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Three Empirical Essays on Fecundity, Household Overcrowding and its Effects. The Case of Ecuador

Juan Pablo Díaz Sánchez

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PhD in Economics | Juan Pablo Díaz Sánchez

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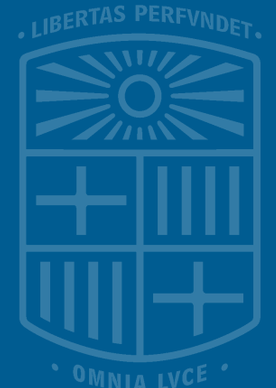

PhD in Economics

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Three Empirical Essays on Fecundity, Household Overcrowding and its Effects. The Case of Ecuador

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To all the people who have trusted me, specially my family.

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Introduction

1.1 Motivation

An excessive number of people living under the same roof is a social problem. Indeed, household overcrowding can be seen as a socioeconomic indicator because people who cannot afford the price of private space are more likely to live in crowded conditions (Solari and Mare, 2012).

Moreover, studying the more immediate individuals' environment, the dwelling unit or household, may be interesting considering that it affects the lives of individuals in important ways. Clearly, families affect their members more strongly than neighbors, for instance, because they are physically and socially closer and more homogeneous (Solari and Mare, 2012). As a matter of fact, as Solari and Mare (2012) indicate, individuals are socialized within the home to learn roles and relate to others. Individuals eat, sleep, work, and seek privacy in the home (Foley, 1980). As a result, the physical characteristics of dwelling units generally, and their degree of overcrowding in particular, may be an important mechanism for explaining, for example, differences in child wellbeing across socioeconomic statuses (Solari and Mare, 2012).

Further, studying household overcrowding is significantly important considering its present and future influence on household members. For example, literature suggest that the lack of a comfortable home affects children school performance. In addition, children in crowded housing have a higher probability of getting ill, which can interfere with their daily routine and interrupt their schooling (Saegert and Evans, 2003; Edwards *et al*., 1994). Also, children growing up in crowded homes are more likely than other children to find themselves in a similar situation as their parents, contributing to the intergenerational transmission of social inequality (Leventhal and Newman, 2010; Duncan and Brooks-Gunn, 1997).

Moreover, the lack of privacy can result in stress, difficult social interactions, and behavioral problems for all household members (Evans *et al.,* 1998). For instance, parents in overcrowded homes tend to show less responsive parenting (Caldwell and Bradley, 1984).

Likewise, recent literature has paid special attention to the high levels of concentration of people in cities (Banerjee *et. al.* 2012, 2010, 2002; Banerjee and Dufflo, 2007) forming slums, particularly in developing countries. Basically, slums are characterized by deprivation of basic services (Banerjee *et. al.,* 2012) and household overcrowding.

Considering this context, we propose along this dissertation a study of overcrowding at a household level (chapters 3 and 4), not only because it is the nearest individuals' environment, but also because it is the most adequate approximation to the phenomenon, especially when we want to verify its effects on individuals. In chapter 2, we approach fecundity at individual level; however, we also consider household socioeconomic characteristics.

In the last decades, there has been a worldwide decreasing tendency of household overcrowding; nevertheless, it still is a problem that affects both developed and developing countries. For example, 17% of European households were overcrowded in 2015 according to Eurostat. Specifically, Spain is the fifth European country with the lowest overcrowding rate, 5%, which is one tenth of the Romanian rate (52%). In the case of Latin America, countries like Argentina (INDEC, 2010) and Costa Rica (INEC, 2011) present overcrowding rates of 3.95% and 5.2%, respectively, which can be considered low compared to the Ecuadorian overcrowding rate of 17.5% (INEC, 2010).

Under this perspective, Ecuador is an interesting case of study not only because its high overcrowding rate, but also by the lack of characterization of a Latin American type country in literature that relates living conditions and socio-economic features. In that line, our empirical evidence shows that the socio-economic variables affect the household size in the Ecuadorian case. Moreover, international migration –as direct channel- influences household overcrowding. In addition, household overcrowding has significant effects on children's outcomes.

The main objective of this dissertation is to contribute to the literature with a complete and updated understanding of the household overcrowding phenomenon, covering the topic all the way starting in its causes (chapters 2 and 3) to its consequences (chapter 4).

Addressing these research questions is relevant because household overcrowding has economic connotations from the formation of the household to inter-generations that have not exploited yet in literature.

1.1.1 Ecuador

Ecuador is a Latin American country located in the north-west side of South America with coast to the Pacific Ocean as west border. In addition, Ecuador limits with Colombia at the north and with Peru at the south and east. It is a small-sized country (283.561 km²) and its population – in 2017- is about 16 million inhabitants. Further, it is geographically divided in four natural regions: Coast, Highlands, Amazon, and the Galápagos Islands. Politically and administrative speaking, Ecuador is divided in twenty four administrative districts named provinces. Twenty three of them are in the mainland and the other province is formed by the Galápagos Islands. In the same way, each province is divided in cantons.

Ecuador uses the United States dollar as currency since 2000 when the most important economic crises of the last century for this country took place. As a matter of fact, some estimations indicate that between 800,000 and 1'500.000 Ecuadorians migrated abroad between 1998 and 2006 as a consequence of such crisis.

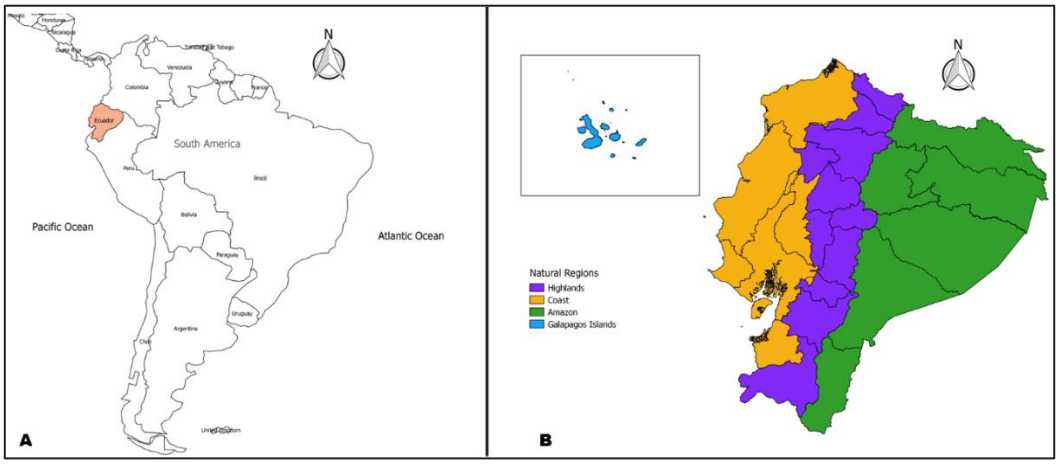

Figure 1.1 A. Location of Ecuador in South America. **B**. Ecuadorian natural regions. Source: Ecuadorian 2010 Census.

Ecuador is a country that presents an increasing tendency in terms of GDP per capita in the last decades (see figure 1.1). Currently, Ecuador is considered a medium-high level of income country according to the World Bank (2017).

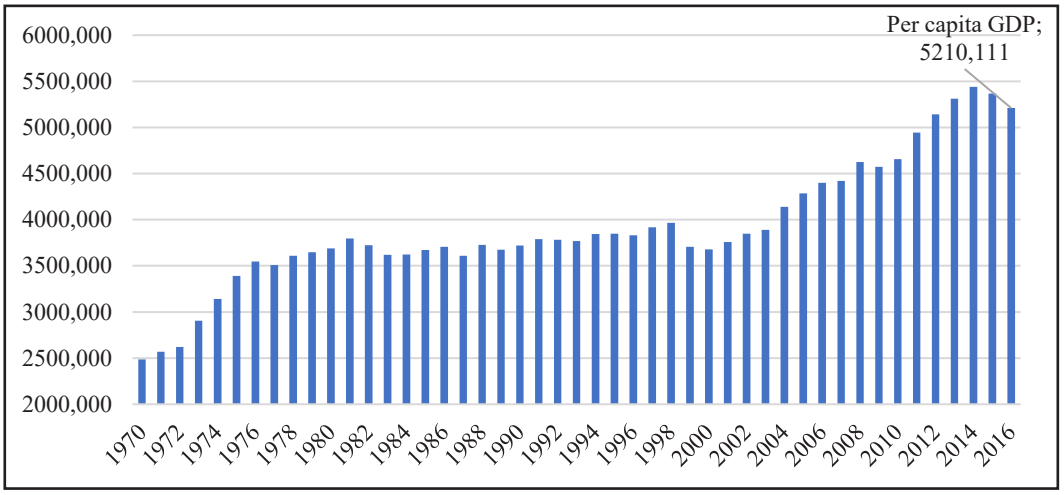

Figure 1.2 Ecuadorian GDP per capita in constant USD of 2010. Source: The World Bank (2017).

The increasing tendency of income has been accompanied with a decreasing tendency in fecundity rates. The fecundity rate has decreased from 6.7 children per woman in 1960 to 2.5 children in 2014. Clearly, the increase in the income level and the decrease of the fecundity rates imply a reduction of the housing overcrowding levels over time. However, this rate is still high (17% of Ecuadorian households are overcrowded in 2010) compared to other Latin American countries.

Moreover, Ecuador has experienced a concentration of population in cities (see Table 1.1) which is, indeed, the tendency in the majority of countries. This concentration has taken place particularly in big cities –mostly Quito, Guayaquil, Santo Domingo, Machala, etc.- where workers have more probabilities of finding a job or improving the quality of it compared to the probability of finding a job in the rural environment.

Table 1.1 Evolution of Ecuadorian population per area of residence

	1990	2001	2010
Rural	4'302.331	4'725.253	5'392.713
	44,59%	38,87%	37,23%
Urban	5'345.858	7'431.355	9'090.786
	55,41%	61,13%	62,77%
Total	9'648.189	12'156.608	14'483.499

Note: Vertical percentages. Source: INEC.

This concentration of people in big cities generates rings of poverty which are known as slums. Slums are characterized by inadequate public services and household overcrowding. Nevertheless, it is important to mention that even if household overcrowding is more intensive in big Ecuadorian cities, it also appears in medium-small cities or even in rural areas (see figure 1.3). In that sense, 17.5% of the Ecuadorian households can be considered overcrowded in 2010 out of which 43.4% of the overcrowded households are located in rural areas and the other 56.6% of them are settled in urban areas.

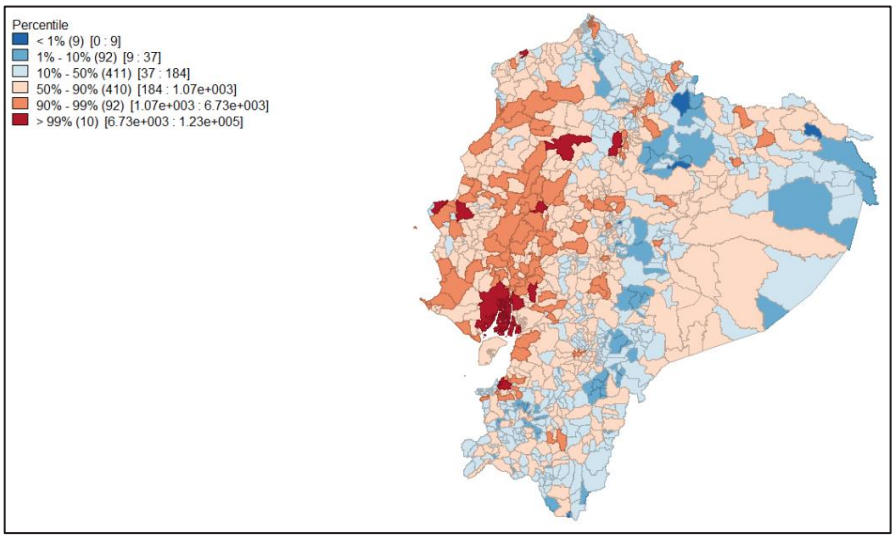

Figure 1.3 Percentile distribution of overcrowded households in Ecuador by canton. Source: Ecuadorian 2010 Census.

1.2 Household overcrowding: a brief state of the art

The concern about the consequences of population overcrowding started with Malthus in the late 1700s; nevertheless, it had its boom during the 70s and 80s of the past century. Obviously, the idea was to study not only its

causes but also its effects. Most of these early researches presented mixed results which may lie in the types of environments examined by researchers (Solari and Mare, 2012). Much of this research focuses on venues with high population densities, like college dormitories (Valins and Baum, 1973), ships, and prisons (Gove and Hughes, 1983; Beeghley and Donnelly, 1989). However, these unusual environments are highly selective and make it difficult to generalize to the crowding experiences of wider populations.

Indeed, as Baldassare (1978) proved, a large number of factors led to believe to a substantial part of the scientific community and most of the general population that a high level of density, in terms of people, has serious harmful effects on humans. Most of these studies focused on the effects of high levels of people density on human behavior. From these studies, it was clear that it was necessary to distinguish between density at the level of macro-environment (people per hectare, for example) and crowding in the micro-environment, such as crowding in home (Carnahan *et al.*, 1974; Galle and Gove, 1978).

Recently, it seems like the interest in the high levels of density of people has come back. For example, Marx and Stoker (2013), referring to slums, which are informal settlements in and around cities in the developing countries, estimates that 450 million new housing units would be needed in the next 20 years just for accommodating households in urgent need of housing due to the increase of migrants to the existing slum populations. Clearly, there is a strong correlation between poverty and high density of people in the house. Indeed, one of the most used methodologies for measuring poverty, especially in Latin America, the Unsatisfied Basic Needs (UBNS) method, uses as an indicator for determining a poverty situation the fact that there are more than three people per room in the house.

In general terms, there are several factors that contribute to the household crowding. First, there is the demographic factor which is basically represented by the vegetative population growth rate and migrations. Second, the physical factors of the dwelling and its environment. Finally, the social factor also plays an important role. As physical factors of the house we can point out the design of the dwelling, the habitability of the construction, the sanitary situation, the conditions of the settlement place and the physical channels of social integration like roads, nearly schools and so on. The social factor refers to the housing density and tenancy regime. The housing density

is the relationship between the number of people and the available space. As a matter of fact, the housing density becomes crowding when this relationship between people and available space exceeds a tolerable limit. On the other hand, the tenancy regime is related to the condition of ownership for the people living in a certain house like owner, renter, usurper or borrower (Puga, 1983).

It is important to mention that there are several approaches to measure crowding. For example, people per bed, people per bedroom, families per dwelling, and dwellings per piece of land (Iglesias de Usel, 1993). Another indicator for measuring the intensive usage of the space is the quantity of square meters per person. We say this because we want to point out that there is not a unique form to define crowding. Indeed, the threshold from which it can be considered an intensive usage of the space varies according to the level of development of societies, cultural and historical realities.

The literature on the consequences of crowding on individuals basically focuses on physical and psychological repercussions. About the physical effects, crowding could be a determinant factor for illness propagation not only in developing countries, but also in the developed ones. For instance, Baker *et al*. (2008) proved that tuberculosis incidence in New Zealand is associated with household crowding. Moreover, an alarming fact about the crowding is that it especially affects children in their growing-up and development processes. Furthermore, according to Iglesias de Usel (1993) and Puga (1983) there are causal relationships between crowding and low-test score performing and high juvenile crime rate.

Regarding the psychological effects, researchers have determined two main alterations in crowding situations: lack of privacy and easiness of circulation (Lentini, 1997). Regarding the privacy, it is clear that it is a required good for a person, for couples (father-mother), for gender separation, for the family as an independent social unity and for certain family activities such as sleeping, studying, etc. About the easiness of circulation, it allows the normal fulfillment of the family functions by avoiding the interferences to the freedom of circulation or the unexpected intrusions. The lack of both, privacy and easiness of circulation, creates an environment in which the members of the household may be exposed to higher levels of psychological stress than those who are not living under this condition.

Until now, we have said that there are at least two main dimensions that help us to understand crowding in households: number of individuals in the household and the dwelling itself. Regarding the number of individuals compounding a household, there are a great number of published papers that contributes to understand the size of the household. For example, Bongaarts (2001) published a study that uses data from household surveys in 43 developing countries to describe the main dimensions of household size and their composition in the developing world. He found that the average household size varies only modestly among regions, ranging from 5.6 in the Near East/North Africa to 4.8 in Latin America. These averages are similar to levels observed in the second half of the nineteenth century in Europe and North America. Moreover, he observed that about four out of five members of the household are part of the nuclear family of the head of the household. In addition, Bongaarts suggests that household size is found to be positively associated with the level of fertility and the mean age at marriage, and inversely associated with the level of marital disruption. An analysis of trends and differentials in household size suggests that convergence to smaller and predominantly nuclear households is proceeding slowly in contemporary developing countries.

Regarding the associated effects of the size of the household, Lanjouw and Ravallion (1995) point out that there is considerable evidence of a strong negative correlation between household size and consumption (or income) per person in developing countries. It is often concluded that people living in larger and (generally) younger households are typically poorer. There has been much debate on which is the 'cause' and which is the 'effect' in this correlation. The position one takes in this debate can have implications for policy, including the role of population policy in development, and the scope for fighting poverty using demographically contingent transfers. In addition, they suggest that the existence of size economies in household consumption cautions against concluding that larger families tend to be poorer. The poor tend to devote a high share of their budget to rival goods such as food. But certain goods (water taps, cooking utensils, firewood, clothing, and housing) do allow possibilities for sharing or bulk purchase such that the cost per person of a given standard of living is lower when individuals live together than apart.

Recent literature has presented deeply concerns in applied research on fecundity and living condition standards, including household overcrowding, of advanced economies and emerging ones. Nevertheless, small developing countries are not in the spot even if they represent most of global population. Thus, this dissertation assesses to cover this gap in literature by characterizing Ecuador.

1.3 Structure of the thesis

This dissertation is organized in three chapters beyond this introduction and final conclusions. All of them use Ecuadorian cross section data. In the case of chapter 2 and chapter 4, data come from Ecuadorian Living Condition Surveys of 2006 and 2014; meanwhile, the Census of Population and Dwellings of 2010 is used for the empirical analysis in chapter 3.

In the chapter 2, we start by analyzing fecundity of women considering socio-economic characteristics. Indeed, high levels of fecundity may be considered the beginning of the household overcrowding problem. Clearly, fecundity and the size of the household are almost the same thing, if we consider fecundity at a household level. In the analytical part of the second chapter, we have analyzed the vast economic literature devoted to the study of fecundity, from which several testable hypotheses that relate it to household income, education level of the mother and her labor market participation have been derived. The chapter provides empirical evidence from 46,716 Ecuadorian women between 12 and 49 years old using survey data from 2006 and 2014. In particular, it was found, through count data models, that mother's education level and the household income have a negative effect on fecundity.

In chapter 3, we start with the study of overcrowding. Considering that Ecuador is a country with emigration tradition and its relatively high rate of overcrowded households (17% in 2010), we approach these two issues jointly. Taking into account that overcrowding is trespassing a threshold of a measure that is a coefficient of people per area, and considering that Ecuador experienced a massive migratory wave, then a reduction of the numerator of this coefficient would imply a reduction of the overcrowding levels. Consequently, we test the hypothesis that migration reduces household

overcrowding levels. If this research hypothesis is accepted, then the alternative hypothesis that emigration favors housing overcrowding due to its contribution to conform extended families in the left-behind household may be rejected. As a matter of fact, our empirical findings allow us to confirm our research hypothesis discarding the alternative one. We believe that remittances, as indirect effect of migration, play an important role in this housing improvement, which is in line with previous literature that indicates that remittances are a potent instrument of development in developing countries (Stark, 1991; Ratha, 2013). Additionally, this chapter also allows us to understand the relationship between the migrant's preferences to use their remitted fraction of his earnings to improve the living/dwelling conditions of his family.

In chapter 4, we deal with the consequences of household overcrowding. Basically, we verify the effect of overcrowding on the prevalence of respiratory diseases among the 0-to-5-year-old children of Ecuadorian households. Considering that overcrowding has been associated with respiratory problems in children (Baker *et al.,* 1998; Mann, *et al.,* 1992), we test if there is a relationship between housing overcrowding and its incidence on respiratory disease prevalence in Ecuadorian 0-to-5-year-old children. Indeed, our findings indicate a statistically significant positive relationship. Moreover, the urban housing settlement on the children respiratory disease probability is specially differentiated in the chapter. There is no doubt that the selected outcome variable in this chapter provides clues of other problems that can be consequence of household overcrowding.

To conclude this introduction, we provide some clarifying definitions of our key variables that are used in the next chapters in the Appendix 1.1.

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Appendix Chapter 1

Appendix 1.1. Definitions

Fecundity

According to Kirch (2008), fecundity is defined as the physiological capacity to conceive. This reproductive capacity is also known as fertility. In demography, which studies human fecundity, fecundity and fertility are terms that are used indistinctly.

The fecundity rate, which is calculated as the coefficient between the born alive children in a period of time and the quantity of female population in the same period, and its dynamics create special interest in demographers and economists, for example in terms of social security sustainability.

Household Overcrowding

Household overcrowding can be defined as the excess of people living in the same dwelling; however, this definition is not too clear because the 'excess of people' part of the definition implies a qualitative nonobjective assumption. Indeed, what is excessive in one country or culture could not be so in another. That is the reason why there are several criteria to consider whether a household is overcrowded or not. Most of these criteria are measures of people per area (people per square feet, people per room, people per bedroom, etc.). Once a socially accepted threshold of people per area is trespassed, then the household is considered overcrowded. These criteria and thresholds are constructed according to the needs and characteristics of the countries that are studied. Furthermore, crowding standards change over time as economic conditions and social expectations change. Even now, social conventions from one country to another make that housing overcrowding is defined and measured differently. For example, the perception of overcrowding in developed countries varies from one to another as is shown in Table Appendix 1.1.

Table Appendix 1.1 Household overcrowding indexes and their characteristics

Index	Based on	Uses couple status	Ages when pairs of boys and girls can share	Ages when pairs of same sex children can share	Ages when own room is required
American Crowding Index	Rooms	no	n/a	n/a	n/a
British Bedroom Standard	Bedrooms	yes	under 10	0-20	21+
Canadian National Occupancy Standard	Bedrooms	yes	under 5	0-17	18+
Equivalized Crowding Index	Bedrooms	yes	under 10	under 10	10+

Note: a household is considered crowded if, under the ACI, there is more than one person per room; and, under the bedroom indexes, if there are insufficient bedrooms to accommodate the usual residents within the household. It is assumed that there should be no more than two people per bedroom.

In any case, since we are going to consider a Latin American country -Ecuador- as unit of analysis, we use the Economic Commission for Latin America and the Caribbean -ECLAC- definition to characterize housing overcrowding. According to this definition a household can be considered overcrowded if there are more than three people per bedroom in such household (Feres and Mancero, 2001).

Migration

Lee (1966), defines migration as "a permanent or semipermanent change of residence. No restriction is placed upon the distance of the move or upon the voluntary or involuntary nature of the act, and no distinction is made between external and internal migration (…). However, not all kinds of spatial mobility are included in this definition. Excluded, for example, are the continual movements of nomads and migratory workers, for whom there is no long-term residence, and temporary moves like those to the mountains for the summer. No matter how short or how long, how easy or how difficult, every act of migration involves an origin, a destination, and an intervening set of obstacles. Among the set of intervening obstacles, we include the distance of the move as one that is always present."

Respiratory diseases

According to the World Health Organization (WHO), respiratory diseases are those that affect the respiratory tract, including the nasal passages, bronchi, and lungs. They range from severe infections such as pneumonia and bronchitis to chronic diseases such as asthma and chronic obstructive pulmonary disease. In addition, according to this organization, some of the most common chronic respiratory diseases are asthma, chronic obstructive pulmonary disease (COPD), respiratory allergies, occupational lung diseases, and pulmonary hypertension. Furthermore, one of the main risk factors, besides tobacco smoking and allergens, is indoor air pollution which is clearly associated with household overcrowding (WHO, n.d, p. 1).

Chapter 2

The Effects of Household Income, Female Education and Woman's Labor Market Participation on Ecuadorian Fecundity[1]

2.1 Introduction

The impact of fecundity on the economy has been studied from earlier authors, like Tomas Malthus, until nowadays. However, there were authors like Leibenstein (1957), Becker (1960), Easterlin (1975), Willis (1973), and Shultz (1997) who have made relevant contributions to the study of the fecundity variation in the economic theory.

Additionally, fecundity is positively associated with the household size (number of members) and its consequent density (people per given area) level in such household (Bongaart, 2001). Furthermore, when the social acceptable level of people per area in the household is surpassed, that household can be considered overcrowded. Household overcrowding can be considered a dimension of poverty since it is assumed that people who cannot afford the price of private space are more likely to live in crowded conditions (Solari and Mare, 2012). Bearing this in mind, the study of fecundity at household level may be a first step to track more complicated socioeconomic phenomena like overcrowding.

The analysis of fecundity and its delay have become a key issue in the last decades. According to Pestieau and Ponthiere (2015), the changes in the population tendency are the consequence of the postponement of the maternity and paternity due to the generalized increase of the economic costs of rising children and the decrease of family altruism. The degree of family altruism from parents to their descendants depends on the fact that their own wellbeing depends on the next generation (Barro and Becker, 1989).

In the same way, developed countries have had different levels of fecundity from high to low ones as time has passed. Indeed, this seems to be related to the economic growth of the country (Strulik and Vollmer, 2015).

[1] This is a research paper jointly elaborated with Cintya Lanchimba. The Spanish-language version of this article has been published in Revista de Análisis Económico, 2017. 32 (1). 47-67.

As a matter of fact, authors like Miyazawa (2006) indicate that economic growth can be positively related to inequality; however, this relation could become negative later due to the population ageing. On the other hand, Lai (2012) showed that there is a direct link between having children and the financial costs of rising them. Additionally, some literature indicates that the fall of fecundity could be caused by the reduction of the economic benefit provided by having children, although the case of Taiwan is the exception since the relation between economic growth and having children has been positive during the demographic transition. In this context, Lanchimba and Medina (2011) have shown empirical evidence that Ecuador may face a demographical dividend, which is a high proportion of working age people with respect to total population, from 2013 to 2022. Consequently, studying the economic determinants of fecundity in Ecuador becomes interesting.

In that sense, authors like Gutiérrez and Domenech (2008) found that this phenomenon could not only be associated to the low fecundity rates, but also to other reasons. For instance, the flexibilization of the labor market may have contributed to the stabilization of the fecundity rates in Netherlands and Sweden; on the contrary, Spain presents a high decrease in fecundity rates.

Ecuador has experienced important demographic and social changes in the last decades. These changes have widened the top of the population pyramid. According to the World Bank, the fecundity rate has decreased from 6.7 children in 1960 to 2.5 children in 2014; meanwhile, the life expectancy changed from 53 to 73 years old in the same period. Then, the aging of the Ecuadorian population generates concerns. Moreover, the World Bank also indicates that the Ecuadorian GDP in constant prices varied from 10.2 billion USD in 1960 to 82.6 billion in 2015. In such a sense, welfare programs and social assistance have been implemented along with the economic growth, although, these programs did not cover all people who needed social assistance. According to the Ecuadorian Ministry of Economic and Social Inclusion (MIES), 30% of the elderly live with their sons. Their sons may represent a source of subsistence and care for the elderly. Hence, the decision of the elderly of having children at that time could be given by the security that sons represent when they grow up, as Barro and Becker pointed (1989).

Furthermore, the role of the woman in Ecuadorian society has changed. Indeed, the level of female education and their labor market share have increased exponentially. According to the Ecuadorian Institute of Statistics

and Census (INEC), women of 24 years old or more had 6.5 years of formal education in average in 2001. In 2012, women of 24 years old or more had 9.5 years of formal education in average. Moreover, the percentage of women in active economic population evolved from 32% to 40.4% from 1990 to 2014 according to the World Bank. However, Ecuadorian female labor share rate increases slower than other countries with similar per capita income.

Additionally, most women enter the job market after obtaining their high school or university degrees. However, more than the half of these women leaves their jobs later, to raise their children. Between 1990 and 2007, Ecuador experienced a fast decrease in the fecundity rate from 10.64% to 6.85%. On the other hand, the life expectancy increased between 1960 and 2014. In this period, it changed from 55 to 79 years in average for women and 52 to 73 years in average for men.

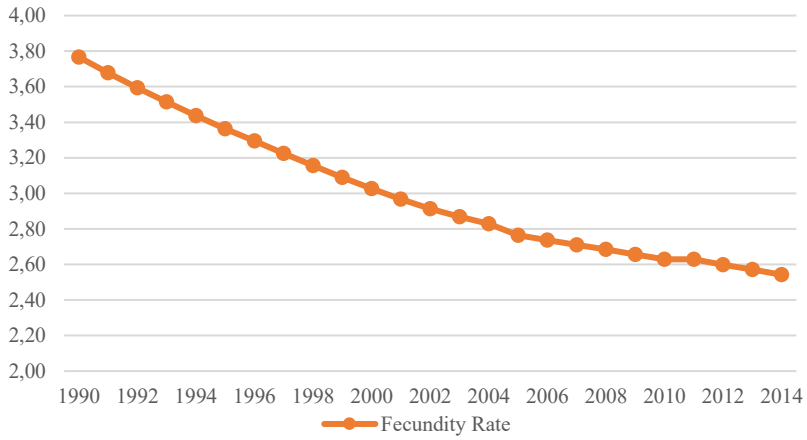


Figure 2.1 Ecuadorian Fecundity Rate. Elaboration: The authors. Source: The World Bank.

Consequently, the decrease of Ecuadorian fecundity rate (see Figure 2.1) may be explained by the fact that women have increased both their education and their participation in the labor market. In this context, this chapter tries to analyze the factors that have influence on the Ecuadorian fecundity rate. Previous studies like Llerena (2012) and Lanchimba and Medina (2011) have analyzed the Ecuadorian fecundity by studying it as an aggregate of the country but leaving aside personal decisions. In contrast, this chapter studies the factors affecting fecundity at a household level. To do so, we use data

from the Ecuadorian Living Conditions Surveys for 2006 and 2014. Basically, we study how the income of the household, the female level of education and her labor market participation affect the fecundity in 2006 and 2014.

The rest of the article is organized as follows. The theoretical framework is presented in Section 2.2. Section 2.3 designates the data. Section 2.4 defines the methodology related to our empirical analysis of fecundity and the results. Lastly, the conclusions are shown in section 2.5.

2.2 Literature review

2.2.1 Female education

Economic growth in developed countries and some developing ones has been frequently associated with the improvement of living conditions of people. In these countries, the level of education of women seems to have an influence in their reproductive behavior. Then, education marks an inflexion point in the decision of having children and in the population fecundity rate then. Specifically, female education has increased women's access to better labor opportunities; then the opportunity cost of rising children is higher for educated mothers. This opportunity cost would be even higher than the one men face because their utility function is different (Dasgupta, 1995).

Furthermore, educated women tend to be better informed about family planning which leads to have smaller families (Dasgupta, 1995). In this sense, Klasen and Launove (2006) found evidence that the increase in the use of contraceptive methods has a significant influence in the decrease of fecundity rate. Consequently, education is associated with the decrease of fecundity rate (Schulz, 1997). Indeed, the influence of higher education would be determinant in the decrease of fecundity (Klasen and Launovi, 2006).

Then, educated women would be more aware of the opportunity cost that having children implies. Then, the more female education level, the less fecundity rate. Figure 2 shows the evolution of the Ecuadorian women´s level of education and the fecundity rate

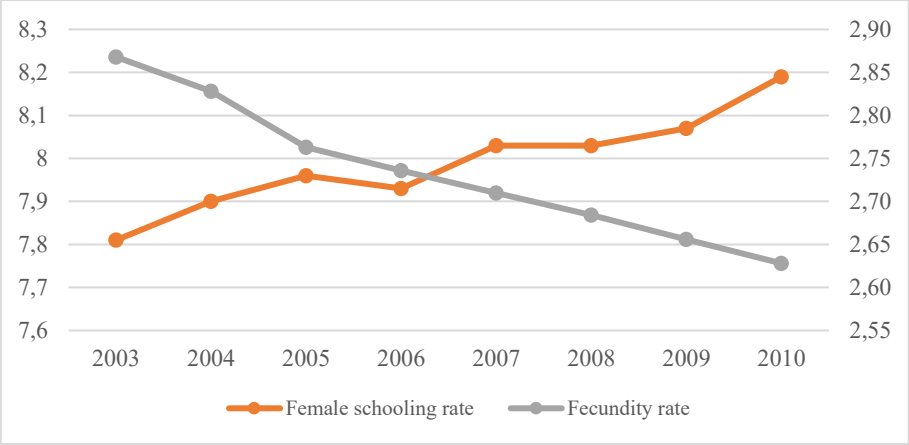


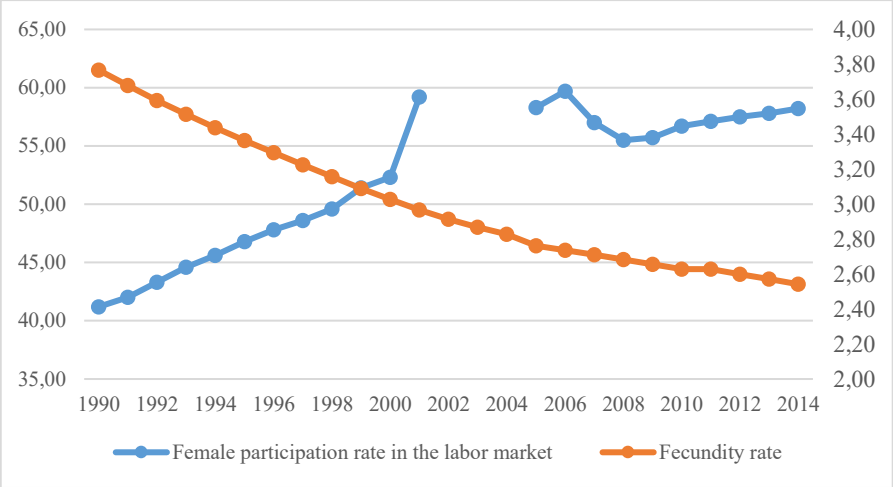
Figure 2.2 Ecuadorian female schooling rate vs. fecundity rate. Elaboration: The authors. Source: The World Bank.

Consequently, we state the following research hypothesis

H2.1: The female level of education has a negative effect on fecundity rate.

2.2.2 Labor market participation

Vlasbom and Schippers (2004) proved empirically that not only education may influence the low levels of fecundity, but also behavioral changes, and social/institutional influence. As a matter of fact, the increase of the female participation –with or without children- in the labor market has been significant in Europe and Ecuador as well (see Figure 2.3).



Note: There is no available data about female participation rate in the labor market for 2002, 2003, and 2004.

Figure 2.3 Female participation rate in the labor market vs. fecundity rate. Elaboration: The authors. Source: The World Bank.

The payment for women's work seems to empower them more than education on the decision about how many children they are going to have (Dasgupta, 1995). Shang and Weinberg (2013) show evidence that fecundity rate increased in the American university-graduated women in the second half of the 90's, especially in those with higher ages. Furthermore, this rate has also increased in women with a lower educational level, but they were younger.

In such a sense, Vere (2007) found that 27-year-old women with higher education augmented their fecundity rate between 1982 and 2002. However, Percheski (2008) indicates that this age could be too early for having children in educated women due to the fact that having more children may lead to a reduction of their labor hours. Consequently, this reduction would affect their labor expectations. Additionally, this author shows evidence that there is no increase in the fecundity between 1960 and 2005. Thus, labor would be a barrier against the formation of families since women delay having children. In other words, the limited combination capacity between labor and maternity may reduce the fecundity rates (Klasen and Launovi, 2006, Gutiérrez and Domenech, 2008, Del Bono, 2001).

In this context, one could say that women's participation in the labor market may influence reproductive decisions. However, this could be rapidly refuted when long run factors, as labor stability, are taken into account. As a matter of fact, unemployment may affect the marriage rates. Marriage, as an institution, is quite important in terms of fecundity since it reduces

information asymmetries that a married couple faces at the time they decide to procreate. The information asymmetry reduction is given by the easiness for the female couple-member to recognize her own offspring; meanwhile, the asymmetry information reduction for the male member is given by his knowledge of his reproductive capacity (Bethmann and Kvasnicka, 2011). Consequently, a decrease in the marriage rate would affect the fecundity rate in the long run (Gutiérrez- Domènech, 2008). Moreover, Ahn and Mira (2001) show empirical evidence that there is a relationship between economic crises and fecundity rate. When an economic crisis takes place, the fecundity rate levels decrease. Although these authors do not analyze female but male labor market participation, they conclude that there is a close link between unemployment and fecundity. Then, the opportunity cost of having a child when there is an economic crisis would be too high considering not only the difficulty of finding a job, but also the difficulty of combining maternity and work and the lack of child-care facilities in some countries (Klasen & Launovi, 2006). This contradicts the standard microeconomic theory which states that the demand of having children increases in high unemployment periods since the opportunity cost of having children would be smaller compared to a person who is employed. Contrary to this, Bono *et al*. (2015) show empirical evidence that unemployment has no significant effect on reproductive decisions; nevertheless, having a child may limit women´s job opportunities. Then, fecundity would influence in the job type of the parents.

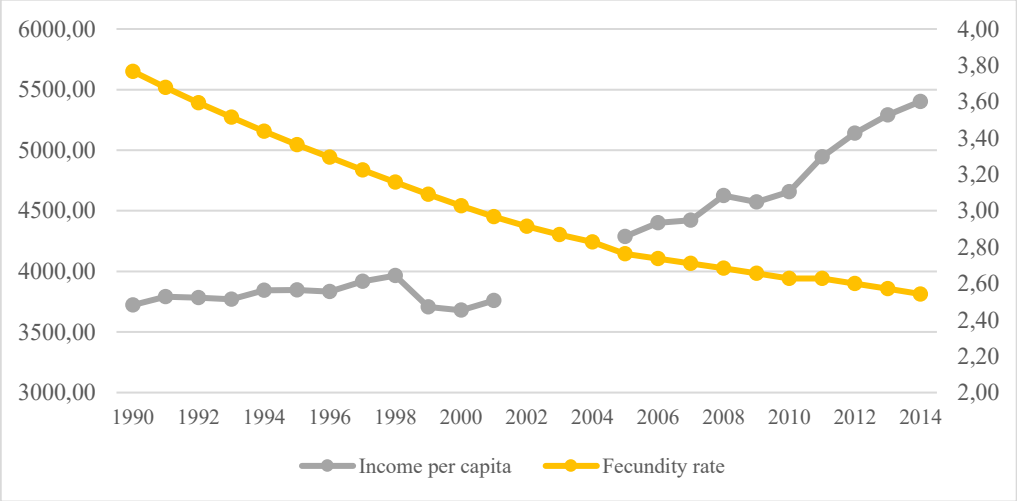
Considering these considerations, the relationship between female labor participation and fecundity would be bidirectional as literature indicates (Salamaki *et al*. 2013). In this chapter, we propose to test the hypothesis that female labor market participation influences on the diminishing of Ecuadorian fecundity and not the other way around. Recently, and as we mentioned in the introduction of this chapter, an increasing number of women go to university, however more than the half of them leave their studies to raise their children. This causes a reduction of women job position alternatives. Additionally, many of these women enter to the labor market after a period, but their low education level, labor inexperience and limited time that can be devoted to work (Percheski, 2008) may restrict their job opportunities. Thus, female labor market participation may affect reproductive decisions in the long-run. Moreover, Ecuadorian labor law may be considered lax in female job contracts since many of them obligate women

not to get pregnant during the last part of the contract in an explicit or tacit way. Then, we state the following research hypothesis:

H2.2: Female labor market participation has a negative effect on fecundity.

2.2.3 Income level

Economic income can be determinant when deciding the number of children due to the cost of raising them (see Figure 2.4). In such a sense, empirical literature (Becker, 1960; Easterlin, 1978; Easterlin *et al*., 1980) shows evidence that fecundity rates are inversely related to the costs of rising children.



Note: There is no available data about income per capita for 2002, 2003, and 2004.
Figure 2.4 Income per capita vs. Fecundity rate between 1990 and 2014. Elaboration: The authors. Source: The World Bank.

As a matter of fact, children can be considered inferior goods in developing countries since once the household income increases, other similar sources of utility can be comparable (work, leisure, future economic security, etc.). Then, the more income, the less demand of children. There may be a low or even negative income elasticity of the demand (Robinson, 1997). In this sense, Becker (1960), who suggests that children can be seen

as consumption goods, indicates that fecundity can be influenced by its own demand. This author defines the parents as rational agents that maximize their utility as a function of their children and the budget restriction that they face. Consequently, the decision of an additional child is based on a rational election model and the interaction between the optimum quantity and quality of resources that would be devoted for each child (Willis, 1973). Meanwhile, children may be chosen as an option due to the lack of elderly care programs in developing countries (Barro and Becker, 1989).

In contrast, Easterlin *et al.* (1980) suggests that people take their reproductive decision based on their current and future levels of income and expected level of life (Chabé-Ferret and Melindi, 2013). This author indicates that if there is a high relationship between levels of income and life (good economic situation), the fecundity rate will be high as well. This will turn out in a population cycle where the fecundity rate would be high. Consequently, children that are born in this cycle would face higher levels of competition in the labor market; Afterwards, this would lead to a populational cycle where there would be a population decrease (Waldor and Byun, 2005). Moreover, Easterlin (1966) also indicates that fertility is inversely related to consumption aspirations. In this context, we state:

H2.3: Income causes a reduction in the fertility rate levels.

2.3 Data

2.3.1 Description of the data

We use Ecuadorian Living Conditions Survey for two periods, 2006 and 2014. These are multipurpose surveys with national coverage that are designed for providing information about the situation and changing trends in the population welfare. Although, it is recommended to perform this type of surveys annually, Ecuador cannot afford it, so the last years they were conducted were 2006 and 2014. In any case, they are quite enough for our research purposes, especially if both databases are pooled together. There are some advantages of data pooling. First, they allow us to get more robust estimators than using cross sections separately. Additionally, the

autocorrelation problem in the error term is automatically overcome since the observations are independent in time.

It is important to mention that these surveys give information about 13.581 households in 2006 and 29.052 households for 2014. Considering the fact that we want to analyze the factors that affect fecundity, we segment our analysis for women between 12 and 49 years old since this is the fertile age interval. Once we have done the segmentation, we have 46.716 observations: 15.613 women in 2006 and 31.103 in 2014. These women are geographically distributed as follows

Table 2.1 Distribution of women that have had children according to geographical region.

Region	Year 2006	Year 2014	Pooled data
Coast	6096	10273	16369
Highlands	8286	14988	23274
Amazon	1231	5262	6493
Galapagos		580	580

Elaboration: The authors.

2.3.2 Dependent variable

The dependent variable is the number of children that each woman has had. By doing a histogram of the dependent variable, one may see that most women have two children followed by one and three children in the distribution.

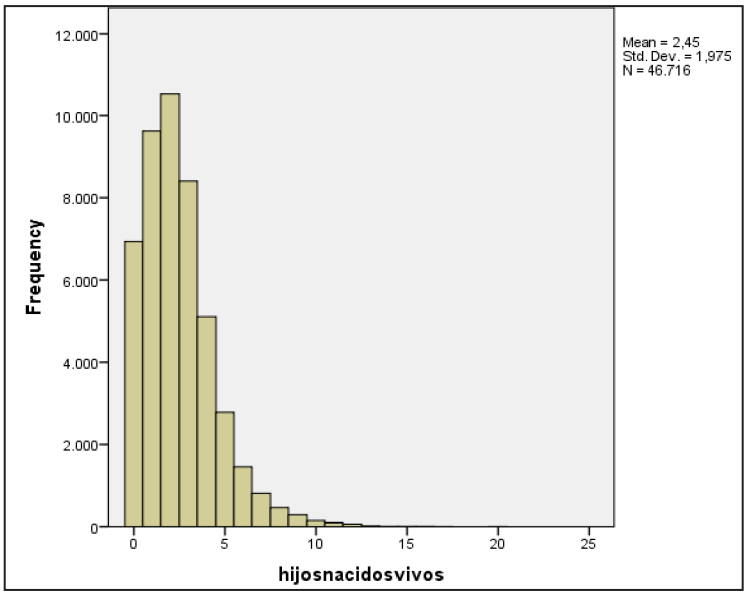


Figure 2.5 Histogram of the variable children born alive per woman.

The mean is 2.45 children per woman between 12 and 49 years old with a standard deviation of 1,975. Additionally, it is important to mention that the mean for 2006 is 2.56 children per woman with a standard deviation of 2.1; meanwhile, the mean in 2014 is 2.39 children per woman with a standard deviation of 1.91. Clearly, there is a decrease in the mean of 0.17 children per woman. Moreover, 85.3% of Ecuadorian women between 12 and 49 years old had become mothers in 2006 and 84.5% in 2014.

2.3.3 Independent variables

The independent variables of the model, which have been chosen from the literature review, are presented in the following table

Table 2.2 Variables of the model

Variable	Brief explanation	Expected sign
Household income	It is the total household income measured in US dollars.	-
Education	It represents the years of formal education of the woman.	-
Work	It is a dichotomy variable that takes the value of 1 if the woman Works and 0 otherwise.	-
Age	It represents the age of the woman. It is measured in years.	+
Ethnics	It is a categorical variable that presents information about the ethnic self-identification of the woman. The category of reference is *mestizo* and the other possible options are indigenous, white, black, *mulatto*[2]*, montubio*[3]*,* and other.	n/a.
Marital Status	It is a categorical variable that represents the civil status of the woman. The category of reference is single, and the other possible options are married, free union, separated, divorced and widowed.	n/a.
HIV	It is a proxy variable of the level of information that takes the value of 1 if the woman has heard or knows something about HIV/AIDS and 0 otherwise.	-
Plan_Fam	It also Works as a proxy variable of information level that takes the value of 1 if the woman has heard or knows something about family planning and 0 otherwise.	-
Region	It is a categorical variable that collects information about the geographical region in which the woman lives. Highland is the category of reference and the other possible options are Coast, Amazon and Galapagos.	n/a.
Area	It is a categorical variable that collects information about the area of residence of the woman. Rural is the category of reference and the other possible categories are Small Urban (between 2000 and 4999 inhabitants) and Big Urban (more than 5000 inhabitants).	n/a.
D_2014	It is a dummy variable that takes the value of 1 if the woman was surveyed in 2014 and 0 if she was surveyed in 2006. This variable catches the effects that can attributed to time passing; in other words, a differential behavior in 2014 with respect to 2006.	-

It is quite common to include the variable age squared of the woman as an explanatory variable in this type of studies. Nevertheless, we have excluded it for two reasons in this chapter. First, the inclusion of the variables age squared and age is given by the necessity of verifying if the dependent

[2] In Ecuador, it is the common noun to identify a brown-skinned person. The word was firstly used in the colonial period to denominate the person who had one white parent and the other black.

[3] Ethnicity that corresponds to the farmer people settled in the Ecuadorian Coast.

variable –number of children in this case- behaves in a U or inverted U shape as time passes. In this chapter, it is quite clear that woman does not only have the majority, but all her children in the fertile age. Then, the majority of events is concentrated in this interval with a decreasing tendency in the extremes. Consequently, it behaves in an inverted U shape. Secondly, the inclusion of the variable age squared usually presents a problem of multicollinearity with age variable since the first has been generated in a process that is based on the second. Considering the fact that we already know the relationship between the age of the mother and her number of children, the inclusion of the age squared variable is unnecessary.

Then, there are three key variables with respect to our research hypotheses. First, the female education which is expressed in years of formal education. Schulz (1997) indicates that female education implies a decrease in the fecundity rate. Then, we expect a negative sign in the estimator. Indeed, Klasen and Launovi (2006) indicate that if a woman reaches higher education levels, this is going to be a determinant factor in the reduction of the fecundity rate. Consequently, the negative sign would indicate a negative relationship between female education and fecundity rate.

Another key variable in our analysis is Work. The sign of this variable is going to tell us the effect of the female participation in the labor market on fecundity. Regarding the expected sign, some authors (Klasen and Launovi, 2006; Gutiérrez and Domenech, 2008) show empirical evidence that the female decision of participating in the labor market and the fecundity rate are inversely related. A woman who decides to work has more difficulties for starting a family than a woman who does not work. Moreover, authors like Dasgupta (1995) and Shang and Weinberg (2013) indicate that the work revenues generate an empowering sensation in women due to the independence they achieve. Thus, female labor market participation decision influences reproductive decisions. Consequently, we expect a negative sign in the estimator which would confirm the negative relationship between female labor market participation and fecundity rate.

Furthermore, authors like Becker (1960), Easterlin (1978), Easterlin *et al*. (1980) have found that high income levels may influence in the decision of having children. Indeed, Robinson (1997) found empirical evidence that children can be seen as inferior goods in developed countries. Then, we

expect a negative sign in the estimated parameter. This would suggest that if the income increases, the fecundity rate will decrease.

Table 2.3 Descriptive statistics and correlation matrix.

	Mean	Std. Dev.	1	2	3	4	5
1. Age	27.9	10.865	1	0.029**	0.001**	0.049**	0.048**
2. Education	10.03	4.057	0.029**	1	0.019**	0.3222**	-0.229**
3. Household Income	1437.33	25061.257	0.001	0.019	1	0.136*	0.0001
4. ln(Income)	6.5419654	1.0563362	0.049**	0.3222	0.136	1	-0.069
5. Number of Children	2.45	1.975	0.048**	-0.229**	0.001	-0.069	1

Level of significance: *=10%, **=5%, ***=1%.

Table 2.3 reports the mean, standard deviation and the correlation matrix between dependent and independent variables (continuous ones). It is possible to appreciate that the Household Income variable is heterogeneous since its standard deviation is higher than its mean. Thus, we have decided to use the logarithm of the variable in the estimation. Additionally, the correlation coefficient between the number of children and the age is quite high; nevertheless, it is not significant.

2.4 Methodology

2.4.1 Count data models

Due to the nature of the independent variable, the number of children that an Ecuadorian female has had, the most accurate one is by using count data models. Then, the options are to model using Poisson or Negative Binomial regressions. In the first case, the Poisson probability function is given as follows

$$P(x) = e^{-\lambda}\frac{\lambda^x}{x!} \tag{2.1}$$

Where λ is a constant value which is the result of the multiplication between the probability that the event takes place (p) and an infinite number of intents. Furthermore, the expected value and the variance are equal to the constant in the Poisson distribution.

Moreover, it is important to remark that the value of the λ depends on the explanatory variables. Thus

$$\lambda_i = e^{\beta_o+\beta_1 X_{1i}+\beta_2 X_{2i}+\cdots+\beta_k X_{ki}} \quad (2.2)$$

Indeed, if we apply logarithms, we get the following lineal equation

$$\ln(\lambda_i) = \beta_o + \beta_1 x_{1i} + \beta_2 x_{2i} + \cdots + \beta_k x_{ki} \quad (2.3)$$

It is important to remember that applying count data models to the dependent variable, which is number of children, we estimate the expected value of the variable. This is quite different from the discrete choice models in which we model the probability. Additionally, Negative Binomial distribution also considers that the expected value of the dependent variable is equal to λ plus an error term. Then

$$Var(Y) = \lambda + \theta \quad (2.4)$$

Consequently, if the error term θ is equal to zero, this suggests that we have a Poisson distribution. Then this would be our preferred functional form. Considering the Poisson functional form, the model to be estimated will be given by

$$\lambda_i = e^Z \quad (2.5)$$

Where

$$Z = \beta_o + \beta_1 \ln(Income)_1 + \beta_2 Education_i + \beta_3 Work_i + \beta_4 Age_i + \beta_5 Ethnics_i + \beta_6 Civil\_Status_i + \beta_7 HIV_i + \beta_8 Plan\_Fam_i + \beta_9 Region_i + \beta_{10} Area_i + \beta_{11} D\_2014_i \quad (2.6)$$

2.4.2 Results

Considering the available explanatory variables in order to model the number of children born alive from Ecuadorian women between 12 and 49 years old, we may apply four possible specifications coherent with literature. We can use Poisson and Negative Binomial regressions; however, we can consider the effect of pass of the time of the 2014 observations with respect

to the ones taken in 2006 in each type of regression. This can be easily achieved by including a dummy variable (D_2014) that takes the value of 1 if the observation corresponds to 2014 and 0 otherwise. All the estimations are done taking into account robust errors, so possible heteroskedasticity problems are avoided. The results of all the four possible specifications are presented in table 2.4

We must select our preferred estimation. To do so, firstly we choose one specification out of each distribution. Then, we use the probability of the log likelihood ratio test for each pair of specifications. In the case of the Poisson regressions, we reject the null hypothesis that indicates that the restricted model, -in our case specification (1)- is the preferred since 9,4325E-25 < 5%, consequently, the unrestricted model –specification (2)- is the preferred between this pair of models. In the case of Negative Binomial Distribution specifications, 1,12232E-06 < 5%, consequently specification (4) is preferred with respect to (3).

To choose between (2) and (4), we can base our decision on the -2(log likelihood) which decision criterion indicates that the best regression is the one with the smallest value of it. In our case, the preferred model is (2). This model has been adjusted to a Poisson regression and includes the dummy variable for 2014 as a control. Once we have chosen our preferred regression, we can see that most of the variables are significant at an individual level. The interest variables, as we stated previously, are household income, education and work.

Table 2.4 Results of the estimations

Variable	**Poisson Distribution**		**Negative Binomial Distribution**	
	(1)	**(2)**	**(3)**	**(4)**
Constant	0,227***	0,270***	0,274***	0,166***
	(0,0257)	(0,0255)	(0,0237)	(0,0295)
ln(Household Income)	-0,015***	-0,008***	-0,016***	-0,009***
	(0,0033)	(0,0034)	(0,0031)	(0,0032)
Education	-0,031***	-0,030***	-0,030***	-0,029***
	(0,0008)	(0,0008)	(0,0008)	(0,0008)
Work	0,035***	0,030***	0,035***	0,030***
	(0,0070)	(0,0070)	(0,0070)	(0,0070)
Age	0,034***	0,035***	0,035***	0,035***
	(0,0033)	(0,0004)	(0,0004)	(0,0004)
Ethnics (ref: mestizo)				
Indigenous	0,122***	0,129***	0,122***	0,128***
	(0,0105)	(0,0105)	(0,0100)	(0,0100)

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White	-0,008	-0,024	-0,007	-0,024
	(0,0162)	(0,0163)	(0,0163)	(0,0163)
Black	0,126***	0,120***	0,101***	0,103***
	(0,0216)	(0,0216)	(0,0182)	(0,0182)
Mulatto	0,086***	0,083***	0,083***	0,089***
	(0,0218)	(0,0217)	(0,0210)	(0,0210)
Other	-0,024	-0,007	-0,022	-0,005
	(0,1102)	(0,1106)	(0,1003)	(0,1002)
Montubio	-0,096***	-0,072***	-0,096***	-0,071***
	(0,0188)	(0,0189)	(0,0204)	(0,0205)
Marital_Status (ref: single)				
Married	0,033***	0,029***	0,026***	0,225**
	(0,0090)	(0,0090)	(0,0093)	(0,0093)
Free union	0,049***	0,051***	0,044***	0,046***
	(0,0094)	(0,0094)	(0,0097)	(0,0097)
Separated	-0,078***	-0,072***	-0,084***	-0,078***
	(0,0130)	(0,0130)	(0,0143)	(0,0143)
Divorced	-0,204***	-0,201***	-0,212***	-0,208***
	(0,0218)	(0,0218)	(0,0264)	(0,0263)
Widowed	-0,014	0,013	0,008	0,007
	(0,0247)	(0,0246)	(0,0256)	(0,0256)
HIV	-0,047***	-0,048***	-0,045***	-0,046***
	(0,0127)	(0,0127)	(0,0112)	(0,0112)
Plan_Fam	-0,036***	-0,035***	-0,036***	-0,036***
	(0,0129)	(0,0129)	(0,0106)	(0,0106)
Region (ref: Highlands)				
Coast	0,055***	0,054***	0,054***	0,053***
	(0,0076)	(0,0076)	(0,0077)	(0,0077)
Amazon	0,130***	0,139***	0,126***	0,136***
	(0,0095)	(0,0095)	(0,0093)	(0,0093)
Galápagos	-0,095***	-0,077***	-0,095***	-0,078**
	(0,0261)	(0,0262)	(0,0308)	(0,0308)
Area (ref: Rural)				
Area Small Urban	-0,045***	-0,047***	-0,044***	-0,047***
	(0,0156)	(0,0156)	(0,0160)	(0,0159)
Area Big Urban	-0,068***	0,270***	-0,067***	-0,073***
	(0,0072)	(0,0255)	(0,0073)	(0,0073)
D_2014		-0,068***		-0,069***
		(0,0069)		(0,0068)
ln(alpha)			-3,805	-3,862
			(0,1194)	(0,1259)
Alpha			0,022	0,0210
			(0,0027)	(0,0026)
Likelihood Ratio Chi-Square	21749,458***	21854,970***	16484,71***	16584,75***
Log likelihood	-83558,057	-83505,301	-83521,349	-83571,326
-2(Log likelihood)	167116,114	167010,602	167042,698	167142,652
Pseudo R2			0,0898	0,0904
Likelihood Ratio Test of alpha			78,69***	70,39***

Significance level: *=10%, **=5%, ***=1%

As we stated in the literature review, the relationship between fecundity and female labor market participation may be bidirectional; consequently, this could lead to possible endogeneity problems. The solution could be given by instrumentalizing the labor market participation variable; however, the lack of variables that can be considered good instruments does not allow us to do it. In any case, it is important to note that the correlation coefficients between the number of children and labor market participation variables are low (Pearson= 0,18; Tau_b de Kendall = 0,17; Spearman = 0,19). Then, one may think that these variables have independent behavior from each other, but keeping in mind that correlation and causality are different topics. Additionally, considering the preferred regression (2), we have done an estimation in which the labor market participation variable has not been considered as an explanatory variable (Hausman Test). This estimation presents similar results to those obtained in (2). Consequently, one may conclude that female labor market participation variable is not endogenous.

Once we have validated our results, we can analyze the results of the preferred regression. Firstly, the variable *Education*, which collects information about the years of formal education of the woman, is statistically significant at λ=1%. Additionally, the sign of the parameter is negative, as we expected. This suggests that if there is a marginal increase in formal education of the woman, the expected number of children born alive will diminish. This result proves the first research hypothesis that indicates the more educated the woman, the less the fecundity rate. This can be associated to the fact that an educated woman has better job opportunities and the possibility of improving her quality of life, so this may influence her decision of having a smaller number of children. Furthermore, the fact of having education also ensures a greater access to information. Indeed, the variable *Plan_Fam*, which is a proxy of the level of information of the woman, is statistically significant at λ=1% and with a negative sign which indicates that when a woman knows about family planning, the expected number of children born alive will be smaller. Moreover, *AIDS*, which is the other proxy variable of information, also has a negative sign. This ratifies the fact that an informed woman, in this case informed about sexual diseases, will have a smaller expected number of children.

Secondly, the variable *Work* is statistically significant at λ=1%. This variable has a positive effect on the dependent variable which means that if

the woman works, then the expected number of children born alive will be greater. This result is contrary to the second proposed research hypothesis. The underlying reasons to this may be given by the fact that women with children have the necessity of landing a job. In other words, if a woman has more children, she has the obligation to work in order to cover the family expenses.

Thirdly, the parameter of the *ln(Household Income)* is statistically significant at λ=1% and has a negative sign. This means that an increase of 1% in the total household income leads to a smaller number of the expected born alive children. This result proves our research hypothesis; then, the more the household income, the less the expected number of children in such a household. As Becker (1960) stated, there may be other preferences with a higher income such as working or leisure that may also influence women's decision of having a smaller number of children. Additionally, a higher income is associated with a higher level of education which, at the end, demonstrates the inverse effect of these two variables on the fecundity.

Furthermore, we observe that the control variables show the expected signs. The *Age* variable is statistically significant and its parameter presents a positive sign which indicates that if the age of the woman increases, the expected number of children born alive also increases.

The categorical control variables present the following results. First, let us give a look at the woman's ethnic self-identification. The categories *indigenous*, *black* and *mulatto* are statistically significant at 99% level of confidence. These categories have a positive sign in their estimators, so they have a higher expected number of children compared to those that have self-identified as *mestiza*. On the other hand, those that have self-identified as *montubio* and *other* have a smaller expected number of children than *mestiza*. Finally, those women that self-identified as *white* are not statistically significant at an individual level in this model.

Regarding the marital status of the woman, we have set *single* as category of reference. In such a sense, we have found that women that are *married* or in a *free union* have a higher expected number of children compared to the *single* women. On the other hand, women that are *separated* or *divorced* have a smaller expected number of children compared to the *single* woman. Only the *widowed* category is not statistically significant at an individual level.

Furthermore, the region in which the woman lives is also a determinant of the expected number of children. Considering *Highlands* as a category of reference, all the categories are statistically significant at an individual level. Categories *Coast* and *Amazon* present a positive sign, so the expected number of children born alive will be higher in these regions compared to the *Highlands*. Moreover, the variable Area indicates if the household is settled in an *urban* area, *small* or *big*, the expected number of children is smaller compared to women that live in the *rural* area.

Finally, the variable *D_2014* is individual statistical significant at λ=1%. The estimated parameter presents a negative sign which suggests that effects that are not collected in the other controls and can be attributed to the pass of the time have an inverse influence in the expected number of children. In other words, as time passes, the expected number of children born alive decreases.

2.5 Discussion and conclusions

We have used 46.716 observations of women between 12 and 49 years old that have been obtained from Living Conditions Survey of 2006 and 2014 in order to estimate the elements that influence the Ecuadorian fecundity. Consequently, we stated three research hypotheses that relate the level of education, female labor market participation and income to fecundity. Using count data models, we have proved that the level of education of the woman and the household income have a negative effect on fecundity. Thus, if Ecuadorian women increase their level of formal education, the fecundity rate decreases. This is clearly associated to the fact that an educated woman has more and better opportunity of jobs that can improve her quality of life. Consequently, she may have a smaller number of children. In the same way, having education guarantees more access to information such as family planning. Indeed, women who know about family planning have a smaller expected number of born alive children as we demonstrated empirically in this chapter.

Moreover, it has not been possible to find solid empirical evidence to verify the fact that female labor market participation has a negative effect on Ecuadorian fecundity. As we stated in the introduction section, this may be

given by the fact that female labor market participation increases in a relatively low speed in Ecuador compared to other countries (i.e. Brazil, Colombia, Peru), so the relationship is not negative in this case of study.

In addition, Ecuadorian households have a heterogeneous composition in which extended families –mainly due to emigration- are not exceptional, but quite common. Probably, the Ecuadorian type of family is not only formed by parents and children, but also grandparent(s), nephews, and so on. Then, more research is required to know how these family and social relationships affect fecundity. Further, this study of fecundity brings the possibility of analyzing more complex socioeconomic phenomena related to the household size in future research, such as household overcrowding.

Further, this chapter indicates that the access to higher labor positions for women would demand a higher opportunity cost between the time devoted to work and rising children. In this context, Ecuador has not a very developed child rising support system. Even though there are public day care centers, they do not supply the existing demand. Moreover, the private day care centers are not accessible for those parents with low income levels. Furthermore, children's academic activities do not always coincide with parents work schedules, then parents have to afford their children extracurricular activities. Without an appropriate support system, the fecundity rate will diminish. Then, consequences like the unviability of the pension system –like in Germany- may take place. A counterexample is the French system (2.1 children per woman in 2016) where parents are helped with the children care not only by the public day care centers, but also with economic subventions. Thus, French and German fecundity rates differ greatly. In such a sense, we want to draw attention to public policy makers in order that they consider increasing female labor market participation and creating integral child rising support systems.

Finally, this chapter is not free of limitations. Firstly, the quantity of control variables has been limited to the availability of them in the data bases. Secondly, the pool data technique has allowed us to obtain robust estimators. However, if there were panel data information, we may be able to do a time tracking of the observations that may lead us to a better approach to the phenomenon. Lastly, we have tried to keep under control the potential problems related to censored variable and endogeneity by applying the

appropriate techniques; however, the possibility of a bias in the results is not totally discarded.

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Chapter 3

Migration Effects on Living Standards of the Left Behind. The Case of Overcrowding Levels in Ecuadorian Households[4]

3.1 Introduction

One of the main challenges of development concerns the improvement of living conditions. Economic growth and investment in education are two means for ensuring individuals in poor countries enjoy a better life. The material side of personal well-being includes housing, that is, a basic dimension of the external quality of life or the environment in which one lives. It is not easy, however, to find a comparable definition of housing quality in international standards, given that each country faces different needs according to the characteristics of their climate and geography. Yet, one factor that can serve as a good proxy of satisfied housing needs is overcrowding. This condition is not only important per se as a constituent element of well-being, but it is also significant as a deterrence factor in several domains of personal development. For instance, the literature reports that children in overcrowded households have a higher probability of getting illnesses that can interfere with their daily routine and interrupt their schooling (Edwards *et al*., 1994; Saegert and Evans, 2003). Moreover, a lack of privacy can result in stress, impede social interactions, and create behavioral problems for all household members (Evans *et al*., 1998).

In developing countries, housing improvements require substantial investments, which can be achieved either thanks to higher incomes driven by enhanced local economic growth, or to inflows of money from emigrants that send remittances home. Indeed, the literature is showing an increasing interest in the effects of migration on the households and countries left behind. Studies suggest that there are two main channels for identifying these effects. The first channel is direct, and includes family reunification (Brunner and Pate, 2016; Jasso and Rosenzweig, 1995), the negative effects on the school attendance of children left-behind (Amuedo-Dorantes and Pozo, 2010), and a brain drain (Ngoma and Ismail, 2013; Croix and Docquier,

[4] This is a research paper jointly elaborated with Vicente Royuela and Javier Romaní.

2012). The second channel is indirect, insofar as migrants interact with households left-behind by means of remittances.

In this study, we analyze the effect of emigration on overcrowding in households left behind. We do so by taking as our case study the country of Ecuador, a small developing economy that has experienced an episode of particular interest for our purposes here, namely, a massive migratory wave between the late 90s and early 2000s (Piracha and Saraogi, 2012) and it presents high levels of household overcrowding (INEC, 2010). We use the universe of the Ecuadorian population, as collected in the 2010 census, to investigate the impact of international emigration on household overcrowding. Our findings show that, once reverse causality is controlled for, there is a significantly negative association between the presence of international migration and levels of overcrowding in the left-behind household. In other words, households with international migrants present lower levels of overcrowding levels in the households left behind.

The remainder of the chapter is organized as follows: a review of the literature on household overcrowding, migration, and remittances is presented in section 2. Section 3 introduces the case study. The methodological approach is presented in section 4. Section 5 presents the main results together with sensitivity analyses and robustness checks. Section 6 concludes by summarizing the main findings and suggesting some policy recommendations.

3.2 Overcrowding and international emigration

3.2.1 Defining overcrowding

A household is considered overcrowded when socially acceptable standards concerning the number of people per given area are surpassed. Such standards differ across countries and time as economic conditions and social expectations change. Different conceptions of overcrowding therefore can be found since, as Jazwinski (1998) points out, there appears to be no research identifying a single density of people per area at which everyone's health will be affected, or at which everyone will feel overcrowded.

Household overcrowding, though, should not be confused with density. Density, defined as number of individuals per given area (per room, per

dwelling, per square meter, etc.), is an objective measure which has no ready interpretation in normative terms (for instance, it is not clear that the lower the density the better). In contrast, overcrowding implies negative effects and is associated with a subjective perception, that is, the uncomfortable sense of being crowded in one's own household, but "the same objective density may or may not be uncomfortable depending on the situation. High density doesn't always lead to crowding" (Jazwinski 1998). Household overcrowding generally refers to an individual's psychological response to density, that is, to their feelings of being crowded, having a lack of privacy or an increase in unwanted interactions or psychological distress (Goux and Maurin, 2005; Jazwinski, 1998; Crothers *et al*., 1995; Gove *et al*., 1979).

Nevertheless, the threshold at which density is considered to become overcrowding reflects the reality of each society. For example, the British Bedroom Standard (UK), the Canadian National Occupancy Standard (Canada), and the Equivalised Crowding Index (New Zealand) assume that there should be no more than two people per bedroom for a household not to be considered overcrowded (New Zealand Statistics Office, 2013). According to Koebel and Renneckar (2003), the optimal occupancy for a single room is 1.5 individuals in Western Europe and the USA. Outside this area, according to Edwards *et al*. (1994), attitudes about personal living space are complicated, and difficult to separate from cultural values. In the case of Latin American countries, differences can also be found in the fixing of overcrowding threshold. Several countries, including Ecuador and Paraguay, adopt the definition given by the Economic Commission for Latin America and the Caribbean (ECLAC): a household is overcrowded if there are more than three people per bedroom (PNUD, 2014).

3.2.2 International migration

Nearly 200 million people, about 3% of the world's population, live outside their country of birth. Royuela (2015) reminds us that the majority of migration flows are from developing to developed countries: in the OECD, immigrants represent more than 12 per cent of the total population. Potential migrants evaluate the costs and benefits of migrating internationally, and migrate to where their expected discounted net returns are higher over some

time horizon. The primary motive for emigrating is to achieve a better life than the one experienced in their current place of residence. A better life includes a higher income, a better work environment, increasing business opportunities and, in general, a higher standard of living (Bartram, 2014; Portes and Rumbaut, 2006). Migrations can also be attributable to push factors, such as conflicts or natural disasters. According to Djajić and Vinogradova (2015), a migrant's motivation for working temporarily in a foreign country is, broadly speaking, to accumulate savings that will help them improve their standard of living on their return, including as specific goals purchasing or building a new home, improving an existing home, purchasing a plot of land for agricultural use or construction, or starting a new business (Djajić and Vinogradova, 2015).

Migration is likely to affect a household's housing and living conditions. Internal migration in developing countries is, today, associated with urban growth and the explosion of large cities, usually resulting in the growth of urban slums (Banerjee *et al*., 2012, 2010, 2002; Banerjee and Duflo, 2007). These spaces are characterized by the absence of basic services and household overcrowding. International migrations, on the other hand, may have several consequences. A massive migratory wave may result in the reduction of household overcrowding levels in these countries, as the numerator of the ratio is reduced. Yet, at the household level, it is likely that international emigration, because of high moving costs, only affects a limited number of family members, usually the householder (Stark and Lucas, 1988). This favors the creation of extended families and, subsequently, a growth in overcrowding, usually as a result of the delegation of the care of the children left-behind (Rae-Espinoza, 2006), who move to the home of their aunties/uncles and/or grandparents.[5]

Consequently, on first inspection, we might think about either a positive or negative direct effect of international migration on household

[5] Suárez-Orozco and Suárez-Orozco (2009) note the high proportion of children left in the care of grandparents as a result of Ecuadorian migration in the late 90s. They point out that female migrants normally arrange substitute care before their departure. They also note that, when a female migrates, it may in fact divide the family. The paternal side may have very little involvement in the care of the children after the mother's migration and the maternal grandmother and aunts become the substitute family.

overcrowding. It is the analysis of this effect that is our research question here.

Remittances, that is, money and goods sent by migrant workers working outside of their communities of origin back to these communities (Adams and Cuecuecha, 2013), may be an indirect channel via which migration influences overcrowding. According to Ratha (2013), worldwide remittances amounted to $401 billion in 2012. Rahman and Fee (2014) claim that remittances are integral to migration, as one of a migrant's basic motives for migrating is to remit a portion of their earnings to his or her community of origin, especially in the case of a temporary labor migrant leaving their family behind. Here, Stark and Lucas (1988) note that the family may act as a cohesive team, in which every member supports each other. Typically, the migrant is the householder or the family's eldest son, who wants one day to return home and whose altruistic behavior strengthens his relation with the family. The strength of this relationship makes it unnecessary to draw up a contract that guarantees remittances will be sent home (Sana and Massey, 2005).

We would expect to find considerable heterogeneity in the use of remittances in migration strategies. Adams (2009) finds that high-skilled migrants tend to remit less to labor-sending countries, and that low-skilled migrants tend to remit a higher share of their income:

> "(…) one possible explanation is that high-skilled migrants remit less because they are more likely to bring family members and to remain in their newly adopted country, and so they are less concerned with any eventual return to their home country. By contrast, low-skilled migrants tend to remit more because their migration is more temporary in nature and they are more concerned with returning home" (Adams, 2009, p. 99).

Hence, the effect of high- and low-skilled migrants on their respective left-behind households may differ. Similarly, income levels may also matter. The World Bank (2015) reports that remittances are a lifeline for poor households (80% of total international remittances), and so they reduce vulnerability; whereas, more resilient households use a variable share of remittances to invest in human (education, health) and social (marriage) capital, and physical (livestock, housing, equipment) and financial assets. A very small share is invested in small businesses or farming activities.

Moreover, the literature shows that remittances can increase investment in human and physical capital in receiving countries with significant effects. For instance, Adams and Cuecuecha (2010) find that households receiving remittances in Guatemala spend more at the margin on two investment goods – education and housing – than they would have spent on these goods without remittances. According to these authors, households respond in this way, because they treat remittances as transitory (rather than permanent) income, and the marginal propensity to invest out of transitory income is higher than that for other sources of income. Households receiving international remittances spend 81% more at the margin on housing that they would spend on this good without the receipt of remittances. Moreover, Osili (2004) finds that, in the Philippines, a 10% increase in migrant income increases the probability of investing in housing by a mean of 3 percentage points in the country of origin.

Adams (1991), drawing on international migration data from rural Egypt, emphasizes family-related motives for making housing investments: "temporary […] migrant households tend to tackle one of their most immediate concerns, namely, that of replacing their crowded, traditional mud-brick houses with modern red-brick buildings" (Adams, 1991, p. 720). Moreover, the process of building a house necessitates considerable management, an element often supplied by family members residing in the village or town of origin. Interestingly, housing investments appear to be common, even when family members do not enjoy direct housing benefits (Mata-Codesal, 2016; Findlay and Samha, 1986; Lawless, 1986).

Consequently, it is our belief that remittances, as an integral part of the migration process, will maintain a positive relationship with migration and housing investment and, subsequently, a negative relation with the level of overcrowding.

3.3 The case of Ecuador

3.3.1 Ecuador

Ecuador is a small country (283,561 km² and 16 M inhabitants in 2017) lying on the north-west coast of South America. In 2017, its population density stands at 58.6 inhabitants/km2. In 2010, the mean Ecuadorian

household size was 3.8 people with 64% of its households lying in urban areas, a percentage share below the Latin American average.

The country comprises four natural regions: the Coast, the Highlands, the Amazon and the Galápagos Islands. Politically and administrative speaking, Ecuador is divided in twenty four provinces[6], twenty three in the mainland plus the Galápagos Islands. Each province is in turn made up of cantons (a total of 224) and each canton is formed by parishes (a total of 1024).

In recent decades, GDP per capita in Ecuador has presented a growing trend; so much so that the country today is considered as having a medium-high level of income, according to the World Bank (2017).

In this chapter, we use data for the universe of the Ecuadorian population collected in the 2010 Census of Population and Dwelling. This source includes up to 3,810,548 Ecuadorian households, representing a population of 14.4 million inhabitants. The Ecuadorian census and statistics authority defines a household as "the social unit formed by a person or group of persons that associate in order to share housing and food. The household is, thus, the set of people that usually reside in the same dwelling or part of it (live under the same roof), and which are united by kinship ties and that cook for all the members (eat from the same pot)." (INEC, undated, p. 1).

3.3.2 Overcrowding

According to the definition of overcrowding provided by ECLAC (a household is overcrowded if there are more than three people per bedroom), we find that 17.5% of Ecuadorian households are overcrowded. This statistic, though, is not homogenously distributed across the territory (see Figure 1.A). In the Coast, home to 51.7% of the population, there is 63.4% of the total of overcrowded households in Ecuador. In contrast, in the Highlands and the Amazon, home to 43.5 and 4.5% of the Ecuadorian population, respectively, present 30.3 and 5.9% of national household overcrowding share. The

[6] The provinces that form the Coast region are El Oro, Esmeraldas, Guayas, Los Ríos, Manabí, Santo Domingo and Santa Elena. The provinces of the Highlands are Azuay, Bolívar, Cañar, Carchi, Cotopaxi, Chimborazo, Imbabura, Loja, Pichincha, and Tungurahua. The provinces of the Amazon region are Morona Santiago, Napo, Pastaza, Zamora Chinchipe, Sucumbíos, and Orellana. Finally, the Galápagos Islands constitute Ecuador's sole insular province.

Galapagos Islands and Ecuador's non-delimited zones make a minimal contribution to household overcrowding with 0.1 and 0.3% of the cases, correspondence to their respective population shares of 0.2 and 0.2%, respectively. Overcrowding is more of a rural phenomenon than an urban issue: 64% (36%) of households live in urban (rural) areas, with 57% (43%) of overcrowded households living in these areas. This negative relationship between spatial population density and overcrowding is illustrated in panel B of Figure 3.1.

Table 3.1 Overcrowding and migration descriptive statistics at province level.

Province	Mean household size	Number of overcrowded households	Households overcrowding rate*	Number of international migrants**	Number of households with migrants	Household migration rate***
Azuay	3.77	22,327	11.83	28,577	18,997	10.06
Bolívar	3.84	8,771	18.34	1,281	904	1.89
Cañar	3.84	8,617	14.68	13,826	8,888	15.14
Carchi	3.72	7,736	17.49	1,076	744	1.68
Cotopaxi	3.96	20,619	19.97	3,878	2,627	2.54
Chimborazo	3.65	18,085	14.40	9,037	5,810	4.63
El Oro	3.67	28,779	17.60	14,223	9,033	5.52
Esmeraldas	4.12	28,579	22.05	6,809	4,466	3.45
Guayas	3.80	210,336	21.92	74,726	46,660	4.86
Imbabura	3.86	15,438	14.97	7,902	4,999	4.85
Loja	3.83	21,660	18.49	11,465	7,124	6.08
Los Ríos	3.85	49,042	24.26	9,230	6,406	3.17
Manabí	3.99	70,304	20.46	14,390	9,254	2.69
Morona S.	4.42	8,607	25.71	3,625	2,310	6.90
Napo	4.59	5,545	24.55	913	633	2.80
Pastaza	4.22	3,930	19.75	1,100	735	3.69
Pichincha	3.54	64,922	8.91	63,940	41,382	5.68
Tungurahua	3.58	14,237	10.11	10,534	6,780	4.82
Zamora Ch.	4.26	4,915	22.93	2,189	1,308	6.10
Galápagos	3.41	916	12.42	286	210	2.85
Sucumbíos	4.08	8,698	20.11	1,577	1,049	2.42
Orellana	4.31	7,710	24.37	899	593	1.87
St. Domingo	3.86	15,406	16.17	6,716	4,317	4.53
St. Elena	4.04	21,168	27.73	1,593	1,087	1.42
No limited	4.10	1,933	24.48	272	190	2.41
Total [average]	[3.93]	668,280	[18.95]	290,064	186,506	[4.5]

*= (overcrowded households / total households)*100.

**In the ten previous years of the data collection.

***= (households with emigrants / total households)*100.

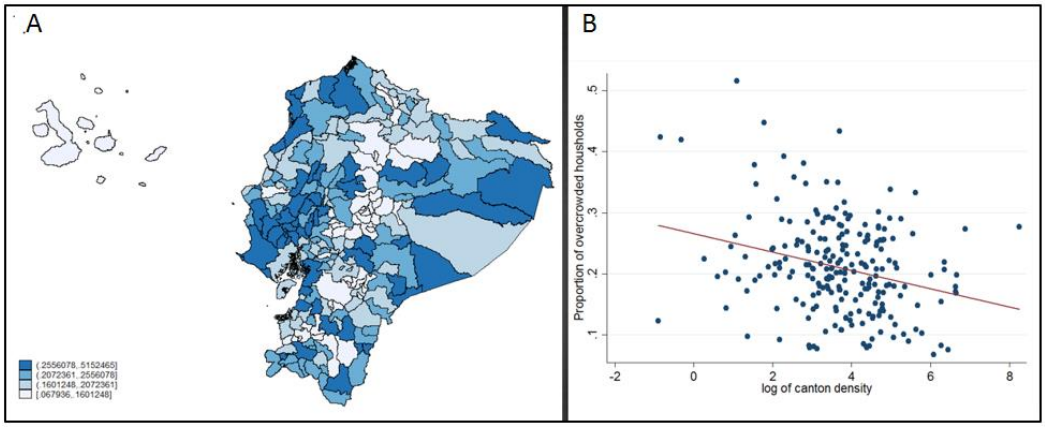

Figure 3.1 A Proportion of Ecuadorian overcrowded household at canton level. **B.** Proportion of overcrowded households vs. logarithm of population density at canton level. Source: INEC (2010).

3.3.3 Migration patterns in Ecuador

A good description of Ecuadorian migration is provided by Bertoli and Marchetta (2014), who stress that the country experienced an unprecedented wave of international migration, induced by a severe economic crisis, at the end of the 1990s.[7] Bertoli *et al.* (2011) indicate that, in the first years of the crisis (1998-2001), more than half a million Ecuadorians left the country. Ecuadorian migration was shaped by the combined effect of the crisis-induced liquidity constraints and the high migration costs that would-be Ecuadorian migrants faced, which were partly policy-induced (Bertoli *et al*., 2011). The sorting was particularly important across destinations[8] and dependent, above all, on the education and income levels of the population. According to Herrera (2008), between 1998 and 2005, about 1.1 million Ecuadorians migrated internationally: 47% to Spain, 33% to the USA, 9.4%

[7] Parandekar *et al.* (2002) report that the poverty headcount rose by an estimated 2 million people between the mid- and the late-1990s (in a country with a population of 12.7 million at that date).

[8] In the last two decades, most Ecuadorian migrants opted for Spain, where they received substantially lower income gains than in the US but where a bilateral visa waiver in force since 1963 reduced the monetary costs of migration (Bertoli *et al*., 2013). Indeed, survey data collected in Spain reveal that the cost of migrating from Ecuador rose on average to $1,800 (Bertoli *et al*., 2011). Although this figure is substantially less than the estimated $7,000-$9,000 it costs in seeking to enter illegally into the US (Jokisch and Pribilsky, 2002), it still hindered both the participation of poor households in this migration wave and had an impact on continuing poverty at origin.

to Italy, 6% to other countries on the American continent, and 4.3% to other European countries.

Vidal and Moreno (2000) distinguish three economic groups among this Ecuadorian wave of migrants: those unable to meet their daily expenses in Ecuador; those, who while able to meet their daily needs, could not attain a higher standard of living in Ecuador; and middle to upper-middle class people whose economic well-being fell considerably because of the economic crisis.

According to information from the 2010 Ecuadorian census, 4.9% of all Ecuadorian households (186,506) reported having at least one member that had migrated abroad in the ten years prior to data collection. In total, 290,064 people emigrated from these households in this period. Additionally, migration can be seen as being an urban-oriented phenomenon, given that 71.2% of the Ecuadorian households with international migrants are located in urban areas, while 28.8% are located in rural areas. However, it is not entirely clear that higher migration rates are found in the cantons of higher density, as shown in panel B of Figure 3.2. As for the spatial distribution of households with migrants, most are concentrated in the Highlands, accounting for 52.3%, followed, respectively, by the Coast, the Amazon, and the Galápagos Islands, with 43.5, 3.6, and 0.1% of cases. Indeed, the two provinces with the highest household migration rates, Cañar (15.1%) and Azuay (10.1%) lie in the Highlands region (see Figure 3.2 panel B).

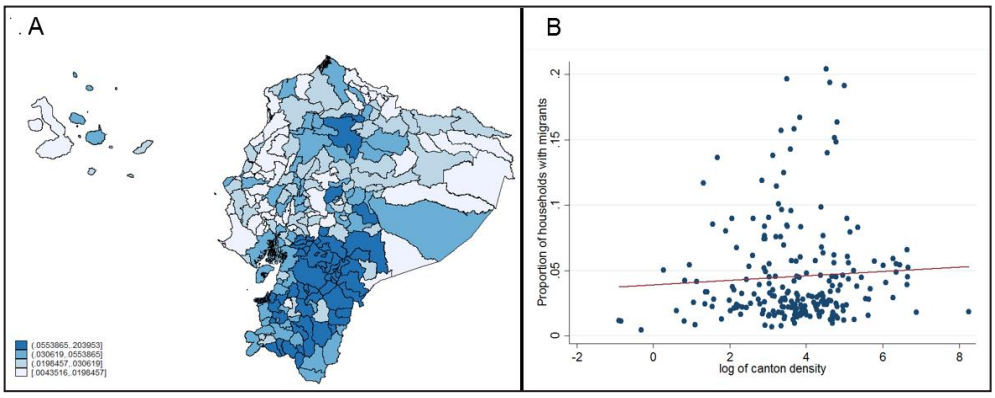

Figure 3.2 A. Proportion of Ecuadorian households with migrants at canton level. **B.** Proportion of Ecuadorian households with migrants vs. logarithm of population density at canton level. Source: INEC (2010).

Of the households with international migrants, just 9.3% are overcrowded vs a national average of 17.5%. Indeed, households with international migrants present a smaller overcrowding rate at the canton level (see Figure 3.3).

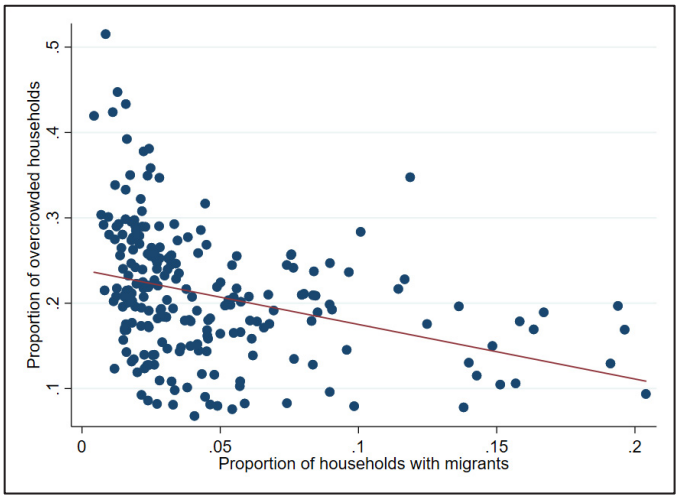

Figure 3.3 Proportion of Ecuadorian overcrowded households at canton level vs. proportion of households with migrants at canton level. Source: INEC (2010).

This growth in international migration has been accompanied by an increase in remittances. Indeed, migrants' remittances constituted, in the latter years of the crisis, one of the main sources of income for the country. Since the start of the Great Recession, the absolute inflow has stable but, because of the country's economic growth, there has been a decrease in the relative importance of remittances. Between 2001 and 2010, remittances amounted to 23,769 M USD, representing on average about 5.4% of the Ecuadorean GDP in this period.

The cross-sectional nature of the data census results in a number of interesting features. The sole question that makes reference to remittances in our data base is: "Have any members of this household received remittances over the last year (2010)?" We received affirmative responses from 266,313 households and found them to be heterogeneously spread across the territory (see Figure 4). Nevertheless, and as highlighted above, 186,506 households reported having at least one member that had migrated abroad since the last census was conducted (2001). This difference, therefore, can be attributed to migrants who left before 2001, when the Ecuadorian migration wave peaked, and who continue to send money to their relatives left behind. In fact, 82,228

households reported having a member that had emigrated between 2001 and 2010 and that they were in receipt of remittances from abroad.

Moreover, households receiving remittances are concentrated in the most heavily populated Ecuadorian provinces. Guayas, Pichincha, and Azuay account for 27.1, 20.7, and 10.8%, respectively, of households that report receiving remittances, and the percentage of households receiving remittances is higher in cantons with a higher population density (Figure 3.4).

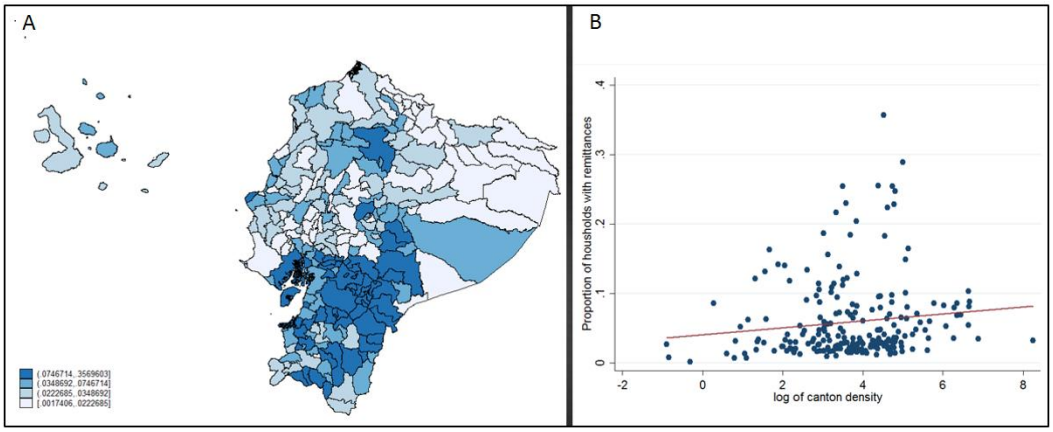

Figure 4. A. Proportion of Ecuadorian households receiving remittances at canton level. **B**. Proportion of households receiving remittances vs. logarithm of canton density. Source: INEC (2010).

3.4 Methodological approach

3.4.1 The model

As our data show, our key variables, overcrowding and international migration, are clearly related: overcrowding being less frequent in households with international migrants than is observed on average. What is not clear, though, is the direction of causality in this relationship and the selectivity of the processes involved. Is it in fact the case that migration reduces overcrowding? Or is it rather the case that less crowded households are the ones with a higher number of international migration episodes?

To address these questions, we propose the use of models that allow us to control for factors that influence both migration and overcrowding.

Moreover, we consider the possibility of endogeneity in the relationship. The aim of employing this strategy is to determine whether a significant influence exists, and, if so, the sign of this association. Our empirical model comprises an instrumental variable regression in which overcrowding depends on migration. Clearly, however, a series of additional controls are included in the equation. Thus, we can propose the following instrumental variable regression:

$$Overcrowding_i = \varphi + \beta X_i + \gamma Migration_i + u_i \quad (3.1)$$

where

Overcrowding is the household density (number of people per bedroom) in household *i*;

Migration is a dummy variable that takes a value of 1 if at least one member of the household has migrated abroad in the ten-year period prior to data collection, or 0 otherwise;

X_i is a set of control variables. It includes information about the householder, the dwelling, geographical characteristics, household structure and observable environmental factors;

u_i is the stochastic error term of the model.

We approach overcrowding as a continuous measure of the number of people sharing a bedroom, as do Solari and Mare (2012) in their study of the effects of overcrowding on children's wellbeing. They aim to capture the degree of crowding in a home by using a continuous measure. In this way, these authors consider that the effects of crowding on a child's wellbeing may begin to manifest themselves in a child when a high ratio of people per room is reached; thus, a continuous measure enables them to capture these possibilities (Solari and Mare, 2012). In our case, we believe that household density should enable us to observe in greater detail the effects of migration on it.

We assume that migration is endogenous to overcrowding. Endogeneity may arise as a result of an omitted variable problem and we seek to avoid this by employing a broad series of controls, included as X_i in our methodological approach. In line with Painter and Yu (2010), who relate migration and

overcrowding at the migrants' point of destination (and not at origin as is our case here), we consider a list of demographic variables, including the householder's sex (with female as category of reference), age (measured in years), age squared, ethnic group (a categorical variable with mestizo as category of reference, where the other possible options are black, mulatto, Montubio[9], indigenous, white, African-Ecuadorian and other), and marital status (a categorical variable that includes married, separated, free union, divorced, widowed and single). We also consider a socioeconomic variable of the householder, in this instance, schooling (measured in the number of years of formal education and which can also be considered as a proxy of income). In the case of the dwelling itself and the geographical characteristics of its location, we consider its tenancy regime (a qualitative variable including householder owned and fully paid, owned but not fully paid, ceded, exchanged for services, rented, and antichresis[10] as possible categories), its location[11] (1 if the dwelling is in an urban area or 0 if in a rural area), and also the province's fixed effects (a qualitative variable with Azuay as category of reference) .

Additionally, we include variables of household structure: the proportion of both women and the elderly in the household (%) are included as regressors. We also consider that the immediate environment may have an effect on the probability of overcrowding, so we included the population density of the canton (number of people per square kilometer). Descriptive statistics of the exogenous variables are presented in Appendix 3.1.

A second potential source of endogeneity is reverse causality. We use two instruments to address this problem. The first instrument, *Distance*, provides information about the distance between the parish in which the household is located and the nearest international airport (Quito, Guayaquil, or Cuenca). The nearer the household is to an international airport, the easier it is to emigrate. The second variable refers to previous internal migration experience, *Internal_exper*. Essentially, it is defined as the proportion of

[9] Ethnicity attributed to the farming people of the countryside of the Ecuadorian Coast region.
[10] Contract under which the owner and the person interested in taking up residence agree to an initial and unique payment at the beginning of a certain period. After that period, the landlord returns to the occupant the initial deposit in full and takes back the dwelling.
[11] All cantons may comprise both urban and rural areas, so this does not necessarily correspond to an administratively defined area.

household heads (husband and/or wife) that were born in a different province from the one in which they currently live. This variable takes a value of 0 if neither the household head nor his/her partner were born in a different province from the one in which they currently live; 0.5 if one of them was born in a different province to the one in which they currently live; or 1 if both were born in different provinces to the one in which they currently live. This variable captures previous (internal) migration experiences, which may affect the decision to migrate abroad. We expect that, having considered all the other controls, these two variables will not be correlated with the disturbance term of the main equation. In this regard, recall that we include the province's fixed effects and the population density of the canton, which must capture the vast share of the association between overcrowding and territorial characteristics. This leaves the distance to the nearest international airport with just residual importance, and as a variable with a greater influence on international migration than on overcrowding. The same is true of the household's previous migration experience: we would expect this variable to affect further migration episodes, but not to be correlated with overcrowding once the other household characteristics are controlled for.

3.5 Results

3.5.1 Basic Results

Table 3.2 shows our OLS results. We find that international migration is negatively associated with the level of household density. The estimated coefficients of migration are statistically significant at the 1% level of significance. The estimated coefficient in column (1) indicates that a household with international migrant members has 0.49 fewer individuals per bedroom than a household without migrants, *ceteris paribus*. The sign and significance of international migration persist even after controlling for other observables of household density (columns 2 to 4), although the parameter is halved, which we interpret to be evidence of important selectivity. As expected, overcrowded households are the ones with fewer international migrants.

Table 3.2 OLS results

	(1)	(2)	(3)	(4)
Migration	-.49212444***	-.41083973***	-.28441564***	-.25376716***
	(.0030445)	(.0030276)	(.0028541)	(.0028403)
Sex householder (Male=1)			-.02188886***	-.02398156***
			(.0022814)	(.0022545)
Age householder			-.00878653***	-.00930634***
			(.0002467)	(.0002452)
Age^2 householder			-.00002061***	-.00001453***
			(2.63e-06)	(2.61e-06)
Years of schooling			-.06644307***	-.0645412***
			(.0001448)	(.0001506)
Proportion women			.26903831***	.30152987***
			(.002976)	(.0029536)
Proportion elderly			-.91417063***	-.87919578***
			(.003365)	(.0033566)
Ethnics			Yes	Yes
Marital status			Yes	Yes
Regime of tenancy			Yes	Yes
Area (Urban=1)		-.32586552***		-.07437956***
		(.001762)		(.0017271)
Canton density		-.00003435***		-8.452e-06***
		(3.07e-06)		(2.81e-06)
Province fixed effects		Yes		Yes
R^2	0.0049	0.0457	0.1951	0.2130
Number of observations	3,810,548	3,810,548	3,810,548	3,810,548

Note: Robust (heteroskedasticity adjusted) standard errors are in parentheses. ***, **, * denote significance at 1%, 5% and 10% levels, respectively. For full estimation report, see Appendix 3.2.

Instrumental variable estimates are presented in Table 3.3; column (1) shows the first-stage estimates. The instruments considered – that is, distance to the nearest international airport and the proportion of internal migrants in the household – have significant negative effects on international migration. The corresponding IV estimate of the effect of international migration on overcrowding is also negative and statistically significant at the 5% level (column 2), while the instruments pass the overidentification tests, which implies that at some point we are able to ameliorate the reverse causality. These results suggest that a household with international migrant members is positively associated with a significant improvement in living conditions, through the reduction of household overcrowding expressed as a continuous measure of household density.

The parameter estimate, that is -0.65, is much higher than that obtained in the OLS estimate (-0.25). We interpret this difference as being an indication that the reverse causality between overcrowding and migration is positive: in other words, the higher the level of a households' overcrowding, the greater

the members' willingness to migrate. Bearing in mind that household overcrowding is a dimension of poverty and analyzing the phenomenon in relation to those households that have no migrant members, it may be the case that they find themselves stuck in some sort of poverty trap. Thus, they might not migrate because they do not have sufficient resources to move abroad; yet, at the same time, they might not have sufficient financial resources because there are no migrant members in their households that can contribute in helping them pay for their travel expenses.

Table 3.3 IV results and robustness checks

	(1) First-stage	(2) 2SLS	(3) (OC = 0, 1)	(4) (OC = 0, 1, 2, 3, 4)
Airport distance	-.0000886***			
	(4.24e-06)			
Proport. internal migrant	-.0058289***			
	(.000343)			
Migration		-.65041203**	-.718753***	-.4244855***
		(.2729907)	(.0495187)	(.0139554)
Sex household. (Male=1)	-.0276512***	-.03510924***	-.0462832***	-.0463676***
	(.0003852)	(.0079745)	(.0029413)	(.0024052)
Age householder	.0004643***	-.00913229***	.0013037***	.0082186***
	(.0000417)	(.0002738)	(.0003764)	(.0003733)
Age^2 householder	6.07e-06***	-.00001204***	-.0001074***	-.0001624***
	(4.58e-07)	(3.12e-06)	(4.43e-06)	(4.35e-06)
Years of schooling	.0010835***	-.06409459***	-.0610729***	-.0613852***
	(.0000256)	(.0003405)	(.0002457)	(.0001867)
Proportion women	-.0126303***	.29646351***	.1546519***	.1399274***
	(.0005173)	(.0045794)	(.0037106)	(.0034154)
Proportion elderly	-.0250055***	-.88902042***	-1.231442***	-1.260257***
	(.0007493)	(.0075212)	(.0066726)	(.0067822)
Ethnics	Yes	Yes	Yes	Yes
Marital status	Yes	Yes	Yes	Yes
Regime of tenancy	Yes	Yes	Yes	Yes
Area (Urban=1)	.0115339***	-.06966663***	-.0541847***	-.0598139***
	(.0002728)	(.0036738)	(.0021727)	(.0019397)
Canton density	6.16e-06***	-5.813e-06*	1.53e-06	-2.06e-06
	(2.89e-07)	(3.37e-06)	(2.70e-06)	(2.52e-06)
Province fixed effects	Yes	Yes	Yes	Yes
Number of observations	3,810,548	3,810,548	3,810,548	3,810,548
F test excluded instruments				
F (2, 3810495) [p-val]		343.36 [0.0000]		
Weak id F		343.36		
Hansen J statistics [p-val]		1.166 [0.2802]		
Wald chi2(103) [p-val]			513779.41 [0.0000]	520910.38 [0.0000]
Log pseudolikelihood			-2223572.2	-3020010.6

Note: Robust (heteroskedasticity adjusted) standard errors are in parentheses. ***, **, * denote significance at 1%, 5% and 10% levels, respectively. For full estimation report see Appendix 3.3.

The control variables also present interesting results. For instance, a one-year increase in the formal education of the head of household is associated with a reduction of .001 in the quotient of people per bedroom, *ceteris paribus*. Additionally, an urban location has a negative and significant (α=1%) effect, with a reduction of .069 people per bedroom compared to a household in a rural location, *ceteris paribus*. Likewise, the population density of the canton in which the household is located has a negative association with the level of overcrowding experienced by a household, albeit of marginal significance (α=10%).

We have approached housing overcrowding by using the quotient of people per bedroom, as in Solari and Mare (2012). However, it is also interesting to approach it by using the dichotomous definition provided by ECLAC: that is, a household is overcrowded if it has more than three individuals per bedroom. To do so, and as part of our robustness checks, we propose two additional estimations. The first estimates a probit model in which the dependent variable takes a value of 1 if the household is overcrowded and 0 otherwise. The second estimation is an ordered probit that considers a scale of the degree of overcrowding; thus, the dependent variable takes the values of 0 if the household is not overcrowded at all (0 to 3 people per bedroom or ppb), 1 if the overcrowding level is what we consider mild (3.1 to 4 ppb), 2 if it is moderate (4.1 to 5 ppb), 3 if it severe (5.01 to 6 ppb), and 4 if it is chronic (more than 6 ppb). The results of these estimations are presented in rows (3) and (4) of Table 3.3.

Due to the discrete nature of the household overcrowding and international migration variables, we use the conditional mixed-process (CMP) methodological framework developed by Roodman (2011) to run the specifications proposed. This enables us to jointly estimate two or more equations with linkages between their error processes, what in our case we use to instrument migration. The CMP modeling framework is essentially one of seemingly unrelated regressions, albeit in a much broader sense as the individual equations need not be classical regressions with a continuous dependent variable (Roodman, 2011).

In both robustness regressions, we obtain negative and statistically significant estimated parameters for international migration. The probit specification (row (3) in Table 3.3) indicates that if a household reports having international migrant members that have left over the last ten-year

period, then it is less likely to present overcrowding than a household that does not report having international migrants, *ceteris paribus*. In the ordered probit specification (row (4) in Table 3.3), the negative sign suggests that a household with migrant members is more likely to be in the lower categories. Clearly, both robustness checks are in line with our basic regression findings.

In the robustness specifications, it is also interesting to analyze the control variables. For instance, the level of education of the household head maintains its negative and statistically significant association with the household overcrowding variable, as in the IV results. Additionally, the negative and statistically significant parameter of the area (urban) variable in the probit and ordered probit specifications suggests that a household in such an area has fewer probabilities of being overcrowded and is more likely to be in the lower categories, respectively. Finally, the canton population density estimate is not statistically significant in either the probit or the ordered probit specifications.

3.5.2 The impact of remittances on the overcrowding-migration relationship

In the 2010 census, 266,313 households reported receiving remittances. In addition, 186,506 households reported that at least one member had migrated abroad since the last census was conducted (2001). This difference can be attributed to those migrants that left the country before 2001. Additionally, just 82,228 households declared that a member had emigrated in the period 2001-2010 and that they were receiving remittances from abroad. This means that over 100,000 households with a recent international migrant are not receiving remittances.

In earlier sections herein, we have argued that remittances operate as a key channel of transmission between migration and overcrowding. To verify the veracity of this claim, we run our basic model on two sub-samples: those receiving remittances and those not receiving remittances. These results are shown in Table 3.4. Columns (1), (2), and (3) show, respectively, the OLS, first-stage, and IV estimates of those households receiving remittances in 2010; while, columns (4), (5), and (6) present the same information for households not receiving remittances.

The households receiving remittances have in common the fact that a family member has emigrated abroad at some point. In this regression, the migration variable is simply an indication that a household member has migrated in the last ten years. The IV estimates (column 3) present a no significant parameter for migration, which we interpret to be evidence of the fact that recent migration is not associated with lower levels of overcrowding than is the case of households experiencing earlier migration.

As for those households that do not receive remittances, the estimated parameter of the international migration is once again not statistically significant in the IV regression. This suggests that even if the household has a recent migrant, if he/she does not send remittances, those left-behind do not enjoy any significant improvement in their levels of overcrowding. In our view, these results are indirect evidence of the role played by remittances in the association between international migration and the material well-being of the households left behind.

Table 3.4 Estimation results for households receiving and not receiving remittances

	(1) OLS	(2) First-stage	(3) 2SLS	(4) OLS	(5) First-stage	(6) 2SLS
Airport distance		-.0001564***			-.0000363***	
		(.0000427)			(3.41e-06)	
Proportion internal migrant		-.0332778***			-.0008921***	
		(.0028926)			(.0002884)	
Migration	-.09534132***		-.24099191	-.21963112***		-.15799727
	(.0047557)		(.2143701)	(.0038219)		(.894292)
Sex householder (Male=1)	.05525361***	-.0960277***	.04092037*	-.04385503***	-.0065893***	-.04344447***
	(.006208)	(.0024889)	(.021961)	(.002403)	(.0002966)	(.0064121)
Age householder	-.01223044***	.0027656***	-.01184681***	-.00889986***	.0006401***	-.00893908***
	(.0007473)	(.000319)	(.0009407)	(.0002584)	(.0000334)	(.000626)
Age^2 householder	.00006195***	-9.40e-06***	.00006069***	-.00002096***	1.68e-06***	-.00002107***
	(7.69e-06)	(3.33e-06)	(7.95e-06)	(2.76e-06)	(3.72e-07)	(3.15e-06)
Years of schooling	-.04854311***	-.0053198***	-.04930622***	-.06521962***	.0011109***	-.06528884***
	(.0005103)	(.0002042)	(.0012404)	(.0001573)	(.0000218)	(.0010153)
Proportion women	.11658926***	-.0542366***	.10852401***	.30919639***	-.0061753***	.30957762***
	(.0089301)	(.0038732)	(.0149203)	(.0031118)	(.0004169)	(.0063438)
Proportion elderly	-.80935789***	-.1088385***	-.8250751***	-.8816962***	-.0120111***	-.88095902***
	(.0096329)	(.0051061)	(.024823)	(.0035563)	(.0006333)	(.0112559)
Ethnics	Yes	Yes	Yes	Yes	Yes	Yes
Marital status	Yes	Yes	Yes	Yes	Yes	Yes
Regime of tenancy	Yes	Yes	Yes	Yes	Yes	Yes
Area (Urban=1)	-.0956023***	-.0223688***	-.09899752***	-.06861886***	.0070386***	-.06906877***
	(.0059207)	(.0024439)	(.0076914)	(.0017992)	(.0002237)	(.0067583)
Canton density	-9.962e-06	.0000122***	-7.927e-06	-5.819e-06**	2.72e-06***	-6.003e-06
	(.0000115)	(4.12e-06)	(.0000119)	(2.88e-06)	(2.29e-07)	(3.95e-06)
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	266,313	266,313	266,313	3,544,235	3,544,235	3,544,235
R^2	0.1513			0.2133		
Excluded Inst. F (2, 266260) [p-val]			72.68 [0.0000]			
Excluded Inst. F (2, 3544182) [p-val]						59.90 [0.0000]
Weak id F			72.68			59.90
Hansen J statistics [p-val]			3.070 [0.0798]			0.417 [0.5186]

Note: Robust (heteroskedasticity adjusted) standard errors are in parentheses. ***, **, * denote significance at 1%, 5% and 10% levels, respectively. For full estimation report, see Appendix 3.4.

3.6 Conclusion

In this chapter, we have analyzed the effects of migration on the levels of overcrowding in the households left behind. Using information from the 2010 census conducted in Ecuador, a small developing economy that experienced a massive migratory wave between the late 1990s and early 2000s and with high levels of household overcrowding, we have estimated an instrumental variable model. We are able to deduce a negative association between the analyzed variables. Thus, it seems to be confirmed that international migration is associated with a reduction in the levels of overcrowding in the households left behind.

Our findings indicate that this negative effect of international migration is stronger than the potentially positive effect of migration on overcrowding via the creation of extended families and the subsequent rise in overcrowding as a result of the delegation of the care of the children left behind, as reported in the literature. Furthermore, our results point to a positive reverse causality between overcrowding and migration, that is, the higher the overcrowding (or poverty) level is in the origin country, the greater the willingness to emigrate. By considering alternative subsamples of households (those receiving and not receiving remittances), we find that even if the household has a recent migrant, if he/she does not send remittances, the left-behind household does not present a statistically significant improvement in terms of a reduction in its level of overcrowding.

From a public policy perspective, a good way to improve the living conditions of citizens in developing countries is to facilitate the conversion of remittances from abroad into housing investments, as improvements to living quarters represent the first step towards improving quality of life and human capital accumulation. Moreover, policy makers need to be aware of the poverty trap in which many households find themselves, since episodes of international migration would certainly be more frequent without present financial constraints. In fact, improving living conditions at the point of origin would reduce the willingness to migrate and, subsequently, reduce the negative implications of international migration, such as effects of the brain drain and the problems caused by family destructuring. Future research can usefully be targeted at isolating the effect of other channels via which migration might impact overcrowding, as well as the effects of migration on other measures of material and psychological well-being.

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Appendix Chapter 3

Appendix 3.1.A. Continuous control variables descriptive statistics

Variable	Mean	Q1	Median	Q3	Std. Dev.	Max.	Min.
Household density	2.26	1	2	3	1.52	28	.05
Householder age	45.96	33	44	57	16.20	120	12
Householder age squared	2374.52	1.089	1936	3249	1640.56	14400	144
Householder years of school	8.47	6	7	12	5.23	22	0
Proportion women	50	33.33	50	66.67	25.93	100	0
Density canton	330.13	79.12	210.60	531.18	372.13	3814.04	0.408
Distance airport	71.24	0	68.95	121.46	77.63	1266.19	0
Proportion internal migrant	25.10	0	0	50	34.82	100	0

Appendix 3.1.B. Categorical control variables descriptive statistics

Categories	Frequency (%)	Share overcrowded households (%)	Share migrant households (%)
Sex of the householder			
Female	28.69	22.42	39.26
Male	71.31	77.58	60.74
Area of residence			
Urban	64.02	56.6	71.2
Rural	35.98	43.4	28.8
Marital status			
Married	43.94	40.9	49.5
Separated	25.19	42.9	14.7
Free union	8.33	6.6	8.4
Divorced	3.46	0.9	6.0
Widowed	7.67	4.2	9.8
Single	11.41	4.5	11.6
Tenancy			
Own fully paid dwelling	46.87	41.1	56.2
Own paying dwelling	6.54	5.5	5.8
Ceded	12.84	18.5	11.4
Exchange for services	1.55	2.2	0.9
Rented	21.43	19.2	16.8
Antichresis	0.20	0.20	0.20
Donation	10.57	13.3	8.7
Ethnic			
Mestizo	70.56	61.7	75.5
Afro-Ecuadorian	4.32	5.8	3.2
Black	1.11	1.5	0.8
Mulatto	1.92	2.5	1.7
Montubio	8.54	12.6	4.6
Indigenous	6.68	10.9	5.7
White	6.42	4.6	7.5
Other	0.43	.04	0.5

Appendix 3.2. Full report OLS estimation results

	(1)	(2)	(3)	(4)
Migration	-.49212444***	-.41083973***	-.28441564***	-.25376716***
	(.0030445)	(.0030276)	(.0028541)	(.0028403)
Sex householder (Male=1)			-.02188886***	-.02398156***
			(.0022814)	(.0022545)
Age householder			-.00878653***	-.00930634***
			(.0002467)	(.0002452)
Age^2 householder			-.00002061***	-.00001453***
			(2.63e-06)	(2.61e-06)
Years of schooling			-.06644307***	-.0645412***
			(.0001448)	(.0001506)
Proportion women			.26903831***	.30152987***
			(.002976)	(.0029536)
Proportion elderly			-.91417063***	-.87919578***
			(.003365)	(.0033566)
Ethnics (ref = Indigenous)				
Afroecuadorian			-.23278837***	-.38092119***
			(.0052846)	(.0053994)
Black			-.27692137***	-.41194763***
			(.0087736)	(.0089197)
Mulatto			-.22390946***	-.36667476***
			(.0067791)	(.0068308)
Montubio			-.21536248***	-.43871602***
			(.004558)	(.0047471)
Mestizo			-.42706618***	-.50582144***
			(.0037441)	(.0037829)
White			-.45328431***	-.57159579***
			(.004444)	(.0045004)
Other			-.39035198***	-.56868123***
			(.0110341)	(.0109419)
Marital status (ref= Married)				
Free Union			.39244387***	.30119589***
			(.002046)	(.002069)
Separated			-.3846332***	-.4675739***
			(.0028848)	(.0028845)
Divorced			-.67950975***	-.65468376***
			(.0030608)	(.0030393)
Widowed			-.39467628***	-.43249293***
			(.0030656)	(.003038)
Single			-.76227293***	-.80155377***
			(.0022941)	(.0022834)
Reg. tenancy (ref= Own fully paid)				
Own paying dwelling			-.03900684***	-.01284181***
			(.0028358)	(.0027826)
Donation			.23099852***	.22843981***
			(.0026153)	(.0025884)
Ceded			.30249144***	.32797122***
			(.0024082)	(.0023881)
Exchange for services			.10243361***	.14101405***
			(.0064152)	(.0064466)
Rented			.04629876***	.1549812***
			(.0018386)	(.0018813)

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Antichresis			.14957642***	.18981512***
			(.0166129)	(.0163028)
Area (Urban=1)		-.32586552***		-.07437956***
		(.001762)		(.0017271)
Canton density		-.00003435***		-8.452e-06***
		(3.07e-06)		(2.81e-06)
Province fixed effects		Yes		Yes
R^2	0.0049	0.0457	0.1951	0.2130
Number of observations	3,810,548	3,810,548	3,810,548	3,810,548

Note: Robust standard errors are in parentheses. ***, **, * denote statistically significant at 1%, 5% and 10% levels, respectively.

Appendix 3.3. Full report of IV results and robustness checks

	(1)	(2)	(3)	(4)
	First-stage	2SLS	(OC = 0, 1)	(OC = 0, 1, 2, 3, 4)
Airport distance	-.0000886***			
	(4.24e-06)			
Proportion internal migrant	-.0058289***			
	(.000343)			
Migration		-.65041203**	-.718753***	-.4244855***
		(.2729907)	(.0495187)	(.0139554)
Sex householder (Male=1)	-.0276512***	-.03510924***	-.0462832***	-.0463676***
	(.0003852)	(.0079745)	(.0029413)	(.0024052)
Age householder	.0004643***	-.00913229***	.0013037***	.0082186***
	(.0000417)	(.0002738)	(.0003764)	(.0003733)
Age^2 householder	6.07e-06***	-.00001204***	-.0001074***	-.0001624***
	(4.58e-07)	(3.12e-06)	(4.43e-06)	(4.35e-06)
Years of schooling	.0010835***	-.06409459***	-.0610729***	-.0613852***
	(.0000256)	(.0003405)	(.0002457)	(.0001867)
Proportion women	-.0126303***	.29646351***	.1546519***	.1399274***
	(.0005173)	(.0045794)	(.0037106)	(.0034154)
Proportion elderly	-.0250055***	-.88902042***	-1.231442***	-1.260257***
	(.0007493)	(.0075212)	(.0066726)	(.0067822)
Ethnics (ref = Indigenous)				
Afroecuadorian	-.0020723***	-.38203659***	-.2841982***	-.3063208***
	(.0006708)	(.0054531)	(.0049705)	(.0047041)
Black	-.0035053***	-.41358488***	-.3061667***	-.3138466***
	(.0009956)	(.0089948)	(.0080265)	(.0076891)
Mulatto	.001291	-.36631482***	-.2635223***	-.2851557***
	(.0008856)	(.0068426)	(.0064194)	(.0060737)
Montubio	-.0067177***	-.44169666***	-.344475***	-.3737746***
	(.0005652)	(.0051583)	(.0042994)	(.0040671)
Mestizo	.0019426***	-.50525685***	-.3870321***	-.4153562***
	(.0004768)	(.0038107)	(.0034087)	(.0031852)
White	.0075931***	-.56880567***	-.4544436***	-.4814511***
	(.0006792)	(.0049118)	(.0049915)	(.004671)
Other	.0100527***	-.56501156***	-.4147707***	-.4415646***
	(.001808)	(.0112412)	(.0131642)	(.0125478)
Marital status (ref= Married)				
Free Union	-.0105284***	.29683857***	.1932005***	.1894368***
	(.0002692)	(.003623)	(.0022447)	(.0019535)
Separated	-.14214***	-.47304656***	-.3169316***	-.3075812***
	(.0004959)	(.0047311)	(.0035018)	(.0034013)
Divorced	.005936***	-.65207678***	-.5873214***	-.597972***
	(.000823)	(.003559)	(.006954)	(.0067467)
Widowed	-.0201784***	-.44032272***	-.244822***	-.2396082***
	(.0005818)	(.0061736)	(.0042773)	(.0041781)
Single	-.0099997***	-.80531915***	-.6238124***	-.589677***
	(.000426)	(.003452)	(.0035626)	(.0035189)
Regime of tenancy (ref= Own fully paid)				
Own paying dwelling	-.0166142***	-.01954135***	-.0095821***	-.0004452
	(.0004555)	(.0053698)	(.0036671)	(.0034321)
Donation	-.0096573***	.22469241***	.177364***	.1738983***
	(.000359)	(.0036373)	(.0027911)	(.0025682)
Ceded	-.0050065***	.32593791***	.2780899***	.2528157***
	(.0003492)	(.0027488)	(.0025778)	(.0023416)

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Exchange for services	-.0157146***	.13436983***	.1504264***	.1420931***
	(.0006562)	(.0078977)	(.0063061)	(.0058071)
Rented	-.0205032***	.14670019***	.1110554***	.1026127***
	(.0003159)	(.0059804)	(.002776)	(.0023028)
Antichresis	-.007391***	.18672671***	.1540419***	.1501319***
	(.0024444)	(.0164585)	(.0178951)	(.0169059)
Area (Urban=1)	.0115339***	-.06966663***	-.0541847***	-.0598139***
	.0002728	(.0036738)	(.0021727)	(.0019397)
Canton density	6.16e-06***	-5.813e-06*	1.53e-06	-2.06e-06
	2.89e-07	(3.37e-06)	(2.70e-06)	(2.52e-06)
Province fixed effects	Yes	Yes	Yes	Yes
Number of observations	3,810,548	3,810,548	3,810,548	3,810,548
F test excluded instruments				
F (2, 3810495) [p-val]		343.3 [0.0000]		
Weak id F		343.3		
Hansen J statistics [p-val]		1.166 [0.2802]		
Wald chi2(103) [p-val]			513779.41 [0.0000]	520910.38 [0.0000]
Log pseudolikelihood			-2223572.2	-3020010.6

Note: Robust standard errors are in parentheses. ***, **, * denote statistically significant at 1%, 5% and 10% levels, respectively.

Appendix 3.4. Remittances analysis results

	(1) OLS	(2) First-stage	(3) 2SLS	(4) OLS	(5) First-stage	(6) 2SLS
Airport distance		-.0001564***			-.0000363***	
		(.0000427)			(3.41e-06)	
Proportion internal migrant		-.0332778***			-.0008921***	
		(.0028926)			(.0002884)	
Migration	-.09534132***		-.24099191	-.21963112***		-.15799727
	(.0047557)		(.2143701)	(.0038219)		(.894292)
Sex householder (Male=1)	.05525361***	-.0960277***	.04092037*	-.04385503***	-.0065893***	-.04344447***
	(.006208)	(.0024889)	(.021961)	(.002403)	(.0002966)	(.0064121)
Age householder	-.01223044***	.0027656***	-.01184681***	-.00889986***	.0006401***	-.00893908***
	(.0007473)	(.000319)	(.0009407)	(.0002584)	(.0000334)	(.000626)
Age^2 householder	.00006195***	-9.40e-06***	.00006069***	-.00002096***	1.68e-06***	-.00002107***
	(7.69e-06)	(3.33e-06)	(7.95e-06)	(2.76e-06)	(3.72e-07)	(3.15e-06)
Years of schooling	-.04854311***	-.0053198***	-.04930622***	-.06521962***	.0011109***	-.06528884***
	(.0005103)	(.0002042)	(.0012404)	(.0001573)	(.0000218)	(.0010153)
Proportion women	.11658926***	-.0542366***	.10852401***	.30919639***	-.0061753***	.30957762***
	(.0089301)	(.0038732)	(.0149203)	(.0031118)	(.0004169)	(.0063438)
Proportion elderly	-.80935789***	-.1088385***	-.8250751***	-.8816962***	-.0120111***	-.88095902***
	(.0096329)	(.0051061)	(.024823)	(.0035563)	(.0006333)	(.0112559)
Ethnics (ref = Indigenous)						
Afroecuadorian	-.21446368***	-.0913513***	-.2282***	-.3854285***	-.001138**	-.38534281***
	(.0200164)	(.0069532)	(.0283031)	(.0055858)	(.0005344)	(.0057243)
Black	-.29407436***	-.1286995***	-.3134992***	-.41354001***	-.00095	-.41346907***
	(.0325474)	(.0104411)	(.043563)	(.0092216)	(.0008234)	(.009281)
Mulatto	-.23144549***	-.0988283***	-.2461021***	-.36599373***	.0005694	-.36602143***
	(.0230205)	(.0080928)	(.0314066)	(.0071194)	(.0007127)	(.0071313)
Montubio	-.25144335***	-.098402***	-.2662429***	-.44585575***	-.0043068***	-.445573***
	(.0191841)	(.0066577)	(.0288417)	(.004886)	(.0004493)	(.0063805)
Mestizo	-.30014192***	-.0868838***	-.3130687***	-.51070225***	.0002211	-.5107055***
	(.0146744)	(.0050445)	(.0238745)	(.0039034)	(.0003748)	(.0039036)
White	-.3564735***	-.1114638***	-.3731661***	-.57730008***	.0081665***	-.57779524***
	(.0162804)	(.0058829)	(.0294758)	(.0046788)	(.0005652)	(.0085616)
Other	-.36565479***	-.1301064***	-.3856115***	-.57292533***	.0099483***	-.5735286***
	(.0308139)	(.0116754)	(.042739)	(.0116126)	(.0015916)	(.0145104)

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Marital status (ref= Married)						
Free Union	.24090182***	-.0331632***	.2358889***	.2981465***	-.0050589***	.29846739***
	(.0073995)	(.0025583)	(.0103868)	(.0021475)	(.0002184)	(.005094)
Separated	-.21802465***	-.0324047***	-.2223634***	-.49452849***	-.0039977***	-.49428342***
	(.0089758)	(.0036714)	(.0109528)	(.0030343)	(.0003947)	(.0046583)
Divorced	-.40732725***	-.0327702***	-.4116658***	-.684335***	.0082066***	-.68484619***
	(.0081635)	(.0041538)	(.0103544)	(.003257)	(.0006979)	(.0081115)
Widowed	-.25367705***	-.0682911***	-.2632519***	-.45452353***	-.00908***	-.45396638***
	(.0084643)	(.0037835)	(.016374)	(.0032272)	(.0004685)	(.008691)
Single	-.52551486***	-.0076315**	-.5262559***	-.82881127***	-.0048449***	-.82851643***
	(.0069619)	(.0030581)	(.0070614)	(.0024121)	(.0003316)	(.0048963)
Reg. tenancy (ref= Own fully paid)						
Own paying dwelling	-.00921652	-.0568662***	-.0176584	-.01594879***	-.0084624***	-.01542307*
	(.0089493)	(.0038016)	(.0152666)	(.0029075)	(.0003783)	(.0081465)
Donation	.26404949***	-.0342848***	.2593034***	.22475269***	-.0048568***	.22505225***
	(.0087774)	(.0032859)	(.0111476)	(.0026945)	(.0002882)	(.0050849)
Ceded	.26748841***	-.0431112***	.2612266***	.3330105***	-.001795***	.33312485***
	(.0075018)	(.0028734)	(.0118719)	(.0025015)	(.0002784)	(.0029809)
Exchange for services	.33658074***	-.0986092***	.3217036***	.13177478***	-.0068131***	.13220701***
	(.0323478)	(.0098513)	(.0393114)	(.0065722)	(.0005574)	(.0090756)
Rented	.23094904***	-.1001476***	.2160966***	.14976911***	-.0105101***	.15042004***
	(.0058643)	(.0023741)	(.0225844)	(.0019759)	(.0002589)	(.0096238)
Antichresis	.15085314***	-.0378703*	.1453153***	.18922418***	-.001414	.18932157***
	(.0464264)	(.0204655)	(.0473427)	(.0171061)	(.0020489)	(.0171577)
Area (Urban=1)	-.0956023***	-.0223688***	-.0989975***	-.06861886***	.0070386***	-.06906877***
	(.0059207)	(.0024439)	(.0076914)	(.0017992)	(.0002237)	(.0067583)
Canton density	-9.962e-06	.0000122***	-7.93e-06	-5.819e-06**	2.72e-06***	-6.003e-06
	(.0000115)	(4.12e-06)	(.0000119)	(2.88e-06)	(2.29e-07)	(3.95e-06)
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	266,313	266,313	266,313	3,544,235	3,544,235	3,544,235
R^2	0.1513			0.2133		
F test excluded instruments:						
F(2, 266260) [p-val]			72.68 [0.0000]			
F(2, 3544182) [p-val]						59.90 [0.0000]
Weak id F			72.68			59.90
nsen J statistics [p-val]			3.070 [0.0798]			0.417 [0.5186]

Note: Robust (heteroskedasticity adjusted) SE are in parentheses. ***, **, * denote statistically significant at 1%, 5% and 10% levels, respectively.

Chapter 4

The Effects of Housing Overcrowding on Respiratory Disease Incidence. The Specific Case of Ecuador[12]

4.1 Introduction

Disparities in terms of development across nations have caught researchers' attention in several fields. One aspect in this regard is population's wellbeing. In that sense, evidence shows that investing in children development allows to decrease the gap between developed and developing countries. In words of Silver and Singer (2014), "investing in child development is the foundation for improved health, economic, and social outcomes. Not getting the early years "right" is linked to violent behavior, depression, higher rates of non-communicable disease, and lower wages, and it negatively affects a nation's gross domestic product. Unless early child development is addressed effectively […], countries will be locked into poverty, and sustainable development will not be achieved" (Silver and Singer, 2014, p.1).

Moreover, the material side of personal well-being includes housing, as a basic dimension of external quality of life, the environment in which one lives. It is hard to find a proper comparable definition of housing quality in international standards, as far as every country will face different needs according to climate and geographical characteristics. Nevertheless, one aspect that can be a good proxy of satisfied needs in terms of housing is overcrowding level. In this context, housing is especially important for children that are in their early stages of formation and raising. As Solari and Mare (2012) state, "children are particularly dependent on and influenced by their home environment because it is where the majority of children's socialization, skill development, and identify formation occurs. These processes can be disrupted if the home environment is strained by overcrowding" (Solari and Mare, 2012, p.1).

This aspect is not only important *per se* as a constituent of well-being, but also as a deterrence factor for several domains of personal development. Consequently, attempting to guarantee an adequate dwelling in terms of

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facilities and space should be a predominant policy objective, especially for developing nations; otherwise, underdevelopment will continue constant for future generations.

Even though we analyze the negative effects of household overcrowding on children's respiratory disease incidence in this chapter, we also want to alert that overcrowding is a persisting developing problem that may reflect more complicated socio-economic issues. To do so, we use data from Ecuadorian 2006 and 2014 living condition surveys. The Ecuadorian case turns out to be interesting because it is a country that has been reducing its household overcrowding rate in the recent years (4.5% annually on average between 2006 and 2014) due to implementation of public policies focused on improving housing conditions jointly with economic growth. Yet, they are not enough to provide children adequate household environments. Indeed, our findings suggest that if a household is overcrowded, then the probability that at least one child contracts respiratory disease increases in a given household increases 3.1%. Additionally, this probability is even stronger (3.5%) when household is in the urban area. Thus, emphasized public policies in crowded households in urban areas –not to mention slums- must be designed.

The remainder of the chapter is organized as follows: literature review on household overcrowding, its effect on people, and the dynamics of overcrowding in cities is presented in section 4.2. Section 4.3 introduces the case of study. The methodological approach jointly with the main results, some sensitivity analysis and robustness checks are presented in section 4.4. Section 4.5 concludes summarizing the main findings and suggesting some policy recommendations.

4.2 Overcrowding and its effects

4.2.1 Defining household overcrowding

A household is considered overcrowded when socially acceptable standards concerning the number of people per given area are surpassed. Such standards differ across countries and time as economic conditions and social expectations change. Different conceptions of overcrowding therefore can be found since, as Jazwinski (1998) points out, there appears to be no

research identifying a single density of people per area at which everyone's health will be affected, or at which everyone will feel overcrowded.

Household overcrowding, though, should not be confused with density. Density, defined as number of individuals per given area (per room, per dwelling, per square meter, etc.), is an objective measure which has no ready interpretation in normative terms (for instance, it is not clear that the lower the density the better). In contrast, overcrowding implies negative effects and is associated with a subjective perception, that is, the uncomfortable sense of being crowded in one's own household, but "the same objective density may or may not be uncomfortable depending on the situation. High density doesn't always lead to crowding" (Jazwinski 1998). Household overcrowding generally refers to an individual's psychological response to density, that is, to their feelings of being crowded, having a lack of privacy or an increase in unwanted interactions or psychological distress (Goux and Maurin, 2005; Jazwinski, 1998; Crothers et al., 1995; Gove et al., 1979).

4.2.2 Household overcrowding and health

There are multiple negative effects of housing overcrowding on people's health. Indeed, the affections caused by high density of people in the dwelling are not only at physical level, but also at psychological and emotional levels.

In the case of physical negative effects, there is empirical evidence that shows that overcrowding is a vehicle for disease transmission since people living in dwellings with little space are more susceptible to becoming ill and if they are already ill, they will have fewer possibilities to rest and heal. For instance, short and long-term gastrointestinal problems mainly caused by Helicobacter pylori might be derived from overcrowding (McCallion *et al.*, 1996; Galpin, *et al.*, 1992). Specifically, overcrowding is considered as one of the main risk factors that affects the health and well-being of children (Goux and Maurin, 2005; Sharfstein and Sandel, 1998; Gove *et al*., 1979).

On the side of physiological effects, literature suggest that people living in overcrowded housing are more likely to have psychological decay and stress (Jacob *et al*., 2013; Wells and Harris 2007; Gove *et al*., 1979) and troublesome familiar relationships (Evans *et al.*, 1998).

Due to their vulnerability compared to the other household members, the study of children in overcrowded spaces has focused the interest of researchers. For instance, there are studies that show that reduced spaces at home diminish children's creativity and ability to play (Maitland *et al*., 2013; Marino *et al*., 2012). Furthermore, crowded and disorganized households have a strong impact on the sleep quality of minors (Quist *et al*., 2015) and encourage unhealthy eating habits in the behavior of younger children (Lumeng *et al*., 2014). All these factors generate a stress load for the child which increases the risk of inflammation and obesity at early ages (McCurdy *et al*., 2010).

Further, overcrowding has been associated with respiratory problems in children (Baker *et al*., 1998; Mann, *et al*., 1992). As a matter of fact, children's asthma is highly correlated with poor air quality and exposure to germs (Wu and Takaro, 2007) as well as the presence of mold and moisture at home (Fisk *et al.*, 2007) and noise exposure (Hohmann *et al*., 2013). Additionally, another set of studies shows the significant relationship between precarious housing conditions and childhood injuries (Evans and Engl. 2002; Krieger and Higgins 2002; Shenassa *et al*., 2004).

Besides the negative immediate effects that overcrowding causes on people's health, it also affects other dimensions of their lives in forthcoming years. For example, there is empirical evidence that housing overcrowding constitutes an important limitation for the performance of the members of such a household especially in education and labor activities (Goux and Maurin, 2005). In that sense, household overcrowding is associated with school absenteeism and low performance (Goux and Maurin 2005), and behavioral problems during school (Conley, 2001). Considering that overcrowding influences children's education, it also impacts in the probability of failing in their future enrollment in the labor market. Finally, there is evidence that relates overcrowding during childhood to a high-risk likelihood of death at maturity (Coggon *et al*., 1993).

Therefore, considering what literature about overcrowding effects on people indicates, we asses to study the effects of household overcrowding on children's respiratory disease prevalence. The analysis of this effect becomes our first research question.

4.2.3 Overcrowding and cities

The transition from predominantly agricultural-based economies to industrialized and services-based ones has led them to internal migration from rural to urban areas. In this context, people move to urban areas to have a large variety of options in education, employment, health services and other amenities that are mainly enjoyable in cities. Clearly, migration is likely to affect the housing living conditions of households. Internal migration in developing countries is nowadays associated with urban growth and the explosion of large cities, what usually ends in the growth of urban slums (Banerjee *et. al.* 2012, 2010, 2002; Banerjee and Dufflo, 2007) which are characterized by deprivation of basic services and household overcrowding.

The reasons causing overpopulation in the periphery around cities are related to lower costs of land in the outer suburbs of cities, improved infrastructure and the population growth itself. Further, the problem of overcrowding is more critical at low income levels since people cannot afford large households or high property taxes in city centers. Indeed, household overcrowding can be seen as a socioeconomic indicator because people who cannot afford the price of private space are more likely to live in crowded conditions (Solari and Mare, 2012).

Furthermore, the lack of urban planning in cities, especially in developing countries, leads to disorganized urban sprawl characterized by low levels of quality of life due to an insufficient infrastructure regarding basic services. Commonly, cities in developing countries spread out without planning; hence, this lack of planned infrastructure exposes population to disease. In this line, Leventhal and Newman (2010) show that not only overcrowding but also the quality of housing, subsidies, mobility, housing ownership and non-affordability are key issues that determine the integral development of children, specially their physical health. Thus, an interesting aspect to have in mind is that the phenomenon of overcrowding can be more problematic, in terms of its effects, in urban areas.

In the last 40 years, Latin America has experienced a growth of rural to urban migration of poor people, therefore, informal settlements have also increased (Duncan, 2005). Generally, these families are in the periphery, due to the high cost of the land in the urban centers. However, these dwellings do not have the adequate infrastructure or access to the basic services. These

limitations force families to share their homes with other relatives, this situation leads them to live in overcrowding situation and makes them more prone to disease transmission (Duncan, 2005).

Among the effects that urban sprawl can produce health issues are one main concern for population. The intense traffic in roads combined with the increasing use of cars in urban areas affect public health. People tend to be overweight and have to deal with blood pressure and respiratory diseases. Moreover, some cities may suffer from inadequate infrastructure that cannot handle the increasing demand of clean water or trash removal. Then, insanitary problems emerge in urban areas reinforced by household overcrowding. Thus, the particular conditions in cities of developing countries should be taken into account when studying the effects of overcrowding.

Literature shows that urban environments in cities may have an indirect effect on morbidity of population (Anderson *et al*. 1996; Schwartz, 1994; Schwartz, 1994; Pope *et al*. 1992; Schwartz and Dockery, 1992). As a matter of fact, the empirical evidence points out a negative effect deriving from air pollution in urban concentrations on respiratory diseases not only for children but for population in general (Peters *et al*. 1996; Braun *et al*. 1992; Romieu *et al.* 1992; Jaakkola *et al*., 1991; Dockery *et al*. 1989; Sobral, 1989). In that sense, it is logical to believe that such an outdoor effect might be transmitted more easily within households affecting the performance of the members. Children are the most affected. Absence from school is just one result of respiratory diseases (Ransom and Pope, 1992; Braun *et al*. 1992).

On the other hand, according to the United Nations (2003), household tenure could help families to improve their housing. It is argued that when families have the ownership of their home, they decide to improve basic infrastructure and basic housing services. This helps home members not to be exposed to disease situations.

Thus, considering the potential effects of overcrowding and its combination with urban conditions, we believe that the probability of children presenting a respiratory disease due to housing overcrowding is higher in cities than in rural areas. This statement drives or second research question.

4.3 The case of Ecuador

4.3.1 Ecuador

Ecuador is a small country (283.561 km²) lying on the north-west coast of South-America. Currently, its population density stands at 58.6 inhabitants/km^2. In 2010, the mean Ecuadorian household size was 3.8 people, 64% of its households lying in urban areas, meanwhile the other 37% lived in the rural.

The country comprises four natural regions: the Coast, the Highlands, the Amazon and the Galápagos Islands. Politically and administrative speaking, Ecuador is divided in twenty four provinces[13], twenty three in the mainland plus the Galápagos Islands. Each province is in turn made up of cantons (a total of 224) and each canton is formed by parishes (a total of 1024).

Ecuador presents an increasing tendency in terms of GDP per capita in the last decades. Indeed, Ecuador is currently considered a medium-high level of income country according to the World Bank (2017).

The unit of observation in the empirical exercise is the household. The Ecuadorian census-and-statistics authority defines a household as "the social unity formed by a person or group of people that associate in order to share housing and food. Then, the household is the set of people that usually reside in the same dwelling or part of it (under the same roof) which are united by kinship ties and who cook for all the members (eat from the same pot)." (INEC, n.d., p. 1).

The main sources of data are the Living Condition Surveys of Ecuador. These surveys provide information on 13.581 households for 2006 and 29.052 households for 2014. Since we want to verify the effects of overcrowding on children´s health, it is necessary to focus the analysis on those households that have children between 0 and 5 years old. Based on this segmentation, pooled data using information for 2006 and 2014 are then

[13] The provinces that form the Coast region are El Oro, Esmeraldas, Guayas, Los Ríos, Manabí, Santo Domingo and Santa Elena. The provinces of the Highlands are Azuay, Bolívar, Cañar, Carchi, Cotopaxi, Chimborazo, Imbabura, Loja, Pichincha, and Tungurahua. The provinces of the Amazon region are Morona Santiago, Napo, Pastaza, Zamora Chinchipe, Sucumbíos, and Orellana. Finally, the Galápagos Islands constitute Ecuador's sole insular province.

constructed. They are composed by 13.719 observations: 4.659 households in 2006 and 9.060 households in 2014. By using pooled data, we are able to obtain more robust estimators than using cross sections separately; in addition, pooled data automatically avoid the problem of autocorrelation in the error term because the observations, in this case from 2006 and 2014, are independent across time.

4.3.2 Overcrowding

The specific case of Ecuador could be an appropriate case of study since public policies have been focused on improving housing conditions. Indeed, overcrowding has reduced by 4.5% annually on average between 2006 and 2014. The largest reduction occurred in the rural area where overcrowding has fallen by 6.7 % annually on average (INEC, 2014). However, there are still several structural deficiencies in sanitation and services. Thus, 14.5% of households do not have access to drinking water and 24.2% do not have drainage systems for the disposal of waste (CEPAL, 2014). In addition, overcrowding conditions are different across regions within this country (see Figure 4.1). For instance, the highest overcrowding rate is 44.4%, (Morona Santiago) and the lowest rate is 15.8% (Tungurahua) in 2014.

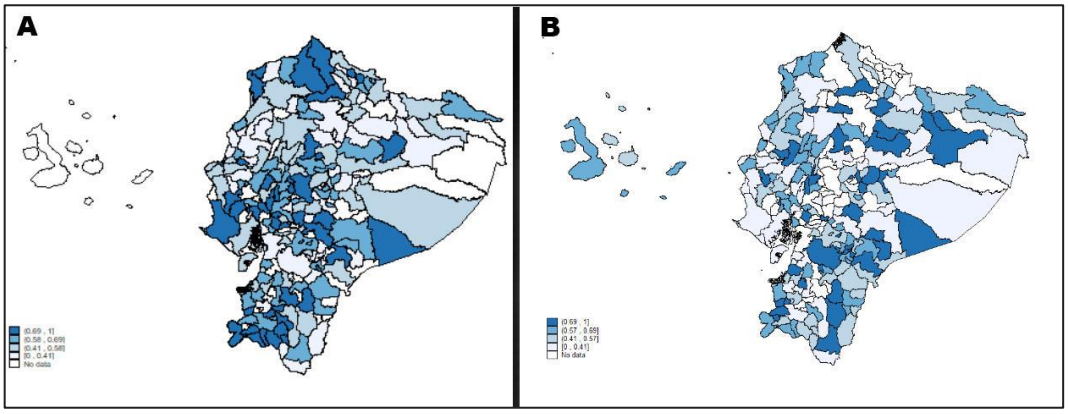

Figure 4.1 Proportion of overcrowded households at canton level in 2006 **(A)** and 2014 **(B).**

4.3.3 Respiratory diseases

According to the World Health Organization (WHO), respiratory diseases are those ones that affect the respiratory tract, including the nasal passages, bronchi, and lungs. They range from flu, cold, severe infections such as pneumonia and bronchitis to chronic diseases such as asthma and chronic obstructive pulmonary disease. In addition, according to this organization, some of the most common chronic respiratory diseases are asthma, chronic obstructive pulmonary disease (COPD), respiratory allergies, occupational lung diseases, and pulmonary hypertension. Furthermore, one of the main risk factors, besides tobacco smoking and allergens, is indoor air pollution which is clearly associated with household overcrowding (WHO, n.d, p. 1).

In our data set, there are 13.719 households out of which 7.325 (53.4%) have at least one child that has suffered any respiratory disease in the last two weeks widespread in heterogeneously in the territory (see Figure 4.2), while the other 6.394 households do not have (46.6% of households). In 2006, 59.8% of households had at least one child with respiratory disease while the other 40.2% did not. In 2014, 50.1% of households had at least one child with any respiratory problem while the other 49.9% did not. Clearly, there is a decrease of 9.7% in the percentage of children with a respiratory disease.

In terms of individuals, 7,547 children of the sample are living in overcrowded households (42.71%); meanwhile, 10,150 0-to-5-year-old children are not in overcrowded households.

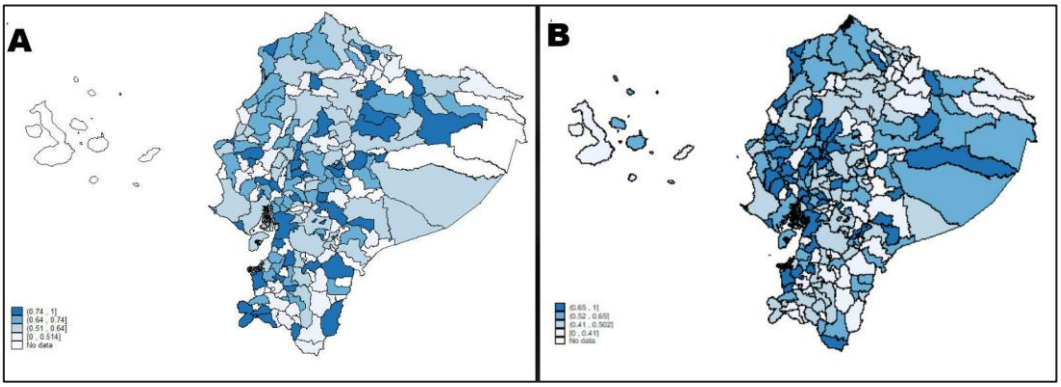

Figure 4.2 Proportion of households with children with respiratory diseases at canton level in 2006 (A) and 2014 (B).

In the explanatory analysis of correlation (see Appendix 4.1), some relationships can be highlighted. For instance, the correlation coefficient between overcrowding and the Highland region is -11%, which suggests that this region faces fewer overcrowding issues than other Ecuadorian regions. This can be explained by the growing urbanization progress of this region. Additionally, the correlation between the overcrowding variable and the type of dwelling categories such as ranch or shack are positive. In fact, we observe coefficients of correlation of 22% and 25%, respectively. Furthermore, the correlation coefficient between the overcrowding variable and the house category is -24%. This suggests that overcrowding is directly related to infrastructure conditions (materials of construction, basic services, etc.).

Regarding the ethnic self-identification, the ratio between mestizo and overcrowding is negative (-17%), while the correlation between indigenous ethnic and overcrowding is positive (17%). It shows that overcrowding is a phenomenon that mainly affects ethnic minority families.

In the Appendix 4.1, the correlation matrix between explanatory variables and control variables is presented. None of the cross-correlations is over 28%, so multicollinearity issues can be discarded a priori between these variables.

4.4 Methodological Approach

4.4.1 Binary choice models

In order to perform the empirical analysis, a model of binary choice is conducted. These models are designed to model the choice between two discrete alternatives (Verbeek, 2004). Thus, the binary choice model describes the probability of the event $Y_i = 1$. In our case, $Y_i = 1$ if there is at least one child who has had respiratory disease in the last 2 weeks in a dwelling or $Y_i = 0$, otherwise.

Specifically, a logit model is conducted. The logit model relates the endogenous variable Y_i with the explanatory variables X_{ki} through a logistic distribution function, so that the specification of this model is given as follows

$$Prob(Y_i = 1|x_1, x_2, x_3, \dots, x_k) = \frac{e^z}{1+e^z} \qquad (4.1)$$

where

$$Z = \beta_0 + \beta_1 Overcrowding_i + \beta_2 Area_i + \beta_3 \ln(Household\ Income)_i + \beta_4 Overcrowding * area_i + \beta_5 Region_i + \beta_6 Rainy_i + \beta_7 Ethnic_i + \beta_8 Type_i + \beta_9 Tenancy_i + \beta_{10} Dewormed_i + \beta_{11} Vitamine\ A_i + \beta_{12} \mathrm{D}_{2014_i} + \mu_i$$

4.4.2 Dependent Variable

The dependent variable is dichotomous. It takes the value of 1 if there is at least one child who got a respiratory disease in the last two weeks in the household or 0 otherwise. Taking into account that airborne diseases are part of the most prevalent conditions in overcrowding environments, then studying respiratory disease persistence on children in overcrowding households seems accurate.

4.4.3 Control variables

Regarding our research hypotheses related to household overcrowding, there are two key variables that have to be analyzed deeply. The first one is the household overcrowding variable, whose coefficient is expected to be positive. Baker *et al*., (1998) and Mann *et al*., (1992) indicate that if a child lives in a household in overcrowding condition, then probability of the child contracting a respiratory disease increases. Overcrowding is measured as a dummy variable that takes the value of 1 if the household is overcrowded and 0 otherwise. We use the ECLAC definition in order to characterize a household as overcrowded. In such a sense, we consider a household as overcrowded if there are more than three people per bedroom in the dwelling.

The other key variable is, indeed, the interaction between household overcrowding and the urban area (dichotomous variable that take the value of 1 if the dwelling is settled in the urban and 0 otherwise) variables. Authors such as Peters *et al*., (1996), Braun *et al*., (1992); Sobral, (1989); Romieu *et al*., (1992); Jaakkola *et al*. (1991) and Dockery *et al*. (1989) indicate that there is a negative effect deriving from air pollution in urban concentrations on respiratory diseases. The conditions of urban areas with intense traffic in

roads and pollution from concentration of industries, combined with household overcrowding might cause negative effects on public health, children being the most affected due to their high vulnerability (Goux and Maurin, 2005). Hence, if a child lives in overcrowding conditions in an urban area, the probability of contracting a respiratory disease should be higher. Consequently, we expect a positive sign in the estimator which would confirm the positive relationship between household overcrowding in urban areas and the probability that a child contracts a respiratory disease.

Regarding control variables, variables related to children's family and social environment characteristics as well as health care are included in the empirical section. In that sense, we use a control variable for the level of income of the household. It collects information about the total monthly income received by the household and it is measured in US dollars. Nevertheless, considering the heterogeneity of this variable, we use its logarithm in the empirical estimation.

Moreover, we also control for the geographical region where the household is settled. The category of reference is Highlands and the other possible categories are Coast, Amazon and Galápagos.

In addition, it is important to consider that seasonal factors may explain the probability of children having respiratory disease. In fact, Kuehn, (2003) suggests that flu viruses may survive better and spread easier in dry conditions. Then, variable rainy is included in the model as a control. It is included in the estimation as a dummy variable that collects information about the season of the year in which the survey was conducted. In Ecuador, seasons depend on the levels of rain; then, the seasons are rainy and dry[14]. Those seasons vary across the three main natural regions: Coast region, Highlands region and Amazon region. In the Coast region, the rainy season takes place from December to May; in the Highland region, it takes place from November to May; whereas in the Amazonian region, it takes place from February to May. The variable rainy takes the value of 1 if the

[14] Contrary to the countries that are located in the Tropic of Cancer and Capricorn that have the 4 seasons in the year (summer, winter, autumn and spring), Ecuador only has two seasons due to its location. Ecuadorian seasons do not depend on the level of sun light and inclination of the Earth like in Europe or the U.S., but it depends on the levels of rain. In that sense, the Ecuadorian Military Geographic Institute differentiates two seasons: the dry season and the rainy one.

information was collected during the rainy season and 0 if the information was collected in the non-rainy season. We expect a negative sign in the estimated parameter, i.e. the probability of a child of becoming ill with respiratory disease increases when the weather is dry.

Additionally, we have included the categorical variables dwelling type and regime of tenancy. Leventhal and Newman (2010) show that the quality of housing and housing ownership are also key issues that determine the integral development of children, specially their physical health. Fisk *et al*., (2007) indicate that the presence of mold and moisture in the home can affect the physical health of children. Consequently, we expect that if the conditions of the house are better, then the probability to contract a respiratory disease decreases. On the other hand, if the house is owned or the family does not spend money in rent, the probability to contract a respiratory disease decreases. The dwelling type variable takes a category of reference the house and the other possible options are apartment, shared flat, and shack; meanwhile, regime of tenancy has as category of reference the partially paid dwelling and the other possible options are rented dwelling, antichresis, fully paid dwelling, ceded dwelling and residence in exchange of services.

Regarding variables specifically related to the child, we include a categorical variable representing the ethnic self-identification of the household. The category of reference is mestizo while the other possible categories are indigenous, white, afro-Ecuadorian, mulatto, and others. In addition, we include the variables vitamin A and Deworming that provides information about the health care in the dwelling. Each variable takes the value of 1 if the child has received vitamin A in the last year and being dewormed, respectively, or 0 otherwise. Indeed, this variable may be seen as a proxy of the parents' care of their children. In other words, a child who has received vitamin A and/or is dewormed indicates that his parents take more care of their children compared to those parents who do not provide this vitamin and deworm to their children. We expect that if children receive vitamins and/or are dewormed, then the probability of having respiratory disease would be lower compared to those who did not received it.

Finally, we include a dummy variable that takes the value of 1 for all observations that were collected in 2014 and 0 for those collected in 2006. Consequently, it captures the differential behavior in 2014 compared to 2006.

4.4.4 Results

We propose to apply a strategy of conditioned regressions that allows us to verify variations of the estimates when interest variables are added. Table 4.1 presents the results.

All estimations have been done considering robust errors to correct possible heteroskedasticity problems. Thus, it is possible to appreciate that the there is no significant variations neither in the signs of the parameters nor in their individual statistical significance among estimations when independent variables are added. Clearly, estimation (4), which includes all our independent variables, is our preferred estimation since it presents the highest goodness of fit and lowest information criteria.

Regarding the estimation results, our first variable of interest, overcrowding, presents a significant at α=1% and positive coefficient. This means that if a household is overcrowded, the probability of having children with respiratory disease in this household would be 3.1% higher compared to a household which is not overcrowded. Therefore, our first research hypothesis is confirmed.

Regarding the Overcrowding*Urban interaction variable, the estimated coefficient is positive and statistically significant at α=5%. The magnitude of its effect is clearly higher than the effect of household overcrowding alone. This indicates that when a child lives in an urban area in an overcrowded household, the probability that a least one child in these conditions contracts respiratory disease is 0.6% higher compared to a child who lives in a rural area and in a non-overcrowding situation. This result could be explained by the fact that in urban areas, people are more exposed to agglomerations that force them to be in constant contact with many people in cities, for example public transportation, place of work or school. Thus, people in urban areas with high population density are more likely to be affected by air transmitted diseases such as flu. Furthermore, overcrowded dwellings might be located at the suburbs of cities which are very likely to be characterized by the lack of basic services and sanitation, then disease transmissions can be spread more easily.

Table 4.1 Results of estimations

Dep. Var Respiratory Desease	(1)		(2)		(3)		(4)	
Variable	**β**	**dy/dx**	**β**	**dy/dx**	**β**	**dy/dx**	**β**	**dy/dx**
Area (Urban=1)	-.078662** (.038775)	-.0188881			-.062597 (.038896)	-.0150046	-.123591*** (.046459)	-.0296149
Overcrowding			.203416*** (.035774)	.0487659	.199121*** (.03588)	.0477294	.130317*** (.045859)	.0312265
Area*Overcrowding							.156044** (.064715)	.0373912
ln(Household income)	-.057013*** (.011694)	-.0136897	-.053618*** (.011323)	-.0128541	-.04834*** (.01178)	-.011587	-.047668*** (.011776)	-.0114222
Dewormed	.032639 (.031475)	.0078373	.036422 (.031508)	.0087316	.036895 (.031514)	.0088437	.035801 (.031522)	.0085786
Vitamin A	.072943** (.032477)	.0175149	.075458** (.032471)	.0180899	.073822** (.032494)	.0176951	.072062** (.032509)	.0172676
Rainy season	-.185464*** (.031139)	-.0445329	-.185361*** (.031154)	-.0444375	-.18671*** (.031166)	-.0447543	-.186066*** (.031175)	-.0445851
Dummy 2014	-.417354*** (.036484)	-.1002135	-.390428*** (.036621)	-.0935992	-.39487*** (.036727)	-.0946504	-.39854*** (.036764)	-.0954983
Ethnics	Yes		Yes		Yes		Yes	
Type of dwelling	Yes		Yes		Yes		Yes	
Regime of tenancy	Yes		Yes		Yes		Yes	
Natural region fixed effects	Yes		Yes		Yes		Yes	
N	17,717		17,717		17,717		17,717	
Wald chi2(22)	431.71		459.72		461.64		467.83	
Prob > chi^2	0.0000		0.0000		0.0000		0.0000	
R squared	0.0185		0.0197		0.0198		0.0200	
Log pseudolikelihood	-11,924.296		-11,910.271		-11,908.98		-11,906.08	
-2(Log likelihood)	23,848.592		23,820.542		23,817.96		23,812.16	
Correctly predicted	57,98%		57.87%		58.04%		58.32%	
AIC	23896.59		23868.54		23867.96		23864.16	
BIC	24083.37		24055.32		24062.52		24066.5	

[+] For full-report of the estimations, with all covariates coefficients, see Appendix 4.3.

The control variables present the expected results. Then, the coefficient of the household income variable is statistically significant (α=1%) and negative. Thus, if the household income increases in 1%, the probability that at least one child in this household contracts respiratory disease decreases in 1.1%.

It is possible to see the estimates for ethnics, type of dwelling, regime of tenancy and region in Appendix 4.3. Regarding the control variable Region, we have set Highlands as the category of reference. Our estimation results show that if the household is settled in the Coast or in the Amazon region, therefore it is more likely that at least one child in this household contracts respiratory disease compared to a household settled in the Highlands. The probability increases 8.1% in the Coast region and 4.3% in the Amazon region.

The coefficient of the rainy season variable is statistically significant at α=1% and it has a negative sign which indicates that the probability that at least one child in the household contracts respiratory disease decreases 4.5% in the rainy season of the year. Clearly, this result is according to the literature that suggests that the flu virus spreads easier in dry conditions.

In the case of the ethnic self-identification of the householder variable, the marginal effect shows that, when the householder self-identifies as indigenous the probability that a child contracts respiratory disease increases 4.4% with respect to a householder who self-identifies as mestizo. On the other hand, the rest of the categories in this case are not statistically significant at any level.

The estimated coefficients for all the categories of the dwelling type variable are not statistically significant at any level, which means that the type of dwelling does not influence on the probability of catching respiratory disease for children.

The estimated parameters for the categories rented dwelling, fully paid dwelling, ceded dwelling and residence in exchange of services present a negative sign; however, only the last-mentioned category is individual statistically significant at α=5% while the others are not significant at any level. In fact, the probability that a child contracts respiratory disease is lower when housing is provided in exchange of services. The marginal effect shows that the probability decreases 7.5%.

The estimated coefficient of the variable Vitamin A is significant only at α=10% and presents a positive sign, which is unexpected. This could be explained by the fact that all children receive this vitamin for free by public sanity services as well as iron supplements when they have health controls. Since both, vitamin A and iron, have universal consumption in 0 to 5 year old children, they may not have a differential effect on children with or without respiratory disease. Moreover, the estimated parameter of the deworming variable is not significant at any level. Then, we are not able to establish a significant causal or association relationship between child deworming and the prevalence of respiratory diseases.

Finally, the estimated coefficient of the dummy variable D_2014, that captures the differential behavior in 2014 compared to 2006, has a negative sign and it is statistically significant α=1%. This suggests that the probability of having at least one child in the household with respiratory disease has decreased between 2006 and 2014. This diminishing tendency can be attributed to improved sanitation facilities, better cleaning habits, and more information about disease precautions.

4.4.5 Robustness analysis

In the empirical section, we have approached housing overcrowding as a dichotomous variable, then it takes values of 1 or 0 depending on the household in which the child lives is overcrowded or not, respectively. Further, we have previously stated that overcrowding is not the same as density considering that density is a measure of people per area, meanwhile housing overcrowding is trespassing a social acceptable threshold of density. Nevertheless, Solari and Mare (2012) study overcrowding effects on several children outputs –general health, educational achievement, and internal and external measures of children's behavior problems- considering density as a verifier of such effects. The idea behind their selection is to capture the extent of crowding in the home through a continuous measure of people per room (Solari and Mare, 2012). These authors consider that the effects of crowding on a child's wellbeing may begin to affect that child at a higher ratio of people per room, so a continuous measure enables to capture these possibilities. As a matter of robustness exercise, we also present our preferred specification using household density (quotient of people per bedroom) and its logarithm

instead of the dummy overcrowding variable previously used in logistic regressions, in order to approach overcrowding. Results are presented in table 4.2.

Table 4.2 Estimations for robustness analysis.

Dep. Var. Respiratory Disease	**(1)**		**(2)**	
Variable	**B**	**dy/dx**	**B**	**dy/dx**
Area (Urban=1)	-.204162*** (.07318)	-.0488552	-.190664** (.077476)	-.0456014
Household density	.05783*** (.012661)	.0138385		
ln(Household density)			.218604*** (.047259)	.0522837
Density*Area	.053236** (.021272)	.0127391		
ln(Density)*Area			.15183** (.068395)	.0363134
ln(Household income)	-.044892*** (.011767)	-.0107425	-.042778*** (.011784)	-.0102312
Dewormed	.041157 (.031538)	.0098488	.041862 (.031554)	.0100121
Vitamin A	.071454** (.032534)	.0170986	.068478** (.032554)	.016378
Rainy season	-.183362*** (.031195)	-.0438779	-.182895*** (.031203)	-.0437431
Dummy_2014	-.395923*** (.036647)	-.0947428	-.393581*** (.036685)	-.0941334
Ethnics	Yes		Yes	
Type of dwelling	Yes		Yes	
Regime of tenancy	Yes		Yes	
Natural region fixed effects	Yes		Yes	
N	17,717		17,717	
Wald chi2(22)	488.86		499.13	
Prob > chi^2	0.0000		0.0000	
R squared	0.0211		0.0214	
Log pseudolikelihood	-11,893.639		-11,889.647	
-2(Log likelihood)	23787,278		23779,294	
Correctly predicted	58.0%		58.23%	
AIC	23839.28		23831.29	
BIC	24041.62		24033.63	

[+]For full-report of the estimations, with all covariates coefficients, see Appendix 4.4.

The parameters of household density and its logarithm are statistically significant at α=1% in their respective equations. Both robustness specifications corroborate the idea that the higher the level of density in the household (the higher the level of overcrowding), the higher the probability of having a 0-to-5-year-old child with respiratory disease in that household.

4.4.6 Sensitivity analysis

We have performed our basic estimations using pooled data of two independent cross sections of 2006 and 2014 Ecuadorian living condition surveys. Additionally, we included a dummy variable for all 2014 observations in order to capture the differential behavior in the origin between the two subsamples. Nevertheless, it may be interesting to see the preferred specification for each cross section separately.

Table 4.3 Sensitivity analysis estimations.

Dep. Var. Respiratory Disease	**Year 2006**		**Year 2014**	
Variable	**β**	**dy/dx**	**β**	**dy/dx**
Area (Urban=1)	-.099922 (.08644)	-.0230515	-.142936** (.055852)	-.0348212
Overcrowding	.130426 (.082909)	.0300884	.129027** (.056321)	.0314327
Area*Overcrowding	.146244 (.111921)	.0337375	.15678* (.081224)	.0381937
ln(Household income)	-.05383*** (.020232)	-.012419	-.044303*** (.014575)	-.0107928
Dewormed	.084963 (.054359)	.0196003	.01679 (.038861)	.0040903
Vitamin A	.108999* (.062188)	.0251455	.049723 (.038523)	.0121133
Rainy season	-.109354** (.053514)	-.0252273	-.218453*** (.038549)	-.0532183
Ethnics	Yes		Yes	
Type of dwelling	Yes		Yes	
Regime of tenancy	Yes		Yes	
Natural region fixed effects	Yes		Yes	
N	6,244		11,473	
Wald chi2(24)	95.96		256.92	
Prob > chi^2	0.0000		0.0000	
R squared	0.0119		0.0168	
Log pseudolikelihood	-4,081.55		-7,804.28	
-2(Log likelihood)	8163,1		15608,56	
Correctly predicted	62.57%		56.05%	
AIC	8,211.11		15,658.56	
BIC	8,372.855		15,842.25	

[+]For full-report of the estimations, with all covariates coefficients, see Appendix 4.5.

One of the advantages of using pooled data for econometric estimation is that the sample size is increased, so that more consistent estimators and statistical tests can be obtained and performed, respectively. In that sense, it is not surprising that none of the parameters of our interest is statistically

significant in the 2006 estimation considering that the sample size is around half of the 2014. On the other hand, the estimators for area and overcrowding are statistically significant at α=5% and the interaction between area and overcrowding is statistically significant at 10% in the 2014 subsample. Bering these results in mind, we can infer that the household overcrowding level, the settling area and the interaction of both of them have influence on the persistence of respiratory diseases on 0-to-5-year-old children.

4.5 Discussion and conclusions

Our findings indicate that housing overcrowding affects children´s health. Our results indicate that if a household is overcrowded, then the probability that at least one child contracts respiratory disease increases 3.1%. The most interesting finding is that this probability is even stronger (3.7%) when household is in the urban area with respect to a household that is not overcrowded and located in a rural area.

Furthermore, the results indicate that there are external factors, such as the residence of the household or the climate that influence more than internal factors such as household income or child health care on children's respiratory disease incidence. In fact, being located in the Coastal region is a characteristic that favors the respiratory disease prevalence among children. In addition, if a household faces rainy seasons, the probability that at least one child contracts respiratory disease increases 4.5%.

Clearly, our findings also have public policy implications. There is no doubt that the improvement of population health levels is directly associated with acceptable dwelling and access to services of quality. Thus, the channel in which the public policy conducts their health prevention efforts should be addressed to guarantee not only the adequate space for living, but also construction materials and services that allow people to develop in adequate conditions. Furthermore, these policies could be carried out by local or regional governments since, as our results shows, the effects -and also the causes- have a heterogeneously effect across the territory.

Finally, this research is not free of limitations. The whole childhood is conformed by children between 0 and 12 years old. Nevertheless, only households with children between 0 and 5 years old were studied, mainly due to the availability of data.

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Appendix Chapter 4

Appendix 4.1. Correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1.Overcrowding	1												
2.Area	-0,02**	1											
3.Rainy Season	0,01	-0,02	1										
4.Sierra region	-0,11***	0,03***	0	1									
5.Coast region	0.07***	-0,01	-0,03***	-0.67***	1								
6.Amazon region	0,06***	-0,03***	0,03***	-0,43***	-0,35***	1							
7.Galapagos	-0,05***	0,03***	-0,01	-0,09***	-0,07***	-0,05***	1						
8.Mestizo	-0,17***	0,03***	-0,01	0,11***	0,06***	-0,23***	0,04***	1					
9.Indigenous	0,17***	-0,04***	0,03***	0,03***	-0,33***	0,38***	-0,02***	-0,71***	1				
10.White	0	0,01	-0,01	-0,03***	0,06***	-0,03***	-0,01*	-0,29***	-0,09***	1			
11.Afroecuadorian	0,03***	0,01	0	-0,08***	0,14***	-0,06***	-0,01	-0,24***	-0,08***	-0,03***	1		
12. Mulatto	0,03***	-0,02**	-0,04***	-0,16***	0,23***	-0,08***	-0,01	-0,31***	-0,10***	-0,04***	-0,03***	1	
13.Other ethnic	0,02***	0	0,01	-0,08***	0,12***	-0,05***	-0,01	-0,23***	-0,07***	-0,03***	-0,03***	-0,03***	1
14.House	-0,24***	0	0,02**	0,02**	-0,05***	0,04***	-0,02***	0,03***	0,02**	-0,03***	0	-0,06***	-0,02**
15.Appartment	-0,16***	-0,01	-0,01	0,06***	0,02**	-0,11***	0,08***	0,12***	-0,15***	0,04***	-0,02**	-0,02**	0
16.Flat share	0,19***	0,03***	-0,01	0,06***	-0,05***	-0,01	-0,01	0,02**	-0,03***	0,02**	0,01	-0,02**	0,02**
17.Shack	0,25***	0	0,02**	0,04***	-0,02***	-0,02*	-0,02***	-0,04***	0,05***	0,01	0	-0,01*	-0,01
18.Ranch	0,22***	-0,02**	-0,04***	-0,20***	0,14***	0,10***	-0,03***	-0,18***	0,13***	-0,02**	0,02**	0,16***	0,03***
19.Paying for house	-0,02**	-0,04***	0	-0,08***	0	0,10***	-0,03***	-0,12***	0,18***	-0,05***	-0,01	0,18***	-0,02*
20.House for rent	-0,02*	0	0,01*	0,02**	-0,01	-0,01*	0	0,02**	-0,02*	-0,01	-0,01	-0,01	-0,01
21.Antichresis	-0,06***	-0,01	-0,01	0,02**	0,01	-0,03***	-0,01	0,05***	-0,06***	-0,01	0	-0,01	0,02**
22.Own house	-0,05***	0,05***	-0,01	0,09***	-0,06***	-0,05***	0,05***	0,11***	-0,14***	0,03***	0	-0,04***	0,02*
23.Ceded house	0,08***	0,01	0,02**	0,01	0,04***	-0,06***	-0,01	0,02***	-0,06***	0,02**	0	0,03***	0,02***
24.House by services	0,04***	-0,03***	-0,03***	-0,01	0,03***	-0,02**	0	-0,01	-0,03***	0,03***	0,04***	0,03***	-0,01
25.Vitamin A	-0,02*	-0,01	0,03***	-0,01	-0,06***	0,07***	0,03***	-0,03***	0,04***	-0,03***	-0,04***	0,06***	-0,01
26.Dewormed	-0,03***	0,01	-0,01	-0,14***	0,12***	0,04***	0,01	0,05***	-0,11***	0.03***	0.02**	0,04***	0,03***

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27. ln(Household income)	-0,24***	0,01*	-0,03***	0,05***	-0,02**	-0,06***	0,10***	0,16***	-0,17***	-0,02***	-0,03***	0	0	

Variables	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
14.House	1													
15.Appartment	-0,53***	1												
16.Flat share	-0,37***	-0,09***	1											
17.Shack	-0,40***	-0,10***	-0,07***	1										
18.Ranch	-0,40***	-0,10***	-0,07***	-0,08***	1									
19.Paying for house	-0,06***	-0,14***	-0,06***	-0,03***	0,04***	1								
20.House for rent	-0,03***	0,05***	0,01	-0,01	-0,01	-0,04***	1							
21.Antichresis	0,05***	-0,02**	-0,04***	-0,02**	-0,01	-0,20***	-0,01	1						
22.Own house	-0,30***	0,36***	0,27***	-0,03***	-0,12***	-0,53***	-0,01*	-0,08***	1					
23.Ceded house	-0,09***	0,01*	0,09***	0,06***	0,01	-0,57***	-0,02*	-0,08***	-0,23***	1				
24.House by services	-0,01	-0,02**	0,03***	0,03***	-0,02**	-0,19***	-0,01	-0,03***	-0,08***	-0,08***	1			
25.Vitamin A	0,01	-0,06***	-0,01	0,02**	0,05***	0,01	0	-0,02*	-0,02***	0,03***	-0,01	1		
26.Dewormed	0,02**	0	-0,01	-0,02***	0	-0,02*	0	0,02**	-0,01	0,01*	0,02**	0,11***	1	
27. ln(Household income)	-0,02***	0,17***	-0,01*	-0,07***	-0,11***	-0,09***	0,01	0.08***	0,14***	-0,05***	0,01	0,02**	0,03**	1

Note: The correlation coefficients were calculated using Tau-b Kendall's correlation.

Appendix 4.2.A. Descriptive statistics of continuous control variables

Variable	Mean	Q1	Median	Q3	Std. Dev.	Max.	Min.
Household Density	3.092	2	2.74	4	1.64	0.50	15
ln(household Density)	1.01	0.69	1.01	1.38	0.47	-0.69	2.71
Household income	444.38	60	240	517.62	972.58	50,777.51	1
ln(Household income)	5.18	4.09	5.48	6.24	1.524	10.84	0

Appendix 2.B. Frequencies of categorical control variables

Vitamin A				Dewormed			
Cat.	**Freq. (%)**	**Share overcrowd. households (%)**	**Households with children with respiratory diseases (%)**	**Cat.**	**Freq. (%)**	**Share overcrowd. households (%)**	**Households with children with respiratory diseases (%)**
Yes	44.1	43.1	56.3	Yes	47.7	46.2	48.6
No	55.9	56.9	43.7	No	52.3	53.8	51.4
Season				**Dummy_2014**			
Cat.	**Freq. (%)**	**Share overcrowd. households (%)**	**Households with children with respiratory diseases (%)**	**Cat.**	**Freq. (%)**	**Share overcrowd. households (%)**	**Households with children with respiratory diseases (%)**
Dry season	42.8	56.9	59.0	2006	35.24	42.5	39.3
Rainy season	57.2	43.1	41.0	2014	64.76	57.5	60.7
Ethnic self-identification				**Natural Region**			
Cat.	**Freq. (%)**	**Share overcrowd. households (%)**	**Households with children with respiratory diseases (%)**	**Cat.**	**Freq. (%)**	**Share overcrowd. households (%)**	**Households with children with respiratory diseases (%)**
Mestizo	68.96	59.9	67.0	Highlands	45.4	38.9	42.1
Indigenous	18.43	26.0	19.5	Coast	35.4	39.5	38.3
White	3.69	3.6	3.7	Amazon	18.2	21.2	18.8
Afro-Ecuadorian	2.56	3.1	2.9	Galapagos	1.0	0.4	0.8
Mulatto	2.30	2.7	2.6				
Other	4.06	4.7	4.2				
Type of Dwelling				**Regime of tenancy**			
Cat.	**Freq. (%)**	**Share overcrowd. households (%)**	**Households with children with respiratory diseases (%)**	**Cat.**	**Freq. (%)**	**Share overcrowd. households (%)**	**Households with children with respiratory diseases (%)**
House	67.8	54.7	67.1	Own paying dwelling	57.5	56.3	58.5
Apartment	11.9	5.8	11.2	Rented	0.2	0.0	0.1
Shared flat	6.0	11.2	6.1	Antichr.	2.7	1.6	2.7
Shack	7.1	14.6	7.5	Fully paid dwelling	17.4	15.3	16.6
Ranch	7.2	13.7	8.1	Ceded	19.5	23.3	19.6
				Exchange for services	2.7	3.5	2.5

Appendix 4.3. Results of estimations

Dep. Var Respiratory Disease	(1)		(2)		(3)		(4)	
Variable	**B**	**dy/dx**	**B**	**dy/dx**	**B**	**dy/dx**	**B**	**dy/dx**
Area (Urban=1)	-.078662** (.038775)	-.0188881			-.062597 (.038896)	-.0150046	-.123591*** (.046459)	-.0296149
Overcrowding			.203416*** (.035774)	.0487659	.199121*** (.03588)	.0477294	.130317*** (.045859)	.0312265
Area*Overcrowding							.156044** (.064715)	.0373912
ln(Household income)	-.057013*** (.011694)	-.0136897	-.053618*** (.011323)	-.0128541	-.04834*** (.01178)	-.011587	-.047668*** (.011776)	-.0114222
Dewormed	.032639 (.031475)	.0078373	.036422 (.031508)	.0087316	.036895 (.031514)	.0088437	.035801 (.031522)	.0085786
Vitamin A	.072943** (.032477)	.0175149	.075458** (.032471)	.0180899	.073822** (.032494)	.0176951	.072062** (.032509)	.0172676
Rainy season	-.185464*** (.031139)	-.0445329	-.185361*** (.031154)	-.0444375	-.18671*** (.031166)	-.0447543	-.186066*** (.031175)	-.0445851
Dummy_2014	-.417354*** (.036484)	-.1002135	-.390428*** (.036621)	-.0935992	-.39487*** (.036727)	-.0946504	-.39854*** (.036764)	-.0954983
Ethnic self-identification (category of reference= Mestizo)								
Indigenous	.202476*** (.046898)	.0483395	.184283*** (.046841)	.0439691	.173842*** (.047287)	.0414913	.17942*** (.047321)	.0427983
White	-.082847 (.082278)	-.0200993	-.07704 (.082411)	-.0186519	-.076221 (.082465)	-.0184471	-.072979 (.082601)	-.0176562
Afro-Ecuadorian	.180438* (.10237)	.0431505	.177826* (.102227)	.042449	.176591* (.102349)	.0421388	.176843* (.102396)	.0421917
Mulatto	.195091* (.105168)	.046603	.18107* (.104962)	.0432129	.187222* (.105116)	.0446398	.179994* (.105284)	.0429333
Other	.060957 (.082119)	.0146921	.068672 (.081619)	.0165121	.058177 (.081942)	.0139913	.060325 (.081927)	.0145035

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Type of dwelling (category of reference= House)							
Apartment	.028084 (.055156)	.0067646	.021682 (.054275)	.0052006	.038283 (.055213)	.0091748	.049248 (.055509)	.0117893
Shared flat	.117798* (.071047)	.028217	.009252 (.072138)	.0022208	.025573 (.072899)	.0061333	.00153 (.073682)	.0003674
Shack	.124915** (.061328)	.029907	.019979 (.063972)	.0047926	.025425 (.064062)	.006098	.019848 (.064125)	.0047597
Ranch	.1568** (.064452)	.0374547	.080779 (.065976)	.019304	.079062 (.065978)	.0188991	.084623 (.065914)	.0202114
Regime of Tenancy (category of reference= Own paying dwelling)								
Rented	-.294636 (.487159)	-.0714604	-.296688 (.490086)	-.071829	-.275828 (.490952)	-.0667453	-.268729 (.493181)	-.064995
Antichresis	.075386 (.09619)	.0179928	.07146 (.095917)	.0170206	.083242 (.096179)	.0198124	.085514 (.09633)	.0203406
Fully paid dwelling	-.016908 (.050124)	-.0040597	-.038739 (.049227)	-.0092923	-.023075 (.05013)	-.0055302	-.026171 (.050216)	-.0062708
Ceded	-.010687 (.041617)	-.0025651	-.024991 (.041728)	-.0059898	-.023178 (.041733)	-.005555	-.025351 (.041738)	-.0060741
Exchange for services	-.287537*** (.096021)	-.0697308	-.28399*** (.095364)	-.0687398	-.30238*** (.096097)	-.0732017	-.301508*** (.096039)	-.0729646
Natural region (category of reference= Highlands region)								
Coast region	.375758*** (.038922)	.0903747	.334227*** (.037956)	.0803459	.35004*** (.03925)	.084091	.343544*** (.039352)	.0825157
Amazon region	.203237*** (.045716)	.0494163	.194961*** (.045789)	.0472798	.192352*** (.045811)	.0466681	.192458*** (.045801)	.0466669
Galapagos	.060482 (.154475)	.0147881	.039297 (.155946)	.00959	.050776 (.155706)	.0123889	.05422 (.156259)	.0132215
N	17,717		17,717		17,717		17,717	
Wald chi2(22)	431.71		459.72		461.64		467.83	
Prob > chi^2	0.0000		0.0000		0.0000		0.0000	
R squared	0.0185		0.0197		0.0198		0.0200	

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Log pseudolikelihood	-11,924.296	-11,910.271	-11,908.98	-11,906.08
-2(Log likelihood)	23,848.592	23,820.542	23,817.96	23,812.16
Correctly predicted	57,98%	57.87%	58.04%	58.32%
AIC	23896.59	23868.54	23867.96	23864.16
BIC	24083.37	24055.32	24062.52	24066.5

Appendix 4.4. Estimations for robustness analysis

Dep. Var Respiratory Disease	(1)		(2)	
Variable	**B**	**dy/dx**	**B**	**dy/dx**
Area (Urban=1)	-.204162*** (.07318)	-.0488552	-.190664** (.077476)	-.0456014
Household density	.05783*** (.012661)	.0138385		
ln(Household density)			.218604*** (.047259)	.0522837
Density*Area	.053236** (.021272)	.0127391		
ln(Density)*Area			.15183** (.068395)	.0363134
ln(Household income)	-.044892*** (.011767)	-.0107425	-.042778*** (.011784)	-.0102312
Dewormed	.041157 (.031538)	.0098488	.041862 (.031554)	.0100121
Vitamin A	.071454** (.032534)	.0170986	.068478** (.032554)	.016378
Rainy season	-.183362*** (.031195)	-.0438779	-.182895*** (.031203)	-.0437431
Dummy_2014	-.395923*** (.036647)	-.0947428	-.393581*** (.036685)	-.0941334
Ethnic self-identification (category of reference= Mestizo)				
Indigenous	.171468*** (.047237)	.0408618	.167796*** (.047337)	.0399706
White	-.064289 (.082434)	-.0155245	-.064091 (.082594)	-.0154678
Afro-Ecuadorian	.166001 (.102676)	.0395748	.164419 (.102661)	.039176
Mulatto	.180014* (.10503)	.042871	.176881* (.105107)	.0421064
Other	.05761 (.081988)	.0138312	.054241 (.081998)	.0130169
Type of dwelling (category of reference= House)				
Apartment	.045879 (.055384)	.0109877	.050173 (.055515)	.0120012
Shared flat	.081445 (.071287)	.0194628	.055593 (.071469)	.0132932
Shack	.057583 (.062006)	.0137811	.043226 (.062084)	.0103438
Ranch	.118661* (.06457)	.0282856	.109671* (.06458)	.026132
Regime of Tenancy (category of reference= Own paying dwelling)				
Rented	-.257594 (.490202)	-.0622005	-.259267 (.493575)	-.0625724
Antichresis	.105263 (.096711)	.0249702	.117544 (.097128)	.0278349
Fully paid dwelling	-.029165 (.050221)	-.0069802	-.033823 (.050287)	-.0080916
Ceded	-.021611 (.041722)	-.0051701	-.025948 (.041742)	-.0062048

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Exchange for services	-.308668*** (.096044)	-.0745996	-.31396*** (.095972)	-.0758455
Natural region (category of reference= Highlands region)				
Coast region	.342968*** (.039213)	.0822546	.333689*** (.039321)	.0800005
Amazon region	.185609*** (.045845)	.0449521	.181204*** (.045887)	.0438571
Galapagos	.068318 (.155351)	.0166262	.066698 (.155468)	.0162211
N	17,717		17,717	
Wald chi2(22)	488.86		499.13	
Prob > chi^2	0.0000		0.0000	
R squared	0.0211		0.0214	
Log pseudolikelihood	-11,893.639		-11,889.647	
-2(Log likelihood)	23787,278		23779,294	
Correctly predicted	58.0%		58.23%	
AIC	23839.28		23831.29	
BIC	24041.62		24033.63	

Appendix 4.5. Sensitivity analysis estimations

Dep. Var Respiratory Disease	Year 2006		Year 2014	
Variable	**B**	**dy/dx**	**B**	**dy/dx**
Area (Urban=1)	-.099922 (.08644)	-.0230515	-.142936** (.055852)	-.0348212
Overcrowding	.130426 (.082909)	.0300884	.129027** (.056321)	.0314327
Area*Overcrowding	.146244 (.111921)	.0337375	.15678* (.081224)	.0381937
ln(Household income)	-.053833*** (.020232)	-.012419	-.044303*** (.014575)	-.0107928
Dewormed	.084963 (.054359)	.0196003	.01679 (.038861)	.0040903
Vitamin A	.108999* (.062188)	.0251455	.049723 (.038523)	.0121133
Rainy season	-.109354** (.053514)	-.0252273	-.218453*** (.038549)	-.0532183
Ethnic self-identification (category of reference= Mestizo)				
Indigenous	.197574** (.086667)	.0449962	.179366*** (.057148)	.0436788
White	.016059 (.107241)	.0037431	-.22596* (.134)	-.0552836
Afro-Ecuadorian	.091525 (.135877)	.0211405	.318099** (.153403)	.076887
Mulatto	.35043** (.170793)	.0779925	.067917 (.137348)	.0166027
Other	-.976478 (117709)	-.2361578	.020985 (.084156)	.0051352
Type of dwelling (category of reference= House)				
Apartment	-.072516 (.090056)	-.0168239	.132416* (.0706)	.0321954
Shared flat	.011025 (.115152)	.0025323	-.042748 (.09752)	-.0104405
Shack	.015555 (.106914)	.0035707	.034002 (.080777)	.0082929
Ranch	-.180557 (.154321)	-.0423714	.117205 (.073861)	.0285136
Regime of Tenancy (category of reference= Own paying dwelling)				
Rented	.178102 (.590039)	.0404568	-1.56432 (112871)	-.3356898
Antichresis	.043942 (.180693)	.0101608	.097974 (.113764)	.0237438
Fully paid dwelling	.020193 (.085609)	.0046828	-.038775 (.062215)	-.0094446
Ceded	.172754** (.075417)	.0392716	-.122238** (.050907)	-.0298234
Exchange for services	-.403491*** (.147774)	-.0971046	-.209921* (.124203)	-.0512452
Natural region (category of reference= Highlands region)				
Coast region	.246542*** (.0629)	.0567546	.42413*** (.051281)	.1038669
Amazon region	.119538 (.094087)	.0279548	.233863*** (.053651)	.0576089

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Galapagos		.068485 (.157039)	.0168776
N	6,244	11,473	
Wald chi2(24)	95.96	256.92	
Prob > chi^2	0.0000	0.0000	
R squared	0.0119	0.0168	
Log pseudolikelihood	-4,081.55	-7,804.28	
-2(Log likelihood)	8163,1	15608,56	
Correctly predicted	62.57%	56.05%	
AIC	8,211.11	15,658.56	
BIC	8,372.855	15,842.25	

Chapter 5

Conclusions

5.1 Main conclusions

The main goal of this thesis is to give a complete overview of the household overcrowding problem. Even though household overcrowding is a worldwide issue, it affects chiefly developing nations. Thus, we have chosen Ecuador as a unit of analysis to characterize household overcrowding dynamics from its causes to its consequences in a medium-high income level Latin American country.

In such a sense, we started studying fecundity not only considering individual mother's characteristics, but also household and socio-economic aspects in the second chapter of the thesis. We have proved that the level of education of the woman and the household income have negative effects on fecundity. Thus, if Ecuadorian women increase their level of formal education, the fecundity rate decreases. This is clearly associated to the fact that an educated woman has more and better job opportunities that can improve her quality of life. Consequently, she may have a smaller number of children. In the same way, having education guarantees more access to information such as family planning methods. Indeed, women who know about family planning have a smaller expected number of born alive children as we demonstrated empirically in the second chapter.

On the contrary, it has not been possible to find solid empirical evidence to verify that female labor market participation has a negative effect on fecundity. This may be given by the fact that female labor market participation increases in a relatively low speed in Ecuador compared to other countries, so the relationship is not negative in this case of study.

Once we gave a fecundity an overview in the second chapter, we properly get into housing overcrowding in the third chapter. As a matter of fact, we have linked two social problems, overcrowding in the origin and migration, which have been studied separately until now. Our findings indicate that there is a negative association between the analyzed variables. Thus, it is true

that international migration is associated with a reduction of overcrowding levels of the left-behind.

In addition, our findings indicate that the negative effect of international migration on household overcrowding is stronger than the possible positive effect due to delegation of care of children and subsequent extended family formation. Moreover, our results show that there is a positive reverse causality between overcrowding and migration, which means that the higher the overcrowding level in the origin country (or poverty level), the higher the willingness to emigrate. By considering alternative subsamples of households receiving and not receiving remittances, we derive that even if the household has a recent migrant, if he/she does not send remittances, the left-behind household does not present a statistical significant improvement in terms of diminishing overcrowding levels.

Finally, we explore the effects of household overcrowding on children's health in the fourth chapter. Specifically, we have chosen the probability that a child between 0 and 5 years old having a respiratory disease as output variable to verify the effect of household overcrowding. In that line, our results indicate that if a household is overcrowded, then the probability that at least one child get a respiratory disease in such household increases 3.1%. Furthermore, this relationship is even stronger when the child belongs to a household located in the urban area. It is well known that high density of population in urban areas implies "costs" like increasing levels of pollution, traffic jams or higher crime rates. In this study, another negative effect is identified. In such a sense, we have found that an overcrowded household in an urban area increases 3.7% the probabilities of having at least one children with a respiratory disease in the household with respect to a household that is not overcrowded and it is located in a rural area.

Additionally, we have founded empirical evidence that the geographical region in which the household is located is determinant for the prevalence of respiratory diseases. Indeed, being in the Coast region is the characteristic that has the greater level of influence on respiratory disease prevalence among children. If a household is settled in this region, the probability that at least a child in the household gets a respiratory disease increases 8.1% with respect to a household located in the Highlands. These results could indicate that there are external factors, such as the settling place of the household, or the climate that influence more than internal factors such as household

income or child health care. Clearly, our results indicate that these external factors have higher influence on children's respiratory disease incidence than household overcrowding; nevertheless, household overcrowding is a variable in which public policy can intervene and exert influence in order to ameliorate its effect and improve the living condition of the population.

5.2 Policy implications

The results of the thesis offer elements to ground a discussion on policy implications. In that sense, we can extract from second chapter that the access to higher labor positions for women would demand a higher opportunity cost between the time devoted to work and rising children. In this context, Ecuador has a not too developed child rising support system. Even though there are public day care centers, they do not supply the existing demand. Moreover, the private day care centers are not accessible for parents with low income levels. Additionally, children academic activities do not always coincide with parents work schedules, then parents must afford their children extracurricular activities. Without an appropriate support system, the fecundity rate will diminish. Then, consequences like the unviability of the pension system –like in Germany- may take place. A counterexample is the French system (2.1 children per woman in 2016) where parents are helped with the children care not only by the public day care centers, but also with economic subventions. Thus, French and German fecundity rates differ greatly. In such a sense, we want to draw attention to public policy makers to consider increasing female labor market participation and creating integral child rising support systems.

With respect to the third chapter, a good way to improve living conditions of their fellow citizens is to facilitate the conversion of remittances from abroad into housing investments, as dwelling improvements are a first step for improving quality of life and human capital accumulation. Besides, policy makers have to be aware of the poverty trap of many households, as international migration episodes would be more frequent without financial constraints. In fact, improving living conditions in the origin would lower the willingness to migrate and subsequently would limit the negative implications of international migration, such as brain drain or family destructuring.

Regarding the public policy issue of chapter fourth, there is no doubt that the improvement of population health levels is directly associated with acceptable dwelling and access to services of quality. Thus, the channel in which the public policy conducts their health prevention efforts should be addressed to guarantee not only the adequate space for living, but also construction materials and services that allow people develop in adequate conditions. Furthermore, these policies could be carried out by local or regional governments since, as our results shows, the effects -and also the causes- have a heterogeneously effect across the territory.

5.3 Future lines of research

The results of the thesis suggest possible extensions for future research. A first line of research has to see with the Ecuadorian fecundity perspectives. In that sense, its dynamics may require special focus in the long-run. For example, the effect of current implications of fecundity on future social security system and labor supply. Moreover, our results have been obtained using pooled cross sections. However, future research should explore the possibility of using panel data, so we may be able to keep a time tracking of the observations that may lead us to a better approach to the phenomenon.

A second extension should be addressed to isolate the effect of other channels through with migration affects overcrowding, as well as the impact of migration on alternative measures of material and psychological wellbeing.

Regarding the effects of household overcrowding on people wellbeing, future research may consider other output variables and extend the analysis to all household members.

Finally, a third extension of this thesis could be to compare the results for Ecuador to other Latin American countries with similar population and economic characteristics.

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