LUND UNIVERSITY
School of Economics and Management

Master in Economic Development and Growth

Fertility Responses to Short-Term Economic Stress in Mexico 1963-2011

Bardomianno Emmanuel Flores Salgado*
eut12bfl@student.lu.se

Abstract

Another way of assessing living standards in Mexico is presented in this paper by adopting the definition of living standards provided by the Eurasia Population and Family History Project. A discrete-time event-history analysis model is performed in order to analyse and examine the responses of fertility to short-term economic stress during the period 1963 to 2011. The main findings support the idea that fertility responds negatively to economic stress in Mexico but this response is very small. Nevertheless, the effect of economic stress differs by socioeconomic groups and cohorts. In this context, the results suggest that living standards in Mexico are not low or at least not as low as they were in other populations in the past. Yet, further research should be enhanced in order to give a final assessment regarding living standards in the Mexican population.

Key Words: Fertility, Birth Parity, Economic Stress, Living Standards, Mexico.

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Introduction

A very innovative way of depicting living standards of societies is by analysing the extent to which economic hardship affects different demographic outcomes. This has been the approach outlined by the scholars involved in the Eurasia Population and Family History Project (EPFHP). Steaming from the Malthusian legacy in which relationships between economic conditions and demographic responses at an aggregate level were analysed, the EPHFP has gone deeper in explaining the differentiation of these responses according to social class, household context and other dimensions of the individual level (Tsuya et al., 2010). This has been done by adopting a combination of time series and event-history analyses of longitudinal micro-level data that has become a powerful tool in order to understand the differences in well-being of different populations throughout time and across countries.

Living standards are a key factor in every society that not only constraint everyone, but influence the poor more directly and have a strong effect on many aspects of life, amongst which one can find the demographic behaviour. Especially in the past when people lived close to the margin (Bengtsson et al., 2004). Nevertheless, nowadays people´s decisions are still driven by their living standards, perhaps not as strongly as in the past, but still they can have a relevant influence on decisions such as how many children to have or when to have them. The strength of the impact may vary as well across countries. The effects of economic shocks might differ greatly between a developed and a developing country, for instance.

Hence, the importance of being aware of the living standards of a certain population and the differences between groups of this population becomes essential to boost development and to improve living conditions of the least favoured sectors. Especially in countries where development has not been consolidated and that face inequality amongst their inhabitants. Therefore, following the way of measuring living standards proposed by the EPFHP, this study looks at the way economic fluctuations affect the fertility decisions of the Mexican population.

Mexico is a peculiar upper middle-income country characterised by a heterogeneous population. Poverty and inequality are still key players in the day life of the society. In addition to this, the country has suffered very intense economic crises in the last three decades, which might have influenced greatly the fertility decisions of the individuals. At the same time, during this period that covers from 1970 until 2010 the fertility transition was consolidated. Hence, it is of great interest to disentangle the effect that the business cycle had on the decision to bear a child within the population. In particular the research question to address is: *what was the fertility response to economic stress within the Mexican population during the recent past (1963 - 2011)?*

Thus, the main aim of this paper is to analyse how people are affected by economic shocks and which groups are more affected, regarding the demographic outcome of fertility. This in turn can be very relevant to find another way of expressing the living standards of the Mexican population and to shed light on alternative starting points to alleviate certain problems related to poverty or inequality. In addition to this, the comparison of living standards of Mexican population with some other populations of different countries and times can be examined.

The pioneer studies that touched upon the differences in the sensitivity of fertility to short-term economic stress focus their attention to populations in Europe and Asia from 1700 to 1900 (Allen et al., 2005; Tsuya et al., 2010). However, few attempts have been made to assess living standards in current times, particularly regarding the case of Mexico. Also, those studies for the country under analysis consider old datasets and apply different methodologies (Menendez and Adsera, 2009; McKenzie, 2003) which are useful but perhaps not optimal for this kind of studies.

Unlike previous researches, this paper uses a recently released dataset of the Demographic Retrospective Survey which is new on its type and tailored for an event-history analysis. The advantages of this dataset are that it has retrospective information for a large sample, has rich background information of the individuals, and is given in a period-person record file, which makes the data management easier. Therefore by using this new data, this study can update and improve previous efforts to depict a picture of the fertility dynamics and its relationship with economic fluctuations in the case of Mexico.

Consequently, in order to answer the research question this paper uses an empirical approach that consists on estimating different specifications of a discrete time event-history model that follows the methodology suggested by the EPFHP. The main hypothesis to test is that fertility has a positive relationship with the business cycle. This means that in times of prosperity women will opt to have children, whereas in times of economic stress they will prefer to defer or postpone having children. The extent to which they react will indicate or signal the living standards of the population. People postponing childbearing as a response to a minimum change in the economic indicator shows that they do not enjoy high livings standards. On the other hand, if people react slightly or not at all to economic stress, this signals high (or sufficient) living standards.

Therefore, in order to achieve the objectives set, the paper is divided into the following sections. Section I explains the response of fertility to economic stress in a theoretical framework. By doing this, the concept of measuring living standards will be clearer and the reader will get a solid background to analyse fertility in those terms. In addition to that, some previous researches regarding the topic of analysis are discussed. Section II provides a brief analysis of the historical background of Mexico for the period under analysis. Section III describes the data that is used and highlights the considerations to be aware of when proceeding with the analysis. Section IV elaborates on the methodology used and Section V presents the results and discussions together with some robustness checks using other economic indicators as proxies for economic stress. At the end some concluding remarks are mentioned.

I. Theory and previous findings

Theoretical Framework

The theoretical framework that embodies the responses of fertility to economic shocks is quite extended and filters down from the contributions of Malthus, the preconditions of a fertility decline of Coale (1973) and the supply and demand work of Easterlin and Crimmins (1985). All of them are directly related to the behaviour of fertility driven by external circumstances. However, to understand in a better way the approach of this paper the theoretical structure that is going to be analysed is based on the contributions of Bengtsson et al. (2004) which are retaken in Oris et al. (2005) about the definition of living standards. In addition to this, the extended framework of Bongaarts (1978) presented by Bengtsson and Dribe (2002) about the proximate determinants of fertility, is discussed. These two theoretical arguments are the backbone of this paper.

First of all, the concept of standard of living is usually related to the possession of goods or the amount of income (Jenkins, 1991, Lustig, 1990) one gets. Another definition is by using adult heights, which are used as proxies for biological and material standards of living as López-Alonso (2007) does for Mexico. These ways of measuring living standards even though are useful; many times have to deal with underlying problems of causality. Income for example can reflect the level of ability that people have and this can be misleading when trying to capture their living standards. In the case of heights, genetics can be a confounder in order to capture the actual living standards. Moreover, these analyses are carried out in a macro level most of the times and aim to find generalization, giving up the detailed examination of different groups and sectors that can be incorrectly labelled with a certain level of living standards.

However, living standards can also be defined as the ability to overcome short-term economic stress. The latter term refers to the variations in an economic indicator such as food prices or income from one year to another or income losses from the death of an income-generating household head. Bearing that in mind, when an individual can fulfil her long term plans - getting married, having children or simply survive - in the face of acute short-term changes, then this individual have high standard of living. Whereas when sensitivity to short-term economic stress is detected, it can be seen as a revelation of lower standards of living (Bengtsson, 2004).

By using this measure, living standards can be estimated using the analysis of the extent and timing of demographic responses to economic changes. This kind of approach diverges from the macro level, which has been the most recurrent way of analysing living standards, and focuses on the social reactions that occur when facing economic stress by different groups of the population at the individual level. This makes the analysis more appealing and rich in information since special attention is paid to the most vulnerable parts of the population.

To illustrate the reactions of people to economic stress Bengtsson (2004) presents a "social ladder" that includes several ways that individuals use to cope with economic hardship. The further down the list people would have to go, the lower the standard of living. By the contrary, the higher the reaction is located in the list, the higher the standard of living.

Table 1.1 Economic and demographic responses to short-term economic stress
1. Spending of savings (foodstuff, money, and saleable items)
2. Borrow from kin, neighbours, employer, church or bank
3. Receive relief (rent, tax, poor)
4. Adjust household labour supply (out-migration of family members)
5. Postpone consumption (delay marriage and births)
6. Reallocate consumption within the family (mortality)

Source: table 2.1 from Bengtsson (2004), pp.35

Table 1.1 summarizes very well the reactions to economic fluctuations by individuals and that are still valid for recent times. When people enjoy from high living standards, which imply having collateral to get loans or ability to save, the responses to an economic shock can stop in the first or second row of the table. However, the poorest sectors of the society can reach even the last row of it. Thus, the sensitivity to economic stress can be a good predictor of living standards. In this paper the analysis will be centred at the 5th row of the table, specifically to the decision of bear a child. This will be the baseline to decide and compare living standards of the Mexican population and to see the reactions of different groups within this population.

In previous studies about living standards, authors pay special attention to the behaviour of demographic outcomes such as: mortality, marriage, migration and fertility. However, the fertility responses to economic stress in those studies were much stronger than mortality or nuptiality (Galloway, 1988; Lee, 1990 cited in Bengtsson and Dribe, 2006). Moreover, fertility responses are expected to be clearer and more reflective of deliberate behaviour.[1] Therefore, it is fair to state that fertility responses can be tractable in the short run and can be easier to capture, since throughout the previous studies this demographic indicator was the most sensitive of all of them to economic stress. In any case, assessing changes in fertility can be a good beginning to start with when trying to analyse living standards for the Mexican society.

In addition to this, when using this framework, previous studies have found clear evidence of responses of fertility, mortality and nuptiality to economic stress in preindustrial societies of different countries (Bengtsson and Dribe, 2006). And this situation is very similar to developing countries of today (Lee, 1990 cited in Bengtsson and Dribe, 2006). Therefore, it is valid to use this framework to analyse the demographic responses of contemporaneous societies, especially in developing countries, such as Mexico.

Regarding the reasons why fertility should respond to economic shocks, one can argue the following. Delaying a birth benefits the household or women in 2 main ways. The first one is the postponement of an increase in consumption due to one more member in the household. And the second one is to avoid the loss of a woman´s labour (Lee et al., 2010). These are the two main direct benefits from postponing childbearing and that can offset the effects of

[1] Lee et al. (2010) mention that in the case of comparing mortality and fertility.

economic stress. However, the main interest lays in the mechanism behind the response of fertility to economic stress.

Bengtsson and Dribe (2002) present a very useful conceptual framework that steams from Bongaarts (1978) and Davis and Blake(1956) contributions. It consists of an extended version of the proximate determinants of fertility. What these scholars do is to summarize the way marital fertility[2] may respond to short-term economic stress and it is depicted in the following figure.

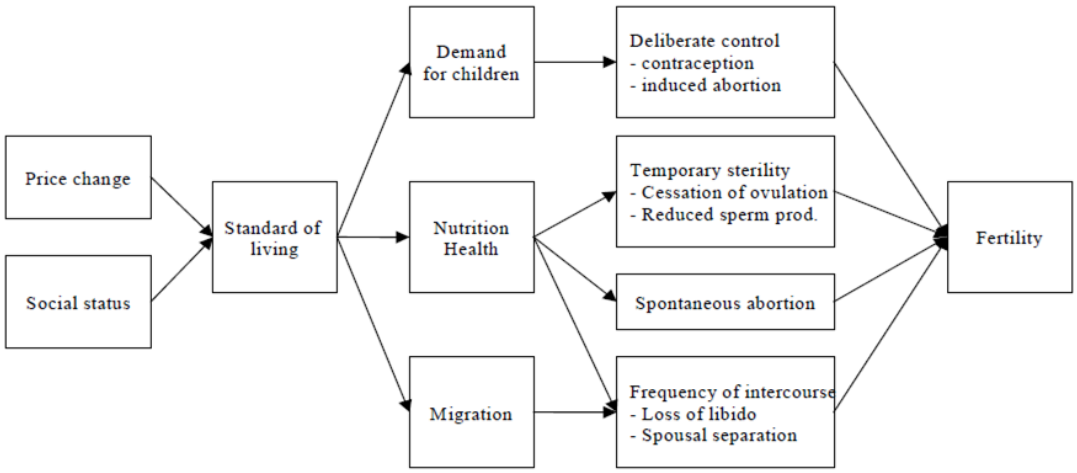


Figure 1.1. Model of marital fertility response to economic stress (Bengtsson and Dribe, 2002)

There are basically 3 ways in which economic stress can affect fertility; the first one is by postponing childbearing. It is sensible to avoid having children while facing economic hardship. The second one is by migrating to find a job or to get a better source of income. This separates spouses or couples causing a reduction in fertility. Finally, if the shock is really big and the living standards are very low, even nutrition of the individuals can be affected because of an increase in prices or loss of income due to unemployment, etc. Therefore, this malnutrition may affect fertility through the cessation of ovulation, loss of libido and reduced sperm production (Bengtsson and Dribe, 2002). In addition to these three, it is also important to take into consideration indirect factors such as socioeconomic, cultural or environmental ones that can have an influence in the proximate determinants.

Subjected to a change in economic conditions, the demographic responses are evident. Nevertheless, these might not be entirely a free decision of the individuals. Thus, these responses could also be classified in voluntary and involuntary in terms of Oris et al. (2005) or intentional and unintentional in terms of Bengtsson and Dribe (2002). The intentional responses refer to the deliberate postponement of childbearing. Whereas the unintentional ones embody decisions or facts that people are forced to make or face, such as migration or malnutrition.

[2] Even though this framework is used to explain marital fertility, it can perfectly be used to explain fertility in a general way without considering marriage. Women or couples that are not married are also affected in a very similar way and thus this conceptual framework is adopted for this study.

To separate out this classification of the responses of fertility to economic stress is very difficult in empirical grounds. It is not clear-cut to know if a response was due to intentional or unintentional effects. However, the main point here is that if fertility responds to economic shocks it can be considered as an indicator of living standards, regardless of whether it is intentional or not as Bengtsson and Dribe (2005) clearly point out.

Summing up, from the theoretical arguments explained above, one would expect individuals to react to short-term economic stress by changing their fertility decisions. No matter the nature of the response, whether intentional or not, the fact of showing a reaction as a consequence of a shock will give a general idea of the living standards that this individual enjoys from. It is expected that the worst off sector of the population will be very sensitive in terms of fertility responses, to an external economic shock. Meanwhile people with high living standards may not be as sensitive or not at all to the same economic shock.

Overview of previous research

Comparing and linking relations between measures of economic performance and demographic changes can yield ways to look at historical well-beings of different social groups (Allen et al., 2005). That is the reason why there are many studies that have focused on assessing the impacts of economic crisis or external shocks; such as famines, droughts, temperature changes, etc., on demographic outcomes.

Many of these studies rely on a micro approach in order to show dissimilarities between the effects of the shock on different groups and even though, there is a loss of generality, the analysis can be richer and point out changes that may not be captured by the macro level. The different demographic outcomes used to carry out these analyses are diverse, but some of the most relevant in the literature are: health and nutrition (Block et al., 2004), mortality (Ezra and Kiros, 2000, Bengtsson and Broström, 2011), marriage and fertility (Oris et al., 2005).

However, the pioneer works on the definition of living standards as the ability to overcome economic stress can be found in a collection of three books that comprise the analysis of different regions of the world and times in history (Bengtsson et al., 2004, Allen et al., 2005, Tsuya et al., 2010). This thorough investigation presents a complete analysis of how some populations of Europe and Asia responded to different economic shocks in the past and how different parts of the society reacted through changing fertility, mortality and marriage amongst others factors. Many sections of those books are analysed here as well as some papers that refer to the way societies react to economic shocks.

In the case of fertility, which is the main demographic outcome analysed here, the Eurasia project performs a comparative study of reproduction distinguishing four levels of context: 1) woman and couple 2) household 3) community and 4) institutional and cultural context. The main objective is to account for these 4 levels and see how fertility was affected in 5 countries in Europe and East-Asia. The populations studied were Sart in East Belgium, four Scanian Parishes in Sweden, the village of Casalguidi and Venice in central Italy, the villages of Shimomoriya and Niita in Japan and some regions in China.

They use event-history analysis models in order to relate the reproductive outcomes to the 4 levels listed above. Continuous proportional hazard models are used when they have complete information about the precise time of the events (Marriages, Births, etc) and discrete time models when they do not. The main variables included in order to account for the different levels are presented in table A1 of the appendix and are worth to look at since many of them will be the variables used in the models presented here.

The analysis is based on marital fertility and usually starting at the 2nd parity in order to avoid problems of premarital behaviour and marriage timing, since the first birth is highly correlated with marriage. Regarding the economic indicator, which is mainly grain prices, they use de-trended series to remove the possible long swings and trends from the indicator since the interest is on the short-term fluctuations. As an example, they have used the Hodrick-Prescott filter for the price series used in the studies of Belgium and Scania (Bengtsson and Dribe, 2010b).

One of the main findings of these analyses is that reproductive responses to food prices were negative and rapid. When there was a lagged positive response to them means that there was compensation and couples would make up for the period of stress. If there was a delayed negative response, then the malnutrition hypothesis would be in place. In addition to this, the difference in responses according to different groups was a constant in almost all the regions. Most of the times, more powerful individuals and richer households could cope with economic stress in a better way. A summary of the studies comprised in the Eurasia Project regarding reproduction is presented in table A2 of the appendix.

The main aim of the project was to compare different societies and the way reproduction was shaped by different factors, such as socioeconomic status, household hierarchies or culture. And even though the studies rely on very small populations and on datasets that might be a bit noisy, these studies allowed the reader to see another way of exploring differences in living standards in the past. However, this approach can also be used to assess living standards in the present, with slight modifications but they can be very fruitful to understand disparities and similarities across societies.

Turning to examples in which the main objective is to examine the impact of certain economic shock on fertility, there are two outstanding papers that using retrospective data explore this topic in Africa. For Ethiopia, Lindstrom and Berhanu (1999) analyse the impact of war, famine and economic crisis on marital fertility, finding negative effects of war and famine on fertility by the channel of re-planning or postponing fertility rather than effects of nutrition on fecundity. On the other hand; for Cameroon, Eloundou-Enyegue et al. (2000) analyse the effect of the 1987 crisis on fertility concluding that there is support for the thesis of a crisis-initiated fertility decline in that country.

Regarding Mexico, there has been plenty of research of the effects of the several economic crises in the 80´s and 90´s but in terms of poverty, income inequality, growth and some other factors (Sobotka et al., 2011). However, the influence that the crises had on fertility has not been explored in a great extent, especially when looking at regional and social group differences.

Nevertheless, Menendez and Adsera (2009) studied the fertility decline in Latin America and the effects of the crises that many countries were drawn into. They take a macro (panel data) and micro approach (Cox proportional hazard models) and the results obtained suggest that there is a strong relation between adverse economic circumstances and delayed maternity among young women that live in urban areas. However, the analysis is done for Latin America which makes it difficult to focus on the case of Mexico. Moreover, the data available for this country is from a survey of 1987.

In addition to this study, McKenzie (2003) touches upon the impact that the tequila crisis had on consumption, income, health and fertility of individuals. He argues that 1 in 20 households postponed having a child as a result of the crisis. Though, he uses a different methodology involving second differences of time effects and sees fertility as a part of the whole impact that the crisis had. The data he uses comes from the Mexican Household survey of Income and Expenditure (ENIGH for its name in Spanish) and he uses pseudo panels to analyse the effect of the crisis.

As one can see, the kind of analysis that this paper is trying to perform follows the attempts that have been made to understand the response of fertility to different downturns in different countries. In addition to this, previous studies in Mexico have covered only one part of the analysis. A more disaggregated view should be explored. Fertility might respond differently according to different characteristics of the sector of the population one is referring to. Especially in countries like Mexico where different kinds of inequalities and heterogeneous populations can be found. The impact of economic crisis might not be the same for rich and poor people, educated and no educated people or for populations living in different States. This last differentiation has been something that most of the previous studies have lacked and not considered in a profound way.

Therefore, this study represents a good chance to complement and extend the investigation regarding fertility and economic crisis. The use of recent and more appropriate data can allow working with a different methodology that can shed light to this issue and can make clearer the influence of economic crisis on the demographic behaviour of the Mexican population. In this way, this paper can contribute to the measurement of living standards not only for Mexico in a country level, but also for different sectors of this population. Finally, this study also contributes to our knowledge on whether pre-industrial populations and populations in today´s developing countries responded in a similar way to short-term economic stress, thereby revealing potential similarities and differences in vulnerability and living standards.

II. Historical Background of Mexico

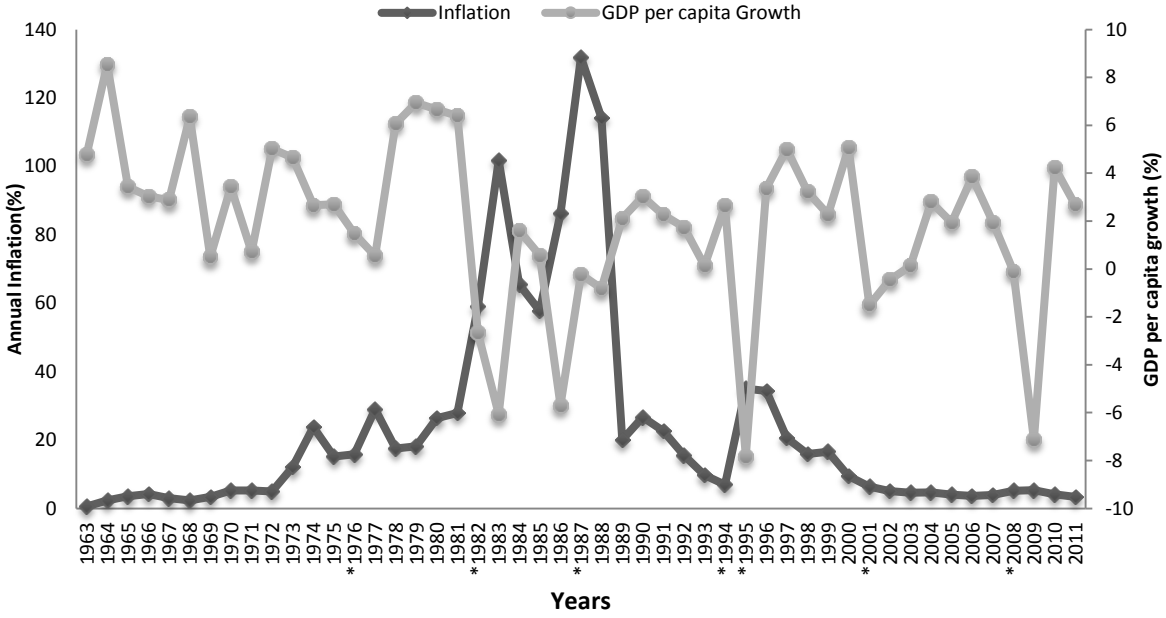
The economic history of Mexico during the second half of the 20th Century has been characterised by periods of progress and short but very intense economic downturns. The population has experienced harsh times of hyperinflation, unemployment, civil tensions, etc., which might have had a great impact on the decisions they made. Thus, I elaborate briefly on the characteristics of these crises and the time when they burst out. It is important for the

analysis because one can see that there were indeed times of economic hardship for Mexican people. In addition to this, a short review of the fertility decline in Mexico is also mentioned since it is the main demographic outcome to analyse. At the end of this section I present a brief review of the studies on living standards that have been carried out in Mexico which can also contribute to the analysis. Finally some a priori expectations drawn from the theory, previous researches and the historical background of Mexico are also outlined.

Economic Crises

It is not within the scope of this study to analyse the causes and consequences of every crises during the period under examination, but to point out and describe them. Hence, the next graph can be a very good platform to spot the times of economic hardship. The variables plotted are the rate of growth of GDP per capita and annual inflation. The patterns of the graphs can match very well the times of crises that have been cited in the economic literature of Mexican history (Mancera, 2009; Gil-Diaz, 1997; Bergoeing et al., 2002) Five different periods can be considered as economic crisis in Mexico: 1976, 1982, 1987, 1994-1995, 2001, and the most recent International crisis of 2008. Usually, steep declines in the GDP per capita growth and abrupt increases in inflation are related to times of crises.

Graph 2.1 Economic Crises in Mexico 1963-2011



Source: Author´s elaboration with data from the World Bank Indicators

Starting with 1976, Mexico had experienced economic stability and good progress from 1940 to 1970, period that is commonly known as the "Mexican Miracle". However, after the reduction of the oil prices in 1973, Mexico started to face a period of slowdown. The government decided to burst growth by participating more actively in the economy and by enlarging the public deficit, which later on proved as a dangerous policy. The international context and the huge Mexican debt went so far that in 1976 flights of capital took place and since the response was to fix the exchange rate, the international reserves were exhausted. As

a result, the fixed exchange rate could not be held anymore and devaluation was imminent. The economy collapsed and inflation started to rise. This obliged Mexico to ask for help to the IFM (Mancera, 2009; Gil-Diaz, 1997).

However, after 1976 the situation improved temporarily with the discovery of a new oil field (Cantarell). The policies were focused to exploit the oil industry and financing growth by external debt. At the same time, this left unattended other sectors which made the economy very vulnerable to external shocks. Hence, by 1981 the oil prices fell and with the rise of the interest rates in US, the debt of Mexico upgraded substantially. The combination of the international market and the internal policies made the situation worse and again devaluation took place. Deficit, debt and inflation drove this time the crisis and in August 1982 the government declared an involuntary moratorium on debt payments and later that year the nationalization of Mexico´s bank system was announced (B.M., 1983).

The problems did not stop there, at the end of the 1980´s Mexico had a huge debt lagging behind, the productive sector was almost entirely dependent on the oil industry and the external shocks such as the reduction in international oil prices in 1986 affected again the Mexican economy. Restrictive monetary policies were applied and structural changes came into place as the decentralization of the economic activity, which implied the privatization of many companies and the retrieval of the government from many of the activities that used to have full control of. However, those efforts were not enough to stop unemployment and the lack of productivity in the country. The illness in the productive sector was transferred to the money market and in 1987 the Mexican stock exchange collapsed, signifying another crisis period in the Mexican economy.

The economic instability derived from the crisis in 1982 can be clearly represented in graph 2.1 from 1981 until 1988. During this period inflation reached its peak in 1987 and the growth of the GDP per capita fell many times featuring a chaotic season in the history of Mexico. However, the subsequent years brought a moment of calm and recovery after inflation was controlled and reforms to the financial system were adopted.

Nevertheless, the structural changes implemented and the debt problems that were passed on from previous decades undermined the stability again in 1994-1995. There were several reasons including overindulgence of credit, exaggerated spending, substantial short-term debt and the over valuation of the Mexican currency due to the fixed exchange rate that set the table for the 1995 economic crisis (Gil-Diaz, 1997). As a response, Inflation went up again due to the devaluation and productivity went down to the lowest point during the whole period as shown in graph 2.1.

Finally, the last two more recent international economic downturns of 2001 and 2008 are considered as well since they also pertained once again the productivity of the Mexican economy. However, in these two last crises, inflation did not play such a significant role as in the last crises due to the monetary policies implemented to control inflation but productivity did and it is clearly seen by the drastic drop in GDP per capita first in 2001 and finally in 2009. Mexico is considered to be among the top 20 countries hardest hit by the last global recession

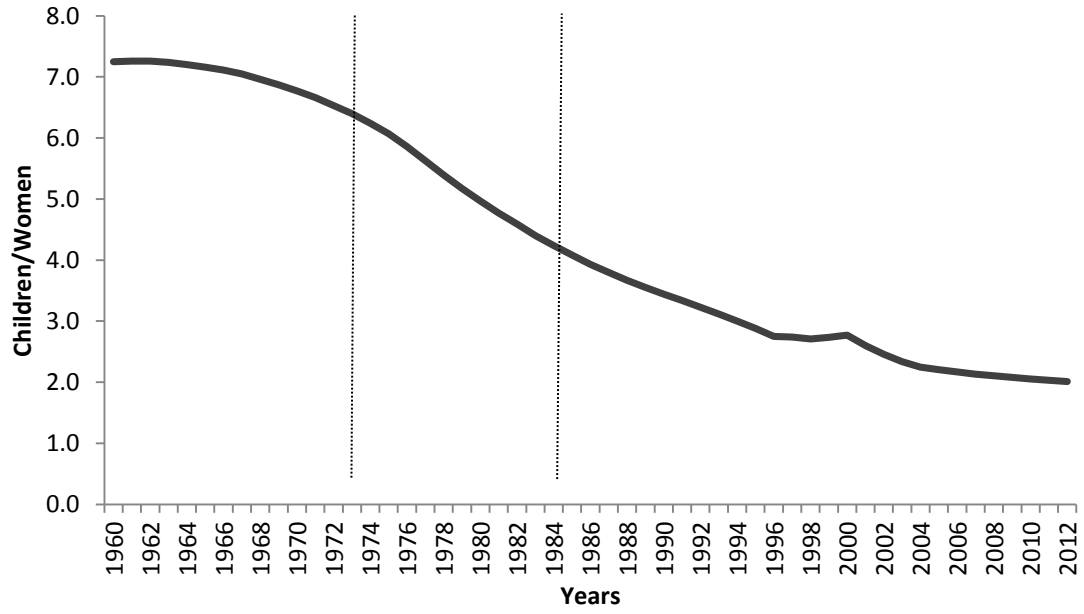
according to Didier and Calderon (2009), damaging badly the exports and manufacturing production. This was reflected in the expectations of a 7% decline in the Mexican GDP for 2009; forecast that matches the data available and shown here.

Fertility Decline

As it can be seen, since the last half of the 20th century Mexico went through many economic crises and transformations. At the same time, the fertility transition was shaped in a very rapid and peculiar way. After a great demographic explosion during the first half of the 20th century, a sudden decrease in fertility took over from 1970 onwards (CONAPO, 2001). There were many the causes of this phenomenon such as public policies to control over population and probably the economic circumstance as well. Hence, it is worth to devote some words to explain the process of the fertility decline in Mexico in order to understand this process and to make correct interpretations when relating it with economic stress.

Fertility in Mexico dropped significantly since 1970 and this decline can be divided in 3 periods according to Tuiran et al. (2002). The initial descent (1960-1973), the accelerate decline (1974-1984), and the modest decline (1985-). During almost all the 1960´s the Total Fertility Rate (TFR) reached an average of 7 children per woman. By 1985 this figure reduced to only 4 children and in 2013 could possibly reach 2 or less. Families were reduced substantially in a short period of time. People that were born during the 1950´s have usually 6 or 7 siblings, while young people now tend to have 1 or two. This abrupt change is very noticeable from one generation to another and in less than 60 years. Graph 2.2 shows the Total Fertility Rate (TFR) for Mexico, which depicts clearly the fertility transition.

Graph 2.2 Total Fertility Rate in Mexico



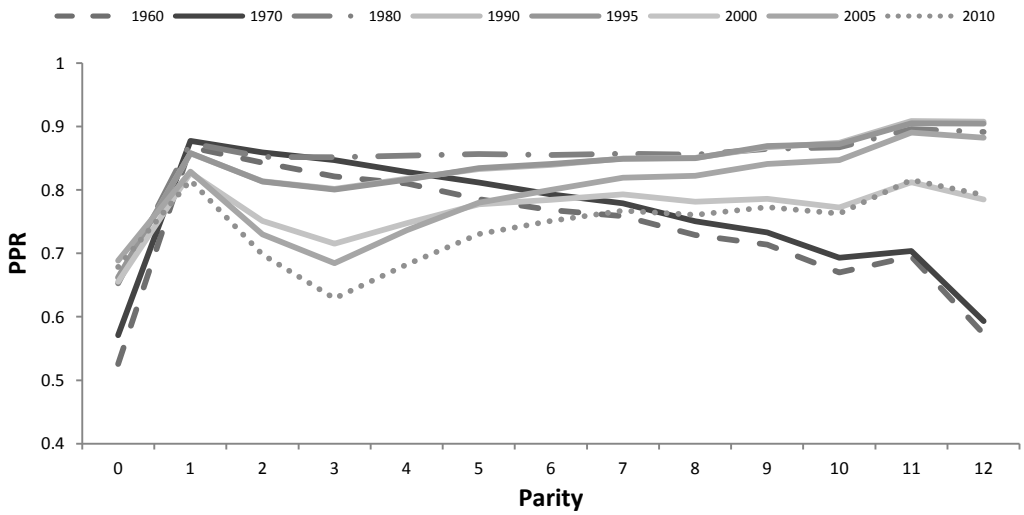
Source: Estimations of CONAPO (Mexico´s National Population Council, CONAPO for its name in Spanish)

Another way to look at fertility is by calculating the proportions of women who have already had a certain number of children but that go on to have another one. The number of children that a women has already have is named parity and therefore the proportion of women of a given parity that go on to have another child is called parity progression ratio -PPR- (Hinde, 1998). These values were calculated using the information for several years about women and the number of children they had, contained in the Historical Statistics of Mexico 2009. The results are plotted in graph 2.3, which is an alternative picture of the declining fertility trend.[3]

First of all, looking at the proportion of women that had 1, 2 or 3 children one can see that these figures were very high during 1960, 1970, and 1980. However, it reduced considerably since 1990 as the graph shows. It is also noticeable that PPR 3 seems to be the cut-off, especially in the 21st Century; women are more likely to prefer 1 or 2 children. Nevertheless, those that exceed this threshold might decide to increase their family. From PPR 4 the figures increase but as a normal pattern since it is easier to extend a family once it is already big. This is shown by the shift upwards of the lines for the different years in the last parities.

This implies that a larger number of women had more children in the past that in recent times. Before most of women were used to have larger families and that implied having more than 3 children. But this has shifted over time and now families are smaller. In 1960 more than 80% of women that had 2 children went for the third one. However, in 2010 this value dropped until 60% showing the decrease in fertility.

Graph 2.3 Parity Progression Ratios



Source: Author´s calculations based on data from INEGI. Historical Statistics of Mexico 2009
Available on:
http://www.inegi.org.mx/prod_serv/contenidos/espanol/bvinegi/productos/integracion/pais/historicas10/EHM2009.pdf

However, when taking into consideration regional dissimilarities within Mexico, not only are there economic differences but also differences regarding the fertility decline. Mexico is a

[3] The figures of the different PPR, graph 2.2, and 2.3 were adapted from a previous unpublished work by my own for one of the course in the Economic history Department. Some parts of the analysis might also be similar to the discussions from the same essay.

large country with 32 states and income inequality and social disparities are evident even within states. This is reflected also in the way fertility transition took place. The decline started in the most developed states and it took 10 to 12 years to include all of the states in this process (Tuiran et al., 2002).

The northern states and Mexico City were the first ones to jump into the fertility decline and states from the South did it later. And this difference persisted even until recent time. The difference in fertility measures is still big with a tendency to converge, but it will still take a while. If one compares the TFR of each state from 1990 until 2010, one can see huge differences for example in States like Distrito Federal (Mexico City) and Guerrero (refer to Graph A1 from the appendix). Guerrero in 2010 has barely the same TFR that Distrito Federal (DF) had in 1990, which points out that the former is 20 years behind the pace of DF regarding fertility decline. Therefore, Regional differences should be taken into account when analysing the fertility transition in this country.

Disparities in Living standards

Classified as an upper middle income country by the World Bank, Mexico still faces serious problems of poverty and moreover inequality. This can also be reflected in the differences in living standards within its population. Recently, the world has shifted from between-country inequalities to within-country ones (Goesling, 2001). And focusing only in Latin America, even though it is not the poorest region in the world, it is certainly the most unequal in the distribution of income (Gootenberg, 2004). Specifically in Mexico, a country with close to 113 million people one can find a handful of the richest people in the world[4] and approximately 12 million living in extreme poverty (World-Bank, 2013). However, these disparities are not new.

Even since the 19th Century there were sectors of the population that could not match the same living standards that the well-off people enjoyed from. Lopez-Alonso (2012) found out a decline in the living standards of the lower strata of the population from 1850 to 1920. She bases her assertions in anthropometric analysis of military records and a detailed history of welfare and institutions. However, as Scott (2013) explains, these records are not considered as a random sample and a decline in living standard might just be a result of the change in composition of the military records that Lopez-Alonso analyses.

In a more recent study, Rubalcava (2002) analyses the changes in living standards in Mexico in the transition period to an open economy (1984-1994) relying on the National Surveys of Income and Expenditure. He uses expenditure as a measure of welfare and finds out that there is a strong correlation between the economic cycle and the well-being of the population. Also he finds that high educated households are more sensitive to the business cycle.

All these studies measure the well-being of the population in the standard way and are good foundations to elaborate on the topic. Even though the studies mentioned present some caveats, such as low power of the records used to measure living standards and the use of

[4] According to the Forbes list, there are 3 Mexicans that appear amongst the 50 richest men in the world, with Carlos Slim as the richest one.

databases that do not consider the same population but repeated surveys for different persons and years, they clearly indicate the need to explore the differences in living standards. If it is by education or income levels, it is essential not to look over the disparities within the Mexican population.

In addition to this, those measures of living standards can be improved and backed up by new evidence yielded from new methods of measuring them. Moreover, an update can be made and the use of more consistent and complete datasets can allow clearing up the way to identify the most vulnerable groups in the society. This has very important implications for public policy and for the development of the country.

Taking together these two sections of the paper, one can easily notice the relevance in studying living standards for contemporary societies such as the Mexican one and also the advantages of adopting the definition of living standard mentioned here. In addition to this, based on the theory and the economic and demographic evolution that Mexico has had from the second part of the 20th Century, one can build some expectations around the way of answering the research question.

First of all, one can expect a negative response of fertility to short-term economic stress in Mexico. In times of economic hardship, people should respond by deferring or postponing childbearing. Population is expected to react markedly to short term economic stress especially in this country since Mexico is still far from a complete development and fluctuations in the business cycle can still cause changes in the demographic outcomes. Therefore, economic hardship could be expected to be one of the determinants of fertility changes. In addition to this, as it has been found in other studies and according to the theory, different sectors of the society should react differently to economic stress. Differences in education, income or area of residence should be important factors that can determine the extent to which people are sensitive to economic stress and thus their living standards. Bearing these *a priori* expectations, the empirical analysis was performed and it will be described in the following section starting with the main characteristics of the data.

III. Data Considerations

The data used were extracted from the "Retrospective Demographic Survey 2011" (Encuesta Demográfica Retrospectiva-EDER) which is provided by the Institute of National Statistics and Geography (INEGI for its acronym in Spanish). The objective of this survey is to collect information of different themes of the complete life of the interviewed, this means from the time she was born until the time of the survey. These records are called life history since the people interviewed provide information about all their lives regarding different topics such as:

- Migration
- Schooling
- Employment
- Family background.

- Number of children ever born
- Contraceptive methods use
- Socioeconomic conditions during the infancy of the respondent.

The information contained is very rich and allows the reader to identify how many children a woman had, whether they are dead or alive, if they live with them or not. It also identifies the years when a woman gets married and the marital status throughout time. However, this information is only collected for three main cohorts:

- 1951-1953, people of 58-60 years in 2011
- 1966-1968, people of 43-45 years in 2011
- 1978-1980, people of 31-33 years in 2011

Though, there is a tolerance to include people that might be out of these cohorts, that is why there is a special group denominated "out of cohort" and includes people that were interviewed but did not belong to those cohorts. This is because the survey was based on previous surveys that chose certain households to interview and amongst them there are people that not match the cohorts specified for this survey. As a result, the sample includes younger and older people compared to the thresholds established by the cohorts.

The survey covers the 32 states in Mexico but only includes certain localities of those states. The areas this survey covers are only cities that can be considered as representatives of each state, implying that many areas are excluded. Most of the cities chosen are the capital cities of the States. Table 3.1 shows the cities that were included in the sample for each state, which means that mainly urban areas are considered in this survey.

Tables 3.1 Cities included in the Survey by State

State	City	State	City
Aguascalientes	Aguascalientes	**Morelos**	Cuernavaca
Baja California	Tijuana	**Nayarit**	Tepic
Baja California Sur	La Paz	**Nuevo León**	Monterrey
Campeche	Campeche	**Oaxaca**	Oaxaca
Coahuila	Saltillo	**Puebla**	Puebla
Colima	Colima	**Querétaro**	Querétaro
Chiapas	Tuxtla Gutiérrez	**Quintana Roo**	Cancún
Chihuahua	Chihuahua	**San Luis Potosí**	San Luis Potosí
Distrito Federal	México	**Sinaloa**	Culiacán
Durango	Durango	**Sonora**	Hermosillo
Guanajuato	León	**Tabasco**	Villahermosa
Guerrero	Acapulco	**Tamaulipas**	Tampico
Hidalgo	Pachuca	**Tlaxcala**	Tlaxcala
Jalisco	Guadalajara	**Veracruz**	Veracruz
México	Toluca	**Yucatán**	Mérida
Michoacán	Morelia	**Zacatecas**	Zacatecas

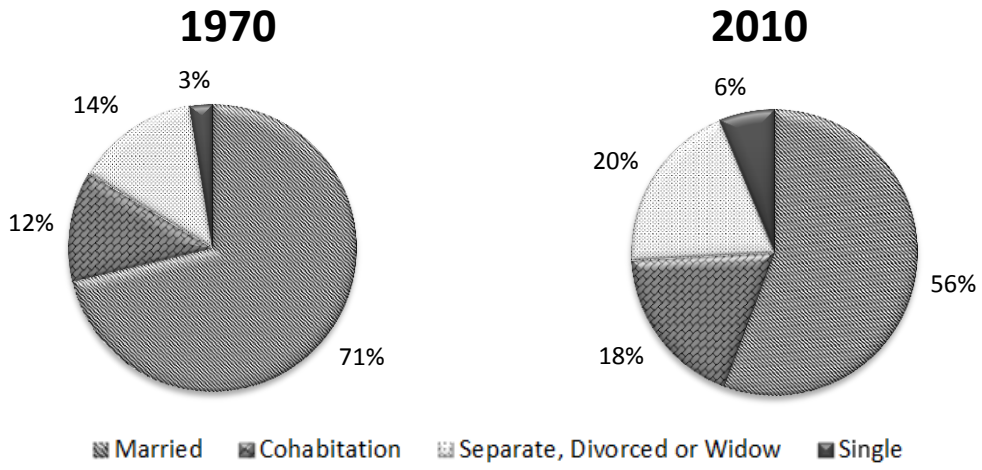
Source: Manual of the EDER 2011

The sample was applied to 3,200 heads of households; half of them were men and half of them women. It means that the sample to use is 1600 women. However, the data available is

only for **1492 women**. The data are ordered historically by years and therefore the information about the women is updated every period. The nature of this data is discrete, since one only observes year intervals for the different observations. This means that there is not exact date of the event such as births or marriage, but one can only know in which year this event took place. The data are disaggregated in a subject-period file arranged by years and this implies that there is more than one observation for each woman. The final sample for this study includes **41,045 person-year observations.** A summary statistics table of the information that is going to be used can be found in Table A3 of the appendix.

The final sample comprises women that are 21 to 63 years of age in 2011. However, in order to carry out an event-history analysis some restrictions to the data were applied in order to create the subject-period file. Most of the studies in the field use marital fertility as the start of the individual history, nevertheless these studies analyze different world populations during the 1700´s until the 1900´s. Nowadays in Mexico many women have children without being married and therefore it will be a source of bias if the people that do not get married and have children are ignored. Therefore, instead of considering marriage as the start event of each individual history, I consider the time when women turn 15 years of age[5]. The following graph supports this argument because in 1970 almost 15% of women were either single or cohabitating and had children. In 2010 this figure rose until 24%. Then, it is important to include in the analysis women that are not married and have children.

Graph 3.1 Distribution of Women with at least one child by marital status



Source: 2010 and 1970 Population Census for Mexico, data from INEGI

The event that ends the individual history is when women turn 50 or at the time of the survey. This means that there is right-censoring for some observations because there might be people in 2011 that have not yet finished their fertility history but since that information is not known, those observations have to be censored.

Some of the caveats of this database that might bias the results are that it only includes information of representative cities in each State and it comprises information only for people

[5] In some other studies, the age considered is even 12 (Menendez and Adsera, 2009). However, 15 can be a good age in which women become more likely or physically able to bear a child. Besides in the sample only 12 women had a child below age 15.

alive in 2011. Not all the cities and communities are included in the survey, which leaves out of the analysis some part of the population. Mainly urban cities were included and this excludes rural areas in which many poor people usually live. This has important implications because even though poor people living in urban areas are included in the sample, there is a possibility that the most vulnerable part of the society, which most of the times is that one living in rural areas, is not being captured by this survey.

In addition to this, as in all retrospective surveys it only deals with the survivors of each cohort. If people who died along the way were different in some aspect to the survivors this could create a bias. It is likely that poorer people die earlier and following the a-priori expectations of the response to short-term economic stress this would be a group more vulnerable to economic shocks. Anyway, the sample only consists of survivors and that creates a potential bias.

However, those are limitations from the way information was collected and do not avoid carrying out with the analysis but one should be aware of the possible bias embedded in this study. Therefore, the most important implication of using this database is that the results obtained could possibly be capturing a sort of lower bound response of fertility to economic stress due to the fact that the information available comprises only the part of the Mexican society that can be considered as better off (Urban Areas). Nonetheless, this still represents a great opportunity to assess living standards in the population represented by the sample, but it is also essential to make the inference as clear as possible when using the tools at hand, such as this database.

Regarding the information about economic stress, there were 3 basic indicators chosen: the rate of growth of the Gross Domestic Product (GDP) per capita, the National Consumer Prices Index (INPC for its name in Spanish) and Real Wages. The former one will be the main indicator considered and the other two are used as a way of checking for robustness and to see different ways of portraying economic stress. These three indicators capture different definitions of economic stress. GDP per capita refers to a more aggregate measure of what happens in the economy. Factors such as unemployment, production, and trade are underlying components of this measure and that affect the economy as a whole. In the case of Inflation and real wages, one can consider them as monetary fluctuations that are related more to the purchasing power of the individuals. Therefore, even though the three can be considered as measures of economic stress, they capture different mechanisms by which people are influenced in their decisions.

Nevertheless, whatever the economic indicator, it has to be de-trended and managed in a way to get a variable that can express short-term economic fluctuations free of long swings in the economy or population as Bengtsson (2004) points out.

The rate of growth of the GDP per capita was obtained from the World Bank indicators[6] and is in percentage form. As it is the annual rate of growth, this value in itself embodies the short-term fluctuations and does not consider any long run trend. However, the values of the INPC

[6] http://data.worldbank.org/country/mexico

and real wages were de-trended using a Hodrick-Prescott filter[7] and the stationary cyclical component was the final variable that is used, which is centered at mean zero. By using this variable one can measure the divergence from the trend in each year. In the case of Inflation (INPC), a positive value will mean economic stress. On the other hand, if the value is negative in the case of real wages, one would be considering a period of economic hardship.

The values for the INPC were obtained from the Tax Administration System (SAT for its name in Spanish) database and can be accessed from the Institution Website.[8] The values from this database are monthly Consumer prices indexes, thus the annual INPC was calculated by averaging the monthly figures for each year. For simplicity this variable will be referred as inflation henceforth.

Real wages are an index obtained from the Bank of Mexico statistics[9] and it is an index with base year December 2012. Similar to the inflation variable, this index is available in a monthly basis. Therefore, in order to make it an annual index, the average of the monthly figures was taken once again and those values were de-trended with the technique mentioned above.

IV. Methodology

One possible approach that can depict the reaction that people have in terms of fertility to economic stress is event-history analysis or duration analysis. The most important feature of this approach is that timing plays an important role and therefore the way of modelling fertility becomes a dynamic and sequential process, in which the likelihood of women to have another child is assessed conditional on having not experienced an event before. In addition to this, this approach also allows to incorporate the effect of observable characteristics at individual, household and community levels as it has been done in previous studies (Tsuya et al., 2010).

The two main models that one can use in the event-history analysis are the continuous and discrete time models. The difference arises in the way that survival information comes in. The transition event of interest might be measured in continuous time. However, the information might be grouped and provided only in discrete periods, such as months or years. If one can get continuous data, the semi-parametric models such as the Cox proportional hazard models can be applied. In the case that discrete information is at hand, the best specification is the discrete time models. This happens very often when researches rely on event history data collected from retrospective cross-sectional surveys or prospectively at particular intervals in panel studies. In the discrete case, one cannot know the exact timing of the event, but rather the interval in which the event of interest happened. This is not problematic when considering short intervals (months or days), but it might be when taking into consideration larger ones such as years. Many different happenings can occur in one year and the order and sequence of the events become essential to answer causality questions (Mills, 2011).

[7] To smooth the data a Hodrick-Prescott filter was used with $\lambda = 6.25$

[8] http://www.sat.gob.mx/sitio_internet/asistencia_contribuyente/informacion_frecuente/inpc/43_24387.html

[9] http://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?accion=consultarDirectorioCuadros&sector=10&sectorDescripcion=Laboral&locale=es

Therefore, in situations when the events can occur in any point in time (continuous nature) but are recoded in only a particular interval of time, it would be inappropriate to treat this data as if it were continuous. Two options are available in these cases. The first one is to assume that there is an underlying continuous-time model and estimate the model´s parameters by methods that take into account the discrete nature of the data. The second one would be to assume that the event occurs in discrete time points recorded by the data and apply discrete time models. In practice, both yield similar results and have several advantages such as: they introduce the possibility to include time varying explanatory variables, they are easy to estimate and they can be more readily understood (Allison, 1982).

Many of the studies related to fertility and economic stress rely on cox proportional hazard models when the information is available in a continuous fashion (Bengtsson and Dribe, 2010a; Alter et al., 2010). One of the advantages of these models is that is does not require any specification of the underlying hazard function. However, some others apply discrete-time models using logistic or complementary log-log functions when the information is recorded discretely (Breschi et al., 2010; Tsuya and Kurosu, 2010).

Given the characteristics of data that is going to be used in this study, a discrete time model was chosen in order to see the impact of economic stress on the probability of giving birth to a child. This goes hand in hand with the purpose of studying living standards by assessing the ability to overcome short-term economic stress as it is done in the different papers presented in Allen et al. (2005).

Discrete time model

The main purpose of the discrete time models is to evaluate the risk of an event occurring at time t, depending on explanatory variables that can or cannot vary throughout time. The problem is how to relate the occurrence of an event with the explanatory variables. This is done by using an unobservable or latent variable that controls the occurrence or non-occurrence of an event and the length of time until the event occurs. This is called the hazard rate. The notation used for the discrete case is the following. Time can only take positive integer values $(t = 1,2,3,4 \dots)$ and one can observe n individuals $(i = 1,2, \dots . , n)$ that are observed from a starting point $t = 1$. For purposes of this analysis, the period of observation comprises from the starting point which is the year when women turn 15 years of age to t_i that is the time of the survey or when women turn 50 years of age.

Having mentioned the above, one can now define the discrete hazard rate as follows,

$$h_{it} = Pr[T_i = t | T_i \geq t, x_{it}] \qquad (1)$$

The discrete-time hazard function is hence, the probability of an event occurring during interval t, conditional on the fact that the event did not occur before t and on the vector of covariates x_{it}, where T is the time of the event (Mills, 2011).

The survival function on the other hand would be:

$$\widehat{S_{it}} = Pr[T_i > t | T_i \geq t, x_{it}] = 1 - h_{it} \qquad (2)$$

which is the probability that the event did not occur before time t. Also the probability that an event occurs before time t (cumulative probability density function) is:

$$F(t) = \Pr(T_i < t) = 1 - \hat{S}(t) \tag{3}$$

However, the most important issue is to specify how the hazard rate depends on time and on the explanatory variables. The dependent variable models the risk or probability that an event will occur conditional on survival and covariates to some time t. Hence, the effect of short-term economic stress and other variables related to fertility can be specified in terms of a binary choice model that is detailed as follows:

$$P(h_{it} = 1 \mid t, x_{it}) = G\left(\alpha_t + \beta_1 x_{it}^1 + \cdots + \beta_k x_{it}^k\right) = G(\alpha_t + \boldsymbol{x_{it}\beta}) \tag{4}$$

where h_{it} is a dichotomous variable that takes the value 1 if the woman i has a child in period t and 0 otherwise[10]. $\boldsymbol{x_{it}}$ is a vector that includes all the explanatory variables that affect fertility and $\alpha_t(t = 1,2,3 \dots)$ is an unspecified function of time. G is a function that ensures that the estimated response probabilities are between zero and one. There are some functions that can be replaced for G, which are the normal cumulative distribution function (Probit model), the logistic function(Logit Model) or the complementary log-log specification (clog-log). Logit models are very common for discrete time and, in practice, the results of this model are very similar to probit or some other specification like clog-log models (Hedeker, 2010; Box-Steffensmeier and Jones, 2004).

Regarding the specifications for α_t one can use the following:

$$\alpha_t = \alpha \tag{5}$$

$$\alpha_t = \alpha_0 + \alpha_1 t \tag{6}$$

$$\alpha_t = \alpha_0 + \alpha_1 \log t \tag{7}$$

Even some authors suggest to use polynomials of t as a specification for α_t. However, conventional Maximum Likelihood (ML) estimation of model (4) can be done without any restrictions to α_t(Allison, 1982).

Until now it has been assumed that individuals contribute with only one event to the analysis. However, in the fertility scenario, women can have repeated events. This means that every birth that they experience will contribute as a different event. This calls for an extended version of the model presented previously.

Following the notation suggested by Allison (1982), let $T_k(k = 1,2,3, \dots)$ be a random variable denoting the time at which the k_{th} birth occurs and t_k the realized value of T_k. The discrete hazard rate for the k_{th} birth is:

$$h_k(t) = Pr[T_k = t | T_k \geq t, T_1 = t_1, T_2 = t_2, \dots, T_{k-1} = t_{k-1}] \tag{8}$$

[10] In the case of discrete time models where the dependent variable is coded 0 or 1, there is an implicit indication of right-censoring (Box-Steffensmeier, J. & Jones, B. 2004)

Furthermore, allowing the hazard rate to depend on explanatory variables, a simple model can be:

$$h_k(t) = G[\boldsymbol{\beta}'\boldsymbol{x}(\boldsymbol{t})] \tag{9}$$

where G could be the standard normal, the logistic or the clog-log function. Nevertheless, if one adds up the dependence of the hazard rate on time (using the starting time resetting the clock every time a birth occurs) and relaxes the assumption that the time at which an individual´s k_{th} birth occurs is independent of the previous event history; one can estimate a model like this:

$$h_k(t) = G[\alpha(t - t_{k-1}) + \boldsymbol{\beta}'\boldsymbol{x}(\boldsymbol{t}) + (k-1)\gamma_1] \tag{10}$$

This model is saying that the hazard rate of the k_{th} birth depends on α_t which is a function of time that can be specified or left arbitrary, the number of previous births$(k-1)$, and the different $\boldsymbol{x}$ covariates included.

A limitation of the model (10) above is that it implies the assumption that the processes affecting the first birth are the same as those for the second, third and later births. One can allow for differences in the explanatory variables for each parity by adding the subscript *k* to the vector of betas:

$$h_k(t) = G\left[\alpha_k(t - t_{k-1}) + \boldsymbol{\beta_k'}\boldsymbol{x}(\boldsymbol{t}) + (k-1)\gamma_1\right] \tag{11}$$

The way to estimate model (11) is by doing a separate analysis for each birth parity, eliminating from the sample all the time units after t_k or before t_{k-1} but including t_{k-1}. Alternatively, the estimation can be done by using dummy variables for each birth parity and then interact them with the vector of covariates to obtain the $\boldsymbol{\beta}$ vector for the different covariates.

Therefore, considering the best specification that can account for the different factors that intervene in the fertility behaviour, model (10) was chosen as the best specification to assess the impact of short-term economic stress on fertility in the sample analysed. Model (11) was also used to see the differences in fertility responses regarding different birth parities and it was estimated using separate regressions for each parity.

Regarding the specification of the function G, it does not make much of a difference to use the logistic, normal or clog-log; moreover it is difficult to choose between them in empirical grounds as Cramer (2003) mentions. The logistic distribution is more friendly when interpreting the results and it is the specification that has been used in several other studies that refer to the same topic (Lindstrom and Berhanu, 1999; Eloundou-Enyegue et al., 2000). The clog-log specification is commonly used to match results yielded from the Cox proportional hazard model. However, for purposes of this study a logistic specification can work very well. Following the arguments above, I chose the logistic distribution function for G which take this form:

$$G(\alpha_t + \boldsymbol{x_{it}\beta}) = \frac{\exp(\alpha_t + \boldsymbol{x_{it}\beta})}{1 + \exp(\alpha_t + \boldsymbol{x_{it}\beta})} \tag{12}$$

As far as it can be seen, the models described above essentially estimate the likelihood of an event to occur. The clear advantages over the continuous models are that the censoring problem is absorbed by the dependent variable because it becomes an implicit indicator of right-censoring. In addition to this, both survival and failures are accounted for the dependent variable and hence the results from the discrete-time model can be appropriately interpreted in terms of the hazard function, or the hazard probability (Box-Steffensmeier and Jones, 2004).

Nevertheless, some of the disadvantages are that problems of inter-correlation between individuals derived from the use of person-year observations arise. By the same token, unlike the cox proportional hazard model estimation, the duration dependence must be explicitly accounted for. Although the main focus of this paper is not the dynamics of fertility and it is not crucial to account so carefully for the duration effect, it is preferable to consider this factor instead of ignoring it. Therefore, in order to correct for the first problem, the logistic regressions are run with robust standard errors (Tsuya and Kurosu, 2010). And to control for the second problem, some kind of duration dependence is considered and some variables that account for that are included in the model.

Model specification

The final specification of the model is depicted in the following equation

$$h_{it}(t, x_{it}) = G\left(\zeta + \sum_{j=1}^{3} \alpha_j Z_{itj} + \sum_{l=1}^{10} \beta_l X_{itl} \sum_{m=1}^{5} \gamma_m W_{itm}\right) \qquad (13)$$

Where h_{it} is a dichotomous variable taking the value 1 if a woman experienced a live birth under the year of analysis and 0 otherwise. Z_{itj} refers to the time-related covariates, X_{itl} are the individual characteristics of the women and W_{itm} are the economic variables representing economic stress. Finally G is the logistic function.

The model described can be estimated by the method of Maximum likelihood. The purpose of using this method is to seek the parameter values that maximize the probability, or likelihood, of observing the outcomes actually obtained[11]. Using this procedure one can measure the change in probability of observing certain outcome of the dependent variable influenced by a change in the characteristics of the independent variables that are observed in the sample.

An Interesting feature of the maximum likelihood estimate is that even though in small samples its properties are not know, in large samples it can be shown that the maximum likelihood estimator is normally distributed, consistent and best, in the sense that no competing estimator has smaller variance (Cartell, Hill et al.; 2011).

However, as one is interested in the effect of the different explanatory variables (x) on the response probability $\Pr(h_{it} = 1|t, x_{it})$ the magnitudes of the $\boldsymbol{\beta}$s are not especially useful by

[11] This is the Maximum likelihood principle, which can be analyzed in more detail in the appendix C.8 of Cartell, Hill et al.(2011)

themselves, thus we need to calculate the partial effect of each covariate on $\Pr(h_{it} = 1|t, x_{it})$ using:

$$\frac{d(h)}{dx_j} = g(\beta_0 + \boldsymbol{x\beta})\beta_j \quad (14)$$

This implies that the magnitude of the effect of an explanatory variable on the response probability is not constant and that the magnitude of it is not determined by the value of β_j itself. Nevertheless, the partial effect always has the same sign that β_j as *g(z)* is always positive.

Considering the case that *x* is a discrete variable, the partial effect on $h_{it} = 1|t, x_{it}$ going from c_k to $c_k + 1$ is:

$$G[\beta_0 + \beta_1 x_1 + \cdots + \beta_k(c_k + 1)] - G[\beta_0 + \beta_1 x_1 + \cdots + \beta_k(c_k)] \quad (15)$$

Therefore, it is common to evaluate partial effects using the sample average values of the explanatory variables for continuous and discreet variables. Regarding the independent variables, a brief description of them is presented in the following table.

Table 4.1 Description of the Independent Variables

Variables	Description	Type of Variable	Values
Time-related Variables			
Duration in Birth Interval	Years since last birth or 15 years of age in case of the first birth	Numeric	From 0 to 45
Trend	Trend in fertility using years from 1962 which is the year from which the oldest woman is observed.	Numeric	Logarithm of years since 1962
Trend squared	Squared logged years after 1962	Numeric	Square of trend
Individual characteristics			
Parity	Is the number of previous live births	Numeric	From 1 to 13
Birth Cohort	To indicate which cohort the women belongs to	Dummy variables	Cohort1=Out of cohort Cohort2=1951-1953 birth cohort (ref.) Cohort3=1966-1968 birth cohort Cohort4=1978-1980 birth cohort
Age Groups	Different age groups can have different influence on the probability of having children, hence it is important to include the age of women	Dummy Variables	AGE 15 to 19 AGE 20 to 24 AGE 25 to 29 (Ref.) AGE 30 to 34 AGE 35 to 39 AGE 40 to 50
National Migration	Whether the individual migrated within Mexico in a given year	Dummy Variable	Conmign=1 if national migration took place,

			0 otherwise
International Migration	Whether the individual migrated outside Mexico in a given year	Dummy Variable	Conmigi=1 if national migration took place, 0 otherwise
Level of Education completed	Indicates the level of education that a woman completed. This is a fixed covariate that is considered for the whole individual history of the women.	Dummy variable	Educ0=No education (ref.) Educ_p=Primary Educ_s= Secondary
Area of Residence	Indicate the residence of each woman according to the socioeconomic regions in Mexico at the time of the survey. Therefore it is a fixed covariate.	Dummy variables	Region1(ref.) Region2 Region3 Region4 Region5 Region6 Region7
Family socioeconomic status at age 15	A wealth index was calculated in order to rank people from very low to high socioeconomic status when they were young (15 years of age).	Dummy Variable	very_low=wealth index from 0-4(ref.) low=wealth index from 5-9 medium=wealth index from 10-14 high=wealth index from 15-18
Contraception Methods use	Whether woman used contraceptive methods in the given year	Dummy Variable	Used contraceptive methods=1 Did not use them=0
Marital Status	It provides information about the woman´s marital status, whether she is married, divorced, single, etc. This is a time variant covariate.	Dummy Variable	married = Married (ref.) Cohabit= Cohabitating dsw= Divorced, separated or widow single=single
Economic Variables			
Rate of Growth of GDP per capita	It represents the annual rate of growth of the GDP per capita		A negative value depicts economic stress.
Lags of the Rate of Growth of GDP per capita	4 lags of the Rate of Growth of GDP per capita		A negative value depicts economic stress

The time-related covariates are included in the model because it is important to consider the duration dependence in the different states and different time trends. That is the reason why the duration from one birth parity to another is included. Lastly in this group I introduce a trend and trend squared in order to capture anything else that might have driven fertility and not the crises. It could be possible that an historical event or simply the trend could have changed the fertility patterns in Mexico despite any crisis or economic stress.

The following set of covariates refers to the characteristics of the women. The number of children that a woman has influences a lot the decision to have another one; this fact is comprised by the parity variable. I considered birth cohort and age groups in order to see the impact of age on the probability of having children. The cohorts might behave differently and therefore they can be affected by economic stress not in the same way. Thus by including this variable the difference in fertility decisions can be captured. The age groups are also accounted for because people in their 20´s do not have the same probability to have children than people in their 40´s for instance.

Migration is also incorporated making the distinction of migrating nationally or internationally. Regarding education, 3 main groups of women are analysed: with no education, with primary school and with secondary school. Women at age 15 could have achieved a completed secondary school degree. The information from the survey tells whether women had a completed level of education at the time of the survey. Therefore, people with education levels higher than secondary school are assumed to have completed a secondary school degree. Although this variable is capturing only the effect of basic education for women when they were 15, it can be a good indicator of the influence of education on fertility patterns.

In addition to this, the region where the woman lives is also included. The division of Mexico in seven regions was done according to the level of education, employment, occupation, health, etc. This division is suggested by INEGI based on the indicators mentioned above and it basically reflects the socioeconomic status of different regions.[12] Region 1 is the least favoured region and Region 7 is the better off region from the country. For the classification of every state of Mexico refer to Figure A1 of the appendix.

A variable capturing socio-economic status is important as well for the analysis. However, it is the initial status of women when they were 15 years old. This variable does not embody the changes in socioeconomic status throughout life, which would have been optimal, but still it provides valuable information that can be substantial to explain fertility decisions. A wealth index was constructed from the information available in the survey. Women were asked whether they have had different items at home or fulfilled certain characteristics that in one way or another give a clue of their socioeconomic status. The person was given a point for each item that she had. Then, the wealth index was constructed by summing up all the points a person scored. There are items that might not be comparable in weight but for simplicity they were valued the same. Once the points were recorded for every person, the sample was divided into 4 groups: very low, low, medium and high[13]. This is a very simple way of capturing the socioeconomic status of women but very useful. Other studies such as Eloundou-Enyegue et al. (2000) have used the same technique to incorporate to their study the family socioeconomic status which makes the analysis richer.

The last two individual characteristics that are included are contraceptive use and marital status. The fact of using contraceptive methods will definitely influence the probability to have children and that is the reason why it is included. With respect to marital status, 4 general

[12] For more information about the methodology to identify every region refer to http://sc.inegi.gob.mx/niveles/index.jsp

[13] For a full description of the items included and the construction of the wealth index, see Appendix.

categories were used: married people, single, cohabitating and the last group includes women that were divorcees, widows or were separated from their spouses.

The two groups of variables described before are introduced in the model to control for all what can drive fertility decisions. However, the main interest of this study is to look at the influence of economic stress on fertility patterns. Therefore, the Rate of growth of GDP per capita was chosen as a good proxy for economic stress.

V. Empirical Analysis

Results and discussion

The results of the models specified in the last section are shown in this part of the study. The objective of this section is to present the most relevant findings and compare and contrast them with previous research and the theory of living standards by the channel of the ability to overcome short-term economic stress.

First of all, the estimated coefficients of the general model that is the platform for all the subsequent models, which analyse the different birth parities, is presented in table 5.1. This model captures the influence of different covariates on the probability to have a child in certain period. Model 1 of column 1 shows only the direct impact of the economic variable, model 2 incorporates the time-related variables and the final model also takes into account the background and individual characteristic covariates. In the three models the second lag of the rate of growth of the GDP per capita remained positive and significant. This is very important since adding more covariates do not change significantly the influence of the economic indicator on the chance of having a child.

Paying attention only to model 3, the coefficient of the second lag of the GDP per capita growth is saying that there is a positive relation between this variable and the possibility of having a child. This means that if GDP grows in time *t*, the likelihood of having a child increases in time *t+2*. At the same time when facing short-term economic stress, a negative value in the GDP growth will affect the childbearing patterns of women with a lagged effect of two years. This makes sense since people face economic hardship in time *t* and decide to postpone having children, then in the following year they can decide to conceive a baby and therefore in the second year the baby is given birth. This can be a possible mechanism that works for the explanation of why the second lag is significant. One has to notice that neither the process of having a baby nor the reaction to economic stress are immediate events. Therefore, the effect of a crisis cannot be seen until after two years.

In addition to this, one can see that the coefficients of the time-related variables are consistent with the expectations. More time spent in the birth parity will increase the possibility of having a child, as the duration variable coefficient shows. The bigger the number of children a woman has, the more likely it is to have babies. It conforms to the idea that it is easier to increase the size of the family when it is already large. And finally the trend is positive and the square term

negative. This trend can be interpreted as previous fertility trends that can be also included in order to avoid confounding the influence of the variables.

Table 5.1 Estimated coefficients of time-related, individual and economic variables on the likelihood of a birth for women of age 15 to 50 in Mexico 1963-2011 (discrete logistic model)

	(1) Model 1		(2) Model 2		(3) Final Model	
GDPpcg	0.0303***	(0.00509)	0.0218***	(0.00509)	-0.0000307	(0.00612)
GDPpcgL1	0.0212***	(0.00486)	0.00974	(0.00498)	-0.00460	(0.00615)
GDPpcgL2	**0.0356*** **	**(0.00478)**	**0.0188*** **	**(0.00499)**	**0.0169** **	**(0.00596)**
GDPpcgL3	0.00609	(0.00524)	-0.00406	(0.00527)	-0.00106	(0.00630)
GDPpcgL4	0.0189***	(0.00525)	0.00228	(0.00531)	0.0117	(0.00618)
Duration			-0.0622***	(0.00379)	0.161***	(0.00766)
Parity			0.187***	(0.00655)	0.636***	(0.0204)
ln_trend (years since 1963)			3.273***	(0.282)	3.423***	(0.585)
trend_sq			-0.655***	(0.0486)	-1.033***	(0.131)
Age15_19					0.646***	(0.123)
Age20_24					0.529***	(0.0746)
Age25_29 (Ref.)					-	-
Age30_34					-0.693***	(0.0843)
Age35_39					-1.689***	(0.157)
Age40_50					-4.146***	(0.302)
cohort1					1.563***	(0.177)
cohort2 (Ref.)					-	-
cohort3					1.926***	(0.183)
cohort4					3.116***	(0.311)
Nat. Migration					-0.00294	(0.103)
Inter. Migration					0.331	(0.410)
No education (Ref.)					-	-
Primary educ.					0.119	(0.0896)
Secondary educ.					0.584***	(0.0990)
region 1(Ref.)					-	-
region2					-0.220**	(0.0782)
region3					-0.198*	(0.0795)
region4					-0.242**	(0.0740)
region5					-0.248**	(0.0841)
region6					-0.288***	(0.0809)
region7					-0.322**	(0.113)
very_low (Ref.)					-	-
low					0.0727	(0.0538)
medium					0.113	(0.0594)
high					0.0101	(0.104)
contraceptive					-1.080***	(0.0461)
married (Ref.)					-	-
single					-3.323***	(0.0906)
cohabit					-0.127*	(0.0514)
dsw					-1.052***	(0.101)
_cons	-2.443***	(0.0256)	-5.873***	(0.407)	-4.830***	(0.692)
Pseudo-R^2	0.0053		0.0622		0.2907	
Obs	41036		41036		41036	
AIC	25393.0		23949.4		18168.2	
CHIsq	124.9		1411.1		3594.8	

Robust Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

When looking at age groups, one can also see that there are significant differences between the reference group and the others. The probability of reporting a live birth is bigger for the younger groups and it decreases for the last three. This entails that young women are more likely to have children, after 30 years their chances to have children seem to be reduced. Regarding cohorts, the probabilities of having children are less for the reference cohort since the coefficients for the control groups are positive and significant. This means that women of the last 2 cohorts have more chances to have children than women born in 1951 to 1953 controlling for all the other variables.

The probability of having a child is not affected by national or international migration; these two variables appear to have a null effect on fertility since both coefficients were statistically insignificant, whereas education can make a difference in fertility. There is no difference between having primary education and no education on the probability of having a child. However, this probability increases for people that have secondary school. This result should be handled carefully because it only represents the difference in education when people were 15. The level of education can be higher as women grow older and that might change these results. However, this result might be related to the possibilities that education represents to earn a better income or more job opportunities that can allow women to have children.

The difference in fertility for the Regions is very clear. The reference group includes the poorest or less developed states (Chiapas, Guerrero and Oaxaca) and the rest of the states are less likely to have children. This means that in these "poor" states, according to this classification, women are more likely to have children. And the region classified in the top (Mexico DF) has the largest coefficient, saying that women living there have the least chances to have children compared to other states.

Accounting for the socioeconomic status, one can see surprisingly that there is no difference between rich and poor women. Fertility seems to follow a general pattern that does not change according to socioeconomic status.

Finally, the marital status changes the probability of having a child in the following way. Married people have the greater chance to have children; in the second place are women in cohabitation, in third the group of divorced, separated or widow and finally the single women. This can be seen from the size of the coefficient.

The model fits the data well. The Pseudo R^2 or McFaddens indicates that the explanatory variables are significant and that its explanatory power corresponds to a 29% approximately. Regarding the Likelihood ratio test, the value of the chi-squared distribution at .01 level with 34 degree of freedom clearly is larger than the critical value and therefore the null hypothesis that the regressors have no effect on the probability of having a child is rejected. Or in other words, we can reject the null hypothesis that the restricted model is better that the unrestricted (Wooldridge, 2009). An additional measure of the model performance is the correct predictions or the "hit rate". In this model 91.2% of the outcome predictions are correct using a cut-off value of 0.5, which means that the model performs successfully.

The results of the previous models, however, only point out the direction of the relation between the covariates and the outcome of the dependent variable. The magnitude of the

effect has to be analyzed by using the marginal effects evaluated at the means of the different covariates. These results are shown in table A4 of the appendix. However, since there are many dummy variables, it is not really convenient to get marginal effects evaluated at the mean, instead is it is better to specify the value of the dummy variable as zero or one to get a better estimate of the marginal effect for the different covariates.

Table 5.2 Marginal effects of the covariates evaluated at specific values of the dummy variables

	(1) min->max	(2) 0->1	(3) -+1/2	(4) -+sd/2	(5) Marginal Effect
GDPpcg	-0.0001	0	0	0	0
GDPpcgL1	-0.0187	-0.0011	-0.0011	-0.004	-0.0011
GDPpcgL2	**0.0687**	**0.0042**	**0.0042**	**0.015**	**0.0042**
GDPpcgL3	-0.0043	-0.0003	-0.0003	-0.0009	-0.0003
GDPpcgL4	0.0475	0.0029	0.0029	0.0098	0.0029
duration	0.7301	0.0322	0.0399	0.2442	0.04
Parity	0.7331	0.1406	0.1568	0.2927	0.1581
ln_trend	0.8853	0.0004	0.6919	0.4023	0.8506
trend_sq	-0.9762	0	-0.2512	-0.6452	-0.2567
Age15_19	0.1516	0.1516	0.1593	0.0618	0.1606
Age20_24	0.1311	0.1311	0.1306	0.0506	0.1314
Age30_34	-0.1701	-0.1701	-0.1706	-0.0625	-0.1723
Age35_39	-0.3614	-0.3614	-0.3967	-0.1331	-0.4196
Age40_50	-0.5209	-0.5209	-0.7746	-0.379	-1.0302
cohort1	0.309	0.309	0.37	0.0641	0.3883
cohort3	0.3934	0.3934	0.4452	0.2223	0.4785
cohort4	0.4244	0.4244	0.6499	0.3192	0.7744
Nat. Migration	-0.0007	-0.0007	-0.0007	-0.0001	-0.0007
Inter. Migration	0.0806	0.0806	0.0822	0.0033	0.0823
Primary educ.	0.0294	0.0294	0.0296	0.0136	0.0296
Secondary educ.	0.1444	0.1444	0.1442	0.0689	0.1452
region2	-0.054	-0.054	-0.0546	-0.0211	-0.0547
region3	-0.0494	-0.0494	-0.0492	-0.0179	-0.0492
region4	-0.0605	-0.0605	-0.0601	-0.0261	-0.0602
region5	-0.062	-0.062	-0.0616	-0.0207	-0.0617
region6	-0.0719	-0.0719	-0.0714	-0.0252	-0.0715
region7	-0.0803	-0.0803	-0.0798	-0.0164	-0.08
low	0.018	0.018	0.0181	0.0082	0.0181
medium	0.0283	0.0283	0.0282	0.0129	0.0282
high	0.0025	0.0025	0.0025	0.0006	0.0025
contraceptive	-0.2548	-0.2548	-0.2621	-0.1298	-0.2684
single	-0.4986	-0.4986	-0.6787	-0.3661	-0.8257
cohabit	-0.0316	-0.0316	-0.0315	-0.0102	-0.0315
dsw	-0.249	-0.249	-0.2556	-0.0668	-0.2614

(1) change in predicted probability as x changes from its minimum to its maximum

(2) change in predicted probability as x changes from 0 to 1

(3) change in predicted probability as x changes from 1/2 unit below base value to 1/2 unit above

(4) change in predicted probability as x changes from 1/2 standard deviation below base to 1/2 standard deviation above

(5) The partial derivative of the predicted probability/rate with respect to a given independent variable.

For example, keeping the continuous variables at their sample means, a woman in the Age group of 20 to 24, from cohort 3 with secondary education, from region 2, married and with a medium socioeconomic level can experience the marginal effects of the different covariates shown in table 5.2 As it can be seen the reaction to GDP per capita growth is very small. If

there is a 1% change in GDP per capita the probability of having a child will increase with 0.42%. If we consider the change from the minimum to the maximum value reported in the sample for the second lag of GDP growth, the probability of having a child varies with 7%.

The most important result here is that there is a significant effect of GDP on fertility but its impact is small. This indicates that women consider economic stress in their fertility decisions but there must be more important factors that drive this behavior. This implication in the living standards setup is that people are not so sensitive to economic stress and therefore living standards can be considered as good or at least not so low.

This small reaction to economic stress, however surprising, might be reflecting a lower bound reaction. As it was acknowledged before in the data section, the sample used consider only urban cities. Therefore, these results might change and possibly become larger if one considers a more extended sample incorporating rural areas as well.

However, when considering the birth parities in a separate way, one can see different results. It is very illustrative also to see which birth parity is affected by economic stress. In the case of Cameroon for example, Eloundou-Enyegue et al. (2000) found out that the later births are the ones that are more affected by economic crisis. In the case of Mexico, it is also important to see how parities respond to economic stress. Hence a separate analysis for each birth parity was performed following model (11) and the results of the estimation are shown in table 5.4.

Once separating out the effects of economic stress for different parities, the impact becomes clearer. In the case of Mexico there was no significant response of fertility to economic stress in the first, second, fourth and fifth parities. However, there was a positive response of fertility to economic stress in the third one and the last parities that go from the 6^{th} until the 14^{th}, which is the last parity included in this sample. This means that the decisions to have the third child and more than 6 children are influenced by the economic environment. This makes sense since people might want to have 1 or 2 children to fulfil their preferences but when it comes to having 3 children, they might consider more seriously the economic environment. The same applies for the last parities. People with 5 children might have already fulfilled their wishes of having children, therefore in order to move forward into the next parities they might considered in a deeper way the economic situation at the time of making that decision.

A very interesting characteristic from these results is the fact that the 3^{th} lag of the GDP growth is significant but with different sign from the 2^{nd} lag for the third parity regression. This means that economic stress has two effects, a positive and a negative one. The positive means that the response of fertility will have the same direction as the GDP growth, in case of economic stress (reduction of GDP) fertility will be reduced. Conversely, the negative effect will make the fertility response to be contrary to the fluctuation of the GDP. This conforms clearly with the theory that people postpone having children when facing economic stress because the immediate response is to reduce fertility but later on the same shock boosts fertility again, making up for the period of crisis and hence embodying a postponement effect.

The marginal effect for the third parity is shown in table 5.3 for a married woman from region 3 that belongs to the age group 25_29 and has secondary school. The rest of the variables were set at their mean. This indicates again a very small change in the probability of having a

child, when facing economic stress. If the rate of growth of GDP lagged 2 periods reduces in 1%, the probability will be reduced in almost 1%. However, if the third lag of the GDP reduces in 1%, fertility will be increased in 0.56%. The overall effect that economic stress has will be nullified by this opposite reaction in the second and third lag. Nevertheless, it is important to see that this effect is significant but very small.

Table 5.3 Marginal effects of an increase in a unit of GDP per capita growth for the third parity

dy/dx w.r.t.	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
rg_gdpL2	0.7352	0.002254	3.26	0.001	0.002934	0.01177
rg_gdpL3	-0.5628	0.002316	-2.43	0.015	-0.01017	-0.00109

Regarding the sixth parity, one can see that the sensibility of fertility to economic stress is reflected in the second and fourth lag of the GDP variable. In this case both lags have a positive sign, meaning that the relation will be always positive. Thus a decrease in the economic indicator will reduce the probability to have children. Again the marginal effects evaluated at the same characteristics of table 5.3 are around 0.5% for both lags.

Table 5.4 Estimated coefficients of time-related, individual and economic variables on the likelihood of a birth for women of age 15 to 50 in Mexico 1963-2011 for different parities (discrete logistic model)

	(1) First Parity		(2) Second Parity		(3) Third Parity		(4) Fourth Parity		(5) Fifth Parity		(6) 6th and higher parities	
GDPpcg	0.00144	(0.0111)	-0.00636	(0.0123)	-0.00754	(0.0130)	-0.0203	(0.0180)	0.000389	(0.0249)	0.0418	(0.0245)
GDPpcgL1	0.00925	(0.0113)	-0.00572	(0.0121)	-0.0194	(0.0131)	-0.0225	(0.0190)	0.0250	(0.0276)	-0.00925	(0.0228)
GDPpcgL2	-0.00124	(0.0104)	-0.00151	(0.0115)	**0.0465*****	(0.0138)	0.0309	(0.0198)	-0.0119	(0.0264)	**0.0494***	(0.0246)
GDPpcgL3	-0.0171	(0.0108)	0.00635	(0.0119)	**-0.0356***	(0.0142)	0.0187	(0.0224)	0.0147	(0.0282)	0.0385	(0.0260)
GDPpcgL4	0.00401	(0.0106)	0.00302	(0.0116)	0.0194	(0.0146)	-0.0210	(0.0202)	0.00638	(0.0296)	**0.0497***	(0.0253)
duration	-0.0748*	(0.0311)	0.00995	(0.0151)	0.00475	(0.0145)	0.0214	(0.0262)	-0.103**	(0.0355)	-0.152***	(0.0308)
ln_trend	0.513	(0.903)	3.115*	(1.260)	3.877*	(1.870)	1.146	(3.239)	9.908	(5.284)	7.543	(6.278)
trend_sq	-0.0517	(0.219)	-0.703**	(0.261)	-0.891*	(0.361)	-0.398	(0.618)	-1.851*	(0.928)	-1.295	(1.017)
Age15_19	-0.413	(0.247)	-0.172	(0.215)	-0.247	(0.298)	0.439	(0.566)	1.138	(1.303)	.	.
Age20_24	-0.0250	(0.153)	-0.0134	(0.128)	-0.0177	(0.153)	0.115	(0.242)	-0.200	(0.321)	1.163*	(0.467)
Age30_34	-0.123	(0.191)	-0.181	(0.147)	-0.108	(0.162)	-0.382	(0.246)	-0.327	(0.310)	-0.0953	(0.286)
Age35_39	-0.101	(0.340)	-0.759**	(0.293)	-0.180	(0.294)	-1.180**	(0.449)	-0.402	(0.494)	-0.124	(0.396)
Age40_50	-0.746	(0.557)	-2.630***	(0.580)	-1.851***	(0.546)	-3.197***	(0.846)	-0.925	(0.843)	-1.138	(0.656)
cohort1	-0.0539	(0.383)	0.309	(0.334)	0.610	(0.362)	0.382	(0.472)	1.354*	(0.685)	0.0713	(0.618)
cohort3	-0.191	(0.357)	0.517	(0.326)	0.734*	(0.368)	0.391	(0.565)	0.848	(0.642)	0.455	(0.491)
cohort4	-0.310	(0.601)	0.931	(0.541)	1.418*	(0.634)	0.490	(0.996)	1.606	(1.118)	0.884	(1.082)
Nat. Migration	-0.273	(0.148)	0.0887	(0.219)	-0.0157	(0.283)	0.00786	(0.426)	0.481	(0.525)	-0.0619	(0.572)
Inter. Migration	0.417	(0.496)	0.0312	(1.147)	0.770	(1.314)	.	.	.	.	.	.
Primary Educ.	-0.107	(0.203)	-0.0311	(0.208)	-0.128	(0.213)	-0.363	(0.244)	-0.113	(0.270)	-0.354	(0.206)
Secondary Educ.	-0.139	(0.209)	-0.130	(0.214)	-0.209	(0.222)	-0.633*	(0.274)	-0.463	(0.380)	-0.138	(0.338)
region2	-0.0915	(0.138)	-0.0406	(0.152)	-0.108	(0.181)	-0.186	(0.271)	-0.0516	(0.377)	0.0175	(0.405)
region3	0.0433	(0.145)	-0.0733	(0.154)	0.122	(0.179)	0.449	(0.264)	0.438	(0.345)	0.134	(0.374)
region4	-0.0241	(0.134)	-0.0842	(0.141)	0.0558	(0.171)	-0.00212	(0.248)	0.0178	(0.342)	-0.0229	(0.384)
region5	-0.0825	(0.150)	-0.0104	(0.158)	0.339	(0.189)	-0.152	(0.282)	-0.272	(0.398)	0.164	(0.454)
region6	-0.129	(0.146)	-0.144	(0.156)	0.200	(0.184)	0.198	(0.268)	0.559	(0.358)	0.0560	(0.402)
region7	0.0529	(0.197)	-0.217	(0.221)	0.106	(0.261)	-0.276	(0.381)	0.405	(0.548)	-0.127	(0.563)
low	-0.204*	(0.0966)	0.0150	(0.0993)	-0.349**	(0.110)	-0.191	(0.157)	-0.202	(0.267)	-0.303	(0.287)
medium	-0.303**	(0.105)	-0.0276	(0.108)	-0.297*	(0.123)	-0.00504	(0.189)	-0.204	(0.341)	-0.103	(0.424)
high	-0.349*	(0.166)	-0.218	(0.181)	-0.993***	(0.256)	-2.663*	(1.044)	0.609	(1.348)	.	.
contraceptive	0.268**	(0.0966)	-1.049***	(0.0828)	-1.228***	(0.0937)	-1.184***	(0.139)	-1.060***	(0.180)	-1.171***	(0.192)
single	-3.346***	(0.240)	-0.605*	(0.262)	0.304	(0.367)	1.052	(0.625)	0.608	(0.888)	.	.
married	0.469*	(0.218)	1.423***	(0.196)	1.017***	(0.212)	0.554	(0.289)	0.560	(0.346)	1.008*	(0.460)
cohabit	0.385	(0.228)	1.270***	(0.206)	1.030***	(0.229)	0.789*	(0.312)	0.725	(0.399)	0.820	(0.480)
dsw	.	.	.	.	.	.	.	.	.	.	.	.
_cons	-0.888	(1.127)	-4.745**	(1.597)	-5.374*	(2.553)	-1.245	(4.461)	-14.50	(7.713)	-12.79	(9.806)
Pse-R^2	0.3489		0.1527		0.1699		0.2458		0.2209		0.2365	
Obs	15414		5896		7107		6181		3145		3246	
AIC	5843.0		4843.6		3962.8		2081.7		1140.7		1256.2	
CHIsq	1781.6		560.4		605.1		477.5		253.8		317.5	

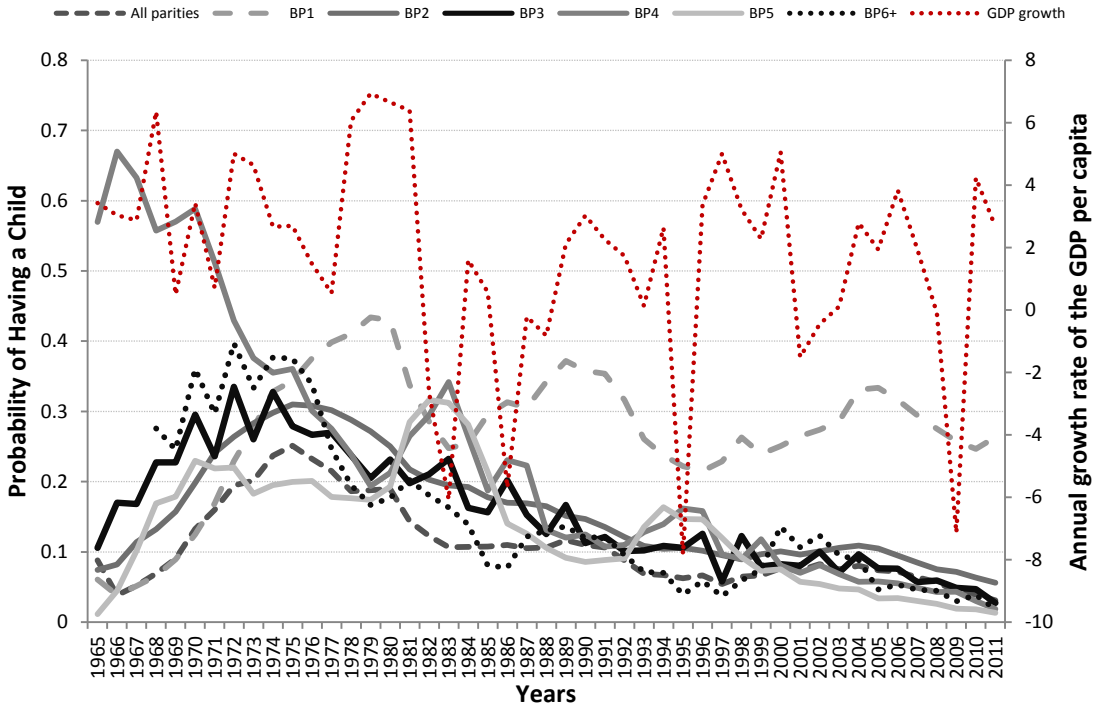
Robust Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The reference groups for the different categories are: Age24_29, Cohort 2, No education, Region 1, Very low socioeconomic status and dsw (divorced, separated or widow)

The results of the models estimated before hint that the there is a significant impact of economic stress on the fertility decisions that women take. However, this impact is very small if one evaluates it at its marginal effects.

On the other hand, another way to look at this issue is by calculating the predicted probabilities from the models regressed and see throughout time the fertility patterns that were yielded for different parities. The predicted probabilities for every observation in the sample were generated and then the mean of the values for every year was plotted in graph 5.2. This gives an idea of the probability of having a child by year. This allows one to see clearly how fertility probabilities have changed throughout time and also one can spot the influence of economic stress on those probabilities.

Graph 5.1 Predicted Probabilities by Birth Parity



Source: Author´s Calculations based on the Historical Statistics of Mexico 2009 from INEGI

First of all, women were very likely to have 4 or more children at the beginning of the series. From 1965 until the middle of the 1970´s the highest probabilities are for the highest parities, especially for the fourth parity. From all the parities, only the first one started to rise gradually in order to take over all of them at the end of the period. This symbolises clearly the fertility decline in Mexico that took place after 1970. Nowadays the probability of having one child is the highest and to have more than 3 children is very unlikely.

Though, what it is important to notice here is the fluctuations of the probabilities accompanied by the fluctuations in GDP per capita growth. From the models estimated, a positive impact of GDP growth was found for all parities and separating out the effect on different parities, the third one and the last parities (6 and more) were the ones directly affected by economic stress. If one looks carefully at the solid black line representing the probabilities of having a third child, it can be seen that these probabilities seem to react to the behaviour of the GDP growth

with two lag-period difference, as it is suggested by the model. Every time that the GDP falls, which represents economic stress, the probability responds by a drop after two periods. This is another way of looking at the effects of economic stress. Something that does not happened as clearly in the case of the other parities. The fluctuations are smoother and the drops in probability are not as marked. Nevertheless, they match as well the behaviour of the GDP growth.

This result suggests that women with two children are more sensitive to economic stress when they want to move to a higher parity than women without children or one. This finding is closely related to what Lindstrom and Berhanu (1999) found for the case of Ethiopia where the third and fourth parities are the ones that respond the most to economic crisis. This results are also different from what Menendez and Adsera (2009) found for some countries in Latin America. They suggest an increase in the probability of moving to the first parity very responsive to economic stress but not for the second or third parities.

All the analysis made before assumes that the effect that economic stress has on fertility decisions is the same for the whole population. However, in an attempt to see the different impact that it may have in different social groups, interactions of the economic variable with socioeconomic status, cohort, region, and educational level were introduced in the general model.

Table 5.5. Socioeconomic Status Interactions		
GDPpcg	-0.00107	(0.0312)
GDPpcgL1	-0.0276	(0.0298)
GDPpcgL2	**-0.0531***	(0.0266)
GDPpcgL3	0.0475	(0.0334)
GDPpcgL4	**-0.0519***	(0.0259)
GDPpcg *vlow	0.00420	(0.0325)
GDPpcg *low	-0.00508	(0.0329)
GDPpcg *medium	0.00194	(0.0332)
GDPpcgL1*vlow	0.0282	(0.0314)
GDPpcgL1*low	0.0290	(0.0317)
GDPpcgL1*medium	0.0124	(0.0318)
GDPpcgL2*vlow	**0.0701***	**(0.0282)**
GDPpcgL2*low	**0.0632***	**(0.0284)**
GDPpcgL2*medium	**0.0893****	**(0.0288)**
GDPpcgL3*vlow	-0.0566	(0.0348)
GDPpcgL3*low	-0.0441	(0.0352)
GDPpcgL3*medium	-0.0497	(0.0353)
GDPpcgL4*vlow	**0.0854****	**(0.0276)**
GDPpcgL4*low	0.0498	(0.0279)
GDPpcgL4*medium	**0.0574***	**(0.0280)**
_cons	-4.7186	(.71333)
Pseudo-R^2	0.2917	
Obs	41036	
AIC	18174.4	
Wald chi2(49)	3614.9	

Robust Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The first interactions introduced were those regarding socioeconomic groups. The coefficients of the regressions are presented in table 5.5 and this model also controls for the all covariates

included in the main model such as: duration, parity, age groups, migration, education, area of residence, socioeconomic, and marital status. The coefficients of the interactions for the second lag of the GDP and the groups suggest that economic stress hits differently people according to their economic status. The reference category is the people with a high socioeconomic status and the relation between GDP growth and the possibility of having children is negative in the second and fourth lag. This means that when economic stress takes place, the probability of having children for "rich people" increases. This could be related to the opportunity cost of having children. When there are times of economic growth rich people might earn more when working and the opportunity cost to have children can be very high. Instead, when there are economic downturns, they would rather have children since it will not represent a big loss from quitting the job or from working less.

On the other hand, for the other three groups the effect is different. These have a positive response of fertility to economic growth, which means that when there is economic stress, the fertility also reduces. From these three groups the more affected is the middle group, since the magnitude of the sum of the interaction coefficient and the second lag of the GDP per capita is the largest. This is saying that economic stress represented in this case by fluctuations in GDP; indicator that is very closely related to aggregate economic condition such as employment, etc., affects more the middle part of the society regarding socioeconomic status after the rich group.

Poor people are also affected but in a lesser extent. This could be due to the kind of jobs that people have. Poor people could be more related to agriculture and primary economic activities, whereas middle people could hold jobs in companies that can be more sensitive to fluctuations in GDP. Companies could rely on the dismissal of employers as a way to cope with economic stress and therefore people can be left unemployed as a result of a crisis. This is something that happened in Mexico after the 2008 crisis, when there were many job losses, especially in the manufacturing sector (Villareal, 2011).

As a result, one can clearly see the different responses of fertility in all the socioeconomic groups. Even though all groups are affected by economic stress, the fertility responses are very different. While fertility in the rich group is enhanced by economic stress, in the other three groups (very low, low and medium) it is reduced. And from these last three, the group that is more affected is the middle one. All of this could be a result of the way economic stress is expressed by GDP per capita. Also one has to consider that it is the case of people living in urban areas. Therefore, it makes sense that the people that react more are rich and people in the middle group, since the magnitude of their overall coefficients are the largest.

The second interactions introduced were those corresponding to the different cohorts and the economic indicator and are shown in Table 5.6. The reference group is cohort 4, which includes the youngest cohort formed by women born from 1978 to 1980. In this case the only significant difference found was with cohort 2 which is the oldest cohort. This means that both the cohort 1 and 3 are affected in the same way by economic stress. However, cohort 2 reacts differently to the other 3 cohorts. Actually the sum of the coefficient for the second lag of the GDP and the interaction term (GDPpcgL2*coh2) gives in total a negative coefficient, which indicates that cohort 2 responds to economic stress by increasing the probability of having a

child. Running a separate model for cohort 2 only, the 2nd lag of the GDP per capita growth was not significant. This means that there is a real and significant difference between the way cohort 2 and the other cohorts react to economic stress. However, it does not mean that it has to be a negative relation of fertility and economic stress, simply the difference between cohorts was such that it offset the coefficient for the base group in the model with interactions. As a result the youngest cohorts are affected more by economic stress than older ones. A possible explanation to this is that in recent times women are more related to economic activities and take part more actively in the labour force. Therefore, when there are economic downturns, their fertility decisions become more sensitive than those of women from previous generations.

Table 5.6. Cohort Interactions

GDPpcg	0.000015	(0.0129)
GDPpcgL1	0.000657	(0.0125)
GDPpcgL2	**0.0386****	**(0.0118)**
GDPpcgL3	0.00162	(0.0137)
GDPpcgL4	0.00478	(0.0126)
GDPpcg *coh1	-0.0747	(0.0398)
GDPpcg *coh2	0.00238	(0.0169)
GDPpcg *coh3	0.00570	(0.0167)
GDPpcgL1*coh1	-0.0518	(0.0405)
GDPpcgL1*coh2	0.0151	(0.0170)
GDPpcgL1*coh3	-0.0160	(0.0159)
GDPpcgL2*coh1	-0.0346	(0.0438)
GDPpcgL2*coh2	**-0.0412***	**(0.0161)**
GDPpcgL2*coh3	-0.0228	(0.0158)
GDPpcgL3*coh1	-0.0715	(0.0466)
GDPpcgL3*coh2	0.0247	(0.0181)
GDPpcgL3*coh3	-0.0186	(0.0168)
GDPpcgL4*coh1	-0.00967	(0.0422)
GDPpcgL4*coh2	0.0174	(0.0176)
GDPpcgL4*coh3	0.00547	(0.0161)
_const	-1.9881	(.62797)
Pseudo-R^2	0.2920	
Obs	41036	
AIC	18164.3	
CHIsq	3632.8	

Robust Standard errors in parentheses

$^{*}\ p < 0.05,\ ^{**}\ p < 0.01,\ ^{***}\ p < 0.001$

The model also controls for the all covariates included in the main model such as: duration, parity, age groups, migration, education, area of residence, socioeconomic, and marital status.

With respect to Education, the only significant interaction was the first lag of the GDP per capita growth with Primary education as table 5.7 shows. With these results one can infer that women with less education are hit slightly harder by economic stress in their fertility decisions than people with secondary school, which is the reference group.

Nevertheless, the first and second lags of the GDP were significant but with opposite sign for the reference group. This means that women with secondary education at age 15 had more probabilities to have children if the lagged GDP decreased. On the other hand, when the second lag of GDP decreases, the probabilities are lower again. This could be a reflection of the

opportunity cost to have a baby. In the case of economic stress represented by a drop in GDP, unemployment could be a common factor and perhaps women prefer to have children in those periods because the opportunity costs are lower.[14] But after two years the relation between GDP growth and fertility becomes positive again. However, this model has to be read carefully since the variable education is only the level of education that women reached at year 15. Further education that a woman might have achieved could change the results and therefore they should not be compared to other studies that involve education and fertility.

Table 5.7. Education Interactions		
GDPpcg	-0.000427	(0.00777)
GDPpcgL1	**-0.0171***	**(0.00746)**
GDPpcgL2	**0.0218****	**(0.00741)**
GDPpcgL3	-0.00740	(0.00792)
GDPpcgL4	0.00492	(0.00753)
GDPpcg *No_educ	0.0125	(0.0262)
GDPpcg *Primary educ.	-0.00506	(0.0126)
GDPpcgL1* No_educ	0.00792	(0.0282)
GDPpcgL1* Primary educ.	**0.0380****	**(0.0132)**
GDPpcgL2* No_educ	-0.00837	(0.0273)
GDPpcgL2* Primary educ.	-0.0167	(0.0126)
GDPpcgL3*No_educ	0.0135	(0.0278)
GDPpcgL3*Primary educ.	0.0161	(0.0134)
GDPpcgL4* No_educ	0.0427	(0.0272)
GDPpcgL4* Primary educ	0.0116	(0.0127)
_const	-4.3267	(.68699)
Pseudo-R^2	0.2913	
Obs	41036	
AIC	18173.8	
CHIsq	3624.8	

Robust Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
The model also controls for the all covariates included in the main model such as: duration, parity, age groups, migration, education, area of residence, socioeconomic, and marital status.

Regarding the interactions with the Regions and economic indicator, no evidence was found of disparities in the way economic stress hits the 7 regions in Mexico that were considered in this study. This means that the region where a woman lives is not a determinant of the way the fertility responds to economic stress. This can be confirmed by Table A5 that shows the coefficients for the interactions, which were not significant and the other covariates of the model. According to the great disparities in different states regarding fertility and socioeconomic classification, one would expect these regions to react differently to economic stress. Nevertheless, it was not the case this time. Though, one has to take into account that the measure of economic stress is a national aggregate and it is possibly why all of the regions react in the same way to this specific measure of economic stress.

[14] The theory about unemployment and fertility is quite extensive and this argument can be considered as only one possibility to explain the results obtained. However, for further discussion refer to Menendez & Adsera (2009)

Robustness Checks using different economic indicators.

The models using the rate of growth of GDP per capita as the economic indicator showed a significant response of fertility to economic stress. This means that the business cycle has a significant but very low impact on fertility decisions. However, in order to assess further the impact of economic stress, the economic indicator can be changed and try with different options such as inflation or real wages. Therefore, this section of the study elaborates on the possibility of representing economic stress with different indicators.

The first indicator to test was Inflation. During the period under analysis, inflation had extreme fluctuations and was a very important indicator that played a substantial role on the different economic crises that Mexico went through. Different to the GDP per capita growth which comprises the whole economic cycle and can be considered as a more aggregated description of the economy, inflation picks up only monetary effects and fluctuations in the prices that consumers directly face. Thus, it can be regarded as a more particular economic indicator.

Previous researches use grain prices as economic indicators for different populations. In the Eurasia project, the grains chosen are based on the importance of them in the economy under analysis. For example for Sweden they use rye price, for Japan they use rice. Nowadays, the INPC considers a complete basket of goods that are considered essential in the everyday life of the Mexican people and hence can be considered as the best way of depicting price changes.

The results of the model estimation with inflation as the variable representing economic stress are shown in table A6. The most interesting result is that the 4^{th} lag of inflation was significant. However, the effect is almost null. The marginal effect of a unit increase in the inflation cyclical component lagged 4 periods is a decrease in the probability of having a child in 0.03%. This is a very small change in probability. According to the theory, a late effect of a price change might be indicating that fertility could be affected by the health (malnutrition) channel. However, this might not be the case for Mexico since the effect is very small and moreover the huge and repetitive fluctuations of inflation in consecutive years might be picking up this negative relation between the fourth lag of inflation and the fertility probabilities.

In addition to this, the inflation behaviour in Mexico was quite peculiar and suffered very extreme changes from year to year and therefore its impact on fertility decisions might not be so clear in the context of this study. Therefore, in order to have a closer look into the welfare of individuals, one can look at real wages. This indicator is more related to the economic constraints that individuals have and in that sense people might be more sensitive to changes in their wages and this sensibility might be reflected in the fertility decisions they made.

Surprisingly, no evidence was found of responses of fertility to changes in real wages. Table A7 shows the estimation of this specification of the model. None of the lags or the real wages value itself was significant, meaning that the probability to have children does not respond to changes in real wages. This is something unexpected but it can be attributable to the historical context of real wages in Mexico. Since there were many problems of inflation and crisis, some policies were implemented such as the fixation of salaries to inflation and very frequent changes to the wages were made. This might have offset the effect of economic hardship and its reflection in this indicator, having as a result a null effect on fertility decisions. However, it is

only a possible hypothesis. It would be interesting to go further in this respect but it is out of the scope of this study.

Nevertheless, inflation or real wages might hit harder rural populations than it does in urban cities. Therefore, these results need to be placed in the right context having in mind the population that is being studied by this sample. Probably if the analysis were extended to rural areas, the results could have changed and one could find stronger effects of economic stress on fertility, in both ways of representing it, by inflation or real wages. However, the results of these robustness checks to the response of fertility to different economic indicators used as proxies for economic stress give a broader picture of the situation that Mexican women face when deciding their fertility history.

First of all, individuals are more sensitive to changes in the economy as a whole. The aggregate measure of GDP per capita that is more related to production and employment is the variable that seems to work best when explaining fertility decisions for the sample under analysis. Indicators as inflation and real wages do not contribute to explain these changes. However, this could change when studying different societies or areas within Mexico.

All in all, this has important implications for the common view of living standards framework. In the case of Mexico people are more sensitive now to changes in the aggregate economy and not in prices, as it was used to be during the 1700´s and 1800´s in some parts of Europe and Asia. It can be also a reflection of the shift of the economy towards different sectors. While in the past the primary sectors (mainly agriculture) were more important and thus fluctuation in grain prices affected people, nowadays it might not be the main factor that affects people´s decisions, such as fertility. Instead, less production, underlying unemployment and factors related to the aggregate economy seem to matter more to explain demographic individual outcomes.

Conclusions

In this paper the fertility responses to short-term economic stress were analysed as a way of depicting the living standards of the Mexican population. The period of analysis is from 1963 until 2010, in which many economic crises happened and the fertility transition took place. The most important result obtained was that a relation between economic stress and fertility decisions does exist. By using event history analysis, it was found that the women´s decision of bearing a child has a positive relationship with the fluctuation in the GDP per capita growth. However, unless huge changes in the economic indicator take place, the response of fertility is not as big as expected because the marginal response is very small.

Nevertheless, this small response might be also pointing out to the lower bound response of fertility to economic stress since the data used in this analysis incorporates only urban areas of different states of Mexico. Leaving out the rural population one might be excluding from the analysis the most vulnerable part of the society to economic stress. Therefore, these results should be handled carefully and not generalized for the whole population.

When separating out the effect of short-term economic stress for different birth parities, it was found that the third parity is the most responsive of all parities. In addition to this, a postponement effect was found since the relation between economic stress and fertility goes from a positive to a negative relationship as time progresses. This means that women will think carefully whether to have the third child if they face economic hardship and they will only postpone this fact but not dismiss it completely.

There are also outstanding differences in the probability of having children for women with different characteristics, especially from different states, different age groups and with different level of education. However, the way that people respond to economic stress only changes by different socioeconomic groups and by cohorts. There is a marked difference in fertility responses amongst socioeconomic groups. While women in the high group are more likely to have children when economic stress takes place, people of the medium, low and very low are less likely. These big differences in fertility responses amongst socioeconomic groups could be due to the nature of the job and economic activity each groups is involved in. About birth cohorts, those women that were born in 1951-1953 are less affected by economic stress. This clearly represents the importance that the role of economic conditions has gained in recent years for younger women. Finally no difference was found for people with different levels of education or by State of Residence.

The small effect of the GDP growth on fertility led to try different economic indicators in order to assess once more the way fertility is affected. However, neither annual inflation nor real wages proved to have greater impacts than GDP growth. Actually, the former two variables did not have any significant effect on the probability of having a child for the period under analysis. This implies that changes in the aggregate economy can have more influence on the fertility decisions that people make than fluctuations in prices or wages.

On the other hand, if one could include more areas to the sample, especially rural areas, these results may change a lot since this part of the population may potentially be affected in a different way by economic crises, being more dependent on real wages and prices fluctuations than on changes in the GDP indicator which probably are more related to employment in the urban areas. Therefore, further analysis should also include more parts of the population and also different specifications of economic stress could be used such as unemployment or some other indicators in order to get a better and more inclusive view of living standards.

Notwithstanding, the most important feature of the fertility response to economic stress in Mexico was that it is significant but very small and therefore, economic conditions might not be a definite determinant of fertility decisions. Nevertheless, this small impact might reflect good living standards in the Mexican population. However, in order to be able to state that Mexican population enjoys from good living standards, which is a very strong statement, one has to extend this analysis by examining other demographic outcomes such as mortality or migration and other parts of the population should also be considered.

Another way to read these results is that in the past fertility was strongly linked to short-term economic stress. Nowadays this relation might have changed and possibly the link is not as strong as before. Cultural factors and different incentives could drive fertility and the extent to which they do it might be more relevant than economic conditions. That is the reason why

other demographic outcomes should be explored as well in order to be able to compare living standards.

Nevertheless, if one adopts the framework explained in this study, the living standards in Mexico can be considered as good regarding only the response of fertility to economic stress. In addition to this, the living standards can be considered better or at least not as low than those of certain European or Asian past generations. The results have indicated differences in the responses for these different populations and this could potentially be generalized to, for example, other Latin American countries that on a general level have evolved similarly to Mexico. However, new comparative studies are needed to elaborate on patterns in living standards among today's developing countries.

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Appendix

Table A1. Measures of individual, household, and community characteristics used in the Eurasia Project

Level	Measures
1)Individual	1. Women´s current age
	2. Number of children ever observed
	3. Size and sex composition of surviving children
	4. Age difference between spouses
	5. Current marriage is first marriage or remarriage of index woman
	6. Time since last birth and survival or previous child
	7. Migrant who arrived in previous three years
	8. Time (years) since last birth or latest marriage*
2)Household	1. Household type
	2. Number of household members aged 15 to 54
	3. Proportion of household members under age 15
	4. Proportion of household members over age 54
	5. Woman´s relationship to household head
	6. Presence of married children
	7. Presence of parents/parents in law
	8. Socioeconomic status of household
3)Community	1. Local grain price, logged and time-lagged by one year
	2. Time period
	3. Community of residence
4)Institutional and Cultural	1. The fourth level is assessed by the comparison of different regions and countries.

*Included only in the discrete time event history models

Source: Table 3.1 in Tsuya et al. (2010) pp.44

Table A2. Summary of the reproduction studies of the Eurasia Project

Country/Region	Period of study	Model	Economic Indicator	Main Results	Observations
Belgium/Sart	1812-1875	They use the Cox proportional hazards model adding interactions between the prices and the socioeconomic status	Oats price	Economic hardship hit harder the poor and landless.	They use occupation of household heads to differentiate between social groups
Sweden/Hög, Kävlinge, Halmstad and Sireköpinge	1766-1865	Cox proportional hazards model with frailty	Rye price	In the South of Sweden there was no indication of family limitation. Also deliberate spacing was practised by couples and there was significant difference in marital fertility by social groups.	They separate intervals from marriage to first birth and intervals after first birth.
Japan/ Shimomoriya and	1716-1870	Series of logistic regressions to an	Rice price	Variations in local rice prices did not	They take two villages and as

Niita		individual's probability of experiencing a given demographic event—death, marital birth, first marriage, or out-migration—in the interval of the next one year following the beginning of the interval.		affect significantly marital reproduction. That can be interpreted as evidence that family control was not limited by economic hardship.	they share many characteristics in common, they pooled the data for both villages together. Infanticide is analysed in this case.
Italy/ Casalguidi and Venice	Casalguidi (1819-1859) Venice (1850-1869)	They use a dicrete-time event-history model for Casarguidi, for which they have annual information and a continous-time model for Venice for which the information on timing of birth is available.	Wheat price control for the period of cholera epidemic to separate the effect of both variables.	The found significant differences amongst social groups and their fertility patterns. For the case of Venice social and economic factors showed weaker effects on marital fertility. For Casalguidi, economic stress hit social groups differently	They exclude the first birth since it´s linked to the time of marriage and also intervals between marriages and first birth are strongly affected by courtship traditions and prenuptial conceptions
China/Daoyi, Chengnei, Guosantum, Daxingtun, Zhaohuatun	1789-1840	They use the discrete model (using clog-log regressions) and treating first birth and later birth separately and making the distinction between male and female births. This distinction is made because the sources recorded male births much more completely than females.	Grain prices including rice, wheat, husked and unhusked millet, soybean, and sorghum.	The low level of marital reproduction was due to a complex combination of cultural prerogatives, economic conditions and social hierarchies. Nevertheless, short-term economic fluctuations had a significant impact on reproductive outcomes.	The child control as infanticide was considered as an important mechanism for reproductive control.

Table A3. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Dependent Variable					
birth	41045	0.093629	0.291315	0	1
Main Independent Variable					
GDP per capita growth	41045	1.284169	3.489733	-7.82527	8.539933
GDP per capita growth (Lag 1)	41045	1.311901	3.532152	-7.82527	8.539933
GDP per capita growth (Lag 2)	41045	1.338362	3.561674	-7.82527	8.539933
GDP per capita growth (Lag 3)	41043	1.653571	3.354135	-7.82527	8.539933
GDP per capita growth (Lag 4)	41036	1.752928	3.392284	-7.82527	8.539933
Inflation	41045	0.274919	13.59133	-37.5184	44.43469
Inflation (Lag 1)	41045	0.1699	13.69013	-37.5184	44.43469
Inflation (Lag 2)	41045	0.022564	13.77434	-37.5184	44.43469
Inflation (Lag 3)	41043	-0.15722	13.89159	-37.5184	44.43469
Inflation (Lag 4)	41036	-0.36534	14.20156	-37.5184	44.43469
Real Wages	41045	164.3244	85.55378	99.7723	372.2194
Real Wages (Lag 1)	41043	-0.08163	6.656522	-18.7229	17.16369
Real Wages (Lag 2)	41036	0.009484	6.851257	-18.7229	17.16369
Real Wages (Lag 3)	41018	0.007221	6.991758	-18.7229	17.16369
Real Wages (Lag 4)	40883	0.050161	7.14869	-18.7229	17.16369
Time related variables					
Duration in last birth parity	41045	7.433865	6.235987	0	36
Trend	41045	3.338235	0.502812	0	3.89182
Trend Squared	41045	11.39663	2.989866	0	15.14626
Demographic Information					
Total of Children	41045	1.836521	1.906773	0	14
Age15_19	41045	0.181752	0.385645	0	1
Age20_24	41045	0.18163	0.385544	0	1
Age25_29	41045	0.181508	0.385443	0	1
Age30_34	41045	0.156584	0.363413	0	1
Age35_39	41045	0.115045	0.31908	0	1
Age40_50	41045	0.183482	0.387066	0	1
Cohort1	41045	0.028189	0.165513	0	1
Cohort2	41045	0.395566	0.488978	0	1
Cohort3	41045	0.336363	0.47247	0	1
Cohort4	41045	0.239883	0.427017	0	1
National Migration	41045	0.027385	0.163203	0	1
International Migration	41045	0.001584	0.039764	0	1
Education					
No education	41045	0.04327	0.203466	0	1
Primary School completed	41045	0.300816	0.458619	0	1
Secondary School completed	41045	0.655914	0.475075	0	1
Area of Residence					

Region1	41045	0.08939	0.285309	0	1
Region2	41045	0.182897	0.386587	0	1
Region3	41045	0.157681	0.364446	0	1
Region4	41045	0.251967	0.434148	0	1
Region5	41045	0.128883	0.335074	0	1
Region6	41045	0.145085	0.352191	0	1
Region7	41045	0.044098	0.205315	0	1
Socioeconomic Status					
Very low	41045	0.357242	0.479193	0	1
Low	41045	0.286417	0.452092	0	1
Medium	41045	0.298356	0.457542	0	1
High	41045	0.057985	0.233718	0	1
Fertility and Marital status					
Use of Contraception methods	41045	0.384407	0.486461	0	1
Married	41045	0.494335	0.499974	0	1
Single	41045	0.315678	0.464791	0	1
Cohabitation	41045	0.119503	0.324383	0	1
Divorced, separated, widow	41045	0.070484	0.255963	0	1

Table A4. Marginal Effects evaluated at the mean

	Delta-method					
	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
GDPpcg	-2.01E-06	0.000401	-0.01	0.996	-0.00079	0.000783
GDPpcgL1	-0.0003011	0.000402	-0.75	0.454	-0.00109	0.000488
GDPpcgL2	0.0011062	0.00039	2.84	0.005	0.000342	0.001871
GDPpcgL3	-0.0000691	0.000412	-0.17	0.867	-0.00088	0.000739
GDPpcgL4	0.0007647	0.000404	1.89	0.059	-2.8E-05	0.001557
duration	0.0105279	0.000471	22.34	0	0.009604	0.011452
parity	0.0416569	0.001237	33.68	0	0.039233	0.044081
ln_trend	0.2240861	0.038291	5.85	0	0.149038	0.299134
trend_sq	-0.0676211	0.008557	-7.9	0	-0.08439	-0.05085
Age15_19	0.0423167	0.008013	5.28	0	0.026612	0.058021
Age20_24	0.0346159	0.004857	7.13	0	0.025097	0.044135
Age30_34	-0.0453831	0.005467	-8.3	0	-0.0561	-0.03467
Age35_39	-0.1105495	0.010122	-10.92	0	-0.13039	-0.09071
Age40_50	-0.2714079	0.019351	-14.03	0	-0.30934	-0.23348
cohort1	0.1023089	0.011583	8.83	0	0.079607	0.125011
cohort3	0.1260531	0.011886	10.61	0	0.102757	0.149349
cohort4	0.2040081	0.020209	10.09	0	0.164399	0.243618
Nat. Migration	-0.0001922	0.006738	-0.03	0.977	-0.0134	0.013015
Inter. Migration	0.0216942	0.026821	0.81	0.419	-0.03087	0.074262
Primary Educ.	0.0077954	0.005864	1.33	0.184	-0.0037	0.019289
Secondary Educ.	0.0382584	0.006472	5.91	0	0.025574	0.050943
region2	-0.0144004	0.005113	-2.82	0.005	-0.02442	-0.00438
region3	-0.0129658	0.005201	-2.49	0.013	-0.02316	-0.00277
region4	-0.0158616	0.004846	-3.27	0.001	-0.02536	-0.00636
region5	-0.0162483	0.005508	-2.95	0.003	-0.02704	-0.00545
region6	-0.0188474	0.005297	-3.56	0	-0.02923	-0.00847
region7	-0.0210653	0.007382	-2.85	0.004	-0.03553	-0.0066
low	0.0047622	0.003519	1.35	0.176	-0.00213	0.011659
medium	0.0074199	0.003885	1.91	0.056	-0.00019	0.015034
high	0.0006613	0.006836	0.1	0.923	-0.01274	0.01406
contraceptive	-0.0706988	0.002938	-24.06	0	-0.07646	-0.06494
single	-0.217537	0.005752	-37.82	0	-0.22881	-0.20626
cohabit	-0.0082972	0.00336	-2.47	0.014	-0.01488	-0.00171
dsw	-0.0688549	0.006561	-10.49	0	-0.08171	-0.056

Table A5. Region Interactions		
GDPpcg	0.0504	(0.0303)
GDPpcgL1	-0.0460	(0.0274)
GDPpcgL2	0.0320	(0.0282)
GDPpcgL3	-0.0335	(0.0279)
GDPpcgL4	0.0429	(0.0263)
GDPpcg *reg1	-0.0689	(0.0354)
GDPpcg *reg2	**-0.0663***	**(0.0330)**
GDPpcg *reg3	-0.0412	(0.0335)
GDPpcg *reg4	-0.0567	(0.0324)
GDPpcg *reg5	-0.0432	(0.0345)
GDPpcg *reg6	-0.0419	(0.0340)
GDPpcgL1*reg1	0.0378	(0.0336)
GDPpcgL1*reg2	0.0557	(0.0308)
GDPpcgL1*reg3	0.0367	(0.0309)
GDPpcgL1*reg4	0.0421	(0.0299)
GDPpcgL1*reg5	0.0596	(0.0323)
GDPpcgL1*reg6	0.0304	(0.0312)
GDPpcgL2*reg1	0.00456	(0.0339)
GDPpcgL2*reg2	-0.0267	(0.0313)
GDPpcgL2*reg3	-0.0127	(0.0312)
GDPpcgL2*reg4	-0.0199	(0.0304)
GDPpcgL2*reg5	-0.0183	(0.0326)
GDPpcgL2*reg6	-0.0109	(0.0322)
GDPpcgL3*reg1	0.0203	(0.0336)
GDPpcgL3*reg2	0.0226	(0.0315)
GDPpcgL3*reg3	0.0329	(0.0317)
GDPpcgL3*reg4	0.0338	(0.0305)
GDPpcgL3*reg5	0.0485	(0.0334)
GDPpcgL3*reg6	0.0421	(0.0322)
GDPpcgL4*reg1	-0.0266	(0.0324)
GDPpcgL4*reg2	-0.0486	(0.0297)
GDPpcgL4*reg3	-0.0410	(0.0294)
GDPpcgL4*reg4	-0.0182	(0.0287)
GDPpcgL4*reg5	-0.0187	(0.0310)
GDPpcgL4*reg6	-0.0415	(0.0301)
Pseudo-R^2	0.2915	
Obs	41036	
AIC	18207.3	
CHIsq	3627.1	

Robust Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The model also controls for the all covariates included in the main model such as: duration, parity, age groups, migration, education, area of residence, socioeconomic, and marital status.

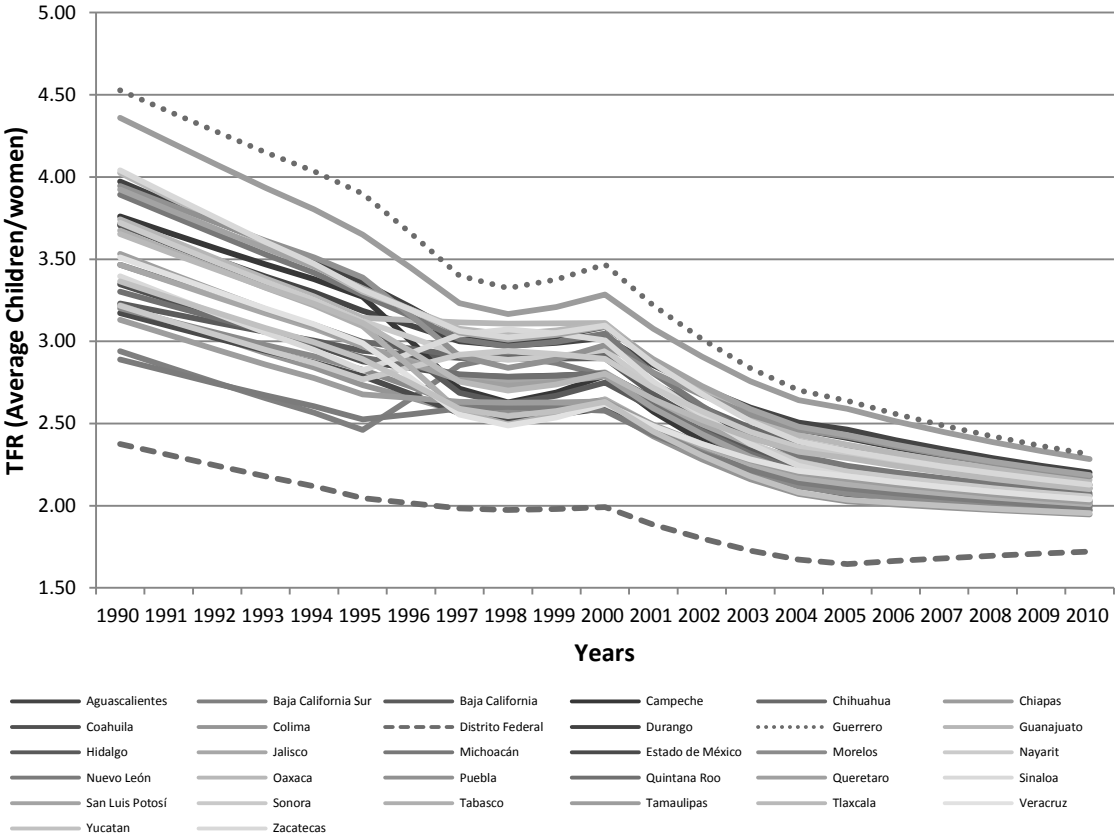
Table A6. Model with Inflation as Economic Indicator		
Inflation	-0.00133	(0.00177)
Inflation L1	-0.00205	(0.00178)
Inflation L2	-0.00372	(0.00211)
Inflation L3	-0.00282	(0.00183)
Inflation L4	**-0.00550****	**(0.00181)**
duration	0.161***	(0.00764)
parity	0.637***	(0.0204)
ln_trend	3.223***	(0.585)
trend_sq	-0.997***	(0.132)
Age15_19	0.670***	(0.124)
Age20_24	0.576***	(0.0779)
Age30_34	-0.680***	(0.0839)
Age35_39	-1.692***	(0.158)
Age40_50	-4.187***	(0.303)
cohort1	1.531***	(0.177)
cohort3	1.869***	(0.184)
cohort4	3.055***	(0.314)
Nat. Migration	-0.00502	(0.103)
Inter. Migration	0.329	(0.412)
Primary Educ.	0.118	(0.0895)
Secondary Educ.	0.584***	(0.0990)
region2	-0.221**	(0.0782)
region3	-0.199*	(0.0795)
region4	-0.242**	(0.0741)
region5	-0.249**	(0.0842)
region6	-0.290***	(0.0810)
region7	-0.325**	(0.113)
low	0.0726	(0.0538)
medium	0.113	(0.0594)
high	0.00809	(0.104)
contraceptive	-1.079***	(0.0461)
single	-3.325***	(0.0904)
cohabit	-0.128*	(0.0514)
dsw	-1.052***	(0.101)
_cons	-4.514***	(0.672)
Pseudo-R^2	0.2908	
Obs	41036	
AIC	18166.6	
CHIsq	3593.9	

Robust Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A7. Model with Real Wages as Economic Indicator		
r.wages	0.00259	(0.00323)
r.wages L1	0.00487	(0.00322)
r.wages L2	0.00189	(0.00275)
r.wages L3	0.00423	(0.00311)
r.wages L4	-0.00182	(0.00292)
duration	0.161***	(0.00768)
parity	0.636***	(0.0205)
ln_trend	3.219***	(0.615)
trend_sq	-1.005***	(0.136)
Age15_19	0.662***	(0.125)
Age20_24	0.543***	(0.0779)
Age30_34	-0.660***	(0.0848)
Age35_39	-1.708***	(0.159)
Age40_50	-4.132***	(0.304)
cohort1	1.563***	(0.178)
cohort3	1.908***	(0.185)
cohort4	3.111***	(0.314)
Nat. Migration	-0.0110	(0.103)
Inter. Migration	0.334	(0.414)
Primary Educ.	0.124	(0.0897)
Secondary Educ.	0.589***	(0.0992)
region2	-0.220**	(0.0781)
region3	-0.200*	(0.0795)
region4	-0.245***	(0.0740)
region5	-0.249**	(0.0841)
region6	-0.291***	(0.0809)
region7	-0.321**	(0.113)
low	0.0713	(0.0538)
medium	0.112	(0.0594)
high	0.00606	(0.104)
contraceptive	-1.078***	(0.0461)
single	-3.312***	(0.0903)
cohabit	-0.126*	(0.0514)
dsw	-1.052***	(0.101)
_cons	-4.435***	(0.721)
Pseudo-R^2	0.2899	
Obs	40883	
AIC	18151.1	
CHIsq	3571.6	

Robust Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Graph A1. Total Fertility Rate for every State in Mexico 1990-2010



Source: Demographic Indicators 1990-2030 from INEGI

Construction of the Wealth Index

The 18 items or characteristics that the survey includes and that were used to construct the wealth index are the following:

1. Television
2. Car
3. Stove
4. Refrigerator
5. Washing Machine
6. Blender
7. Running water
8. Stereo
9. Fixed Telephone
10. Camera
11. Encyclopaedia
12. Pay someone to do housework
13. Concrete ceiling
14. Bathroom inside the house
15. Exterior paved road
16. Working animals (donkeys, horses)
17. Livestock (Cows, pigs, goats, sheep)
18. Tractor

Once the points for each woman were recorded the classification was made based on the following rules.

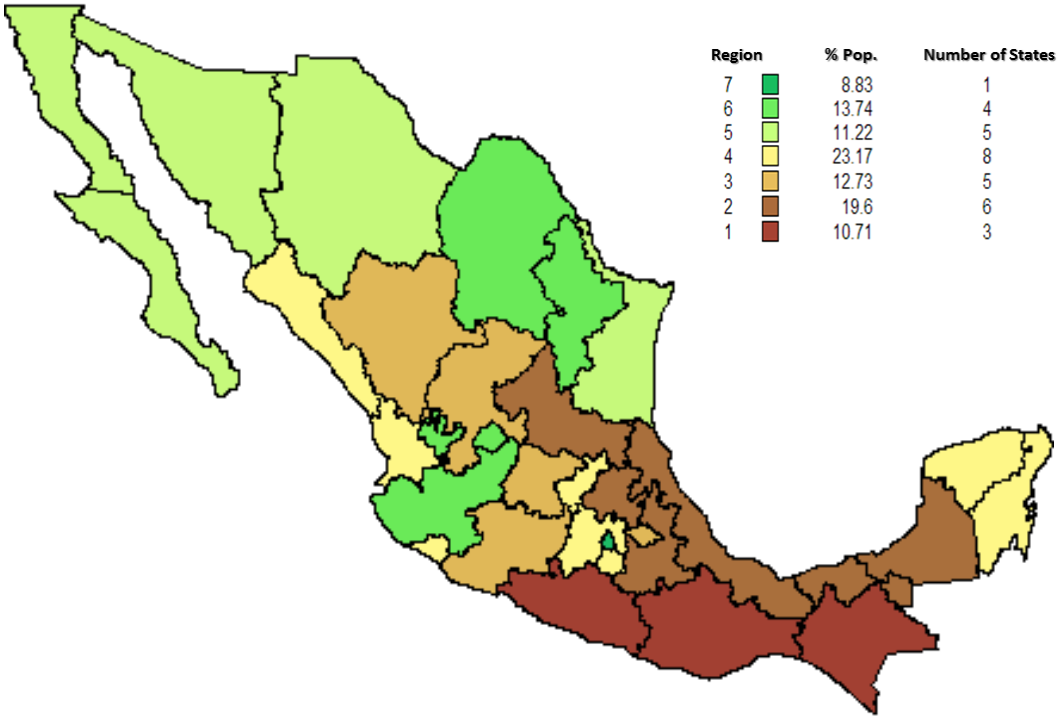
Very Low: this group consists of all the women that scored between 0 and 4 points. This is considered the poorest or the least favoured group since the facilities or items at home were very limited.

Low: people who scored between 5 and 9. In this group people can have access to more items or characteristics but they are still in a low status.

Medium: the score of this group goes from 10 to 14. Belonging to this group implies that a woman had more than half of the items asked in the survey.

High: The last group includes people scoring between 15 to 18 items. This is considered the wealthiest group.

Figure A1. Map of the socioeconomic Regions in Mexico



Region	Population	State	Region	Population	State
7	8,605,239	DISTRITO FEDERAL	4	2,536,844	SINALOA
6	944,285	AGUASCALIENTES	4	1,658,210	YUCATÁN
6	2,298,070	COAHUILA DE ZARAGOZA	3	1,448,661	DURANGO
6	6,322,002	JALISCO	3	4,663,032	GUANAJUATO
6	3,834,141	NUEVO LEÓN	3	3,985,667	MICHOACÁN DE OCAMPO
5	2,487,367	BAJA CALIFORNIA	3	962,646	TLAXCALA
5	424,041	BAJA CALIFORNIA SUR	3	1,353,610	ZACATECAS
5	3,052,907	CHIHUAHUA	2	690,689	CAMPECHE
5	2,216,969	SONORA	2	2,235,591	HIDALGO
5	2,753,222	TAMAULIPAS	2	5,076,686	PUEBLA
4	542,627	COLIMA	2	2,299,360	SAN LUIS POTOSÍ
4	13,096,686	MÉXICO	2	1,891,829	TABASCO
4	1,555,296	MORELOS	2	6,908,975	VERACRUZ-LLAVE
4	920,185	NAYARIT	1	3,920,892	CHIAPAS
4	1,404,306	QUERÉTARO DE ARTEAGA	1	3,079,649	GUERRERO
4	874,963	QUINTANA ROO	1	3,438,765	OAXACA

Source: Classification of Federal States in National Institute of Statistics and Geography (INEGI for its acronym in Spanish), Consulted on May 20th 2013, available in: http://sc.inegi.gob.mx/niveles/index.jsp