EFFECT OF FERTILITY ON FEMALE LABOR SUPPLY IN TURKEY

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

ORHUN SEVİNÇ

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN THE DEPARTMENT OF
ECONOMICS

AUGUST 2011

Approval of the Graduate School of Social Sciences

Prof. Dr. Meliha Altunışık
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

Prof. Dr. Erdal Özmen
Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

Assoc. Prof. Dr. Murat G. Kırdar
Supervisor

Examining Committee Members

Assoc. Prof. Dr. Asena Caner	(TOBB-UET, ECON)	
Assoc. Prof. Dr. Murat G. Kırdar	(METU, ECON)	
Dr. Yusuf Soner Başkaya	(CBRT, RESEARCH DEPT.)	

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name: Orhun, Sevinç

Signature :

ABSTRACT

EFFECT OF FERTILITY ON FEMALE LABOR SUPPLY IN TURKEY

Sevinç, Orhun
M.S., Department of Economics
Supervisor: Assist. Prof. Dr. Murat G. Kırdar

August 2011, 73 pages

The effect of fertility on female labor supply decisions in Turkey is analyzed in this thesis. Taking the endogeneity between fertility and labor supply into account, the causal effect of fertility is interpreted in an instrumental variables estimation framework. Results of the analysis indicate that fertility estimates of sex preference and twin based instruments on short term labor supply of women differ substantially. While fertility increases due to sex preference instrument cause no significant change in labor supply decisions, unexpected fertility shocks by twin instrument have an adverse effect on female labor supply.

Keywords: Fertility, Female Labor Supply, Instrumental Variables

ÖZ

TÜRKİYE'DE DOĞURGANLIĞIN KADIN
İŞGÜCÜ ARZI ÜZERİNDEKİ ETKİSİ

Sevinç, Orhun
Yüksek Lisans, İktisat Bölümü
Tez Yöneticisi: Doç. Dr. Murat G. Kırdar

August 2011, 73 sayfa

Bu çalışmada doğurganlığın Türkiye'de kadınların işgücü arzı tercihlerindeki etkisi incelenmiştir. Doğurganlığın nedensellik içeren etkisi, doğurganlık ve işgücü arzı arasındaki içsellik hesaba katılarak enstruman değişkenler yöntemi çerçevesinde açıklanmaktadır. Analiz sonuçları cinsiyet tercihi ve ikiz doğum tabanlı enstrumanlar tarafından kısa dönem işgücü arzı üzerinde tahmin edilen doğurganlık etkilerinin önemli ölçüde farklılaştığına işaret etmektedir. Cinsiyet tercihi enstrumanlarına bağlı olarak gerçekleşen doğurganlık artışları işgücü arzında anlamlı bir değişikliğe yol açmazken, ikiz enstrumanıyla hesaplanan beklenmeyen doğurganlık şokları kadın işgücü arzı üzerinde ters bir etkiye sahiptir.

Anahtar Kelimeler: Doğurganlık, Kadın İşgücü Arzı, Enstruman Değişkenler

To Işıl, A Perfect Friend and Mother

ACKNOWLEDGMENTS

I would like to thank my thesis supervisor Assoc. Prof. Dr. Murat G. Kırdar, whose guidance and encouragement helped a lot for this thesis to be accomplished in a limited time. I would also like to thank to the examining committee members Assoc. Prof. Dr. Asena Caner and Dr. Yusuf Soner Başkaya for their invaluable comments and critiques.

I am grateful to my colleague Utku Özmen for his comments and motivation as well as his support as a close friend. I owe him many thanks also because of his patience while he was constantly subject to my think-alouds and concerns. In addition, my special thanks is for Çağlar Yüncüler who shared his experiences throughout the thesis period and always provided detailed answers to my how-to-do questions. I would also like to thank my colleagues Oğuz Atuk and Fethi Öğünç for their support.

I would like to thank The Scientific and Technological Research Council of Turkey for the financial support they provided throughout my graduate studies. I also want to thank to my directors at The Central Bank of the Republic of Turkey for their permit for completing my graduate studies during working hours.

My deepest love and respect is to my family and especially my mother. Their endless support and strong belief in me always gave enough motivation to overcome the challenges of life. Finally I thank my old friends whose presence and friendship provided the refreshment and joy of life which I needed most during the thesis period.

TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

CHAPTER 1

INTRODUCTION AND THEORETICAL BACKGROUND

1.1 Introduction

Fertility of women gained considerable attention by economists especially after Second World War. The post war decrease in the female fertility is then considered to be related to many social and economic variables such as income, wages, and labor force participation of women, in addition to children outcomes such as schooling, labor supply and wages. Indeed it is hard to find household-related economic activities on which existence or the number of children plays no role. Economists (and also demographers) have directed their research in a vast area of interest. The research covers the effect of children on the consumption (life-cycle consumption or only focused on demand); on the portfolio behavior in terms of allocating the income; on the demand for specific consumption categories such as durables and housing; on the labor supply of parents; and also on migration.

This thesis has a special focus on the effects of the number of children on female labor supply in Turkey. Two arguments in particular can be accounted for the selection of the research question for Turkey. First relates to specific characteristics of Turkey. It turns out to be an interesting question when one thinks the above mentioned fact of decrease in fertility with respect to the other stylized fact regarding the increasing labor force participation of women in many developed and developing countries. Unlike those countries where fertility and labor force participation moves in opposite directions as evident as a trend, Turkey shares only the first part of the observation while labor supply of women in Turkey do not show a marked increase in line with reduced fertility levels in time.[1] Therefore the result of such a quest for Turkey could be insightful on the discussion about the causal evidence.

Second reason that assigns importance to the topic for Turkey is based on the policy perspective in the sense of family planning. Many developing countries adopted family planning and used it as a policy for economic growth in addition to benefits on healthcare and savings. In Turkey, family planning is never discussed in depth in terms of the effect of number of children as a political issue. Rather it is implemented in terms of regulation of contraception, ending the pregnancy and sterilization. On the contrary, recently governments comment on the issue that encourages at least three children. Therefore it is interesting to see whether such policy stances matter in terms of labor supply of women given the existing structure of Turkish family and labor market.

Female labor force participation attracted substantial interest for Turkey as well as many other countries.[2] Aiming to address the determinants of Turkish female labor force participation, Dayıoğlu and Kırdar (2010) emphasizes that fertility is associated with lower participation rates. Yet, number of studies which concern with the effects of fertility on female labor supply is limited.[3] The first and only study estimating the impact of fertility on labor force participation is done by Şengül and Kıral (2006) who take the simultaneity of fertility and labor supply into account. This study follows an estimation strategy with a similar concern, but extends the scope by estimating effects for women with different numbers of children and adding more instruments for comparison.

The study evaluates above mentioned question in an instrumental variables (IV) framework where endogeneity of fertility and labor supply are given credit. The data

---

[1] On the contrary, there is a pronounced decline in the Turkish female labor force participation in the last half of the 20th century. It fell to 26 percent in 2000 from 72 percent in 1955 (Tansel, 2002, p. 3)
[2] Some of the studies are Tunalı (1997), Özar and Şenesen (1998), Dayıoğlu (2000), Tansel (2002) and Dayıoğlu and Kırdar (2010).
[3] Researchers are aware of the drawbacks of taking fertility as exogenous.This might lead researchers to avoid includingfertility in labor force equations. For example, Tansel (2002) expresses this concern and does not condition on fertility.

used is 1993, 1998 and 2003 samples of Hacettepe Demographic and Health Survey. Instruments are selected according to their disturbance to the fertility of women through biological randomness.

Next section discusses the theoretical background on the effects of fertility on labor supply. Chapter 2 focuses on the methodology and previous work that leads to the specific instruments and estimation technique in this field of research. Chapter 3 explains the data and variables of the analysis. In Chapter 4 IV estimation is performed with different instruments and results are compared with those of ordinary least squares (OLS) results. Chapter 5 compares the results of IV estimands of fertility and discusses the issues of validity of instruments in detail and finally, Chapter 6 concludes the study.

1.2 Theoretical Background

In addition to opposing post-war trends in fertility levels and labor supply of women, indeed, there is enough motivation also in cross sectional dimension to search for a relationship between household socio-economic variables and fertility. Observations go back as early as 1960s. Some of the studies which document a negative correlation between fertility and female labor supply are Mincer (1962), Cain (1966), Bowen and Finegan (1969) and Nakamura and Nakamura (1990). There is vast evidence on the negative correlation between income, wages and fertility of women. An example is Jones and Tertilt (2008) for United States (U.S.) which finds that the negative correlation not only exists for a long period of time but also it is stable over time comparing the period between 1830 and 1960.

Discussions of fertility theories in modern economics literature which go back to 1960s, especially try to explain the observed relationship. Becker (1960) study is an attempt through generalizing and developing theories of fertility that are as old as the theory of Malthus. According to Willis, the most important contribution of the study was his finding that (Willis, 1987, p. 69): "… *the cost of children was in part endogenous because parents receive utility from increased child "quality" as well as* *from increased numbers of children*." Based on his work, the famous quantity-quality theory of fertility emphasizes the existence of a trade-off between the quality and the quantity of the children and as importantly, introduces children as a kind of consumption durables. This theory alone does not predict the observed negative correlations of fertility and mother's labor and income variables. In terms of quantity-quality hypothesis, it is reasonable to think that labor force participation of and more income earned by women induces more qualified children, yet number of children does not necessarily diminish. At first, straightforward thinking puzzles one's mind when the negative relationship between fertility and labor force variables is explained by consumer theory since if children are consumption goods they should be inferior. In quantity-quality framework, it is possible to generate the observed correlations and trends by introducing time costs and quality function characteristics when treating children as normal goods.[4] In a setup where children are taken as consumer durables which yield material returns and direct utility, labor force participation and higher wages could create an opportunity to invest more in quality and hence giving way to increases in expenditure for existing children, not for the quantity.

In addition to fertility theories, other strands of research supported the development of the research of related questions. The labor supply theories of Lewis (1950) and Mincer (1962); Becker (1964) study introducing human capital into the theory; and introduction of time allocation (Becker, 1965) are important contributors.

It is not only the number of children that is associated with labor supply variables but also the age of children. It is usually found that age of children has a high impact on the negative relationship such that younger children suppress labor supply more heavily. Moreover, the relationship should not be assumed to be homogenous across the population. Religious, ethnic and socio-economic differences in the family characteristics add differences in the labor supply decisions of women together with

[4] Jones and Tertilt. (2008) discuss the fertility theories in the literature and show that the negative relationship proposed by theories is not robust as commonly believed. They emphasize the need for several assumptions to ensure the observed relationship.

their fertility tendencies. After underlining the variances, however it should be noted that these do not suggest a divergence in the negative relationship pattern.

When the literature aiming to estimate the relationship between labor supply and fertility is looked at more carefully, it turns out that the most pronounced difference in the studies regards the endogeneity issue. While more is discussed in the next chapter, some is related to the development of the theory since the issue is directly about how to model the presence of fertility in the labor supply.

Models which ignore the endogeneity associated with the variables in general are based on models where their interpretation could be held plausible only if children are safely treated as predetermined. As mentioned in Browning (1992, p.1462): *"ignoring the issue of endogeneity if we have a linear model and we have "got the dynamics right"… Then, since children aged more than one are given we can treat them as predetermined…"*

In this context, linearity assumption for labor supply is inherently non plausible. On the other hand, research has shown that taking children as predetermined requires proper conditioning on past labor supply of women. For example, Nakamura and Nakamura (1990) shows that mothers who did not participate in the previous year participated at very low levels in the labor force in the current year. On the other hand, for mothers who worked in the previous year, labor force participation is only slightly reduced when the baby is under one years of age. Capturing such early information on women's labor supply is not always possible. Moreover, there is important evidence that treats models which treat fertility as being exogenous. That is, not only labor supply depends on previous work status, but it is significantly determined by the behavior after the first birth (Shapiro and Mott, 1991). If first birth is especially important for labor supply decisions of women, because it is hard to imagine it independently of working decision, exogeneity assumption seems likely to fail on theoretical grounds.

On the other hand, endogeneity is tested empirically too, however with no single consistent conclusion. For instance, Cain and Dooley (1976) and Jakubson (1988) have rejected exogeneity while Mroz (1987), Korenman and Neumark (1992) and Waldfogel (1995) confirms the absence of endogeneity.

There is more to discuss about estimation of fertility effect on labor supply. For example, the problems associated with simultaneous equation models and reduced form equations even when there is an instrument for variation in fertility, should be addressed for the motivation of the methodology that is used in the study, as done in Chapter 2. Next section summarizes the strand of literature that concerns the estimation of fertility and labor supply relationship in a time series perspective. That could complete the discussion on the causal relationship before moving to the details of IV strategy.

1.3 Time Series Evidence on Causal Relationship

Theoretically one can hold different positions regarding the direction of causality between fertility and labor force participation of women. Beside one-directional causal links, it is also possible to expect bi-directional links or no causation at all. Studies of cross section data cannot explicitly address the causality. Unfortunately, the empirical research on time series sheds no more light on the theoretical predictions.

The evidence from time series is mixed in both the existence and the direction of causality. The findings depend heavily on the restrictions imposed by the models. For instance, Cheng (1996) and Cheng et al. (1997) employs a bivariate vector error correction model for United States and Japan respectively. These studies confirm the existence of causality in United States and Japan such that fertility Granger causes labor force participation. However, conclusion is reversed when the effect of other variables are included. Cheng (1999) extends Cheng (1996) and estimates cointegrating relationship of fertility, labor force participation and education of women and finds no Granger causality between the first two. Based on Granger

(1969), Cheng (1996) argues that omission of relevant variables could affect the Granger causality. However, this result is still questionable since education may not be the only omitted variable.

Michael (1985) finds that female labor force participation Granger causes fertility and the relation in the reverse direction does not include causality. By changing the definition of fertility, study confirms the opposite direction of causality. Not only variable definitions matter, but also type of tests changes the results. For instance, Klijzing et al. (1988) show that for a Dutch survey (using 1977-1984 period) while according to Sims' version of Granger causality test suggests the existence of one-directional causality from fertility to labor force participation, results imply bi-directional causality under standard versions of the test.

Similarly and taking the long-run relationship between fertility and female labor supply along with structural breaks into account for data from various developed countries Engelhardt et al. (2001) finds causality in both directions and notes the weakening of negative correlation for the time series data after about mid-1970s. The study links this shift in the strength of relationship to changes in the institutions which could make child-rearing and working less incompatible for women. As a result, the time series literature presents mixed results on the direction and existence of causality.

CHAPTER 2

FERTILITY AND FEMALE LABOR SUPPLY LITERATURE AND METHODOLGY

2.1 Previous Work on Fertility-Labor Supply Relationship

Studies in the literature consist of two categories of strategies in estimating the effect of fertility on labor force participation of women. The crucial difference between these two strategies is the assumption on the endogeneity of fertility variable. While theories of women fertility emphasize the links of interaction which imply joint decision making with respect to both variables, first strand in literature includes studies which have taken fertility as an exogenous variable. Examples are Mincer (1962), Gronau (1973), Heckman (1974) and Heckman and Willis (1977). Their resulting estimates are potentially problematic for several reasons. First, explanatory variables that are thought to have impact on labor supply may at the same time determine fertility. This biases the resulting estimates. Second, estimates are further contaminated by omitting variables which simultaneously determine fertility and labor supply. In this case population correlation of fertility reflects effects of these left-out components.

The second line in the literature takes endogeneity into account. First strategy is the use of simultaneous equation models to overcome the endogeneity in decision making process. Cain and Dooley (1976), Schultz (1977) and Fleisher and Rhodes (1979) estimate the effect of fertility in such setting. However these models suffer from the lack of suitable exogenous variables required for identification. Rosenzweig and Wolpin (1980a, p. 346) emphasize the absence of extra information obtained from these models in terms of interpreting the causal impact:

… [when] the price of children were known, the use of price as a regressor dominates the use of quantity, as simultaneous-equations estimates were shown to provide conditional demand estimates which must rely on the existence of price information to exogenously alter quantities independently of tastes. Empirical models of the simultaneous determination of fertility and labor supply are thus no more informative than the usual set of consumer demand equation estimates (to which they must correspond) in terms of verifying theory.

In the absence of exogenous variation in fertility, varying preference characteristics among individuals yield inconsistent estimates. However, if natural experiments associated with exogenous variation in fertility are used, simple statistical analysis could supply the necessary information for identifying the causal impact. For this purpose, another strand in the literature sought for the ways to utilize such natural experiments. Rosenzweig and Wolpin (1980a) introduced twin-births (specifically, twins in the first birth), as multiple-births are not anticipated prior to the decision of having a child. Moreover, they argue that having twins in the first birth is not related to other variables which determine labor supply of women. Using this instrument, they estimate the effect of fertility on life-cycle labor supply of women based on two U.S. samples, where they find lower than actual fertility measure based estimates of fertility. Rosenzweig and Wolpin (1980b) use number of twin births per pregnancy for testing the quantity-quality fertility model. Since probability of having twins increase with total number of pregnancies, twin per birth instrument is preferred to estimate the effect of fertility on schooling of children in rural India. However, using twins as instruments for fertility is criticized based on its rarity. When used in small samples, there are very few observations of individuals for whom the treatment is effective. Bronars and Grogger (1994), and Gangadharan and Rosenbloom (1996), Angrist and Evans (1998) and Jacobsen et al. (1998) applied the same approach in larger samples.

Bronars and Grogger (1994) utilize "twins-first methodology" to 1970 and 1980 censuses for U.S. and estimate life-cycle and short-term effects of unanticipated children on labor force participation, poverty and welfare recipiency among unwed mothers. They note that their results vary considerably among different races and cohorts and find that, for most of the mothers, having an unplanned child has direct short-run effects in labor supply while life cycle consequences are significant only for some black mothers. Gangadharan and Rosenbloom (1996) treat first born twins as instrument using Public Use Micro Samples (PUMS) from 1980 to 1990 for U.S. and directly estimate the effect of an unanticipated increase in the number of children due to multiple-births on married women's labor supply and earnings for different ages of children and controlling the time since first birth. Jacobsen et al. (1998) applies the same methodology to 1970 and 1980 censuses and estimate short and long-term effects of unplanned births on labor force participation and earnings of married women. Among the last two studies the former documents that labor supply and wage effects of fertility on women are more pronounced and persistent in 1990 sample. The latter one finds that the effect of fertility is substantial for earnings and more persistent than the effect for labor supply. These studies confirm the negative impact of fertility on labor supply and income in general and emphasize that as women's labor force participation increases a stronger effect of fertility is estimated.

Rozensweig and Wolpin (1980a) introduce a true instrument in the sense that it constitutes an almost natural experiment where the source of variation on fertility comes directly from the biological stochastic process of twin births. However, the spirit of their work is characterized by concerns for simultaneity of fertility and labor supply; they perform a reduced form regression to estimate the effect of fertility. Therefore their estimates potentially suffer from omitted variable bias since there can be variables which are not observed, yet influential in the labor supply decision. In this context, individual preferences play the leading role as an omitted variable. It might be a case where women with low labor force attachment tend to have more children than women with strong labor force attachment. That is the reason why Bronars and Grogger (1994) also present the IV estimates for comparison.

Angrist and Evans (1998) extended the search for natural experiments by utilizing sex balancing tendency in United States for women with at least 2 children. The so-called "same sex" instrument externally disturbs fertility since families with two children of same sex are more likely to have more children compared with balanced families in terms of gender of children. They also generate twins-second instrument for comparison purposes, since the study focuses on transition to third child as a restriction of same-sex instrument. They estimate the effect of number of children on women's labor supply variables and income as well as husbands' income for married women by means of two-stage IV estimation. They also note that differences in estimates of different instruments come from birth-spacing (i.e. difference in the ages of third children for different instruments). Their estimated IV effects imply that twins instrument implies a smaller negative impact than that of same sex instrument.

In the above mentioned studies instrumentation by twin births or sex balancing behavior confirms the negative impact of fertility on labor supply and earnings of women estimated by OLS, though direction of the bias is controversial. Rosenzweig and Wolpin (1980a) document that instrumenting yields a more negative impact, whereas Angrist and Evans (1998) find that OLS-estimated impacts are larger.

Other studies use different instruments other than the ones based on gender preference by parents and twin births. Mroz (1987) and Chiappori et al. (2002) use functional forms of age and education variables. Waldfogel (1995) instruments fertility by marital status. Cain and Dooley (1976) use religion and rural residential industry structure as instruments. Hout (1978) use duration of marriage. Other instruments include land area per person, ideal family size, being a part-time worker etc. It should be noted that most of the studies with these instruments do not find a significant estimate for the fertility effect while some find a positive effect. There are also studies offering measures related with contraception and miscarriage.[5] These instruments are either potentially correlated with labor supply characteristics of women or hard to detect in large samples.

Sex preference and twin instruments have their limitations on the subject of interest. These studies can only search for the fertility effect for women having one or more children. On the other hand, an ideal experiment should also include women with no child as well as women who are randomly assigned children. Such a setting then

[5] See Hotz et al. (1999) and Miller (2003) for examples.

requires no use of two stage estimation, simply OLS would work. Cristia (2006) is an example to those in which certain types of women are included in the sample such that fertility differences are exogenously determined. The study uses a survey where women with no children who intends having one. Successful ones in having a child exogenously disturb the number of children randomly and irrespective of the labor characteristics.[6] The estimated effect of having a child on labor force participation of women is high and negative.

Though suffering from scarcity in the number of related studies, instrumentation for identifying the causal effect of fertility on labor supply variables take its place in the literature for developing countries.[7] Chun and Oh (2002) utilize the dominant son preference in Korean society as an instrument. They find significant effect for Korea. Their estimates are also stronger than what one-stage estimation suggests.[8] Following the same idea, Şengül and Kıral (2006) applied the same instrument for Turkey and found a significant negative effect of fertility. On the other hand, Cruces and Galiani (2004) discuss for Mexico and Argentina that son preference appears in the society only as a weak cultural characteristic and suggest that sex balancing behavior is a better base in terms of instrument relevance. They replicate Angrist and Evans (1998) study for these two countries and validate their result to these developing countries where fertility is higher and child-care facilities are worse than United States.

2.2 Methodology

The estimation procedure implemented in order to specify the impact of fertility on women's labor supply is instrumental variables approach. Instrumental variables estimation solves the problem of omitted variable bias. Since, as mentioned in the previous chapters that fertility and labor supply involves an endogenous relationship

---

6 Only if reason for not having a child is not related with the type of the work.

7 There are studies for developing countries where fertility is taken exogenous or simultaneous equation estimation is performed These studies generally agree with the negative impact of fertility on female labor supply and earnings. Some of them are Assad and Zouari (2002) for Morocco, Hallman et al. (2003) for Guatemala and Gong and Van Soest (2000) for Mexico.

8 They use probit and IV-probit as their one and two stage estimation mehod.

(at least theoretically) the approach supplies a framework which enables to determine the causal effects as it uncovers the bias of OLS estimates.

IV estimation specifies the causal effect of endogenous variable on the dependent variable (Angrist and Imbens, 1994). If the effects of fertility on labor supply decisions of women are constant for all women, then instrumental variables estimation gives the effect of endogenous variable on the whole population. On the other hand if effects are heterogeneously distributed among women, then the effect is estimated on women who are involved in treatment (increase their fertility level) group due to the instrument's induction.

Two main assumptions should hold for IV estimation to capture the causal effect. First requires a significantly high first stage effect. That is to say, the instrument should not be weak in affecting fertility level. That constitutes the relevance of the instrument. Second, the instrument should not be correlated with the error term. This assumption has two aspects. On one hand, the instrument is required to be independent of potential outcomes, it should be randomly assigned. On the other hand, exclusion restriction should hold for the instrument.

Exclusion restriction implies that instrument's only role in affecting the dependent variable is its disturbance on the endogenous variable. If the instrument has effects directly on the dependent variable it could not resolve the problem of endogeneity. Indeed many exogenous variables could have significant effects on both the dependent and the endogenous variables such as age or education possibly affects both fertility and labor supply.

It is also important that instrument has monotonicity property. That is, if the instrument affects the fertility level of a woman in a certain direction, it should not have an opposite effect for any other person. If an instrument could provide all these properties then it estimates the local average treatment effect.

Local average treatment effects are local in the sense that they reflect the sub-populations they represent. Therefore the implications of the results are directly related with the nature of the instrument. Because every instrument is unique, it is conceptually natural to expect different results from different instruments. On the other hand, instruments could capture the same effect, which strengthens the results. Nevertheless discussing the differences in instruments is important in understanding different aspects of the effect in question. Moreover, instruments could successfully capture the causal effect; however the captured effect cannot be used to make prediction in general if the natural experiment which governs the instrument can not be replicated.

Methodology of the analysis is inspired from Angrist and Evans (1998) study where labor supply effects of fertility is measured by same sex instrument and then resulting estimates are compared with those for twins at second birth instrument. However the instrumental methodology of this study differs in many aspects from Angrist and Evans (1998). First of all, the range of analysis is extended to include the effects of second and forth born children as well as third born using suitable sex preference instruments. Second, twin birth instrument is not defined as of a certain order of birth, rather as proportion of twin births out of total births.

Third difference regards the sex preference instruments used. As will be shown in the following chapters sex preference in Turkey is homogenously present in the form of male preference as the dominant sex preference behavior. Several sex preference behaviors exist in different countries. For instance, parents in U.S tend to balance the sex composition whereas in Asia male preference is the dominant sex preference. It is found that women of the data set reflect both characteristics of sex preference. Most decisive reaction is found to be given when families are dominated by females. On the other hand, women also respond to the nonexistence of daughters by increasing their level of fertility which indicates the presence of sex balancing behavior. The relevance and properties of instruments will be discussed later in detail.

CHAPTER 3

DATA AND VARIABLES

3.1 Data

Data used in this study is Turkey Hacettepe Demographic and Health Survey (DHS) of years 1993, 1998 and 2003. Surveys are conducted by the Hacettepe University Institute of Population Studies in collaboration with Ministry of Health and Prime Ministry Undersecretary of State Planning Organization as a project of the Scientific and Technological Research Council of Turkey (TUBITAK).[9]

DHS is designed to generate data on fertility, child mortality, contraceptive methods, maternal, child and reproductive health. Related information is collected through questionnaires conducted by interviews with ever-married women of ages 15-49. DHS also provides information about various demographic characteristics of women, their children and partners as well as about some labor supply variables. Since aim of this study is to estimate the effect of fertility on labor supply decision of women via making use of biologically stochastic reproductive shocks on fertility, DHS turns out to be a suitable data set as it gives a detailed profile of reproductive history of mothers. Data set is also easy to handle since none of the variables used in the surveys are inferred by algorithms, rather all are directly asked to respondents.[10]

DHS of 1993, 1998 and 2003 are pooled for the analysis. Reason for merging samples rather than examining them individually is related to the sample size in hand. Since the instruments used in the study are effective for only a small fraction of population (especially for twin births), more observations are preferred for better

[9] For more detailed information on the surveys see http://www.hips.hacettepe.edu.tr/
[10] For isntance Bronars and Grogger (1994) and Angrist and Evans use indirect ways to detect twin births from U.S. Census data.and impose many assumptions for matching data.

estimates. In the regression analysis potential structural differences in surveys are controlled by survey-specific dummies. Moreover, pooling surveys is not very likely to complicate the analysis because of behavioral differences for different periods since time between surveys (five years) is rather short.

There are also other restrictions made in data. Throughout the study, ever-married women of ages 20-44 are studied. Women under 20 years of age are excluded since there can be barriers to entry to the labor market or marriage. Women older than 44 are ruled out since beginning from 45 years old the fraction of women who are retired and out of labor force increase. For that reason it is better not to take these women inside the scope of the analysis. In addition, women who live in rural areas are not included. The reason behind this restriction is that labor supply dynamics in the rural areas are likely to be fundamentally different.[11] Another restriction comes from dependent variables. Some variables of labor supply are not available for all surveys which results in having less number of observations in analysis regarding those variables. Last, since instruments require existence of children, women with no children are excluded from sample.

3.2 Variables and Descriptive Statistics

Variables used in the analysis are classified in three categories. First includes variables which reflect labor supply decisions of women in the sample. Three of them are dummy variables which indicate whether the respondent is currently working, worked in last 12 months (including current status) or works for cash. For this last variable women who do not work are assigned zero. Other labor variable is days worked in last 12 months. This variable is also assigned zero for women who do not supply their labor. Second group of variables include fertility variables instruments. In addition to the number of children variable as a direct measure of fertility level, in order to estimate the effect of transition to n^{th} child (where n=1, 2, 3),

[11]The reason for that is in Turkey labor force participation of women is significantly higher in rural areas and also the share of women involved in agriculture related work which requires family labor. More information emphasizing this difference is presented by Tansel (2002, p. 5) and Dayıoğlu and Kırdar (2010, p. 22).

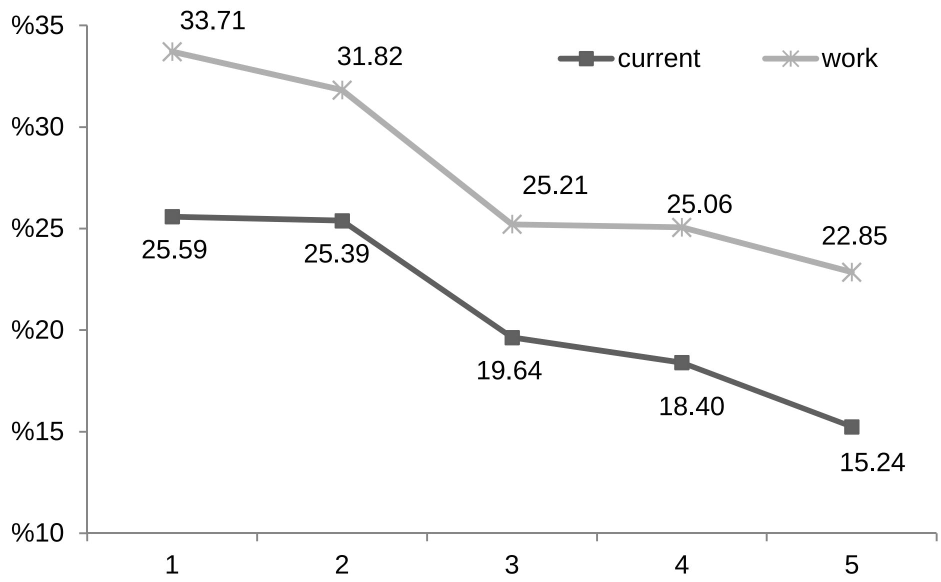
dummies indicating transition at a given number of children are generated. In addition to actual fertility variables, instrumental variables according to the sex of first, second and third child as well as number of twins per birth are constructed. Sex based instruments appear as dummies indicating whether all children are female at a given level of fertility. Instruments are explained in more detail in the following sections. Last and third group is demographic variables that are used as covariates. These include age and square of age, age at first birth dummies for geographical and place of residence characteristics, current marital status and educational attainment of women.

Table 1 to Table 3 give descriptive statistics associated with dependent variables, fertility variables, instruments and some of covariates. Summary statistics are segregated in different tables according to samples of varying number of children. In tables statistics are not combined for different survey periods to let comparison of main variables of interest.

Before looking at summary statistics a general picture about the characteristics of the survey respondents would give an idea about the women involved in the analysis. With all the restrictions there are 10960 women in the combined DHS of three survey years. The average woman of the pooled data set is around 32.5 years old, participated in formal education for 5.57 years. 96 percent of women are currently married and about 18 percent of the women have no educational attainment, while just below 6 percent of them have a high school diploma or higher.

Since the focus of the study is on the relationship between women's labor supply and their fertility, labor force participation according to different number of children is presented in Figure 1. Labor force participation variable is given by the work status with respect to last one year. According to the graph, labor force participation of women tends to decrease with the number of children where the most remarkable fall happens at transition to the third child with a reduction of nearly 6.5 percentage points. The graph includes only women with at most 5 children. Higher fertility levels do not display a clear pattern probably because there are too few observations for them. Only 8 percent of women fall in this category.

Figure 1. Female Labor Force Participation and Number of Children



Notes: Pooled sample of DHS 1993 to 2003 is used. Vertical axis indicates labor force participation." Current" is the participation variable regarding current work status, "work" represents the participation variable regarding the work status including last 12 months.

Table 1 presents summary statistics for women with at least one child. Mean number of children is quite high, for all samples the average is around 2.8. *More than one child variable* corresponds to the transition to the second child given the presence of a child. Around 80 percent of women having a child decide to have their second. Women with one or more children on average are 32 years old and had their first birth nearly at 21 years old. Almost 96 percent of women are currently married.

Summary statistics continue in Table 2 where sample excludes women who have only one child. Of course, average number of children increases to 3.3 implying that considerable fraction of women who have two children also have third one. Indeed, more than 55 percent of women who already have their second child realize the transition to three or more children. Mean age of women increases slightly to 33 while age at first birth comes down to 20.1.

For women having at least three children average number of children is 4.3. Mean age of women is higher and around 35 as age at first birth further decreases with more children to 19. Majority of the women in this group goes for the fourth child. Approximately 54 percent of women having three children decide to have the fourth birth. It is interesting that the probabilities of transition to third and fourth children are equal.

Descriptive statistics for labor supply variables imply that labor force participation, days worked and earnings of women tend to go down as number of children increase. These figures also confirm low levels of female labor force participation in Turkey. When all surveys are combined, around 22 percent of survey respondent women in Turkey participate in the labor force at the time of interviews, 29 percent participated in the labor force in the date of interview or since one year before the interview and 23 percent of these worked for cash.

Instruments for fertility are given by *one girl (F), two girls (FF)* and *three girls (FF)* variables. *F* and *FF* are expected to generate variation in transition to third and fourth children respectively. On the other hand *F* is unlikely to impose variation on transition to second child given that around 80 percent of women who had a child also have the second one. Similarly *twin per birth* measures indicates the existence of twin births of a mother - adjusted for family size and it does not allow differentiating for birth orders. Rather, it varies the number of all children.

From the tables it can be calculated that probability to have a girl as the first child is 0.46. Women have two and three girls out of two and three children with probabilities 0.22 and 0.15 respectively. However, probability that a woman has a twin in any birth is 0.01. This probability is not increasing significantly with more children. That implies the measure is freed from family size.

Table 1. Summary Statistics, Women Aged 20-44 with 1 or More Children

	DHS 1993		DHS 1998		DHS 2003	
Variable	Obs.	Mean	Obs.	Mean	Obs.	Mean
Children ever born	3134	2.91 (1.82)	3207	2.82 (1.82)	4619	2.69 (1.76)
More than one child (=1 if mother has more than one children, =0 if mother has one child)	3134	0.80 (0.39)	3207	0.78 (0.40)	4619	0.76 (0.42)
One girl (F) (=1 if first first child is girl)	3134	0.46 (0.49)	3207	0.45 (0.49)	4619	0.47 (0.49)
Twin per birth	3134	0.0096 (0.07)	3207	0.0102 (0.07)	4619	0.0112 (0.08)
Age	3134	32.0 (6.55)	3207	32.2 (6.63)	4619	32.8 (6.65)
Age at first birth	3134	20.4 (3.69)	3207	20.6 (3.79)	4619	21.0 (3.86)
Mother's years of education	3134	5.13 (3.78)	3207	5.43 (3.94)	4619	5.97 (4.04)
Current marital status (=1 if currently married, =0 otherwise)	3134	0.96 (0.17)	3207	0.96 (0.18)	4619	0.95 (0.21)
Currently working	3130	0.22 (0.41)	3204	0.24 (0.42)	4618	0.21 (0.40)
Worked	-	-	3206	0.26 (0.44)	4619	0.31 (0.46)
Worked for cash	-	-	3206	0.21 (0.40)	4618	0.24 (0.43)
Days worked	-	-	3200	42.9 (96.6)	-	-

Notes: The samples include women of age 20-44 living in urban areas with at least one child. Standard deviations are in parantheses.

Table 2. Summary Statistics, Women Aged 20-44 with 2 or More Children

	DHS 1993		DHS 1998		DHS 2003	
Variable	Obs.	Mean	Obs.	Mean	Obs.	Mean
Children ever born	2534	3.37 (1.74)	2530	3.31 (1.75)	3539	3.21 (1.70)
More than two children (=1 if mother has more than two children, =0 if mother has two children)	2534	0.59 (0.49)	2530	0.56 (0.49)	3539	0.54 (0.49)
Two girls (FF) (=1 if first two children are girls)	2534	0.22 (0.41)	2530	0.18 (0.39)	3539	0.24 (0.43)
Twin per birth	2534	0.0119 (0.07)	2530	0.01 (0.08)	3539	0.0147 (0.09)
Age	2534	33.3 (6.05)	2530	33.5 (6.17)	3539	34.2 (6.20)
Age at first birth	2534	19.9 (3.39)	2530	20.0 (3.46)	3539	20.2 (3.50)
Mother's years of education	2534	4.61 (3.55)	2530	4.9 (3.72)	3539	5.28 (3.75)
Current marital status (=1 if currently married, =0 otherwise)	2534	0.96 (0.17)	2530	0.96 (0.18)	3539	0.96 (0.19)
Currently working	2530	0.22 (0.41)	2528	0.23 (0.42)	3538	0.19 (0.39)
Worked	-	-	2530	0.25 (0.43)	3539	0.29 (0.45)
Worked for cash	-	-	2530	0.19 (0.39)	3538	0.22 (0.41)
Days worked	-	-	2526	39.1 (93.7)	-	-

Notes: The samples include women of age 20-44 living in urban areas with at least two children. Standard deviations are in parantheses.

Table 3. Summary Statistics, Women Aged 20-44 with 3 or More Children

	DHS 1993		DHS 1998		DHS 2003	
Variable	Obs.	Mean	Obs.	Mean	Obs.	Mean
Children ever born	1512	4.30 (1.72)	1431	4.32 (1.76)	1920	4.23 (1.76)
More than three child (=1 if mother has more than three children, =0 if mother has three children)	1512	0.55 (0.49)	1431	0.55 (0.49)	1920	0.52 (0.49)
Three girls (FFF) (=1 if first three children are girls)	1512	0.25 (0.43)	1431	0.20 (0.40)	1920	0.29 (0.45)
Twin per birth	1512	0.0146 (0.07)	1431	0.01 (0.07)	1920	0.0167 (0.07)
Age	1512	34.8 (5.59)	1431	35.0 (5.74)	1920	35.6 (5.74)
Age at first birth	1512	19.1 (3.08)	1431	19.1 (3.20)	1920	19.3 (3.22)
Mother's years of education	1512	3.52 (3.13)	1431	3.59 (3.13)	1920	3.98 (3.22)
Current marital status (=1 if currently married, =0 otherwise)	1512	0.96 (0.17)	1431	0.96 (0.19)	1920	0.96 (0.19)
Currently working	1509	0.19 (0.39)	1429	0.20 (0.40)	1920	0.17 (0.37)
Worked	-	-	1431	0.21 (0.41)	1920	0.27 (0.44)
Worked for cash	-	-	1431	0.14 (0.35)	1920	0.17 (0.38)
Days worked	-	-	1429	27.7 (81.7)	-	-

Notes: The samples include women of age 20-44 living in urban areas with at least three children. Standard deviations are in parantheses.

CHAPTER 4

EXOGENOUS VARIATION ON FERTILITY AND IV ESTIMATION

4.1 Sex Preference Instruments

4.1.1 Male Preference and Female Avoidance

Sex preference possibly provides variation on fertility. It depends on cultural characteristics of a society and may be linked with other socio-economic variables. For example, it is found that in U.S., the dominant form of sex preference is sex balancing behavior which manifests itself in increasing fertility levels when sex composition of children is homogenous. Ben-Porath and Welch (1976) document this for United States and Angrist and Evans (1998) use it as the primary instrument for their study on parents in the United States. On the other hand, male preference has a higher weight in sex preference behavior in many Asian countries such as China, South Korea and Taiwan.[12] Dominance of a type of sex preference behavior does not necessarily exclude the existence of other sex preference types as it is the case for Turkey according to the data set used in this analysis.

Kind of sex preference that is effective in Turkey could be understood by calculating the fraction of people who changed their behavior when the treatment is on.[13] After determination of the existence of sex balancing behavior or male preference, that behavior could be used as an external source of variation on fertility. Table 4 shows fraction of women having an additional child given the sex mixture of their children.

[12] Lin (2005) emphasizes the dominance of son preference in Taiwan, Park and Cho (1995) for Korea and Arnold and Zhaoxiang (1986) for China.

[13] Ben-Porath and Welch (1976) introduced calculating fractions of people who have more children for this purpose. Angrist and Evans (1998) use this for their sample to show the dominance of sex balancing behavior for United States.

Because sex balancing behavior could only be observed starting with two children *same sex* is not present for families with at most one child. As mentioned above, vast majority of women, regardless of having girl or boy as their first child decide to have additional children.[14] Therefore, it is in line with the expectations that sex preference plays no significant role in transition to the second child.

Lower panels of Table 4 at first sight suggest that having children of same sex in general induce women to have more children. Fraction having additional children is higher for women with children of same sex than mothers of children with mixed sexes. However when sexes within the same sex group are differentiated, it is apparent that having all children male or having a sex mix of children are not very different in their effect on having another child in general. Hence, what seems like sex balancing behavior in Turkey is in fact a result of male preference. In other words, same sex induced fertility ratios look high because the effect when all children are female is substantially greater. However, this does not mean that sex balancing behavior does not hold in Turkey. Though not as high as the case when all children are female, a greater fraction of women with all children of male sex decide to have more children. If absolute male preference were the case, then mothers of children consisting of males only would prefer fewer children than mothers who have daughters. This asymmetry in sex balancing behavior reflects the existence of male preference in terms of what can be called as female avoidance. To check the significance of the difference, fractions regarding having additional child in the domination of female children in the total number of children are given in Table 5 for combined data set.

For women with two and three or more children, having all children female generates a significantly high variation on fertility. The impact is bigger than sex balancing behavior that Angrist and Evans (1998) find for U.S. Hence instruments based on female avoidance signify relevance in this respect.

[14] However, it imposes a variation in the total number of children. See Table 6.

If female avoidance instruments are randomly assigned as a fertility shock then it is possible to obtain causal interpretation out of estimates of fertility on labor supply variables by using it as an instrument. Comparing means of important explanatory variables according to instruments provide some insights about their randomness. Yet it is not a proof, since some other mechanism other than through these variables may govern the relationship of instruments with both dependent and fertility variables. Moreover, existence of significant difference does not conceptually contaminate the soundness of two stage estimation since it does not necessarily refuse conditional randomness which is essential for instrument validity. In addition, existence of these variables in the first and second stages provides control for instruments' interaction with explanatory variables. Absence of difference in means of covariates only implies that the instrument's effect is not realized by means of these variables.

Table 6 presents results of such a comparison. Once again it confirms that female avoidance instruments change the means of fertility variables. On the other hand, instruments do not change the means of other covariates high enough. None of the differences are significantly different from zero at 5-percent level.

4.1.2 Wald Estimates

Consider the linear regression model,

$$y_i = \alpha + \beta x_i + \varepsilon_i \tag{1}$$

where y_i is labor supply and x_i is fertility measure. Let z_i be the instrument which is ought to be binary for estimation of Wald measure. Wald estimate that is calculated by switching on and off the instrument is:

$$\beta_{wald} = \{E(y|z = 1) - E(y|z = 0)\}/\{E(x|z = 1) - E(x|z = 0)\} \tag{2}$$

Table 4. Fraction of Women Having Additional Child

Families with one or more children						
	1993 DHS		1998 DHS		2003 DHS	
Sex of first child	Fraction of Sample	Fraction Having another Child	Fraction of Sample	Fraction Having another Child	Fraction of Sample	Fraction Having another Child
One boy	0.53	0.81 (0.39)	0.55	0.80 (0.39)	0.52	0.74 (0.43)
One girl	0.47	0.80 (0.01)	0.45	0.77 (0.01)	0.48	0.78 (0.00)

Families with two or more children						
	1993 DHS		1998 DHS		2003 DHS	
Sex of first child	Fraction of Sample	Fraction Having another Child	Fraction of Sample	Fraction Having another Child	Fraction of Sample	Fraction Having another Child
Two boys	0.28	0.58 (0.01)	0.28	0.55 (0.01)	0.26	0.52 (0.01)
Two girls	0.23	0.68 (0.01)	0.19	0.60 (0.02)	0.25	0.64 (0.01)
Same sex	0.51	0.62 (0.01)	0.46	0.57 (0.01)	0.51	0.58 (0.01)
Mixed sex	0.49	0.56 (0.49)	0.54	0.55 (0.49)	0.49	0.49 (0.50)

Families with three or more children						
	1993 DHS		1998 DHS		2003 DHS	
Sex of first child	Fraction of Sample	Fraction Having another Child	Fraction of Sample	Fraction Having another Child	Fraction of Sample	Fraction Having another Child
Three boys	0.14	0.56 (0.03)	0.22	0.45 (0.02)	0.14	0.49 (0.03)
Three girls	0.12	0.69 (0.03)	0.17	0.43 (0.03)	0.16	0.62 (0.02)
Same sex	0.26	0.62 (0.02)	0.39	0.44 (0.02)	0.29	0.56 (0.02)
Mixed sex	0.74	0.52 (0.49)	0.61	0.63 (0.48)	0.71	0.50 (0.50)

Notes: Samples corresponding to number of children are the same as Table 1, Table 2 and Table 3. Standard errors are in parantheses.

Table 5. Fraction of Women Having Additional Child When All Children are Female

One or More Children			Two or More Children			Three or More Children		
Sex of first child	Fraction of Sample	Fraction Having another Child	Sex of first child	Fraction of Sample	Fraction Having another Child	Sex of first child	Fraction of Sample	Fraction Having another Child
One girl	0.47	0.78 (0.005)	Two girls	0.22	0.64 (0.010)	Three girls	0.15	0.57 (0.018)
One boy	0.53	0.78 (0.005)	Others	0.78	0.54 (0.006)	Others	0.85	0.53 (0.007)
Difference		0.00 (0.007)	Difference		0.10 (0.012)	Difference		0.04 (0.019)

Notes: Sample is the same as Table 1, Table 2 and Table 3 and combined in terms of survey years. Standard errors are in parantheses.

Wald estimate is easy to interpret in terms of what it measures. Since fertility is endogenous to labor supply and estimation of β by ordinary least squares is problematic, what is needed is the change in labor supply when fertility is disturbed exogenously by one unit. Mean differences of labor supply and fertility are comparable in this sense when they are controlled according to the effectiveness of the instrument. Angrist and Imbens (1994) shows that Wald estimates computed in this fashion are local average treatment effects. They detect the effect of treatment on those who receive the treatment. In the context of analysis, they measure the effect of fertility on labor supply for women who change their fertility behavior through female avoidance.

Table 7 to 9 present Wald estimates associated with binary labor supply measures of *currently working*, *working status in last 12 months* and *working for cash*. Third column gives the mean differences conditional on whether the instruments are on or not. Columns four and five present Wald estimates associated with fertility variables. Each panel gives the effect of corresponding instrument. They display the effect of one girl (F), two girls (FF) and three girls (FFF) respectively. Note that due to missing observations number of observations in each table is limited by dependent variables

Table 6. Mean Differences of Explanotary Variables by Sex Preference Instruments

Variable	One Girl	Two girls	Three Girls
Age	-0.0474	-0.0837	-0.0257
	(0.12688)	(0.15963)	(0.22871)
Age at first birth	0.09645	0.09399	0.44817
	(0.07294)	(0.09192)	(0.12941)
Mothers' years of education	0.10368	-0.0819	0.18236
	(0.07581)	(0.09730)	(0.13534)
Currently married	-0.0023	0.00149	-0.0004
	(0.00373)	(0.00474)	(0.00753)
Lives in capital or a big city	0.00255	0.01088	0.04476
	(0.00877)	(0.01176)	(0.01786)
Lives in a small city	-0.01686	-0.03031	-0.05788
	(0.00956)	(0.01293)	(0.02000)
Lives in a town	0.01430	0.01942	0.01312
	(0.00791)	(0.01094)	(0.01722)
Lives in the west (=1 if region of residence is south, 0 otherwise)	-0.0011 (0.00602)	-0.0107 (0.00799)	0.00359 (0.01263)
Lives in the south (=1 if region of residence is south, 0 otherwise)	0.00606 (0.00742)	-0.0077 (0.01001)	-0.0184 (0.01543)
Lives in the north (=1 if region of residence is south, 0 otherwise)	-0.0059 (0.00774)	0.01199 (0.01090)	-0.0293 (0.01769)
Lives in the center (=1 if region of residence is south, 0 otherwise)	0.00520 (0.00889)	-0.0031 (0.01174)	0.04051 (0.01745)
Lives in the east (=1 if region of residence is south, 0 otherwise)	-0.0037 (0.00766)	0.01066 (0.01048)	0.00566 (0.01576)

Notes: Sample is the same as Table 1, Table 2 and Table 3 and combined in terms of survey years. Standard errors are in parantheses

Table 7 suggests mixed evidence on the direction of fertility effect on current labor supply of women. Women who are mothers of one girl are 1 percentage points more likely to have another child, whereas mothers of two girls and three girls are more likely to increase their fertility levels by 11 and 4 percentage points respectively. When no other relevant variables controlled, women with at least one and two children who only have daughters work less than mothers who have at least one son. This effect is most prominent for women with two girls; they work 1 percentage point less than other women. On the other hand mothers of three girls work 1 percentage point more than others. Table 8 replies the same exercise for women who currently work or worked in last 12 months. This specification shows a different picture than what is presented in Table 7. Here Wald estimates indicate a positive fertility effect for mothers of one or more and two or more children but very high negative effects for women with at least three children. In addition this very prominent negative effect does not come from the expected mechanism of the instrument, since having three girls seems not to increase fertility levels of women with three or more children. The source of difference in behavior of women under different dependent variables is missing observations associated with each variable. *Working for cash* variable whose Wald estimates are presented in Table 9 implies similar effects as Table 8. It should be noted that these both variables are not present in 1993 DHS.

Apart from differences for Wald estimates between and within labor supply measures, all estimates share one aspect in common. That is very high standard errors relative to the estimated values and regardless of signs of estimates. Wald estimates suggest that fertility under different number of children and labor supply specifications does not have a significant effect on labor supply. Interpreting the results more accurately, when effects of demographic variables are not controlled for, the effect of an increase in the number of children does not cause supplying less labor for women who change their fertility behavior under the presence of associated instrument.

Controlling the effects of other variables in the regression analysis could change the estimates as well as their significance. However before that, further information about the presence of fertility effect could be analyzed for subgroups of the sample using Wald estimates.

Education is capable of changing human reactions to specific events. Since male preference is shaped by cultural characteristics, people with varying degrees of educational attainment may act differently in terms of their labor supply decisions subject to fertility shocks. Education is also a proxy for income to some extent. Hence, among the characteristics of women that data set could provide education is an appropriate choice. Table 10 shows the results of Wald estimates for subgroups of different education categories.

There are four education categories of educational attainment in DHS data set. *No education* corresponds to women who do not have any kind of educational attainment. *Primary*, *secondary* and *high* groups include women with primary, secondary and higher degrees of education.

Comparing the Wald estimates for different education groups does not clarify the mixed evidence on the direction of effect nor does it result in significant estimates under some category. Hence it is now more probable that full sample Wald estimates are not affected heavily by differences in reactions of people in different educational categories to the instrument. This claim could be extended to the categories for which education serves as a proxy.

Since equation (1) considers a bivariate model where labor supply is assumed to be determined only by fertility, it is still important to consider if this result with Wald estimates persist even after proper adjustment for demographic variables that are likely to affect labor force participation behavior of women. Next, ordinary least squares and two stage least squares (2SLS) results of the fertility effect on labor supply variables and earnings are discussed.

.

Table 7. Wald Estimates of Female Avoidance Instruments

Dependent Variable: Current Work Status				
Instrument	Variable	Mean Difference	Number of Children	More than N children
F (10952 Obs.)	Number of children	0.08	-	-
	More than one child (N=1)	0.01	-	-
	Currently working	0.00	-0.01 (0.104)	-0.22 (1.188)
FF (8596 Obs.)	Number of children	0.33	-	-
	More than two children (N=2)	0.11	-	-
	Currently working	-0.01	-0.01 (0.032)	-0.05 (0.098)
FFF (4858 Obs.)	Number of children	0.08	-	-
	More than three children (N=3)	0.04	-	-
	Currently working	0.01	0.075 (0.217)	0.140 (0.389)

Notes: Sample is the same as Table 1, Table 2 and Table 3 and combined in terms of survey years. Standard errors are in parantheses

Table 8. Wald Estimates of Female Avoidance Instruments

Dependent Variable: Whether Worked in Last 12 Months				
Instrument	Variable	Mean Difference	Number of Children	More than N children
F (7824 Obs.)	Number of children	0.07	-	-
	More than one child (N=1)	0.01	-	-
	Worked	0.01	0.081 (0.153)	0.511 (1.018)
FF (6068 Obs.)	Number of children	0.32	-	-
	More than two children (N=2)	0.10	-	-
	Worked	0.01	0.025 (0.044)	0.076 (0.134)
FFF (3351 Obs.)	Number of children	-0.04	-	-
	More than three children (N=3)	0.00	-	-
	Worked	0.01	-0.34 (0.871)	-71.1 (8389.)

Notes: Sample is the same as Table 1, Table 2 and Table 3 and combined in terms of survey years. Standard errors are in parantheses

Table 9. Wald Estimates of Female Avoidance Instruments

Dependent Variable: Working for Cash

Instrument	Variable	Mean Difference	Number of Children	More than N children
F (7824 Obs.)	Number of children	0.07	-	-
	More than one child (N=1)	0.01	-	-
	Worked for cash	0.01	0.150 (0.165)	0.952 (1.207)
FF (6068 Obs)	Number of children	0.32	-	-
	More than two children (N=2)	0.10	-	-
	Worked for cash	0.00	0.007 (0.039)	0.022 (0.121)
FFF (3351 Obs.)	Number of children	-0.04	-	-
	More than three children (N=3)	0.00	-	-
	Worked for cash	0.01	-0.21 (0.597)	-43.0 (5073)

Notes: Sample is the same as Table 1, Table 2 and Table 3 and combined in terms of survey years. Standard errors are in parantheses.

4.1.3 Two Stage Least Squares Equations

Wald estimates are simple indicators of the causal effect of fertility. For more precision in estimates (even when the instrument is no correlated with covariates) 2SLS estimation is conducted for different levels of fertility.

First, the instruments of one, two and three girls are defined by following equations:

$$F_i = s_{1i} \quad (3)$$

$$FF_i = s_{1i}\ s_{2i} \quad (4)$$

$$FFF_i = s_{1i}\ s_{2i}\ s_{3i} \quad (5)$$

In these equations s_{ni} corresponds to the sex of n^{th} child (n=1, 2, 3) for i^{th} respondent woman. It is a binary variable which takes value 1 when associated child is female and 0 if the child is male.

The following multivariate linear regression equation describes the model used for interpreting the determinants of women's labor supply variables where primal interest is on the effect of fertility.

$$y_i = \alpha\pi_i + \beta x_i + \varepsilon_i \quad (6)$$

In equation (6) y_i is the labor supply measure for which the effect of fertility is intended to be estimated, π_i is the set of exogenous covariates which are thought to be related with labor supply, x_i is the preferred fertility variable which is either the *number of total children* variable or *more than n children* (n=1, 2, 3) binary variable and ε_i is the error term.

The covariate set consists of mother's age, mother's age squared, mother's age at first birth, mother's educational attainment dummies and dummies for geographic region.

Results of this regression by ordinary least squares will be discussed. For estimating the impact of exogenous variation on fertility however two stage estimation is necessary. The following equation gives the proposed relationship between number of children indicators and instruments.

$$x_i = \theta\pi_i + \gamma z_i + \eta_i \qquad (7)$$

Equation (7) is the first stage equation and γ gives the effect of the instrument on fertility variable. The predicted values for fertility from this equation are then replaced for the actual variable in the second stage equation of (6).

4.1.4 Two Stage Least Squares Estimation and Results

4.1.4.1 Fertility Equation

Results of first and second stage regressions as well as OLS results are presented in Table 11 to 14 for labor supply variables. Tables show regressions for *currently working*, *worked*, *worked for cash* and *days worked* variables respectively. Fertility variables are *number of children* and *more than n children* (for n=1, 2, 3).

First stage ordinary least squares fertility equations indicate that the instruments are statistically different than zero in their effect on fertility variables except one girl and three girls instruments for observations which are restricted to the availability of days worked variable. Also, the estimated effects for related specifications are negative. However the estimated positive effects of these instruments on other regressions suggest that this contradictive result is probably due to missing number of observations.

Table 10. Wald Estimates of Female Avoidance Instruments for Education Groups

	Instrument	Fertility Var.	No Education Wald	No Education Dif.L.S.	No Education Dif. Chl.	Primary Education Wald	Primary Education Dif.L.S.	Primary Education Dif. Chl.
CURRENT	F	chl	-0.10	-0.026	0.255	0.007	0.001	0.073
			(0.081)			(0.139)		
		chl1	-3.82	-0.026	0.007	0.043	0.001	0.013
			(6.832)			(0.791)		
	FF	chl	-0.07	-0.040	0.570	0.025	0.006	0.227
			(0.039)			(0.061)		
		chl2	-0.48	-0.040	0.083	0.056	0.006	0.104
			(0.269)			(0.132)		
	FFF	chl	-0.39	-0.025	0.063	0.116	0.017	0.145
			(1.070)			(0.155)		
		chl3	-0.39	-0.025	0.063	0.464	0.017	0.036
			(0.452)			(0.675)		
WORK	F	chl	-0.13	-0.039	0.289	0.194	0.019	0.098
			(0.104)			(0.163)		
		chl1	-3.48	-0.039	0.011	0.936	0.019	0.020
			(4.928)			(0.860)		
	FF	chl	0.001	0.001	0.651	0.088	0.020	0.232
			(0.044)			(0.082)		
		chl2	0.010	0.001	0.081	0.209	0.020	0.098
			(0.356)			(0.195)		
	FFF	chl	-0.04	0.008	-0.194	0.141	0.016	0.113
			(0.192)			(0.259)		
		chl3	0.257	0.008	0.033	-1.32	0.016	-0.012
			(1.154)			(4.270)		
CASH	F	chl	-0.09	-0.027	0.289	0.193	0.019	0.098
			(0.080)			(0.153)		
		chl1	-2.47	-0.027	0.011	0.931	0.019	0.020
			(3.620)			(0.818)		
	FF	chl	-0.00	-0.005	0.651	0.013	0.003	0.232
			(0.037)			(0.070)		
		chl2	-0.06	-0.005	0.081	0.032	0.003	0.098
			(0.302)			(0.167)		
	FFF	chl	-0.14	0.027	-0.194	-0.17	-0.020	0.113
			(0.203)			(0.241)		
		chl3	0.841	0.027	0.033	1.662	-0.020	-0.012
			(1.341)			(4.774)		

Notes: Number of observations are in brackets. Standard errors are in parantheses. “chl” abbreviates number of children, “chl#” represents more than # child(ren) variable. “Dif. L.S”. abbreviates mean difference of labor supply variable and “Dif. Chl.” Abbreviates mean difference of fertility variable. Each panel is for the labor supply variable that is vertically written. “Current”, “work” and “cash” corresponds to current work status , wrok status in last 12 months and whther the respondent works for cash variables respectively.

Table 10 (Continued). Wald Estimates of Female Avoidance Instruments for Education Groups

	Instrument	Fertility Var.	Secondary Education Wald Estimate	Dif.L.S.	Dif. Chl.	Higher Education Wald Estimate	Dif.L.S.	Dif. Chl.
CURRENT	F	chl	-0.01 (0.355)	-0.001	0.048	1.613 (3.951)	0.039	0.024
		chl1	-0.30 (6.784)	-0.001	0.003	1.658 (3.048)	0.039	0.024
	FF	chl	0.067 (0.135)	0.013	0.187	-0.50 (0.933)	-0.036	0.071
		chl2	0.087 (0.175)	0.013	0.144	-0.89 (1.889)	-0.036	0.040
	FFF	chl	-19.1 (818.9)	0.040	-0.002	-0.72 (0.971)	-0.114	0.157
		chl3	0.771 (1.149)	0.040	0.052	-0.65 (0.849)	-0.114	0.175
WORK	F	chl	-0.09 (0.419)	-0.005	0.051	3.766 (17.73)	0.051	0.013
		chl1	-0.44 (1.992)	-0.005	0.011	4.743 (20.25)	0.051	0.011
	FF	chl	-0.02 (0.128)	-0.007	0.234	-0.30 (0.613)	-0.033	0.109
		chl2	-0.03 (0.183)	-0.007	0.164	-0.42 (0.889)	-0.033	0.078
	FFF	chl	0.525 (2.475)	0.016	0.030	0.076 (1.805)	0.008	0.109
		chl3	0.273 (0.964)	0.016	0.058	0.060 (1.401)	0.008	0.139
CASH	F	chl	0.096 (0.409)	0.005	0.051	3.956 (18.66)	0.053	0.013
		chl1	0.439 (2.050)	0.005	0.011	4.982 (21.31)	0.053	0.011
	FF	chl	0.042 (0.121)	0.010	0.236	-0.11 (0.612)	-0.013	0.109
		chl2	0.060 (0.173)	0.010	0.166	-0.16 (0.865)	-0.013	0.078
	FFF	chl	1.845 (6.304)	0.055	0.030	0.615 (2.494)	0.067	0.109
		chl3	0.961 (1.271)	0.055	0.058	0.484 (1.754)	0.067	0.139

Notes: Number of observations are in brackets. Standard errors are in parantheses. “chl” abbreviates number of children, “chl#” represents more than # child(ren) variable. “Dif. L.S”. abbreviates mean difference of labor supply variable and “Dif. Chl.” Abbreviates mean difference of fertility variable. Each panel is for the labor supply variable that is vertically written. “Current”, “work” and “cash” corresponds to current work status , wrok status in last 12 months and whther the respondent works for cash variables respectively.

Looking closer at the instrument effects on fertility suggests that when other variables are controlled having a girl as the first child increases the number of children by around 0.11. Number of children induced by existence of two (first born) girls out of at least two children increases to levels just more than 0.3. The effect reduces to the interval between 0.15 and 0.21 for three girls instrument.

Similar to the number of children, as an indicator of having additional children given a level of fertility, more than n children variable is positively affected by the instruments in general. On average for women with at least one child, probability of having another child given the existence of a first child whose gender is female increases by about 1.5 percentage points. This likelihood increases to around 10 percentage points under two girls instrument and reduces to approximately 5 percentage points when first three children are female.

In general terms (noting the existence of contrasting estimates for more limited number of observations under some specifications) female avoidance based instruments possess significantly positive effects on fertility variables with two girls instrument having the greatest impact. Fertility equations also give notable information on the impact of other exogenous variables.

Age, not surprisingly, has a big impact on fertility which is significantly higher than zero for all specifications. The effect of a unit increase in age on the number of children, depending on the related labor supply variable, varies from 0.3 to 0.4 when other exogenous variables are controlled for. On the other hand the squared effects of age on fertility are at a slightly negative rate. In addition, age at first birth is found to have adverse effect ranging from -0.15 to -0.18 on the number of children.

Educational attainment has significantly negative effects on both types of fertility variables. All stages of educational attainment compared to having no formal degree of education affects women towards having fewer number of children such that the impact is more prominent in higher degrees. Indeed, having an educational degree decreases the number of children by more than 1 in most of the specifications while the negative effect of higher education rise as high as 1.6 for women with at least two children. For more than n children variable a similar pattern is observed which reaches the highest impact for women with at least two children. For those women who have higher educational attainment, having the third child is less likely to happen by around 40 percentage points.

4.1.4.2 Ordinary Least Squares Results

Before discussing the results of second stage estimation, ordinary least squares estimates given in Table 11 to Table 14 provides the fertility-labor supply relationship when endogeneity is not taken into account.

On current work status of women, having more children is found to have a negative impact for those with at least one and at least two children. Increasing the number of children (by 1) results with a fall in current labor force participation of women by 1 and 0.7 percentage points for women with at least one and two children respectively. On the other hand, for at least three children the estimated impact is positive.

Similar to the other fertility measure, transition to more children reduces the current labor supply of women. The effect is 4.8 percentage point fall in labor force participation for women with at least one children. Moreover, transition to third child makes mothers with more than one child less likely to work by 5.6 percentage points. Although the effect for at least three children is negative for this fertility variable, it does not imply a significant relationship.

When the scope of work status is extended to the year of survey (work status regarding last 12 months) fertility estimates go down. Number of children variable has a coefficient of -0.02 and -0.013 for mothers of at least one and two children. This corresponds to approximately doubling of the estimates compared to regressions with current work status. More than two children specifications lead to a positive estimate yet found to be insignificant.

Transition to second child is found to push labor force participation in the survey year down by 8.7 percentage points while the negative effect of transition to third child rises to 7.4 percentage points compared to current work variable and the increase is higher for transition to the second child.

The estimates continue to grow when women are classified not in terms of labor force participation but according to whether they work for cash or not. When mothers who work not necessarily for cash and previously counted in the working category are given zero in the labor supply indicator along with women who do not supply labor, number of children variable has coefficients of around -0.03, -0.02 and -0.01 for women with increasing at least one, two and three children. Negative impact is also confirmed for transition to more children variable and estimates rise as high as 10 percentage points in absolute terms. Here, as an exception both fertility variables have a negative impact for women with at least three children.

Days-worked in the survey year is a measure which is different than the rest. Simply it has the potential to give the effect of fertility not only on working status but also on the working intensity of women. Ordinary least squares estimation suggests that such an effect exists and significantly negative. The greatest effect is for transition to third child for women who already have two such that on average women work 17.26 days less than women with only two children.

Effects of exogenous variables on labor supply measures are worth noting. Age has an important effect on labor supply of women in positive direction for all specifications. While generally significantly different than zero, estimate of the age consistently ranges from 3 to 4 percentage points where left hand side variables are binary participation indicators. Age squared variable on the other hand implies that the estimated positive age effect is concave. Similarly mothers who had their first births at relatively younger ages are found to participate less in labor force and work less when they participate.

On the other hand, educational attainment pushes up the labor supply measures for higher levels. When the base category is women with no education, the coefficient of primary education is negative almost in all regressions. However, the effect of education turns to positive and increases proportional to the level of attainment. While significances of primary and secondary education vary in each different specification, higher education has a clear and important positive impact on labor supply outcome of mothers.

To sum up, OLS estimation results indicates that though with exceptions depending on the number of children and the labor supply measure used, fertility has a significant and negative though not too strong effect on women. This effect is bigger and more widely observed for specifications regarding mothers of at least two children. Under assumptions of exogeneity and no unobserved heterogeneity, estimation associated with more than three children suggests that fertility effect perishes after transition to third child. Also as expected, ordinary least squares imply significant impacts for both age and education variables

4.1.4.3 Two Stage Least Squares Results

2SLS provides the treatment effects on people who are faced with the instruments and gives mixed evidence in the specifications given in Table 11 to Table 14 about the direction effect of fertility for different labor supply measures.

Two stage estimates of fertility on current work status are negative except for women with at least three children. The estimates are higher in magnitude for all mothers (where instrument F is used) and lower for mothers with at least two children (where instrument FF is used). It is found that for mothers of at least one child the effect of having second child suppresses labor supply as high as 26 percentage points. However the effects estimated display a very wide range. Moreover, estimates are insignificant even at 10 percent level for all fertility variables and all numbers of children.

Adding women whose work status is categorized including the year before the survey changes this scheme for the direction of estimates. Estimates for all instruments are greater than zero. For instrument F, women increase their labor force participation by 0.3 percentage points for an increase in the number of children by one, by 2.4 percentage points if women have the second children. Impacts grow for higher order instruments of F through FFF. However again, mentioned impacts are not statistically meaningful.

While numbers change, the interpretations of estimates of instrumented fertility levels are the same as above for working for cash status and days worked variable (Table13 and Table14). Enough details are presented to show the insignificance of the relationship between fertility and labor supply of mothers when fertility is instrumented by absolute female dominance in the first children. The final picture after controlling for exogenous variables does not contain more information than what is given by Wald estimates in terms of the essence of the causal relationship between the number of children a woman has and her labor force participation. One further observation could be added that after controlling for covariates, impacts that are estimated by 2SLS are generally lower in magnitude.

Another difference in estimates to note after instrumentation is that many of the age and education variables which are found to have a statistical meaning on the work status of women are no longer significant. After instrumentation, it seems like almost none of the variables in hand are robustly capable of explaining labor supply decisions of women.

These results point to two possibilities. First, if the instruments used are proper for the focus of analysis then the negative OLS estimated effects of fertility are illusive, affected by the very likely presence of endogeneity. Second, the instrument is not strong enough to carry the effect of fertility or not valid so that the estimates hover around zero and suffer from large standard errors. Female avoidance instruments seem to be weak for more than two children specifications; however validity instruments needs to be discussed in more detail.

Without further investigation of the underlying mechanism of male preference in its effects to both variables whose causal relationship is desired to be understood, we are left with the presented picture. Leaving this chapter in its straightforward technical form and delaying the discussion regarding the possibilities mentioned above, more information about the relationship could be provided through the same analysis with a different instrument. The results would constitute a base for comparison and enriches the discussion. Hence, next chapter searches for the effect of fertility on labor supply of women by instrumentation based on twins.

4.2 Twin Birth Instruments

4.2.1 Twin per Birth

In chapter 2, Rozensweig and Wolpin (1980a) was introduced as one of the pioneering studies approaching the problem from the viewpoint of utilizing exogenous variation in fertility. They use twin first births to obtain the effect of an unplanned child on labor supply outcomes. Rozensweig and Wolpin (1980b) on the other hand treats twin ratio (twin per pregnancy) instrument to make use of twins at higher parities as well. Angrist and Evans (1998) introduce multiple second births as source of variation in fertility. Their aim in using that instrument is to compare it with so called same sex instrument which is constructed to reflect sex balancing behavior of families in U.S.

Twin birth instruments have their own limitations. The most important drawback of using instruments based on multiple-births is their low chance of occurrence. For removing the effect of rarity on the number of observations Bronars and Grogger (1994) and Gangadharan and Rosenbloom (1996) used Census samples which contain large size data. These studies used first born twins to consider its exogenous effects on fertility. However as criticized in de Haan (2006), it is easy for families to adjust family size when unplanned child comes at first birth. For that reason the study suggests the use of twins at last birth instrument.

Table 111. 2SLS Results (Sex Preference Instruments)

Dependent Variable: Current Work Status						
Variable	First Stage	OLS	Second Stage	First Stage	OLS	Second Stage
	Fertility: Total Number Of Children (10805 observations)			Fertility: Transition to Second Child (10805 observations)		
Fertility		-0.013 (0.0031) a	-0.031 (0.0672)		-0.048 (0.0117) a	-0.259 (0.5661)
Age	0.398 (0.0182) a	0.039 (0.0060) a	0.046 (0.0274) c	0.177 (0.0048) a	0.043 (0.0062) a	0.080 (0.1008)
Age^2	-0.004 (0.0002) a	-0.000 (0.0000) a	-0.000 (0.0003) c	-0.002 (0.0000) a	-0.000 (0.0000) a	-0.001 (0.0013)
Age at First Birth	-0.176 (0.0033) a	-0.004 (0.0012) a	-0.008 (0.0119)	-0.038 (0.0008) a	-0.004 (0.0011) a	-0.012 (0.0217)
Primary Educ.	-1.151 (0.0340) a	-0.005 (0.0115)	-0.026 (0.0783)	0.015 (0.0090) c	0.010 (0.0109)	0.013 (0.0140)
Secondary Educ.	-1.525 (0.0401) a	0.056 (0.0137) a	0.029 (0.1033)	-0.079 (0.0106) a	0.072 (0.0129) a	0.056 (0.0469)
Higher Educ.	-1.569 (0.0600) a	0.502 (0.0199) a	0.474 (0.1074) a	-0.170 (0.0159) a	0.515 (0.0194) a	0.479 (0.0987) a
One Girl	0.112 (0.0235) a			0.013 (0.0062) b		
	Fertility: Total Number Of Children (8505 observations)			Fertility: Transition to Third Child (8505 observations)		
Fertility		-0.007 (0.0033) b	-0.002 (0.0320)		-0.056 (0.0103) a	-0.008 (0.0915)
Age	0.330 (0.0245) a	0.032 (0.0075) a	0.030 (0.0129) b	0.137 (0.0078) a	0.037 (0.0076) a	0.031 (0.0146) b
Age^2	-0.003 (0.0003) a	-0.000 (0.0001) a	-0.000 (0.0001) b	-0.001 (0.0001) a	-0.000 (0.0001) a	-0.000 (0.0001) b
Age at First Birth	-0.159 (0.0043) a	-0.005 (0.0014) a	-0.004 (0.0052)	-0.041 (0.0013) a	-0.006 (0.0014) a	-0.004 (0.0040)
Primary Educ.	-1.167 (0.0377) a	-0.007 (0.0121)	-0.001 (0.0396)	-0.140 (0.0120) a	-0.005 (0.0116)	0.001 (0.0176)
Secondary Educ.	-1.582 (0.0468) a	0.051 (0.0152) a	0.059 (0.0528)	-0.351 (0.0149) a	0.044 (0.0147) a	0.061 (0.0353) c
Higher Educ.	-1.575 (0.0807) a	0.524 (0.0252) a	0.532 (0.0566) a	-0.409 (0.0257) a	0.514 (0.0250) a	0.534 (0.0452) a
Two Girls	0.319 (0.0334) a			0.111 (0.0106) a		
	Fertility: Total Number Of Children (4822 observations)			Fertility: Transition to Fourth Child (4822 observations)		
Fertility		0.006 (0.0038)	0.013 (0.0728)		-0.003 (0.0125)	0.036 (0.2020)
Age	0.315 (0.0406) a	0.021 (0.0110) c	0.019 (0.0254)	0.093 (0.0125) a	0.023 (0.0110) b	0.019 (0.0217)
Age^2	-0.003 (0.0005) a	-0.000 (0.0001) c	-0.000 (0.0002)	-0.000 (0.0001) a	-0.000 (0.0001) c	-0.000 (0.0002)
Age at First Birth	-0.155 (0.0067) a	-0.003 (0.0019) c	-0.002 (0.0114)	-0.038 (0.0020) a	-0.004 (0.0018) b	-0.002 (0.0079)

Table 11 (Continued)

Primary Educ.	-1.022 (0.0474) a	0.002 (0.0134)	0.009 (0.0760)	-0.205 (0.0147) a	-0.004 (0.0131)	0.003 (0.0438)
Secondary Educ.	-1.346 (0.0748) a	0.026 (0.0209)	0.036 (0.0995)	-0.333 (0.0231) a	0.017 (0.0206)	0.030 (0.0697)
Higher Educ.	-1.306 (0.1792) a	0.518 (0.0487) a	0.527 (0.1072) a	-0.416 (0.0555) a	0.509 (0.0488) a	0.525 (0.0975) a
Three Girls	0.209 (0.0565) a			0.075 (0.0175) a		

Notes: Sample is the same as Table 1, Table 2 and Table 3 and combined in terms of survey years. Standard errors are in parantheses.”a”, “b” and “c” corresponds to significance at 1, 5 and 10 percent level respectively.

Table 122. 2SLS Results (Sex Preference Instruments)

Dependent Variable: Work Status (Including Last 12 Months)						
Variable	First Stage	OLS	Second Stage	First Stage	OLS	Second Stage
	Fertility: Total Number Of Children (7680 observations)			Fertility: Transition to Second Child (7680 observations)		
Fertility		-0.020 (0.0040) a	0.003 (0.0823)		-0.087 (0.0148) a	0.024 (0.5961)
Age	0.405 (0.0216) a	0.042 (0.0078) a	0.032 (0.0343)	0.170 (0.0059) a	0.048 (0.0081) a	0.029 (0.1017)
Age^2	-0.004 (0.0003) a	-0.000 (0.0001) a	-0.000 (0.0003)	-0.002 (0.0000) a	-0.000 (0.0001) a	-0.000 (0.0013)
Age at First Birth	-0.174 (0.0039) a	-0.009 (0.0015) a	-0.004 (0.0144)	-0.038 (0.0010) a	-0.008 (0.0015) a	-0.004 (0.0231)
Primary Educ.	-1.244 (0.0409) a	-0.018 (0.0154)	0.010 (0.1034)	0.015 (0.0111)	0.007 (0.0145)	0.006 (0.0174)
Secondary Educ.	-1.607 (0.0474) a	0.024 (0.0181)	0.062 (0.1331)	-0.081 (0.0129) a	0.050 (0.0169) a	0.059 (0.0509)
Higher Educ.	-1.622 (0.0698) a	0.460 (0.0257) a	0.498 (0.1359) a	-0.171 (0.0190) a	0.478 (0.0249) a	0.497 (0.1050) a
One Girl	0.119 (0.0277) a			0.016 (0.0075) b		
	Fertility: Total Number Of Children (5989 observations)			Fertility: Transition to Third Child (5989 observations)		
Fertility		-0.013 (0.0043) a	0.017 (0.0399)		-0.074 (0.0133) a	0.053 (0.1199)
Age	0.342 (0.0290) a	0.035 (0.0099) a	0.025 (0.0169)	0.130 (0.0094) a	0.041 (0.0099) a	0.024 (0.0185)
Age^2	-0.003 (0.0004) a	-0.000 (0.0001) a	-0.000 (0.0002)	-0.001 (0.0001) a	-0.000 (0.0001) a	-0.000 (0.0002)
Age at First Birth	-0.159 (0.0051) a	-0.010 (0.0018) a	-0.005 (0.0065)	-0.040 (0.0016) a	-0.011 (0.0018) a	-0.006 (0.0052)

Table 12 (Continued)

Primary Educ.	-1.259 (0.0453) a	-0.015 (0.0162)	0.023 (0.0528)	-0.146 (0.0147) a	-0.009 (0.0153)	0.009 (0.0236)
Secondary Educ.	-1.665 (0.0551) a	0.013 (0.0199)	0.064 (0.0689)	-0.351 (0.0178) a	0.008 (0.0191)	0.053 (0.0460)
Higher Educ.	-1.609 (0.0942) a	0.487 (0.0325) a	0.537 (0.0720) a	-0.426 (0.0305) a	0.476 (0.0322) a	0.531 (0.0606) a
Two Girls	0.335 (0.0396) a			0.111 (0.0128) a		
	Fertility: Total Number Of Children (3316 observations)			Fertility: Transition to Fourth Child (3316 observations)		
Fertility		0.002 (0.0052)	0.084 (0.1338)		0.002 (0.0167)	0.271 (0.4308)
Age	0.357 (0.0486) a	0.030 (0.0146) b	0.001 (0.0498)	0.101 (0.0151) a	0.030 (0.0146) b	0.003 (0.0458)
Age^2	-0.003 (0.0007) a	-0.000 (0.0002) c	-0.000 (0.0005)	-0.001 (0.0002) a	-0.000 (0.0002) c	-0.000 (0.0005)
Age at First Birth	-0.159 (0.0079) a	-0.009 (0.0025) a	0.003 (0.0213)	-0.039 (0.0024) a	-0.009 (0.0024) a	0.001 (0.0170)
Primary Educ.	-1.112 (0.0576) a	-0.023 (0.0182)	0.067 (0.1504)	-0.211 (0.0179) a	-0.025 (0.0176)	0.031 (0.0934)
Secondary Educ.	-1.444 (0.0874) a	-0.004 (0.0272)	0.112 (0.1940)	-0.348 (0.0272) a	-0.007 (0.0268)	0.085 (0.1513)
Higher Educ.	-1.177 (0.2260) a	0.436 (0.0679) a	0.533 (0.1730) a	-0.361 (0.0703) a	0.434 (0.0679) a	0.532 (0.1714) a
Three Girls	0.151 (0.0654) b			0.047 (0.0203) b		

Notes: Sample is the same as Table 1, Table 2 and Table 3 and combined in terms of survey years. Standard errors are in parantheses."a", "b" and "c" corresponds to significance at 1, 5 and 10 percent level respectively.

Table 133. 2SLS Results (Sex Preference Instruments)

Dependent Variable: Work for Cash Status (Including Last 12 Months)						
Variable	First Stage	OLS	Second Stage	First Stage	OLS	Second Stage
	Fertility: Total Number Of Children (7680 observations)			Fertility: Transition to Second Child (7680 observations)		
Fertility		-0.032 (0.0037) a	0.044 (0.0771)		-0.100 (0.0136) a	0.322 (0.5767)
Age	0.405 (0.0216) a	0.046 (0.0071) a	0.015 (0.0321)	0.170 (0.0059) a	0.050 (0.0074) a	-0.021 (0.0984)
Age^2	-0.004 (0.0003) a	-0.000 (0.0001) a	-0.000 (0.0003)	-0.002 (0.0000) a	-0.000 (0.0001) a	0.000 (0.0012)
Age at First Birth	-0.174 (0.0039) a	-0.008 (0.0014) a	0.004 (0.0135)	-0.038 (0.0010) a	-0.007 (0.0013) a	0.009 (0.0223)

Table 13 (Continued)

Primary Educ.	-1.244 (0.0409) a	-0.023 (0.0141) c	0.071 (0.0968)	0.015 (0.0111)	0.018 (0.0133)	0.011 (0.0168)
Secondary Educ.	-1.607 (0.0474) a	0.037 (0.0165) b	0.160 (0.1247)	-0.081 (0.0129) a	0.080 (0.0154) a	0.114 (0.0492) b
Higher Educ.	-1.622 (0.0698) a	0.499 (0.0235) a	0.624 (0.1273) a	-0.171 (0.0190) a	0.534 (0.0228) a	0.607 (0.1016) a
One Girl	0.119 (0.0277) a			0.016 (0.0075) b		
	Fertility: Total Number Of Children (5989 observations)			Fertility: Transition to Third Child (5989 observations)		
Fertility		-0.025 (0.0039) a	-0.000 (0.0359)		-0.095 (0.0120) a	-0.001 (0.1077)
Age	0.342 (0.0290) a	0.042 (0.0089) a	0.034 (0.0152) b	0.130 (0.0094) a	0.046 (0.0089) a	0.034 (0.0166) b
Age^2	-0.003 (0.0004) a	-0.000 (0.0001) a	-0.000 (0.0001) b	-0.001 (0.0001) a	-0.000 (0.0001) a	-0.000 (0.0002) b
Age at First Birth	-0.159 (0.0051) a	-0.010 (0.0016) a	-0.006 (0.0059)	-0.040 (0.0016) a	-0.010 (0.0016) a	-0.006 (0.0046)
Primary Educ.	-1.259 (0.0453) a	-0.022 (0.0146)	0.008 (0.0475)	-0.146 (0.0147) a	-0.005 (0.0138)	0.008 (0.0212)
Secondary Educ.	-1.665 (0.0551) a	0.028 (0.0179)	0.068 (0.0620)	-0.351 (0.0178) a	0.036 (0.0172) b	0.069 (0.0413) c
Higher Educ.	-1.609 (0.0942) a	0.529 (0.0293) a	0.569 (0.0647) a	-0.426 (0.0305) a	0.528 (0.0290) a	0.569 (0.0544) a
Two Girls	0.335 (0.0396) a			0.111 (0.0128) a		
	Fertility: Total Number Of Children (3316 observations)			Fertility: Transition to Fourth Child (3316 observations)		
Fertility		-0.010 (0.0045) b	0.036 (0.1137)		-0.017 (0.0144)	0.091 (0.3577)
Age	0.357 (0.0486) a	0.041 (0.0127) a	0.024 (0.0423)	0.100 (0.0151) a	0.040 (0.0126) a	0.030 (0.0379)
Age^2	-0.003 (0.0007) a	-0.000 (0.0001) a	-0.000 (0.0004)	-0.001 (0.0002) a	-0.000 (0.0001) a	-0.000 (0.0004)
Age at First Birth	-0.159 (0.0079) a	-0.009 (0.0021) a	-0.002 (0.0181)	-0.039 (0.0024) a	-0.008 (0.0021) a	-0.003 (0.0144)
Primary Educ.	-1.112 (0.0576) a	-0.029 (0.0158) c	0.022 (0.1278)	-0.211 (0.0179) a	-0.022 (0.0152)	0.006 (0.0791)
Secondary Educ.	-1.444 (0.0874) a	0.007 (0.0236)	0.073 (0.1649)	-0.348 (0.0272) a	0.014 (0.0232)	0.061 (0.1282)
Higher Educ.	-1.177 (0.2260) a	0.482 (0.0589) a	0.536 (0.1470) a	-0.361 (0.0703) a	0.486 (0.0589) a	0.536 (0.1452) a
Three Girls	0.151 (0.0654) b			0.047 (0.0203) b		

Notes: Sample is the same as Table 1, Table 2 and Table 3 and combined in terms of survey years. Standard errors are in parantheses.”a”, “b” and “c” corresponds to significance at 1, 5 and 10 percent level respectively.

Table 144.. 2SLS Results (Sex Preference Instruments)

Dependent Variable: Days Worked (Including Last 12 Months)						
Variable	First Stage	OLS	Second Stage	First Stage	OLS	Second Stage
	Fertility: Total Number Of Children (3191 observations)			Fertility: Transition to Second Child (3191 observations)		
Fertility		-6.799 (1.2883) a	1847. (52299.)		-14.33 (4.8148) a	1321. (7373.1)
Age	0.416 (0.0330) a	8.623 (2.4604) a	-763.6 (21787.)	0.184 (0.0088) a	8.429 (2.5661) a	-237.3 (1357.0)
Age^2	-0.004 (0.0005) a	-0.097 (0.0373) a	8.278 (236.28)	-0.002 (0.0001) a	-0.101 (0.0388) a	3.145 (17.928)
Age at First Birth	-0.182 (0.0061) a	-1.831 (0.5056) a	1340. (37701.)	-0.038 (0.0016) a	-1.145 (0.4861) b	296.7 (1607.8)
Primary Educ.	-1.013 (0.0606) a	5.835 (4.5958)	1884. (52990.)	0.031 (0.0162) c	13.17 (4.4223) a	-28.72 (232.38)
Secondary Educ.	-1.361 (0.0721) a	31.11 (5.5256) a	2554. (71200.)	-0.058 (0.0193) a	39.53 (5.2630) a	117.8 (433.21)
Higher Educ.	-1.392 (0.1127) a	160.3 (8.3768) a	2742. (72837.)	-0.122 (0.0302) a	168.0 (8.2279) a	331.6 (904.06)
One Girl	-0.001 (0.0431)			-0.002 (0.0115)		
	Fertility: Total Number Of Children (2520 observations)			Fertility: Transition to Third Child (2520 observations)		
Fertility		-5.308 (1.3676) a	17.26 (29.837)		-17.26 (4.2068) a	37.41 (63.426)
Age	0.358 (0.0441) a	6.408 (3.0647) b	-1.635 (11.097)	0.137 (0.0143) a	6.881 (3.0790) b	-0.605 (9.2257)
Age^2	-0.003 (0.0006) a	-0.068 (0.0454)	0.015 (0.1207)	-0.001 (0.0002) a	-0.076 (0.0457) c	0.013 (0.1145)
Age at First Birth	-0.165 (0.0079) a	-1.837 (0.5923) a	19.31 (32.989)	-0.041 (0.0025) a	-1.672 (0.5741) a	12.02 (26.954)
Primary Educ.	-1.054 (0.0674) a	5.737 (4.8451)	29.67 (32.006)	-0.137 (0.0219) a	8.949 (4.6587) c	16.60 (10.072) c
Secondary Educ.	-1.456 (0.0846) a	28.38 (6.1339) a	61.21 (43.825)	-0.325 (0.0274) a	30.50 (5.9587) a	48.24 (21.425) b
Higher Educ.	-1.422 (0.1497) a	169.9 (10.443) a	202.3 (44.083) a	-0.438 (0.0486) a	169.9 (10.422) a	194.1 (30.015) a
Two Girls	0.156 (0.0648) b			0.072 (0.0210) a		
	Fertility: Total Number Of Children (1480 observations)			Fertility: Transition to Fourth Child (1480 observations)		
Fertility		-3.308 (1.5745) b	36.08 (50.653)		-7.295 (4.9700)	75.31 (96.296)
Age	0.370 (0.0707) a	6.457 (4.2254)	-8.342 (19.674)	0.104 (0.0224) a	5.993 (4.2206)	-2.826 (11.245)
Age^2	-0.003 (0.0010) a	-0.069 (0.0610)	0.083 (0.2097)	-0.001 (0.0003) a	-0.065 (0.0611)	0.031 (0.1315)

Table 14 (Continued)

Age at First Birth	-0.162 (0.0119) a	-1.417 (0.7496) c	48.05 (55.429)	-0.038 (0.0037) a	-1.162 (0.7310)	41.63 (45.111)
Primary Educ.	-0.926 (0.0836) a	3.188 (5.1593)	39.56 (47.146)	-0.191 (0.0264) a	4.854 (5.0437)	20.57 (19.102)
Secondary Educ.	-1.262 (0.1312) a	25.81 (8.0195) a	75.94 (65.113)	-0.314 (0.0415) a	27.70 (7.9312) a	54.03 (31.831) c
Higher Educ.	-0.844 (0.3879) b	88.81 (23.013) a	121.8 (50.626) b	-0.260 (0.1228) b	89.71 (23.029) a	111.0 (35.254) a
Three Girls	-0.135 (0.0966)			-0.064 (0.0306) b		

Notes: Sample is the same as Table 1, Table 2 and Table 3 and combined in terms of survey years. Standard errors are in parantheses. .”a”, “b” and “c” corresponds to significance at 1, 5 and 10 percent level respectively.

Another and more important criticism on using twin birth instruments is that they are more likely to occur in greater families. Hence, correlation of the instrument and number of children increases due to a fact that is beyond instrument’s effect on fertility. Hence, treatment tends to select families with more number of children and this constitutes the need for adjusting the measure for family size. The twin per birth instrument is constructed by dividing the number of twin births to the total number of pregnancies which result with children. Twin per birth instrument is also used in DHS Turkey data of 1998 by Dayıoğlu et al. (2009).

Indeed, allowing for direct comparison between the results of male preference instrument in the preceding chapter, twin first, twin second and twin third instruments should be used. Using twin births according to birth order makes comparing the effects of transition to the second, the third and the fourth child. However, since survey data used in the analysis such categorization of multiple-births according to the birth order ends up with a very limited number of observations for those who are positively subjected to the instrument. Twin per birth instrument on the other hand contains all twins in the data set and provides a satisfactory number of observations. For the pooled sample of 1993, 1998 and 2003 DHS 2.53 percent of children are born as a result of multiple-births. In addition, chance of being born in a multiple-birth is homogenous among different survey years. For the year 1993, 1998 and 1998 the rates are 2.65, 2.34 and 2.58 respectively. Moreoever, differences between the rates are not significant at 10 percent level.

Twins are exogenous to the fertility decision of women yet it is not unconditionally independent of other explanatory variables. An important criticism for reduced form equations of Rosenzweig and Wolpin (1980a, 1980b) is that if the instrument is correlated with other exogenous variables that are omitted, resulting estimates are not consistent. Having twin birth is documented to be correlated with characteristics regarding age, race and education. For U.S., Waterhouse (1950) finds that having twin birth are more likely for older women and Myrianthopulos (1970) find correlations between twin births and being black. Angrist and Evans (1998) also confirm these facts with their data set. Twin births are associated with many demographic variables in this data set too. Table 15 presents the mean differences for selected demographic characteristic of women in the sample by comparing women with multiple-births and women who never experienced multiple-births. Table 15 confirms that older women are more likely to have experienced twin births and contrary to what Angrist and Evans (1980) find, less educated women are more likely to have twins. Moreover, twins could be correlated with other family characteristics which are not explicitly included in the regression. However, these findings are questionable given the fact that probability of having multiple-births is affected by family size. Comparing the correlations of these variables with twin as a binary instrument and with twin per birth instrument indicates that after controlling for number of children, these correlations get weaker or even become unimportant. In any case 2SLS overcomes this problem of association with other covariates by allowing to control the effect of instrument on fertility with exogenous variables in the first stage and generates more precise estimates as well as saving the estimates from any association with omitted variables.

4.2.2 Two Stage Least Squares Estimation Results

Table 16 represents the estimation results of first and second stages of 2SLS as well as OLS. Results of fertility equations confirm almost all findings of first stage equations associated with female avoidance instruments. Older age is associated with having more children; age squares affects fertility in a negative direction for a small amount. Age at first birth also has decreasing impacts on fertility. In addition, results imply that twin per birth instrument positively and significantly as expected.

OLS results are the same with Table 11 to Table 14, since they are the same regressions for a given dependent variable. However, second stage regressions differ a lot in many aspects from those for male preference instruments.

Since twin per birth instrument involves multiple-births without differentiation according to the birth order, only effects of total number of children is analyzed here Hence the magnitudes of the estimates are not directly comparable. For current work status it is estimated that increasing the number of children by one reduces the probability of working by nearly 6 percentage points. This is a quite improved estimate when compared to the OLS estimate of a reduction impact of 1 percentage points. This estimated coefficient is statistically significant at 10 percent.

Instrumentation with twin per birth does not seem to cause a serious change in estimates for exogenous variables compared with OLS. Results confirm relatively strong effects of age and having a higher educational attainment which increase the likelihood of currently working of women around 6 and 4 percentage points respectively.

When women’s work status is considered including their past regarding the year before survey, unit increase in women’s fertility cause women to work 11 percentage points less while the effect is estimated as 2 percentage points by OLS. This effect for fertility by 2SLS is statistically significant at 5 percent level. Both for current work status and extended work status variables 2SLS estimates regarding the effect

Table 15. Mean Differences of Explanotary Variables by Instruments

Variable	Twin Instrument
Age	2.09724 (0.37647)
Age at first birth	-0.76846 (0.23079)
Mothers' years of education	-1.28671 (0.24338)
Currently married (=1 married, 0 otherwise)	0.00719 (0.01083)
Lives in capital or a big city (=1 if place of residence is capital or big city, 0 otherwise)	-0.05981 (0.02615)
Lives in a small city (=1 if region of residence is small city, 0 otherwise)	0.05779 (0.03039)
Lives in a town (=1 if region of residence is town, 0 otherwise)	0.00201 (0.02526)
Lives in the west (=1 if region of residence is west, 0 otherwise)	-0.06800 (0.02626)
Lives in the south (=1 if region of residence is south, 0 otherwise)	0.00161 (0.02367)
Lives in the north (=1 if region of residence is north, 0 otherwise)	-0.01547 (0.01799)
Lives in the center (=1 if region of residence is center, 0 otherwise)	-0.00385 (0.02421)
Lives in the east (=1 if region of residence is east, 0 otherwise)	0.08742 (0.02769)

Notes: Sample is the same as Table 1, Table 2 and Table 3 and combined in terms of survey years. Standard errors are in parantheses.

of fertility are roughly 6 times the estimates of OLS. Effects of other covariates are similar to OLS estimates and confirm the interpretations done for current work status specification.

2SLS effect of fertility is still stronger than OLS when work status is categorized as working for cash. On the other hand, the estimated effect is lower than previous labor supply variable while it is greater than current work variable. It is found that women work for cash less by nearly 7 percentage points for when their fertility level in terms of number of children increases by one unit. However, this effect is determined to be statistically insignificant by being just above 10 percent level of significance as standard errors do are not very much different than in previous two regressions.

When the effect of fertility is estimated on the days worked variable same pattern is observed. OLS results suggest that women on average work less by around 6.8 days in a year when number of children they have increase by one whereas the estimated impact increases to nearly 28 days when instrumented by twin per birth variable. This increase by 4 times is roughly consistent across other variables of female labor supply. Also note that working 28 days less in a year corresponds to around 10 percent fall in the working intensity which is in line with the estimates on participation variables.

There is also an interestingly high effect observed when compared with the effects estimated in previous specifications. A woman who has an educational attainment that is higher than secondary education on average works more by 131 days in a year. Comparing with other 2SLS estimates of higher education, this suggests that effect of education is more pronounced when working is scaled rather than left as a binary variable. Also it should be noted that the sign of primary education coefficient turns to positive when days worked is the dependent variable. In line with the intuition, education is reflected more markedly among people who are already decided to participate in labor force.

In sum, compared to OLS, twin per birth instrument robustly indicates 3 to 5 times higher estimates for the negative effect of fertility on labor supply measures. Moreover, impacts estimated by OLS are not widely affected by instrumentation as they almost completely become insignificant under male preference instruments. Replicating the analysis with twin birth instrument contrasts with what is suggested in previous chapter. These two different family of instruments on fertility not only deviate from each in their results regarding significance of the impact of fertility on labor supply outcomes of women, but also according to the bias of OLS estimates. Male preference instruments in general imply that OLS estimates are too much negative than it is supposed to be (ignoring high standard deviations), on the other hand twin per birth instrument significantly suggests the opposite way in terms of direction of the bias. Hence results lead one to think more on the possible ways of the nature of the instruments. Next chapter discusses the validity of instruments and comments on the mechanisms which might lead to different results for different instruments.

Table 166. 2SLS Results (Twin per Birth Instrument)

Variable	First Stage	OLS	Second Stage	First Stage	OLS	Second Stage
	Dependent Variable: Current Work Status (10805 observations)			Dependent Variable: Work Status (Including Last 12 Months) (7680 observations)		
Total Number of Children		-0.013 (0.0031) a	-0.059 (0.0354) c		-0.020 (0.0040) a	-0.111 (0.0536) b
Age	0.397 (0.0182) a	0.039 (0.0060) a	0.058 (0.0153) a	0.405 (0.0215) a	0.042 (0.0078) a	0.079 (0.0232) a
Age^2	-0.004 (0.0002) a	-0.000 (0.0000) a	-0.000 (0.0001) a	-0.004 (0.0003) a	-0.000 (0.0001) a	-0.000 (0.0002) a
Age at First Birth	-0.176 (0.0033) a	-0.004 (0.0012) a	-0.013 (0.0063) b	-0.175 (0.0039) a	-0.009 (0.0015) a	-0.025 (0.0094) a
Primary Educ.	-1.152 (0.0340) a	-0.005 (0.0115)	-0.059 (0.0423)	-1.241 (0.0409) a	-0.018 (0.0154)	-0.132 (0.0683) c
Secondary Educ.	-1.526 (0.0400) a	0.056 (0.0137) a	-0.014 (0.0556)	-1.605 (0.0474) a	0.024 (0.0181)	-0.121 (0.0878)
Higher Educ.	-1.568 (0.0598) a	0.502 (0.0199) a	0.429 (0.0590) a	-1.619 (0.0697) a	0.460 (0.0257) a	0.312 (0.0907) a
Twin per Birth	1.357 (0.1474) a			1.150 (0.1679) a		
	Dependent Variable: Work for Cash Status (In Last 12 Months) (7680 observations)			Dependent Variable: Days Worked (In Last 12 Months) (3191 observations)		
Total Number of Children		-0.032 (0.0037) a	-0.074 (0.0478)		-6.799 (1.2883) a	-27.59 (14.641) c
Age	0.405 (0.0215) a	0.046 (0.0071) a	0.063 (0.0207) a	0.412 (0.0329) a	8.623 (2.4604) a	17.28 (6.5888) a
Age^2	-0.004 (0.0003) a	-0.000 (0.0001) a	-0.000 (0.0002) a	-0.004 (0.0005) a	-0.097 (0.0373) a	-0.191 (0.0764) b
Age at First Birth	-0.175 (0.0039) a	-0.008 (0.0014) a	-0.016 (0.0084) c	-0.182 (0.0061) a	-1.831 (0.5056) a	-5.622 (2.7095) b
Primary Educ.	-1.241 (0.0409) a	-0.023 (0.0141) c	-0.076 (0.0610)	-1.010 (0.0604) a	5.835 (4.5958)	-15.23 (15.523)
Secondary Educ.	-1.605 (0.0474) a	0.037 (0.0165) b	-0.030 (0.0783)	-1.365 (0.0718) a	31.11 (5.5256) a	2.812 (20.660)
Higher Educ.	-1.619 (0.0697) a	0.499 (0.0235) a	0.430 (0.0809) a	-1.395 (0.1122) a	160.3 (8.3768) a	131.3 (22.088) a
Twin per Birth	1.150 (0.1679) a			1.385 (0.2680) a		

Notes: Sample is the same as Table 1, Table 2 and Table 3 and combined in terms of survey years. Standard errors are in parantheses. .”a”, “b” and “c” corresponds to significance at 1,5 and 10 percent level respectively.

CHAPTER 5

INSTRUMENT VALIDITY AND ALTERNATIVE MECHANISMS

5.1 More on Instruments

Preceding chapters show that 2SLS results lead to different conclusions on the causal effect of fertility on labor supply variables of women. They differ from each other and from OLS estimates in varying aspects. Sex preference based instruments do not robustly suggest a positive or negative effect. The implication is that there is no causal effect from fertility to labor supply. On the other hand, twin per child instrument estimates a negative and significant impact of fertility on labor supply as OLS suggests while these estimates indicate a stronger relationship than what is suggested by OLS estimates.

When one thinks both instruments simply as exogenous variation sources on fertility, there is no expected reason to estimate completely different outcomes from them. However, it should not be surprising that male preference and twin instruments differ in their conclusions as one looks more closely to how instruments affect the outcomes.

Different results regarding sex preference and twin birth instruments are documented in the literature. Black et al. (2007) finds that fertility has remarkably adverse effects on children's IQ scores in Norway under the compliance of twin birth instrument whereas no causal effects are estimated based on sex preference instrument in line with OLS results. On the other hand, their results indicate that both instruments imply negative fertility effects on labor supply and although not directly comparable, show close resemblance with Angrist and Evans (1998) study where twin instrument estimates a smaller impact of fertility.

Different instruments, most important of all, involve completely different experiments. Results could diverge because each event regarding the instruments may affect women in different ways even though they both increase fertility. First of all it should be questioned whether the instruments are truly random or affected by other parental characteristics. If they are not random, then estimates reflect the behavior of a certain selection of the population. Second, it should be verified whether instruments have implications which directly affect women’s work status. These two issues constitute the validity of the instruments. Third, regardless of the validity of instruments different experiments could disturb the fertility such that their effects on labor supply could be realized in indirectly different ways. That is, not every external fertility shock is supposed to mean the same impact on women.

5.2 Validity of Instruments

5.2.1 Randomness

In the preceding sections it is shown that both male preference and twin birth instruments generate strong variation in fertility without significantly disturbing other characteristics of women by their own. After building the relevance of instruments, they are assumed to be randomly assigned among individuals. Randomness implies that conditional on a variable, probability that experiencing the case when the instrument is on is the same for all people. Essentially for randomness, it should be shown that the event is not determined by some relevant characteristics. Nevertheless, whether all observable characteristics together have an impact on the probability of occurrence of events is a question that is not answered. Having a twin birth is definitely external to the fertility decision, however if certain characteristics affect the probability of having twins, then those same characteristics could relate having a multiple-birth and labor supply decision. In such a case external variance provided by the instrument does not guarantee exogeneity which is vital for the IV methodology. Here and after, validity of the instruments and their differences in the ways of effectiveness is evaluated similar to Black et al. (2007) and Angrist et al. (2010).

Column two of Table 17 shows results of a linear probability model where probability of a child born from a twin birth is regressed on family and demographic characteristics. None of the variables used in the analysis is found to have a significant effect on the probability of a child born in a multiple-birth. Also husband's characteristics which are not included in the two stage estimations do not imply a significant relationship which indicates that it is likely that having a twin birth is independent from those variables.

Table 17. Linear Probability Model Results

	Dependent variable	
Variables	Twin	Male
Age of woman	0.0002 (0.0002)	-0.0001 (0.0005)
Age at first birth	0.0007 (0.0003) c	0.0003 (0.0008)
No edcuation (mother)	0.0049 (0.0079)	-0.0293 (0.0194)
Primary education (mother)	0.0029 (0.0076)	-0.0198 (0.0182)
Secondary education (mother)	0.0048 (0.0075)	-0.0390 (0.0183) b
Age of husband	-0.0001 (0.0001)	-0.0003 (0.0003)
No edcuation (husband)	-0.0014 (0.0064)	0.0022 (0.0152)
Primary education (husband)	-0.0014 (0.0051)	0.0066 (0.0116)
Secondary education (husband)	-0.0042 (0.0050)	0.0151 (0.0113)
Parents live in capital or big city	-0.0011 (0.0031)	0.0078 (0.0083)
Parents live in small city	0.0022 (0.0029)	0.0175 (0.0072) b

Standard errors are in parantheses. Number of observations is 29447. Standard errors are clustered according to the mother. Base category is women living in towns for place of living variables and women with higher educational attainment for education variables. ."a", "b" and "c" corresponds to significance at 1,5 and 10 percent level respectively.

Another concern on multiple-births is their likelihood of being affected by recent fertility treatments. This would threat the reliability of the instrument if multiple-births are associated with fertility treatments in the data set. If that is the case, then richer people who live in big cities should be more likely to have twins since they potentially have an easier and wider access to the treatment. If education is supposed to be a good indicator of income, then Table 17 suggests that such a concern does not hold for the sample used in the analysis, because both education and place of living indicators are insignificant on the probability of a child to born of a multiple-birth.

Same search is required for the occurrence of female instruments. Probability of having "n" daughters could be safely assumed to be consisting of "n" independent events. Therefore it is enough to check whether the probability of having a son (or daughter) is determined by any parental or demographic characteristics. Column three of Table 17 shows the results of the related linear probability model. Not surprisingly, none of the family and demographic variables is strongly related to the probability of a child born as a member of a certain sex.

Hence the data set does not provide enough evidence on the claim that twin and sex preference instruments are not random. Having shown the internal validity of the instruments, other possibilities that could lead the diversification of 2SLS results should be discussed.

5.2.2 More on Validity

Angrist and Imbens (1994) discuss the subset of population for which the IV estimates reflect the causal effect. They show that IV estimates give the treatment effect on the compliers. Treatment in the context of analysis is having more children and compliers are defined as the women who change their fertility behavior when the instrument is switched on and who do not change their fertility behavior when the instrument is off. On the other hand, the treated also consists of women who are inclined to increase their fertility level regardless of the instrument's status. Similarly, the non-treated also includes women who never tend to increase their given level of fertility even when the instrument is on.

Given the nature of instruments, estimated average treatment effects are likely to reflect their unique characteristics. For example, in twin birth experiment the non-treated set is the same as women who do not change their number of children additionally when they do not have twin birth because there are no *never takers*. That is, if a woman has a twin birth, her number of children increases by more than one for sure. Hence, IV estimation for twin births measures the effect on the non-treated. On the other hand, sex preference instrument does not exclude never takers or always takers by nature of the experiment. More elaborately, sex preference instrument does not automatically induce women to have an additional child. In other words, even when the instrument is on women can refuse to increase their fertility. This puts a slight and important difference in the interpretation of causal effects.

In addition to the differences stemming from the construction of instruments, complier sets could involve cultural and demographic effects. In this sense, an instrument may tend to reflect the effects for people of certain characteristics for whom the instrument is more effective. An example is the Sephardic Jews of Israel in Angrist et al. (2010) study. Sephardic Jews are originated from Asia and Africa and differ from other Israelites in many demographic aspects. On average they have more children, less educational attainment and poorer labor supply outcomes. While same sex instrument strongly affects fertility in all population, it is found in the first stage estimation that Sephardic Jews have a higher reaction to the absolute domination of daughters (FF instrument). In other words, as found in our analysis, Sephardic Jews are more inclined to prefer males. As a result this change in tastes across subpopulations, Sephardic Jews are found to react more strongly to the same sex instrument than the rest. On the contrary, Asian and African originated Israelites do not increase their fertility levels significantly higher than others when twin instrument is on. Quoting Angrist et al. (2010, p. 18): *"Thus, any comparison of* *twins and sex-composition IV estimates is implicitly a comparison for very different groups."*

Preferences of Sephardic Jews look very similar to that of our data set which indicates the Asian roots of male preference. Moreover, demographic characteristics of Asian-African originated Israelites are considered such as high fertility, low labor supply outcomes and income levels suggest similarity with the characteristics of people who are subject to Kurdish ethnicity or who live in the eastern part of Turkey. Hence, a similar argument may hold for the case of Turkey. That is, people who are of Kurdish origin and/or living in the eastern part of Turkey may be preferred more instensively by the sex preference instrument. If that is so, then the difference between different estimates by different instruments could be adressed to the varying characteristics of the complier populations.

In the case of twin per birth instrument, randomness of the instrument coincides with the randomness of the effectiveness of the instrument on fertility decision. However, sex preference instrument's effectiveness on fertility seems to be correlated with certain characteristics though its occurrence is independently distributed among the population. To see this Table 18 presents the differences in means of selected characteristics between people who moved on to additional children and who did not given that sex preference instrument is on. Table 18 shows that these two group of people differ in certain characteristics. People who decide to increase their fertility according to the female avoidance are significantly more likely to be less educated, live in the east or in a small city, be Kurdish and less likely to live in a capital or big city and live in the west of Turkey. Moreover it turns out to be that it is not a matter of ethnicity since the same conclusions for the mean differences still hold when people from Kurdish ethnicity are excluded from the sample. Hence the IV effects which are estimated on the compliers disproportionately reflect the decisions of these women with worse socio-economic characteristics.

Different instruments' fertility effects on labor supply should be evaluated taking into account the fact that sex preference instrument selects women with certain characteristics. Then it is possible to re-interpret the results of the analysis as the following: There is no causal relationship between fertility and labor supply for the population dominated by people living in the eastern part or small cities or having less education. In fact, if we would run this analysis for this restricted sample, we would see that the OLS estimate for fertility on labor force participation in a sample of women with these characteristics is insignificant. Moreover, negative signed OLS estimates grow in magnitude as educational attainment increases. On the other hand, twin instrument estimate of the average treatment effect is on the non-treated population indicates that fertility has a significant negative causal effect for women in Turkey. Hence, results indicate that on average, labor supply of women in Turkey is adversely affected by more children while this effect is insignificant for the sub-populations with lower socio-economic characteristics.

This heterogeneity captured in the effect of fertility can be associated with the differences in the cost of childbearing. Childbearing costs could be lower for people with worse socio-economic characteristics. Greater family size and preservation of traditional bonds with relatives in these families could provide more support for working women. Moreover, informal employment, which is more likely to be the type of employment for women in the lower socio-economic part of the population, may provide more flexibility in terms of labor force participation (Çınar, 1994). Informal employment usually allows for working at home which enables women to take care for the child and work at the same time.

Beside diverging estimates due to complier subpopulation heterogeneity, the side effects associated with the instruments potentially affect the outcomes. Rozensweig and Wolpin (2000) criticize same sex instruments on the grounds that they affect the cost of childbearing. Having children of the same sex could have a positive effect on the costs of children such that educational costs and costs of clothing are reduced for the younger children of the same sex. The so called hand-me-down effect could directly influence labor supply decision of women other than its effect through number of children. Unfortunately our data set does not provide the information which enables testing such a threat on the validity of the instrument.

Similarly, another threat on the validity of female avoidance instruments is that in countries like Turkey where society assigns the burden of home-based activities on women, in families where oldest children are girls, daughters would help the mother in childbearing and other housework. Since these families are more likely to be larger ones, contrary to the impact of fertility, women might find working more plausible accordingly. The effect of fertility measured through instrumentation by female same sex instrument could then become ambiguous.

Table 188. Differences of Means Between Treated and Non Treated When The Instrument is on

Variable	Subjects of F	Subjects of FF	Subjects of FFF
Ethnicity	0.095 (0.009) a	0.144 (0.016) a	0.232 (0.027) a
Age at first birth	-2.970 (0.136) a	-2.183 (0.171) a	-2.123 (0.231) a
Mother's years of education	-2.912 (0.136) a	-3.145 (0.171) a	-2.508 (0.239) a
Husband's years of education	-1.945 (0.136) a	-2.103 (0.190) a	-1.751 (0.280) a
Lives in capital or a big city	-0.067 (0.016) a	-0.088 (0.022) a	-0.066 (0.033) b
Lives in a small city	0.045 (0.017) a	0.036 (0.023)	0.075 (0.037) b
Lives in a town	0.021 (0.014)	0.051 (0.019) a	-0.008 (0.032)
Lives in the north	0.013 (0.010)	0.004 (0.014)	-0.029 (0.024)
lives in the south	0.014 (0.013)	0.014 (0.018)	-0.016 (0.028)
Lives in the east	0.087 (0.012) a	0.138 (0.018) a	0.198 (0.030) a
Lives in the center	-0.008 (0.013)	-0.020 (0.019)	-0.059 (0.029) b
Lives in the west	-0.107 (0.016) a	-0.136 (0.022) a	-0.092 (0.033) a

Notes: Sample is the same as Table 1, Table 2 and Table 3 and combined in terms of survey years. Standard errors are in parantheses. .”a”, “b” and “c” corresponds to significance at 1,5 and 10 percent level respectively.

It is shown that the difference in the results according to different instruments is not surprising due to heterogeneous effects of fertility. However, the way instruments affect women's decision is inherently different due to the timing of events regarding the instruments. That is, there are indirect ways regarding the unique features of instruments related with the anticipation of the fertility shock.

Rosenzweig and Wolpin (1980a) introduces twin instrument by emphasizing that thanks to their methodology they estimate the causal impact of an unanticipated increase in fertility on labor force participation of women. Bronars and Grogger (1994) and Gangadharan and Rosenbloom (1996) also claim that they are measuring the unexpected second born children's impact on female labor supply variables. This point is also underlined to differentiate the interpretation of different results suggested by sex preference and twin birth instruments by Black et al. (2007) who based their study on a very homogenous population (Norway) as they express.

Sex preference instruments, whether based on sex balancing, male preference or female avoidance as in this analysis, impose an expected disturbance on women's fertility. Because sex preference based instruments are dependent on cultural characteristics, they are reflected in the preference set of women and their partners. That leads women to anticipate and plan for another child. On the contrary, having a twin birth is unplanned; it is a true random shock on fertility. These two different kinds of disturbances could provide different results according to the characteristics regarding decision making process of families and the labor market.

One crucial difference between Turkey and many industrialized countries is the trends in labor supply participation of women. Many countries saw an opening of labor market to women such that labor force participation of women sharply increased; whereas fertility rates declined in the meantime. On the other hand, Turkey experienced decline in fertility rates but not an increase in labor supply of women, contrary to the evidence in many other western, Latin American or East Asian countries. Figure A1 clearly presents the result of divergence from the trend in Turkey. Low level of labor force participation of urban women is also reflected in the data set used in this analysis. If we think participation rate as the probability of working, then it is reasonable to assume rigidity on women's labor force participation in Turkey. These rigidities could involve cultural barriers on working as well as labor market conditions.[15] Indeed, it is very likely that both are relevant or may be interrelated. Even though the population is assumed to be homogenous, instruments could yield different results. Suppose that all women have the same skills and all work in the formal sectors. Suppose also that women are subject to discrimination (due to cultural convention in the society) in the labor force so that returning to the labor force after quitting from the job prior to the birth is costly and discouraging. Then, these rigidities potentially cause working women in the formal sector to adjust for the timing of the birth in order to reduce the costs associated with having an additional child; so that returning to the job is possible within the limits of the legal child-bearing period. On the other hand, unanticipated shocks leave the women with an intensive motherhood period and by definition does not allow them to adjust for the timing for the additional child, which could force them to leave the labor force longer than the legal period and discourage their future participation. Such effects are not discussed in the literature in this context since both kinds of instruments so far yielded similar results. Though theoretically possible, modeling and exploration of these rigidities are required to save the discussion from being speculative. Such a quest is important and requires an effort beyond the scope and the means of this analysis.

[15] For instance İlkkaracan (2000) documents gender-based division which forms a kind of rigidity preventing women from participating in economic activity.

CHAPTER 6

CONCLUSION

This thesis aims to disentangle the effect of fertility on labor supply decisions from the simultaneity embedded in two possibly interrelated decisions for Turkish women. Though the inverse relationship observed in many industrialized countries for fertility and labor force participation does not hold historically for Turkey, there is a cross sectional negative correlation of these variables. Majority of the recent studies which use biologically stochastic fertility instruments imply a significant and high causal adverse effect of fertility. It is important to note that the literature is deeply motivated by the inverse movement of fertility and labor force participation in time, while of course many other reasons also motivate this investigation. However country specific characteristics of family or labor market could hide the time series pattern while the causal link still holds. That makes the case for Turkey more interesting.

First remarkable finding of this study is that the search for a valid instrument provided important insights about the sex preference tendencies in Turkey. The dominant sex preference pattern is male preference as expected while this tendency is embedded in sex balancing behavior. As a result, male preference is realized in the form of female avoidance.

The core of the results of this study is that sex preference and twin instruments imply a huge difference in interpreting the causal effect of fertility on labor supply. As instrumental validity could not be rejected with the data used in the study, the difference is likely to come from the heterogeneity of the effects across the subpopulations. Sex preference instruments are found to be more effective in inducing additional children for women with lower socio-economic characteristics, while twin per birth instrument are equally likely to affect fertility for all women since the occurrence of a twin birth is random. Sex preference based instruments indicate no causal relationship between fertility and labor supply of women contrary to the OLS estimates. On the other hand, the average negative impact of a fertility increase by an unplanned birth on the probability of labor force participation is around 7.5 percentage points which indicates a weaker effect for Turkey than East Asian and European countries and United States and (though not directly comparable) remarkably similar to the estimates of Cruces and Galiani (2007) study for Argentina and Mexico which use same sex instrument. This analysis also shows that like Israel population analyzed by Angrist et al. (2010) study, sex preference instrument captures the heterogeneity associated with the cultural and socio-economic characteristics in the subpopulations.

The conclusion of the thesis should emphasize the importance of the instruments on the results. If there is no significant cost reducing effect of having two girls on child bearing and ignoring heterogeneity, there is room for the possibility that unlike for United States and Norway anticipation of the fertility shock matters in Turkey, which needs further investigation for the underlying causes.[16] Moreover, results of the study could be improved if validity of sex preference instruments is proven in terms of cost reducing effects and twin estimates are obtained in a larger data set.

[16] Result regarding United States is of Angrist and Evans (1998). Black et al.(2007) informs the reader about their finding of no difference in estimates for different instruments in page 22.

REFERENCES

Angrist, J. D. and .Evans, W. N (1998), Children and their parents' labor supply: evidence from exogenous variation in family size, *American Economic Review*, 88, 450-477.

Angrist, J., Lavy, V. and Schlosser, A.(2010) "Multiple Experiments for the Causal Link between the Quantity and Quality of Children," *Journal of Labor Economics*, 28(4), 773-824.

Arnold, F. and Zhaoxiang, L. (1986) "Sex preference, fertility, and family planning in China," *Population and Development Review*, 12, 221-46.

Becker, G. S. (1960) "An Economic Analysis of Fertility," in Demographic and Economic Change in Developed Countries, Universities National Bureau Conference Series No. 11, Princeton: Princeton University Press.

Becker, G. S.(1964)"Human Capital", New York: Columbia University Press.

Becker, G. S.(1965) "A Theory of the Allocation of Time," *Economic Journal*, 75, 493-517.

Ben-Porath, Y. and Welch, F.(1976) " Do Sex Preferences Really Matter?", *Quarterly Journal of Economics*, 90(2), 285-307.

Black, S. E., Devereux, P.J. and Salvanes, K. G. (2010) "Small Family, Smart Family? Family Size and the IQ Scores of Young Men," *Journal of Human Resources*, University of Wisconsin Press, 45(1).

Bowen, W. G. And Finegan, T. A. (1969) "The economics of laborforce participation," Princeton: Princeton U. Press

Bronars, S.G., Grogger, J.(1994) "The Economic Consequences of Unwed Motherhood: Using Twins as a Natural Experiment," *American Economic Review*, 84(5), 1141-56.

Browning, M. (1992) "Children and Household Economic Behavior," *Journal of Economic Literature*, 30(3), 1434-75.

Cain, G. G. (1966) "Married women in the labor force, an economic analysis," Chicago: U. of Chicago Press,.

Cain, G. G. Dooley, M. (1976) "Estimation of a Model of Labor Supply, Fertility and Wages of Married Women," *Journal of Political Economy*, 84(4), S179-99.

Cheng, B. (1999). “Cointegration and causality between fertility and female labor force participation in Taiwan: A multivariate approach,” *American Economic Journal,* 27(4), 422-434.

Cheng, B. S. (1996), “An investigation of cointegration and causality between fertility and female labor force participation,” *Applied Economics Letters, 3*, 29-32.

Cheng, B., Hsu R.C. and Chu, Q. (1997). “The causality between fertility and female labor force participation in Japan,” *Applied Economics Letters*, 4, 113-116.

Chiappori, P. A. and Lacroix, G. (2002) “Marriage Market, Divorce Legislation, and Household Labor Supply,” *Journal of Political Economy*, 110(1), 37-72.

Chun, H. and Oh, J. (2002), “An instrumental variable estimate of the effect of fertility on the labour force participation of married women,” *Applied Economics Letters,* 9(10), 631-634.

Cristia, Julian P.(2006) "The Effect of a First Child on Female Labor Supply: Evidence from Women Seeking Fertility Services," Congressional Budget Office Working Paper, 11.

Cruces, G. and Galiani, S. (2007), Fertility and female labor supply in Latin America: New causal evidence, *Labour Economics*, 14, 565-573.

Çınar, E. M. (1994), “Unskilled urban migrant women and disguised employment: home-working women in Istanbul, Turkey,” World Development, 22(3), 369– 380.

Dayıoğlu, M. and Kırdar, M. G. (2010) “Determinants of and Trends in Labor Force Participation of Women in Turkey”, State Planning Organization of the Republic of Turkey and World BankWelfare and Social Policy Analytical Work Program Working Paper, 5.

Dayioglu, M. (2000) “Labor Market Participation of Women in Turkey,” in F. Acar and Gunes-Ayata (eds.) Gender and Identity Construction: Women of Central Asia, Caucasus and Turkey, The Netherlands: E.S. Brill.

Dayioğlu, M., Kirdar, M. G. and Tansel, A. (2009), “Impact of Sibship Size, Birth Order and Sex Composition on School Enrolment in Urban Turkey,” *Oxford Bulletin of Economics and Statistics*, 71, 399–426.

de Haan, M. (2006). “Birth-order family size and educational attainment,” Paper Presented at the Meeting of European Society of Population Economics (ESPE), Verona, Italy.

Engelhardt, H., Kogel, T. and Prskawetz, A. (2001) “Fertility and female employment reconsidered: A macro-level time series analysis,” MPIDR Working Paper WP, 2001 021.

Fleisher, B. M., Rhodes, G. F. (1979) "Fertility, Women's Wage Rates and Labor Supply," *American Economic Review*, 69(1), 14- 24.

Gangadharan, J., and Rosenbloom, J. L. (1996) "The Effects of Child-bearing on Married Women's Labor Supply and Earnings: Using Twin Births as a Natural Experiment," National Bureau of Economic Research (Cambridge, MA) Working Paper No. 5647

Granger ,C. W. J.(1969) “Investigating Causal Relations by Econometric Models and Cross-spectral Methods,” *Econometrica*, 37(3), 424-438.

Gronau, R. (1973) "The Effect of Children on the Housewife's Value of Time," *Journal of Political Economy*, 81(2, Part II), 99- S168.

Heckman, J. J.(1974) "Life Cycle Consumption and Labor Supply: An Explanation of the Relationship Between Income and Consumption Over the Life Cycle," *American Economic Review*, 64(1), 188-94.

Heckman, J. J., Willis, R. J. (1977) "A Beta- Logistic Model For the Analysis of Sequential Labor Force Participation by Married Women," *Journal of Political Economy*, 85(1), 27-58.

Hout, M. (1978) "The Determinants of Marital Fertility in the United States, 1968-1970: Inferences From a Dynamic Model," *Demography*, 15(2), 139-59.

Ilkkaracan, I. (2000). “Why are there so few women in the urban labor market in Turkey? A supply side account based on findings from an action-research study,” In The annual conference of IAFE, Istanbul, August 15–17.

Imbens, G. W., Angrist, J. D. (1994) "Identification and Estimation of Local Average Treatment Effects," *Econometrica*, 62(2), 467-76.

Jacobsen, J. P., Pearce, J. W. and. Rosenbloom, J. L (1999), The effects of child-bearing on married women’s labor supply and earnings: Using twin births as a natural experiment, *The Journal of Human Resources*, 34(3), 449-474.

Jakubson, G. (1988) "The Sensitivity of Labor Supply Parameter Estimates to Unobserved Individual Effects: Fixed- and Random-Effects Estimates in a Nonlinear Model Using Panel Data," *Journal of Labor Economics*, 6, 302- 329.

Klijzing, E., Sieger, X., Keilman, J. and Groot, J. (1988). “Static versus dynamic analysis of the interaction between female labor force participation and fertility,” *European Journal of Population*, 4, 97-116.

Korenman, S.,Neumark, D. (1992) "Marriage, Motherhood, and Wages," *Journal of Human Resources*, 27(2), 233-55.

Larry, E. J., Schoonbroodt A. and Tertilt, M. (2010) "Fertility Theories: Can They Explain the Negative Fertility-Income Relationship?" NBER Chapters, in: Demography and the Economy, National Bureau of Economic Research, Inc., 43-100

Lewis, H. G.(1957) "Hours of Work and Hours of Leisure," in Proceedings of the Industrial Relations Research Association, Princeton University, 196-207.

Lin, W.(2005). "The Demand for Sons in Taiwan: Evidence from Divorce, Custody and Fertility," Manuscript.

Michael, R.T. (1985). "Consequences of the sire in female labor force participation rates: Questions and probes," *Journal of Labor Economics*, 3, 117-157.

Mincer, J. (1962) "Labor Force Participation of Married Women: A Study of Labor Supply," *in Aspects of labor economics*. Ed.: H. Gregg Lewis. Princeton: Princeton U. Press, 63-97

Mroz, T. A. (1987) "The Sensitivity of an Empirical Model of Married Women's Hours of Work to Economic and Statistical Assumptions," *Econometrica*, 55(4), 765-99.

Myrianthopoulos, N., Tinos, C. (1970) "An Epidemiologic Survey of Twins in a Large Prospectively Studied Population," *American Journal of Human Genetics*, 22(6), 611-29.

Nakamura, A., Nakamura, M. (1981) "A Comparison of the Labor Force Behavior of Married Women in the United States and Canada, with Special Attention to the Impact of Income Taxes," *Econometrica*, 49(2), 451-89.

Özar, S. and Senesen, G. G. (1998) "Determinants of Female (non) Participation in the Urban Labor Force in Turkey," *METU Studies in Development*, 25(2): 311-328.

Park, C. B. and Cho, N. (1995) "Consequences of son preference in a low-fertility society: imbalance of the sex ratio at birth in Korea," *Population and Development Review*, 21, 59-84.

Rosenzweig M. R. and Wolpin K. I. (2000) "Natural "Natural Experiments" in Economics," *Journal of Economic Literature*.

Rosenzweig, M. R. and Wolpin, K. L. (1980b) "Testing the Quantity-Quality Fertility Model: The Use of Twins as a Natural Experiment," *Econometrica*, 48(1), 227-40.

Rosenzweig, M. R., Wolpin, K. I.(1980a) "Life-Cycle Labor Supply and Fertility: Causal Inferences From Household Models," *Journal of Political Economy*, 88(2), 328-48.

Schultz, T.P. (1997), “Income inequality in Taiwan 1976-1995: Changing family composition, aging, and female labor force participation,” Working Papers *778*, Economic Growth Center, Yale University.

Shapiro, D., Mott, F. L. (1991) "Long-Term Employment and Earnings of Women in Relation to Employment Behavior Surrounding the First Birth." Mimeo. Pennsylvania State U., Department of Economics

Şengül, S. and Kıral, G. (2006) “Türkiye'de Kadının İşgücü Pazarına Katılım Ve Doğurganlık Kararları,” Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi, 20(1)

Tansel, A. (2002) “Economıc Development and Female Labor Force Participation in Turkey: Time-Series Evidence and Cross-Provınce Estımates”, Economic Research Center Working Paper,01/05.

Tunali, I. (1997) “To Work or Not to Work: An Examination of Female Labor Force Participation Rates in Urban Turkey,” Processed. Istanbul: Department of Economics, Koç University.

Waldfogel, J. (1995) “The Price of Motherhood: Family Status and Women's Pay in Young British Cohort,” *Oxford Economic Papers New Series*, 47(4), 584-610.

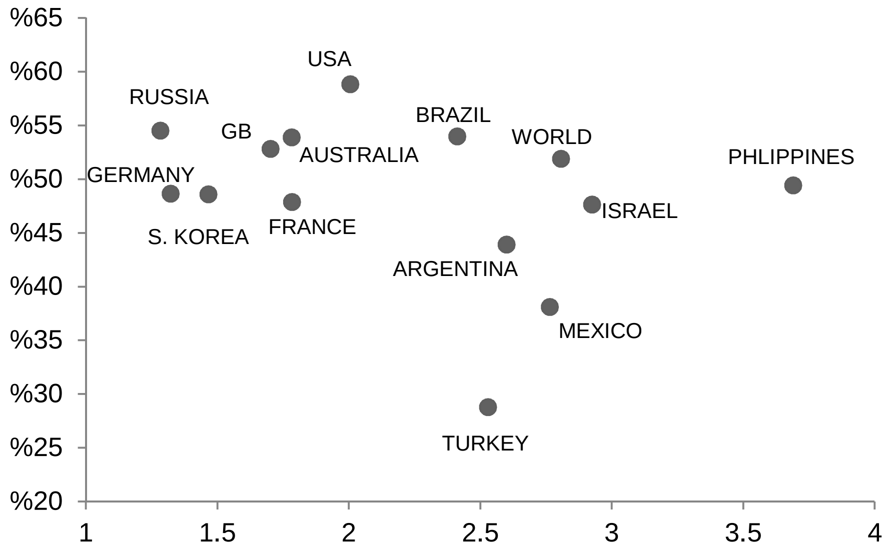
Waterhouse, J. A. H. (1950) "Twinning iin Twin Pedigrees," British Journal of Social Medicine, (6), 197.

Willis, R. J.(1987) ” What Have We Learned from the Economics of the Family?,” *The American Economic Review*, Vol. 77, No. 2, Papers and Proceedings of the Ninety-Ninth Annual Meeting of the American Economic Association, 68-81

World Bank Database, http://data.worldbank.org/, 05.08.2001.

APPENDIX

Figure A1 Labor Force Participation Rate and Fertility for Selected Countries



Source: http://data.worldbank.org/
Notes: Vertical axis is female labor force participation (LFP). Both LFP and fertility are calculated as the average of 1993-2003 period.GB abbreviates Britain.