# HEALTH INSURANCE AND PREGNANCY OUTCOMES: AN ANALYSIS OF FERTILITY, PRENATAL CARE AND EMPLOYMENT IN MEXICO

Jorge R. Gallardo-García

A DISSERTATION

in

ECONOMICS

Presented to the Faculties of the University of Pennsylvania

in Partial Fulfillment of the Requirements

for the Degree of Doctor of Philosophy

2006

---

Supervisor of Dissertation

---

Graduate Group Chairperson

**To Susana, my Mother, and Viviana.**

## ACKNOWLEDGEMENTS

I am very grateful to Petra Todd for her guidance and support in every aspect of this research. Jere Behrman and Kenneth Wolpin also provided helpful supervision. Luis Ruvalcaba kindly helped me to understand and use the MxFLS data set. I received valuable comments and suggestions from Aureo de Paula, John Knowles, Kevin Song, Ahu Gemici, Melissa Tartari, members of the Penn Empirical Micro Discussion Group, members of the Penn Macro Club, and seminar participants at the University of Pennsylvania, Bates White, the Federal Reserve Bank of Philadelphia, ITAM, Banco de México, and the Inter-University Student Conference at Princeton University. All remaining errors are mine.

I came to do the Ph.D. at Penn thanks to the invaluable help and encouragement of Susana García Montes de Oca, my mother. Viviana Vélez-Grajales, my fiancée, made the last two years of my Ph.D. the best ever.

David Cass provided encouraging support and friendship throughout my Ph.D. student years. Life at the Ph.D. was much better thanks to the company of my friends, specially Daniel Velázquez-Núñez, Carlos Bethencourt, Fernando Riosmena, Alberto Garibi, Juan Manuel Licari, Philipp Kircher, Rafael Calderón, José Suárez-Lledo, Manolis Galenianos, Ryo Okui, Ana Moro-Ejido, Braz Ministerio de Camargo, Ahu Gemici, Daniela Iorio, Yi Liu, Irina Telyukova, and Arturo De Visdomini.

I gratefully acknowledge financial support from the Department of Economics at the University of Pennsylvania, the CONACYT, and the Mellon Foundation Grant to the Population Studies Center of the University of Pennsylvania.

## ABSTRACT

HEALTH INSURANCE AND PREGNANCY OUTCOMES: AN ANALYSIS OF FERTILITY, PRENATAL CARE AND EMPLOYMENT IN MEXICO

Jorge R. Gallardo-García

Petra E. Todd

This dissertation analyzes family decision-making about labor force sector participation, health insurance, fertility, and prenatal care in Mexico, where a large proportion of the population has little or no access to medical services and where the incidence of low birth weight and infant mortality rate are relatively high. The lack of access to health care is mainly due to a large uncovered labor market sector, where workers are not eligible for government health benefits. I develop and estimate a forward-looking, dynamic discrete choice model that can be used to study the interplay between employment and insurance decisions and pregnancy outcomes. The model incorporates a birth weight production function and a probability of infant death. I estimate the model using panel data from the Mexican Family Life Survey (MxFLS). The estimates show that prenatal care has a positive effect on birth weight of 13% on average. It is estimated that being born with normal birth weight, as opposed to low birth weight, decreases the probability of infant death from 37% to 5%. Additionally, I use the model to evaluate alternative policies aimed at increasing access to prenatal care services, such as the Universal Access Health Insurance (SPS), health care vouchers programs, and construction of health care centers. The most beneficial policy, in terms of pregnancy outcomes, is to build health care centers in every locality to decrease the cost of prenatal care; low birth weight incidence decreases from 6.77% to

5.68%, and infant mortality rate drops from 3.96% to 3.83%. The government's SPS has smaller impact on infant health because it has a strong crowding-out effect on the demand for private doctors, which are of higher quality than government hospitals. Vouchers programs have positive impact but of smaller magnitudes and at a higher cost to the government than SPS. Results from the policies' simulations suggest that, if the objective is to improve infant health, the government should not only try to increase the usage of prenatal care through subsidies, but it should implement policies aimed at improving the quality of the government health centers and their physical availability in the localities.

# Contents

# List of Tables

# Chapter 1

# Introduction

In many Latin-American countries, a large proportion of the population has little or no access to health care services. The lack of access is, in part, due to a large uncovered labor market sector, in which workers are not eligible for government health benefits. Many of these same countries have high rates of infant mortality and a high incidence of low birth weight. For example, Mexico ranks very high among OECD countries in terms of percentage of low birth weight children (9%) and infant mortality rate (2.5%). In recent years, improving infant health has become a primary concern of many governments and international institutions. For instance, the UN made reducing infant mortality rates in developing countries its fourth Millennium Development Goal.[1]

One of the potential policy instruments for improving birth outcomes is prenatal care, but whether and to what extent prenatal care affects child health outcomes is a matter of much debate.[2] Empirical estimates of the impact of prenatal care on birth

[1] See World Health Organization (2005a,b).

[2] See, for example, Corman *et al.* (1987), Grossman and Joyce (1990), Rosenzweig and Wolpin (1991, 1995), Racine *et al.* (1992), Joyce (1994, 1999), Alexander and Korenbrot (1995), Frankenberg

weight vary widely, depending on the data set and the estimation approach used. One of the main problems addressed in the economic literature is how to control for endogeneity in the choice of prenatal care services. For example, studies like Corman *et al.* (1987), Grossman and Joyce (1990), Rosenzweig and Wolpin (1991, 1995), and Joyce (1994, 1999) use fixed effects and instrumental variables methods to control for unobserved determinants of prenatal care decisions. This literature also studies how the timing and quality of prenatal care services affect child health outcomes.

Even if existing studies are able to consistently estimate the birth weight production technology, knowledge of the technology alone is insufficient for conducting policy experiments that would likely modify the behavior of families in their choice of inputs. For example, if the government subsidizes the cost of prenatal care, then we not only need to know the effect of prenatal care on outcomes, but also how families will change their insurance and prenatal care choices. A decrease in child mortality resulting from such a policy could also lead to different fertility decisions, as families no longer replace children who die. Another limitation of the existing literature is that most studies use data from developed countries where a high percentage of pregnant women receive some prenatal care,[3] so the findings are not necessarily generalizable to a developing country setting. In Mexico, the availability of medical services and the pricing of those services is closely tied to labor force sector participation and family income. Therefore, understanding how government policies affect prenatal care access and child health outcomes requires a fuller consideration of the determinants of labor supply, fertility and health care provider choices in a way that recognizes their interlinkages.

(1995), Paneth (1995), Shiono and Behrman (1995), Conley and Bennett (2000), Behrman and Rosenzweig (2004), Evans and Lien (2005), Almond *et al.* (2005), and Black *et al.* (2005).

[3]See Racine *et al.* (1992) and World Health Organization (2005c).

This work is the first to relate and jointly study family decision-making about labor sector participation of the husband and wife, health insurance, fertility and prenatal care with a focus on understanding the consequences of these decisions for pregnancy outcomes. To this end, I develop and estimate a forward-looking dynamic behavioral model using a new panel data set called the Mexican Family Life Survey (MxFLS). The model incorporates a birth weight production function that specifies the relationship between health inputs and birth weight outcomes, as well as stochastic child mortality. It allows for unobserved heterogeneity that may affect decisions to get prenatal care. In each period in the model, a husband and wife receive wage offers from both the covered and uncovered sectors and make decisions about whether and where to work. They also decide on health insurance, fertility, and, for pregnant women, on type of provider (if any) for prenatal care. Their choices are constrained by the prices they face and by their geographic location.

The dynamic model builds on earlier static models of related choices in Rosenzweig and Schultz (1983), Grossman and Joyce (1990), and Rosenzweig and Wolpin (1991). It is the first model to consider how the covered/uncovered sectoral choice decisions may depend on access to medical services. My model also builds on earlier work on dynamic fertility models such as Hotz and Miller (1988), Eckstein and Wolpin (1989), Mira (1995), Rosenzweig and Wolpin (1995), Shnaps (2001), Todd and Wolpin (2003) and Gayle and Miller (2003).

The model estimates indicate that prenatal care has a positive and important effect on birth weight. The direct effect of prenatal care amounts to 13% of the birth weight, on average, which are approximately 379 grams (13 ounces). Additionally,

being born with normal birth weight, as opposed to low birth weight, decreases the probability of dying within the first year of life from 37% to only 5%.

I use the estimated behavioral model to simulate and evaluate alternative government policies that extend the provision of prenatal care services, for which there are no available data. For example, I evaluate the recently installed Universal Access Health Insurance (*Seguro Popular de Salud*, SPS) which is an attempt by the Mexican government to extend the covered sector health care insurance (IMSS) to all the population regardless of their labor sector participation.[4] The simulations of this policy indicate that its impact on infant health is relatively small, mainly because of the strong crowding-out effect that this policy has on the demand for private health care services, which, as the model estimates indicate, are of better quality than IMSS services.

As an alternative to the SPS, I evaluate a hypothetical policy that consists on different schemes of health care vouchers program, which are targeted to low-income families. The impacts of these policies are smaller than those of the SPS and also report a higher cost for the government.

Finally, I evaluate the impact that building more hospital facilities would have on infant health, given that the estimates of the model suggest that the distance from the household to a health care center is a very important component of the total cost of seeking prenatal care services. Having a hospital in each locality or neighborhood improves infant health indicators better than the SPS.

[4]IMSS is the Social Security Mexican Institute which provides health care services to covered sector individuals and their families, see Section 3.2.

These results suggest that, when the government's main objective is to improve infant health through prenatal care services usage, it may not be enough to just subsidize such services. From the health care quality differences and the results from the hospitals construction policy simulations, it seems that the government would improve infant health in higher magnitudes through more long-run policies such as government hospital's quality improvement and increments in physical availability of health care centers.

The remainder of this dissertation is organized as follows. Chapter 2 reviews the related literature to for this work. In Chapter 3, I present detailed description of the characteristics of the Mexican National Health System. The data set description and the details of the sample used in this dissertation are discussed in Chapter 4. Chapter 5 develops the behavioral model, describes the model solution, and estimation method. Chapter 6 presents the estimation results and model fit assessment. The policy experiments are described and evaluated in Chapter 7. Finally, Chapter 8 concludes.

# Chapter 2

# Literature Review

The labor sector participation literature on which my model builds is based on the seminal ideas from Roy (1951) who proposes the notion of heterogeneity on skills and comparative advantage in a two sector economy. Willis and Rosen (1979) estimate a version of Roy's model to analyze college attendance decisions. Heckman and Sedlacek (1985, 1990) study, in an empirical equilibrium setting, a three sector model, with a decision process based on utility maximization rather than earnings maximization. Keane and Wolpin (1997) extend these models to a dynamic setting with uncertainty, estimating a structural model in which individuals make schooling, work, and occupational choice decisions, and where individual's experience is accumulated endogenously.[5]

Several papers in the literature consider, in a dynamic setting, women's labor market participation. They include the fertility decision as part of the choice set. Hotz and Miller (1988) study the labor supply decisions of women in a dynamic model

[5]These models have been extended in many dimensions. For instance, Gould (2003) relates career choice, schooling and labor market participation decisions of men with their marriage opportunities. Todd and Wolpin (2003) develop a model of schooling, and labor market participation of children to evaluate a schooling subsidies program (*Progresa*) in Mexico.

that takes into account fertility decisions and time devoted to take care of children. Eckstein and Wolpin (1989) present a dynamic model where women choose whether to work or not by maximizing a family utility function on consumption and number of children in the family.[6] Francesconi (2002) extends the model from Eckstein and Wolpin (1989) to consider the quantity of working hours supplied instead of the dichotomic decision - work or do not work. In a similar fashion, Van der Klaauw (1996) models the labor market participation along with the marital decision of women. That paper takes fertility as exogenous, stochastic, and as an absorbing state.[7] There is the possibility of divorce (also a choice), affected by the labor market opportunities and the presence of children.[8] Finally, in a similar way, Gayle and Miller (2003) model the woman's time allocation and fertility decisions. They allow the woman to divide her available time into working, nurturing children and leisure.

In many developing countries the labor market sector can be divided into a protected or formal sector and an unprotected or informal sector.[9] There are many definitions of covered (formal)/uncovered (informal) sector.[10] For the purpose of this paper, I consider that a person has a covered sector job if she is employed by a firm or employer that provides the Social Security benefits, which include the government

[6]The authors take the husband's income as exogenous and stochastic.

[7]The model takes into account if the woman has children or not but not the number of children.

[8]Another example of modeling with implicit fertility is Bernal (2003). She focuses on the effect that child care has on children's cognitive ability. It is assumed that children attend to child care because their mothers work.

[9]Schneider (2002) computes the size of the informal sector in terms of percentage of the official GDP for 110 countries in the year 2000. He reports that the average size of the informal sector of the economy in developing countries is 41% as opposed to only 18% in the OECD countries. In particular, he finds that the informal economy in Mexico accounted for 30% of its GDP for the same year.

[10]See Maloney (2003) for a description of the characteristics of the informal sector in Latin-America and the main definitions used in the literature.

health insurance;[11] an uncovered sector job is one that does not provide benefits.[12] The approaches taken in the literature regarding the formal and informal sectors depend on assumptions about how the labor market operates: whether it is a segmented or a competitive market. Papers that consider the labor market as segmented assume that firms are the decision makers and workers accept what firms offer; workers who do not get covered sector offers are then left with an uncovered sector job.[13] Alternatively, as in the present study, the assumption of a competitive labor market implies that the employees decide where to get a job depending on their individual characteristics and the benefits (or costs) provided by those jobs.[14] Navarro-Lozano (2002) presents evidence that this is the labor market arrangement in Mexico.[15] Marrufo (2001) takes this approach to analyze the effect that the 1997 Social Security Reform had on the size of the uncovered sector in Mexico. She concludes that employers are able to shift the cost of higher benefits to their workers in the form of lower wages in the covered sector and that employees switch from one sector to the other, depending on the benefits they perceive.

Infant health and fertility decisions have been studied extensively in the widest range of disciplines such as medicine/biology, demography, sociology and, economics. In this study, as is established in the literature, infant health is measured by two pregnancy outcomes: the birth weight of the born child and the infant mortality rate.[16] According to the literature, in both developed and developing countries, these two

[11]This definition has been widely used in this literature, for example, see Maloney (2003) and Heckman and Pagés (2004a).

[12]Under this definition, a self-employed person that does not get these benefits for herself would also be considered as having an uncovered sector job.

[13]See, for example, Levenson and Maloney (1998), Dabla-Norris and Feltestein (2003), and the several papers contained in Heckman and Pagés (2004b).

[14]See Maloney (2003).

[15]Pratap and Quintin (forthcoming) report similar findings for Argentina.

[16]An infant is a child less than one year old.

outcomes are used as key indicators to evaluate public policies.[17] I present evidence from diverse disciplines of the importance of these outcomes and how they are related to the prenatal care provision considered in the present study.

In the medical literature the birth weight of a child is considered as the best indicator of how a pregnancy has progressed. The birth weight of a child is classified as normal, low and very low birth weight. An infant is considered to have low birth weight when she weighs less than 2,500 grams (5 pounds 8 ounces) and to have very low birth weight when she is less than 1,500 grams (3 pounds 5 ounces).[18] From the policy implementation point of view, the percentage of low birth weight births together with the infant mortality rate are the most commonly used indicators to measure and evaluate a country's infant health status and its health system's degree of development.[19]

At the same time, there is substantial medical evidence that the level of birth weight determines the infant mortality (in particular, neonatal mortality) probability of a child.[20] In this direction, Paneth (1995) finds that, between 1976 and 1978, the 74% (83%) of the neonatal deaths in white (black) infants were from children with low birth weight or preterm delivery.[21] Even when the infant born with low birth

[17]See, for example, UNICEF and World Health Organization (2004) and World Health Organization (2005a,c).

[18]This definition was prescribed by the World Health Organization in 1950 (See World Health Organization (1950)). It has been argued that this definition does not represent an accurate healthy birth weight threshold for all races and regions in the world but it is recognized as an easily computable figure and as the best benchmark for international comparison widely used in all policy evaluations (See, for example, UNICEF and World Health Organization (2004) and World Health Organization (2005a,c)).

[19]See Dávila and Guijarro (2000) and OECD (2005), for instance.

[20]A neonate is the child with 28 or less days of life.

[21]Preterm delivery is a pregnancy that lasted less than 37 weeks. In the medical literature the gestational age (time that the pregnancy lasts) is regarded as a better indicator and predictor of the current and future health status of the child than the birth weight alone. Unfortunately, this

weight survives infancy, the negative effects can be very serious and affect every aspect of the individual's life such as her health, educational performance and future employment opportunities.

Even though the focus of this work is not to study the future consequences of low birth weight on individuals beyond their first year of life, I illustrate this part of the literature to emphasize the importance of a high incidence of low birth weight births for a country. Hack *et al.* (1995) document various medical studies that have found that children and early adolescents born with low birth weight have a higher than normal probability of presenting physical and neurological abnormalities, lower growth attainment, a higher rate of illnesses, and higher rate of rehospitalizations (aside from the treatments received at birth such as the use of incubators). Among the studies mentioned by these authors are those that, in order to control for the child's sociodemographic factors, measure medical conditions that are present at birth and determined only by biological factors such as the rates of cerebral palsy, blindness, deafness, and seizures, which are more common in this group of children. These studies also find that, later in their childhood, these children are more prone to chronic conditions such as asthma, and respiratory and ear infections, lower average weight, height and head circumference. Supplemental studies find that these children also perform relatively worse in tests measuring disfunctions related to intelligence, memory, speech, language, psychomotor abilities, academic achievement, behavior, and attention even after controlling for sociodemographic factors.

---

gestational age is measured with huge errors, when available, because it was common practice to start counting from the date of the last menstrual period, as reported by the mother, which is subject both to recall error and biological differences. In this study I do not consider this measure and focus on the birth weight. See Paneth (1995).

Aside from the psychic costs that these negative effects from low birth weight may have on the families, the economic costs are gargantuan. For instance, Lewit *et al.* (1995) estimate that, in 1988 for the United States, additional expenditures on health care, special education and child care due to low birth weight on children from 0 to 15 years old (that accounted for only the 7% of the children in that age group) amounted to $6 billion.

In the demography and economics literatures, being born with low birth weight has been identified as a determinant of the educational attainment of the child that persists even after her adolescence. In general, these studies had been preoccupied by the possible estimation bias due to the effect of different socidemographic conditions of the children compared. For instance, if a low birth weight child, from a poor family, reports a low school attainment it could be a consequence of the resources available after birth and not of the low birth weight itself. To avoid this potential problem, Conley and Bennett (2000) use information on siblings to compare educational attainment from normal and low birth weight children within a family. They estimate a family fixed effects model and find that low birth weight has a lasting negative impact on school attainment (measured as the probability of graduating from high school before or at 19 years old). A similar finding regarding school attainment is reported at Boardman *et al.* (2002). They use a panel data with information on PIAT scores over time for siblings within families.[22] They estimate a nested random effects model to control for unobserved heterogeneity in the family, the child, and the test scores measurements over time. They conclude that children born with low birth weight perform worse in these standardized tests than normal birth weight

[22]PIAT stands for Peabody Individual Achievement Tests. The mathematics and reading recognition tests were considered in their paper.

children. Behrman and Rosenzweig (2004) go further and analyze the effect of low birth weight on school attainment and adult earnings. That study utilizes data on monozygotic twins to control for genetic factors and biological endowments during pregnancy. They find that there is a positive effect of increasing the birth weight of children both on their school attainment, height, and labor market payoffs. Recently, the debate on the importance of being born with low birth weight has been continued by Almond *et al.* (2005) and Black *et al.* (2005). Almond *et al.* (2005), using a sample of twins, examine the effect of low birth weight on short run outcomes such as additional hospital expenditures. These authors find that, for their sample, the effect of being born with low birth weight on additional hospital expenditures is small and that its relationship with infant mortality rate is not as large as in other studies. Reconciling the past literature with the former paper, Black *et al.* (2005) find that the effect of low birth weight, although small on short run outcomes as in Almond *et al.* (2005), has a strong effect on longer run outcomes such as height, body mass index, IQ, education, and earnings as found in previous papers like Behrman and Rosenzweig (2004).

The negative effects of having a disadvantageous start in life have motivated the governments to develop policies to improve infant health. In order to do this, it has been necessary to study the infant health determinants and how policies would affect them. The focus of these studies is on the parents' decisions regarding the quantity and quality (for instance, health) of their children as extensions to the model proposed by Becker and Lewis (1973). There are two common factors in these papers: 1) the link made between fertility decisions and infant health; and, 2) the implicit or explicit idea of a health production function.[23]

[23]The concept of a health production function was first put forward by Grossman (1972), who

Wolpin (1997) surveys multiple studies from which he identifies a list of inputs that have been most commonly used in the infant health literature. He classifies these factors in three categories: 1) biological; 2) prenatal; and, 3) postnatal. Among the biological factors are those that can not be changed by individual decisions such as gender, maternal height, maternal disease history, race, and residual frailty endowment; and those that depend on the mother's fertility decision like birth order, maternal age at birth, and prior birth spacing. The prenatal inputs factors are those behaviors that the mother chooses during pregnancy such as drugs and alcohol use during pregnancy, prenatal medical care visits, maternal nutrition, maternal activity, and disease exposure. Lastly, the postnatal inputs are those choices made by parents at and after birth, which include nutrition and feeding practices, medical care visits (prevention and treatment), and disease and accident exposure.[24]

The focus of this work is to study the effect of the prenatal care services on infant health. Alexander and Korenbrot (1995), from the medical point of view, consider that the four main targets of prenatal care that could contribute to a better birth weight outcome and, therefore, reduce the risk of infant mortality are: 1) education regarding the risks of smoking, alcohol and drugs abuse during pregnancy; 2) nutritional guidance to prevent inadequate weight for height or weight gain and poor nutritional status; 3) treatment and prevention of chronic and current diseases, including sexually transmitted diseases, reproductive tract infections, hypertension, and diabetes; and, 4) immunization as preventive action. I divide the works that analyze

considers that the individual's biological and sociodemographic endowments, along with her personal decisions are inputs that affect her health status (output).

[24]Clearly, only those factors that are parental choices (fertility, prenatal and postnatal factors) are modifiable by policy.

the effect of prenatal care on infant health (although they consider some of the other inputs as well) into those that take fertility as exogenous, and those that explicitly model the fertility decision, as the present study.

Among those papers with exogenous fertility are Rosenzweig and Schultz (1983), Grossman and Joyce (1990), Rosenzweig and Wolpin (1991), and Peabody *et al.* (1998). This part of the literature, as pointed out by Rosenzweig and Schultz (1983), recognizes that the health heterogeneity of individuals may lead to correlations between the inputs and the outputs in health production functions, which would be a source of bias of the estimated effects. This bias, regarding medical services, in particular, prenatal care, can go in two opposite directions. First, the effect of prenatal care services could be overestimated if the decision of getting them is an indicator of people that have healthier behaviors such as better nutrition or better general care during pregnancy. Second, the effect of prenatal care services would be underestimated if the mother had some information (unobserved to the econometrician) of a possible negative outcome of the pregnancy (that realizes), such as a genetic predisposition or prior pregnancy histories, that would make the mother seek these services. Rosenzweig and Schultz (1983) develop a static model in which parents maximize their utility subject to a budget constraint and a birth weight production function that considers this potential bias. They estimate it using a two-stage least squares procedure with prices, income, and education of the mother as instruments. They conclude that the bias from heterogeneity is negative and that it is the reason for which previous literature, that did not control for such heterogeneity, found little or no effect of prenatal care services on birth weight.

Grossman and Joyce (1990) focus on the estimation of a birth weight produc-

tion function that contains the prenatal care services as an input. Their model also includes the choice of getting an abortion. They include this choice arguing that estimations of birth weight production functions can have a selection bias because it is possible that mothers who have information of a bad pregnancy outcome (very low birth weight or malformations) choose to terminate the pregnancy. They estimate a dynamic system of equations in which the mother decides to have an additional child if she has not yet reached her optimal number of children in that period. Their selection bias corrected results indicate that prenatal care has a positive effect on birth weight and it can be treated as an exogenous variable in their sample.

In a similar fashion, Rosenzweig and Wolpin (1991) use information on birth weight and gestational age from siblings along with maternal choices that affect the pregnancy outcomes such as prenatal care. Their goal is to decompose the variance of the birth weight into four parts: 1) the part explained by the variation in endowments; 2) the portion that comes from the mother's response to endowments, in the form of health-related choices; 3) the correlation between endowments and environmental variables that determine the choice set of the household; and, 4) the part related to measurement error. The model consists of equations for birth weight and gestational age with their corresponding measurement errors, estimated by fitting the sample covariance matrix to the population matrix. Their main findings are that: early prenatal care has a positive effect on birth weight although the effect on gestational age is not definite; smoking has a negative effect on birth weight; heavier women before pregnancy or women with higher weight gain during pregnancy deliver heavier babies earlier; and, the first born children effect has a negative effect on birth weight. Regarding the variance decomposition, one third of the predicted birth weight variance is related to measurement error and from the remaining, 90%

can be related to endowments variation, and the rest to parental responses to their endowments. Interestingly, Rosenzweig and Wolpin (1991) observe that 60% of the gestational age variance for first births, and almost 90% for later births is related to measurement error. In this sense, Racine *et al.* (1992) survey numerous studies, conducted mainly in the medical field, that investigate the effect of prenatal health care both on birth weight and on infant mortality. The connection between prenatal care and infant mortality is the positive effect that medical services during pregnancy have in birth weight. They conclude that the existing evidence suggests that prenatal medical services are beneficial to pregnancy outcomes.

The papers mentioned before focused on data from the United States where prenatal care services are more commonly available and of better quality than in developing countries.[25] An example from a developing country is Peabody *et al.* (1998) which studies the effects that, on the one hand, higher availability of prenatal care services and, on the other hand, higher quality services have on pregnancy outcomes in Jamaica. These authors suggest that health services of higher quality may attract women that are not getting any prenatal care services. Their method consists in constructing indices that represent the known determinants of pregnancy outcomes and comparing their averages across different villages with similar characteristics, differentiated by the availability and quality of medical services.[26]

More related to the present study are those models that consider fertility as en-

[25]For instance, in 1989 more than 76% of American women received early prenatal care (See Racine *et al.* (1992)), a number that contrasts with the estimated 53% in the developing countries for 1990 (See UNICEF and World Health Organization (2001) and World Health Organization (2005c)).

[26]Frankenberg (1995) is another example of research on the effects of the access to health care during pregnancy and infant mortality in a developing country (Indonesia). She reaches similar conclusions regarding the number of clinics through a matching method similar to what in economics is known as nearest neighbor matching.

dogenous. In general, the fertility literature focuses on two theories that relate the decision of having a child to infant mortality, called replacing and hoarding.[27] Replacing is when a family decides to have an additional child to replace a dead child. Hoarding is when the family insures itself from having a child death by having more children than those they would have if there was no possibility of infant death. These concepts are best analyzed in a dynamic context.[28]

Wolpin (1984) constitutes the first attempt to study this decision with an estimable dynamic stochastic structural model. That paper served as a starting point for many other studies both in the study of fertility and in the structural models estimation literature.

Representative examples of papers that relate the fertility decision to infant health in a structural dynamic model fashion are Mira (1995), Rosenzweig and Wolpin (1995), and Shnaps (2001). Mira (1995), develops a model of fertility replacement incorporating learning of a family-specific factor of infant mortality risk from the mother.

Rosenzweig and Wolpin (1995) use family and kinship data to estimate a dynamic model of intrafamily investment decisions that incorporates endowment heterogeneity. In that paper, fertility decisions are modeled explicitly. Surprisingly, they find no evidence of reporting errors in the birth weight by comparing information from current rounds of their survey with retrospective data. They compare the effect of selection bias on the estimates from different methods and find that those that fit

[27] See Ben-Porath (1976).
[28] See Arroyo and Zhang (1997) and Wolpin (1997) for surveys on this literature.

the data best are those coming from a model that controls both for differences in endowments and endogeneity, i.e., a model with mother fixed effects combined with the use of instrumental variables.

Finally, Shnaps (2001) models the mother's fertility choice along with the decision of smoking during pregnancy. The goal of that paper is to study the effect of smoking on the child's birth weight. He finds a negative effect of smoking on birth weight and conducts a set of counterfactual policy experiments that affect cigarette consumption.

# Chapter 3

# The Mexican National Health System (MNHS)

## 3.1 Context

Mexico had a population of 102,946,000 in the year 2002; this figure places this country in the 11th place worldwide; among the OECD countries it is the third most populated country, after the United States (289,821,000) and Japan (127,525,000); and, with respect to the other Latin-American countries it occupies the second place only after Brazil (178,895,000). Almost one third of the total population in Mexico is concentrated in the four major metropolitan areas in the country: Mexico City, Monterrey, Guadalajara and Puebla, with approximately 20 million people living in Mexico City's metropolitan area. 24% of the population lives in rural areas (localities with less than 2,500 inhabitants). This country has a young population compared with those of the other OECD and Latin-American countries. Only 7.2% of the total population is 60 years or older in contrast with the averages of 17.1% and 8.2% observed in the OECD and the Latin-American countries, respectively. Mexico's total

fertility rate is 2.5%, the highest of the OECD countries which have a rate of 1.5% on average. The Mexican fertility rate is lower than the Latin-American average of 2.9%.[29]

According to GDP per capita measures, Mexico is the second poorest (only behind Turkey) OECD country with a per capita GDP of $8,979.00 USD PPPs in 2002, almost one third of the average of this group of countries which have an average per capita GDP of $22,933.00 USD PPPs. Mexico is the third richest country in Latin-America after Argentina and Chile, exceeding this region's average of a per capita GDP of $5,536.00 USD PPPs.[30]

Focusing on infant health, in particular, on birth weight and infant mortality rate, Mexico is placed at the bottom of the OECD countries and in the middle among the Latin-American countries (See Tables 3.1 and 3.2). In the year 2002, 9% of the live births in Mexico were classified as low birth weight which places Mexico only above Turkey among the OECD countries and behind the average for this group of 7.6%. Among Latin-American countries, Mexico has the same percentage of live births with low birth weight as Bolivia, Colombia, Jamaica and Paraguay; and is behind countries with lower per capita GDPs such as Belize, Costa Rica, Cuba, Uruguay, and Venezuela. Mexico is also behind Argentina and Chile.[31]

The infant mortality rate in Mexico in 2000 was 2.5% of live births. This is the

[29]See CONAPO (2004), OECD (2005) and, World Health Organization (2005b).

[30]See CIA (2002, 2003).

[31]The measures of the percentage of live births with low birth weight are believed to be biased downwards for most developing countries due to high percentages of non-weighted live births that would be mostly localized in the poorest areas of such countries (See World Health Organization (2005a,c)).

Table 3.1: **Pregnancy Outcomes, OECD Countries**

| **Country** | **Low Birth Weight (%)** | **Infant Mortality (%)** |
|---|---|---|
| Australia | 7 | 0.6 |
| Austria | 7 | 0.5 |
| Belgium | 8 | 0.5 |
| Canada | 6 | 0.5 |
| Czech Republic | 7 | 0.5 |
| Denmark | 5 | 0.4 |
| Finland | 4 | 0.4 |
| France | 7 | 0.4 |
| Germany | 7 | 0.5 |
| Greece | 8 | 0.5 |
| Hungary | 9 | 0.8 |
| Iceland | 4 | 0.3 |
| Ireland | 6 | 0.6 |
| Italy | 6 | 0.5 |
| Japan | 8 | 0.3 |
| Luxembourg | 8 | 0.5 |
| **Mexico** | **9** | **2.5** |
| Netherlands | 6 | 0.5 |
| New Zealand | 6 | 0.6 |
| Norway | 5 | 0.4 |
| Poland | 6 | 0.8 |
| Portugal | 8 | 0.6 |
| Slovakia | 7 | 0.8 |
| South Korea | 4 | 0.5 |
| Spain | 6 | 0.4 |
| Sweden | 4 | 0.3 |
| Switzerland | 6 | 0.5 |
| Turkey | 16 | 3.8 |
| United Kingdom | 8 | 0.6 |
| USA | 8 | 0.7 |

Table 3.2: **Pregnancy Outcomes, Latin-American Countries**

| Country | Low Birth Weight (%) | Infant Mortality (%) |
|---|---|---|
| Argentina | 7 | 1.7 |
| Belize | 6 | 3.4 |
| Bolivia | 9 | 5.9 |
| Brazil | 10 | 3.5 |
| Chile | 5 | 1.1 |
| Colombia | 9 | 2.0 |
| Costa Rica | 7 | 1.0 |
| Cuba | 6 | 0.7 |
| Dominican Republic | 11 | 3.3 |
| Ecuador | 16 | 2.7 |
| El Salvador | 13 | 3.4 |
| Guatemala | 13 | 3.9 |
| Haiti | 21 | 8.1 |
| Honduras | 14 | 3.3 |
| Jamaica | 9 | 1.7 |
| **Mexico** | **9** | **2.5** |
| Nicaragua | 12 | 3.4 |
| Panama | 10 | 2.0 |
| Paraguay | 9 | 2.6 |
| Peru | 11 | 3.2 |
| Uruguay | 8 | 1.5 |
| Venezuela | 7 | 2.0 |

second worst among the OECD countries, only lower to the 3.8% from Turkey for that year. The Mexican rate highly contrasts with that of Japan, Iceland, and Sweden of 0.3%, and it is more than three times the average rate of the OECD countries (0.8% of the live births). The Mexican infant mortality rate is around the Latin-American average of 2.9%, again placing Mexico behind countries with lower GDPs per capita: Colombia, Costa Rica, Cuba, Jamaica, Panama, Uruguay, and Venezuela. Also, Mexico's infant mortality rate is higher than the two countries with the highest GDPs per capita in Latin-America: Argentina, and Chile.[32]

[32]See UNICEF (2005) and World Health Organization (2005b).

## 3.2 The MNHS in Detail

The MNHS can be divided into a fragmented public sector and its private counterpart.[33] The public sector includes, on the one hand, a Social Security (SS) (insurance) system that covers the formal sector employees and is funded by the government, the employers and the employees and,[34] on the other hand, a public decentralized health system administered and operated by the federal and state governments through the Ministry of Health (MH). The private sector is a very unregulated market in which most patients pay the health services directly "out of their pocket" at market prices.[35]

Based on figures from 2002, Mexico has a low total expenditure on health of 6.1% of the GDP compared with the OECD average of 7.6% and the Latin-American average of 7%. The total per capita expenditure on health is $550.00 USD PPPs, less than a third of the OECD average ($1,762.00 USD PPPs) and higher than the Latin American average of $396.00 USD PPPs. From the total expenditure on health, 44.9% is financed by the government which means that 55.1% of the expenditure on health services is paid by the individuals.[36] It is remarkable that 94.6% of the private expenditures on health is "out of the pocket".[37]

[33]For an excellent overview of the MNHS and its position with respect to the other OECD countries see OECD (2005). Dávila and Guijarro (2000) describe the MNHS in detail and analyze its evolution over time through past reforms. Also Docteur and Oxley (2003) analyze and compare the various types of health systems across the OECD countries and the results from the recent reforms experienced.

[34]The formal sector of the Mexican economy includes those businesses that subscribe their employees to the SS system.

[35]There is an undersized private health insurance market that covers a very small percentage of the population.

[36]Translated to USD PPPs, the per capita government health expenditure is only $247.00. From the total government health expenditure, 66% is to cover the SS institutions' operation.

[37]See World Health Organization (2005b).

Table 3.3: **Social Security Health Insurance Programs in Mexico, Covered Sector**

| Scheme/Program | Type of Scheme | Groups Targeted | Eligibility | Financing Method |
|---|---|---|---|---|
| IMSS | SS schemes with integrated providers. | All private salaried formal workers (excludes self-employed workers, informal sector workers, and unemployed people). | a)Contributors (workers). b)Family members: spouse, dependent parents, dependent children (up to 16 years old; students up to 25 if in full-education; disabled children, with no age limits). | Tripartite contribution:* i)Federal: 13.9% of the 1997 minimum wage, updated by inflation (In January 2004 14.5% of the min. wage). ii)Employer: 13.9% of min. wage in 1997. The perc. will increase up to 20.4% in 2007. iii)Employee/Employer: varies depending on wage.** The contribution will decrease annually, reaching 1.1% for employers and 0.4% for employee in 2007. |
| ISSSTE | SS schemes with integrated providers. | All government workers (Federal and some State employees). | a)Contributors (workers). b)Family members: spouse, dependent parents, dependent children (up to 18 years old; students up to 25 if in full-education; disabled children, with no age limits). | Tripartite contribution: i)Employer (usually the Federal Gov.; this contribution is in its role as employer): 6.75% of basic salary. ii)Employees: 2.75% of basic salary. |
| ISSFAM and PEMEX | SS schemes with integrated providers. | Employees of the military, navy and PEMEX (State Company). | See above. | See above. |

Table 3.3: **Social Security Health Insurance Programs in Mexico, Covered Sector (Continued)**

| Scheme/Program | Benefit Package | Facilities Used | Cost Sharing |
|---|---|---|---|
| IMSS | In-kind health benefits, i.e., health care services. The SS Law sets broad benefit provisions, including preventive and curative services; primary, secondary and simple tertiary care. No exclusions for pre-existing conditions or waiting periods set in the SS Law. Available resources determine services actually on offer. Cash benefits are also provided when the worker is unable to work due to disease or maternity. Regulatory frameworks for each institution establish the requirements, duration and other conditions. | Each scheme owns and operates clinics and hospitals. In case of emergencies, patients can be treated in other institutions' facilities. | No cost-sharing is required according to the social security laws and rules governing these institutions. |
| ISSSTE | See above. | See above. | See above. |
| ISSFAM and PEMEX | See above. | See above. | See above. |

* These contribution levels were established in the 1995 reform to the SS Law.

** IMSS contribution rates vary as follow: If contribution base salary $<$ 3 min. wage: Employees: Zero; If contribution base salary $>$ 3 min. wage: Employees: 2% $\times$ (contribution base salary 3 min. wage); Employers: 6% $\times$ (contribution base salary 3 min. wage).

Source: Modified version of Table 1.4 from OECD (2005).

Table 3.4: **Public Voluntary Health Insurance Programs to Ensure Access to Health Care in Mexico, Uncovered Sector**

| Scheme or Program | Type of Scheme | Groups Targeted | Eligibility | Financing Method |
|---|---|---|---|---|
| *Seguro de Salud para la Familia* (SSF) | Voluntary public health insurance operated by IMSS. | Uninsured individuals willing to purchase health insurance cover voluntarily. | Subject to payment of SSF premiums. | Since the 2001 SS Law: i)Federal: 13.9% of the min. wage as observed in 1997, updated by inflation. ii)Family members: premiums set by age groups, adjusted yearly by inflation. |
| *Seguro Popular de Salud* (SPS) | Voluntary public health insurance coordinated by the MH. | Uninsured individuals excluded from social health security, which are willing to purchase voluntary public health insurance. | Subject to an annual fee per family affiliated according to income level. | Tripartite contribution: i)Social Quota (Federal Government). ii)Federal + State joint contribution. iii)Family contribution related to income level. |

Table 3.4: **Public Voluntary Health Insurance Programs to Ensure Access to Health Care in Mexico, Uncovered Sector (Continued)**

| Scheme or Program | Benefit Package | Facilities Used | Cost Sharing |
|---|---|---|---|
| *Seguro de Salud para la familia* (SSF) | Same as IMSS benefit package. Some exclusion for pre-existing conditions and waiting periods apply according to the SS Law. | IMSS owned and operated facilities. | None. |
| *Seguro Popular de Salud* (SPS) | Essential package of primary and secondary interventions and certain high-cost tertiary care interventions. | State Health Services facilities and other MH coordinated federal facilities. The reform allows for the possibility to use other providers from the National Health System on the basis of service provision agreements (e.g., SS or the private sector). | None as 2004. The law allows for the possibility to implement cost sharing. |

Source: Modified version of Table 1.4 from OECD (2005).

Table 3.5: **Government Schemes to Ensure Access to Health Care in Mexico, Uncovered Sector**

| Scheme/Program | Type of Scheme | Groups Targeted | Eligibility | Financing Method |
|---|---|---|---|---|
| State Health Services (SHS) and Ministry of Health (MH) facilities | Public integrated system. | Specifically aimed at furnishing access to care for those without social insurance cover. | MH/SHS facilities are open to all the population, with user fees. | i)Federal budget. ii)State owned resources. iii)Patient user charges (for those not enrolled in the SPS). |
| IMSS-*Oportunidades* | Geographically targeted program providing basic health services to marginalized populations, administered by IMSS but financed by the Federal Government. | Marginalized groups residing in rural areas with no access to any kind of basic health services. | Geographically based according to the level of margination. All members of communities where IMSS-*Oportunidades* exist (17 States) are eligible to care. | Budget allocations from the Federal Government. |
| PAC | Geographically targeted program, financing access to a basic package, administered by the SHS, funded by the Federal Government. | Residents in rural and highly marginalized areas. | Geographically based. All members of communities where PAC operated were eligible to care. | Budget allocations from the Treasury and World Bank support until 2003. |
| *Oportunidades* | Means-tested poverty alleviation program providing income support and social services, financed and administered by SEDESOL. A health component is comprised within the broad antipoverty strategy. | Individuals in extreme poverty. | Families in highly marginalized areas identified through a means-tested process. These people are given an identification card. | It is financed by the Federal Gov. Resources for the *Oportunidades* health component are channeled via MH budget. |

Table 3.5: **Government Schemes to Ensure Access to Health Care in Mexico, Uncovered Sector (Continued)**

| Scheme/Program | Benefit Package | Facilities Used | Cost Sharing |
|---|---|---|---|
| State Health Services (SHS) and Ministry of Health (MH) facilities | The General Health Law of 1984 sets broad benefits (primary, secondary and simple tertiary care; preventive and curative services). Available resources determine actual available services. | SHS and other MH facilities (clinics, hospitals, high-tech specialized tertiary care facilities such as the National Institutes of Health). | The Ministry of Finance sets indicative rates of cost sharing that depend on household income. Rates actually applied are set by each state or facilities and can vary among states and hospitals. |
| IMSS-*Oportunidades* | Outpatient and inpatient care; medicines, supplied in any of the IMSS *Oportunidades* facilities. | IMSS-*Oportunidades* facilities (3,540 first level facilities and 69 second level). | None. |
| PAC | Basic package including 13 interventions. | State Health Services facilities. | None. |
| *Oportunidades* | The health component offers free access to the same basic package of interventions as PAC; it also provides nutritional supplements as well as health education. | IMSS-*Oportunidades* and State Health Services facilities. | None. |

Source: Modified version of Table 1.4 from OECD (2005).

The SS coverage is compulsory for employees in the formal sector of the economy. It provides health services and other benefits to the employee and her dependants in the terms of the Social Security Laws (Table 3.3). The institutions included in this category are: IMSS (*Instituto Mexicano de Seguridad Social*/Mexican Social Security Institution) which provides services to formally employed, salaried private-sector workers and their families; ISSSTE (*Instituto de Seguridad y Servicios Sociales para los Trabajadores del Estado*/Institute of Security and Social Services for State Employees) provides SS for people employed by the government, both at the federal and the state level; PEMEX health services (*Petróleos Mexicanos*/Mexican Petroleum) provides health services to people employed by the state-owned oil monopoly; ISSFAM (*Instituto de Seguridad Social de las Fuerzas Armadas Mexicanas*/Institute of Social Security for the Mexican Armed Forces) provides services to the Mexican army and navy soldiers; and, state clinics with special arrangement for local government employees as in Mexico City, where the police, the federal district government and the subway system (Metro) have their own SS arrangements. The SS institutions finance and provide health services to their beneficiaries.[38]

According to the Ministry of Health (MH), in 2002, 51% of the total population (52.5 million people) had access to the SS services. The low coverage is due to the division of the Mexican labor market in which the targeted group for the SS insurance are the formal sector employees and in which the informally employed people (and their families) are left uncovered. In 2000, the official estimate of the size of the informal employment was 61% of the available labor force (approximately, 24 million people); only 38% (almost 15 million people) were formally employed and entitled

[38]Aside from health services, IMSS provides additional benefits, such as sickness and maternity leave, old-age, disability, life insurance, severance and retirement, work-related injury and child care.

to direct SS benefits. This provides evidence that the number of people with access to the SS health services due to the extended coverage from a family member is the most important component of the benefited population (See Table 3.3 for the rules of extending the SS services coverage to the worker's family).[39]

The SS institutions are jointly financed by the federal government, the employer and the employee in different proportions. In the 90's there were some reforms aimed to increase the contribution of the government and the employer, and to reduce the employee's contribution. For the health insurance services provided by IMSS, since 1997, the Federal Government contributes 13.9% of the minimum wage, adjusted for inflation;[40] the employer contributes 13.9% of the minimum wage of 1997, adjusted every year for inflation,[41] plus 6% of the employee's wage (when this wage exceeds 3 times the minimum wage);[42] the employee contributes with 2% of her wage if it exceeds three times the minimum wage,[43] or nothing if her wage is up to three times the minimum wage.[44] The ISSSTE contributions are 6.75% of the wage from the government in its role of employer, and 2.75% of the wage from the employee. Regarding monetary transfers from the sickness and maternity insurance the total contribution is 1% of the employee's wage, covered as follows:[45] 70% from employers; 25% from employees; and, 5% from the Federal Government.[46]

[39] See Ministry of Health (2004).

[40] From January 2004, this contribution will be 14.5% of the minimum wage.

[41] Which will increase up to 20.4% in 2007.

[42] This contribution will decrease annually to 1.1% in 2007.

[43] This contribution will decrease to 0.4% in 2007.

[44] The limit of the wage dependant contributions is 25 times the minimum wage.

[45] In what follows, for government employees, the term employer refers to the government itself.

[46] In addition to these SS contributions, in order to cover for the other job benefits provided in a covered sector job, there are other fees that also have to be paid by the Federal Government, the employer and the employee. The employer has to deposit 2% of the employee's wage and the Federal Government 5.5% of one minimum wage in the employee's individual retirement account. These retirement accounts can be increased voluntarily by the employee. For the old-age and disability insurance, the employee contributes with 1.125% of her wage, the employer contributes with 3.5% of

There is no comprehensive list of the health care benefits covered by the SS institutions as they mostly depend on the availability in each clinic or hospital, although the General Health Law provides a generic entitlement. In general, the treatments offered include acute treatment and outpatient care in hospitals and ambulatory clinics, care for pregnancy and childbirth, physicians and specialists, and supply of the prescription drugs included in the government's basic list. These services are free of charge for beneficiaries. For non-beneficiaries, the SS system provides emergency services and other health services only if there is no MH center available in the area, applying the same price schemes as the MH institutions, as will be explained later.

In the SS reform of 1997, a voluntary health-care benefits scheme was instituted, aimed to self-employed individuals and informal sector workers which was provided by IMSS and called the Family Health Insurance (*Seguro de Salud para la Familia*, SSF). The coverage of this insurance is similar in content to that provided by IMSS to regular beneficiaries but different in that services are subject to availability and waiting times (favoring regular beneficiaries), and excludes pre-existing conditions (See Table 3.4). This program is financed by the government, contributing 13.9% of the minimum wage in 1997 updated by inflation, and a family premium that was set taking into account the age groups of the members of the family, adjusted yearly by inflation. In practice, this insurance has not been successful, including only around

the employee's wage, and the Federal Government contributes with 7.143% of all the employer fees. Regarding the housing fund, designed to provide loans to buy government-constructed houses with subsidized interest rates and payments administered by the government, the employer contributes 5% of the employee's wage (up to 10 times the minimum wage). Finally, the employee has to pay income taxes under a progressive scheme. In general, the taxable income is the total monthly income minus the exemptions, equivalent to $6,333.33 pesos (In 2002, the average exchange rate was 0.10 dollars per peso). There are two main tax brackets: for a taxable income up to $208,333.33 pesos, the income tax rate is 25%; and, for a taxable income from $208,333.34 pesos and higher, there is a fixed fee of $52,083.33 plus a tax rate of 28%. See CDHCU (1998, 2004a,b,c,d, 2005a,b,c).

360,000 individuals in 2003.[47] This is the reason for which this scheme is not considered in the model.

The MH or open institutions are those that provide health services for those individuals not entitled to the SS health care services. These institutions have a price scheme that depends on socioeconomic characteristics of the person or family (See Table 3.5). These health services are provided free of charge if the family's income falls in the first two deciles of the income distribution as defined by the MH, i.e., an annual income up to $28,616.00 pesos,[48] base 2002.[49] The hospitals are managed and operated by the MH. If the family's income falls in a higher decile, the price of health services increases proportionally with income up to the total cost of the services provided. The population covered by these services is very heterogeneous consisting mainly of people living in marginal urban areas and rural areas. There is evidence that in many rural areas one of the main obstacles for the access to health care is the distance to the MH centers.[50]

In addition to this health services system, there are two other schemes for uncovered people to get health care access which work in a very similar way to the MH institutions (See Table 3.5). The IMSS-*Oportunidades* program is administered by IMSS and financed by the Federal Government. The targets of this program are people living in marginalized rural areas with no access to basic health services. It provides ambulatory care, basic hospital services and prescriptions to its beneficiaries which, by definition, fall in the first two deciles of the income distribution. The Cov-

[47] See OECD (2005).
[48] In 2002, the average exchange rate was 0.10 dollars per peso.
[49] See PEF (2003) and CDHCU (2004d, 2005a).
[50] See OECD (2005).

erage Extension Program (*Programa de Ampliación de Cobertura*, PAC) existed from 1996 to 2003 with the objective of extending the health services access to marginalized rural and indigenous areas. The program was financed by the Federal Government with contributions from the States and financial aid from the World Bank. In 2003, it was suspended and the funds transferred to the local governments as part of their MH budget. Since these programs are aimed exclusively to poor people and they provide the same services as the MH institutions, I make no distinction among them in the model.

In the 2003 reforms to the General Health Law and the Social Security Law the government created the System of Social Protection in Health (*Sistema de Protección Social en Salud*, SPSS) which later became the Universal Access Health Insurance (*Seguro Popular de Salud*, SPS). Its main objective is to gradually extend health care services similar to those provided by the SS/IMSS institutions to the whole population, regardless of their employment or economic situation (See Table 3.4). This program is explained in detail in Section 7.1, as its evaluation is one of the main goals of this investigation.

Finally, the private sector is completely managed and owned by private individuals under loose government's supervision. This sector is very fragmented having very high quality hospitals or clinics with modern equipment and resources which charge high prices but independent from one another. There is a second component of this sector, which I do not consider in this paper: the NGOs such as the Red Cross. These institutions do not have an important role on health services provision, although they make a very important contribution regarding health education and awareness of the most deadly diseases such as STDs.

Only the 3% of the population has private health insurance. People with private health insurances come mainly from high-income groups or professionals that get the insurance from their employers, who can deduct the premia against taxable income. The main operation of the MNHS' private sector is in the form of "out of pocket" expenditures as, in 2002, these kind of expenditures represented 94.6% of the total private expenditure on health from the individuals.[51]

There exists some limited overlap between health sectors regarding clients or beneficiaries who mostly visit facilities belonging to the institution from which they get their insurance status. There is evidence, from the National Health Survey 2000 (*Encuesta Nacional de Salud*), that patients also use providers from other institutions. For instance, for those that are covered by the SS insurance only, around 20% would rather visit another institution when they have a health problem. From those that have access only to IMSS (ISSSTE), 18.4% (24.4%) would prefer a private provider. Finally, from those covered by an SS institution, only 9% would rather visit a MH provider. Some high-income people, even when they are beneficiaries of the SS institutions, visit expensive private medical centers as they perceive them as better quality services providers. Nevertheless, according to a survey conducted by the World Bank regarding individuals' perceived care quality, 6.3% considered that the quality of the health services received was very good; 78.2% considered them as good quality; and, 14.1% were considered as average. Even analyzing these figures by sector, health services are positively evaluated. Among the SS institutions, 72.3%

[51] According to the MH, with data from the Income-Expenditure of the Households National Survey from 2000 (See OECD (2005)), 19.1% of the households in the first income quintile suffered at least one impoverishing health expending. In a similar way, 3.8% of all households had an impoverishing health expending. An impoverishing expending is defined as an expenditure such that it makes the family fall under the poverty line.

of the individuals considered IMSS services as above average; 82.9% considered federal ISSSTE services as above average; and, 84.4% considered ISSSTE services in the States as above average. In a similar way, 87.1% (80.9%) of the people regarded the MH (IMSS-*Oportunidades*) as above average; as well as 89.1% of the individuals considered the private services of that quality.[52] The long distances between localities and medical centers in rural areas with low-income people could also be a source of sector switching leading these groups to skip medical services.

[52]See World Bank (2004).

# Chapter 4

# The Data

## 4.1 The Mexican Family Life Survey (MxFLS)

The Mexican Family Life Survey (MxFLS) is designed as a longitudinal survey at the household level representative of the whole country both for urban and rural regions.[53] There is individual, household, and community information. The survey includes information about:

- expenditures and consumption at household level; saving decisions, asset property, and intrafamiliar and intergenerational information on transfers both at household and individual levels;
- information on personal formal and informal credits and loans;
- retrospective information about school attendance, grade repetition and school achievement as well as education levels at the individual level;
- retrospective information about employment of every household member;

[53] A detailed description of the survey, the data sets, and the documentation in English are publicly available at www.mxfls.cide.edu.

- sociodemographic and geographic information of the extended family individuals;
- time allocation information for all household members;
- retrospective individual information about permanent and temporal migration;
- individual health status (such as direct measurement, own perception, habits and functioning indicators, chronic diseases, morbidity, anthropometric outcomes, hemoglobin levels, and demand for health services);
- reproductive health history of all household's women in fertile age (fertility information, service use during pregnancy and childbirth, contraceptive methods, and retrospective information about child births and deaths);
- retrospective information about marriages and/or unions of every adult in the household; crime incidence information; and,
- information on use of agricultural soil for rural households.

At the community level, there is information about schools, health services, and socioeconomic infrastructure characteristics.

The sample is representative of all the Mexican population. The sampling design follows the methodology designed by the Mexican Statistics Bureau (*Instituto Nacional de Estadística, Geografía e Informática*, INEGI) for the all-year surveys (such as the National Employment Survey or the National Urban Employment Survey) using the cartographical information from the Census.[54] The universe consists on all

[54]The exact details of the sampling design can be found in INEGI (1998), for example. The baseline is a probabilistic sample, stratified, multi-staged and independent at each study dominion. The primary sampling unities were selected considering that representation at the national, urban-rural,

private dwellings in Mexico. The first wave, released on October 2004, was completed in July 2002. The survey is planned to become a 10 year long panel with 5 waves scheduled every two years from 2002 to 2012. The initial sample consists of 8,440 households with 35,677 individuals.

## 4.2 Sample Construction

The base sample are those households with at least one woman in fertile age (12 to 49 years old): 6,135 households with 8,739 women in this age range. This sample is reduced to 4,773 households with 6,147 women due to missing data on the main information required by this study and inconsistencies in fertility histories. Because the model focuses on joint family decisions made by the head couple of the household, I restrict the sample to those women that are the spouse of the household's head or the head herself when both the head and her spouse are present in the household. Therefore, I do not consider single-headed households or women that report to be either daughters of the household's head or part of the extended family. The sample is restricted to 2,315 household (one woman per family).

The sample is further refined to exclude: those families for which the initial conditions are not available (mother's marriage age, parents' age, parents' education, mother's height, locality, and distance to a health care center); and those women that report births but do not report birth dates. The sample then included 1,251 women. I eliminate 25 more women that report to have children prior to 1997 but

and regional levels was the objective. The stratification was built upon regions so that to maximize the representation of the population, as well as to capture Mexican cultural and socioeconomic diversity.

not so on or after that year given that there is no information about those births. Regarding job information, I do not consider those families in which both the mother and the father are unemployed because the model neither includes the possibility of the existence of extended family that would contribute to the household's income nor the probability of becoming unemployed due to an external factor; this restriction is not crucial since only 66 families are eliminated under this criterium. Also, in the sample, it is very uncommon to observe couples where the father does not work and the mother does, so for computational convenience, I also eliminate those families (45 families). The final sample includes 1,115 families with 1,381 births from 1997 to 2002 and 116 pregnancies in 2002.

## 4.3 Variable Definitions

The family's locality is considered urban if it has $2,500$ or more inhabitants. The model considers that the distance to a health care center affects the health care prices that families face. The variable distance is a discrete variable that takes the value equal to 1 if the health care center is in the same locality or community as the household; equal to 2 if the health care center is not in the same locality but is in the same municipality or district; and, equal to 3 if it is neither in the same locality nor municipality but is in the same state.[55]

The parents' education is defined as the number of completed years of school, starting at the primary school level. The education structure in Mexico consists of 6

[55]In the data set there is some distance information measured in kilometers. Unfortunately, there are too many missing data to be able to consider such measure. Therefore, I consider the geographical definition of distance.

years of primary school (elementary); 3 years of secondary school (junior high-school); and, 3 years of preparatory school (high-school). After completing the secondary school it is possible to study 3 more years to become a primary school teacher, called "normal" school. Once the preparatory school is completed, on average, the college takes 5 years of study. Finally, the graduate level takes 3 years of study on average. Then the education variable takes values from 0 to 20. The mother's height is measured in centimeters and is the one observed at the moment of the survey (2002).

A person is considered to have a covered sector job if she reported to have a job that provides the SS health insurance (access to IMSS, ISSSTE, etc.); and she is considered to have an uncovered sector job if she reported to have no access to such health services. A family is considered as covered if either parent has a covered sector job and uncovered if neither parent has a covered sector job.

A household is classified as poor if the yearly total household income falls in the first two deciles of the income distribution defined by the Ministry of Health. The cutoff value for the poor/non-poor classification is $28,616.00 pesos (with 2002 as base year).[56]

The woman reports the birth date of the child. I assume that all pregnancies last the same time, say 9 months, and that each one begins just in time so the mother gives birth on her birthday (which is when the period changes in the model).[57] Also,

[56]See PEF (2003) and CDHCU (2004d, 2005a). In 2002, the average exchange rate was 0.10 dollars per peso.

[57]Although data on pregnancy durations are available, I do not consider them for three reasons: 1) measurement errors of this variable are known to be very large, specially for those pregnancies that do not seek any kind of prenatal care; 2) there is very little knowledge on the determinants of a short gestational age; and, 3) there is evidence that this variable is not a good indicator of child inequality at birth. See Rosenzweig and Wolpin (1991) and Shiono and Behrman (1995).

I assume that a woman can become pregnant only once per year and that at most one birth can occur per year. For those women in the data that had more than one pregnancy in a given age, I roll over the second pregnancy to the next period.[58] In case the pregnancy results in more than one birth (twins or more) the mother is asked only about the first child born and that is the information I consider, although I do not consider the child's weight because the normal birth weight cutoff values for multiple births are different to that of single births.[59] Additionally, I do not consider abortions/misscarriages information given its low reliability because abortions are illegal in Mexico, and thus, underreported.

The prenatal care variable for each kind of health service is defined as whether it is reported to have visited at least once the health service provider during the pregnancy period and before giving birth, regardless of the number of times.[60]

The birth weight is measured in grams as reported in the survey. A low birth weight is defined as weighing less than 2,500 grams (5 pounds 8 ounces) at the time of birth.[61]

[58] In the very few cases in which there are two pregnancies in the same age and there is another pregnancy in the following year, I assume that the mother had pregnancies at three consecutive ages starting from one period before to that in which she reported two pregnancies.

[59] In the sample, less than 2% of the pregnancies resulted in more than one child.

[60] In the data, the average number of visits is 7.18 (with standard deviation of 3.52) for those that visited a prenatal care provider.

[61] See World Health Organization (1950) and Chapter 2.

## 4.4 Descriptive Statistics

Table 4.1 presents descriptive statistics for the families in the sample. The wives' average marriage age is 19.67 years. At the first period considered in the sample (1997) the mean women's age is 24.38 years, and for men is 27.43. In the sample, 70.5% of the couples were married before 1997 and 29.3% on or after 1997. For those married before 1997 the average number of children born before that year (the period not observed) is 1.91; and, the mean of the number of dead children per family, for the same period, is 0.11. For the whole sample, the average total number of children ever born is 2.57, and, on average, 0.12 infants per family died.[62]

Husbands, on average, are more educated than wives. The average total number of school years for husbands is 8.62 and for wives is 8.16. The mean wives' height is 153.89 centimeters (approximately, 5 feet).

The reported earnings are the after-tax and after-fees yearly earnings for an individual. Table 4.1 presents a summary of the wage distributions across gender and across labor market sectors. On average, covered sector employees earn more than uncovered sector employees for both genders; although the variances in the uncovered sector earnings are higher. Also, notice that husbands have higher earnings than wives. Husbands working in the covered sector, in average, make $60,335.00 pesos (base 2002) with a standard deviation of $40,375.00 pesos, and those in the uncovered sector earn $52,842.00 pesos (base 2002) with a relatively higher standard deviation of $42,515.00 pesos.[63] Regarding women, those employed in the covered sector earn

[62] 9.3% of the families in the sample ever experienced an infant death. In the period I observe, 4.8% of the families experienced such event.

[63] In 2002, the average exchange rate was 0.10 dollars per peso.

Table 4.1: **Descriptive Statistics for Selected Family Variables**

| Variable | Mean | Standard Deviation |
|---|---|---|
| Wife's marriage age | 19.67 | 4.16 |
| Wife's age in 1997 | 24.38 | 6.11 |
| Husband's age in 1997 | 27.43 | 6.98 |
| Number of children born before 1997 | 1.91 | 1.77 |
| Number of dead children before 1997 | 0.11 | 0.36 |
| Total number of children ever born | 2.57 | 1.87 |
| Total number of dead children | 0.12 | 0.38 |
| Wife's years of education | 8.16 | 3.57 |
| Husband's years of education | 8.62 | 3.91 |
| Wife's height (cm.) | 153.89 | 7.02 |
| Annual earnings in 2002 pesos: | | |
| Husband, covered sector | 60,325 | 40,375 |
| Husband, uncovered sector | 52,842 | 42,515 |
| Wife, covered sector | 52,578 | 27,741 |
| Wife, uncovered sector | 38,101 | 29,453 |

$52,578.00 pesos (base 2002) in average with a standard deviation of only $27,741.00 pesos; the mean earnings for women employed in the uncovered sector are $38,101.00 pesos (base 2002), significantly lower than those in the covered sector but with a relatively higher standard deviation of $29,453.00 pesos. Given these yearly earnings, 20.9% of the families are classified as poor.

Table 4.2: **Descriptive Statistics for Families by Locality Type**

| Variable | Urban (%) | Rural (%) |
|---|---|---|
| Locality | 62.24 | 37.76 |
| Distance to health care center (categories): | | |
| Same locality/neighborhood | 37.61 | 43.23 |
| Same municipality | 50.58 | 38.48 |
| Same state | 11.82 | 18.29 |

Table 4.2 shows some additional family statistics by locality. 62.24% of families live in an urban locality. A higher percentage of rural (37.61%) than urban families

(43.23%) have a health care center in the same neighborhood. But the percentage of urban families with a health care center in the same municipality is much higher (50.58%) than that of rural families (38.48%). Then, putting together the two former categories, the 88.19% of the urban households are relatively close to a health care center as opposed to 81.71% of the rural families. This means that 18.29% (11.82%) of the rural (urban) families have to go further (out of their municipality) to get health services from a health center.

The model described in Section 5.1 assumes that the wife has three activities to choose from: covered job, uncovered job, and stay at home; and the husband always works and only chooses the labor market sector: covered, or uncovered. Table 4.3 presents the labor sector distribution for couples. Only 3.4% of families have both parents with a covered sector job. 27% of husbands have a covered sector job, much lower than the 73% that have an uncovered sector job. In a similar way, only 6.3% of wives have a covered sector job; 20.5% have an uncovered sector job; and, a relatively high 73.2% of wives stay at home. The most common activity choice combination is a husband with an uncovered sector job and a wife that stays at home (53.1%). Regarding coverage due to the labor market participation decision, the light-grey colored cells represent those husband-wife activity combinations that provide coverage to the family, which amount to only 29.9% of the families with access to such benefits. The dark-grey colored cells represent those husband-wife activity combinations that leave the family uncovered.

In the remainder of the present study, I refer to the SS health care services only as IMSS health care services, to stress the type of institutions that mainly provide these health services. Table 4.4 shows descriptive statistics for observed births. The

Table 4.3: **Labor Sector Distribution of Parents**

| Husband/Wife (%) | Covered Job | Uncovered Job | Home | Total |
|---|---|---|---|---|
| **Covered Job** | 3.4 | 3.5 | 20.1 | 27.0 |
| **Uncovered Job** | 2.9 | 17.0 | 53.1 | 73.0 |
| **Total** | 6.3 | 20.5 | 73.2 | 100.0 |

average birth weight for all births is 3,303 grams (approximately, 8 pounds 4 ounces). Distinguishing by the type of prenatal care received, the average birth weight varies: the highest birth weight is observed in children that had prenatal care in IMSS hospitals, 3,343 grams (approximately, 8 pounds 6 ounces); the average birth weights reported from those whom received MH or private services were very similar, 3,296 and 3,285 grams (approximately, 8 pounds 4 ounces and 8 pounds 3 ounces), respectively. Children that did not receive prenatal care services had the lowest average birth weight: 3,100 grams (approximately, 7 pounds 9 ounces). The incidence of low birth weight births for the whole sample is 6.74%. The lowest incidence is observed in births with IMSS prenatal care with 4.80%, followed by 7.29% of births that received MH prenatal care. The highest incidence of low birth weight births is observed in children that did not get prenatal care: 10.3%. Finally, the incidence is also relatively high for those births that had private prenatal care (9.1%), which could be evidence of the presence of a strong selectivity since there could be people who use these supposedly higher quality services because they anticipate a bad outcome due to the mother's health endowment, for example.

Infant mortality rate for all births was 3.19% (Table 4.4). Separating by prenatal care received, the highest rate observed was for those pregnancies with no prenatal care services, 9.57%. Births that received MH prenatal care services reported an infant mortality rate of 2.93%. In a similar way to the incidence of low birth weight

Table 4.4: **Pregnancy Outcomes for Observed Births**

| **Variable** | **Mean** | **Standard Deviation** |
|---|---|---|
| Birth weight | 3,303 | 605 |
| Birth weight by prenatal care: | | |
| IMSS | 3,343 | 580 |
| MH | 3,296 | 611 |
| Private | 3,285 | 646 |
| No care | 3,100 | 603 |

| | **Percentage** |
|---|---|
| Low birth weight rate | 6.74 |
| Low birth weight rate by prenatal care: | |
| IMSS | 4.80 |
| MH | 7.29 |
| Private | 9.06 |
| No care | 10.26 |
| | |
| Infant mortality rate | 3.19 |
| Infant mortality rate by prenatal care: | |
| IMSS | 2.25 |
| MH | 2.93 |
| Private | 3.00 |
| No care | 9.57 |
| | |
| Infant mortality rate by birth weight: | |
| Low birth weight (less than 2,500 gr.) | 4.76 |
| Normal birth weight (2,500 gr. or more) | 1.03 |

births, private services reported the highest infant mortality rate among those cases that visited a doctor during pregnancy with 3.00%, again indicating the potential existence of a selectivity bias in the choice of type of doctor. Only 2.25% of the infants that received prenatal care services in IMSS hospitals died. Comparing births classified as low birth weight against those considered normal birth weight, the mortality rate is higher for the former with 4.76% with respect to 1.03% for the later, confirming the strong relationship observed in the literature between low birth weight and infant death.

Table 4.5 shows descriptive statistics for observed births by birth order. The mean spacing between the first and the second child (3.87 years) is shorter than for subsequent children (not including the category "sixth or later"). First children are born when the mother is 22.46 years old on average. The average birth weight presents an inverted U relationship with respect to birth order, being relatively low for the first child (3,214 grams or, approximately, 8 pounds) and increasing until the fourth (3,407 grams or, approximately, 8 pounds 8 ounces) to decline to the lowest average birth weight for children born in sixth place or later (3,101 grams or, approximately, 7 pounds 9 ounces). These average birth weight do not present a clear pattern when the incidence of low birth weight is computed: first and sixth or later children present a high incidence of low birth weight births (8.52% and 9.09%, respectively), as also indicated by the average birth weights; but for children between the second and fifth, the incidence goes up and down with no clear pattern. Finally, as incidence of low birth weight births, infant mortality rates vary by birth order. The pattern is not clear with the lowest mortality present for third children (2.40%) and the highest for fourth children (5.38%).

Table 4.5: **Pregnancy Outcomes for Observed Births by Birth Order**

| | Spacing (years) | | Mother's Age | | Birth Weight (grams) | | Low Birth Weight | Infant Mortality |
|---|---|---|---|---|---|---|---|---|
| Birth Order | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Rate | Rate |
| 1 | – | – | 22.46 | 4.53 | 3,214 | 600 | 8.52 | 2.93 |
| 2 | 3.87 | 2.30 | 25.15 | 4.29 | 3,340 | 589 | 5.73 | 3.14 |
| 3 | 4.31 | 3.14 | 28.30 | 4.62 | 3,346 | 586 | 5.86 | 2.40 |
| 4 | 4.78 | 3.28 | 30.58 | 4.70 | 3,407 | 641 | 5.36 | 5.38 |
| 5 | 4.44 | 3.13 | 31.08 | 5.01 | 3,299 | 614 | 6.12 | 3.13 |
| 6+ | 3.83 | 2.84 | 34.09 | 4.89 | 3,101 | 627 | 9.09 | 3.85 |

Tables 4.6 to 4.8 show prenatal care choices for observed births. Considering all births in Table 4.6, the most popular choice is to visit IMSS hospitals (43.25%) followed by MH services (28.11%). These two state-administered options make for 71.36% of the prenatal care services. The 8.62% of families that do not visit a doctor during pregnancy could have several explanations: these families could be those with no access to health care services or with low income; even when they had access to health care, the locality type and distance may increase the price of getting these services; and, there could be selectivity in the choice of seeking care in the sense that healthier people would be less willing to pay for these services.

Table 4.6: **Prenatal Care Choice**

| Care Provider | Percentage |
|---|---|
| IMSS | 43.25 |
| MH | 28.11 |
| Private | 20.01 |
| No care | 8.62 |

Table 4.7 presents the prenatal care choices by coverage status of the family. As expected, most covered families (54.79%) visit IMSS hospitals as opposed to only

33.16% of uncovered families. In the same sense, MH institutions are more visited by uncovered families (32.62%) than by covered families (only 12.33%). Private doctors are visited in very similar proportions both by covered and uncovered families, 23.29% and 24.06%, respectively. Also, similar percentages across coverage status do not seek health care services during pregnancy: 9.59% and 10.16%, respectively. An interesting observation is that a relatively high proportion of covered families do not visit a doctor even when they are entitled to these services in IMSS hospitals. One possible explanation is the effect that the distance to health care center plays in the decision of getting prenatal care services.

Table 4.7: **Prenatal Care Choice by Coverage Status**

| **Care Provider** | **Covered** (%) | **Uncovered** (%) |
|---|---|---|
| IMSS | 54.79 | 33.16 |
| MH | 12.33 | 32.62 |
| Private | 23.29 | 24.06 |
| No care | 9.59 | 10.16 |

Prenatal care choices also vary by poverty status of the family (Table 4.8). A higher proportion of non-poor (51.42%) than poor families (35.94%) visit the IMSS hospitals. This is explained, on the one hand, by the higher earnings in covered sector jobs, which identify the family as non-poor; on the other hand, for uncovered families, IMSS services are relatively expensive, as explained before. The MH hospitals, as was expected, are visited in a higher proportion by poor (37.50%) than non-poor families (19.34%). Also, a higher percentage of non-poor (24.53%) than poor families (18.75%) visit private hospitals. Finally, the percentage of families that do not seek prenatal care services is higher for poor than for non-poor families (4.71% and 7.82%, respectively). As observed in Tables 4.6 to 4.8, the decision of seeking prenatal care

Table 4.8: **Prenatal Care Choice by Poverty Status**

| **Care Provider** | **Poor** (%) | **Non-Poor** (%) |
|---|---|---|
| IMSS | 35.94 | 51.42 |
| MH | 37.50 | 19.34 |
| Private | 18.75 | 24.53 |
| No care | 7.82 | 4.71 |

services is influenced by the coverage and poverty statuses but, nevertheless, there seem to be more factors, in particular, distance to health care center (also locality type) and selectivity in such decision from healthier families. This issue is addressed in Chapter 6.

The dynamic model I estimate incorporates a birth weight production function that depends on the child's sex, the mother's age, the time elapsed between pregnancies, the parents' years of education, the mother's height, the birth order, and the type of prenatal care received during pregnancy.

Table 4.9 presents the reduced form OLS estimation of this production function using the log birth weight as dependent variable. Boys are born relatively heavier than girls. Mother's age has a quadratic relationship with birth weight. Spacing between children has a positive but small effect on birth weight. Parents' education seems to have no effect on birth weight given that its estimated parameters are non significant. The mother's height, as an indicator of her health status, has a positive association with birth weight, which turns out to be fairly large since this variable is measured in centimeters. Birth order has a negative effect, although non significant, on birth weight. In general, visiting the doctor for prenatal care is associated with higher birth weight and the effects for the three types of services are all significant.

Those who visit IMSS institutions benefit the most from prenatal care followed by the MH institutions and then by the private services. The relative effect of prenatal care type of doctor observed in Table 4.4 persists. Private doctors seem to contribute the least to a heavier child; this again gives the idea of the presence of a strong selectivity bias regarding the choice of type of doctor.

Table 4.9: **Log Birth Weight Production Function, OLS Estimates**

| **Variable** | **Parameter Estimate** | **Standard Error** |
|---|---|---|
| Constant* | 7.0785 | 0.1700 |
| Child's gender* | 0.0273 | 0.0116 |
| Mother's age* | 0.0182 | 0.0081 |
| Mother's age squared* | -0.0003 | 0.0001 |
| Spacing* | 0.0069 | 0.0023 |
| Father's years of education | -0.0019 | 0.0019 |
| Mother's years of education | -0.0014 | 0.0021 |
| Mother's height* | 0.0046 | 0.0009 |
| Birth order | -0.0046 | 0.0047 |
| Prenatal care IMSS* | 0.0705 | 0.0253 |
| Prenatal care MH* | 0.0547 | 0.0257 |
| Prenatal care private** | 0.0479 | 0.0278 |

* significant at 5%

** significant at 10%

Table 4.10 presents a logit estimation of the probability of dying before the first year of life as a function of birth weight status. Infant death is 4 times more likely when the child is born with low birth weight than when she is born with normal birth weight. The significance of the low birth weight parameter confirms the relationship between this condition and infant mortality, as was also observed in Table 4.4.

Tables 4.11 to 4.14 show OLS estimates for the log earnings for husbands and wives across sectors. Table 4.11 presents estimates for husbands in the covered sec-

Table 4.10: **Infant Death Probability, Logit Estimates**

| Variable | Parameter Estimate | Standard Error |
|---|---|---|
| Constant* | -4.5634 | 0.2901 |
| Low birth weight* | 1.5677 | 0.5888 |

* significant at 5%

tor. Age has a positive but decreasing relationship with earnings. The quadratic term of years of education is positive, and the linear term is negative but non significant. Living in an urban locality has a significant and positive effect on earnings.

Table 4.11: **Log Earnings for Husbands with Covered Sector Jobs, OLS Estimates**

| Variable | Parameter Estimate | Standard Error |
|---|---|---|
| Constant* | 9.2660 | 0.4549 |
| Age* | 0.0739 | 0.0277 |
| Age squared* | -0.0011 | 0.0004 |
| Years of education | -0.0049 | 0.0253 |
| Years of education squared* | 0.0030 | 0.0011 |
| Urban* | 0.1656 | 0.0595 |

* significant at 5%

Table 4.12: **Log Earnings for Husbands with Uncovered Sector Jobs, OLS Estimates**

| Variable | Parameter Estimate | Standard Error |
|---|---|---|
| Constant* | 9.5642 | 0.2917 |
| Age | 0.0256 | 0.0168 |
| Age squared | -0.0003 | 0.0002 |
| Years of education* | 0.0612 | 0.0199 |
| Years of education squared | 0.0001 | 0.0010 |
| Urban* | 0.1766 | 0.0411 |

* significant at 5%

Table 4.12 shows similar estimates for husbands in the uncovered sector. The age

parameters are non significant, although they have similar signs to those in Table 4.11. Years of education have a positive effect on earnings in a linear way; the quadratic term is non significant. Finally, urban localities have a positive and significant effect on earnings. Tables 4.13 and 4.14 show estimates for wives in the covered and uncovered sectors, respectively. Both models consider linear and quadratic terms for age and years of education, and a dummy variable for urban localities. In Table 4.13, only the urban variable is significant (at the 90% level) and negative. For the uncovered sector, only the years of education terms are significant with the expected signs.

Table 4.13: **Log Earnings for Wives with Covered Sector Jobs, OLS Estimates**

| **Variable** | **Parameter Estimate** | **Standard Error** |
|---|---|---|
| Constant* | 8.6587 | 1.2056 |
| Age | 0.0991 | 0.0757 |
| Age squared | -0.0016 | 0.0012 |
| Years of education | 0.0829 | 0.0782 |
| Years of education squared | -0.0012 | 0.0033 |
| Urban** | -0.2534 | 0.1511 |

* significant at 5%

** significant at 10%

Table 4.14: **Log Earnings for Wives with Uncovered Sector Jobs, OLS Estimates**

| **Variable** | **Parameter Estimate** | **Standard Error** |
|---|---|---|
| Constant* | 9.9329 | 0.7115 |
| Age | -0.0587 | 0.0477 |
| Age squared | 0.0011 | 0.0008 |
| Years of education* | 0.1550 | 0.0527 |
| Years of education squared** | -0.0045 | 0.0024 |
| Urban | 0.0756 | 0.1165 |

* significant at 5%

** significant at 10%

# Chapter 5

# The Model

## 5.1 Model Set Up

I develop a dynamic model in which parents make decisions about fertility, prenatal care, and their own labor supply to maximize family's utility.[64] This model has features found in Willis and Rosen (1979), Eckstein and Wolpin (1989), Shnaps (2001), and Todd and Wolpin (2003). Let $f$ and $m$ identify the father (husband) and mother (wife) of the family, respectively. The behavioral model begins at the time at which the family is formed, i.e., the marriage age of the family's wife, $a^0$,[65] and the family solves the model until the wife is 50 years old, $A$.[66] I assume that the wife is fertile until she is 49 years old, and that the family has perfect foresight about prices on medical services, which are constant, and about wages. The family can be located

[64] In this study the family considered is the nuclear family, i.e., the family consisting in a couple and its children with no further vertical or horizontal considerations. The reason to consider only head parents and their own children is to simplify the analysis by avoiding taking into account more complex family relations. Moreover, in the sample considered in the estimation, more than 90% of the families are nuclear families.

[65] See Appendix A, Table A.1 for the complete model's notation.

[66] The model does not consider retirement decisions because it focuses on the fertile period of the woman. Considering retirement would complicate the model solution and estimation and would go beyond the scope of the present study.

either in a rural or an urban area, identified by an indicator function, $l = 1$ if the family lives in an urban locality, and $l = 0$ for a family living in a rural locality.[67] The model begins at the time of marriage, and the marriage ages ($a^0$, $a_f^0$) and years of education of the couple ($E_m$, $E_f$) are taken as exogenous,[68] conditional on the family's unobserved heterogeneity. Also, the wife's height, $H$, is taken as exogenous and time-invariant.

Let $a \in \{a^0, ..., A\}$ be the wife's age. Every period in the model corresponds to one year. Each parent has a set of mutually exclusive activity options every period. The wife can: 1) stay at home; 2) have a job that provides the IMSS health insurance (covered sector job); and, 3) have a job that does not provide the IMSS health insurance (uncovered sector job). The husband is assumed to work every period, so his activity decision is reduced to the type of job (options 2) and 3)).[69] Additionally, the couple decides whether the wife becomes pregnant or not every period until she is 49 years old.[70] If the wife becomes pregnant, the couple also chooses whether to get prenatal care or not, and the type of prenatal care provider.[71]

[67] The family does not have the option to migrate, therefore, the family location is time-invariant and exogenous. Also, to save on parameters and estimation, I assume that the terms rural and urban are homogeneous across regions and do not consider regional differences.

[68] This assumption is in order to avoid modeling the marriage decision choice which would enormously complicate the model and would not provide a better insight regarding the focus of this study. Additionally, it is assumed that there are no divorces, as in the data, less than 1% of women have ever been divorced. For references modeling the marriage/divorce decision, see Chapter 2.

[69] In the data, only around the 1% of men report to be unemployed in the available years, 2000 and 2002.

[70] Notice that the decision of becoming pregnant do not precludes the woman from her activity choice decision. In covered jobs women are given maternity leave of 60 days only. Mothers that have uncovered jobs would decide wether to work or not during pregnancy which is a choice available for them in the model.

[71] As described in Chapter 2, most papers in the prenatal care literature focus on whether a woman received early prenatal care or not in developed countries. This study focuses on receiving any kind of prenatal care at any time in a developing country. The number of visits is not considered to avoid additional computational burden since they would have to be included as a choice.

Let $n$ be an index that identifies each of the births in the family by birth order with $n \in \{1, 2, 3, ...\}$, and let $N(a)$ be the total number of alive children in the family at the end of period $a$. Also, let $s_n(a)$ be an indicator function for the gender of the $n$-th child who is also born at mother's age $a$, which is equal to 1 if its a boy and equal to 0 if its a girl.

If the wife stays at home at age $a$ in a given period, the indicator function $h(a)$ is equal to 1 and equal to 0 if she works. Let $e_i^c(a)$, $i \in \{f, m\}$ be an indicator function equal to 1 if parent $i$ has a covered job at wife's age $a$ and equal to 0 otherwise; and let $e_i^u(a)$ be an indicator function equal to 1 if parent $i$ has an uncovered job at wife's age $a$ and equal to 0 otherwise.

There are specific characteristics for each kind of job, as explained before.[72] Covered jobs provide access to IMSS health care insurance, although the worker has to pay the corresponding fees or taxes. In contrast, uncovered jobs, provide no benefits for the worker. The health insurance allows coverage of the spouse and children of the employee. Let $d^c(a)$ be an indicator function equal to 1 if, at wife's age $a$, the family is covered by the IMSS health insurance because either of the parents has a covered sector job, and equal to 0 otherwise. Additionally, there is another health care alternative: the MH institutions. Poor people get the service at subsidized prices from these health care centers. Then, let $d^o(a)$ be the indicator function that takes value equal to 1 if, at wife's age $a$, the family is considered poor and thus eligible for this subsidized kind of health care services, and equal to 0 otherwise.

Let $p(a)$ be an indicator function equal to 1 if the wife becomes pregnant at age $a$

[72] See Section 3.2.

to give birth at age $a+1$, and equal to 0 otherwise. In the model, I assume that there is perfect contraception, i.e., a woman in fertile age can get pregnant only and every time she decides to do so.[73] Also, there are no abortions or miscarriages so every pregnancy ends with a live birth.[74] Once a woman gets pregnant, the couple decides whether to seek prenatal care and where to go. There are four options for prenatal care, represented by indicator functions $v_q(a)$, $q \in \{1, ..., 4\}$ where $q$ represents its type: 1) an IMSS institution, $v_1(a) = 1$; 2) an MH or public institution, $v_2(a) = 1$; 3) a private institution, $v_3(a) = 1$; and, 4) no prenatal care, $v_4(a) = 1$.[75] For ease of notation, let $V(a)$ be a vector that includes the four prenatal care indicator functions at period $a$.

At the moment of birth, the child's weight is a proxy of her health. The birth weight of the $n-$th child, who is born at wife's age $a$, is determined by the production function:

$$w_n(a) = w\left(s_n(a), a, x(a), n, V(a-1), \varepsilon_n^w(a); E_f, E_m, H, \mu\right),$$

which depends on the child's gender, $s_n(a)$; the mother's age, $a$; the time elapsed since the last birth, $x(a)$; the child's birth order, $n$; the type of prenatal care received during pregnancy at mother's age $a-1$, $V(a-1)$; a stochastic weight shock, $\varepsilon_n^w(a)$; the parents' years of education, $E_f$ and $E_m$;[76] the mother's height, $H$; and, a family-

[73] In the data there is contraceptive information. Unfortunately, these data is not complete enough to be used in the estimation.

[74] Data on abortions is very unreliable due to underreporting. In Mexico, abortion is illegal in every case which makes abortion data quality even worse.

[75] In the "no prenatal care" option I consider both women that did not seek prenatal care services and those that visited a midwife. In the data this choice was not very important and the pregnancy outcomes were very similar. Also, one could argue that a midwife would have little to do with the outcome before the moment of birth; visiting a midwife for prenatal care could be considered equivalent to getting advice from a family member or a friend with experience in pregnancies.

[76] Parents' years of education are not inputs per se. Their inclusion can be interpreted as shifters

specific factor that affects birth weight, $\mu$, which could be interpreted as different health endowments for different families. The number of periods elapsed between the birth date of the last child born and the present period, $x(a)$, evolves in the following way:

$$x(a) = \begin{cases} x(a-1)+1 & \text{if} \quad p(a-2)=0 \\ 1 & \text{if} \quad p(a-2)=1 \end{cases} .$$

There is the possibility of infant death, i.e., the child dies within her first year of life.[77] The indicator function $r_n(a)$ is equal to 1 if the child born at mother's age $a$, which also is the $n$-th child, dies before $a+1$, and equal to 0 otherwise. The probability of infant death for this child, i.e., $r_n(a)=1$, is given by:

$$\pi_n\left(w_n(a)|p(a-1)=1,\mu\right),$$

which depends on the child's birth weight, and a family-specific factor that is assumed to be unobserved to the researcher, $\mu$, but possibly known to the family, that can also be interpreted as different health endowments for different families.[78]

---

to the birth weight technology, i.e., presumably, a more educated person would take more advantage of the available inputs.

[77] Due to the lack of data and for simplicity, I do not consider newborn deaths separately from infant deaths. See Mira (1995).

[78] This specification for the infant mortality probability is a simple one. A richer specification should include decisions at the moment of birth (like the type of hospital they visit to give birth or the use of a cesarean procedure) and after birth (such as breast feeding, postnatal health care, or general nutrition in the first year of life) as Wolpin (1997) suggests. I opt for this specification to save on the number of parameters to be estimated and because the number of infant deaths observed in the data would not be enough to precisely estimate a more complicated model for the infant mortality probability.

The family's utility function, at every wife's age $a$, is given by:

$$U(a) = U\left(C(a), p(a), N(a), w_n(a), w_{n-1}, r_n(a), e_f^c(a), e_m^c(a), h(a), V(a), \varepsilon^p(a), \varepsilon^h(a); a^0, \mu\right),$$

where $C(a)$ represents the family's total consumption.[79] The utility function incorporates a psychic effect that parents may have from having a pregnancy, $p(a)$. Utility also depends on the number of alive children in the family, $N(a)$; on the birth weight of the child born in the current period, $w_n(a)$; and on birth weight of the previously born child, $w_{n-1}$.[80] The family's utility is also affected by the death of the child born in the current period, $r_n(a)$. The family obtains non-pecuniary utility (or disutility) from working in the covered sector, $e_f^c(a)$ and $e_m^c(a)$, and from the wife staying at home, $h(a)$. Also, utility depends on the type of doctor that a pregnant woman visits in period $a$, $V(a)$, which will capture the non-pecuniary utility that the family would have, for example, when visiting a private doctor because the facilities are nicer. $\varepsilon_p(a)$ is a stochastic shock to the preference of being pregnant; $\varepsilon_h(a)$ is a shock on the value assigned to the mother staying at home; and, $\mu$ is a family-specific factor that could affect preferences for children in the family, the value of the mother staying at home, the utility the family derives from the child's health, or consumption, for example.

[79]Note that this model considers a family utility function and, hence, does not consider any distribution of the consumption among the family members; it is assumed that the family cares about total family's consumption only. This is a common assumption in this literature; see Eckstein and Wolpin (1989), Mira (1995) and Todd and Wolpin (2003), for example.

[80]This term is added in the utility function to capture the dynamics that exist between past experiences with births and present decisions regarding the quantity/quality of children as introduced by Becker and Lewis (1973). In the implementation of the model, I only consider the low birth weight status of the last child born due to lack of birth weight data for births prior to the period observed, which means that $w_{n-1}$ is an indicator function that is equal to 1 if the $(n-1)$-th child was born with low birth weight and equal to 0 otherwise. In theory, it would be possible to integrate over the missing birth weight of previous children but this is not possible in practice due to computational burden.

The income for a parent in any period depends on the kind of job she has. The income for parent $i$ of age $a_i$ at wife's age $a$ can be represented by

$$\begin{aligned} y_i(a;\gamma) &= (1-\gamma)\, e_i^c(a) y_i^c\left(i, a_i, E_i, l, \varepsilon^{y_i^c}(a); \mu\right) + \\ & \quad e_i^u(a) y_i^u\left(i, a_i, E_i, l, \varepsilon^{y_i^u}(a); \mu\right), \end{aligned}$$

where $\gamma$ is the income tax rate or fees faced in the covered sector,[81] $\varepsilon^{y_i^c}(a)$ and $\varepsilon^{y_i^u}(a)$ are stochastic shocks in each kind of job for parent $i$,[82] and, $\mu$ represents the permanent unobserved family-specific heterogeneity components corresponding to covered and uncovered jobs, respectively, which can be interpreted as different skills for different families.[83]

In this model there are no savings possibilities so the total family consumption plus health expenditures are equal to the total family income every period.[84] The family's budget constraint is:

$$C(a) + \sum_{q=1}^{3} P_q v_q(a) = y_f(a;\gamma) + y_m(a;\gamma),$$

where $P_q$ is the price of prenatal care of type $q$. On the left-hand side of the budget

[81] See Section 3.2 for the details on this tax rate/fee.

[82] There are four income shocks in total: $\varepsilon^{y_f^c}(a)$, $\varepsilon^{y_f^u}(a)$, $\varepsilon^{y_m^c}(a)$, and $\varepsilon^{y_m^u}(a)$.

[83] In the estimation I use a Mincer like equation (See Mincer (1958)), although I do not consider experience because is not available on the data. In my specification, current age, the current age squared and education should work as proxies for job experience as suggested by Bernal (2003).

[84] This assumption is to avoid modeling the savings decision which would complicate the model because it is not clear that every family would have the same saving choices and would have to be also considered in the model as choices. For instance, a poor family, if it saves at all, would not have access to the same financial markets as a non poor family. Also, this is a common assumption in this literature; see Eckstein and Wolpin (1989), Mira (1995) and Todd and Wolpin (2003), for example.

constraint the first term is the total family consumption. The second term represents the expenditures if the family's mother becomes pregnant at age $a$ and decides to get prenatal care. On the right-hand side of the equation is the family's total after-tax income. The first term is the husband's income and the second term is the wife's income.

If the family is covered by the health insurance at wife's age $a$, it would face a lower price than an uncovered family in a IMSS institution. In a similar way, a poor family would face a lower price in an MH institution than a non-poor family. All the families face the same prices at private hospitals. Hence, conditional on health insurance coverage and family's total income, there are four different price schemes that a family may face at a given wife's age $a$: 1) a covered family considered poor, $d^c(a) = 1$ and $d^o(a) = 1$; 2) a covered family considered non poor, $d^c(a) = 1$ and $d^o(a) = 0$; 3) an uncovered family considered poor, $d^c(a) = 0$ and $d^o(a) = 1$; and, 4) an uncovered family considered non poor, $d^c(a) = 0$ and $d^o(a) = 0$. Additionally, prices are assumed to be time invariant but to depend on locality ($l$) and distance of the household to the closest health center ($ds$):[85]

$$P_q = P_q(l, ds; e_f^c(a), e_m^c(a), y_f(a) + y_m(a) \leqq \bar{y}),$$

where prices also depend on whether the family is covered by the IMSS health insurance and on wether the family is poor, with $\bar{y}$ as the poverty cutoff value.

The stochastic shocks are assumed to be *iid* with mean zero and jointly normally

[85] In the data there are a few observed prices for doctor visits but, unfortunately, not enough to be considered as input in the estimation.

distributed $g(\varepsilon(a))$;[86] and the permanent family-specific factor unobserved to the researcher has a distribution function $z(\mu)$. The stochastic shocks are independently distributed from the unobserved heterogeneity factor.

The state space of the family at wife's age $a$ is given by:

$$\Omega(a) = \left\{a^0, a_f^0, l, ds, E_m, E_f, H, a, a_f, p(a-1), V(a-1), x(a), N(a), w_{n-1}, \varepsilon(a), \mu\right\}.$$

Note that I assume that all processes in the model are stationary. This is not an unreasonable assumption because the years spanned by the sample, 1997 to 2002, were relatively stable in Mexico and the period is relatively short.[87] Regarding infant health, the improvements in the last years have been small in magnitude, so it is safe to assume that technological change did not substantially affect the relationships of birth weight and infant mortality with their inputs.[88]

## 5.2 Model Solution

Each period $a$, the family has to choose one of the, mutually exclusive, available options, $k \in K(a)$, given by the combination of activities for the parents, fertility, and health care decisions. Let $d_k(a)$ be an indicator function equal to 1 if the family chooses option $k$ at wife's age $a$ and equal to zero otherwise.

[86] There is an implicit time-varying shock regarding infant mortality which is assumed to be independently distributed from the other 7 shocks explicitly considered in the model.

[87] García-Verdú (2004), for example, reports that the real wages in both the covered and uncovered sectors in Mexico, among other economic indicators, have been relatively constant over this period.

[88] See World Health Organization (2005c).

The family's problem is to maximize the present discounted value of its remaining lifetime utility at wife's age $a$ by choosing some option $k \in K(a)$. This problem can be represented in value function form:

$$V(\Omega(a), a) = \max_{k \in K(a)} E\left( \sum_{\tau=a}^{A} \delta^{\tau-a} U^k(\tau) \middle| \Omega(a) \right),$$

where $\delta$ is the discount factor and the expectation is taken over the distribution of the stochastic shocks.[89] The solution to the optimization problem is a set of decision rules that relates the optimal choice at each period, $k^* \in K(a)$, to the family's state space at that wife's age, $\Omega(a)$.

This problem can be stated in a dynamic programming framework using the Bellman (1957) equation representation:

$$V(\Omega(a), a) = \max_{k \in K(a)} V^k(\Omega(a), a),$$

where the right-hand side represents the maximization over alternative-specific value functions. These value functions are given by:

$$V^k(\Omega(a), a) = \begin{cases} U^k(a, \Omega(a)) + \delta E\left(V(\Omega(a+1), a+1) | d_k(a) = 1, \Omega(a)\right), & \forall a < A \\ U^k(A, \Omega(A)), & a = A \end{cases}.$$

The model does not have a closed form solution, only a numerical one. I solve the model by backwards recursion, starting from the last period, $A$, to the initial period, $a^0$, for a given family. It is assumed that the terminal value is equal to zero, i.e., at time $A$ the value function given by an option $k$ is equal to the current utility obtained

[89] The expectation is also taken over the born child's gender distribution. I assume that the probability of having a girl is 0.5.

from that option with no expectation term about the future. At period $A$ the family would choose the option $k$ that maximizes its current utility, given $\Omega(A)$.[90] Then at period $A-1$, the family would have to calculate the alternative-specific value functions using the distribution of the shocks at period $A$, i.e., the family has to compute $E\left(V(\Omega(A),A)|d_k(A-1)=1,\Omega(A-1)\right)$ for all $k \in K(A-1)$ and all elements of the state space, $\Omega(A-1)$. Keane and Wolpin (1994) call this function the EMAX. These steps are repeated every period until the initial period, $a^0$, is reached.

As mentioned before, the EMAX function has to be obtained for each point in the state space that could be reached from the current state space point and every available choice. In the present case, that is not possible given the size of the state space and because some of the state variables, such as the mother's height, are continuous. This makes a full solution of the problem computationally intractable. Instead, I use an approximation method proposed in Keane and Wolpin (1994, 1997, 2001) that expresses the EMAX functions as a parametric function of the current state space variables. The parameters of this function are obtained by fitting a global polynomial of the EMAX functions calculated at a subset of the state space points on their corresponding state space points. Also, since the EMAX functions' calculation implies a multivariate integration of dimension 7, Monte Carlo integration has to be performed.[91]

[90] Notice that, at the moment of making the decision, the family knows the current period's stochastic shocks, in this case $\varepsilon(A)$.

[91] I solved the model using 1,250 state space points with 100 draws for the shocks. I tried higher numbers both for the state space points and shocks' draws with minimal differences in the results but very high increases in computing times.

## 5.3 Model Estimation

The model's parameters are estimated using the Simulated Maximum Likelihood (SML) method.[92] The solution of the model is used as an input to the likelihood. The value functions for each alternative are known up to the stochastic shocks faced by the family on that period so, conditional on the deterministic part of the state space, the probability of choosing option $k$ can be represented by the multiple integral over the subset of stochastic shocks that would make that the best option for the family. The contribution to the likelihood of each family is given by the probability of observing some outcome on the data given the current state variables' values from all possible outcomes one could observe from the model solution. The observed outcome consists of: the choice $k$ (labor choices, fertility choice, and prenatal care choice); parents' incomes; newborn's weight; and, whether the infant survived or not. Then, the outcome at mother's age $a$ can be represented by $O(a) = \{d^k(a), y_m(a), y_f(a), w_n(a), r_n(a)\}$.

Suppose that a sample of $I$ families is observed from the wives' marriage age $a_\iota^0$ to some period $\overline{a}_\iota$, $\iota \in \{1, ..., I\}$. Let $\Omega(a_\iota^0)$ be the state space at the time of marriage, which includes the observable initial conditions: parents' marriage ages, locality type, distance to health care center, parents' years of education, and wife's height, $\Omega(a_\iota^0) = \{a^0, a_f^0, l, ds, E_m, E_f, H\}$. The likelihood for this sample is:

$$\prod_{\iota=1}^{I} P\left(O(\overline{a}_\iota), O(\overline{a}_\iota - 1), ..., O(a_\iota^0) \middle| \Omega(a_\iota^0), \mu\right).$$

The family-specific factors, $\mu$, are assumed to be unobserved to the econometrician

[92] Stern (1997) describes this method and compares it with the Method of Simulated Moments (MSM). In general, the SML method is preferred whenever the characteristics of the model allow the likelihood function to be simulated.

but known by the family and taken into account by the couple when solving the model. Then, it is necessary to integrate out these factors to compute the likelihood function. Assuming that the family-specific factor, $\mu$, identifies a finite number $J$ of family types in the population, the likelihood function "net" of types becomes:

$$\prod_{\iota=1}^{I}\sum_{j=1}^{J} P\left(O(\overline{a}_\iota), O(\overline{a}_\iota - 1), ..., O(a_\iota^0)\middle|\Omega(a_\iota^0), \mu_j\right) \times P\left(\mu_j\middle|\Omega(a_\iota^0)\right),$$

where the second term represents the probability of being of type $j$ for family $\iota$. Now, it will be necessary to also estimate this probability for each of the $J$ types for the $I$ families to compute the likelihood function.[93] Before explaining how I compute these probabilities there are some data issues that affect how I calculate the likelihood function, and that have to be considered.

First, the survey provides child's weight and prenatal care information only for either the last four pregnancies of the mother or all the pregnancies observed from 1997 to 2002. Second, the survey has limited information on labor force histories. It contains information about their 2000 and 2002 jobs. Additionally, it has information on the last job realized in case the person was unemployed at the time of the interview and whether the person has ever worked or not. These two issues could be addressed by just integrating over all the possible sequences of decisions and state variables' values available to a family, conditional on its initial conditions. This procedure would be computationally intractable, so it becomes necessary to restrict the analysis to the period of time with available data.

[93]The treatment of types follows Heckman and Singer (1984) in which the type probabilities are interpreted as proportions of each type present in the population.

The first issue implies that I do not observe all the families from their marriage period, $a^0$, which means that the likelihood contribution of these families has to be modified. Let $\bar{I} \subset I$ denote the subset of the observed families with $a_\iota^0 \geqq 1997$, i.e., those families with available information from their marriage date. Then, $\underline{I} = I \backslash \bar{I}$ represents the families with a marriage date previous to 1997. The likelihood for the families in $\underline{I}$ is given by:

$$\prod_{\iota=1}^{\underline{I}} \sum_{j=1}^{J} P\left(O(a_\iota^{02}), O(a_\iota^{01}), O(a_\iota^{00}), O(a_\iota^{99}), O(a_\iota^{98}), O(a_\iota^{97}) \middle| \Omega(a_\iota^{97}), \mu_j\right) \times P\left(\mu_j \middle| \Omega(a_\iota^{97})\right).$$

Notice that the above expression is conditioned on the observed state space at the year 1997 which is not exogenous.[94] In this study, the assumption of serial independence in the shocks implies that the state variables at any wife's age, $a$, are exogenous with respect to the decisions at $a$, conditional on the family's type. Another issue is that those families married before 1997 do not present birth weights for children that were born before that year. Because the last child's low birth weight status enters in the utility function, there is a problem of missing initial conditions. I solve this problem by computing the likelihood contribution, first, assuming that the last child had low birth weight, and second, assuming that the last child had normal birth weight; then, I sum these two contributions for the family.

Regarding the second issue, it will be necessary to reconstruct the job histories for all the observed families. The way to consider the missing choices data is to compute the probability for all the possible job combinations that a family could have chosen

[94] Heckman (1981) analyzes this issue known as the initial conditions problem and gives alternatives to solve it.

for the 1997, 1998, 1999, and 2001 years.[95] For each of these periods, the family's contribution to the likelihood is the summation of 6 probabilities.

Now, I turn back to the specification of how the type distribution is related to the state variables, $P\left(\mu_j|\Omega(a_\iota)\right)$. The form of this conditional distribution function is given by the structure of the model and the relationship between the family's type and the initial state variables (initial conditions), $\Omega(a_\iota^0)$. In the estimation procedure, for those families in $\bar{I}$, it is a function of the initial conditions; and, for those families in $\underline{I}$, it is a function of the state space variables in 1997.

For computational convenience, the first term of the likelihood contribution can be represented by the product of the conditional probabilities. Then, for the $\iota-$th family with some type $j$, the probability of jointly observing all the period outcomes can be rewritten as:

$$\begin{aligned} P\left(O(\overline{a}_\iota), O(\overline{a}_\iota - 1), ..., O(a_\iota^0)\middle|\Omega(a_\iota^0), \mu_j\right) = \\ P\left(O(\overline{a}_\iota)\middle|O(\overline{a}_\iota - 1), ..., O(a_\iota^0), \Omega(a_\iota^0), \mu_j\right) \times \\ P\left(O(\overline{a}_\iota - 1)\middle|O(\overline{a}_\iota - 2), ..., O(a_\iota^0), \Omega(a_\iota^0), \mu_j\right) \times ... \times \\ P\left(O(a_\iota^0)\middle|\Omega(a_\iota^0), \mu_j\right). \end{aligned}$$

Due to the shocks' serial independence assumption, each conditional probability can be computed individually.

As a way to illustrate the computation of the conditional probabilities, consider

[95] This is the procedure used in Keane and Wolpin (2001) to integrate over unobserved endogenous state variables to form the likelihood function.

some available option $k$ for the $\iota-$th family at wife's age $a$. Assume that the woman was pregnant the previous period so a child is born and survives at wife's age $a$; the option $k$ consists on the father having a covered sector job, the mother having an uncovered sector job, and the health care decision; the observed output includes both parents' observed incomes, the birth weight of the newborn, and the indication that she survived ($r_n(a) = 0$). Then, the conditional probability of observing the described outcome is:

$$\begin{aligned} P\left(d^k(a) = 1, y_m(a), y_f(a), w_n(a), r_n(a) = 0 \middle| \Omega(a), \mu_j\right) = \\ P\left(y_m(a), y_f(a), w_n(a), r_n(a) = 0 \middle| d^k(a) = 1, \Omega(a), \mu_j\right) \times \\ P\left(d^k(a) = 1 \middle| \Omega(a), \mu_j\right), \end{aligned}$$

where the first term on the second row of this probability represents the joint density of the parents' incomes, the newborn's weight and the newborn's status at the end of the period (alive) conditional on choosing option $k$, the state space at period $a$ and the family's type. The second term represents the probability of choosing option $k$ conditional on the current state space and the family's type. The former equation can be rewritten as follows:

$$\begin{aligned} P\left(d^k(a) = 1, y_m(a), y_f(a), w_n(a), r_n(a) = 0 \middle| \Omega(a), \mu_j\right) = \\ \int_{\varepsilon} g\left(y_m(a), y_f(a), w_n(a), r_n(a) = 0 \middle| d^k(a) = 1, \Omega(a), \mu_j\right) \times \\ P\left(d^k(a) = 1 \middle| \Omega(a), \mu_j\right) d\varepsilon, \end{aligned}$$

where the integral is taken over the vector of shocks, $\varepsilon$. The first term is obtained from the distributional assumptions made for the shocks. The second term, can be computed using a smoothed frequency simulator like the one proposed by McFadden

(1989) as follows: 1) for each one of $R$ draws of the shocks' vector, compute

$$\frac{\exp\left(\frac{V^{k^*}(a)-\max_k(V^k(a))}{\varpi}\right)}{\sum_i \exp\left(\frac{V^i(a)-\max_k(V^k(a))}{\varpi}\right)},$$

where $\varpi$ is a smoothing parameter chosen in a way that provides enough smoothing given the magnitudes of the value functions computed;[96] this kernel represents the probability of choosing option $k^*$, conditional on the state space (and family type); 2) integrate over the $R$ draws of the vector of shocks.

The maximization of the likelihood function iterates between the solution of the model and the computation of the likelihood function. The discreteness of the choices in the model requires the use of a maximization algorithm that does not make use of first order conditions; as is common in this literature I use a simplex method.[97] The identification of the parameters in the model is obtained from the combination of exclusion restrictions and the functional forms assumed.

As mentioned in Chapter 2, estimating the effect of medical services is difficult because of the potential presence of selection bias that would not allow the econometrician to identify the real effect of these services from the effect that, for example, the mother's health endowment would have on pregnancy outcomes. I have to consider this issue when estimating the effect of prenatal care services on birth weight. There are two main factors that allow me to identify such effect and which work in similar

[96] In the estimation, the smoothing parameter $\varpi$ is set equal to 1000. I used 100 draws to perform the numerical integration. In this case, I also tried different numbers of draws with no significant benefit.

[97] In particular, the simplex method I use is the Nelder and Mead (1965) algorithm.

ways as the within mother fixed-effects with instrumental variables in Rosenzweig and Wolpin (1995): data availability and the use of types. First, approximately 31% of the families in the sample had more than one birth in the years observed (1997 to 2002) which, under an additivity assumption, enables identification of the permanent effect of the health endowments of the family (in particular, of the mother) from the effect of the other inputs in the birth weight production function.[98] This within-family variability also allows me to identify the preference parameter in the utility function that refers to the birth weight status of the previously born child. Second, given that I use the Heckman and Singer (1984) approach to consider the unobserved heterogeneity with three types, the effect of health endowments of a family can be identified even from the effect of prenatal care from the cross-section data by comparison across families of the same type.

The exclusion restrictions are locality type and distance to health care center, which are the arguments of the prenatal care prices specifications.[99] The locality type and the distance to the health care center essentially serve as instruments because they are correlated with the decision to seek prenatal care services but not directly with the birth weight. In fact, these variables do not appear in either the birth weight production function, the probability of infant death, or the utility function in a direct way.

[98]Specifically, between 1997 and 2002, 27.8% of the families had 2 births; 2.6% had 3 births; and, 0.3% had 4 births.

[99]In this case, the prices of the different prenatal care services would be better instruments. Unfortunately, I do not have enough observations of such prices to use them directly in the estimation procedure.

# Chapter 6

# Estimation Results and Model Fit

## 6.1 Parameter Estimates

In the model estimation procedure it is necessary to assume specific functional forms for the equations presented in Section 5.1; these functional forms are presented in the Appendix B, Section B.1.[100] The model was estimated considering 3 types of households. 120 parameters were estimated, for which the estimates and standard errors are presented in the Appendix B, Section B.2.

Among the most interesting parameters, due to the focus of this work, are those in the birth weight production function, which are all significant (Table 6.1). The model estimates indicate that receiving prenatal care on average increases birth weight by 13%, which approximately amounts to 379 grams (13 ounces). The highest benefits are received by those who use private services; visiting this type of services has an

[100]The identification of the parameters in the model is obtained from the combination of the exclusion restrictions explained in the last part of Section 5.3 and the functional forms assumed. For instance, I assume a CRRA utility function and Mincer-like wage functions. The actual number of parameters and the functional forms were obtained by an iterative process between the model estimation and the data.

estimated parameter of 0.144, which means an average increase in birth weight of 14%, 470 grams (16.6 ounces). In second place, the estimated parameter for the IMSS services is 0.135 that can be interpreted as an increase in birth weight of 13.5% or 440 grams in average (15.5 ounces).[101] Finally, MH prenatal care services have an estimated parameter of 0.085; the increase in birth weight of visiting an MH institution, instead of not receiving prenatal care services is approximately 8.5%, that is 278 grams on average (9.8 ounces). These results are very interesting in several aspects. The effect of seeking prenatal care services is much higher in this model estimations than those reported in previous studies. The reason for this relatively large effect is that access to prenatal care services can mean access to a variety of inputs that have positive effects on birth weight. Alexander and Korenbrot (1995) argue that prenatal care services can contribute to better pregnancy outcomes in several dimensions: education regarding risks of substance abuse during pregnancy; nutritional guidance and monitoring to prevent inadequate weight gain or to improve poor nutritional status; treatment and prevention of diseases; and, immunizations. These factors may be more helpful in a developing country environment than in a developed country given that the life quality conditions are higher in the later. For instance, one important factor to prevent several diseases could be to boil water before using it to cook or drink; this issue would be most helpful in a developing country given that the quality of water is very poor, but in a developed country it may be unimportant given that water is already treated and cleaned before arriving to a household.

It is also very interesting to compare the estimated parameters of the birth weight production function from the structural model and the OLS estimation presented in Section 4.4 (See Table 6.1). The first issue to notice is that the prenatal care effect of

[101] Notice that the parameters for IMSS and private services are statistically different.

Table 6.1: **Log Birth Weight Production Function, Comparison of Model and OLS Estimates**

| Variable | Model | | OLS | |
|---|---|---|---|---|
| | **Parameter Estimate** | **Standard Error** | **Parameter Estimate** | **Standard Error** |
| Constant type 1 | 6.051 | 0.006 | 7.078 | 0.170 |
| Constant type 2 | 6.039 | 0.019 | – | – |
| Constant type 3 | 6.148 | 0.012 | – | – |
| Child's gender | 0.093 | 0.004 | 0.027 | 0.012 |
| Mother's age | 0.029 | 0.000 | 0.018 | 0.008 |
| Mother's age squared | -0.0005 | 0.00001 | -0.0003 | 0.0001 |
| Spacing | -0.0004 | 0.0002 | 0.0069 | 0.0023 |
| Father's years of education | -0.021 | 0.0003 | -0.0019 | 0.0019 |
| Mother's years of education | 0.011 | 0.0004 | -0.0014 | 0.0021 |
| Mother's height | 0.010 | 0.00001 | 0.005 | 0.0009 |
| Birth order | -0.015 | 0.001 | -0.005 | 0.005 |
| Prenatal care IMSS | 0.135 | 0.003 | 0.070 | 0.025 |
| Prenatal care MH | 0.085 | 0.003 | 0.055 | 0.026 |
| Prenatal care private | 0.144 | 0.003 | 0.048 | 0.028 |

the three types of services are much higher in the model than in the OLS estimation. This is an indication of presence of selectivity regarding the decision of visiting a doctor or not. In general, women that have information about having better health endowments are less likely to seek medical services during pregnancy than those with information about bad health endowments. The second issue is that the magnitudes ordering of the estimated model is different from the observed in the OLS estimation. As mentioned above, private prenatal care services are the most beneficial of the three doctor options, exactly the opposite of what the OLS estimates report. This is evidence of a strong selectivity that complements the one mentioned before: women with information about having bad health endowments visit the best quality doctors (private) hoping to increase the possibility of better pregnancy outcomes.

The constant term of the birth weight production function was allowed to vary

by family type to capture possible health endowment differences. The estimates for type 1 and type 2 are very similar, although statistically different; only type 3 seems to present a relatively better endowment. The remaining parameters of the birth weight production function have the expected signs with the exception of the effect of husband's years of education which is negative. This negative parameter estimate could be either due to the presence of wife's years of education or because the real relationship of this variable with birth weight is non-linear. It would be necessary to add an additional parameter for the (squared) husband's years of education to verify this relationship, although I do not do so to avoid increasing the number of estimated parameters.

Regarding probability of infant death, the model estimates report that being born with normal birth weight (5 pounds and 8 ounces or more), instead of with low birth weight, reduces, on average, the probability of infant death from 37% to 5%. Table 6.2 presents the estimated parameters. The specification also allowed for family type variation in the form of different constants. Notice that, in this case, the types differences are relatively large, implying that different families faced very different probabilities of infant death even when, from the birth weight production function, it seems that their health endowments were relatively similar.

Table 6.2: **Infant Death Probability, Model Estimates**

| **Variable** | **Parameter** | **Standard Error** |
|---|---|---|
| Constant type 1 | -2.534 | 0.091 |
| Constant type 2 | -3.253 | 0.037 |
| Constant type 3 | -2.949 | 0.029 |
| Low birth weight | 2.385 | 0.232 |

The CRRA parameter was also allowed to vary by family type. The three types estimates are 0.847, 0.878, and 0.889. This implies that the utility is close to being linear in consumption. Also, it is estimated that number of alive children and wife's leisure are complements with consumption. As expected, there is a large disutility of having an infant death in the family. Also, birth weight, as a proxy of the future health and performance of a child, provides a positive and large utility, although with decreasing marginal utility. In the same direction, having had a low birth weight birth in the past has a negative utility for the family.[102]

## 6.2 Model Goodness of Fit

The model fits the data quite well in several dimensions and is able to capture both qualitative and quantitative features observed in the data. Tables 6.3 to 6.5 present the comparison between the data and the model across several statistics of interest.

Table 6.3 compares statistics of interest, in the data and the model, related to fertility and infant health by wives' age groups. In this table I also include within-sample $\chi^2$ goodness-of-fit statistics.[103] The pregnancy rates are very similar and the decreasing trend by age is well predicted. The model predicts a lower average number of children per family (0.91%) than the data (1.30%), for younger women (15 to 25 years old); although for older women the predicted averages are very close to those observed in the data. The incidences of low birth weight by age group are predicted relatively well; the U-shape relation with age observed in the data is predicted by

[102] See Table B.1 in Appendix B, Section B.2.

[103] The $\chi^2$ statistics are not corrected for the fact that the predicted distributions from the model are based on estimated parameters.

the model, and, according to the $\chi^2$ statistics, the predictions present the same distribution as the data. Finally, the infant mortality rates predicted by the model are close to those in the data, although the increasing relationship with women's age is a little flatter for the model predictions; nevertheless, based on the $\chi^2$ statistics, these distributions are the same.

Table 6.3: **Fertility and Infant Health Statistics, Comparison between Data and Model Predictions**

| | Data/Simulated | | | | | | |
|---|---|---|---|---|---|---|---|
| **Wives' Age Group** | **Fertility** | | **Number of Children** | **Low Birth Weight** | | **Infant Mortality** | |
| | (%) | $\chi^2$ | | (%) | $\chi^2$ | (%) | $\chi^2$ |
| 15 to 25 | 27.04/27.76 | 0.73 | 1.30/0.91 | 8.16/8.54 | 0.02 | 2.55/3.83 | 2.79 |
| 26 to 35 | 19.15/17.66 | 4.76 | 2.57/2.54 | 5.29/4.71 | 0.44 | 3.10/3.93 | 1.18 |
| 36 to 45 | 14.22/13.29 | 0.48 | 4.31/4.23 | 7.06/9.03 | 0.40 | 7.69/4.70 | 2.08 |

$\chi^2_{(1,0.05)} = 3.84$

The comparison of the data with the model predictions regarding prenatal care choices by coverage status are presented in Table 6.4. The model fits the data well in all choices. The largest discrepancy between data and predicted statistics is the choice of not visiting a doctor for covered families. In the table I also present $\chi^2$ statistics per coverage status, which imply that the distributions are statistically the same.

Table 6.5 compares the model's predictions of the distribution of labor market participation for both parents to the one observed in the data. In general, the model fits the data well both regarding the joint and the individual labor market participation decisions. The $\chi^2$ statistic for the test of whether the joint choice distributions

Table 6.4: **Prenatal Care Choice by Coverage Status, Comparison between Data and Model Predictions**

| | Data/Simulated | |
|---|---|---|
| **Care Provider** | **Covered (%)** | **Uncovered (%)** |
| IMSS | 54.79/56.24 | 33.16/31.19 |
| MH | 12.33/13.40 | 32.62/33.69 |
| Private | 23.29/23.12 | 24.06/26.10 |
| No care | 9.59/7.24 | 10.16/9.02 |
| $\chi^2$ | 0.896 | 1.150 |

$\chi^2_{(3,0.05)} = 7.81$

are the same is 7.814, which means that the null hypothesis is not rejected.[104] Also, it is not possible to reject the null hypotheses for the individual decisions: for husbands the $\chi^2$ statistic is 0.627;[105] and, for wives it is 3.953.[106]

Table 6.5: **Labor Sector Distribution of Parents, Comparison between Data and Model Predictions**

| | Data/Simulated | | | |
|---|---|---|---|---|
| **Husband/Wife (%)** | **Covered Job** | **Uncovered Job** | **Home** | **Total** |
| **Covered Job** | 3.39/3.33 | 3.49/3.24 | 20.11/21.23 | 26.99/27.80 |
| **Uncovered Job** | 2.92/3.68 | 16.99/15.37 | 53.10/53.15 | 73.01/72.20 |
| **Total** | 6.31/7.01 | 20.48/18.61 | 73.22/74.38 | 100/100 |

[104]The $\chi^2$ statistic with 5 degrees of freedom and size 5% is 11.07.
[105]The $\chi^2$ statistic with 1 degree of freedom and size 5% is 3.84.
[106]The $\chi^2$ statistic with 2 degrees of freedom and size 5% is 5.99.

# Chapter 7

# Counterfactual Policy Experiments

## 7.1 The Universal Access Health Insurance

The Universal Access Health Insurance (*Seguro Popular de Salud*, SPS) is a program that aims to extend the protection from the IMSS (covered sector) health insurance to all the Mexican population. It consists of a voluntary public health insurance coordinated by the Ministry of Health at the federal level but provided mainly in state health facilities from the IMSS and the public system. This program is aimed mainly to individuals and families not covered by the IMSS health insurance and whose income falls in the lower 6 deciles of the income distribution. The coverage would consist on primary and secondary interventions, similar to those covered by the IMSS health insurance, including medical services during pregnancy, at birth, and during the first months of life. This program started in its pilot phase on October 2001 in selected localities but, it was until the second half of 2004 when made available for all the population.[107] From the years 2001 to 2004 the Federal Government and the

[107]In the year 2002, only 296,000 families were incorporated to the trial version of the program which had different characteristics to what is being implemented country-wide.

Congress set the rules and organization for the program. Now it is available in the whole country and its affiliation is voluntary. The family has to pay an annual fee which depends on the decile its income level falls.[108]

In order to evaluate this policy, and given that it is a voluntary program, it is necessary to add a new choice to the model. Using the estimated parameters, I simulate the behavior of the families in the sample making the insurance available for everyone.[109]

Tables 7.1 to 7.5 present simulation results for this policy. Table 7.1 compares the labor sector choice distributions with and without the policy. An expected side effect of this policy could be that it increases the incentives to go to the uncovered sector given that now the government health insurance is available also for this sector. Surprisingly, the labor sector choice distributions are very similar, with small decreases in covered sector participation by both parents. Once the IMSS prenatal care access is untied from the labor market participation, only approximately 1% of the families switch from covered to uncovered status, which comes from the fact that some families would do better, in terms of income (or utility having the wife staying at home), by being uncovered and buying the health insurance to gain access to IMSS.

Table 7.2 presents the take-up rates of the insurance by wives' age groups for covered and uncovered families. Because the benefits from the insurance are equivalent to those under the covered sector regarding the IMSS prenatal services but at some

[108]The fees by income level are presented in Table C.1 in Appendix C, as published by the government in PEF (2003).

[109]In this experiment I abstract from congestion effects (increase in queuing times or decrease in quality) that may be a side consequence of higher usage of IMSS hospitals.

Table 7.1: **Labor Sector Distribution of Parents, Comparison between Baseline and Policy Predictions (SPS)**

| | Baseline/Policy | | | |
|---|---|---|---|---|
| **Husband/Wife (%)** | **Covered Job** | **Uncovered Job** | **Home** | **Total** |
| **Covered Job** | 3.33/3.33 | 3.24/2.86 | 21.23/20.85 | 27.80/27.04 |
| **Uncovered Job** | 3.68/3.57 | 15.37/15.41 | 53.15/53.98 | 72.20/72.96 |
| **Total** | 7.01/6.90 | 18.61/18.27 | 74.38/74.83 | 100/100 |

cost, it is natural that covered sector families' take-up rates are zero. Also, given that, in the model, the policy's benefits come in the form of access to prenatal care services, it is to be expected that the take-up rates are decreasing in wife's age, as younger women have higher pregnancy rates. 30.36% of uncovered families with a wife between 15 and 25 years old purchase the insurance. Uncovered families with women at older ages have take-up rates close to 18%.

Table 7.2: **SPS Take Up–Rates**

| **Wives' Age Group** | **All Sample (%)** | **Covered (%)** | **Uncovered (%)** |
|---|---|---|---|
| 15 to 25 | 15.41 | 0.0 | 30.36 |
| 26 to 35 | 9.16 | 0.0 | 18.57 |
| 36 to 45 | 9.18 | 0.0 | 18.12 |

The overall benefits of the policy are not as large as would be expected. Table 7.3 shows the pregnancy rates by wives' age with and without the introduction of the health insurance, showing small changes. An increase in fertility rates is observed because the access to health care services makes less likely to have bad pregnancy outcomes, which allows some families to have more children than they would given their limited access to such health services.

The sample average birth weight increases only by 22 grams (from 3,259 to 3,281

Table 7.3: **Fertility Rates, Comparison between Baseline and Policy Predictions (SPS)**

| | **Baseline/Policy** |
|---|---|
| **Wives' Age Group** | (%) |
| 15 to 25 | 27.76/27.87 |
| 26 to 35 | 17.66/17.73 |
| 36 to 45 | 13.29/13.36 |

grams). Table 7.4 compares low birth weight births incidence and the infant mortality rate for the baseline and policy predictions; both pregnancy outcomes improve slightly for the whole sample. The baseline incidence of low birth weight births for the whole sample places Mexico in 15th place among OECD countries and 4th among Latin-American countries. Regarding infant mortality rates, the whole sample's baseline figure of 3.87% places Mexico in the last place of the OECD countries and in 20th place in the Latin-American group (See Tables 3.1 and 3.2).[110]

Table 7.4: **Pregnancy Outcomes Statistics, Comparison between Baseline and Policy Predictions (SPS)**

| | **Low Birth Weight** (%) | **Infant Mortality** (%) |
|---|---|---|
| All Sample: | | |
| Baseline (100%) | 6.41 | 3.87 |
| Policy (100%) | 5.64 | 3.76 |
| Covered: | | |
| Baseline (47.86%) | 5.63 | 3.47 |
| Policy (49.19%) | 4.88 | 3.47 |
| Uncovered: | | |
| Baseline (52.14%) | 7.14 | 4.23 |
| Policy (50.81%) | 6.38 | 4.05 |

Low birth weight births incidence decreases approximately one percentage point

[110]Notice that these rankings are different from those reported in Tables 3.1 and 3.2 because this study is focused on nuclear families where both husband and wife are present, which leaves out single parents.

both for covered and uncovered families. The apparent improvement for covered families comes from the switching of families from the covered to the uncovered status; families that had low birth weight children and were covered in the baseline model, switch to the uncovered sector under the policy to take advantage of the SPS but, nevertheless, still have low birth weight children. The improvement in the uncovered sector families comes from the direct effect of having access to health care services. For these families, infant mortality rate also decreases. The overall improvement in low birth weight births incidence ranks Mexico in the 7th place among OECD countries and in 2nd place in Latin-America; also, the improvement in infant mortality rate takes Mexico to the 29th place in the OECD group but leaves it in the same place as in the baseline case in Latin-America.

Table 7.5: **Prenatal Care Choice by Coverage Status, Comparison between Baseline and Policy Predictions (SPS)**

| | **Baseline/Policy** | |
|---|---|---|
| **Care Provider** | **Covered (%)** | **Uncovered (%)** |
| IMSS | 56.24/55.89 | 31.19/65.13 |
| MH | 13.40/15.00 | 33.69/11.45 |
| Private | 23.12/21.01 | 26.10/17.17 |
| No care | 7.24/8.10 | 9.02/6.24 |

The reason for this relatively low impact of the policy in overall pregnancy outcomes can be due to some unforeseen effects on the demand for health care services. In particular, as shown in Table 7.5, within uncovered families there is a high percentage of families that visit MH hospitals and private doctors when there is no SPS that visit IMSS institutions under the policy. This switching seems to have two opposite effects. As the model estimations show,[111] the most beneficial prenatal care services

[111] See Table 6.1.

are those provided by private doctors, followed by IMSS and then by MH hospitals. It seems that the improvement of pregnancy outcomes that occurred by the switch of 22.24% from MH hospitals to IMSS (and the 2.78% from "no care" to IMSS) are counteracted by the 8.93% of uncovered pregnancies that, under the policy, seek IMSS services, instead of the private services they would have chosen otherwise. This observation indicates that there is an unforseen crowding-out effect on the demand for private prenatal care services that implies that some people substitute higher quality prenatal care services for lower quality health services on the basis of changes in price.

## 7.2 Health Care Vouchers Program

The analysis in the former section seems to imply that the SPS should target only those people that would benefit the most from the availability of IMSS prenatal care services. In this section I propose another subsidies scheme that can be targeted more easily and compare its impact to the one predicted for the SPS. The policy I evaluate in this section is a hypothetical Health Care Vouchers Program that aims to subsidize prenatal care services. In this case, people receive a voucher exchangeable in a given doctor type. This subsidy would increase the incentive to make use not only of prenatal care services in general, but to visit the type of doctor targeted by the program. In order to make comparable the SPS and this vouchers program, the voucher value should be one that maintains the government expenditures constant, that is, the cost for the government of having a family visit the IMSS institutions under the SPS. For the present simulation, a family for which income falls within the lower 6 deciles of the income distribution, contingent on a pregnancy, receives an annual voucher for $5,278 pesos (equivalent to $527.80 dollars in 2002). I computed this amount based on the

reported budget figures that the Mexican government assigned to the SPS in 2004 divided by the number of families that were affiliated to the policy in the same year.[112]

The first scheme I evaluate is a free-choice vouchers program in which all families within the targeted income levels receive an annual voucher of $5,278 pesos. Tables 7.6 and 7.7 compare statistics of interest from the baseline model and this policy's predictions. Parents' labor sector choice distribution and fertility rates present very small changes. Table 7.6 compares pregnancy outcomes with and without policy. The impacts on infant health are smaller than under the SPS. In contrast to SPS, the group that benefits the most from the policy are the covered families, which present higher improvements on both pregnancy outcomes. Notice that this policy has no effect on Mexico's ranking among OECD and Latin-American countries with respect to pregnancy outcomes.

Table 7.6: **Pregnancy Outcomes Statistics, Comparison between Baseline and Policy Predictions ($5,278 Pesos Voucher with Free Choice)**

| | **Low Birth Weight (%)** | **Infant Mortality (%)** |
|---|---|---|
| All Sample: | | |
| Baseline (100%) | 6.41 | 3.87 |
| Policy (100%) | 6.19 | 3.85 |
| Covered: | | |
| Baseline (47.86%) | 5.63 | 3.47 |
| Policy (47.81%) | 5.39 | 3.42 |
| Uncovered: | | |
| Baseline (52.14%) | 7.14 | 4.23 |
| Policy (52.19%) | 6.92 | 4.23 |

In Table 7.7 it can be observed that there is an increase in the usage of prenatal

[112]See Nigenda (2005). This is the best figure I can use given that, to the best of my knowledge, there are no publicly available statistics on the cost for the government of the utilization of IMSS institutions for prenatal care services or similar medical procedures.

care services both for covered and uncovered families; but also there is a higher proportion of covered families visiting private doctors than with no policy. These results indicate that a general subsidy is not the best policy to implement, given that people that were not the main target of the policy end up taking more advantage than the real objective of these policies, which is to increase the access to prenatal care for uncovered sector families.

Table 7.7: **Prenatal Care Choice by Coverage Status, Comparison between Baseline and Policy Predictions ($5,278 Pesos Voucher with Free Choice)**

| | Baseline/Policy | |
|---|---|---|
| **Care Provider** | **Covered (%)** | **Uncovered (%)** |
| IMSS | 56.24/53.58 | 31.19/31.40 |
| MH | 13.40/11.51 | 33.69/35.60 |
| Private | 23.12/29.49 | 26.10/24.79 |
| No care | 7.24/5.42 | 9.02/8.22 |

Then, it seems appropriate to propose a vouchers' scheme specifically targeted to uncovered families. After trying different schemes, it turns out that a vouchers program which that allows only uncovered families to decide between IMSS and private prenatal care services, benefits uncovered families by the most. In this case, I also try a voucher of $5,278 pesos. The effect of this scheme on fertility is almost null. In contrast with the former scheme, given that only uncovered families are subsidized, the percentage of uncovered families increases by almost 1%, mainly because husbands switch from covered to uncovered sector jobs (See Table 7.8). This change is reflected in the prenatal care choices by coverage status presented in Table 7.9. Covered families' usage of private prenatal care services seems to increase, although the number of covered families visiting this kind of services is almost the same; this implies that those families that switch coverage status under the policy, visit other

kinds of health services in the baseline simulations. Regarding uncovered families, under the policy, there is an increase in the proportion of families visiting IMSS institutions; also, although the percentage of families that visit private doctors increases only slightly, the number of families using such services increases.

Table 7.8: **Labor Sector Distribution of Parents, Comparison between Baseline and Policy Predictions ($5,278 Pesos Voucher with IMSS and Private Services' Choice for Uncovered Families)**

| | Baseline/Policy | | | |
|---|---|---|---|---|
| **Husband/Wife (%)** | **Covered Job** | **Uncovered Job** | **Home** | **Total** |
| **Covered Job** | 3.33/3.45 | 3.24/3.13 | 21.23/20.46 | 27.80/27.04 |
| **Uncovered Job** | 3.68/3.53 | 15.37/15.37 | 53.15/54.06 | 72.20/72.96 |
| **Total** | 7.01/6.98 | 18.61/18.50 | 74.38/74.52 | 100/100 |

Table 7.9: **Prenatal Care Choice by Coverage Status, Comparison between Baseline and Policy Predictions ($5,278 Pesos Voucher with IMSS and Private Services' Choice for Uncovered Families)**

| | Baseline/Policy | |
|---|---|---|
| **Care Provider** | **Covered (%)** | **Uncovered (%)** |
| IMSS | 56.24/51.67 | 31.19/37.91 |
| MH | 13.40/11.69 | 33.69/26.74 |
| Private | 23.12/30.60 | 26.10/26.25 |
| No care | 7.24/6.04 | 9.02/9.10 |

Table 7.10 shows the effect of this policy scheme on pregnancy outcomes. As expected, covered families receive no benefit from the policy, given that the vouchers are given only to uncovered families. Uncovered families benefit from the policy both in terms of low birth weight births incidence and infant mortality rate, although these improvements are still smaller than under the SPS. Again, this vouchers program has no effect on Mexico's rankings.

Table 7.10: **Pregnancy Outcomes Statistics, Comparison between Baseline and Policy Predictions ($5,278 Pesos Voucher with IMSS and Private Services' Choice for Uncovered Families)**

| | Low Birth Weight (%) | Infant Mortality (%) |
|---|---|---|
| All Sample: | | |
| Baseline (100%) | 6.41 | 3.87 |
| Policy (100%) | 6.20 | 3.84 |
| Covered: | | |
| Baseline (47.86%) | 5.63 | 3.47 |
| Policy (47.33%) | 5.60 | 3.49 |
| Uncovered: | | |
| Baseline (52.14%) | 7.14 | 4.23 |
| Policy (52.67%) | 6.74 | 4.15 |

The effects of these vouchers programs are sensitive to the value of the voucher given to the family. Given that schemes with a voucher of $5,278 pesos were not more beneficial than the SPS, I experimented with several (higher) voucher values. In order to get better pregnancy outcomes than those from the SPS for uncovered families, the government would have to give vouchers in the amount of $25,000 pesos, almost five times the cost of SPS per family. Tables 7.11 to 7.13 show the effects of this policy on statistics of interest. Fertility rates increase in very small amounts. In Table 7.11 it can be seen that the percentage of uncovered families increases by 2.35%, under the policy with respect to baseline simulations.

Table 7.11: **Labor Sector Distribution of Parents, Comparison between Baseline and Policy Predictions ($25,000 Pesos Voucher with IMSS and Private Services' Choice for Uncovered Families)**

| | Baseline/Policy | | | |
|---|---|---|---|---|
| **Husband/Wife (%)** | **Covered Job** | **Uncovered Job** | **Home** | **Total** |
| **Covered Job** | 3.33/3.44 | 3.24/2.67 | 21.23/19.70 | 27.80/25.81 |
| **Uncovered Job** | 3.68/3.32 | 15.37/15.19 | 53.15/55.68 | 72.20/74.19 |
| **Total** | 7.01/6.76 | 18.61/17.86 | 74.38/75.38 | 100/100 |

Regarding prenatal care choices (Table 7.12), covered families seem to increase the usage of private medical services as percentage of this group, although, as in the former policy, the number of families doing so remains almost unchanged. Uncovered families increase the usage of IMSS services from 31.19% to 63.05%. The main prenatal care choice changes are the drop in MH usage and the "no care" option. Although the uncovered families' usage of private services seems to decrease under the policy, the number of families actually visiting such doctors slightly increases.

Table 7.12: **Prenatal Care Choice by Coverage Status, Comparison between Baseline and Policy Predictions ($25,000 Pesos Voucher with IMSS and Private Services' Choice for Uncovered Families)**

| | Baseline/Policy | |
|---|---|---|
| **Care Provider** | **Covered (%)** | **Uncovered (%)** |
| IMSS | 56.24/51.36 | 31.19/63.09 |
| MH | 13.40/13.12 | 33.69/7.74 |
| Private | 23.12/28.01 | 26.10/23.31 |
| No care | 7.24/7.51 | 9.02/5.86 |

The impact of this policy on pregnancy outcomes can be observed in Table 7.13. Incidence of low birth weight births for uncovered families drops from 7.14% in the baseline to 6.16% under this policy; this incidence is also lower than the 6.38% obtained under the SPS. For the same group, the infant mortality rate under the policy is 3.97%, also lower than the baseline rate of 4.23% and the one under the SPS of 4.05%. Nevertheless, the overall benefit of this policy is very close to that of SPS but 5 times more expensive. In this sense, this policy has the same effect on Mexico's rankings regarding incidence of low birth weight births (7th in OECD countries and 2nd in Latin-America), although it has no effect on its rankings regarding infant mortality rates.

Table 7.13: **Pregnancy Outcomes Statistics, Comparison between Baseline and Policy Predictions ($25,000 Pesos Voucher with IMSS and Private Services' Choice for Uncovered Families)**

| | Low Birth Weight (%) | Infant Mortality (%) |
|---|---|---|
| All Sample: | | |
| Baseline (100%) | 6.41 | 3.87 |
| Policy (100%) | 5.66 | 3.81 |
| Covered: | | |
| Baseline (47.86%) | 5.63 | 3.47 |
| Policy (46.32%) | 5.36 | 3.60 |
| Uncovered: | | |
| Baseline (52.14%) | 7.14 | 4.23 |
| Policy (53.68%) | 5.91 | 3.98 |

## 7.3 Health Care Centers Construction

In this section, I analyze a third type of policy aimed at increasing the access to health care services during pregnancy for the Mexican population. The policy would consist of a decrease of the distance between households and health care centers. As mentioned before, there is evidence in the literature that one of the reasons for which individuals do not seek medical services is the long distance, and the high cost related to it, that they have to cover to visit a medical center. Recall that, in this work, distance to a health care center is a discrete variable that represents the geographical location of the health care center with respect to the household. Such health care center can be in the same neighborhood; not in the same neighborhood but in the same municipality; or, not in the same locality but in the same state.[113] In particular, I evaluate two similar policies: first, one in which I "reduce" the distance from being

[113]See Section 4.3.

in the same state to being in the same municipality for those families that report having a health care center in the same state; second, I simulate the families as if there was a health care center in each locality.

Table 7.14: **Labor Sector Distribution of Parents, Comparison between Baseline and Policy Predictions (Hospital Construction in Municipalities)**

| | Baseline/Policy | | | |
|---|---|---|---|---|
| **Husband/Wife (%)** | **Covered Job** | **Uncovered Job** | **Home** | **Total** |
| **Covered Job** | 3.33/3.34 | 3.24/3.37 | 21.23/21.39 | 27.80/28.10 |
| **Uncovered Job** | 3.68/3.75 | 15.37/15.45 | 53.15/52.70 | 72.20/71.90 |
| **Total** | 7.01/7.09 | 18.61/18.82 | 74.38/74.09 | 100/100 |

The first case can be interpreted as constructing health care centers in those municipalities in which there is no such infrastructure. As presented in Table 4.2, this means that 11.82% of the urban families and 18.29% of the rural families would be benefited by this policy. There is no significant effect on the labor sector distribution of parents or in fertility rates (Tables 7.14 and 7.15). Table 7.16 shows the prenatal care choices by coverage. The most important changes are in the decision of not seeking prenatal care. As expected, under the policy, in which the cost of visiting a doctor is lower, the proportion of families that decide not to do so is lower. In particular, 5.94% of covered families which with no policy were not visiting a doctor, seek medical services when the distance to the health care center is reduced. In a similar fashion, 3.27% of uncovered families switch from "no care" with no policy to some kind of prenatal care services under the policy. Also, there is a high increase in the usage of IMSS institutions from covered families under the policy.

The effect of the increase in the usage rates of prenatal care services has a positive effect on infant health outcomes (Table 7.17). Both incidence of low birth weight

Table 7.15: **Fertility Rates, Comparison between Baseline and Policy Predictions (Hospital Construction in Municipalities)**

| | Baseline/Policy |
|---|---|
| **Wives' Age Group** | (%) |
| 15 to 25 | 27.76/27.79 |
| 26 to 35 | 17.66/17.73 |
| 36 to 45 | 13.29/13.35 |

births and infant mortality rates are reduced. Covered families are benefited by the most, although uncovered families also see an improvement in infant health indicators. Nevertheless, this policy has a smaller impact than the SPS analyzed above and has no effect on Mexico's rankings neither among OECD nor Latin-American countries for both pregnancy outcomes statistics.

Table 7.16: **Prenatal Care Choice by Coverage Status, Comparison between Baseline and Policy Predictions (Hospital Construction in Municipalities)**

| | Baseline/Policy | |
|---|---|---|
| **Care Provider** | **Covered** (%) | **Uncovered** (%) |
| IMSS | 56.24/60.06 | 31.19/31.89 |
| MH | 13.40/14.82 | 33.69/37.53 |
| Private | 23.12/23.62 | 26.10/24.83 |
| No care | 7.24/1.50 | 9.02/5.75 |

The second case would be equivalent to building hospitals in localities that do not have such infrastructure. This policy would benefit a very large proportion of the sample: 62.39% of covered families and 56.77% of uncovered families. In this case, there is a decrease in the percentage of uncovered families (Table 7.18), and relatively important increases in fertility rates for younger women (Table 7.19). The increase in fertility rates comes from the lower cost of visiting a doctor, which potentially reduces the likelihood of negative pregnancy outcomes; this increases the incentive of a family

Table 7.17: **Pregnancy Outcomes Statistics, Comparison between Baseline and Policy Predictions (Hospital Construction in Municipalities)**

| | Low Birth Weight (%) | Infant Mortality (%) |
|---|---|---|
| All Sample: | | |
| Baseline (100%) | 6.41 | 3.87 |
| Policy (100%) | 6.01 | 3.80 |
| Covered: | | |
| Baseline (47.86%) | 5.63 | 3.47 |
| Policy (48.08%) | 5.15 | 3.38 |
| Uncovered: | | |
| Baseline (52.14%) | 7.14 | 4.23 |
| Policy (51.92%) | 6.81 | 4.19 |

to have a child even when the risks of low birth weight or infant mortality rate are relatively high.

Table 7.18: **Labor Sector Distribution of Parents, Comparison between Baseline and Policy Predictions (Hospital Construction in Localities)**

| | Baseline/Policy | | | |
|---|---|---|---|---|
| **Husband/Wife (%)** | **Covered Job** | **Uncovered Job** | **Home** | **Total** |
| **Covered Job** | 3.33/3.22 | 3.24/3.15 | 21.23/22.90 | 27.80/29.27 |
| **Uncovered Job** | 3.68/3.72 | 15.37/14.96 | 53.15/52.05 | 72.20/70.73 |
| **Total** | 7.01/6.94 | 18.61/18.11 | 74.38/74.95 | 100/100 |

Regarding prenatal care choices, the effect of this policy goes in the same direction than the former but is stronger. Table 7.20 shows that both covered and uncovered families visit a doctor during pregnancy, i.e., under the policy all families seek prenatal care. It is worth noticing that the policy has different effect in the type of doctor choice for covered and uncovered families. Under the policy, covered families visit each kind of doctor in similar proportions than in the baseline.

Table 7.19: **Fertility Rates, Comparison between Baseline and Policy Predictions (Hospital Construction in Localities)**

| | Baseline/Policy |
|---|---|
| **Wives' Age Group** | (%) |
| 15 to 25 | 27.76/28.62 |
| 26 to 35 | 17.66/18.41 |
| 36 to 45 | 13.29/13.78 |

Uncovered families switch from all categories to MH hospitals; this is explained by the fact that uncovered families are poorer on average than their covered counterparts and because, in the absence of distance costs, MH health care services are the cheapest for these group of families.

Table 7.20: **Prenatal Care Choice by Coverage Status, Comparison between Baseline and Policy Predictions (Hospital Construction in Localities)**

| | Baseline/Policy | |
|---|---|---|
| **Care Provider** | **Covered** (%) | **Uncovered** (%) |
| IMSS | 56.24/59.90 | 31.19/30.95 |
| MH | 13.40/12.66 | 33.69/59.54 |
| Private | 23.12/27.44 | 26.10/9.51 |
| No care | 7.24/0.00 | 9.02/0.00 |

Given the important increase in prenatal care services' usage, the effect of this policy is positively higher than the former policy (Table 7.21). Again, covered families benefit the most with decreases in low birth weight births incidence and infant mortality rate. Under this policy, infant health indicators for covered families are even better than under the SPS (See Table 7.4). In the case of uncovered families, there is an important improvement regarding the incidence of low birth weight births, although the impact of the policy on infant mortality rate is very small. In general, the benefits from this hospital building policy are higher than those from the SPS,

although Mexico's rankings are the same as those under the SPS. The drawback from such a policy is that it may be more expensive for the government to build health care centers in each locality than the administration of the national SPS. A lesson to learn from this policy experiment is that distance to a health care center is an important factor in the decision of visiting a doctor during pregnancy and that the government may improve infant health by increasing the physical availability of health care services rather than just subsidizing them.

Table 7.21: **Pregnancy Outcomes Statistics, Comparison between Baseline and Policy Predictions (Hospital Construction in Localities)**

| | **Low Birth Weight (%)** | **Infant Mortality (%)** |
|---|---|---|
| All Sample: | | |
| Baseline (100%) | 6.41 | 3.87 |
| Policy (100%) | 5.29 | 3.74 |
| Covered: | | |
| Baseline (47.86%) | 5.63 | 3.47 |
| Policy (48.89%) | 4.45 | 3.25 |
| Uncovered: | | |
| Baseline (52.14%) | 7.14 | 4.23 |
| Policy (51.11%) | 6.08 | 4.21 |

# Chapter 8

# Conclusions

This dissertation studies the effect of prenatal care on two of the most important pregnancy outcomes, birth weight and infant mortality. The focus is on a developing country setting, Mexico, where a large proportion of the population has limited or no access to health care services due to the way in which the labor market and health care system are organized. In Mexico, as in most Latin-American countries, there is a large uncovered labor market sector, in which workers are not eligible for government health benefits.

The effect of prenatal care on pregnancy outcomes has been widely studied with mixed results.[114] Studies like Corman *et al.* (1987), Grossman and Joyce (1990), Rosenzweig and Wolpin (1991, 1995), and Joyce (1994, 1999) use fixed effects and instrumental variables methods to control for unobserved determinants of prenatal care decisions in the estimation of birth weight technology and infant death probability. However, knowledge of the technology alone is insufficient for conducting policy experiments that would likely modify the behavior of families in their choice of in-

[114] See Chapter 2.

puts. Another limitation of the existing literature is that most studies use data from developed countries where a high percentage of pregnant women receive some prenatal care,[115] so the findings are not necessarily generalizable to a developing country setting. In Mexico, the availability of medical services and the pricing of those services is closely tied to labor force sector participation and family income. Therefore, understanding how government policies affect prenatal care access and child health outcomes requires a fuller consideration of the determinants of labor supply, fertility and health care provider choices in a way that recognizes their interlinkages.

This dissertation contributes to the economics literature on pregnancy outcomes in these two dimensions. First, I develop a forward-looking dynamic behavioral model in which parents make decisions about labor sector participation of husband and wife, health insurance, fertility, and prenatal care with a focus on understanding the consequences of these decisions for pregnancy outcomes. The model incorporates a birth weight production function that specifies the relationship between health inputs and birth weight outcomes, as well as stochastic infant mortality. It allows for unobserved heterogeneity that may affect decisions to get prenatal care. Second, the model is estimated by simulated maximum likelihood using a longitudinal data set, the MxFLS.

I find that prenatal care has a positive and important effect on birth weight. The direct effect of prenatal care on birth weight, on average, amounts to 13%, approximately 379 grams (13 ounces). In particular, visiting IMSS hospitals increases birth weight by 13.5%; MH services increase birth weight by 8.5%; and, private prenatal care increases birth weight by 14%. Additionally, being born with normal birth

[115]See Racine *et al.* (1992) and World Health Organization (2005c).

weight,[116] as opposed to low birth weight, decreases the probability of dying within the first year of life from 37% to 5%.

Using the estimated model, I evaluate three types of policies that aim to facilitate the access to prenatal care for lower income families in Mexico. The main policy I evaluate is the Universal Access Health Insurance (SPS). This is a newly created health insurance that the Mexican government designed to extend the IMSS coverage to the whole population, regardless of the labor market sector they work. The simulations indicate that this policy, in its current shape, has a small impact on pregnancy outcomes due to a relatively high percentage of uncovered families switching from higher quality private prenatal care to medium-quality, subsidized by the SPS, IMSS prenatal care that counteracts the benefits from extending the IMSS services to those groups that were not using prenatal care or were visiting MH hospitals.

The second policy evaluated consists on several schemes of hypothetical health care vouchers programs in which low income families are given the choice of visiting different kinds of prenatal care in order to exchange them. Providing a voucher of $5,278 pesos, which is what the Mexican government expends per family in the SPS, has very small effect on pregnancy outcomes, even smaller than those observed under the SPS simulations. The impact of the vouchers program is sensitive to the voucher's value. Only when the voucher is worth $25,000 pesos or more, this program has a bigger impact on infant health than SPS.

Finally, the third policy I evaluate is the impact of building more hospital facilities, given that the estimates of the model suggest that the distance from the household

[116] 5 pounds 8 ounces or more.

to a health care center is a very important component of the total cost of seeking prenatal care services. Having a hospital in each locality or neighborhood improves infant health indicators better than the SPS. Under this policy, low birth weight incidence decreases from 6.77% to 5.68%, and infant mortality rate drops from 3.96% to 3.83%, with respect to the baseline simulations.

These results suggest that, when the government's main objective is to improve infant health through prenatal care services usage, it may not be enough to just subsidize them. The estimated prenatal care quality differences and the results from the hospitals construction policy simulations suggest that the government would improve infant health in higher magnitudes through government hospital's quality improvement and a higher physical availability of health care centers. This conclusion depends on the cost of such policies; it is possible that, given the available resources, the short-run most cost-efficient policy would actually be the SPS or some other kind of prenatal care services subsidies. Nevertheless, it still seems that a long-run policy for the improvement of health outcomes would be an increase in infrastructure.

It is necessary to point out that the results of the policy simulations in this work do not consider general equilibrium or other secondary effects that these policies may have when implemented. For instance, the policies analyzed in this work would not only have impact on the usage of prenatal care services but it would have income effects, and would also affect wage distributions and differentials across sectors due to the labor market sector switching they induce. Regarding medical services, it would be necessary to consider the effect that subsidizing some kind of prenatal care services would have in its quality, its price, or even the composition of the MNHS. The study and measure of these effects should be the subject of future investigations.

# Appendix A

# Model Notation

Table A.1: **Model Notation**

| Variable | Description |
|---|---|
| $a^0$ | Wife's marriage age (starting period) |
| $a_f^0$ | Husband's marriage age |
| $A$ | Wife's age 50 (terminal period) |
| $a$ | Wife's age |
| $a_f$ | Husband's age |
| $l$ | Indicator function for urban/rural household |
| $H$ | Wife's height |
| $E_m$ | Wife's years of education |
| $E_f$ | Husband's years of education |
| $n$ | Child's birth order |
| $N(a)$ | Total number of alive children at the end of period $a$ |
| $s_n(a)$ | Indicator function for child's gender |
| $h(a)$ | Indicator function for the wife staying at home |

Table A.1 **Model Notation (Continued)**

| Variable | Description |
|---|---|
| $e_i^c(a)$ | Indicator func. for parent $i$ working in a covered sector job |
| $e_i^u(a)$ | Indicator func. for parent $i$ working in an uncovered sector job |
| $d^c(a)$ | Indicator function for family's IMSS coverage |
| $d^o(a)$ | Indicator function for poor family |
| $p(a)$ | Indicator function for being pregnant |
| $x(a)$ | Time elapsed from the last birth to wife's age $a$ |
| $v_1(a)$ | Indicator function for prenatal care at IMSS hospital |
| $v_2(a)$ | Indicator function for prenatal care at MH hospital |
| $v_3(a)$ | Indicator function for prenatal care at private doctor |
| $v_4(a)$ | Indicator function for no prenatal care |
| $w_n(a)$ | Birth weight of child |
| $\varepsilon_n^w(a)$ | Birth weight shock |
| $\mu$ | Family-specific factor of unobserved heterogeneity |
| $r_n(a)$ | Indicator function for infant death |
| $\pi_n$ | Probability of infant death |
| $U(a)$ | Family's current period utility |
| $C(a)$ | Family's total consumption |
| $\varepsilon^p(a)$ | Preference shock to pregnancy |
| $\varepsilon^h(a)$ | Preference shock to staying at home |
| $y_i(a;\gamma)$ | Income for parent $i$ |
| $\gamma$ | Tax rate in covered sector jobs |
| $\varepsilon^{y_i^c}(a)$ | Covered sector job shock for parent $i$ |
| $\varepsilon^{y_i^u}(a)$ | Uncovered sector job shock for parent $i$ |

Table A.1 **Model Notation (Continued)**

| **Variable** | **Description** |
|---|---|
| $ds$ | Distance to health care center |
| $P_q$ | Price of prenatal care of type $q$ |
| $g(\varepsilon(a))$ | Joint distribution of stochastic shocks |
| $z(\mu)$ | Distribution function of unobserved heterogeneity |

# Appendix B

# Estimation

## B.1 Functions Specification

Utility function:

$$U(a) = \sum_{j=1}^{3} I_{(type=j)} \frac{1}{\theta_{1,j}} C(a)^{\theta_{1,j}} \left[1 + \theta_2 N(a) + \theta_3 h(a)\right] + \theta_4 N(a) + \theta_5 N(a)^2 + \theta_6 r_n(a) + \theta_7 w_n(a) + \theta_8 w_n(a)^2 + \theta_9 w_{n-1} + \theta_{10} I_{(a \leqq 25)} p(a) + \theta_{11} I_{(25 < a \leqq 35)} p(a) + \theta_{12} I_{(35 < a \leqq 40)} p(a) + \theta_{13} I_{(40 < a \leqq 50)} p(a) + \theta_{14} p(a-1) + \theta_{15}(e_f^c(a) + e_m^c(a)) + \theta_{16}(e_f^c(a) e_m^u(a)) + \theta_{17}(e_f^u(a) h(a)) + \theta_{18} h(a) + \theta_{19} d^c(a) v_3(a) + \theta_{20}(1 - d^c(a))(1 - v_4(a)) + p(a)\varepsilon^p(a) + h(a)\varepsilon^h(a).$$

Prices; there are 5 possible prices: IMSS services for covered families ($P_1^1$); IMSS services for uncovered families ($P_1^2$); MH (public) services for poor families ($P_2^1$); MH services for non-poor families ($P_2^2$); and, private services ($P_3$); given by:

$$P_q^i = \varrho_{1,q}^i + \varrho_2 I_{(ds=2)} + \varrho_3 I_{(ds=3)} + \varrho_4 l,$$

for $i = 1, 2$ and $q = 1, 2$; and:

$$P_3 = \varrho_{1,3} + \varrho_2 I_{(ds=2)} + \varrho_3 I_{(ds=3)} + \varrho_4 l.$$

Budget constraint:

$$\begin{aligned} C(a) + I_{(d^c(a)=1,d^o(a)=1)} \left[P_1^1 v_1(a) + P_2^1 v_2(a)\right] + \\ I_{(d^c(a)=1,d^o(a)=0)} \left[P_1^1 v_1(a) + P_2^2 v_2(a)\right] + \\ I_{(d^c(a)=0,d^o(a)=1)} \left[P_1^2 v_1(a) + P_2^1 v_2(a)\right] + \\ I_{(d^c(a)=0,d^o(a)=0)} \left[P_1^2 v_1(a) + P_2^2 v_2(a)\right] + \\ P_3 v_3(a) = y_f(a;\gamma) + y_m(a;\gamma). \end{aligned}$$

Birth weight production function:

$$\begin{aligned} \ln(w_n(a)) = \sum_{j=1}^{3} I_{(type=j)}\alpha_{1,j} + \alpha_2 s_n(a) + \alpha_3 a + \alpha_4 a^2 + \alpha_5 x(a) + \\ \alpha_6 E_f + \alpha_7 E_m + \alpha_8 H + \alpha_9 n + \alpha_{10} v_1(a) + \alpha_{11} v_2(a) + \\ \alpha_{12} v_3(a) + \varepsilon_n^w(a). \end{aligned}$$

Infant mortality probability:

$$\pi_n = \frac{\Lambda}{1+\Lambda},$$

where:

$$\Lambda = \exp\left(\sum_{j=1}^{3} I_{(type=j)}\lambda_{1,j} + \lambda_2 I_{(w_n(a)<2{,}500)}\right).$$

Husband with covered sector job earnings function:

$$\begin{aligned} \ln(y_f^c(a)) = \sum_{j=1}^{3} I_{(type=j)}\eta_{1,j} + \eta_2 a^f + \eta_3 (a^f)^2 + \eta_4 E_f + \eta_5 (E_f)^2 + \\ \eta_6 l + \varepsilon^{y_f^c}(a). \end{aligned}$$

Husband with uncovered sector job earnings function:

$$\begin{aligned} \ln(y_f^u(a)) = \sum_{j=1}^{3} I_{(type=j)}\vartheta_{1,j} + \vartheta_2 a^f + \vartheta_3 (a^f)^2 + \vartheta_4 E_f + \vartheta_5 (E_f)^2 + \\ \vartheta_6 l + \varepsilon^{y_f^u}(a). \end{aligned}$$

Wife with covered sector job earnings function:

$$\ln(y_m^c(a)) = \sum_{j=1}^{3} I_{(type=j)}\zeta_{1,j} + \zeta_2 a + \zeta_3 a^2 + \zeta_4 E_m + \zeta_5 (E_m)^2 + \zeta_6 l + \varepsilon^{y_m^c}(a).$$

Wife with uncovered sector job earnings function:

$$\ln(y_m^u(a)) = \sum_{j=1}^{3} I_{(type=j)}\nu_{1,j} + \nu_2 a + \nu_3 a^2 + \nu_4 E_m + \nu_5 (E_m)^2 + \nu_6 l + \varepsilon^{y_m^u}(a).$$

Type probability function:

$$P\left(type = j\right) = \frac{M_j}{\sum_{k=1}^{3} M_k},$$

for $j = 1, ...3$, where

$$M_j = \exp\left(\mu_{1,j} + \mu_{2,j} a^0 + \mu_{3,j} a_f^0 + \mu_{4,j} l + \mu_{5,j} I_{(ds=1)} + \mu_{6,j} E_m + \mu_{7,j} E_f + \mu_{8,j} H + \mu_{9,j} \underline{a} + \mu_{10,j} \underline{a}_f + \mu_{11,j} N(\underline{a})\right),$$

and $\underline{a}(\underline{a}_f)$ represents the wife's (husband's) age at which the family is observed for the first time in the survey.

## B.2 Estimated Parameters

Table B.1: **Utility Function**

| **Variable** | | **Parameter Estimate (s.e.)** |
|---|---|---|
| CRRA parameter: | | |
| Type 1 | $\theta_{1,1}$ | 0.847 |
| | | (0.003) |
| Type 2 | $\theta_{1,2}$ | 0.889 |
| | | (0.004) |
| Type 3 | $\theta_{1,3}$ | 0.878 |
| | | (0.002) |
| Consumption × Number of alive children | $\theta_2$ | 0.019 |
| | | (0.011) |
| Consumption × Wife stays at home | $\theta_3$ | 0.121 |
| | | (0.016) |
| Number of alive children | $\theta_4$ | 260.93 |
| | | (427.43) |
| Number of alive children squared | $\theta_5$ | -3.990 |
| | | (15.90) |
| Presence of infant death | $\theta_6$ | -190,203.34 |
| | | (33,300.16) |
| Birth weight | $\theta_7$ | 4.747 |
| | | (3.313) |
| Birth weight squared | $\theta_8$ | -0.0003 |
| | | (0.0006) |
| Low birth weight status of last child | $\theta_9$ | -25,864.79 |
| | | (5.121E+06) |
| Pregnancy at: | | |
| Age 12 to 25 | $\theta_{10}$ | -2,707.03 |
| | | (4,955.47) |
| Age 26 to 35 | $\theta_{11}$ | -113,866.70 |
| | | (4,694.43) |
| Age 36 to 40 | $\theta_{12}$ | -267,913.17 |
| | | (6,663.01) |
| Age 41 to 50 | $\theta_{13}$ | -40,001.49 |
| | | (54,547.84) |
| Child birth | $\theta_{14}$ | -243,610.23 |
| | | (4,350.48) |

Table B.1 **Utility Function (Continued)**

| **Variable** | | **Parameter Estimate (s.e.)** |
|---|---|---|
| Parents' covered sector, job status | $\theta_{15}$ | -6,600.42 |
| | | (367.91) |
| Husband covered job and wife uncovered job | $\theta_{16}$ | 1,613.92 |
| | | (426.94) |
| Husband uncovered job and wife stays at home | $\theta_{17}$ | 1,458.40 |
| | | (406.16) |
| Wife stays at home | $\theta_{18}$ | 1,825.09 |
| | | (490.44) |
| Private doctor visit for covered family | $\theta_{19}$ | 4,950.51 |
| | | (376.01) |
| Doctor visit for uncovered family | $\theta_{20}$ | -2,476.21 |
| | | (350.48) |

Table B.2: **Budget Constraint**

| **Variable** | | **Parameter Estimate (s.e.)** |
|---|---|---|
| Constant of IMSS services price, covered | $\varrho^1_{1,1}$ | -28,522.47 |
| | | (1,145.00) |
| Constant of IMSS services price, uncovered | $\varrho^2_{1,1}$ | -13,178.99 |
| | | (1,313.13) |
| Constant of MH services price, poor | $\varrho^1_{1,2}$ | -38,752.47 |
| | | (1,314.63) |
| Constant of MH services price, non-poor | $\varrho^2_{1,2}$ | -35,668.45 |
| | | (1,039.82) |
| Constant of private services price | $\varrho_{1,3}$ | -816.77 |
| | | (1,034.99) |
| Distance: | | |
| Municipality | $\varrho_2$ | 47,570.31 |
| | | (1,061.22) |
| State | $\varrho_3$ | 88,082.95 |
| | | (2,377.41) |
| Locality type (urban) | $\varrho_4$ | 41.97 |
| | | (615.26) |

Table B.3: **Log Birth Weight Production Function**

| **Variable** | | **Parameter Estimate (s.e.)** |
|---|---|---|
| Constant: | | |
| Type 1 | $\alpha_{1,1}$ | 6.051 |
| | | (0.006) |
| Type 2 | $\alpha_{1,2}$ | 6.039 |
| | | (0.019) |
| Type 3 | $\alpha_{1,3}$ | 6.148 |
| | | (0.012) |
| Child's gender | $\alpha_2$ | 0.093 |
| | | (0.004) |
| Mother's age | $\alpha_3$ | 0.029 |
| | | (0.000) |
| Mother's age squared | $\alpha_4$ | -0.0005 |
| | | (0.00001) |
| Periods elapsed since last pregnancy | $\alpha_5$ | -0.0004 |
| | | (0.0002) |
| Father's years of education | $\alpha_6$ | -0.021 |
| | | (0.0003) |
| Mother's years of education | $\alpha_7$ | 0.011 |
| | | (0.0004) |
| Mother's height | $\alpha_8$ | 0.010 |
| | | (0.00001) |
| Birth order | $\alpha_9$ | -0.015 |
| | | (0.001) |
| IMSS prenatal care services | $\alpha_{10}$ | 0.135 |
| | | (0.003) |
| MH prenatal care services | $\alpha_{11}$ | 0.085 |
| | | (0.003) |
| Private prenatal care services | $\alpha_{12}$ | 0.144 |
| | | (0.003) |

Table B.4: **Infant Mortality Probability**

| **Variable** | | **Parameter Estimate (s.e.)** |
|---|---|---|
| Constant: | | |
| Type 1 | $\lambda_{1,1}$ | -2.534 |
| | | (0.091) |
| Type 2 | $\lambda_{1,2}$ | -3.253 |
| | | (0.037) |
| Type 3 | $\lambda_{1,3}$ | -2.949 |
| | | (0.029) |
| Low birth weight status | $\lambda_2$ | 2.385 |
| | | (0.232) |

Table B.5: **Earnings Functions**

| **Variable** | | **Husbands** Parameter Estimate (s.e.) | | **Husbands** Parameter Estimate (s.e.) | | **Wives** Parameter Estimate (s.e.) | | **Wives** Parameter Estimate (s.e.) |
|---|---|---|---|---|---|---|---|---|
| Constant: | | | | | | | | |
| Type 1 | $\eta_{1,1}$ | 7.501 | $\vartheta_{1,1}$ | 9.723 | $\zeta_{1,1}$ | 4.938 | $\nu_{1,1}$ | 7.913 |
| | | (0.159) | | (0.132) | | (1.127) | | (0.325) |
| Type 2 | $\eta_{1,2}$ | 7.822 | $\vartheta_{1,2}$ | 9.396 | $\zeta_{1,2}$ | 5.966 | $\nu_{1,2}$ | 6.525 |
| | | (0.111) | | (0.108) | | (0.180) | | (0.200) |
| Type 3 | $\eta_{1,3}$ | 8.188 | $\vartheta_{1,3}$ | 9.026 | $\zeta_{1,3}$ | 6.593 | $\nu_{1,3}$ | 5.322 |
| | | (0.056) | | (0.071) | | (0.091) | | (0.269) |
| Age | $\eta_2$ | 0.073 | $\vartheta_2$ | 0.030 | $\zeta_2$ | 0.077 | $\nu_2$ | 0.074 |
| | | (0.012) | | (0.006) | | (0.066) | | (0.024) |
| Age squared | $\eta_3$ | -0.0009 | $\vartheta_3$ | -0.0005 | $\zeta_3$ | -0.0005 | $\nu_3$ | -0.0003 |
| | | (0.0002) | | (0.0001) | | (0.0010) | | (0.0004) |
| Years of education | $\eta_4$ | 0.124 | $\vartheta_4$ | 0.004 | $\zeta_4$ | 0.202 | $\nu_4$ | -0.047 |
| | | (0.033) | | (0.004) | | (0.054) | | (0.036) |
| Years of education squared | $\eta_5$ | -0.0006 | $\vartheta_5$ | -0.0004 | $\zeta_5$ | -0.0026 | $\nu_5$ | -0.0020 |
| | | (0.0014) | | (0.0004) | | (0.0031) | | (0.0017) |
| Locality type (urban) | $\eta_6$ | 0.315 | $\vartheta_6$ | 0.126 | $\zeta_6$ | 0.154 | $\nu_6$ | 0.166 |
| | | (0.102) | | (0.062) | | (0.370) | | (0.100) |

Table B.6: **Variance-Covariance Shocks' Matrix**

| **Variable** | | **Parameter Estimate (s.e.)** |
|---|---|---|
| Variance of birth weight shock | $\sigma_{1,1}$ | 0.012 |
| | | (0.00005) |
| Variance of husband's covered sector shock | $\sigma_{2,2}$ | 0.620 |
| | | (0.053) |
| Variance of husband's uncovered sector shock | $\sigma_{3,3}$ | 1.571 |
| | | (0.088) |
| Variance of wife's covered sector shock | $\sigma_{4,4}$ | 0.790 |
| | | (0.112) |
| Variance of wife's uncovered sector shock | $\sigma_{5,5}$ | 1.418 |
| | | (0.135) |
| Variance of wife's leisure shock | $\sigma_{6,6}$ | 177,360.00 |
| | | (314,801.91) |
| Variance of pregnancy shock | $\sigma_{7,7}$ | 8.982E+10 |
| | | (3.347E+09) |

Table B.7: **Types Probabilities**

| **Variable** | | **Type 1** Parameter Estimate (s.e.) | | **Type 2** Parameter Estimate (s.e.) | | **Type 3** Parameter Estimate (s.e.) |
|---|---|---|---|---|---|---|
| Constant | $\mu_{1,1}$ | 0.1062 | $\mu_{1,2}$ | 0.1077 | $\mu_{1,3}$ | 0.1072 |
| | | (200.14) | | (199.92) | | (199.93) |
| Wife's marriage age | $\mu_{2,1}$ | 0.0985 | $\mu_{2,2}$ | 0.1088 | $\mu_{2,3}$ | 0.1079 |
| | | (0.6001) | | (0.8828) | | (0.7493) |
| Husband's marriage age | $\mu_{3,1}$ | 0.1075 | $\mu_{3,2}$ | 0.1079 | $\mu_{3,3}$ | 0.1080 |
| | | (0.5264) | | (0.8262) | | (0.6790) |
| Urban locality | $\mu_{4,1}$ | 0.1077 | $\mu_{4,2}$ | 0.1097 | $\mu_{4,3}$ | 0.1058 |
| | | (46.97) | | (46.94) | | (46.96) |
| Distance neighborhood | $\mu_{5,1}$ | 0.1056 | $\mu_{5,2}$ | 0.1073 | $\mu_{5,3}$ | 0.0983 |
| | | (8.488) | | (8.443) | | (8.454) |
| Wife's years of education | $\mu_{6,1}$ | 0.1048 | $\mu_{6,2}$ | 0.1082 | $\mu_{6,3}$ | 0.0821 |
| | | (0.4666) | | (0.4635) | | (0.4578) |
| Husband's years of education | $\mu_{7,1}$ | 0.1100 | $\mu_{7,2}$ | 0.1079 | $\mu_{7,3}$ | 0.1075 |
| | | (0.3303) | | (0.3275) | | (0.3270) |
| Wife's height | $\mu_{8,1}$ | 0.1086 | $\mu_{8,2}$ | 0.1019 | $\mu_{8,3}$ | 0.1117 |
| | | (0.0101) | | (0.0098) | | (0.0082) |
| Wife's age in 1st year observed | $\mu_{9,1}$ | 0.1600 | $\mu_{9,2}$ | 0.1077 | $\mu_{9,3}$ | 0.1057 |
| | | (0.4385) | | (0.8002) | | (0.7010) |
| Husband's age in 1st year observed | $\mu_{10,1}$ | 0.1067 | $\mu_{10,2}$ | 0.1066 | $\mu_{10,3}$ | 0.1078 |
| | | (0.5039) | | (0.8011) | | (0.6413) |
| Number of alive children in 1st year observed | $\mu_{11,1}$ | 0.1070 | $\mu_{11,2}$ | 0.1051 | $\mu_{11,3}$ | 0.1060 |
| | | (3.0242) | | (3.0102) | | (3.0319) |

# Appendix C

# Universal Access Health Insurance Fees

Table C.1: **Universal Access Health Insurance Fees by Income Deciles (2002 Pesos)**

| Income Deciles | Income Range | Annual Fee |
|---|---|---|
| I | 7,232.00 – 20,680.00 | 260.00 |
| II | 20,684.00 – 28,616.00 | 380.00 |
| III | 28,620.00 – 37,184.00 | 640.00 |
| IV | 37,188.00 – 46,756.00 | 1,140.00 |
| V | 46,760.00 – 58,080.00 | 1,900.00 |
| VI | 58,084.00 – 72,140.00 | 2,400.00 |
| VII | 72,144.00 – 90,796.00 | 3,160.00 |
| VIII | 90,800.00 – 117,584.00 | 3,780.00 |
| IX | 117,588.00 – 178,756.00 | 5,040.00 |
| X | 310,372.00 – 411,420.00 | 6,300.00 |

Source: PEF (2003).

# Bibliography


Alexander, Greg and Carol Korenbrot (1995), "The Role of Prenatal Care in Preventing Low Birth Weight", *The Future of Children*, volume 5, no. 1.

Almond, Douglas, Kenneth Chay and David Lee (2005), "The Costs of Low Birth Weight", *The Quarterly Journal of Economics*, volume 120, no. 3, 1031–1083.

Arroyo, Cristino and Junsen Zhang (1997), "Dynamic Microeconomic Models of Fertility Choice: A Survey", *Journal of Population Economics*, volume 10, no. 1, 23–65.

Becker, Gary and H. Lewis (1973), "On the Interaction between Quantity and Quality of Children", *Journal of Political Economy*, volume 81, no. 2, S279–S288.

Behrman, Jere and Mark Rosenzweig (2004), "Returns to Birthweight", *The Review of Economics and Statistics*, volume 86, no. 2, 586–601.

Bellman, Richard (1957), Dynamic Programming, Princeton Univ. Press, Princeton, NJ.

Ben-Porath, Yoram (1976), "Fertility Response to Child Mortality: Micro Data from Israel", *Journal of Political Economy*, volume 84, no. 4, Part 2, S163–S178.

Bernal, Raquel (2003), Employment and Child Care Decisions of Mothers and the Well-Being of their Children, Ph.D. thesis, New York University, New York.

Black, Sandra, Paul Devereux and Kjell Salvanes (2005), "From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes", Working Paper, IZA.

Boardman, Jason, Daniel Powers, Yolanda Padilla and Robert Hummer (2002), "Low Birth Weight, Social Factors, and Developmental Outcomes Among Children in the United States", *Demography*, volume 39, no. 2, 353–368.

CDHCU (1998), "Ley del Trabajo", Mexico.

CDHCU (2004a), "Ley de los Institutos Nacionales de Salud", Mexico.

CDHCU (2004b), "Ley del Impuesto sobre la Renta", Mexico.

CDHCU (2004c), "Ley del Seguro Social", Mexico.

CDHCU (2004d), "Reglamento de la Ley General de Salud en Materia de Protección Social en Salud", Mexico.

CDHCU (2005a), "Ley de los Sistemas de Ahorro para el Retiro", Mexico.

CDHCU (2005b), "Ley del Instituto del Fondo Nacional de la Vivienda para los Trabajadores", Mexico.

CDHCU (2005c), "Ley General de Salud", Mexico.

CIA (2002), "The World Fact Book 2002", Technical report, CIA, Washington, D.C.

CIA (2003), "The World Fact Book 2003", Technical report, CIA, Washington, D.C.

CONAPO (2004), "Proyecciones de la Población de México 2000-2050", Technical report, CONAPO (Consejo Nacional de Población), Mexico, URL `www.conapo.gob.mx`.

Conley, Dalton and Neil Bennett (2000), "Is Biology Destiny? Birth Weight and Life Chances", *American Sociological Review*, volume 65, no. 3, 458–467.

Corman, Hope, Theodore Joyce and Michael Grossman (1987), "Birth Outcome Production Function in the United States", *The Journal of Human Resources*, volume 22, no. 3, 339–360.

Dabla-Norris, Era and Andrew Feltestein (2003), "An Analysis of the Underground Economy and its Macroeconomic Consequences", IMF Working Papers, IMF, Washington, D.C.

Dávila, Enrique and Maite Guijarro (2000), "Evolución y Reforma del Sistema de Salud en México", Technical report, CEPAL, Santiago de Chile, Chile.

Docteur, Elizabeth and Howard Oxley (2003), "Health-Care Systems: Lessons from the Reform Experience", OECD Health Working Papers, OECD, Paris, France.

Eckstein, Zvi and Kenneth Wolpin (1989), "Dynamic Labour Force Participation of Married Women and Endogenous Work Experience", *Review of Economic Studies*, volume 56, no. 3, 375–390.

Evans, William and Diana Lien (2005), "The Benefits of Prenatal Care: Evidence from the PAT Bus Strike", *Journal of Econometrics*, volume 125, no. 1-2, 207–239.

Francesconi, Marco (2002), "A Joint Dynamic Model of Fertility and Work of Married Women", *Journal of Labor Economics*, volume 20, no. 2, Part 1, 336–380.

Frankenberg, Elizabeth (1995), "The Effects of Access to Health Care on Infant Mortality in Indonesia", *Health Transition Review*, volume 5, no. 2, 143–162.

García-Verdú, Rodrigo (2004), "El Sector Informal de la Economía en México", Working Paper, Banco de México, Mexico City, Mexico.

Gayle, George-Levi and Robert Miller (2003), "Life-Cycle Fertility and Human Capital Accumulation", GSIA Working Papers, Carnegie Mellon University, Pittsburg.

Gould, Eric (2003), "Marriage and Career: The Dynamic Decisions of Young Men", Working Paper, Hebrew University and CEPR, Israel.

Grossman, Michael (1972), "On the Concept of Health Capital and the Demand for Health", *Journal of Political Economy*, volume 80, no. 2, 223–255.

Grossman, Michael and Theodore Joyce (1990), "Unobservables, Pregnancy Resolutions, and Birth Weight Production Functions in New York City", *Journal of Political Economy*, volume 98, no. 5, Part 1, 983–1007.

Hack, Maureen, Nancy Klein and Gerry Taylor (1995), "Long-Term Developmental Outcomes of Low Birth Weight Infants", *The Future of Children*, volume 5, no. 1.

Heckman, James (1981), "The Incidental Parameters Problem and the Problem of Initial Conditions in Estimating a Discrete Time-Discrete Data Stochastic Process", in Charles Manski and Daniel McFadden (Editors), Structural Analysis of Discrete Data with Econometric Applications, The MIT Press, Cambridge, MA, 179–197.

Heckman, James and Carmen Pagés (2004a), "Introduction", in James Heckman and Carmen Pagés (Editors), Law and Employment: Lessons from Latin America and the Caribbean, NBER Conference Report Series, University of Chicago Press, Chicago and London.

Heckman, James and Carmen Pagés (Editors) (2004b), Law and Employment: Lessons from Latin America and the Caribbean, NBER Conference Report Series, University of Chicago Press, Chicago and London.

Heckman, James and Guilherme Sedlacek (1985), "Heterogeneity, Aggregation, and Market Wage Functions: An Empirical Model of Self-Selection in the Labor Market", *Journal of Political Economy*, volume 93, no. 6, 1077–1125.

Heckman, James and Guilherme Sedlacek (1990), "Self-Selection and the Distribution of Hourly Wages", *Journal of Labor Economics*, volume 8, no. 1, Part 2, S329–S363.

Heckman, James and Burton Singer (1984), "A Method of Minimizing the Impact of Distributional Assumptions in Econometric Models for Duration Data", *Econometrica*, volume 52, no. 2, 271–320.

Hotz, Joseph and Robert Miller (1988), "An Empirical Analysis of Life Cycle Fertility and Female Labor Supply", *Econometrica*, volume 56, no. 1, 91–118.

INEGI (1998), "Documento Metodológico de la Encuesta Nacional de Empleo Urbano", Technical report, INEGI, Mexico.

Joyce, Theodore (1994), "Self-Selection, Prenatal Care, and Birthweight Among Blacks, Whites, and Hispanics in New York City", *The Journal of Human Resources*, volume 29, no. 3, 762–794.

Joyce, Theodore (1999), "Impact of Augmented Prenatal Care on Birth Outcomes of Medicaid Recipients in New York City", *Journal of Health Economics*, volume 18, no. 1, 31–67.

Keane, Michael and Kenneth Wolpin (1994), "The Solution and Estimation of Discrete Choice Dynamic Programming Models by Simulation and Interpolation: Monte Carlo Evidence", *The Review of Economics and Statistics*, volume 76, no. 4, 648–672.

Keane, Michael and Kenneth Wolpin (1997), "The Career Decisions of Young Men", *Journal of Political Economy*, volume 105, no. 3, 473–522.

Keane, Michael and Kenneth Wolpin (2001), "The Effect of Parental Transfers and Borrowing Constraints on Education Attainment", *International Economic Review*, volume 42, no. 4, 1051–1103.

Levenson, Alec and William Maloney (1998), "The Informal Sector, Firm Dynamics and Institutional Participation", World Bank Working Paper, World Bank, Washington, D.C.

Lewit, Eugene, Linda Baker, Hope Corman and Patricia Shiono (1995), "The Direct Cost of Low Birth Weight", *The Future of Children*, volume 5, no. 1, 35–56.

Maloney, William (2003), "Informality Revisited", World Bank Working Paper, World Bank, Washington, D.C.

Marrufo, Grecia (2001), Incidence of Social Security Regulation: Evidence from the Reform in Mexico, Ph.D. thesis, The University of Chicago, Chicago.

McFadden, Daniel (1989), "A Method of Simulated Moments for Estimation of Discrete Response Models without Numerical Integration", *Econometrica*, volume 57, no. 5, 995–1026.

Mincer, Jacob (1958), "Investment in Human Capital and Personal Income Distribution", *Journal of Political Economy*, volume 66, no. 4, 281–302.

Ministry of Health (2004), "Boletín de Información Estadística", Technical Report 22, Ministry of Health (Secretaría de Salud), Mexico.

Mira, Pedro (1995), Uncertain Child Mortality, Learning and Life Cycle Fertility, Ph.D. thesis, University of Minnesota, Twin Cities.

Navarro-Lozano, Salvador (2002), "The Importance of Being Formal: Testing for Segmentation in the Mexican Labor Market", Working paper, The University of Chicago, Chicago.

Nelder, J. and R. Mead (1965), "A Simplex Method for Function Minimization", *Computer Journal*, volume 7, 308–313.

Nigenda, Gustavo (2005), "El Seguro Popular de Salud en México, Desarrollo y Retos para el Futuro", Working Paper 2/2005, Inter-American Development Bank.

OECD (2005), "OECD Reviews of Health Systems: Mexico", Technical report, OECD, Paris, France.

Paneth, Nigel (1995), "The Problem of Low Birth Weight", *The Future of Children*, volume 5, no. 1, 19–34.

Peabody, John, Paul Gertler and Arleen Leibowitz (1998), "The Policy Implications of Better Structure and Process on Birth Outcomes in Jamaica", *Health Policy*, volume 43, no. 1, 1–13.

PEF (2003), "Diario Oficial de la Federación", July 4th, Mexico.

Pratap, Sangeeta and Erwan Quintin (forthcoming), "Are Labor Markets Segmented in Argentina? A Semi Parametric Approach", *European Economic Review*.

Racine, Andrew, Theodore Joyce and Michael Grossman (1992), "Effectiveness of Health Care Services for Pregnant Women and Infants", *U.S. Health Care for Children*, volume 2, no. 2, 43–57.

Rosenzweig, Mark and Paul Schultz (1983), "Estimating a Household Production Function: Heterogeneity, the Demand for Health Inputs, and Their Effects on Birth Weight", *Journal of Political Economy*, volume 91, no. 5, 723–746.

Rosenzweig, Mark and Kenneth Wolpin (1991), "Inequality at Birth: The Scope for Policy Intervention", *Journal of Econometrics*, volume 50, no. 1-2, 205–228.

Rosenzweig, Mark and Kenneth Wolpin (1995), "Sisters, Siblings, and Mothers: The Effect of Teen-Age Childbearing on Birth Outcomes in a Dynamic Family Context", *Econometrica*, volume 62, no. 2, 303–326.

Roy, A.D. (1951), "Some Thoughts on the Distribution of Earnings", *Oxford Economic Papers*, volume 3, no. 2, 135–146.

Schneider, Friedrich (2002), "Size and Measurement of the Informal Economy in 110 Countries around the World", Technical report, Johannes Kepler University of Linz, Linz-Auhof, Austria.

Shiono, Patricia and Richard Behrman (1995), "Low Birth Weight: Analysis and Recommendations", *The Future of Children*, volume 5, no. 1.

Shnaps, Reuven (2001), Estimating the Effect of Smoking on Birth Weight in a Dynamic Model when Fertility is a Choice, Ph.D. thesis, University of Pennsylvania, Philadelphia.

Stern, Steven (1997), "Simulation-Based Estimation", *Journal of Economic Literature*, volume 35, no. 4, 2006–2039.

Todd, Petra and Kenneth Wolpin (2003), "Using a Social Experiment to Validate a Dynamic Behavioral Model of Child Schooling and Fertility: Assessing the Impact of a School Subsidy Program in Mexico", PIER Working Papers Archive, University of Pennsylvania.

UNICEF (2005), "UNICEF Statistics: Monitoring the Situation of Children and Women", Technical report, UNICEF, New York, URL `www.childinfo.org`.

UNICEF and World Health Organization (2001), "Antenatal Care in Developing Countries: Promises, Achievements and Missed Opportunities", Technical report, UNICEF, New York.

UNICEF and World Health Organization (2004), "Low Birthweight: Country, Regional and Global Estimates", Technical report, UNICEF, New York.

Van der Klaauw, Wilbert (1996), "Female Labour Supply and Marital Status Decisions: A Life-Cycle Model", *Review of Economic Studies*, volume 63, no. 2, 199–235.

Willis, Robert and Sherwin Rosen (1979), "Education and Self-Selection", *Journal of Political Economy*, volume 87, no. 5, Part 2, S7–S36.

Wolpin, Kenneth (1984), "An Estimable Dynamic Stochastic Model of Fertility and Child Mortality", *Journal of Political Economy*, volume 92, no. 5, 852–874.

Wolpin, Kenneth (1997), "Determinants and Consequences of the Mortality and Health of Infants and Children", in Mark Rosenzweig and Oded Stark (Editors), Handbook of Population and Family Economics, Elsevier Science, volume 1A of *Handbooks in Economics*, 483–557.

World Bank (2004), "Universal Health Insurance Coverage in Mexico: In Search of Alternatives", Human and Social Development Group, Latin America and the Caribbean Region, Mexico, Colombia Country Management, World Bank, Washington, D.C.

World Health Organization (1950), "Public Health Aspect of Low Birthweight", WHO Technical Report Series 27, Expert Committee on Maternal and Child Health, Geneva, Switzerland.

World Health Organization (2005a), "Make Every Mother and Child Count. A Toolkit for Organizers of Activities", Technical report, WHO, Geneva, Switzerland.

World Health Organization (2005b), "World Health Organization Statistical Information System (WHOSIS)", Technical report, WHO, Geneva, Switzerland, URL `www3.who.int/whosis/menu.cfm`.

World Health Organization (2005c), "World Health Report 2005: Make Every Mother and Child Count", Technical report, WHO, Geneva, Switzerland.