

A Dynamic Structural Model of Contraceptive Use and Employment Sector Choice for Women in Indonesia

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Abstract

This research investigates the impact of the Indonesian Family Planning Program on the labor force participation decisions and contraceptive choices of women. I develop a discrete choice dynamic structural model, where each married woman in every period makes joint choices regarding the method of contraceptive used and the sector of employment in order to maximize their expected discounted life-time utility function. Each woman obtains utility from pecuniary sources, nonpecuniary sources, and choice-specific time shocks. In addition to the random shocks, there is uncertainty in the model as a woman can only imperfectly control her fertility.

Several forms of state and duration dependence capture dynamics in the model. Women in this model make different choices due to different preferences, differences in observable characteristics, and realization of uncertainties. The choices made by a woman depend on the compatibility between raising children and the sector of employment (including wages). While making decisions regarding contraceptive use, a woman considers the trade-off between costs (monetary and nonmonetary) of having a child and the benefits from having one.

The primary source of data for this study is the first wave of the Indonesia Family Life Survey (IFLS 1), a retrospective panel. In my research, I use the geographic expansion and the changing nature of the family planning program as sources of exogenous variation to identify the parameters of the structural model. I estimate the model using simulated maximum likelihood techniques with data from IFLS 1 for the periods 1979-1993. The structural nature of my model allows me to conduct policy experiments such as the consideration of how decreasing cost of contraceptives, reducing cost of child care for working mothers, and allowing flexibility in working hours for formal sector jobs affect choices made by women.

Keywords: Family planning, female labor force participation, contraception, formal sector, Indonesia

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1. Introduction

In the 1960s the average Indonesian woman had between five and six children; by the mid 1990s the average number of children had declined to close to three per woman. Figure 1 shows the decline in total fertility rate in Indonesia for the period 1965-2002 using Indonesian Demographic and Health Survey data. A large part of this reduction in the total fertility rate has been attributed to the extensive family planning program that was initiated in the late 1960s under the administration of President Suharto. Contraceptive use among married women increased from 5% in the late 1960s to approximately 55% in the mid 1990s. Figure 2 shows the trend in modern contraceptive prevalence rate among married women in Indonesia for the period 1977-2006.

While the family planning program reduced fertility rates and increased contraceptive use, there has been very little investigation of the program's impact on other aspects of a woman's life such as labor force participation. In my research, I use the geographic expansion and the changing nature of the family planning program as sources of exogenous variation to identify model parameters.

Indonesia experienced rapid economic growth from the 1970s until late 1990s. This broadened the employment opportunities available to Indonesian women. Table 1 lists labor force participation rates by gender in rural and urban areas of Indonesia for the periods 1971, 1980, and 1990. It can be seen that the rate of increase of female labor force participation is greater than male labor force participation in both urban and rural areas.

In Indonesia after 1970, illiteracy rates in population greater than 10 years old declined considerably due to the implementation of the Presidential Assistance Program for Elementary School in 1974 and the Six-Year Compulsory Education Program in 1984. Under the Presidential Assistance Program, there was large-scale provision of educational facilities by the government.¹ In addition, a massive literacy program was launched in Indonesia in 1984. This program advocated compulsory primary school education. This program encouraged both school attainment and enrollment. The primary school enrollment in Indonesia increased from 60 percent in 1971 to 92 percent in 1990 (Tjiptoherijanto 1997).²

It was during the same period that the large-scale family planning program was implemented in stages across Indonesia. Availability of contraceptives further broadened the choices available to the women in Indonesia. However, what remained unchanged in many developing countries is that women continue to hold the primary responsibility for taking care of children. The labor force participation decision of women in Indonesia, a developing country, cannot be correctly modeled as a simple yes

¹ The women in my sample (IFLS 1) may have benefited from this. I do not model educational attainment and enrollment.

² Women in my sample are too old to have benefited from this massive literacy program.

or no decision as done in standard labor force participation models. Large fractions of working women are employed in the informal sector of the economy. The informal sector comprises of small-scale production and service activities that are individually or family owned (Todaro 2000). Informal sector jobs, usually carried out at home or at close proximity to one's residence, are characterized by flexibility of hours, ability to choose the pace of work, and ease of entry and exit.³ Women may work in the informal sector due to the compatibility between work and family responsibilities, especially provision of childcare. Women face different costs of participation across sectors and as a result are not indifferent between where they work. It is reasonable to assume that women's motivation in controlling their fertility depends on the compatibility between raising children and the sector of employment. One can infer the degree of motivation women have in controlling their fertility based on the contraceptive method used.

One of the problems in studying joint choices is in determining the direction of causation. A woman may use contraceptives to delay or avoid birth in order to work in the formal sector. On the other hand, a woman may have used contraceptives and had fewer children; the small family size may then give her the flexibility to work in the formal sector. In particular, my research investigates how investments in family planning services affect the well-being of women by impacting their employment choices and child bearing decisions, while at the same time recognizing the interdependency of these interrelated life choices. I use the exogenous variation in the timing of introduction of different types of contraceptive clinics as instruments for fertility to identify the causal relationship between employment and contraception choices. In addition, I use the exogenous variation in minimum wage rates over time and across provinces as instruments for employment sector choice to further aid in identification.

Women in most societies provide critical economic support to their families by participating in the labor force, whether it may be the formal sector or informal sector. Fertility and health of the women are key determinants in women's ability to participate in the labor force, which in turn promotes the welfare of family. In addition, women continue to hold the primary responsibility for doing housework and for taking care of children. In a society where family structure is changing from extended to nuclear, women face a greater burden on the domestic front. In East Asian countries such as Indonesia, South Korea, Thailand, and Taiwan where there has been an increase in access to contraceptives, there has also been an increase in participation of women in formal sector. According to a report by United Nations Population Fund, access to contraceptives has allowed women to get more education and training, reap more economic benefits, and boost their self-esteem. Economic independence may provide women with a greater role in household decision making. This research looks at how access to family planning in Indonesia affects female labor force participation and contraception decisions, ultimately affecting their welfare levels. An added motivation

³ Informal sector jobs on average do not pay as much as formal sector jobs.

to undertake this research is that it can be fairly easily extended in studying behavior of women in other developing countries, conditional on data availability.

This research formulates and estimates a dynamic structural model in which employment sector and use of contraceptives are choice variables. I model the behavior of married women as a finite horizon, discrete choice dynamic programming problem.⁴ In each period, each woman chooses the contraception method and the employment sector to maximize her expected discounted life-time utility function. She obtains utility from pecuniary sources, nonpecuniary sources, and choice-specific time shocks. In addition to the random shocks, there is uncertainty in the model as women can only imperfectly control their fertility. Women in this model make different choices due to different preferences, differences in observable characteristics, and realization of uncertainties. Several forms of state and duration dependence capture dynamics in the model. The choices made by women depend on the compatibility between raising children and the sector of employment (including wages). While making decisions regarding contraceptive use, a woman considers the trade-off between costs (monetary and nonmonetary) of having a child and the benefits from having one. My model closely resembles Francesconi (2002) and Sylvester (2007) in its modeling approach, but differs from previous work by allowing both employment sector and contraceptive method choice in a dynamic structural context.

I study the impact of exposure to a family planning program on the following direct behavioral responses: changes in timing of first birth, spacing of births, and number of children. In addition, I examine the impact of the family planning program on labor force participation of women, which depends on both their past and the future ability to control fertility. Access to different methods of contraceptives provides the woman better control over her fertility and thus help in preventing unwanted births. This widens the employment choices that the woman faces. For instance, the impact of availability of modern contraceptives not only increases the probability that the woman participates in the labor force but also increases the likelihood that the woman gets employed in the formal sector of the economy. Availability of modern methods of contraception increases the wage rates that women can command, an effect I have endogenized in my model. Participation of women in the labor force and especially in the formal sector increases the income per capita at the household level.

I estimate the model using maximum likelihood techniques with data from the first wave of Indonesia Family Life Survey 1 (IFLS 1) for the period, 1979 to 1993. This survey is a retrospective panel⁵ containing data at both individual and family level on

⁴ I do not treat marital decisions as endogenous for two reasons: first, it increases the complexity of estimating the dynamic model; and second, I do not have an identification strategy to deal with it. Traditionally marriages in Indonesia are arranged by parents, with girls having very little choice in the selection of their spouse.

⁵ Indonesia Family Life Survey (IFLS) is an ongoing longitudinal study of individuals, households, communities, and facilities. There have been four waves with the fourth wave extending the panel up to 2008.

contraception, fertility, health, and labor force activities. In addition to the household surveys, IFLS 1 includes community surveys that can be linked to all households.

The structural nature of the model aids in understanding issues that are of interest to policy makers who are concerned about economic growth as it shows the relationship between availability of family planning and economic outcomes (labor force participation and wage rates). The model helps us understand how changes in the availability and prices of different methods of contraceptives affect the labor force participation decisions and wage rates of women. It also is useful in determining how the nature of employment and the associated wage rates affect contraceptive use decisions of women.

This paper is organized as follows: Section 2 provides a brief history of the Family Planning Program in Indonesia. Section 3 provides a brief literature review pertinent to this research. Section 4 provides a description of the economic model and theory that forms the basis of this research. Section 5 provides a description of the data used in the estimation. I also provide a detailed explanation of the different sources of exogenous variation used for identification of the model parameters. Section 6 describes the econometric model. Section 7 discusses estimation and identification. Section 8 discusses results of the structural model. Section 9 discusses policy experiments. The final Section provides conclusions for this research.

2. Family Planning Program in Indonesia

2.1 Family Planning Program in Indonesia

The establishment of Indonesian Planned Parenthood Association in 1957 introduced family planning by encouraging its use through sale of contraceptives. Supply of contraceptives was mostly restricted to urban areas in Java and Bali. During Sukarno's administration (1945-1967), there was no attempt to establish a family planning program at a national level in Indonesia. The approach towards family planning began to change in the late 1960s under President Suharto. When Suharto became president, the economic conditions were weak with per capita income at US \$50 and a 400% inflation rate (Lubis 2003). In 1969, Indonesia introduced its first five-year development plan. A policy premise was that in order to facilitate economic growth, population growth had to be curbed. In an attempt to reduce birth rates and increase contraceptive use, the Indonesian government introduced five-year family planning programs as part of the five-year development plans.⁶ The stated goal of the five-year plan was to reduce birth rates and improve the health and welfare of mother and child. To meet these goals the government established the National Family Planning Coordinating Board (BKKBN) in 1970. The BKKBN set up offices at the province and

⁶ A comprehensive summary of the family planning program is given in Lubis (2003).

district levels as the program spread over time across different parts of the country. Although, the goal of the family planning program was to increase contraceptive use, as the program spread it was integrated with nutrition and health related projects in villages to promote the well-being of families.

2.1.1 Geographic Expansion and Changing Nature of the Family Planning Program

The family planning program spread across Indonesia in three stages under three five-year development plans.⁷ In the first stage (1970-74), the program was introduced in the provinces of West Java, Jakarta, Central Java, East Java, Yogyakarta, and Bali.⁸ In the second stage (1975-79), the program was introduced in 10 other provinces belonging to the Outer Islands 1.⁹ In the third stage (1980-84), the family planning program was introduced in the Outer Islands 2, which constitutes the rest of the provinces in Indonesia.¹⁰ Figures 3 to 5 show the geographic expansion of the family planning program across Indonesia. Since the start of the family planning program, users have been obtaining contraceptives free of charge or at a subsidized rate. In 1989, the government launched the KB Mandiri (Self-Reliant Family Planning) in urban areas where contraceptives could be obtained from the private sector for a fee.

The family planning program initially followed a clinic-based approach. The family planning program under the clinic-based approach was implemented through the Community Health Centers (Puskemas) that were established at the sub-district level. In the early 1970s in Java and Bali, family-planning field workers, who earlier worked at the clinics, were shifted to the villages so that they would be able to reach a broader client base. Field workers were placed only in Java and Bali as these were the most densely populated areas and distance between villages was not too great. In the mid 1970s, the community-based approach was established to complement the clinic-based approach. The realization that the clinic-based approach failed to reach a large group of target women resulted in the adoption of a community-based approach of providing contraceptives (Shrestha 2007). This was done to encourage contraceptive use, increase family planning awareness, and to facilitate a system of supplying contraceptives at a village level. Moreover, this made it possible for the family planning workers to reach out to prospective clients as opposed to waiting for the clients to come

⁷ The primary sources of obtaining contraception in Indonesia include the following 1) Government Health Centers 2) Private practitioners such as doctors and midwives 3) Government and private hospitals 4) Village Integrated Health Posts 5) Family Planning Distribution Points 6) Pharmacies. In the period covered in this study Government Health Centers, Family Planning Distribution Points, and Village Integrated Health Posts are the primary source of contraceptives.

⁸ West Java, Jakarta, Central Java, East Java, and Yogyakarta are provinces that are located on the Island of Java.

⁹ These provinces include Aceh, North Sumatra, West Sumatra, South Sumatra, Lampung, North Sulawesi, South Sulawesi, South Kalimantan, West Kalimantan, and West Nusa Tenggara.

¹⁰ Outer Islands 2 include the following provinces: Riau, Jambi, Bengkulu, East Nusa Tenggara, Central Kalimantan, East Kalimantan, Central Sulawesi, South East Sulawesi, Maluku, Irian Jaya, and East Timor.

back to the clinic. A key idea in the community-based approach was to use the existing village institutions to promote the idea of family planning.¹¹ The community-based approach was further aided by the Family Welfare Movement and Family Planning Kaders, usually led by wives of government officials. In addition to encouraging people to use contraceptives, efforts needed to be made to ensure existing users did not discontinue use of contraceptives. This resulted in the development of the Family Planning Distribution Point (PKKBD) in 1975, managed by the Village Family Planning Management Assistant.¹² As stated in Lubis (2003), the PKKBDs are full-fledged community family planning posts. In addition, as the family planning program developed, community based groups became involved in encouraging contraceptive use and supplying contraceptives at the village level. In the late 1970s, the development plan focused on nutrition of children. This led to the establishment of nutrition posts at a village level, which weighed children and provided awareness related to their nutrition. The National Family Planning Coordinating Board (BKKBN) in the mid 1980s recognized the possibility of using these nutrition posts to promote family planning. This resulted in the established of Village Integrated Health Posts (Posyandu) that has become the central activity of the community-based approach of family planning. The family planning program that began with a clinic-based approach expanded to include a community-based approach to reach large groups of women that the clinic-based approach failed to reach. In this research, I use the variation in timing of introduction of Community Health Centers (Puskemas), Family Planning Distribution Point (PKKBD), and Village Integrated Health Posts (Posyandus) across Indonesia as instruments that aid in the identification of the model parameters.¹³

Table 2 shows the increase in the number of contraceptive users for the period 1973 to 1990 in the provinces of Java and Bali, Outer Islands 1, and Outer Islands 2.¹⁴ In 1973-74, the clinic-based approach of family planning program was introduced only in Java and Bali where there were 1.6 million users. In the second five-year plan, the number of contraceptive users in Outer Islands 1 was nearly 0.5 million and the number of contraceptive users in the provinces of Java and Bali increased to 5 million, where the family planning program had shifted to a community based approach. During the third five-year plan, family planning was introduced in Outer Islands 2 where the number of contraceptive users was 0.3 million. During 1983-84 and 1989-90, the number of contraceptive users increased substantially in all provinces.

2.1.2 Price of Contraceptives in Indonesia

¹¹ For instance, *banjar*, a traditional institution was used in Bali to promote family planning by training *banjar* heads. In Java, local officials were used to promote family planning as traditional institutions were not as strong as that in Bali.

¹² PKKBD is also referred to as Village Contraceptive Distribution Center (VCDC).

¹³ A detailed discussion of sources of exogenous variation is provided in Section 5.

¹⁴ Table 2 is quoted from Shrestha (2007). Source of this data is BKKBN (1992).

The current specification of the structural model allows the price of contraception method used to impact consumption levels, and in turn pecuniary utility.¹⁵ It is reasonable to assume that price of traditional methods of contraception do not have any monetary costs associated with it. However, modern methods of contraception do have a monetary cost associated to it, although not substantial.

In Indonesia, there have been changes over time in the contraception pricing policy. For much of the 1970s and 1980s contraceptives were available free of charge (Frankenberg 2003). Starting in the late 1980s, there has been two movements: First, the “Blue Circle” campaign that encouraged users to buy contraceptives from the private sector at a subsidized rate; Second, the “KB Mandiri” movement that was a movement for self-sufficiency that encouraged users to pay small fees for contraceptives that were still subsidized by the government (Frankenberg 2003).

2.1.3 Role of Family Planning Program in Indonesia

There is considerable debate on the contribution of the family planning program to reducing fertility rates. Arguments in support of it being the main cause is twofold: first, Indonesia had very low levels of economic development when the program was launched, yet there was dramatic reduction in fertility rates; and second, the family planning program was run efficiently with help from government officials at different levels, volunteers, and village organizations (Jones 2003). However, it needs to be mentioned that there were other phenomena happening at the same time such as rapid economic development, expansion of school system (discussed in Section 1), and greater employment opportunities for women that may have contributed towards reducing fertility (Jones 2003).

3. Literature Review

There have been several studies in the United States on the impact of birth control pills on fertility and other socio-economic outcomes of young women. Goldin and Katz (2002) look at how the availability of birth control pills in the late 1960s to young unmarried women in the United States affected age of marriage and the fraction of enrollment of college graduate women in professional programs. They exploit cross-state and cross-cohort variation in the timing of availability of the pill to young unmarried women caused by lowering the “age of majority” to 18 years in different states at different times. They find an increase in age at first marriage and an increase in enrollment in professional programs. Bailey (2006) investigates the impact of the availability of the pill on timing of first birth, participation in the labor force, and hours worked for women in the United States. Using an identification strategy similar to that

¹⁵ A discussion of the economic model is given in Section 4.

in Goldin and Katz (2002), she finds a significant reduction in the likelihood of birth before age 22, and an increase in both labor force participation, and hours of work.

Many researchers have investigated the impact of family planning programs in developing countries on fertility and socio-economic outcomes. However, the findings are subject to debate as many of these studies rely on timing and placement of family planning programs to provide identification. The debate regarding the validity of the results is rooted in the fact that placement of family planning programs may be linked to demand for children. The most persuasive evidence about the impact of family planning programs on fertility was from the experiment, Matlab, conducted in Bangladesh in 1978. A homogenous region of 70 square miles was selected in Bangladesh. One-half of the villages were randomly assigned to receive family planning services. Health workers visited every single married woman of reproductive age in the treatment area every two weeks, and offered them modern contraceptives for free. A significant reduction in completed fertility is found in women living in treatment relative to control villages (Joshi and Schultz 2007). However, such large-scale experiments encounter many practical difficulties. Miller (2005) investigates the impact of contraceptive supply provided by the family planning program, PROFAMILIA, Colombia on the timing of first birth, fertility, education, likelihood to work in the formal sector, and likelihood to cohabit. He uses the variation in the timing of introduction of the program across municipalities and over time for identification and argues that the program spread in a random fashion. He shows that availability of contraception allows women to postpone first birth, reduce fertility, increase schooling and participation in formal sector, and lower the likelihood of cohabitation.

Fertility choices have been examined in two broad categories of economic models: supply and demand models. The demand models explicitly model the quality and number of children as arguments in the utility function (Willis 1973). The supply models have utility from contraceptive methods as an argument of the utility function. Although the modeling approach may be different, both types of models are based on the idea that modern contraceptive techniques reduce the cost of preventing pregnancies. Contraceptive behavior has been separately studied in both static (Easterlin and Crimmins 1985) and dynamic (Newman 1985; Montgomery 1988; Carro and Mira 2002,) settings. Montgomery (1988) develops a dynamic structural model of contraceptive choice which allows him to accommodate the dynamic nature of fertility choices over one's life time and also allows the birth process to be stochastic. Carro and Mira (2002) also develop a dynamic model of imperfect fertility control.

The increase in female labor force participation in the United States over the last several decades has resulted in a number of studies that investigate women's decisions to work. Female labor force participation is often treated as a dichotomous choice: to work or not to work. As this literature expanded, several studies have looked at female labor force participation in developing countries, where a considerable fraction of the labor force is engaged in the informal sector of the economy. The informal sector

provides a flexible working environment for women, who are able to simultaneously work and provide care to their children. Economists have recognized the importance of the informal sector for almost 50 years. Jaffe and Azumi (1960) observe that women working in cottage industries in Japan and Puerto Rico had more children than women who worked in the formal sector. They attribute this difference in number of children to compatibility between work and household responsibilities. Hill (1983), using data from Japan, allows a trichotomous labor force participation model where women can work in the formal sector, informal sector, or not work. Hill finds that women do not treat decisions to participate in the formal and informal sector identically. The two sectors differ in terms of wage offers, flexibility of hours, and fixed costs as a result of child care and transportation cost. Tiefenthaler (1994), using data from Cebu, Philippines, extends Hill's model by classifying labor force participation into four categories: formal sector, informal sector, not working, and piece sector.¹⁶ She finds that women with young children and greater number of children are more likely to work in the informal sector compared to the formal sector and piece sector.

The models in the fertility and employment literature differ in several ways: whether labor force participation decision is binary, whether there is uncertainty in birth, whether hours of work are modeled, whether wages are endogenous, whether the model is static or dynamic, whether the model is structural or nonstructural, and whether other interrelated life choices are modeled. Many researchers have investigated the joint nature of labor supply and fertility decisions in both a static (Fleisher and Rhodes 1979; Rosenzweig and Schultz 1985; Cain and Dooley 1976) and a dynamic framework (Moffitt 1984; Hotz and Miller 1988; Francesconi 2002). Rosenzweig and Schultz (1985) develop a theoretical model of dynamic optimization, where agents make fertility and labor supply decisions in each period. However, in their empirical Section, they estimate the reproduction technology without accounting for dynamics. Like my model, their model allows for uncertainty in birth and unobserved fecundity. They do not consider different methods of contraception and employment sectors or endogenous wages. Hotz and Miller (1988) consider a dynamic model of contraceptive choice and female labor supply. They model participation and hours of work and allow for imperfect control over birth. They neither allow for different methods of contraception (due to data limitations), nor consider choices of employment sector. Francesconi (2002) estimates a dynamic model of fertility and labor supply choices of married women. He makes a distinction between part and full-time work by allowing the employment options to have different pecuniary and nonpecuniary returns. He also assumes that a woman has perfect control over births. In each period, she chooses whether or not to have a child as well as whether to work part time, full time, or not work at all. Work experience is endogenous, and this, in turn impacts sector-specific human capital accumulation. The forward-looking model allows this sector-specific experience to impact future wages, which affects the cost of having a child. My model is

¹⁶ Piece sector consists of women who make handicrafts at home on contract.

developed in a framework similar to that of Francesconi (2002). Contraceptive use and labor force participation have also been studied in dynamic models, where other related life choices such as marriage and education are also modeled (Sylvester 2007). Sylvester (2007) allows for uncertainty in birth but does not model contraceptive methods or employment sectors.

My research contributes to the literature on female labor supply and contraceptive choice in several ways. First, I model the behavior of women in a developing country. A large fraction of women in developing countries are employed in the informal sector of the economy. A distinction is made between formal and informal sectors of employment in terms of both pecuniary and nonpecuniary returns. To make the model realistic, I allow the choice of employment sector. Second, I combine choices of contraceptive methods with choices of employment sector. I allow the joint choice of contraception and employment sector in order to understand the compatibility between family responsibility and employment sector. Third, the wage rate is endogenous in the model. Fourth, the model allows for control over fertility in every period by allowing the women to choose from different methods of contraception; however, the control is imperfect because there is uncertainty introduced in the birth function. Fifth, the model allows for unobserved time invariant preference heterogeneity, unobserved ability level, and unobserved natural fecundity level. Finally, my model combines features of the supply and demand models by allowing the woman to obtain utility from the interaction of the number of children and the method of contraceptive used.

4. Economic Model

In this Section, I present the dynamic structural model that will be estimated in this paper. First, I present the choice set that a married woman faces each period. Second, I discuss the utility function that a woman maximizes each period and also present the budget constraint. Third, I discuss the birth probability function. Fourth, I discuss state space and value function. Finally, I discuss issues relevant to this model such as migration and role of men in the decision making process.

4.1 Choice Set

I consider a finite horizon problem in which married women in each period make discrete choices regarding contraceptive methods and sector of employment to maximize their expected discounted life-time utility function.¹⁷ Women in this model choose one out of three contraceptive choices, denoted m_t in each period t . The choices are a modern method ($m=1$), a traditional method ($m=2$), and no contraception ($m=3$).

¹⁷ Sample selection bias is not much of an issue in the Indonesian context as most marriages are arranged by parents when their daughters are young. The proportion of women who remain single at any given age is lower in Indonesia compared to its neighboring countries. To get an idea, in 1990, less than 5% of women aged 30-34 were single in Indonesia, compared to 13.4% in Philippines and 14.1% in Thailand (Jones 2002). In 1990, the median age of marriage for women in Indonesia was 20.9 years.

Modern methods include implant, IUD, pills, injection, and condoms. Traditional methods include rhythm, withdrawal, traditional herbs, and any other method that does not require a visit to the family planning clinic. Classification into modern and traditional methods is based on two criteria: first, effectiveness of the methods in preventing pregnancies; and, second, only access to modern methods requires presence of a family planning program. Although I aggregate several methods as modern and others as traditional, rate of failure of the different methods under each category varies. Table 3 lists the contraceptive failure rate for each method using the 1995 National Survey of Family Growth in the United States as estimated in Trussell and Vaughan (1999). The contraceptive failure rate is the proportion of women who experience unintended pregnancy while using the contraceptive for one year. Note that the failure rates for all modern methods are significantly lower than traditional methods. I have created the categories for contraceptive method to capture the motivation women have in controlling their fertility. It can be assumed that women who have a greater motivation to control fertility use modern methods. It can also be hypothesized that women use modern methods in order to work in the formal sector.

Aggregating various methods of contraception into modern and traditional categories has its own benefits and costs. The main advantage from aggregation is the reduction in the size of the choice set, and subsequently reduction in the computational burden. However, this model does not pick up differences in preferences that a woman may have for methods grouped into either category. Another cost of aggregation is that the three clinic types I consider as sources of exogenous variation in contraception provision are not identical in the types of modern methods of contraception that they provide.¹⁸ To the extent that a woman chooses not to use contraception because the clinic type present in her area does not offer her preferred method of contraception within the modern method category, the impact of clinic presence on contraception choice of the woman will not be captured correctly.¹⁹ To the degree that all modern methods affect a woman's choice in the same way, aggregate promotes statistical efficiency. If not, aggregation results in model misspecification.

Abortion is a common form of 'contraception' in Indonesia. Like in many developing countries stigma is attached to abortion.²⁰ Since abortion is illegal in most circumstances it is very hard to collect accurate information on its incidence. Women in

¹⁸ Sources of exogenous variation are discussed in Chapter 5.

¹⁹ In the community-based sources of family planning usually oral contraceptives and condoms are available. Injections and other methods are offered only if trained health workers are present. However, in clinic-based sources of family planning all modern methods are offered. (Frankenberg et al 2003).

²⁰ A restrictive view on abortion was enacted under the Dutch colonial government according to which abortion would lead to imprisonment of both the woman and other persons who may be involved such as doctors, midwives, and pharmacists. This code did not allow for any exception to abortions, although by the mid 1970s an informal understanding was reached that "those abortions could be performed to preserve a woman's life or health". In 1992 a new health law was passed that suggested that abortions could be performed to save the life of the woman.

IFLS 1 are not asked questions about abortion; as a result I do not model abortion in this research.

Let k_t denote sector of employment chosen in period t . The choice of sector in this study is limited to the formal sector ($k=1$), the informal sector ($k=2$), and not working ($k=3$). It is assumed in the model that in every period a woman receives job offers from both sectors and gets to choose from the various alternatives. A more realistic approach would be to allow for uncertainty in job offers each period. The identification of the parameters of the job offer function would come from the functional form assumption of the arrival rate function. Formal sector workers include government employees, private workers, and individuals who are self-employed with permanent workers. Informal sector workers include self-employed workers, self-employed individuals with temporary workers, and family workers.

I have classified the sectors into formal and informal based on the compatibility between job and family responsibility. Informal sector jobs may provide an environment for taking care of children even while at work. An example would be a woman who sells food that she cooks at home and watches her children while at work. The amount of childcare responsibility that a woman has depends to a large extent on the age of the youngest child and the number of children. Informal sector jobs usually involve working from the house or jobs where one can take one's child to work. Informal sector jobs have flexibility of hours and easy entry and exit. Formal sector jobs are characterized by working away from home, fixed hours, better pay, and more benefits. One would expect that expansion of the family planning program will increase contraceptive use, and therefore, encourage employment in general and formal sector employment in particular. Switching jobs between sectors is not unusual in Indonesia where even formal sector jobs require few skills. For instance, a decline in wages in the formal sector may cause women to move to the informal sector.

I assume that the timing of marriage is exogenous. Each woman has a decision-making horizon that starts at age A_0 , when she gets married and continues until period T^* . In this research, I model choices that women make from the time of their first marriage. I do not explicitly model divorce, separation, and multiple marriages. Change in marital status might cause changes in both employment and contraception decisions. For instance, a married woman is more likely than a divorced woman to use contraception, given higher incidence of sexual activity. Similarly, a divorced woman with children might be more likely to participate in the labor force compared to a married woman. One has to keep in mind that I do not model multiple marriage and divorces when looking at the structural estimates. I assume that a woman lives until

period T^F , $T^F > T^*$.²¹ In every period, a woman faces 9 mutually exclusive alternatives; denote $d_{kmt} = 1$ if she chooses sector k and contraceptive method m in period t .²²

4.2 Utility Function and Budget Constraint

At each time t women derive nonpecuniary utility q_t and ξ_{kmt} , the latter representing a choice-specific random shock, and pecuniary utility from consumption of composite commodity c_t . Nonpecuniary utility includes utility from number of births, age of the youngest child, state dependence, duration in a particular state, unobserved preference heterogeneity, and utility from the interactions between exogenous characteristics with the choices made. Let n_t be a dichotomous variable that takes the value one if the woman gives birth in period t . Let N_t denote the total number of births for a woman, such that

$$N_t = N_{t-1} + n_t. \quad (4.1)$$

I do not model child deaths for two reasons. First, average annual neonatal mortality and post-neonatal mortality rates for the years 1982 to 1997 are 2.6% and 3.4%, respectively (Demographic Household Survey of Indonesia 1997). Indonesia has lower infant mortality rates than do countries like India, Bangladesh, Nigeria, and Pakistan.²³ Second, it increases the complexity of the estimation process significantly, as I would have to account for possibility of child death in the future when women maximize their expected life-time utility. In addition, keeping track of future feasible points in the state space when evaluating value functions becomes complex. Note that not modeling child death implies that number of children a woman has is the same as number of births. Let r_t denote the age of the youngest child.²⁴ It evolves according to

$$r_t = \begin{cases} r_{t-1} + 1 & \text{if } n_t = 0 \\ 0 & \text{if } n_t = 1 \end{cases} \quad (4.2)$$

I allow interactions of the age of youngest child with sector of employment. If working in the informal sector, this may capture the disutility a woman experiences from taking her child to work. It is reasonable to assume that women obtain utility from spacing of births. Several demography studies show that spacing births improve both mother's

²¹ All women are assumed to be fecund only until T^* . I have ignored sterilization, as this is not a very popular form of birth control in Indonesia, predominantly a Muslim country.

²² This assumes that a woman cannot have one job in the formal sector and work at a second job in the informal sector in the same period.

²³ According to UN Population Division 2004 estimates, for the period 1985-1990 the infant mortality rate in Indonesia was 69.8 per thousand live births. For the same period the infant mortality rate per thousand live births was 94.4 in India, 121.3 in Nigeria, 98.5 in Pakistan, and 104.2 in Bangladesh.

²⁴ I keep track of only age of the youngest child. Keeping track of ages of all children would increase the size of the state space and therefore cost of estimation.

and infant's health.²⁵ Let b_t represent the number of periods before which the previous birth occurred.

Women also obtain utility from state dependence.²⁶ If a woman was not working in one period but works in the formal sector in the next, her choice in the previous period must be included in the utility function, as it may capture nonmonetary costs of finding a job. Similarly, the method of contraception used in the previous period must be included in the utility function as it may capture the inconvenience of moving to a different method.²⁷

Yet another source of nonpecuniary utility is the duration for which an individual worked in a particular sector or used a certain method of contraception. Let O_{t-1}^k denote the total number of periods that an individual worked in sector k until time t . These evolve according to

$$O_t^k = O_{t-1}^k + o_t^k \quad (4.3)$$

where o_t^k is a dichotomous variable equal to one if the person was employed in sector k in period t and equal to zero otherwise. The duration term may pick up nonpecuniary benefits of being in the same sector as a result of sector-specific human capital accumulation. Let $\bar{o}_t = (o_t^1, o_t^2, o_t^3)$ and $\bar{o}_{t-1} = (o_{t-1}^1, o_{t-1}^2, o_{t-1}^3)$ denote the vectors that

represent choice of employment sector in period t and $t-1$, respectively. Similarly, the duration term for using a particular method of contraceptive may capture the ease of using a particular method. It is reasonable to assume that, the longer an individual uses a particular method, she may learn to use it more efficiently. Let M_{t-1}^m denote the total number of periods the individual used contraceptive method m until time t . These evolve according to

$$M_t^m = M_{t-1}^m + m_t^m \quad (4.4)$$

where m_t^m is a dichotomous variable equal to one if the person used contraceptive method m in period t . Let $\bar{m}_t = (m_t^1, m_t^2, m_t^3)$ and $\bar{m}_{t-1} = (m_{t-1}^1, m_{t-1}^2, m_{t-1}^3)$ denote the vectors

that represent choice of employment sector in period t and $t-1$, respectively. Let $D_{t-1} = [O_{t-1}^1, O_{t-1}^2, O_{t-1}^3, M_{t-1}^1, M_{t-1}^2, M_{t-1}^3]$ denote the vector that represents the duration components.

Nonpecuniary utility is also a function of unobserved preference heterogeneity for employment sector and contraceptive method that varies across individual but is

²⁵ Several studies sponsored by United States Agency for International Development (USAID) using Demographic and Health Survey (DHS) data show that spacing improves maternal and child health. In addition, birth spacing also reduces the incidence of child mortality (Miller et. al 1992; Forste 1994).

²⁶ I allow state dependence to enter the utility function explicitly in this Section. However, in the estimation it enters via the duration dependence term.

²⁷ I assume that there is no inconvenience in choosing a different method within modern methods or within traditional methods.

constant over time. Let it be represented by $\mu_q^i = \{\mu_o^i, \mu_m^i\}$. These permanent unobserved heterogeneity terms help in explaining why some women never work or why some women do not use contraceptives.

Nonpecuniary utility is also a function of observable exogenous characteristics such as religion of woman, urban or rural location, province in which the women resides, her education level, and the age of the woman.²⁸ Let this be denoted by vector \mathbf{X}_t . I allow for interaction of observable exogenous characteristics of a woman with choices she makes.

In reality, the labor force participation decision of women also depends on the number of individuals living in the household and their distribution by sex and age. For instance, the presence of other women in the household might make it easier for a woman to work outside the house. On the other hand, the presence of adult men and children may increase the likelihood of her being a stay at home mother. However, I do not model this feature as it causes a significant increase in the cost of estimation.²⁹

Women obtain pecuniary utility from the consumption of a composite commodity, c_t . A woman has income from the following sources: wages w_t^k if employed in the formal or informal sector, husband's income w_t^h , and combined unearned income of husband and wife Y_t .³⁰ The wage of the husband is observed in the data. Expenditures include purchase of a composite commodity with price equal to one, expenses P_m associated with contraceptive use, and expenses P_n related to bringing up children, multiplied by the total number of children. I assume that the private consumption enjoyed by a woman is a certain fraction of the difference between the family pooled income and expenditure on contraception and children. I allow this fraction, the sharing rule parameter ψ , to be 0.5.³¹

The maximization problem in each period is subject to the budget constraint

$$c_t = \psi^* [w_t^k + w_t^h + Y_t - P_m m_t^m - P_n N_t] \quad (4.5)$$

Wage earnings of women in this model are endogenous and stochastic. The formal and informal sectors have different wage structures. There are several reasons why they differ. The formal sector is subject to minimum wage laws.³² The classic

²⁸ I allow for only two province classifications: Java and Non-Java. However, 13 Indonesian provinces are covered in IFLS 1.

²⁹ Gallaway (2001) allows the labor force participation decision of women to depend on the age and sex of other household members in a nonstructural framework (Multinomial Logit model).

³⁰ Non-wage earnings are observed if the woman is in the informal sector.

³¹ Assigning the sharing rule parameter to be 0.5 is arbitrary. Several studies show mothers, on average, care more about children than fathers (Schultz 1990; Thomas, Contreras, Frankenberg 2002). These studies are based on the idea that increasing mother's bargaining power results in better outcome for children. An alternative would be to make the sharing rule parameter a function of exogenous characteristics. However, the identification of the sharing rule requires data on assignment of a private good to one of the spouses (Browning et. al 1994).

³² Minimum wage laws vary across provinces, and, in some provinces, they vary across districts as well.

model of a dual economy predicts that the wage differential between the sectors will not be eroded by the mobility of labor to the formal sector. There might be compensating wage differentials if flexibility in terms of hours of work, ability to take care of kids while at work, and ease of entry and exit into the job is substitutable for wages. However, there may be poor working conditions or lack of pension and health insurance benefits that work against this compensating differential.

The wage equation is a function of schooling G , age, local labor market conditions X_t^L represented by the minimum wage rate at the province level, experience in the formal sector O_{t-1}^1 , experience in the informal sector O_{t-1}^2 , and a random wage shock ε_t^k . Let $\varepsilon_t = \{\varepsilon_t^1, \varepsilon_t^2\}$ be the vector of wage errors. Schooling is a binary variable where the 2 categories are : primary or less than primary school education and greater than primary school education. The wage also depends on μ_w^i , which is the unobserved ability to work. This varies across individuals but is constant over time. The wage for a nonworking woman is assumed to be zero, and the wage structure for $k = \{1, 2\}$ is

$$w_t^k = w^k(G, t, X_t^L, O_{t-1}^1, O_{t-1}^2, \varepsilon_t^k, \mu_w^i). \quad (4.6)$$

In this paper I do not model market determination of wage rates. I look at wage rates in a partial equilibrium framework. In Indonesia, like in many developing countries, there is a huge variation in how wage rates are determined across sectors. In the informal sector wage rates may be determined on an individual basis, while in the formal sector, say in a government job, wage rates determination will be more structured.

The objective of each woman is to maximize her expected discounted life time utility function

$$E\left[\sum_{t=A_0}^{T^F} \beta^{t-A_0} U(\bar{o}_t, \bar{o}_{t-1}, \bar{m}_t, \bar{m}_{t-1}, n_t, D_{t-1}, r_t, X_t, c_t, N_t, b_t, \mu_q^i)\right] \quad (4.7)$$

where E is the expectation operator, β is the discount factor, and X_t is the vector of observable characteristics. The utility function of the woman in a particular period t when she chooses d_{kmt} is

$$U(d_{kmt}) = c_t + q(\bar{o}_t, \bar{o}_{t-1}, \bar{m}_t, \bar{m}_{t-1}, n_t, D_{t-1}, r_t, X_t, N_t, b_t, \mu_q^i) + \xi_{kmt} \quad (4.8)$$

where $q(\cdot)$ is the nonpecuniary utility function and ξ_{kmt} is the choice-specific time shock to utility. Let ξ_t denote the vector of choice-specific shocks in period t .

4.3 Birth Probability Function

I introduce another source of uncertainty in this model through the birth function. The probability that a birth will occur in period $t+1$ when contraceptive method m_t^m is used in period t is

$$F_{m,t+1} = \Phi(t, m_t^m, M_t^m, \mu_f^i) \quad (4.9)$$

where Φ is the normal distribution function. The probability of birth depends on the age of the woman, the method of contraception used, the duration for which the method was used, and the unobserved natural fecundity level μ_f^i .

I assume that capital markets are perfect and consumption is separable. These assumptions together reduce the above problem to one of wealth maximization, but with psychic value from nonpecuniary components of the utility function (Eckstein and Wolpin 1989).³³

4.4 State Space and Value Function

The utility maximization problem can be expressed using value functions. The decision at a particular point t depends on the contraceptive choice, employment, and birth history of the woman until that point. The state at t is

$$S(t) = (\bar{o}_{t-1}, \bar{m}_{t-1}, D_{t-1}, r_{t-1}, N_{t-1}, b_t, t, \xi_t, \varepsilon_t). \quad (4.10)$$

The value function of a given choice provides the woman's lifetime discounted value of that particular choice. The value function of a woman at time t , given state $S(t)$ and unobserved heterogeneity $\mu_i = \{ \mu_o^i, \mu_m^i, \mu_f^i, \mu_w^i \}$ is

$$V_t = \max[V_{1,1,t}(S(t), \mu_i), \dots, V_{3,3,t}(S(t), \mu_i)] \text{ where} \quad (4.11)$$

$$V_{k,m,t}(S(t), \mu_i) = U_{kmt}(S(t), \mu_i) + \beta EV_{t+1}(S(t+1), \mu_i | S(t), d_{kmt} = 1) \text{ for } A_0 \leq t < T^* \quad (4.12)$$

$$V_{k,m,T} = \sum_{t'=T^*}^{T^F} \beta^{t'-T^*} U_{kmt'}(S(t'), \mu_i) \text{ for } T^* \leq t' \leq T^F \quad (4.13)$$

In the above equations, $V_{k,m,t}$ denotes the alternative-specific value function associated with sector k and method m in period t . Expectations are taken with respect to the future choice-specific random shock to utility, future wage offer shocks, and uncertainty in births. The unobserved heterogeneity is known to the woman, but unknown to the econometrician.

4.5 Other Issues

Two more issues (unrelated to each other) require some discussion to make the model set up complete. First, I discuss how I deal with migration of women in this paper; and second, I discuss the role that men play in making decisions regarding contraception and employment.

4.5.1 Migration

Most migration in Indonesia is based on individual choices. However, some of the migration was as a result of the government's Transmigration Program where incentives such as land, food, fertilizers were offered by the government to families

³³ Savings behavior is not modeled as it comes at the cost of expanding the choice set and the state space.

relocating from over populated islands such as Java and Bali to less populous ones. The objective of this program was to reduce poverty in overpopulated areas.

Non-random selection involved in migration causes problems for economic analysis. It is important to keep track of migration of women across the different regions as I use the variation across Enumeration Areas in availability of contraceptives for identification. If a woman moves from an Enumeration Area that does not have family planning clinics to one that has clinics for the purposes of obtaining contraception, then the impact of clinics on reducing fertility will be overstated. However, in my analysis, I do not model migration of women across Enumeration Areas. Controlling for migration will not reduce bias unless migration is exogenous. The drawback of this approach is that a woman may no longer continue to reside in the Enumeration Area she is assigned. If a woman actually lives in an Enumeration Area that does not have access to family planning clinics, but is assumed to live in an area that does have access to clinics, then the impact of clinics in reducing fertility may be biased downward. In my analysis I assume that a woman continues to live in the Enumeration Area that she lived in during 1993 as part of IFLS wave I.³⁴ Incorporating location of women each period taking into account migration as part of state space will increase the complexity of the estimation.

4.5.2 Women as Decision-Makers

A glance at the model might make one think that the husband's preference regarding the wife's labor force participation decision and contraceptive choice has not been considered. This, in other words, is the fundamental problem of the unitary household model where a single utility function reconciles the preference of several individuals in the household. In my model, I have allowed the woman to maximize her utility function subject to her budget constraint. She enjoys a certain fraction of the family pooled income. This modeling set up may be questioned especially in the context of Indonesia, which is predominantly patriarchic. Women's status in family and society is an important factor in determining employment and family planning choices.³⁵ The manner in which the above utility maximization problem has been modeled can be interpreted in ways that may be more appealing to the reader.

The utility maximization problem can be considered as a two-stage Benevolent Dictator problem. In the first stage, the benevolent dictator (husband) splits the funds in the household between him and his spouse. In the second stage, the benevolent dictator maximizes the utility function of the wife in the exact same manner as she would have because he cares about her. However, there is no easy way to estimate how the funds are split between husband and wife. The sharing rule here is a constant and is given

³⁴ Enumeration Areas are not administrative units. A given community can have more than one Enumeration Area. There are 321 Enumeration Areas, but only 312 communities.

³⁵ Status of women varies greatly in Indonesia depending on ethnicities and class (Lubis and Niehof 2003).

exogenously. Even in models where the husband does not actually care about his wife, the utility maximization will hold because it is reasonable to assume that both husband and wife care about children.

The utility maximization problem can also be viewed as Chiappori's collective approach, where only Pareto efficiency of the bargaining outcome is assumed. The sharing rule interpretation of the collective approach proposes that the allocation decisions can be seen as the outcome of a two-stage procedure. In the first stage, funds are allocated between the household members for their private consumption. The sharing rule here is a function of prices and income. The identification of the sharing rule requires some additional assumptions.³⁶ In the second stage, each member maximizes their utility function subject to their funds. The utility maximization problem of the woman in my model can be thought of as the second stage problem in Chiappori's collective approach.

5. Data

This Section discusses the data used in the estimation of the model described in Section 4. Then it presents sources of exogenous variation used for identification of model parameters.

5.1 Indonesia Family Life Survey 1

The primary data source for this study is the first wave of the Indonesia Family Life Survey IFLS 1 (1993).³⁷ This survey is a retrospective panel containing data at both individual and family level on contraception, fertility, health, and labor force activities. In addition to the household surveys, IFLS 1 includes community surveys that can be linked to all households. The sampling framework stratified on provinces and then randomly selected enumeration areas within the provinces. Households were then randomly selected within the EAs and then respondents were selected within the households. The Enumeration Areas are randomly selected from a nationally representative sampling frame used in SUSENAS 1993, a socioeconomic survey covering 60,000 households. Urban areas EAs and EAs in smaller provinces were over sampled to enable urban-rural and Javanese-Non-Javanese comparisons.³⁸ Within each household respondents were selected based on the following selection rule: "The household head and his or her spouse; two randomly selected children (biological, step, adopted, or fostered) of the head and spouse, aged 0 to 14 (interviewed by proxy); an individual aged 50 and above, randomly selected from remaining members, and his or her spouse; and for a randomly selected 25 percent of the households, an individual

³⁶ A detailed description of the assumptions is given in Browning et al (1994).

³⁷ Following is the webpage for IFLS: <http://www.rand.org/labor/FLS/IFLS/>.

³⁸ Sampling weights are provided with the data to adjust for the oversampling.

aged 15 to 49 randomly selected from remaining members, and his or her spouse.”³⁹(IFLS newsletter November 95(2)).⁴⁰

The 1993 sample consists of 7,730 households drawn from 321 randomly selected Enumeration Areas (EA), spread across 13 of the 26 Indonesian provinces. Figure 6 shows the IFLS 1 provinces in Indonesia. The 13 IFLS 1 provinces cover 83% of the country’s population and much of its cultural diversity. The provinces were chosen to achieve a certain level of cultural and socioeconomic diversity at a minimum cost.

In order to obtain my final sample of women, I start with 4,890 ever-married women drawn from across 13 provinces. Next, I drop 712 women with missing and inconsistent responses. In addition to this, I restrict my sample to women who get married during or after 1979. I do this as I do not observe contraceptive choices made in the 1960s and 1970s.⁴¹ The final sample includes 2,067 ever-married women aged 16 to 46 years in 1993. The mean age of the women in 1993 is 27.7 years. I keep track of each woman from the year in which she was married up to the year 1993. This results in a total of 20,707 woman-years. On average, I observe a woman in the sample for 10 years. The mean age at the time of marriage is 19.7 years. Distribution of the final sample across the different provinces is given in Table 4 and descriptive statistics are given in Table 5.

A complete fertility summary was obtained for all women, including outcome of the pregnancy and the year of birth. This enables me to create indicator variables for every year after marriage during which the woman gave birth, and then calculate the number of births the woman has had in total up to that particular year for all the years since marriage. This information is used to construct the child spacing variable which is the number of years from the time of marriage to the first birth or the number of years between two births. The average number of children per woman in the sample is 2.44. The total number of children for all the women in the sample is 4,160. The average age of the youngest child for woman-year observation in my sample is 2.07 years.

Table 6 presents data on levels of education for the women in my sample. Categorical variables are created for the different levels of education: Primary, Junior Secondary, Senior Secondary, and College. Nearly 60% of the sample has only a primary education, only about 3% have a college education, and the remaining is almost equally split in the two categories in between.

Table 7 provides the distribution of woman-year observations across contraceptive and employment sector choices. The measure of contraceptive use is the method of contraceptive that the woman uses every period as obtained from the contraceptive calendar found in IFLS 1. A monthly five-year retrospective calendar was

³⁹ <http://www.rand.org/labor/FLS/news2/more.html>”

⁴⁰ Weights are provided to adjust for respondent selection rules.

⁴¹ Gertler and Molyneaux (1994) note that the family planning programs in Indonesia had a significant impact on the reduction in fertility in the 1980s and early 1990s.

given to women whose first marriage was before 1984. For women married after 1984, which is nearly 53% of the sample, the contraceptive calendar covers the entire period after marriage. I group the different methods of contraceptives used into three broad categories: modern method, traditional method, and not using any method. Modern methods include pills, condoms, IUDs, and injection. Traditional methods include methods such as rhythm, withdrawal, and herbs which do not require visits to the clinic. I convert the monthly contraceptive use information to yearly information using the following guidelines: First, if more than one method is used, then the method that is used the most number of times is considered as the method used for that year; and second, if only one method is used in a year (it could be for one month, two months, or twelve months) that method is considered as the method for that year. In the year 1993, 38% of the sample did not use any form of contraceptives, nearly 5% of the sample used traditional methods, and the remaining 57% used modern methods. The survey also collected information on when the woman first used contraceptives and the method of contraceptive used. In addition, information on contraception use included questions on whether she had heard of several traditional and modern methods, whether she knew where to get the method, price of the method, and distance and travel cost to the facility.

Individuals are asked extensive questions on their current and retrospective labor market experiences.⁴² Detailed information including occupation, type of employer, industry, hours of work, and wages, is recorded from the period, 1987 to 1993, on an annual basis for both the woman and her spouse. Similar information, where appropriate, is also recorded for the first job held, for the job held in 1983, and for the job held in 1973.⁴³ I categorize employment choice by the sector in which a woman is employed: formal, informal, and not working. Formal sector workers include government employees, private workers, and self-employed individuals with permanent workers. Informal sector workers include self-employed, self-employed with temporary workers, and family workers. For the year 1993, nearly 35% of the sample is employed in the informal sector, almost 49% of the sample does not work, and the remaining 16% are employed in the formal sector. In addition, there is data on unearned income of the respondents.

The IFLS data enables me to identify the Enumeration Area and province that each respondent lives in. In addition, there is information on whether the person lives in an urban area or rural area. In 1993, the sample was almost evenly split between urban and rural areas. The detailed migration history in the IFLS helps in identifying the Enumeration Area each woman lives in every period. This allows me to link each

⁴² In my empirical analysis, I do not include data regarding secondary jobs. 6% of the sample has more than one job.

⁴³ Data on employment sector choice is not collected for every period. The employment sector choice is simulated for the years in which the data has not been collected.

woman with the family planning program in the community that she resides in every period.⁴⁴

The sample used in the empirical analysis includes women of a very wide age interval, ranging from 16 years to 46 years. Including the relatively older women in the sample has a trade-off. On the one hand, I get to observe how the older women are affected differentially by the expansion of the family planning program; on the other, I face the missing initial value problem that has to be resolved, as I do not observe the choices that they made early in life.

Community level information was collected from the village (community) leader and from the head of the Village Women's Group for each of the 321 Enumeration Areas. In addition, data is collected from heads of several educational and health facilities in each Enumeration Area. Community level data include both current and historical data. An important feature of this data set is that the household level data can be linked to the community level data. This availability of community level data allows one to know when the community level programs were introduced, and thereby enables me to study its impact on the community.

In my empirical analysis, I use the following three measures of access to contraceptives in each Enumeration Area: Community Health Centers (Puskemas), Family Planning Distribution Points (PKKBD), and the Village Integrated Health Posts (Posyandu). The Community Health Centers were established across the different provinces in three stages under the clinic-based family planning approach. Government Health Centers are physician-headed clinics that provide subsidized primary health care. (Frankenberg 2003). The Family Planning Distribution Points were set up at the village level to be able to provide contraceptives more easily to the local population. Posyandu, one of the central activities of the community-based approach of family planning also distributes contraceptives at the community level. Posyandus are monthly activities organized by volunteers where the nutrition of women of reproductive age and children are monitored. In addition, contraceptives are made available here by family planning field workers. Information on the year of introduction of these sources of contraceptives was obtained mainly from the community leader. In case the information was not provided by the community leader, responses of the head of the village women's group were used where available. Table 8 provides the timing of introduction of the three types of contraceptive sources across the Enumeration Areas. Since I am interested in the impact of the expansion of the family planning program after 1980, it is of interest to note that 77% of the Posyandus, 58% of the Family planning Distribution Points, and 33% of the Community Health Centers were introduced after 1980. Figure 7 provides information on the total number of facilities of each type that was introduced over time.

⁴⁴ Although theoretically straight-forward, I do not model location decisions as it increases the computational cost of estimation. I assume that the woman lives in the EA she lived in during 1993.

5.2 Sources of Exogenous Variation

I model the decisions that women make in every period regarding contraceptive use and sector of employment to study the impact of the family planning program on their well-being between the years 1980 to 1993. One of the problems in studying joint choices lies in determining the direction of causation. The endogeneity problem of contraceptive use here is that there may be individual unobserved heterogeneity that affects both contraceptive and employment decisions. If indeed the unobserved heterogeneity drives both decisions, it will lead to biased estimates. I use the exogenous variation in the timing of introduction of three types of contraceptive clinics in the different Enumeration Areas to identify the causal relationship. These sources of variation in contraceptive availability make it easier to obtain contraceptives by lowering the costs of getting them, but there is no direct impact on labor force participation decisions. I also use the exogenous variation in minimum wage rates over time across provinces to identify parameters related to employment decisions. Variation in minimum wage rates does not directly affect choices women make regarding contraceptives.

5.2.1 Exogenous Variation in Timing of Introduction of Different Types of Clinics

I present graphical evidence to show that the timing and placement of the different types of family planning clinics are not related to the demand for children (Miller 2005).⁴⁵ For each contraceptive clinic type (Posyandu, PKKBD, and Puskesmas), I group the different Enumeration Areas into two categories: those where the clinic type was introduced before 1980 (“Before” Enumeration Areas), and those where the fertility clinic was introduced after 1980 (“After” Enumeration Areas). I categorize the Enumeration Areas in this manner, as it is not feasible to show graphical evidence for all the Enumeration Areas separately. Ideally, examining the completed average fertility of women born in the 1920s and 1930s would give true trends and levels in fertility, because these women would not have been exposed to any form of family planning during the course of their entire reproductive period. However, IFLS 1 has fertility data only on women born after 1940. I use 4,720 women from IFLS 1 to conduct this graphical analysis.⁴⁶ As a result, I compare trends and levels in fertility of women born between 1940 and 1970 living in “Before” and “After” Enumeration Areas.

Figure 8 shows that, for women born during the 1940s who would have been between 30 years and 40 years in 1980 (and even older after 1980), there are no differences in average fertility levels across areas with differential timing of introduction of Posyandus. For women born in the 1950s, the average fertility level is lower in “Before” areas compared to “After” areas. For women born in the 1960s (who were between 10 and 20 years in 1980), there is a convergence in the average fertility

⁴⁵ Miller (2005) provides similar graphical evidence to show that the placement and timing of the family planning program in Colombia, PROFAMILIA was not related to demand for children.

⁴⁶ Of these, only 2,067 women belong to the final sample used for empirical analysis.

level across the two groups. This is because the women in the “After” areas have access to Posyandus at this later time.

Figure 9 shows that, for Enumeration Areas that are classified as “Before” and “After” based on the timing of introduction of PKKBDs, the average fertility level for women born during 1940s to 1960 is lower in “Before” areas as compared to “After” areas. However, this gap reduces for women born after 1960 as women in “After” areas have access to PKKBDs at this later time.

Figure 10 shows that, for women born in the early and mid 1940s (who were between 35 years and 40 years in 1980), there are no differences in average fertility levels across areas with differential timing of introduction of Puskemas. For women born between the late 1940s and early 1960s, the average fertility level is lower in “Before” areas as compared to “After” areas. For women born after early the 1960s (who were between 10 and 20 years in 1980), there is a convergence in the average fertility level across the two groups. This is because the women in the “After” benefit from the presence of Puskemas.

The current literature (Miller 2005; Joshi and Schultz 2007) uses access to family planning programs as an instrument to identify the causal relationship between fertility and labor force participation decisions. This approach, however, is not free of complications, which affect my results too. Some previous studies have shown that estimates of the impact of the family planning program expansions on outcomes of interest may be biased by the non-random nature of the program expansion. The above graphical evidence is not sufficient to show that the government introduced family the planning programs in different areas in a random fashion. The main problem in the timing of introduction of the clinics is that the government may have customized it according to the characteristics of the population. If the family planning clinics are established first in the areas where there is greatest need for contraceptives, then the timing of the placement will be correlated with unobserved tastes for higher fertility. This may result in a downward bias in my estimates of the effectiveness of the presence of family planning clinics on fertility levels (Rosenzweig and Wolpin 1986). On the other hand, placement of family planning programs in areas where there is a lower taste for fertility would result in an upward bias in my estimates of the effectiveness of the program on fertility levels. There have been several cross-sectional studies that have shown a negative relationship between family planning program inputs and contraceptive prevalence in the Indonesian context (Molyneaux, Pandi, and Wibisono 1990).

The outcome of interest in this research is the impact of access to family planning services on contraception and employment outcome of women. If health services are offered in addition to contraceptives in family planning clinics, then it may be the case that it is improvement in health that is driving increased female labor force participation as opposed to say, fertility reduction. One has to keep this in mind, while looking at the parameters of interest.

5.2.2 Exogenous Variation in Minimum Wages Rates in Indonesia

Minimum wage legislation was introduced in Indonesia in the 1970s. Indonesia, like many other developing countries, has two-thirds of its work force engaged in the informal sector of the economy. The minimum wage legislation does not cover workers in the informal sectors of the economy. This incomplete coverage is attributed to two reasons: first, workers employed in the informal sector are not “wage” earners; and second, it is almost impossible to enforce minimum wages in the informal sector. Until the year 2000, the minimum wages for each province were set annually by the Minister of Manpower in Indonesia based on the recommendations of the provincial governors (Jones 1997).⁴⁷ Most provinces had just one minimum wage rate. The exceptions were South Sumatra, East Java, and Bali, which had more than one minimum wage rate (Jones 1997).⁴⁸ In 1989, a new mechanism of setting minimum wages was introduced in response to internal and external pressures. The internal pressure came from the government, which was concerned about the fact that workers were not benefiting from the economic growth. They did not want to experience political violence similar to that in the 1960s (Rama 2001). The external pressure came from trade unions in North America who were concerned about exploitation of labor in Indonesia. This new minimum wage policy resulted in a two-fold increase of minimum wages in real terms (Rama 2001).

I use the exogenous variation in the minimum wages in the different provinces over time to identify model parameters related to employment choices. Figure 11 shows real minimum wages in different provinces for the period 1985-1995.⁴⁹ In order to aid in identification, two requirements have to be met. First, the variation in minimum wage rates in the different provinces over time should be exogenous. In other words, the minimum wage rates should not be correlated with unobserved preferences of individuals related to employment. This is not a concern in the Indonesian context where minimum wage recommendations are made to the Minister of Manpower based on firms’ affordability to pay its workers and not based on worker’s preferences. Moreover, after 1989, there was an exogenous increase in the minimum wage rates due to internal and external pressures that are unrelated to local economic conditions. Second, the exogenous variation in the minimum wage rates should impact employment sector choices, not contraceptive method choices. It is reasonable to assume that variation in minimum wage rates do not impact choice of contraceptive methods.

⁴⁷ Minimum wages were not always set annually for all the provinces until 1990.

⁴⁸ I have listed only provinces that are included in IFLS 1.

6. Econometric Specification of the Structural Model

In this Section, I present the econometric specification of the wage equation and nonpecuniary utility function. Then, I briefly discuss the distributional assumptions made about the choice-specific time shocks, ξ_{kmt} . The pecuniary component of the utility function is obtained from consumption c_t that depends on the alternative chosen and the budget constraint. If a woman works or were to work in the formal or informal sector, her wage earnings are included in the budget constraint. The wage structure is

$$w_t^k = w_{k0} + \theta_{k1}G + \theta_{k2}t + \theta_{k3}X_t^L + \theta_{k4}O_{t-1}^1 + \theta_{k5}O_{t-1}^2 + \varepsilon_t^k + \mu_w^i, \quad k = 1, 2. \quad (6.1)$$

The wage error terms are assumed to be distributed iid normal, $\varepsilon_t^k \sim N(0, \sigma_{k\varepsilon}^2)$.

For each choice, the nonpecuniary utility function is specified as the sum of the following terms: first, interaction of choices with exogenous characteristics such as religion, education, province, urban or rural location, and age of woman; second, state and duration dependence terms as discussed in Section 4; third, a term that captures utility obtained from number of children; fourth, a term that captures utility obtained from birth spacing; fifth, a term that allows utility from giving birth in the previous period; sixth, disutility from giving birth when woman's age is greater than 35; seventh, several terms that capture utility obtained from interaction of choices with birth in the previous period, age of youngest child and number of children; eighth several terms that capture interaction of indicators of presence of clinic with choice of contraception methods, and finally, terms to capture utility obtained from unobserved preference heterogeneity. The nonpecuniary utility function is specified as

$$\begin{aligned} q_{kmt} = & \alpha_{1km} o_t^k \mathbf{X}_t + \alpha_{2km} m_t^m \mathbf{X}_t + \alpha_4 o_t^k O_{t-1}^k + \alpha_5 m_t^m M_{t-1}^m + \alpha_6 N_t \\ & \alpha_7 b_t n_t + \alpha_8 n_{t-1} + \alpha_9 (t > 35) n_t + \alpha_{10} o_t^k n_{t-1} + \alpha_{11} N_t o_t^k + \alpha_{12} r_t o_t^k + \alpha_{13} m_t^k n_{t-1} + \alpha_{14} N_t m_t^k \\ & + \alpha_{15} r_t m_t^k + \alpha_{16} m_t^m \mathbf{X}_c + \mu_o^i + \mu_m^i \end{aligned} \quad (6.2)$$

The direct nonpecuniary utility or disutility obtained from employment sector and contraception method is captured by vector of parameters α_{1km} and α_{2km} , respectively. The vector of observables \mathbf{X}_t , includes age, religion, and an indicator for whether the person is located in an urban or rural area, education (primary or less / more than primary school), and province in which the woman resides. The nonpecuniary utility obtained from duration of being in a particular sector and using a particular contraceptive method is captured by α_4 and α_5 , respectively. The coefficient α_6 on N_t captures the nonpecuniary utility obtained from the number of births. The coefficient α_7 captures utility from birth spacing. The coefficient α_8 captures the utility or disutility associated with giving birth in the previous period. The disutility that women experience in giving birth at an age greater than 35 is reflected in α_9 . The nonpecuniary utility obtained from simultaneity of birth in previous period, number of births, and age

of youngest child with sector of employment is captured by α_{10} , α_{11} , and α_{12} respectively. These terms capture differences in utility experienced by women across sectors from number and birth of children. For instance, a woman in the informal sector may derive more utility from number of kids compared to a woman in the formal sector. Women in the formal sector may space the birth of children differently compared to women in the informal sector as there may be differences in difficulties of entry and exit into jobs in the two sectors. The utility obtained from the simultaneity of contraceptive method choice with birth in period $t-1$, total number of births, and age of youngest child is captured by α_{13} , α_{14} , and α_{15} respectively. Coefficient α_{16} captures utility obtained from interaction of presence of clinics with method of contraception used in period t , m_t^m . For instance, it may be picking up the nonpecuniary utility associated with ease of access to contraceptives when it is present in one's Enumeration Area. The variables included in \mathbf{X}_c are indicators for the presence of the three different types of contraceptive clinics in the Enumeration Area where the individual resides. All interaction terms capture the utility over and above the utility obtained from the individual components.

The final component of the utility function is the choice-specific time shock. Let ξ_{kmt} be the shock, which is assumed to have an independent extreme value distribution. This distributional assumption has two advantages. First, the expected value of the maximum of the next period's value function has a closed solution. Conditional on the wage errors and taste parameters, we get

$$E \max_{\{k,m\}} [V_{km} | \varepsilon, \mu_i] = \gamma + \ln \left(\sum_{\{k,m\}} \exp \bar{V}(\{k,m\} | \varepsilon, \mu_i) \right) \quad (6.3)$$

where $\bar{V}_{km} = V_{km} - \xi_{kmt}$ and γ is the Euler's constant. Second, each choice probability in the model after conditioning on unobserved heterogeneity is in the form of a multinomial logit.⁵²

7. Structural Model Estimation

This Section discusses estimation of the dynamic structural model, but does not include unobserved heterogeneity and wage error discussed in Section 4 and Section 6. This Section begins by describing the dynamic programming problem. Then, there is a discussion of the maximum likelihood technique that I use to estimate the parameters of the model. This Section concludes by discussing sources of identification of the parameters in the model.

7.1 Solving Dynamic Programming Problem

⁵¹ Time subscripts have been ignored.

⁵² See Rust (1987) and Berkovec and Stern (1991).

Solving the dynamic programming problem is not an easy task. The solution involves obtaining the value function for each person for each point in the state space for a given set of parameters. The value functions minus the choice-specific time shocks \bar{V} , are required to construct the probability of the choice actually observed in the data. This, in turn, is used to compute the corresponding likelihood contribution.

I can solve the dynamic programming problem by backward recursion because I assume that the horizon is finite. I assume that in the period between T^* and T^F probability of giving birth is zero, meaning women make no decisions regarding contraceptive method.⁵³ I assume that the individual makes the same choice through periods T^* through T^F as she made in period T^*-1 regarding sector of employment. Having knowledge of the choice enables me to compute the individual's value function at time T^* . At time T^* , \bar{V} at each point in the state space is the sum of current pecuniary and nonpecuniary utility. For all time periods $t < T^*$, the value function at each point in the state space is the sum of current utility plus the discounted value of the expected best choice in the following period.⁵⁴ I am going to refer to the discounted value of the expected best choice in the next period as *Emax*. For example, while computing the value function in period $t-1$, I know the *Emax* in period t (as this would have already been computed). Calculating *Emax* involves only those value functions linked to points in the state space that could follow given choices and state space in a particular period. I compute \bar{V} at each point in the state space by adding *Emax* to the current utility. This backward recursive process continues until period $t=0$, and a large array of value functions has been computed for each person in each point in the state space. However, the large size of the state space makes it computationally expensive to evaluate the value function for each person at each point in the state space for each guess of the parameters. I use two techniques to reduce the computational burden.

First, to reduce the computational cost of the dynamic programming problem, upper bounds are imposed on several state variables. For instance, I keep track of only the age of the youngest child. This can take only 13 values (zero through 12 years).⁵⁵ The number of births a woman has had can take only 9 values (zero through 8), and birth spacing can take 5 values (zero through 4 years). In addition, the sector-specific experiences and experience in using a particular method of contraceptive can take only up to two values (zero and one).

Second, to further reduce the computational cost, I estimate the value function at only a subset of the points in the state space and interpolate the value function at the other points. I compute the value functions for only 4 out of 13 values of age of youngest child, 4 out of 9 values of number of births, and 3 out of 5 values of birth spacing. I interpolate the value function at the remaining points as the weighted

⁵³ This automatically means the contraceptive method is "not using contraceptives".

⁵⁴ The term value function here does not include choice-specific time shocks.

⁵⁵ I believe that it is reasonable to assume that children older than 12 are capable of taking care of themselves and do not require supervision.

average of the value functions with the closest greater than and less than state points. Since I interpolate over 3 dimensions, each interpolated value function has $2^3 = 8$ closest value functions. I follow the weighting scheme used in Brien, Lillard and Stern (2006).

The value function has to be evaluated for each person in the sample for every guess of the parameter. In my model, individuals can differ by the following exogenous characteristics: religion (Muslim/Not Muslim), location (urban/rural), province (Java/Non-Java), education (primary or less/more than primary school), and initial age of woman in 1979 (from 16 to 30). I use the interpolation method suggested by Brien, Lillard, and Stern (2006) to compute the value function array for $2 \cdot 2 \cdot 2 \cdot 2 \cdot 15 = 240$ representative people. The exogenous characteristics does not include unobserved heterogeneity). An attempt was made to include the presence of each of the three types of clinics as part of exogenous characteristics, but there were two problems in doing so. First, it increases the types of representative people by a factor of 8 (2 possibilities for each of the 3 types of clinics). Second, it is non-trivial to model time-varying exogenous characteristics as a woman would have different values in different periods based on whether a particular clinic type was introduced. I get around this difficulty by including the presence of clinics as part of state space. I model the transition probability as a hazard model where the probability of a clinic being present each period depends on whether it is located in an urban or rural area, and also depends on how long the clinic has been present.

7.2 Estimating Birth Probability Function and Wage Equation

I estimate the birth probability function outside the structural model as a probit, where the dependent variable is one in the event of a birth and zero otherwise. This reduces the computational burden, but results in loss of information. For example, inference cannot be made about the impact of the effectiveness of a method on the job choice of an individual. I use the parameters from the probit regression to obtain the probability of birth in the structural model after conditioning on contraceptive method chosen, duration for which the method is used, age of the woman, and unobserved fecundity level. To further reduce the costs of computation, I estimate the wage equation outside the structural model. To correct for selection bias when determining the impact of observables on wage rates, I model the selection process as multinomial logit regression model.⁵⁶

7.3 Maximum Likelihood Estimation

After solving the dynamic problem and obtaining the parameters for the wage equation and birth probability function, then, with the data on observed choices and state variables, the parameters of the utility function and budget constraint will be estimated by the method of simulated maximum likelihood. The solution to the individual's optimization problem provides the choice probabilities in the likelihood

⁵⁶ A detailed description follows in Section 9.

equation. The sample likelihood equation is the product across individuals, time and choices of the contributing probability corresponding to each alternative.

$$L(.) = \prod_i \int \prod_t \Pr(\mu_i, t, \overline{S(t)}) dH(\mu_i) \quad (7.1)$$

where $\Pr(\mu_i, t, \overline{S(t)})$ is the likelihood contribution of a woman at a particular time t , given μ_i and $\overline{S(t)}$. Here $\overline{S(t)}$ is defined to be the part of the state space without the wage errors. The likelihood contribution can take two forms depending on whether the woman is working or not. For a woman who is not working at a particular period t , the integration is performed over the distribution of the wage errors. Her likelihood contribution in a period t given $\overline{S(t)}$ and μ_i is:

$$\Pr(\mu_i, t, \overline{S(t)}) = \int \prod_{\{k,m\}} \left[\frac{\exp[\overline{V}(d_{kmt} | (\overline{S(t)}, \varepsilon_t, \mu_i) / \tau]}{\sum_{\{l,z\}} \exp[\overline{V}(d_{lzt} | (\overline{S(t)}, \varepsilon_t, \mu_i) / \tau]} \right]^{d_{kmt}} dF(\varepsilon_t^1) dG(\varepsilon_t^2) \quad (7.2)$$

The likelihood contribution of a woman working in the informal sector is the joint density of the observed choice and the observed wage. It takes the form

$$\Pr(\mu_i, t, \overline{S(t)}, w_t^{2*}) = \int \prod_{\{k,m\}} \left[\frac{\exp[\overline{V}(d_{kmt} | (\overline{S(t)}, \varepsilon_t, \mu_i) / \tau]}{\sum_{\{l,z\}} \exp[\overline{V}(d_{lzt} | (\overline{S(t)}, \varepsilon_t, \mu_i) / \tau]} \right]^{d_{kmt}} g(w_t^{2*} - \overline{w_t^2}) dF(\varepsilon_t^1) \quad (7.3)$$

where w_t^{2*} is the observed wage, $\overline{w_t^2} = w_t^2 - \varepsilon_t^2$, and $g(\cdot)$ is the density of the observed wage.⁵⁷

Recall that the value functions are computed only for the representative people. I use the technique suggested in Brien, Lillard, and Stern (2006) to obtain the likelihood contribution of each sample person i . I compute the conditional likelihood contribution for each sample person i using the value functions calculated for the representative people j . For every sample person i , I compute choice probabilities P_{ji} for each j , as though she is of the same type as representative type j . Then I multiply each of these choice probabilities for person i with weights ω_{ji} , where the weights are inversely proportional to the distance between the sample person i and representative person j .⁵⁸ The weights associated with a particular sample person i and all representative people sum to 1. The conditional likelihood contribution of sample person i is the sum of the product of each choice probability associated with a representative person with the

⁵⁷ A similar expression can be obtained for a woman working in the formal sector.

⁵⁸ Since all exogenous characteristics are discrete, the weight ω_{ji} will be one for one of the representative types and zero for the rest.

respective weights. These conditional likelihood contributions become a part of the sample likelihood equation (equation 13).

7.3.1 Optimizing the Log-likelihood function

Parameter estimates are obtained by maximizing the log-likelihood function using a numerical optimization routine. Particularly, I use the Berndt, Hall, Hall, and Hausman (1974) algorithm to maximize the log-likelihood function. The estimation procedure is as follows: First, I start with an initial guess of the parameter vector; second, conditional on the guess, I compute the likelihood function and derivative of the likelihood function with respect to the guess; third, I adjust the guess depending on the value of the likelihood function. The simplest way to update the parameters is by specifying the first derivatives, but this does not take into account rate at which the maximum is reached (it accounts only for direction); fourth; a second derivative measure captures the step size (how much to increase the parameters by) component of how to update the parameters. However, it is non-trivial to compute the second derivative and may sometimes be impossible. The inverse of the outer product approximation to the information matrix is used in lieu of the second derivative of the log-likelihood equation ⁵⁹; fifth, the product of the gradient matrix and the step-size measure updates the parameters; and finally, this updating is continued until the log-likelihood function is maximized. BHHH (1974) algorithm is used, as the likelihood function is complex. Numerical derivatives are computed, as it is difficult to compute analytical derivatives given the log-likelihood equation.

The estimation of the standard errors of the parameters is done using the Berndt, Hall, Hall, Hausman (1974) technique. This is a method to estimate the covariance matrix of a maximum likelihood estimator by using the first derivatives instead of second derivatives of the log-likelihood function.

7.4 Identification

The coefficients of the wage equation are identified by the covariation of observable characteristics and wages across individuals within a sector. The variance of the unobserved ability is identified by the persistent differences over time across individuals in wages conditional on observables. The variance of the wage error is identified by the difference in wages across individuals in a sector in a given period conditional on observables. The identification of the wage structure comes from covariation of wages and observables across the two sectors for similar occupations. Parameters of the utility function, like in all discrete choice models, are identified only up to a base. In addition to data on choice and individual characteristics, identification is obtained from exogenous variation in the timing of introduction of the different types

⁵⁹ Information matrix is the negative of the expected value of the Hessian.

Outer product approximation is the sum over the outer products of the first derivative to the log likelihood equation.

of fertility clinics within each Enumeration Area, and variation over time and across Enumeration Areas in the access to contraceptives. There is also exogenous variation in the local labor market condition (minimum wage rates) that varies across provinces and over time. It affects women in the formal and informal sector differently. Variances of the unobserved preference heterogeneity for employment and method of contraception are identified by persistence in choices made by individuals over time relative to individuals who have the same observable characteristics. Unobserved natural fecundity level is identified by variation in fertility across women conditional on observables and choices made. Identification of state dependence separately from unobserved heterogeneity comes from variation in choices made by individuals with similar observable characteristics, who have experienced a certain state relative to individuals who have not experienced the state.

8. Structural Estimation Results

In this Section I discuss parameters from the estimation of wage equation, birth probability function, utility function, and budget constraint. Recall that the estimation excludes wage errors and unobserved heterogeneity.

8.1 Woman's Wage Equation

Recall that the wage equation is estimated outside the structural model in order to reduce the computational cost of estimating a full structural model. The wage parameters are taken as given in the structural model. This implies that there is no uncertainty for the woman as to how sector-specific experience, local labor market conditions (minimum wage rates at province level), time period, and education affect her wage rates. The normally distributed random wage error term described in 6 is not included in the estimation of the structural model.

Each period, wages are observed in the sector in which the woman works. To correct for selection bias when determining the impact of observables on wage rates, I model the selection process as multinomial logit regression model. More specifically, I use Fournier and Girgand's (2004) user written SELMLOG program.⁶⁰ A multinomial model is chosen over the two-stage method in Heckman (1979) since there are multiple sectors of employment that needs to be modeled. I use Dubin and McFadden's (1984) correction method to estimate the wage equation. Consistent estimators of conditional expected values of residuals from the multinomial logit model are included as additional regressors in the wage regression. The coefficients on these terms show the covariance between the error term in the wage equation and some function of the residuals in the multinomial logit equation.

⁶⁰ The code is downloaded from <http://www.pse.ens.fr/senior/gurgand/selmlog13.htm>.

The probability of participation of a woman in each sector is a function of her education, sector-specific labor market experience, age, number of births, religion, birth in the previous period, whether the woman resides in an urban location, and age of her youngest child. The wage rate of a woman depends on age of the woman, whether the woman resides in an urban location, local labor market condition captured by minimum wage rates, education, and sector-specific experience. The wage rate of a woman who is not working is zero. Separate wage equations are estimated for both the formal and informal sector. This implies that different characteristics such as education, age, and experience have differential impact on the wage rates of women across sectors. Recall that the minimum wage rates at the province level should have no significant impact on wage rates in the informal sector, but have impact on wage rates in the formal sector.

Table 11 presents parameter estimates from the wage equation and selection equation for both formal and informal sectors. 'Not working' is considered as the base category. The second and third columns show the estimates of wage equation and selection equation for the formal sector. The fourth and fifth columns do the same for informal sector. Standard errors are given in parenthesis and are derived from 10 bootstrap replications.

Results suggest that participation of woman in the formal sector increases with age, experience in both formal and informal sectors, education, and urban location. It is worth noting that as age of youngest child increases, a woman is more likely to participate in the formal sector. This is consistent with the notion that it is easier for a woman to work outside the home as the child ages. Women with higher level of education are more likely to participate in the formal sector, suggesting that it is the marginalized women who tend to work more in the informal sector. Participation in the informal sector also increases with age, work experience, and decreases if the woman is Muslim or lives in an urban area. A woman is more likely to participate in the informal sector as her youngest child becomes older and as she has more births.

As expected for the formal sector, experience in the formal sector and education have a significant positive impact on wages. The province level minimum wage rates have a positive impact on the wages of woman in the formal sector. In the informal sector, as expected the province level minimum wage rates do not have any significant impact on wages. This is because it is not possible to enforce minimum wage laws in the informal sector of the economy. Work experience does not have any significant impact on the wages in the informal sector.

8.2 Birth Probability Function

Recall that the birth probability function, like the wage equation, is estimated outside the structural model in order to reduce the computational load of estimating a full structural model. The probability of birth in period t for a woman is a function of her age, her choice of contraception method in the previous period, and the duration of

use of the contraception method used in the previous period. Estimating the birth function outside the structural model implies that the woman knows with certainty how her age, contraception choice in the previous period, and its duration impacts the birth probability. These parameters are used in the structural model to estimate the probability of birth after conditioning on age of the woman, method used in the previous period, and the duration of its use.

Table 9 presents the results of the probit estimation. The dependent variable takes the value one if a birth occurs in period t , and takes a value zero otherwise. As expected the likelihood of birth decreases with age of the woman. The probability of birth decreases with use of either modern or traditional method of contraception, with modern methods of contraception having a stronger effect. The longer modern methods of contraception have been used; more effective it is in preventing pregnancies. The duration of use of traditional methods of contraception do not seem to have any significant impact on probability of birth.

8.3 Parameters of Utility Function and Budget Constraint

This section discusses the results from the structural estimation. Recall that the decision-making period for a woman starts when she is first married. The final decision period is the decision made in year 1993. The highest number of years for which the decisions are observed is 15. This covers women who get married in the year 1979. Women derive utility for a period of 5 years based on their choices in 1993. This might not be the best way to model choices considering the fact that some women are still young and will continue to get utility from time-varying choices. Integrating, later waves of the Indonesia Family Life Survey (2, 3, and 4) will allow me to observe choices made by women in later years all the way up to 2008 and thereby, overcome this issue.

The discount factor is set to 0.90 in this model and not estimated.⁶¹ The identification of the results of the structural model is relative to a base choice of not using contraception and not working.

The structural estimates of the discrete choice dynamic model are presented in Table 10. The results in Table 10 are results of the model specified in Section 4 minus unobserved heterogeneity and wage errors. The estimates should be interpreted as the additional utility flow relative to the base choice of not working or not using contraceptives, with a unit increases in the corresponding covariate. For example, a Muslim woman who work in the formal sector and uses modern methods of contraception has $(0.0211) + (-0.6530) = -0.6319$ units of utility lesser than her non-Muslim counterpart and this is relative to the base utility. Note that all women have the same utility in the base choice.

⁶¹ Previous literature has shown that it is non-trivial task to estimate the discount factor. Assignment of the discount factor to be 0.90 is arbitrary.

8.3.1 Estimates associated with Contraception Method

The structural estimates reveal that Muslim women enjoy higher utility flows from using modern contraception relative to the non-Muslim counterparts. This might be as a result of the Indonesian government's ability to convince Muslim religious leaders that population control promoted national interest.⁶² The estimates for the traditional method suggest the opposite. It is of interest to note that women with more education derive greater utility flows from using modern methods of contraception relative to women who have no education or less than primary school education. This is consistent with the current literature on contraceptive and education relationships that predict that women with greater educational attainment are more likely to use contraceptives. This may be because of the following reasons: first, they may be more inclined to work in the formal sector (that has less opportunities for joint production); second, it may be because they are more informed on how to use the method or; third, it may be because they desire higher levels of education for their children, thus raising the cost per child. For the estimates with regard to traditional method, women with more education derive lesser utility flow. Residing in urban areas compared to rural areas provide less utility flow from modern methods of contraception. The reverse is true for utility flow derived from traditional methods. Younger women derive less utility flow from modern methods compared to older women. This may be because younger women are in the beginning phase of their child-bearing years and may have a greater desire to have children. Consistent with reduced form findings, as age of the youngest child increases, a woman will derive less utility flow from using a modern method of contraception. This may be attributed to the willingness of women to have another child after sufficient spacing. Women who already have children enjoy higher utility flow from modern methods of contraception. This may have to do with the effectiveness of modern methods in reducing fertility. The estimates suggest positive duration dependence in using modern methods of contraception. The utility flow enjoyed by a woman increases in the presence of a Posyandu, Puskesmas, or PKKBD. This is because of reduction in cost that a woman faces in obtaining contraceptives as a result of easy access.

8.3.2 Estimates associated with Employment Sector

The presence of children provides lower utility flow from working in the formal sector, but provides higher utility flow when working in the informal sector. This suggests that informal sector jobs are more compatible with household responsibilities (where number of children is a proxy for demand for woman's time and household responsibilities). The utility flow as age of the youngest child a woman has increases when participating in the formal sector. This may be because as the child gets older, the

⁶² In October 1983, almost 22 years ago, a national conference of the Ulama (local-level religious leaders), passed a resolution stating, "Islamic teachings justify family planning for the betterment of health conditions of mother and child, to make the child healthy, intelligent and devout"(Singh 2005).

mother may be more comfortable leaving the child at home.⁶³ As number of birth increases the utility gains from working in the formal sector decreases. There is positive duration dependence associated with working in the formal sector. The duration dependence associated with working in the informal sector is negative. This may be because jobs in the informal sector require very little skill and there is no benefit in working in the informal sector for a long time. The duration terms are capped at two years in the estimation in order to reduce computational costs. Women derive negative utility flow if they had a birth in the previous period and worked in the formal sector. This might be due to difficulties new mothers face in leaving an infant at home when they go out to work.

8.3.3 Budget Constraint

The coefficient of income, which is the marginal utility of consumption, is 0.067. The marginal utility of consumption is positive indicating that an increase in income increases utility flow. The budget constraint is in 1 million Indonesian Rupiah, meaning which consumption is measured in units of 1 million Indonesian Rupiah (approximately US \$100).⁶⁴The Rupiah amount is expressed in year 2005 value. A 0.1 million Rupiah increase in income, increases utility by 0.067 utils. One util is equal to one standard deviation of the extreme value error (where parameter τ is given the value one). The coefficient on consumption implies that one unit of non-pecuniary utility is equal to $(1/0.067) * 100,000 = \text{Rp } 1492537$. This is roughly equal to \$149.23. Each of the non-pecuniary utility values can be converted to Indonesia Rupiah by multiplying utils with 1492539.

8.3.4 Parameter Estimates on Choice-Independent Variables

Women derive negative utility flow when they give birth at an age greater than 35 years. This captures the physical difficulties that older women face in giving birth. Women derive positive utility flow from having children. This may be as a result of satisfaction of being a mother, in addition to knowing that they have a form of additional security for old age.⁶⁵ Women derive positive utility flow when they give birth. This suggests that the satisfaction from having a child is greater than the physical pain endured in having one.⁶⁶

⁶³ Recall that only age of youngest child is used instead of modeling ages of all children. This is done in order to reduce computational cost.

⁶⁴ In 2009, one US dollar is approximately equal to 10,000 Indonesian Rupiah. The Indonesian Currency has been devalued several times in the past as a result of high levels of inflation.

⁶⁵ The monetary cost of raising children cannot be separately identified from the nonpecuniary utility associated with having children.

⁶⁶ I do not make any distinction between giving birth to a boy versus a girl in this model. Several studies have shown that gender bias is not a problem in Indonesia.

9 Policy Experiments ⁶⁷

This Section discusses counterfactual experiments that can be conducted with the structural estimates that will have important policy implications. I can also study the impact of altering specific parameter values on the decision path that individuals take. Some of the experiments that I propose to conduct include the following: first, decreasing the cost of using contraceptives; second, increasing the utility associated with working in the different sectors for mothers of young children; and third, imposing an exogenous increase in sector-specific wages for women. The first experiment involves decreasing the cost of using contraceptives for all married women. This policy experiment can be used to simulate an improvement in quality of family planning services (including quality of treatment at clinic and wait times at the clinics), reduction in distance to the clinic, or a reduction in the price of contraceptives. I can then look at how this affects the employment and contraceptive choices of women.

The second experiment involves a decrease in the disutility experienced by all working mothers. This can be done separately for each of the sectors. This policy simulation is equivalent to a reduction in the cost of childcare for working mothers. This could also be thought of as flexibility in timing of employment in the case of formal sector or some kind of financial payment in the case of the informal sector. The above policy experiment could be limited to mothers with children less than age five. A greater impact of an increase in utility for working mothers may be seen for this group of women as children over five largely have the option of being enrolled in school. In addition, utility flow associated with working in formal or informal sector can be increased to simulate the policy changes based on a positive or negative view of the informal sector. The former argues that given barriers to entry in formal sector, the existence of informal sector is essential for women to support themselves and help their families (Berger and Buvinic 1989). The second perspective is that the informal sector is inferior to the formal sector in terms of earnings, job security, and exploitation. However, both perspectives agree that informal sector is more suited for combining work with family responsibilities (Bernasek and Gallaway 2002). One side argues that women choose informal sector for its convenience in balancing work and child care and therefore policies should focus on improving conditions in the informal sector. The side with the negative view argues that policy is needed to improve compatibility between formal sector employment and child care such as better child care arrangements, better maternity leave policy, and more focus on female education. These policies would facilitate participation of women in the formal sector.

The third policy experiment involves simulating wage subsidies for all women by exogenously imposing a sector-specific wage increase. In addition, each of the above experiments can be done for different groups of women to see whether the different

⁶⁷ As a US Census Bureau Employee at the time of writing this paper, I refrain from making any policy statements. I limit the content of this Section to possible policy experiments that can be conducted with this research.

types (may be based on religion, location, age) respond differently to the different policy changes.

10. Conclusion

I investigate the impact of the expansion of the Indonesian family planning program on choices made by women regarding their employment and use of contraceptives, while at the same time recognizing the interdependency of these interrelated life choices. An important contribution of my research is to study how the expansion of the family planning program affects labor force participation decisions of women in addition to contraceptive choice, an area that has not been investigated extensively. A problem associated with studying joint choices is that there may be unobserved heterogeneity that drives both decisions. However, preliminary analysis shows that there exists exogenous variation in the timing of introduction of different types of contraceptive clinics that affects contraceptive choices, but not labor force participation decisions. In addition, variation in minimum wage rates affect labor force participation outcomes, but do not impact contraception choices. These sources of exogenous variation serve as instruments in identifying model parameters.

This research contributes to the literature in the following ways: First, I distinguish between formal and informal sectors of employment; second, I allow for joint contraception and employment choices to understand link the between family responsibility and employment; and third, I endogenize wage rates so that sector-specific experience impacts wages, and this in turn affects cost of having a child; and finally, I allow uncertainty in fertility control. All this is carried out in a structural framework that will enable analyzing how different external changes affect a woman's lifetime decisions.

This research investigates the impact of the Indonesian Family Planning Program on the labor force participation decisions and contraceptive choices of married women. Specifically, I develop a discrete choice dynamic structural model, where each period each married woman makes joint choices regarding the method of contraceptive used and the sector of employment. Each woman obtains utility from pecuniary sources, nonpecuniary sources, and choice-specific time shocks. In addition to the random shocks, there is uncertainty in the model as a woman can only imperfectly control her fertility. Dynamics in the model are captured by several forms of state and duration dependence. The probability that a woman gives birth in period t , depends on her contraceptive choices in period $t-1$. Sector-specific experience affects her employment decisions in the following periods by impacting her future wages. Women in this model make different choices due to different preferences, differences in observable characteristics, and realization of uncertainties. The choices made by a woman depend on the compatibility between raising children and the sector of employment (including wages).

The dynamic structural model is estimated using maximum likelihood estimation technique. I estimate this model using data from the first wave of Indonesia Family Life Survey. This is a retrospective panel covering 83% of the population across 13 Indonesian provinces. It has individual and family level data on employment, income, education, migration, contraception use, and fertility that can be linked to community level data. Community level data of interest in this research is timing of introduction of different types of family planning clinics across various provinces in Indonesia.

Structural model estimates indicate that informal sector jobs offer greater compatibility between work and childcare. Parameter estimates indicate that women with more kids and young kids derive more utility from working in the informal sector. Access to modern methods of contraception (presence of clinics) reduces cost of using modern methods. This increases its use and in turn, reduces likelihood of birth and number of births encourages participation of women in formal sector by reducing number of births. Parameter estimates indicate that choices of contraception method and employment sector vary by exogenous characteristics such as religion, urban or rural residence, and presence of clinics and age of woman. The number of kids woman have, birth spacing, and age of youngest child seem to play an important role in impacting choices made by married women.

The results must be looked at with two caveats: birth probability function and wage equation have been estimated outside the structural model. Several assumptions have been made in estimating the parameters of this model. Some of these assumptions will be relaxed in the future. I categorize a selection of these as areas of future tasks: 1) An important task to be performed in the future is to estimate the structural model with unobserved heterogeneity so as to determine how inherent taste affects choices that a woman makes; 2) Another task would be to estimate the probability that a woman receives offer from both sectors each period instead of assuming that a woman receives job offers with certainty each period. ; 3) Incorporating migration decisions of a woman in the model may improve the model's ability to explain contraception choices of a woman; 4) Incorporating death of children in the model might explain why a woman has additional children; and 5) Answering the research question in a bargaining framework may capture the role that men play in using contraception and deciding their wife's employment in a patriarchal society such as Indonesia.

Appendix

A₀ (13, 17)- The period in which the woman gets married. Her choices are made from this period onward.

Base choice (34)-Reference category to interpret the parameter estimates in the context of discrete choice models.

Choice set (17) - Universe of all options from which a woman can choose from in each period.

Choice-specific random shocks (1,4, 13, 38)-This adds randomness to the utility enjoyed by a woman each period.

Choice-specific time shocks (1, 17, 26, 27, 38)-Same as Choice-specific random shocks.

Choice variables (4)-These are the variables a woman chooses each period.

Composite commodity (13, 15, 16)- All other commodities other than contraception and expenditure on children.

Consumption (26)- Income spent on other items after contraception expenditure and expenditure on children

Decision-making horizon (13)- Number of periods over which a woman makes choices.

Discount factor (34)- The factor by which next period's utility is discounted.

Disutility (14)- Negative Utility

Dynamic framework/models/programming (10, 11, 27, 34, 38, 39)-Dynamic programming usually refers to a simplification of a decision by breaking it down into a sequence of decision steps over time.

Endogeneity problem (23) - In econometrics, the problem of endogeneity occurs when the independent variable is correlated with the error terms in the model.

Expected discounted life-time utility function (11, 17)-Expectation is because of uncertainty in future, discounted since future experiences are valued less than present ones, and life-time utility function is utility function for all periods in the model.

Extreme value error (36)-Errors drawn from an iid extreme value distribution. This allows nice closed form solutions that simplify estimation.

Finite horizon problem (11, 28)- Number of periods in the model is fixed and finite.

Partial equilibrium framework (16)-The focus is on a particular subsection of the economy, while holding everything else exogenous.

Pecuniary/nonpecuniary (1,4, 8, 11, 13, 15, 17, 26, 36, 38)- Monetary/nonmonetary.

Preference heterogeneity (11, 15)- Variation in preferences.

Sector-specific human capital accumulation (14-15,-)Skills pertaining to a particular sector that have been accumulated over time.

State dependence (14)- Dependence of choices and utility on current state.

Static framework (10)- One-period model where dynamics are not considered.

T*, T^F (13, 17, 28)-T* is the final period until which a woman makes decisions.

T^F is the period 5 years after T^* .

Taste parameters (27)- Same as unobserved heterogeneity. See below.

Unitary household model (19)- All household members have only one set of preferences.

Unobserved ability level (11)- A type of unobserved heterogeneity.

Unobserved heterogeneity (23, 38)-Inherent person-specific traits that varies across people. Modeling unobserved heterogeneity reduces bias in parameter estimates.

Time invariant (11)- Does not vary over time.

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Table 1: Labor Force Participation Rates by Gender in Rural and Urban Areas, Indonesia

	<i>1971</i>	<i>1980</i>	<i>1990</i>
Male			
Urban	61.2	59.1	64.0
Rural	70.4	71.2	74.4
Total	68.7	68.5	71.1
Female			
Urban	22.5	24.2	31.6
Rural	34.2	35.2	42.2
Total	32.1	32.7	38.8
Both Sexes	49.9	50.2	54.7

Notes: This table is quoted from Manning (1998).

Source: CBS, Population Censuses, 1980 and 1990.

Table 2: Number of Contraceptive Users in Different Provinces over time (in millions)

	<i>1973/74</i>	<i>1978/79</i>	<i>1983/84</i>	<i>1989/90</i>
Java-Bali	1.6	5	10.7	12.3
Outer Islands 1		0.5	3.1	4.5
Outer Islands 2			0.5	1.6
Indonesia	1.6	5.5	14.3	18.4

Notes: This table is obtained from Shrestha (2007). Minor modifications have been made. Blanks indicate family planning program has not yet been introduced in that province.

Source: National Family Planning Coordinating Board (1992).

Table 3: Estimates of Contraceptive Failure Rates in the United States

<i>Method</i>	<i>Failure Rate in 12 Months(Typical Use)</i>
Implant	2.8
Injectable	3.2
IUD	3.7
Pill	6.9
Diaphragm	8.1
Male Condom	8.7
Withdrawal	18.8
Periodic Abstinence	19.8
Other	32.0

Notes: Failure rate is the percentage of women who accidentally become pregnant as estimated in Tussell and Vaughn (1999) using 1995 National Survey of Family Growth in the United States.

Source: Quoted from Tussell and Vaughn (1999).

Table 4: Distribution of the sample of women by Province in 1993

<i>Province</i>	<i>Number of women</i>	<i>Percentage</i>
North Sumatra	197	9.53
West Sumatra	99	4.79
South Sumatra	116	5.61
Lampung	87	4.21
DKI Jakarta	213	10.30
West Java	331	16.01
Central Java	200	9.68
DI Yogyakarta	101	4.89
East Java	288	13.93
Bali	128	6.19
West Nusa Tenggara	121	5.85
South Kalimantan	96	4.64
South Sulawesi	90	4.35
Total	2067	100

Source: IFLS 1

Table 5: Descriptive Statistics

<i>Variable</i>	<i>Mean</i>	<i>Standard Deviation</i>
Sample of 2067 Women		
Age at time of marriage*	19.67	3.97
Urban	0.51	0.50
Muslim	0.86	0.35
Sample of 20,707 woman-year observations		
Age*	24.20	5.21
Number of children	2.44	1.27
Age of youngest child*	2.07	2.29
Gives birth	0.22	0.42
Duration in formal sector*	2.62	1.81
Duration in informal sector*	2.93	1.98
Duration not working*	10.79	8.69
Duration using modern methods*	2.37	1.61
Duration using traditional methods*	0.10	0.53
Duration not using contraceptives*	4.47	2.88

Notes: * denotes unit of measurement is Year.

Source: IFLS 1

Table 6: Distribution of Sample Women by Level of Education

<i>Education</i>	<i>Proportion</i>
Primary	0.572
Junior Secondary	0.167
Senior Secondary	0.208
College	0.050

Source: IFLS 1

Table 7: Distribution of Woman-Year Observations by Choices Made

<i>Choice</i>	<i>Percentage</i>
Modern Method and Formal Sector	9.17
Modern Method and Informal Sector	7.44
Modern Method and Not Working	23.82
Traditional Method and Formal Sector	0.96
Traditional Method and Informal Sector	0.55
Traditional Method and Not Working	1.80
No Contraceptives and Formal Sector	10.14
No Contraceptives and Informal Sector	10.78
No Contraceptives and Not Working	35.33
Total	100

Source: IFLS 1

Table 8: Timing of Introduction of the three Types of Contraceptives across EAs

<i>Year</i>	<i>Posyandu</i>	<i>Puskemas</i>	<i>PKKBD</i>
Before 1980	42	175	104
1980	32	17	30
1981	9	11	12
1982	15	11	7
1983	37	17	21
1984	35	5	18
1985	35	10	25
1986	36	8	25
1987	22	3	19
1988	17	4	12
1989	15	6	12
1990	7	7	8
1991	5	6	7
1992	2	5	5
1993	3	1	6
Total *	312	287	312

Notes: Posyandu is Village Integrated Health Posts, Puskemas is Community Health Center, and PKKBD is Family Planning Distribution Points. * In the remaining EAs the particular source of contraceptive has not yet been introduced.

Source: IFLS 1

Table 9: Birth Probability Function

<i>Variable</i>	<i>Estimate</i>
Age of Woman	-0.0109* (0.0021)
Lagged Modern Method	-0.5655* (0.0574)
Lagged Traditional Method	-0.3438* (0.1262)
Duration of Modern method & Lagged Modern Method	-0.0885* (0.0182)
Duration of Traditional Method & Lagged Traditional Method	-0.087 (0.0468)
Constant	-0.3439 (0.0508)

Note:* implies statistical significance at 5%

Dependent variable takes the value 1 if the woman had a birth in period t.

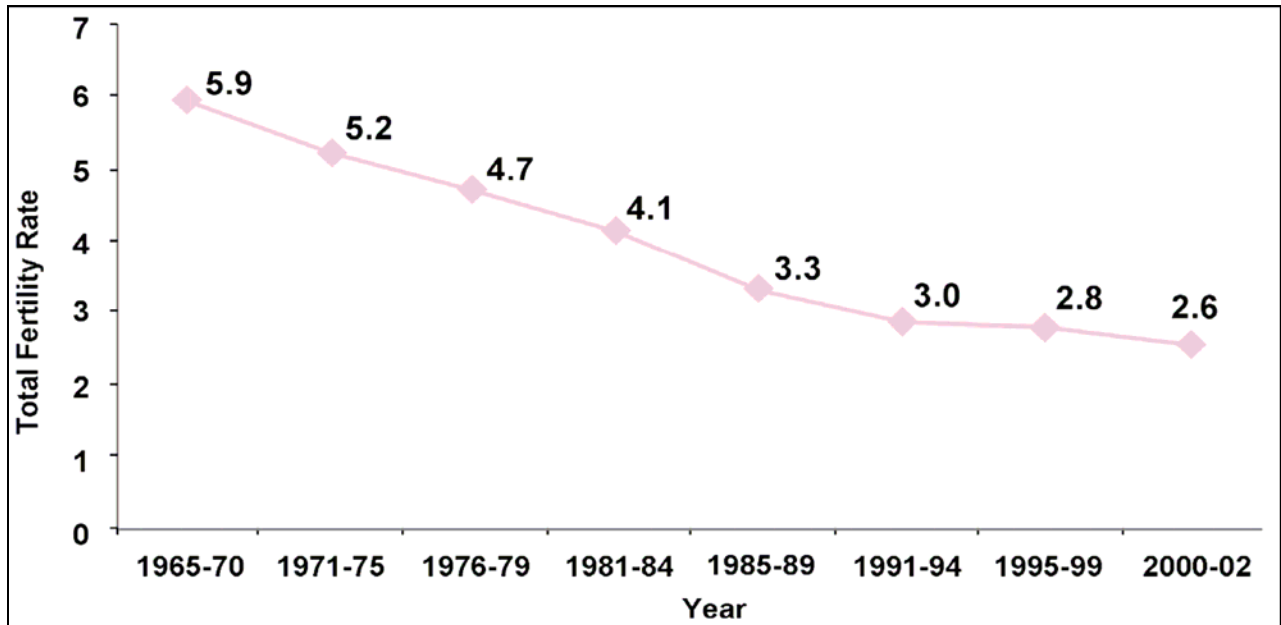
Table 10: Results of Structural Estimation

<i>Variable</i>	<i>Estimates</i>	<i>Standard Error</i>
Modern Method of Contraception		
Age of Woman	0.3103*	0.0022
Religion (Muslim)	0.0211*	0.0019
Education	0.0522*	0.0081
Urban	-0.2105*	0.0054
Presence of Posyandus	0.4218*	0.0439
Presence of Puskemas	0.2013*	0.0087
Presence of PKKBDs	0.3321*	0.0309
Age of Youngest Child	-0.1447*	0.0030
Birth in the previous period	-0.0022*	0.0008
Number of births	1.4528*	0.0687
Duration of modern method	0.8891*	0.0992
Constant	1.8904*	0.0321
Java and Bali	1.4429	1.2208
Traditional Method of Contraception		
Age of Woman	0.0203	0.0220
Religion (Muslim)	-0.0015*	0.0003
Education (More than primary)	-0.041*	0.0048
Urban	0.0021*	0.0007
Presence of Posyandus	0.0002	0.0080
Presence of Puskemas	0.0036	0.0200
Presence of PKKBDs	0.0031	0.0740
Age of Youngest Child	-0.0052	0.0043
Birth in the previous period	0.0013*	0.0009
Number of births	0.0237*	0.0082
Duration of traditional method	0.0019	
Constant	-0.3223*	0.0904
Java and Bali	0.0066	0.0426
Formal Sector		
Age of Woman	1.5672*	0.3050
Religion (Muslim)	-0.6530*	0.0623
Urban	0.2059*	0.0865
Age of Youngest Child	1.2887*	0.0741
Birth in the previous period	-2.6549*	0.0927
Number of births	-1.7381*	0.0373
Duration in formal sector	0.8539*	0.0092

Constant	2.4314	0.0865
Java and Bali	1.002*	0.0004
Informal Sector		
Age of Woman	0.8991*	0.0032
Religion (Muslim)	1.009*	0.0059
Urban	-0.0038*	0.0004
Age of Youngest Child	-0.0012*	0.0001
Birth in the previous period	0.032*	0.0018
Number of births	1.535*	0.0665
Duration in informal sector	-0.0786	0.0540
Constant	1.4220*	0.0081
Java and Bali	-0.9928*	0.0027
Not Choice-Dependent		
Disutility from birth when age>35	-0.2035*	0.0009
Utility from birth spacing	0.0311*	0.0068
Utility from birth	0.0008*	0.0000
Benefit from children	0.019*	0.0002
Consumption		
Marginal Utility of Consumption	0.067	0.0000

Note: * implies statistically significant at 5 percent.

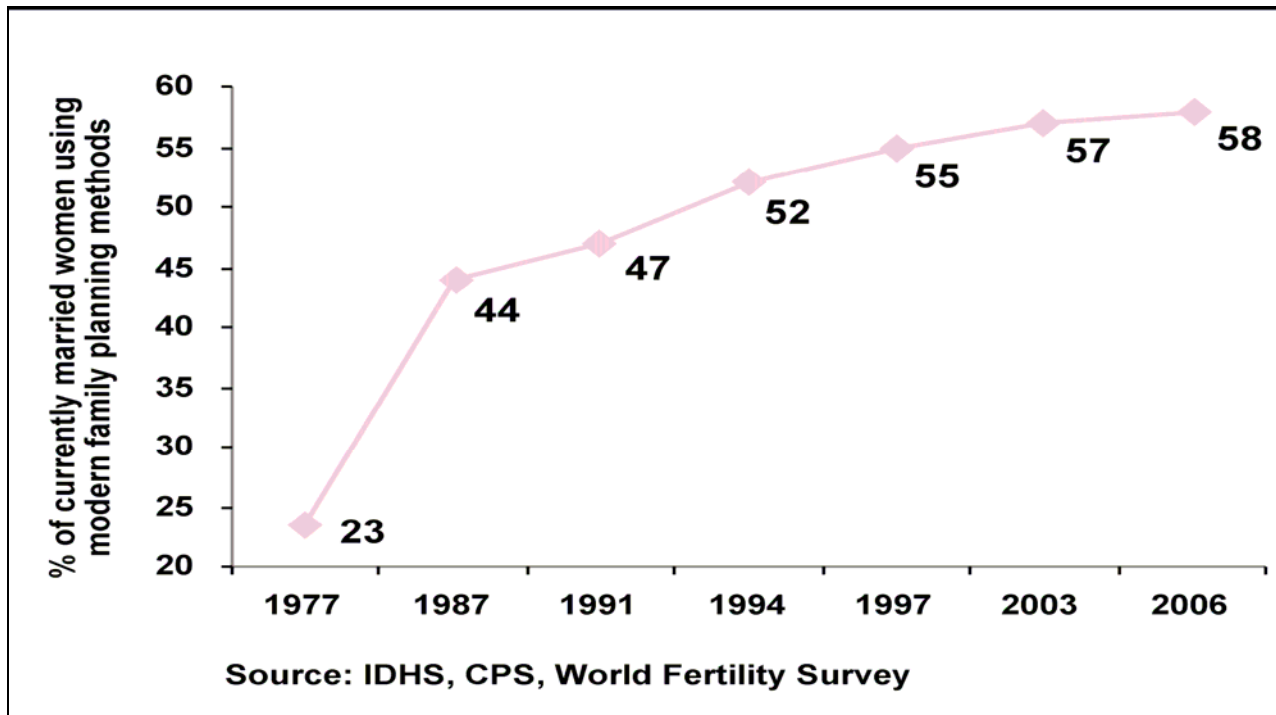
Figure 1: Total Fertility Rate in Indonesia, 1965-70 to 2000-02



Notes: This figure is from Mize (2006).

Source: Contraceptive Prevalence Survey (1987) and Indonesian Demographic and Health Survey (1991, 1994, 1997, 2002-2003)

Figure 2: Contraceptive Prevalence Rate in Indonesia, 1977-2006



Notes: This figure is from Mize (2006).

Figure 3: Phase 1 of the Indonesian Family Planning Program as part of first Five-Year Development Plan



Notes: Shaded regions indicate provinces where the clinic-based approach of family planning was newly introduced: West Java, Jakarta, Central Java, East Java, Yogyakarta, and Bali. These regions adopted a community-approach of family planning in addition to a clinic-based one during phase 2.

Figure 4: Phase 2 of the Indonesian Family Planning Program as part of Second Five-year Development plan



Notes: Shaded region indicates the 10 provinces where family planning was newly introduced: Aceh, North Sumatra, West Sumatra, South Sumatra, Lampung, North Sulawesi, South Sulawesi, South Kalimantan, West Kalimantan, and West Nusa Tenggara. Regions from phase 1 that moved to community-based approach have not been shaded here.

Figure 5: Phase 3 of the Indonesian Family Planning Program as part of third Five-year Development plan

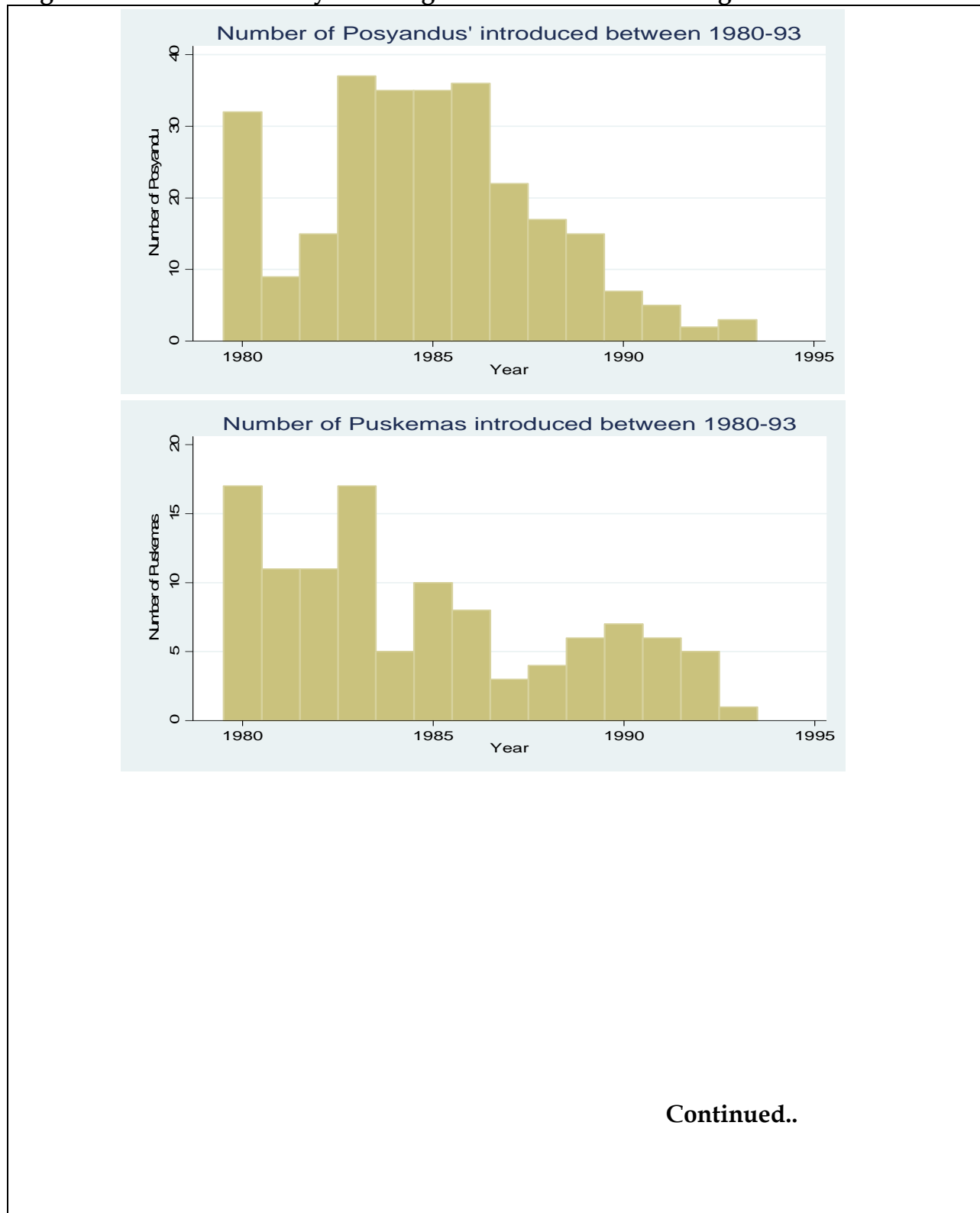


Notes: Shaded regions denote provinces in which family planning program was newly introduced: Riau, Jambi, Bengkulu, East Nusa Tenggara, Central Kalimantan, East Kalimantan, Central Sulawesi, South East Sulawesi, Maluku, Irian Jaya, and East Timor. Shaded regions do not include provinces from phase 1 and phase 2 that may have adopted new approaches to family planning.

Figure 6: IFLS 1 Provinces



Source: IFLS 1

Figure 7: Number of Family Planning Clinics Introduced during 1980-93

Continued..

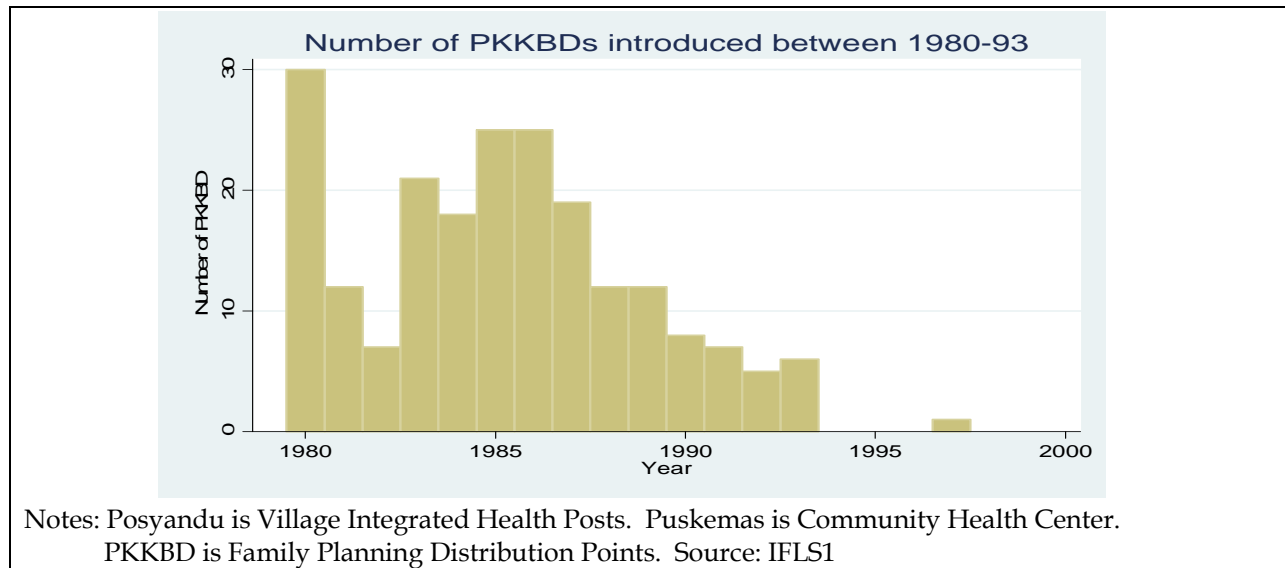
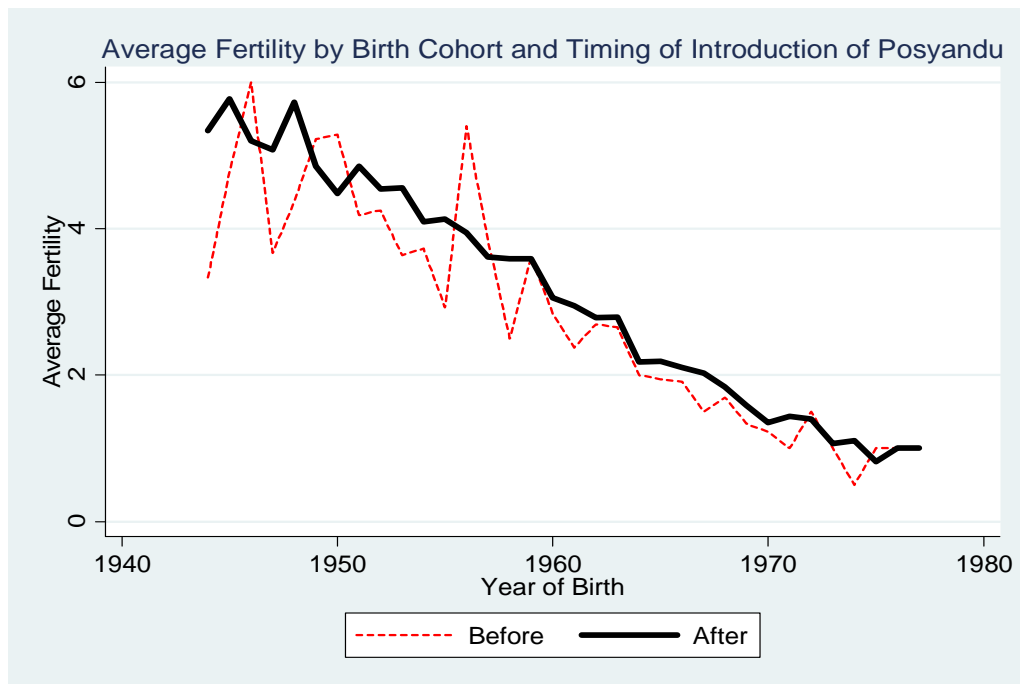
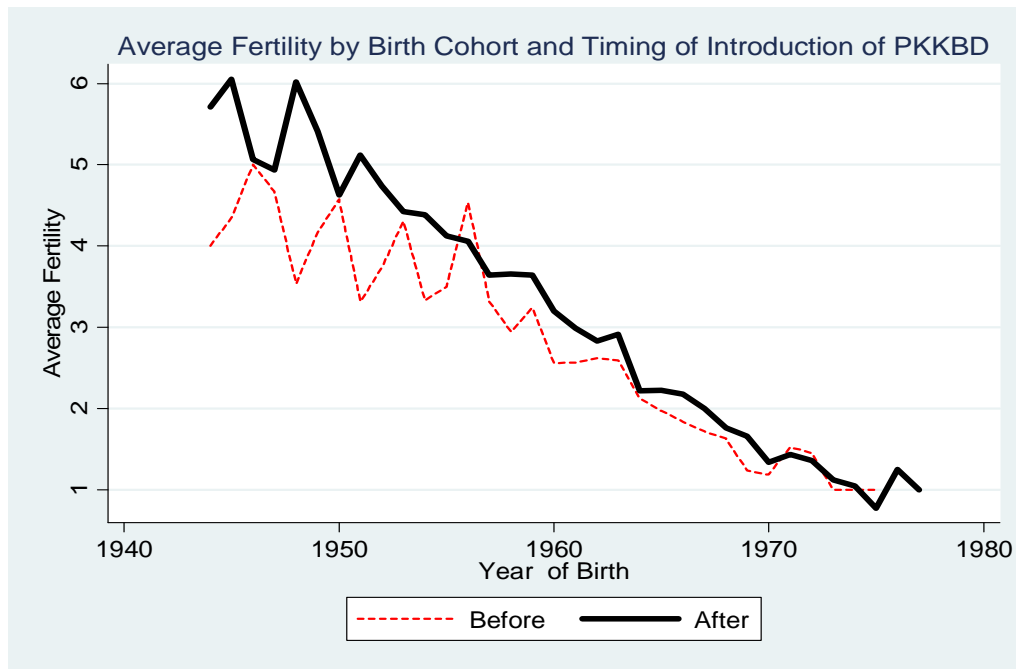


Figure 8: Exogenous Variation in Timing of Introduction of Posyandu



Notes: Posyandu is Village Integrated Health Posts. "After" is for EAs where Posyandu was introduced after 1980 and "Before" is for EAs where Posyandu was introduced before 1980. Source: IFLS 1

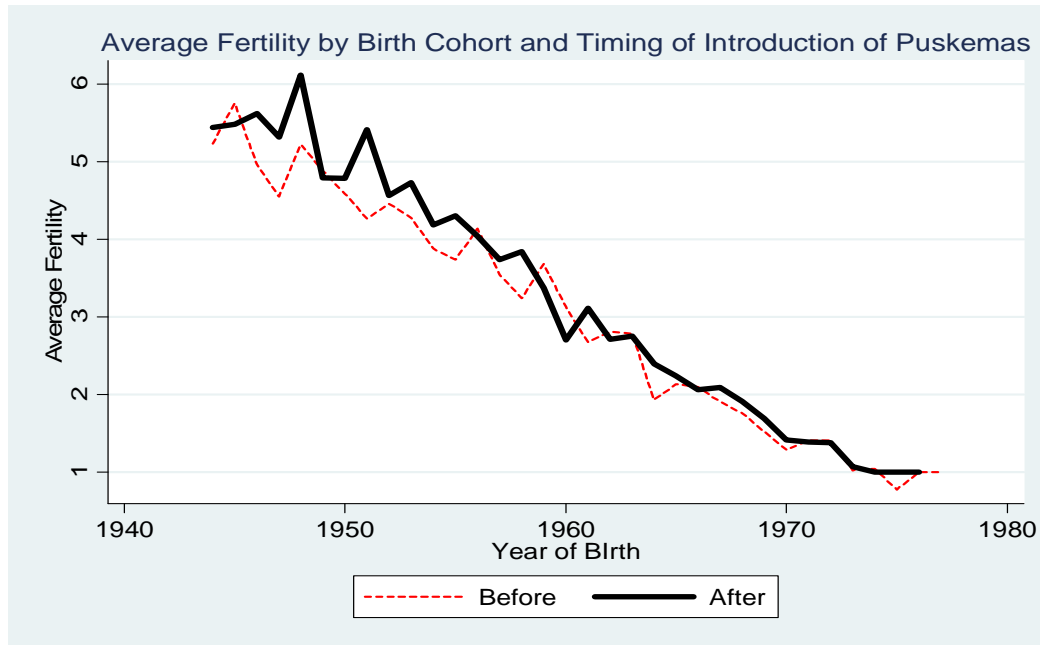
Figure 9: Exogenous Variation in Timing of Introduction of PKKBD



Notes: PKKBD is Family Planning Distribution Points. “After” is for EAs where PKKBD was introduced after 1980 and “Before” is for EAs where PKKBD was introduced before 1980.

Source: IFLS 1

Figure 10: Exogenous Variation in Timing of Introduction of Puskemas



Notes: Puskemas is Community Health Center. "After" is for EAs where Puskemas was introduced after 1980 and "Before" is for EAs where Puskemas was introduced before 1980.

Source: IFLS 1

Figure 11: Real Minimum Wages in IFLS 1 Provinces, 1985-1994



Notes: Real Wages are in 2005 Indonesian Rupiah.

Source: Minimum Wage data was obtained from Arup Suryahadi and David Newhouse.

