000669	0.0000
pd13a	Educational level of the mother	-0.0001559	0.0000907	0.0860
pa23a	Salary	-0.000015	0.00001	0.1350
Edad	Age	-0.0002949	0.0000299	0.0000
Sec	secondary education of women	0.0010758	0.0002641	0.0000
Constant		7.608718	0.0008487	0.0000

The independent variables for each of the models are:

pf14: Continuous variable of the number of children ever born.

pd13a: A continuous variable of educational level of the mother.

pa23a: continuous variable which collects salary or income that women have.

Age: Continuous variable which reflects the age of the individual.

Sec: Binary variable which takes the value one for the secondary education of the mother.

Given these results we can and we are able to confirm in the light of the results in the table above.

In general the interpretation of the parameters for the Poisson model should be interpreted as semi-elasticities directly, being its correct interpretation as the proportional change in the conditioned media to a unit change in the corresponding explanatory variable.

Table 9: Interpretation Poisson Model

Variable	Analysis and Interpretation of β_k
Children ever born	If there is a change in the rate of live births to one per cent, the fertility rate is increased by 0.05985 percent.
Level of studies of the mother	If there is a change in the educational level of the mother of one percent, the fertility rate is diminished in -0.01559 percent.
Salary or wage	If there is a change in the salary or wages of the wife of one percent, the fertility rate is diminished in -0.0015 percent.

Age	If there is a change in age in a extra year of life, fertility is diminished in -0.02949 percent.
Sec	If there is a change in age at enrollment rate of women in high school, the fertility rate is increased by 0.10758 percent.

As we can see the selected variables are significant and confirm the economic theory, We also checked that in Ecuador the increment of enrollments at secondary level by women, understood as a progress in human capital, is widely confirmed by our results.

Women with less education tend to decrease fertility, but women with secondary education produce an increase in the fertility rate, this can be interpreted that the theory is satisfied, that women with higher income and more educated, i.e. those with better expectations of stability, increase their demand for children, therefore, the fertility rate is affected in this way and may also be influenced by the good economic times going through the region.

8. Conclusions

The overall results are as expected and in some cases, surprising the strong relationship they present, and that is even more revealing because the countries compared, keep socio-demographic relationships:

In the countries we chose from the highland region of Latin America, it can be concluded that the decrease in infant mortality is a primary objective in the advancement of the social development of the region. In this regard, a significant reduction in rates of this indicator is observed, both related to infants and children under 5 years in the period between 1996-2012.

With regard to education, Also during this period have been made significant progress in expanding primary education and increasing years of schooling, but the results obtained in terms of education and in terms of reducing mortality child, are still insufficient to close inequality gaps.

Based on the recognition of the role that education can play in the advancement of well-being have been found with three econometric models the positive effect that it has on reducing child mortality and affect fertility.

The higher incidence years of schooling have, the impact will be significantly negative for infant mortality rate and all other variables related to the study, such as employment, inclusion of women in the labor market and GDP per capita, showing significantly positive impacts on the studied rates, which is a confirmation of implementing joint and individual policies to achieve the objectives of the millennium.

The results of the panel data model, demonstrate the importance of education in the analysis of the social situation of the countries of the region and also they have made great progress in reducing fertility and infant mortality in the period studied.

As our study is based on the relation of the impact of education on fertility, there have been major advances in the homogenization of primary education rates, and in the increment in years of schooling but these achievements are still scarce if one considers the big socioeconomic inequalities in the Andean countries.

We have found that:

• The link established between education and the advancement of welfare, which can be seen in the impulse response analysis.

• The variable of spending on education is the most influential, which impact was significantly negative on fertility, fulfilling our purpose of showing it.

• The results of the VAR model with the analysis of the impulse response functions demonstrate the importance of using several tools when it comes to identifying the possibilities of effect by implementing macroeconomic policies to directly influence individual well-being and that the return on this investment is transformed into macroeconomic growth.

• Women with higher incomes and more years of education, translated as having better expectations of stability, increase their demand for children.

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ANNEX 1

Countries originally linked to the history of the Inca Empire

Countries that complete the territorial organization of the Andean Confederation of Nations nowadays

ANNEX II

Paper	Autor	dependent variables	independent variables	Database	model
The effect of education on fertility: Evidence from a compulsory schooling reform.	Kamila Cygan-Rehm, Miriam Maeder	Different measures for woman i's fertility outcomes	years of education, state fixed effects, cohort fixed effects (cohort), state-specific cohort trends, reform	German Mikrozensus (MZ) German Socio-Economic Panel (SOEP).	OLS
The Fertility Effect of Education: Regression Discontinuity for Counts and Exponential Models.	Kamhon Kan Myoung-jae Lee	Years of schooling & Number of children	Age, Age Square, Reform		IVE IVE for Structural Exponential Model
The Impact of Female Education on Fertility: Evidence from Turkey	Pınar Mine Güneş	Years of Education, Fertility Before Age	Women Aged 7-11, to 12-15; Women ages 12 to 15 in 1997 dummy ; Province of birth dummies; Year of birth*Number of children; Year of birth*Enrollment	Turkish Demographic and Health Surveys (TDHS-2008)	Panel. D Differences-in-differences
FERTILITY AND SCHOOLING: HOW THIS RELATIONSHIP CHANGED BETWEEN 1995 AND 2005 IN COLOMBIA	Nohora Forero; Luis Fernando Gamboa	Total Children Ever Born	Age, Area of Residence, Region of Residence, Education, Active Index, Socioeconomic Strata, Partner's Age, Age of first Marriage, Marital duration.	Demographic and Health Survey from 1995 and 2005	Poisson Regression Models
The Impact of Women's Education on Fertility In Latin America: Searching for Explanations	Teresa Castro Martín and Fátima Juárez	Women's education, Husband's education, Listens to radio daily Knows source of contraception uerstands ovulatory cycle, Urban residence Has refrigerator, Used contraceptive at parity 0 or 1, Currently cohabiting Had premarital birth Had first birth < 18 yrs. Worked before marriage Worked after marriage		Frst round of the Demographic and Health Surveys (DHS), -1980 9 countries.	multivariate analysis
Women's fertility intentions and level of education: why are they positively correlated in Europe?	Maria Rita Testa	lifetime fertility intentions	age, sex, enrolment in education, level of education, marital status, employment status, and self-location on the social scale.	Eurobarometer data (2011)	The multilevel analysis.
EDUCATION AND ECONOMIC DEVELOPMENT: THE ROLE OF INTERNATION COOPERATION IN THE DEVELOPMENT OF THE THIRD WORLD	NEIRA, Isabel	Log Fertility	GDP pc, fertility rate, public spending on eduation, spending per student in primary level, spending per student in secundary level, spending on terciary education, net ratio of escolarization, repeaters, active population, higher educational level, secondary, illiteracy rate, adultsescolarizacion, Repetidores, Poblacion activa nivel educativo sup, secundaria, tasa de analfab, adultos hombres y mujeres	Barro y LEE y de la UNESCO y el PIB de Summer y Heston.	Panel, fixed effects, correction of heteroskedasticity
Co-Integration Between Fertility and Human Development Indicators: Evidence from Pakistan	Muhammad Abdullah, Muhammad Irfan Chani, Amjad Ali and Ayza Shoukat	total fertility rate	GDP per capita, life expectancy at birth and secondary school enrollment	World Development Indicators (WDI) online database by World Bank	Time series data from 1971 to 2010 co-integrational relationship of the variables and VECM
The impact of education on fertility and child mortality: Do fathers really matter less than mothers?	Lucia Breierova and Esther Duflo	Interaction between an individual's cohort and the number of schools built in his region of birth to evaluate the impact of the program		1995 intercensal survey of Indonesia	IVE of the effect of average parental education and the difference between father's and mother's education on fertility and child mortality
Fertility changes in Latin America in the Context of Economic Uncertainty	Alicia Adsera and Alicia Menendez	total fertility rate	GDP per capita, unemployment rate, consumer prices, rate of literacy	panel of 18 nations for over 45 years and a demographic and health survey data from 10 countries	panel and Cox Proportional hazards model