THE EFFECTS OF FERTILITY ON FEMALE LABOR SUPPLY

by

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Abstract

This report reviews the effects of fertility on female labor supply, primarily female labor force participation and work hours. Although estimates of the causal relationship between fertility and female labor supply are mixed, this report tries to review why and by how much an additional child in a family affects work decisions and work hours of mothers on average. Statistical analysis shows a decreasing trend in fertility and an increasing trend in female labor force participation throughout the world over the last four decades. Using different specifications and estimation techniques, empirical studies suggest that fertility has negative effects on maternal labor supply because childbearing falls on women and women have lower wage rates than men on average. The negative relationship between fertility and female labor supply is explained by social, economic, and technical forces that affect fertility and female labor supply, including an increase in the value of women's time due to an increase in education levels of women, expensive childcare, and substitutes for children; emphasis on quality instead of quantity of children; an increase in employment opportunities for women; changes in social norms towards supporting women working outside their home; and technical progress in birth control.

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1. Introduction

In the economic development process, fertility decline is almost universal. Fertility has dramatically decreased in most parts of the world, both in developed and developing countries. Developed countries experienced a demographic transition from high to low fertility in the last quarter of the nineteenth century, while in the most developing countries fertility declined more rapidly in the last quarter of the twentieth century. For some developing countries, this demographic transition is in the middle of their development (Schultz, 1981, 2005; Del Boca et al., 2003). At one time, economic and demographic changes in the development process were studied separately. Demographers focused on finding explanations for the demographic transition, while economic researchers often concentrated on studying economic growth without linking it to population dynamics.

More recently, economists have recognized the importance of fertility and economic changes to theories of development since fertility behavior or demographic changes affect the economic performance of a country in many aspects. For example, higher population growth can decrease the stock of physical capital and negatively affect income per capita. High fertility is often associated with low educational achievement, lowers human capital accumulation, and eventually lowers the economic growth rate. High fertility leads to a profound change in the age structure of the population and tends to increase the dependency ratio. On the other side, a high fertility rate may also enlarge the labor force and boost output of the countries. Thus, studies of fertility and economic development should recognize the interaction between these two forces.

This report reviews the effects of fertility on female labor supply, primarily labor force participation and female work hours. Most studies recognize the endogeneity of fertility in female work decision and work hour models and then provide methods to remedy the problem of endogeneity, such as simultaneous equations and instrumental variable methods. Empirical results suggest that fertility has negative effects on maternal labor force participation and work hours because childbearing falls on women and women have lower wage rates than men on average. The negative effect of fertility on female labor supply has been explained by social, economic, and technical forces that affect fertility. The size of the negative effect of fertility on female labor supply, however, differs by countries, locations within a country, age group, race, religion, and marital status of women.

Section 2 of the report reviews the causal relationship between fertility and female labor supply. Section 3 discusses fertility and maternal labor force participation. It also tries to explain the fertility decline and the increase in maternal labor force participation. Section 4 reviews methods used in empirical work to estimate the effects of fertility on female employment. Sections 5 and 6 provide the empirical results measuring effects of fertility on female labor supply, both labor force participation and hours of work. Section 7 concludes the report.

2. Causality of fertility and female labor supply

In reality, there is no tight linkage between fertility and female labor supply. Many theoretical models have been developed, and huge numbers of empirical studies have investigated the linkages of a household's behavior such as childbearing, the number of

children, the child's gender, and labor supply of household members. These studies try to investigate how fertility causally affects maternal decisions of participating in work or supplying their time to the labor market. Theoretically, there are four possibilities describing the causal relationship between fertility and labor supply: There are (i) no causal effects of fertility on female labor supply; (ii) the unidirectional causal effect running from fertility to female labor supply; (ii) the unidirectional causal effect running from female labor supply to fertility; and (iv) the bidirectional causal effects between fertility and female labor supply.

Empirical studies of the causal nexus between fertility and female employment found mixed results. For example, Cheng (1999), using the Granger causality test, found no causality from fertility to female labor force participation in Taiwan during 1952-1994, and Papapetrou (2004) failed to obtain statistically significant relationship between female labor force participation and fertility in the United Kingdom from 1958 to 1998. Among the studies finding a causal effect running from fertility to female labor supply are Zimmermann (1985) for Germany from 1960 to 1979, Cheng (1996) for the United States during 1948-1993, Cheng et al. (1997) for Japan from 1950-1993, and McNown and Rajbhandary (2003) for the United States from 1948 to 1997. Michael (1985), applying a bivariate model to examine the causal relationship between fertility and female employment in the United States, found that the female labor force participation positively granger caused fertility. The author also found the unidirectional causal effect running from lagged fertility to female labor force participation. Bidirectional causality is also supported by Klijzing et al. (1988) for Dutch data from 1977-1984, Cramer (1980) for the

United States, Engelhardt et al. (2001) for panel data of selected European countries and the United States from 1960-1994.

3. A fertility decline and an increase in female labor force participation

Over the last four decades, fertility has declined throughout the world, especially in the developing countries. Accompanying the fertility decline, the female labor force participation rate substantially increased throughout the world. This section provides some facts about decreasing fertility and increasing female labor force participation rate and reviews some of the main explanations for these facts.

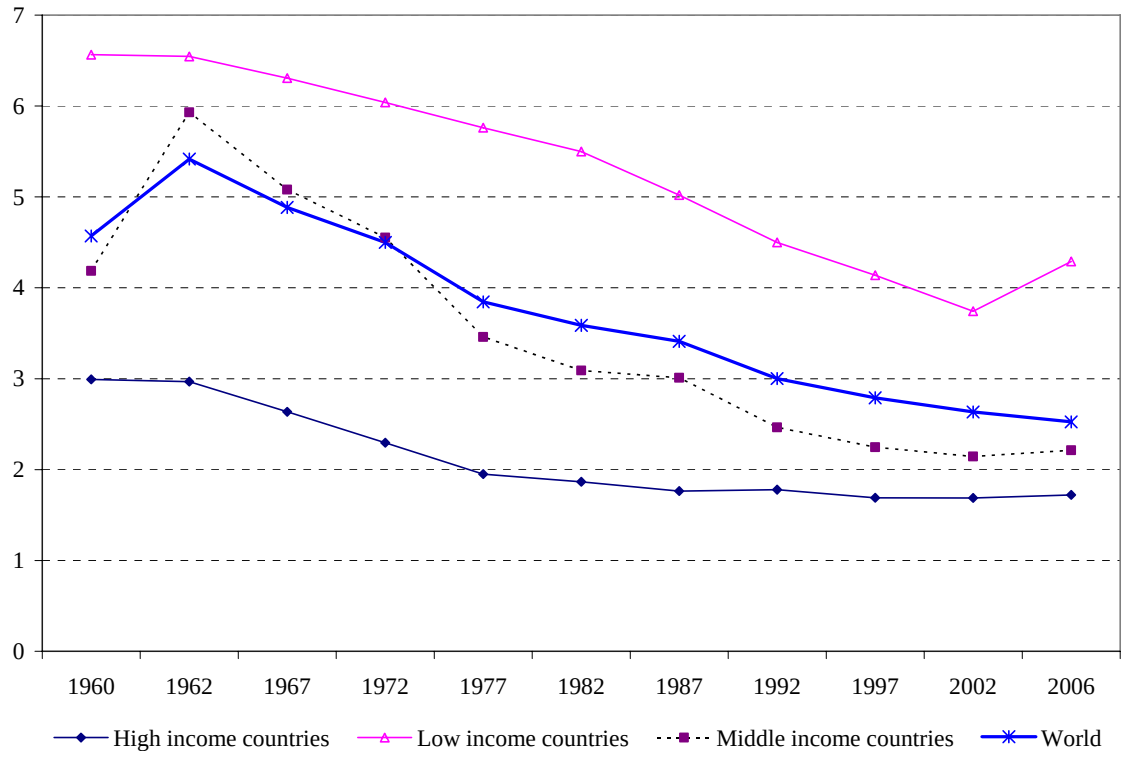
3.1. The decrease in fertility over time

During the period 1962-2006, there was a sustained decline in fertility over the world, in high-income, middle-income, and low-income countries. Figure 1 shows that the fertility of the world declined from 5.42 children per woman of child-bearing age in 1962 to 2.52 children in 2006, a decline of over 50 percent. This decrease in fertility is similarly found in high-income, OECD, and middle-income countries. For example, the fertility decline was 63 percent for middle-income countries, 44 percent for high-income countries, and 35 percent for low-income countries during the same period.

Some explanations for the fertility decline over time and its negative correspondence to income are found in the demographics and economics literature. Most of the explanations are based on economic theories of time and physical wealth allocation within households among production and consumption activities. The allocations of time and wealth of families help to interpret the changes in fertility over time. Some other

explanations are based on technical progress in birth control and changes in social attitudes regarding women and their work outside the home.

Figure 1: World fertility trend during 1962-2006



Source: World Development Indicators 2008, CD-ROM.

The first explanation for declining fertility is increasing value of women's time, which is usually measured by their wages earned outside the home or by their schooling attainment. The increasing value of women's time increases the opportunity cost of having children, so parents are more likely to work outside their home rather than to participate in home production by supplying child services. Parents, thus, decide to have fewer children in their family (Schultz, 1981, 1997; Mincer, 1963). The second reason is an increase in demand for goods and services that are substitutes for number of children, which may include quality of the children (human capital) rather than quantity of children, health care

services for the elderly, social benefits, old-age pensions, and development of intergeneration capital markets. All these factors are expected to decrease demand by parents for children and to reduce fertility (Becker et al., 1981; Hirschman, 1994).

The third explanation for lower fertility is based on changes in socio-cultural structures such as rising age at marriage; a shift from traditional to a nuclear family system (Smith, 1980; Bulatao, 1985); a secularization process in which government encourages small family (Lesthaeghe and Wilson, 1980); increased childcare costs; and agricultural growth. Whittington and Stapleton (1995) argue that an increase in agriculture output would increase demand for children, other things equal. But because of technological progress, the marginal product of another child tends to fall. These changes are believed to reduce fertility in most developing countries and some developed countries for the last half of the twentieth century. The fourth reason is family planning programs and development of birth-control techniques. Family planning has had a great impact on the fertility decline in developing countries for the last 50 years (Schultz, 1997). Along with the family planning programs, Gertler and Molyneaux (1994) argue that birth-control techniques help to reduce financial and psychic costs of effective control. These techniques also reduce uncertainty regarding the timing of births and fertility, so they help women in planning their families and eventually reducing fertility.

Figure 1 also shows that the average fertility is higher in poorer countries and lower in higher-income countries at any point in time, and a high fertility rate is one of key characteristics of the developing countries. For example, in 1962 the average fertility in high-income countries was 2.99 children per women, while the numbers for middle-income and low-income countries were 5.99 and 6.56 children, respectively. In 2006, the

average number of children per women of child-bearing ages was 1.72 for high-income countries, 2.21 for middle-income countries, and 4.29 for low-income countries. Higher income is generally associated with lower fertility because an increase in income or per capita income leads to an increase in opportunity costs of having children and education level of women. These factors are expected to reduce fertility (Whittington and Stapleton, 1995; Schultz, 2005). Recently, for the developing/less developed countries, the fertility tends to increase, and the empirical studies find that poorer countries have a higher population growth rate and larger household size. High fertility is persistent and driven by lack of economic growth, poor access to birth control techniques, and ineffective family planning programs in these countries (Aassve et al., 2005).

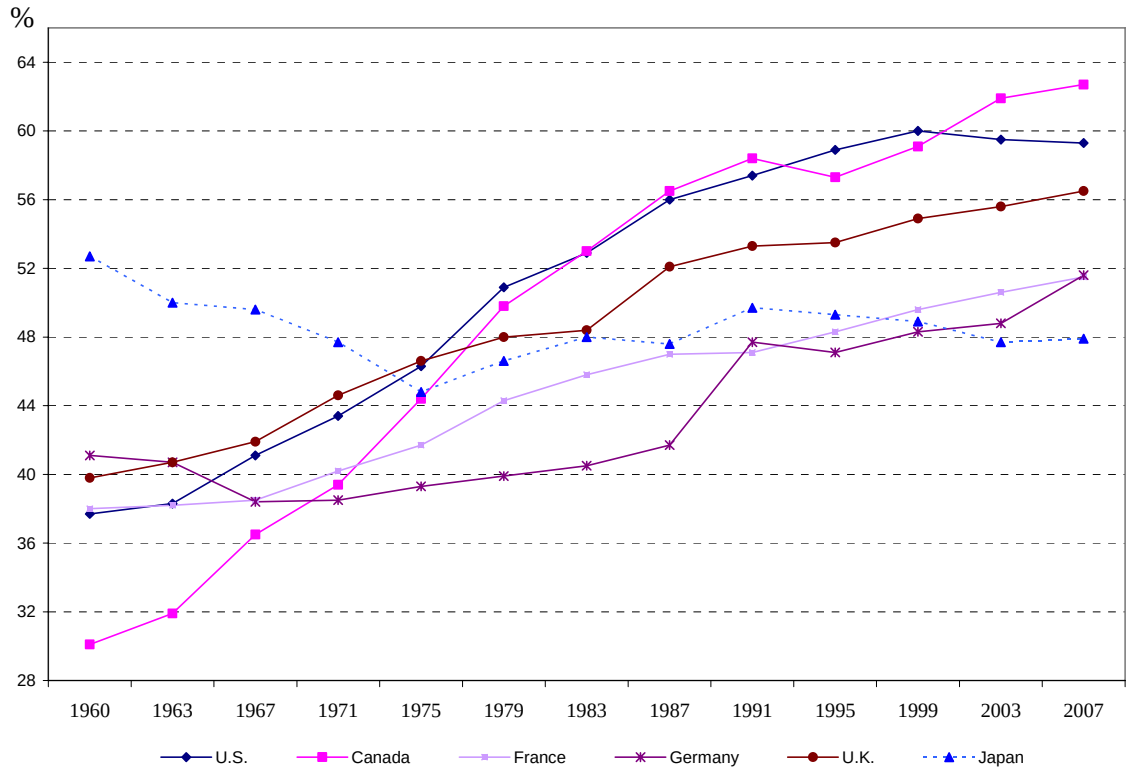
3.2. The increase in female labor force participation rate

One important dimension of labor supply is female labor force participation. In the early twentieth century, very few women participated in the labor force. They were at home to take care of the family and manage the intra-household work, and certain professional work was viewed as unfit for women. Most women did not work in the labor market, and they just spent time on daily chores around their home. Over time, however, the number of women participating in the workforce has continuously increased. This trend appeared over the world in low-income, middle-income, and high-income countries (Davis, 1997). Figure 2 provides the female labor force participation rate of selected developed countries from 1960 to 2007.

Female labor force participation rates substantially increased in the last four decades for those countries, except for the special case of Japan. During the last four

decades, the percentage of women participating in the workforce increased dramatically. It was almost twice as high in 2007 as in 1960, and in some countries this increase was even

Figure 2: Female labor force participation rates of selected countries, 1960-2007



Source: Department of Labor, Bureau of Labor Statistics.
ftp://ftp.bls.gov/pub/special.requests/ForeignLabor/lfcompendiumt04.txt

higher. For example, Canadian female labor force participation rate more than doubled between 1960 and 2007.

Among the reasons for increasing female labor force participation are the decline in fertility, increasing education levels of women, more job opportunities for women, and changes in social attitudes. Becker (1985) argued that childbearing mostly fell on women's shoulders, so a decrease in fertility relieved women from taking care of children and doing housework and other forms of household activities. Many studies found a negative relationship between fertility and female labor participation (Heckman, 1974; Heckman

and Willis, 1977; Angrist and Evans, 1998; Bloom et al., 2007). Thus a decrease in fertility leads women to have more time to work outside their home.

The second reason for the increase in female labor force participation is an increase in female educational attainment over time. Theoretical and empirical studies show a strong and positive relationship between female educational attainment and probability of participation in the labor force, and education is one of the most important factors explaining differences in female labor force participation across countries and over time (Goldin, 1995; Stanfors, 2003). Education is considered as an investment in human capital, and those highly educated women have a strong incentive to participate in the workforce to get back their investment. In addition, high education generally results in high earnings from work, and it increases the costs of leisure or doing non-market activities. High education is, thus, positively correlated with female labor force participation.

The third factor is increasing job opportunities of women. There has been a substantial increase in traditionally female jobs such as sale clerks in retail trade, nurses, administrative support, secretaries and typists, and food preparation services. Women have also increased their presence in many occupations that used to be male-dominated. Thus, more job opportunities for women increase female labor force participation. Another reason to explain the increase in female labor force participation is an increase in real wages paid to women over time, so it makes leisure or non-market activities more expensive, and women want to participate in the workforce.

The fifth factor explaining the increase in female labor force participation is the change in social attitudes concerning appropriateness for married women working outside their household, even after having a newborn child. Some statistical studies argue that the

change in social attitudes regarding women and their work outside the home has played an important role in explaining why more and more women participate in the labor force (Fernandez et al., 2004).

4. Estimation methods

This section reviews the main methods that have been used to estimate the effects of fertility on maternal labor supply, especially labor force participation. In the economics and demographics literatures, methods used to estimate the effects of fertility on female labor supply are often categorized by how those empirical studies deal with potential endogeneity of fertility.

4.1. Exogeneity in fertility

Exogeneity of fertility means that parental decisions of having another child and employment (labor force participation and hours worked) are not simultaneously determined. In other words, fertility is determined outside the models of parental labor supply. Many studies assume that fertility is an exogenous variable when estimating the effects of fertility on maternal labor supply. For example, Gronau (1973) investigated wives' decision of whether to participate in the labor force and wives' time allocated among market activities, housework, and leisure based on assumptions that fertility was an exogenous variable. Heckman (1974) and Heckman and Willis (1977) considered a common set of variables that determine changes in female labor supply. In those studies, the authors also assumed that fertility was an exogenous variable in the models that describe work decision and work hours of women and unmarried women.

In several other papers, fertility is recognized to be potentially endogenous. When using testing procedures for endogeneity, however, the authors do not find endogeneity of fertility in female labor force participation equations and female work hour equations. This result can be found in the studies of Carlin and Flood (1997) and Cristia (2006). Since the preceding studies treat fertility as an exogenous variable in the models of parental work decision and work hours, Probit and Ordinary Least Squares (OLS) models are sufficient to estimate the effects of fertility on maternal labor force participation and hours worked, respectively. Assuming exogeneity of fertility may result in a bias in estimating the effects of fertility on female labor force participation and work hours, and it leads to misleading inferences, if fertility is an endogenous variable in those models. The following section reviews methods used to estimate the effects of fertility on maternal working decision and work hours when fertility is an endogenous variable.

4.2. Endogeneity of fertility

Most studies investigating the effects of fertility on female labor supply use the Hausman test for testing endogeneity of fertility. Many papers find that fertility is an endogenous variable in maternal work decision and work hour models. That means that female labor supply and fertility are simultaneously determined. According to the econometrics theories, the presence of endogeneity of fertility creates a bias and inconsistency in Probit, Logit, and OLS estimators. Thus, those papers use methods other rather than Probit, Logit, and OLS to estimate the effects of fertility on maternal labor force participation and hours worked. Common methods used to remedy the endogeneity problem include simultaneous equations and two stage least squares or instrumental variable models.

Simultaneous equations

If fertility and female employment variables are jointly determined, a two-equation model can be used to estimate the effect of fertility on maternal labor force participation and the effect of maternal labor force participation on fertility. In this system, fertility and maternal labor force participation are two dependent variables, and they are affected by each other.[1] For example, Cain and Dooley (1976) used the simultaneous equation model to estimate the effects of fertility on labor supply of black, white, and Spanish-American women using data from the 1970 census of standard metropolitan statistical areas. By using a simultaneous equation model, Gregory (1982) investigated effects of fertility on female labor force participation in Soviet Union and Eastern Europe. The simultaneous equations used to estimate the effects of fertility on female labor force participation and hours worked are also found in Schultz (1978), Fleisher and Rhodes (1979), Robinson and Tomes (1982).

Using the simultaneous equations may lead to problems of over-identification. In this case, input information for solving the system is more than needed, so one has to impose certain restrictions on the reduced-form coefficients and test certain hypotheses. Simultaneous equations give unbiased and consistent estimators for just-identified systems but inconsistent estimators for over-identified system. Fortunately, one can overcome this issue and obtain consistent estimates measuring the effects of fertility on female labor force participation and hours worked by using two-stage least squares and instrumental variable methods.

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[1] The general form of simultaneous equations is $\begin{aligned} Fer &= f(X_1, Ls) \\ Ls &= g(X_2, Fer) \end{aligned}$, where Fer and Ls are fertility and labor supply, respectively; X_1 and X_2 are vectors of independent variables.

Two-stage least squares

Another way to remedy the endogeneity of fertility is two-stage least squares. In the first stage, fertility is specified and estimated as a function of instruments and other independent variables, and then one can obtain predicted fertility, which is exogenous. In the second stage, the effects of fitted/exogenous fertility on maternal labor supply are estimated.

Instrumental variable methods

The instrumental variable model is another method to remedy endogeneity of fertility. Using instrumental variables helps to generate exogenous variations in fertility, and this exogenous fertility is used to estimate the effect of fertility on female working decision and work hours. Using instrumental variable model requires valid instruments. Theoretically, a valid instrument must satisfy two conditions: an instrumental variable should be uncorrelated with the error terms, and it should be highly correlated with the potential endogenous regressor(s).[2] In this context, it means that the instrumental variables have no correlation with factors that directly affect maternal labor supply and that the instruments are correlated with fertility.

Many instrumental variables have been used in the literature to generate exogenous variations in fertility. For instance, many studies have suggested that a twin first birth is a factor that produces exogenous variations in fertility (Rosenzweig and Wolpin, 1980; Bronars and Grogger, 1994; Jacosen et al., 1999; Oyama, 2001; and Black et al., 2007). Bloom et al. (2007) used abortion legislation as an instrumental variable for fertility, while Kim and Aassve (2006) used the contraceptive choice of couples to generate the

[2] Mathematically, an instrument Z must satisfy $Cov(Z, \varepsilon) = 0$ and $Cov(Z, Fer) \neq 0$.

exogenous variations in fertility. Angrist and Evans (1998) used a mixed sibling-sex composition as the instrumental variable. Other studies used the gender of the first child as the instrumental variable (Chun and Oh, 2002; Lundberg and Rose, 2002). Theoretically, those instruments are uncorrelated with other independent regressors and highly correlated with fertility. For example, mixed sibling-gender variable does not have correlation to other independent variables in Angrist and Evans (1998) model, but it is strongly correlated with fertility. Angrist and Evans (1998) argue that if the first two children of a household are either two boys or two girls, this household tends to have other children. However, if the first two children of the household are mixed, one boy and one girl, the chance of having more children significantly decreases.

Using the IV methods to estimate the effects of fertility on maternal labor supply can yield unbiased estimators even when fertility is or not exogenous. Thus, IV methods are a preferred technique for empirical studies.

5. Fertility and female labor force participation

The economics and demographics literatures discuss two different effects of having an additional child in a household on maternal labor force participation. The *specialization effect*, named by Becker (1985), argued that an increase in family size would lead women to spend more time and energy on supplying child services because childbearing mostly falls on women, but men are likely to spend more energy and time in the labor market due to the higher return of labor on the labor market. Thus women are less likely to participate in the labor market activities in response to an increase in family size. The second effect is the *home-intensive effect*, which is used in Lundberg and Rose (1999). This argument is

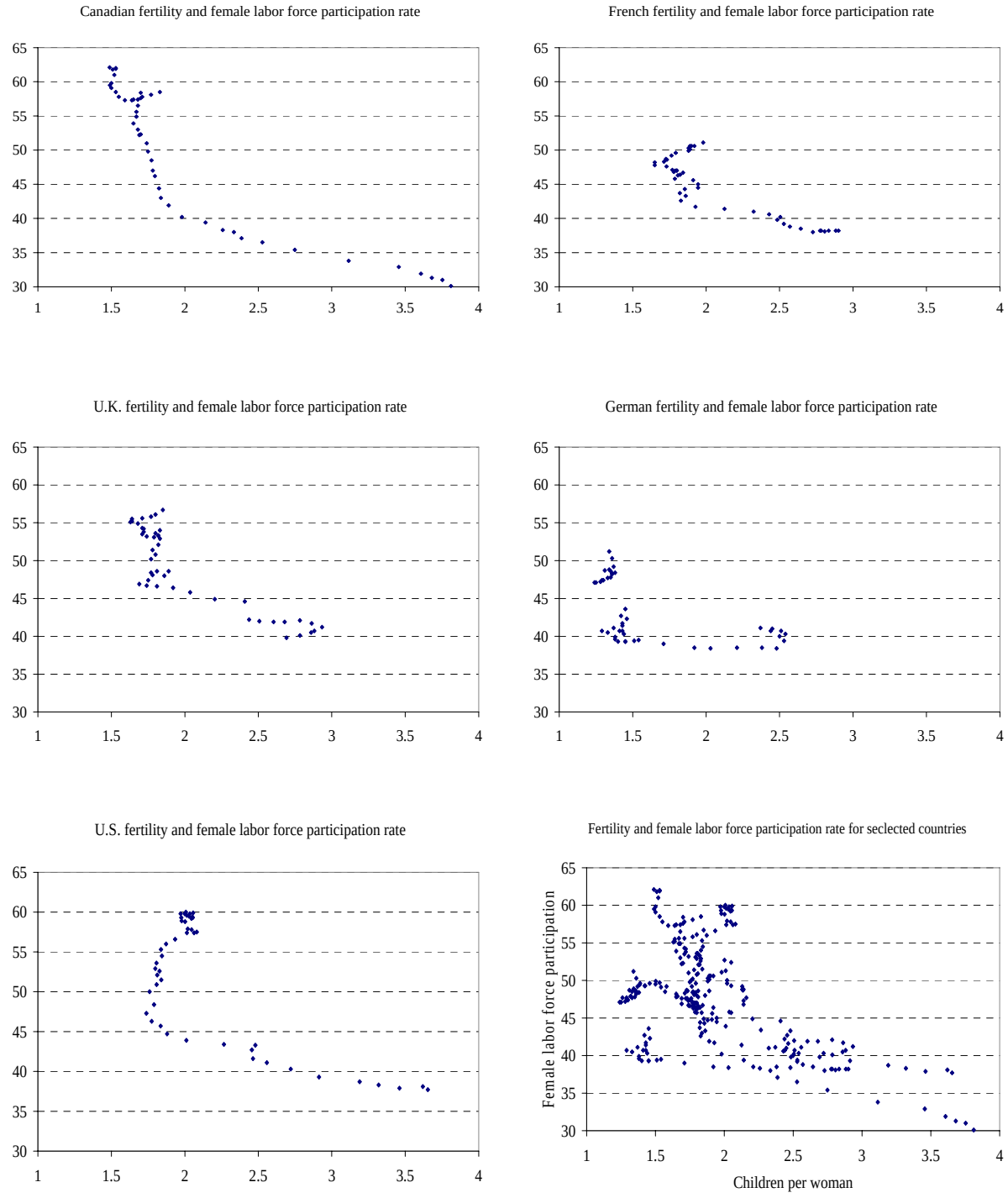
that more children increase the value of parents' time as an input of the home production. In this case, thus, women tend to reduce the probability of going to work outside the household. Both arguments predict that the female labor force participation decreases in response to an increase in fertility, and this prediction is confirmed by empirical analyses.

Statistical analyses show that, over the last four decades, labor market participation rates of women significantly increased, while fertility declined throughout the world. Figure 3 describes this relationship in selected countries from 1960 to 2006.[3] As shown in Figure 3, a negative nexus between fertility and maternal labor force participation is found in Canada, France, Germany, the United Kingdom, and the United States, while this negative relationship is more clearly observable in the combined sample of countries. Similar statistical results were also found in cross-country statistical studies (Brewster and Rindfuss, 2000; Engelhardt et al., 2001; Engelhardt and Prskawetz, 2002; and Engelhardt et al., 2004).

Almost all empirical studies on motherhood and the labor market behavior of women have found that having children significantly reduces women's labor force participation rates. The decrease in probability of women participating in the labor force in response to an increase in the family size differs by age, race, marital status, and education of women. Table 1 provides some empirical results of the effects of fertility on maternal labor force participation. Note that empirical results in the Table 1 show the average effect of having an additional child on working decision of women.

[3] Due to the data availability, this report just provides a statistical analysis for countries, for which data on fertility and female labor force participation rates are continuously available for the period of 1960-2006. They are Canada, France, Japan, Germany, the United Kingdom, and the United States. The data come from Department of Labor, Bureau of Labor Statistics.

Figure 3: Scatter plot of fertility and female labor force participation rates for selected countries, 1960-2006



Source: Bureau of Labor Statistics and World Development Indicators, 2008.

Note: Due to data availability, the countries selected for this purpose are Canada, France, Japan, Germany, the United Kingdom, and the United States.

Table 1: Some empirical estimates of the effects of fertility on female labor force participation

Authors	The effects	Sample of	Dataset
Gregory (1982)	-25.10%	Soviet Union women	Time series cross section of Eastern European countries and the Soviet Union
Nwakeze (1987)	-17.20%	Nigerian women	Nigeria Fertility Survey 1981/1982
Waddoups (1997)	-21.0%	Pooled sample	National Healtb Interview Survey. 1987-Adoption Supplement
Waddoups (1997)	-19.70%	Non-adopting child sample	National Healtb Interview Survey. 1987-Adoption Supplement
Waddoups (1997)	-19.40%	Adapting child sample	National Healtb Interview Survey. 1987-Adoption Supplement
Angrist and Evans (1998)	-17.0%	U.S. women	1980 and 1990 Census Public Use Micro Sample
Chun and Oh (2002)	-27.5%	Korean women	Korean National Survey of Family Income and Expenditure in 1996
Rica and Ferrero (2003)	-17.0 to - 39.0%	Spanish women	European household panel for Spain 1994-1998
Assaad (2004)	-2.2 to -7.5%	Moroccan women	Moroccan Living Standards Measurement Study, 1990-1991
Shin and Moon (2006)	- 15.9%	U.S. sample women	National Longitudinal Survey of the Young Women 1968-1988
Shin and Moon (2006)	- 21.1%	U.S. women teachers	National Longitudinal Survey of the Young Women 1968-1988
Cristia (2006)	-26.0%	U.S. sample	National Survey of Family Growth
Bloom et al. (2007)	-5.0 to -15.0%	Panel of 97 countries	Unbalanced five-year panel from 1960 to 2000 for 97 countries
Cruces and Galiani (2007)	-9.70%	Argentina women	National Institute of Statistics and Censuses 1991
Cruces and Galiani (2007)	-9.0%	Mexican women	National Institute of Statistics and Censuses 1991

Table 1 shows that the negative effects of fertility on maternal labor force participation were found over the world regardless of regions and national income. For example, the negative effect of fertility on female labor force participation was found in

Nigeria with GDP per capita of $288 at the time of the paper's publication in 1987; in Mexico, Argentina, South Korea, and Russia, which are middle-income countries; and in United States and European countries, which are high-income countries.

The size of the effects of fertility on female labor force participation also differs by age of mothers, in general, and age of mothers at the first birth. Bloom et al. (2007) showed that, with an additional child, maternal labor force participation decreased by 10 to 15 percentage points in the women's age group 25-39, and by 5 to 10 percentage points for women between the ages of 40-49. Assaad (2004) studied the effects of fertility on probability of participating in the labor force of Moroccan women and found that, for first birth, having a child at a later age decreased the probability of women going to work by a greater amount. For example, if women have the first birth at 20-24 years of age, their probability of participating in the labor force is 0.49% lower than those who have the first birth at 15-19. The probabilities of going to work of women who have first birth at 30-34 and 50-54 are 2.03% and 5.63% lower, respectively, than that of women who have the first birth at 15-19.

The size of the negative effect of fertility on maternal labor force participation also differs by race and education of women. It is plausible that differences in female labor force participation responsiveness to number of children are explained by race and educational attainment. The negative effect of fertility on female labor force participation is more pronounced for white women than for their black counterparts (Lehrer, 1992). In addition, the higher the education of women, the stronger and more negative the effects of fertility on maternal labor force participation (Rica and Ferrero, 2003). Angrist and Evans (1998) found that white women decreased their labor force participation after they had the

first and second child. Black women's labor force participation, however, was not significantly affected until they had the third child.

The negative effect of fertility on maternal labor force participation differs very little among never-married and married women. For example, Francesconi (2002) found that the effects of children on mother's work decisions are similar for married women and never-married women. Having an additional child decreases probability of participation in the labor force of married women by 19.6 percent and by 19.1 percent for never-married women. Empirical results from Angrist and Evans (1998) show that the presence of the third child reduces the probability of working by 17 percentage points for both the full sample and the married women subsample.

When studied for the married women sample only, the effects of fertility on probability of participating in the labor force by married women are strong. For example, using the Korean National Survey of Family Income, Chun and Oh (2002) found that an additional child reduces the probability of participating in the labor force of married women by 27.5 percent and by 26 percent for the American women (Cristia, 2006). Similar results are found in Cain and Dooley (1976), Gregory (1982), and Lehrer (1992). This conclusion is that having an additional child discourages the labor force participation of married women.

In addition to the explanation based on the specialization and home-intensive effects of having a new baby on female labor force participation, there are other explanations for the negative effects of fertility on maternal labor supply. Some studies used the term "second demographic transition" to describe the fall in the propensity to have children and the increase in economic status of women (Lesthaeghe, 1995). Some papers

referred to the higher opportunity cost of motherhood, particularly for high-skilled women. Becker (1992) argued that the decreasing propensity to have children resulted from the rise of women's education attainment and labor market activities.

Since the mid-1980s, however, European countries showed both high levels of female labor force participation rates and high levels of fertility in Denmark and France, while some countries showed low levels of fertility and low female labor force participation such as Spain, Italy, and Greek (Del Boca et al. 2005).[4] Some studies have found a shift from negative to positive correlation between fertility and female labor force participation rate in some western European countries (Brewster and Rindfuss, 2000; Rindfuss et al., 2003, Del Boca et al., 2003). Many studies have tried to explain this positive correlation between fertility and female labor force participation. For example, Matysiak and Vignoli (2007) argued that differences in legal and cultural frameworks across European countries created the positive correlation between those two forces. Brewster and Rindfuss (2000) suggested that the reasons were changes in institutional context such as attitudes towards working mothers, while Del Boca et al. (2003) referred to differences in the income effects of women's wages and effects of unemployment among European countries. Kogel (2004), however, argued that the negative relationship between fertility and female labor force participation would be found if studies took into account heterogeneity across countries. A similar conclusion was found in Engelhardt et al. (2004) and Apps and Rees (2004).

[4] See more detail in the appendices A1 and A2.

6. Fertility and female hours worked

This section reviews the effects of fertility on maternal work hours presented in the demographics and economics literatures when women have an exogenous increase in fertility. As discussed previously, the literature suggests that there are two effects of children on parental labor supply. The specialization effect argues that an increase in family size would lead women to spend more time and energy on supplying child services because of the increase in the intensity of child care, but men are likely to spend more energy and time on labor market due to their generally higher return to labor (Becker, 1985). The home-intensive effect argues that more children increase the value of parental time as an input of household production by supplying child services; thus, parents are likely to reduce their labor supply (Lundberg and Rose, 1999). According to both arguments, women would reduce their labor supply in the labor market in response to an increase in family size, while the male labor supply may increase or decrease, depending on which of the two effects dominates.

Evidence from empirical studies of fertility and female labor supply shows that there is a strong negative effect of fertility on work hours of women. Table 2 provides some key empirical results of the effects of fertility on maternal hours worked. The effects of fertility on female work hours presented in the Table 2 are measured by the average effect of an additional child on maternal hours worked, holding other factors constant.

Table 2 shows that size of the effects of fertility on female work hours are different depending on country samples, race, religion, and martial status of women. Uunk (2005), for example, found that women from Scandinavian countries, Belgium, France, and

Table 2: Some empirical results of the effects of fertility on female hours worked

Authors	The negative effects of one more child	Sample of	Dataset
Chiswick (1986)	4.6 to 6.9 hours per week	Second-generation Americans	1970 Census of Population
Vella (1993)	10.6 to 12 hours per week	Australian women	The 1985 panel of the Australian Longitudinal Survey
Angrist and Evans (1998)	6.4 to 6.8 hours per week	U.S. women	1980 and 1990 Census Public Use Micro Sample
Milimet (2000)	0.45 to 0.7 hours per day	U.S. women	Panel Study of Income dynamic in 1976
Uunk et al. (2005)	2 to 20 hours per week	European countries	Panel data of 12 countries
Kim and Aassve (2006)	1.1 to 3.6 hours per week	Indonesian women	Indonesian family life survey in 2000
Cruces and Galiani (2007)	8.1 to 9.6 hours per week	Argentinean women	National Institute of Statistics and Censuses 1991
Cruces and Galiani (2007)	6.3 to 8.6 hours per week	Mexican women	National Institute of Statistics and Censuses 1991

southern European countries had modest reductions of 2 to 5 hours in work hours per week while women from Ireland, the United Kingdom, the Netherlands, Germany and Austria showed more substantial reductions of 8 to 20 hours per week in response to an additional child in the family. The effects found in this study are much larger than those generally found in the literature because using cross-sectional data overestimates child effects (Van der Lippe, 2001).

The effect of fertility on female work hours is much weaker in developing countries than in developed countries (Lehrer and Nerlove, 1986). Table 2 shows that women in Indonesia reduce work by 1.1 to 3.6 hours per week in response to an increase in fertility,

and this effect is much smaller than that of American, Australian, and European women. To give an appropriate explanation, several authors have considered differences in the availability and prices of childcare among households, mother's education, and ease of female employment. For example, in developing countries, the opportunity cost of having a child is relatively cheap and family childcare is available (says grandparents, older children, and other relatives). Those factors lessen the effects of fertility on female work hours in the developing countries compared to those in developed countries (Lehrer and Nerlove, 1986).

Several studies have documented that presence of a child has different effects on maternal labor supply depending on the race and religion of women. Bell (1974) and Lehrer (1992) found that an increase in family size had a greater depressing effect on work hours of white women than black women. Black mothers are more likely to engage in the labor market in order to maintain the basic expenditures of their family. This result does not imply that black women care less about their children. Instead, black mothers find it easier to access both low paid and unpaid childcare services. Another factor is the differences in education between white and black mothers. Survey data confirm that, on the average, black women have lower education and higher fertility than white women. However, whether the effects of the presence of a child on the labor supply of highly educated women is the same for black women and for white women is not fully investigated (Lehrer and Nerlove, 1986).

In a study of the effects of fertility on Jewish and non-Jewish women, Chiswick (1986) found that the effects of an additional child on work hours of mothers were more pronounced for Jewish women. An additional child reduced the numbers of work hours per

week and the proportion of weeks worked by 4.6 hours and 12 percentage points for non-Jewish women and by 6.9 hours and 20 percentage points for Jewish women, respectively. According to Lehrer and Nerlove (1986), however, research on racial and religious differentials in effects of fertility on maternal labor supply has just started and further research on this issue would be desirable. The different effects of fertility on female labor supply depending on races and religions of women groups are found in some empirical studies (Hill and Stafford, 1980; Lehrer and Kawasaki, 1985).

Nakamura and Nakamura (1992) concluded that the effect of fertility on female work hours is higher for married women than unmarried women. Similarly, Cruces and Galiani (2007) found that having more than two children reduced a mother's work hours by about 8.1 hours per week for never-married mothers and about 9.6 hours per week for married mother in Argentina. A similar effect observed for Mexican never-married and married mothers is 6.3 and 8.6 hours per week, respectively. In the United States, however, the effect of fertility on female work hours per week does not appear to be higher for married women. Angrist and Evans (1998) found that married mothers reduced their labor supply by 6.4 hours per week, while never-married mothers decreased their labor supply by 6.8 hours per week. Because the Aid to Families with Dependent Children and Medicaid serve as a disincentive to work for single mothers (Kimmel, 1997), the negative effect of fertility on their labor supply is likely to be larger for single mothers. Favorable welfare and tax policies, especially the reform of the Earned Income Tax Credit, however, encourage single mothers to pursue more market work than prior to these reforms (Meyer and Rosenbaum, 2001; and Grogger, 2003).

In addition to factors determining the effects of fertility on female labor supply such as countries, race, religion, and marital status of women, the effects of fertility on female work hours are also different among locations within a country such as rural and urban areas (Kim and Aassve, 2006), time periods (Walman, 1983), and in different specifications of models that were used to estimate the effects of fertility on maternal labor supply. For example, Kim and Aassve (2006) find that urban women decrease work hours by 1.1 hours per week, while rural women decrease their work hours by 3.6 hours per week. This difference is explained by flexible work in rural areas and stronger traditional gender power rules in rural areas than urban areas.

7. Conclusions

This report has reviewed the effects of fertility on female labor force participation and work hours. Although estimates of the causal relationship between fertility and female labor supply are mixed, this report tries to review why and by how much an additional child in a family affects work decision and work hours of mothers on average. Statistical analysis shows a decreasing trend of fertility and an increasing trend of female labor force participation throughout the world over the last four decades. Using different specifications and estimation techniques, most empirical studies of fertility and female labor force participation and hours worked confirm the negative relationship between those two forces. The size of these effects varies by country, locations within a country, race, religion, marital status, and educational levels of women.

The negative relationship between fertility and female labor supply is explained by social, economic, and technical forces that affect fertility and female labor supply,

including an increase in the value of women's time due to an increase in education level of women, and substitutes for children; emphasis on quality instead of quantity of children; an increase in employment opportunities for women; changes in social norms towards supporting women working outside their home; and technical progress in birth control.

The negative effect of fertility on female labor supply implies that women are more likely to focus on supplying child services, in which they have higher productivity than what they may obtain from the labor market. The differences in the effects of fertility on female labor supply may attribute to differences in public effort supporting employment of women, and the results might shed the light on consequences of having children in affecting female labor supply.

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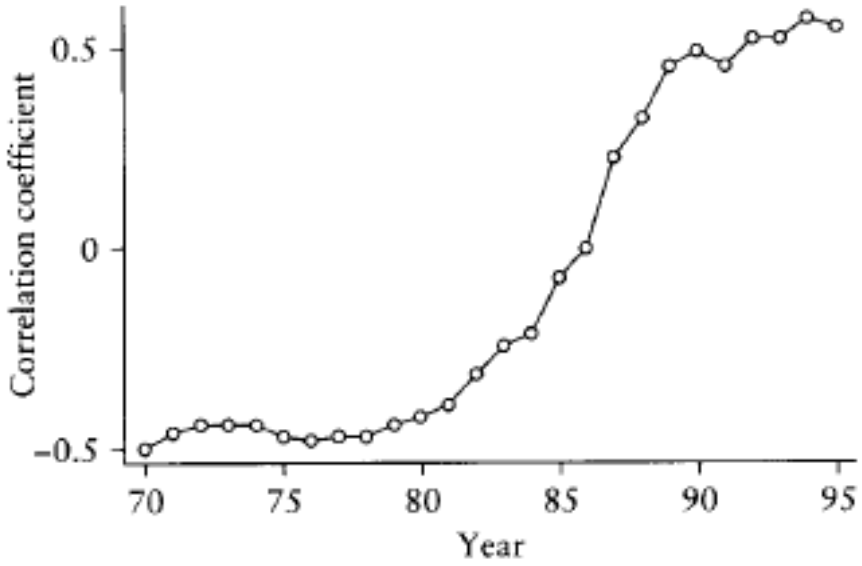
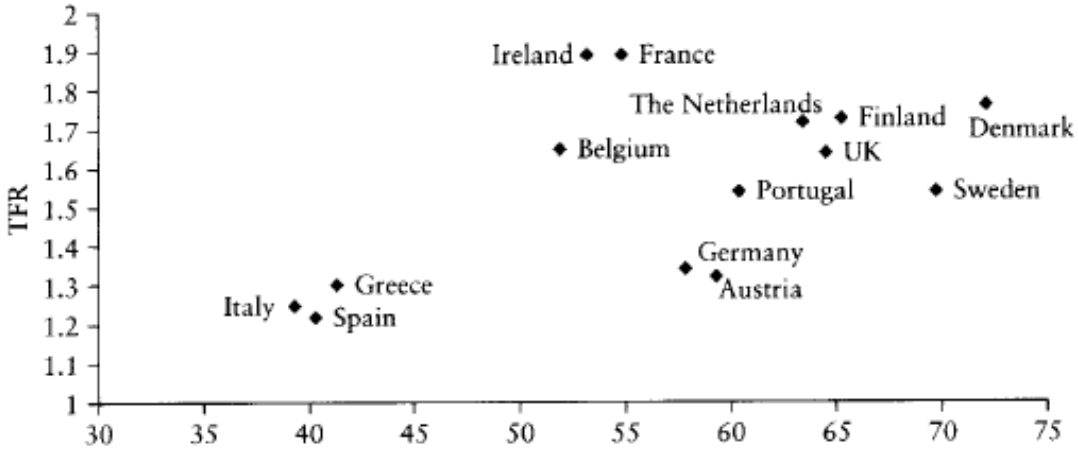
Appendix

Appendix A1: Cross-European country correlation between fertility and female labor force participation rates



Source: Brewster and Rindfuss (2000), referenced in Del Boca (2005).

Appendix A2: Female labor force participation rate and fertility of European countries, 2000



Source: Del Boca (2005).