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ABSTRACT

Twins, Family Size, and Female Labor Force Participation in Iran

Despite the remarkable increase in women's education levels and the rapid fall of their fertility rate in Iran, female labor force participation (FLFP) has remained low. Using the instrumental variable method, this paper estimates the causal impact of number of children on mothers' participation in the labor market. It finds that having an extra (unplanned) child would only reduce female participation rate for low educated mothers and mothers with young children, thus having no causal impact on most mothers' participation. This result explains why the rapid decline in fertility rates did not increase female participation; rather, other factors should be at play. It hence moves us a step forward in explaining the puzzle of female labor force participation in Iran. Policy implications are discussed.

JEL Classification: J13, J22, O53

Keywords: female labor force participation, fertility, Iran, twins, instrumental variable

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1. Introduction

Iranian women have made significant accomplishments in the last three decades. For example, the average years of schooling for 20 to 30 year-old women rose by more than 8 years between 1970 and 2010 (Data Source: Barro and Lee 2013). At the same time, total fertility rates have fallen from about 6.5 children per woman in 1984 to almost 2 children per woman in 2002 (Salehi-Isfahani et al. 2010). In spite of all these accomplishments, their labor force participation rates have remained almost constant at about 20% in the last three decades.[1] This has remained a puzzle (the *puzzle of female labor force participation*).

Solving this puzzle could play a critical role in empowering women and increasing their economic prowess. In addition, it could generate more economic growth as it leads to more economic activity by the 'missing' half of the population. Cavalcanti and Tavares (2008) argue that, if female participation in Saudi Arabia increases to levels seen in the West, its GDP per capita nearly reaches to the level of the US (i.e. more than doubles.) To solve this puzzle, one needs to evaluate every factor that affects female labor force participation (FLFP) in Iran. Economic theory and a large body of empirical economics in other countries argue that one major factor is fertility (see Killingsworth and Heckman 1986; Xie 1997; McNown and Ridao-Cano 2005; Narayan and Smyth 2006; Contreras et al 2010; Collet and Legros 2016). This paper sheds light on the FLFP puzzle by studying whether fertility has any causal impact on FLFP in Iran, as found in many countries around the world (see for example, Jacobsen et al. 1999, for results for the US).

Besides moving us toward solving the FLFP puzzle, this study and its context is important and interesting for three other reasons: first, it is not surprising to see that fertility had an effect on women's participation in other countries. In many countries, the fall in fertility and the rise in female participation have been correlated over time. By contrast, this research question in the context of

Iran is significantly more interesting because there has been no correlation between the trends in fertility and female participation in Iran. The result is not predictable and can be surprising. Second, Iran is a unique setting for this research as it has had one of the lowest FLFP rates in the world while it has experienced the fastest fertility transition in modern human history (Abbassi-Shavazi et al. 2009). Third, the substantial decline in the fertility rate of Iranian women has created a baby boom generation which will reach the retirement age by 2050. If such low shares of women participate in the labor force at that time, the ratio of retirees surpasses 60% of the working population, and the country will face a severe pension crisis. For all these reasons, it is interesting and important to both researchers and policy makers to study this research question in the context of Iran. The results of this paper provide insights for other countries in the Middle East and North Africa (MENA) region, as they have the same stylized facts and puzzle mentioned above.[2]

The main problem in identifying the impact of number of children on mothers' labor force participation (LFP) is that they are jointly determined and, hence, endogenous. Women who have a strong inclination to work may decide to have fewer children. This naturally creates a negative correlation between fertility and FLFP that is not causal (Blundell and Macurdy, 1999; Killingsworth and Heckman, 1986).[3] On the other hand, if poorer mothers both work more and have more children because they are poor, the correlation between the two would be positive which is again not causal. Following the seminal work by Rosenzweig and Wolpin (1980a) (and subsequent work by Angrist and Evans (1998), Jacobsen et al. (1999), Caceres-Delpiano (2006), Vere (2011), and Karbownik and Myck (2016)), this study uses twins at first birth as an instrumental variable and shows that the number of children does not have a causal impact on labor force participation of the majority of mothers in Iran.

Twins at the first birth rather than twins in subsequent births is used as an instrument. As Rosenzweig and Wolpin (1980a) discuss, this is because mothers who give birth to twins in their first birth are comparable to mothers who had at least one child, which is almost all women. Therefore the result of this study is generalizable to practically all Iranian women. Mothers who have twins at second birth order have already decided to have more than one child and are therefore only comparable to women with two or more children, which is a smaller set of women. The comparable sample becomes smaller as one considers twins at higher birth orders.[4]

FLFP in Iran has been studied in the past. Salehi-Isfahani (2005) was the first paper trying to understand the effect of fertility and education on FLFP using a reduced form. Esfahani and Shajari (2012) use urban vs. rural place of birth as an instrument for women's education and find that education increases FLFP modestly.[5] Azimi (2015) estimates the effect of the number of children on FLFP using son-preference as the instrumental variable and finds no significant effect of fertility on FLFP in urban areas. This instrument, however, may not satisfy the exclusion restriction in Iran. That is, son-preference may affect FLFP through a different channel than via the number of children. For example, husbands who prefer to have sons may have more negative views towards participation of women in the labor market (more patriarchal/androcentric). By law in Iran, husbands have a veto power over the decision of women to work, so son-preference can affect participation of women through preference of their husbands as well as through the number of children. Hence, son-preference will be correlated with the error term in the second stage. This study, however, uses twinning at the first birth as an instrument which does not have this issue.

The rest of this paper is organized as follows: Section 2 briefly discusses the female labor market in Iran. Section 3 explains the econometric model and the data upon which this paper is based. Results are discussed in Section 4. Section 5 concludes this study and provides insights for further research.

2. The Puzzle of FLFP in Iran

Education levels, particularly for women, have increased continuously in the past seven decades in Iran. As can be seen in Figures 1(a) and (b), there has been an exponential rise in average education levels of both genders over age 25, particularly women (Data source: Barro and Lee 2013). While almost all women aged 25 and older were illiterate in 1950, the average number of years of education for the same age group in 2010 was almost eight. The gender gap has been declining as well. Figure 1(b) follows men and women aged 20-24. It shows that average years of education for women in this age group rose from 0.35 in 1950 to 11.08 to 2010, when it surpassed educational attainment of men in the same age group.[6]

This phenomenal increase in women's education has been coupled with a rapid reduction in their fertility rate since the mid-1980s. As shown in Figure 2, total fertility rate declined from about 6.5 children per woman in 1984 to 2.09 by early 2001 (just below the replacement rate of 2.1). As Abbasi-Shavazi et al. (2009) describe, this is the fastest reduction in fertility in modern human history. Total fertility rate has continued to decline and reached 1.69 children per woman in 2015 (lower than all countries in the MENA region including Turkey).

Despite these developments, labor force participation of women aged 15+ has fluctuated between 10 and 20 percent (Figure 3). This phenomenon – that FLFP did not increase despite the rapid rise in education and fall in fertility – has remained a puzzle. There is a large body of literature offering hypotheses to explain this puzzle, but rarely have these hypotheses been tested. The hypotheses range from discriminatory institutions on the supply and the demand sides, state policies, and the oil economy (Moghadam 1995, 2000; Karshenas 2001; Ross 2008; Majbouri 2017). This paper, however, is one of the first rigorous attempts to provide robust empirical evidence of the

contribution of an important factor to this puzzle. It moves us s step forward toward solving this complex multidimensional puzzle.[7]

3. The Econometric Model and the Data

The econometric model to estimate the effect of fertility on mother's labor force participation can be simply written as:

$$L_i = X_i'\alpha + \beta N_i + \epsilon_i \qquad (1)$$

in which L_i is the labor force participation (LFP) for mother i, X_i is a set of control variables. N_i is the number of children mother i has. N_i is endogenous, and the OLS estimate of β is biased. But, one can use giving multiple births at first birth (twins, triplets, or higher orders; *twins* from now on) as an instrument for N_i. Having twins at first birth rather than having twins at higher birth orders is used as an instrument so that mothers with twins would be compared with the largest set of women possible. As Rosenzweig and Wolpin (1980a) discuss, this is because mothers who give birth to twins in their first birth are comparable to mothers who had at least one child, which is almost all women. Therefore, the result of this study is generalizable to practically all Iranian women. Mothers who have twins at the second birth order have already decided to have more than one child and are hence only comparable to women with two or more children which is a smaller set of women. The comparable sample becomes smaller as one considers twins at higher birth orders.

The following equation is estimated as the first stage:

$$N_i = X_i'\alpha + \gamma T_i + \omega_i \qquad (2)$$

in which T_i is a dummy that is equal to one if mother i gave multiple births at her first birth. Having a twin at first birth, however, is not fully random. Medical literature has shown that the probability

of having twins at first birth is related to mother's age at the time of birth (Mittler 1971). Age is also correlated with FLFP which is the outcome of interest in this study. But, if one controls for age at birth, having a twin becomes random and exogenous to FLFP (Rosenzweig and Wolpin 1980a,b). Therefore, following the seminal twin studies, this study controls for a third-order polynomial of mother's age at first birth (as part of X_i) in both Equations (1) and (2).[8]

The use of some infertility treatments, such as In Vitro Fertilization (IVF), increases the chance of giving birth to twins (e.g., Callahan et al., 1994; Gleicher et al., 2000; Fauser et al., 2005). To the extent that the use of these treatments is correlated with mother's LFP, it may make the exclusion restriction of the twins instrument invalid. However, in Iran, these infertility treatments became legal only after 1999 by a fatwa from the Supreme Leader (Moaveni 2014).[9] To address this subtle issue, I use an excellent data set that is collected in 2000, the Demographic and Health Survey (DHS) of Iran. Practically all twins in the dataset happened before the fatwa was issued. In addition, the share of mothers who had twins at first birth is 0.65% (see the mean for twins dummy in Table 1) which is even less than the natural rate of 0.7%. Use of infertility techniques raises this share to more than 1%.[10] Therefore, it clearly provides evidence that infertility treatments that raise the chance of having twins were not in use, and one does not need to worry about them in this study.[11] It is good to note that, although date sets prior to the DHS (such as the censuses or household surveys) were collected before the fatwa was issued, none of them contain all the necessary variables to identify twins such as birth month or children ever born. Therefore, they are not useful for this study.

The Demographic and Health Survey (DHS) of Iran is collected from over 92,000 mothers by the Ministry of Health and is nationally representative. The dataset itself identifies all twins at all births. Following Jacobsen et al. (1999), the sample in this study only contains mothers in households that 1) have one mother, her husband, and the mother's own children, 2) the number of children present

in the household is equal to the number of children ever born by the mother, and 3) the age of the first child is less than 18. The first condition is used because mothers in other household compositions, for example households with multiple spouses or those with extended family (grandparents, in-laws, etc.), have access to more people/resources for help and may respond differently to an exogenous increase in the number of children. The last two conditions are to make sure all the children the household has are present in the household and may stay in the household for some time in the future and affect mothers' participation in the labor market. This sample has 32,237 mothers (or households) for which all variables used in the regressions are non-missing. Table 1 reports the summary statistics of these variables for these mothers.

The dataset identifies the twins. There are 211 twins at first birth in the dataset. *First-birth twins* is a dummy that is equal to one if the first birth was a multiple birth and zero otherwise. LFP is a dummy that is equal to one if the individual reported either of the following for the employment status question: 1) working in the last seven days, 2) unemployed but was previously employed, or 3) unemployed and was not previously employed. It is equal to zero if the individual has chosen any of the following for the employment status question: 1) student, 2) homemaker, 3) has income but not through working, or 4) other. DHS datasets cover mothers aged 14 to 49 and our sample also contains the same age cohorts. Urban is a dummy that is equal to one if the household lives in an urban area and zero otherwise. Educational levels are only identified at the schooling level: primary, middle school, high school, and college and above. 20% of the sample of mothers (aged 14 to 49 in 2000) were illiterate. 38% had primary education. 19% and 18% had middle and high school education, respectively, and about 5% were college educated.

[Table 1 around here]

4. Results

First, we look at the impact of having twins at first birth on fertility. Equation (2) is estimated for four sub-samples that are defined based on the first child's age cohort at the time of the survey. These cohorts are 0-2, 3-6, 7-10, 11-14, and 15-17 years old. Figure 4(a) depicts γ, the coefficients of first-birth twins, for these sub-samples and their 95% confidence intervals. In all regressions, I control for mother's age, mother's education, a third-order polynomial of mother's age at first birth (in months), and province-fixed effects. When the first child's age is between 0 and 2, the effect of having twins on the number of children is the largest. This is not surprising because, if twins are born recently, mothers with twins have about one child more than those without twins. Over time, mothers who did not have twins would give birth to more children and catch up with mothers with twins. Therefore, the effect of having twins at first birth becomes smaller as time passes (or the first child gets older.) But even for the age group of 15-17 (15-17 years after the twins were born), the effect has not completely dissipated to zero, although it is estimated with less accuracy. Figures 4(b) and 4(c) show the same effect for rural and urban areas respectively. In rural areas, the effect of having twins on the number of children remains at about one until the first child becomes ten years old and then it gradually dissipates. In urban areas, however, the effect declines quickly. This could be because mothers with twins in rural areas continue to give birth, because either they have a preference for more children or have less access to fertility control methods (than urban mothers). As a result, having twins did not reduce rural mothers' fertility in short and medium terms (a span of ten years.) Urban mothers, however, may want to have two children only. Hence, mothers without twins quickly catch up with mothers with twins as mothers with twins stop giving birth after the first birth. In general, the effect of twins on fertility is statistically significant particularly in the first few years after the twins are born.

[Figure 4 around here]

The next step is to estimate Equation (1) using twins as the instrumental variable. It would be first interesting to see how a linear regression predicts the impact of number of children on mother's LFP. The results for the GLS estimation of this equation are reported in Table 2. In all regressions, I control for province fixed effects, mother's age and education, and a third-order polynomial of mother's age at first birth. The latter is employed to make the specification identical to the IV estimations because, as discussed, the IV estimations include this polynomial. Robust-heteroskedastic standard errors corrected for correlation within clusters are in the parentheses. Clusters are rural and urban areas in each province[12]. As depicted, number of children has a statistically significant and negative correlation with mother's LFP in rural and urban areas. One more child is correlated with about one percentage point reduction in participation in either area. Because the average participation rate is about 20%, these correlations amount to about 5% reduction in participation.

[Table 2 around here]

Age has a positive but small correlation with LFP in both urban and rural areas. Education coefficients, however, form a U-shaped curve in rural areas. Mother's with middle school education have the lowest participation. Rural mothers with primary and high school education have participation rates similar to those of illiterate mothers (the omitted group). By contrast, participation is 55 percentage points larger for rural mothers with college and above education. In urban areas, however, more education increases participation at all levels, exponentially. That is, urban mothers with primary and middle school education are only 2 percentage points more likely to participate than illiterate mothers. This number is 9 and 64 percentage points for high school and

college and above education. In summary, there is a very strong association between college education and mothers' participation in both urban and rural areas.

Table 3 shows the first and the second stages of the 2SLS estimates of Equation (2) for various samples. The columns reporting the second stage show estimates of the causal effect of having more children on FLFP. Contrary to the correlations in Table 2, the results show no causal effect. Interestingly, these insignificant coefficients of the number of children in the second stage have the opposite sign of the correlations as well. As reported in Table 3, the first stage is strong and the Kleibergen-Paap Wald statistics for weak instruments is larger than the critical value calculated by Stock and Yogo (2005), i.e. about 16.38. Therefore, it strongly rejects that twins are weak instruments for the number of children. These null effects are interesting, as they are consistent with the surprising fact that the widespread reduction in fertility in Iran did not lead to more FLFP.

[Table 3 around here]

One may argue that as the effect of having twins on the number of children is the largest when the first child is still young (Figures 1(a)-(c)), the effect of having more children on mother's FLFP could be only pronounced in the first few years after the first child is born. To test this hypothesis, I estimate the same IV regressions as in Table 3 for each of the first child's age categories. The second stage estimates of the causal effects are reported in Table 4. This hypothesis seems to hold, but only when the first child is very young. In rural areas, there is a 17.7 percentage point decline in participation in the first three years of the first child's life, after which the effect goes to zero. In urban areas, there is a 27.7 percentage point reduction in participation when the first child is between three and six years old. These are indeed large effects that are also highly statistically significant. But they quickly drop to zero as the child gets older, i.e. more years pass since the first

child's birth. In other words, fertility has an effect on FLFP, but it is very transient. The mother's participation returns to the steady-state quickly.

[Table 4 around here]

It would be interesting to see if the effect differs by mother's education. Table 5 reports such estimates. Considering the Kleibergen-Paap Wald statistics, almost all IV regressions in this table have a weak first stage except those for mothers with primary education in the whole sample and in the rural areas. The results suggest that the reduction in participation is only pronounced for mothers with primary education. The size of the effect is about 17 percentage points for the whole sample. The rest of the results in this table, even those that are statistically significant, have a weak first stage regression and provide no evidence that one more child has any effect on the mother's participation when the mother's education is more than primary level. This may potentially explain why the fall in fertility in Iran had little impact on FLFP. In other words, the rise in women's education over time dampened the impact of a fall (or rise) in fertility.

[Table 5 around here]

The results in this paper provide evidence that reduction in fertility did not cause FLFP to increase. This interesting result corroborates the hypothesis that other factors, such as social norms and laws, are substantially stronger than fertility and override the effect of fertility or even education on women's participation. For example, by law, men have veto power over women's decision to work. As Majbouri (2017) shows, these laws which are particularly pronounced in the MENA region have significant consequences on FLFP.

These results are particularly interesting as the Iranian government has recently reversed its population control policy and is now advocating for larger families. For instance, the government has stopped offering free contraception to rural households. It is questionable as to whether this

sharp reversal in policy actually increases fertility. Even if it does, this study predicts that it will have little impact on FLFP in the future. FLFP in Iran seems sticky to the number of children and does not change easily with these policies.

5. Conclusion

This paper documents the causal impact of having more children and illustrates that it only reduces labor force participation rate for low-educated mothers and mothers with young children while having no impact on the majority of mothers' participation rate. The null results are the same as those found for other countries in the MENA region (see Majbouri (2018) for Egypt, Jordan, Morocco, and Tunisia.)

The result of this study provides more evidence that factors such as fertility that have been shown to reduce FLFP in the rest of the world have little impact, if any, on Iranian FLFP. The MENA region in general and Iran in particular have stronger forces, such as social norms and laws, that override the effect of classical factors such as fertility or even education on FLFP. Social norms and laws should receive more attention from researchers and policy makers alike.

Understanding the effect of fertility on FLFP not only has implications for Iran but also other countries in the MENA region that have the same low levels of FLFP. Further research in this area is beneficial.

References

Abbasi-Shavazi, Mohammad Jalal, Peter McDonald, and Meimanat Hosseini-Chavoshi (2009). *The Fertility Transition in Iran: Revolution and Reproduction*. New York, NY: Springer.

Angrist, DJ. and N.W. Evans (1998). "Children and their parent's labor supply: Evidence from exogenous variation in family size", *American Economic Review*, 88(3): 450–477.

Azimi, Ebrahim (2015). "The effect of children on female labor force participation in urban Iran." *IZA Journal of Labor and Development*, 4(5), doi:10.1186/s40175-015-0030-x.

Barro, Robert J. and Jong-Wha Lee (2013). "A new data set of educational attainment in the world, 1950-2010." *Journal of Development Economics* 104 (C): 184-198.

Blundell, R. and Macurdy, T (1999). "Labor supply: A review of alternative approaches", In O. Ashenfelter & R. Layard (ed.), *Handbook of Labor Economics*, Vol. 3, pp. 1559–1695.

Braakmann, Nils and John Wildman (2014). "Reconsidering the impact of family size on labour supply: The twin-problems of the twin-birth instrument," Working Paper Series in Economics 316, University of Lüneburg, Institute of Economics.

Bronars, GS. and Grogger, J (1994). "The economic consequences of unwed motherhood: Using twin births as a natural experiment", *American Economic Review*, 84: 1141–1156.

Caceres-Delpiano, J (2006). 'The impacts of family size on investment in child quality', *Journal of Human Resources*, 41, pp. 738–754.

Callahan, Tamara L., Janet E. Hall, Susan L. Ettner, Cindy L. Christiansen, Michel F. Greene and William F. Crowley (1994). The economic impact of multiple gestation pregnancies and the

contribution of assisted-reproduction techniques on their incidence. *New England Journal of Medicine* 331(4): 244-249.

Cavalcanti, Tiago V. de V. and José Tavares (2008). "The Output Cost of Gender Discrimination: A Model-Based Macroeconomic Estimate," Proceedings of the German Development Economics Conference, Zurich 2008 43, Verein für Socialpolitik, Research Committee Development Economics.

Collet R. and D. Legros (2016). "Dynamics of female labour force participation in France." *Applied Economics*, 48(30): 2807-2821.

Contreras, D., de Mello, L. and E. Puentes (2011). "The determinants of labour force participation and employment in Chile." *Applied Economics*, 43(21): 2765-2776.

Esfahani, H. S. and P. Shajari (2012). "Gender, education, family structure, and the allocation of labor in Iran." *Middle East Development Journal* 4(2): 1-40.

Fauser, Bard C.J.M., Paul Devroey and Nick S. Macklon (2005). "Multiple birth resulting from ovarian stimulation for subfertility treatment." *The Lancet* 365(9473): 1807-1816.

Gleicher, Norbert, Denise M. Oleske, Ilan Tur-Kaspa, Andrea Vidali and Vishvanath Karande (2000). "Reducing the risk of high-order multiple pregnancy after ovarian stimulation with gonadotropins." *New England Journal of Medicine* 343(1): 2-7.

Jacobsen, Joyce P., James Wishart Pearce III, and Joshua L. Rosenbloom (1999) "The Effects of Childbearing on Married Women's Labor Supply and Earnings: Using Twin Births as a Natural Experiment." *The Journal of Human Resources*, 34(3): 449-474.

Karbownik, Krzysztof, and Michal Myck (2016). "For some mothers more than others: how children matter for labour market outcomes when both fertility and female Employment are low." *Economics of Transition*, 24(4): 705–725.

Karshenas, Massoud (2001). "Economic Liberalization, Competitiveness and Women's Employment in the Middle East and North Africa." In ed. Djavad Salehi-Isfahani, *Labor and Human Capital in the Middle East: Studies of Markets and Household* Behavior, 92–147. London: Ithaca Press.

Killingsworth, Mark R. and James Heckman (1986). "Female labor supply: A survey", In O. Ashenfelter & R. Layard (ed.), *Handbook of Labor Economics*, Vol. 1, pp. 103–204.

Majbouri, Mahdi (2010). "Against the wind: labor force participation of women in Iran." Ph.D. Dissertation, University of Southern California.

Majbouri, Mahdi (2015). "Female labor force participation in Iran: a structural analysis" *Review of Middle East Economics and Finance,* 11(1): 1-24.

Majbouri, Mahdi (2016). "Against the wind: labor force participation of women and economic instability in Iran." *Feminist Economics*, 22(4): 31-53.

Majbouri, Mahdi (2017). "Oil, laws, and female labor force participation," *International Advances in Economic Research* (2017), 23(1): 91-106

Majbouri, Mahdi (2018). "Fertility and the Puzzle of Female Employment in the Middle East," Working paper.

McNown, Robert and Cristobal Ridao-Cano (2005). "A time series model of fertility and female labour supply in the UK." *Applied Economics*, 37(5): 521-532.

Mittler, Peter J (1971). *The Study of Twins*. Harmondsworth, Middlesex: Penguin.

Moaveni, Azadeh (2014). "The Islamic Republic of Baby-Making," *Foreign Policy*, January 17, 2014. http://foreignpolicy.com/2014/01/17/the-islamic-republic-of-baby-making/, accessed on April 17, 2018.

Moghadam, Valentine M. (1995). "Women's Employment Issues in Contemporary Iran: Problems and Prospects in the 1990s." *Iranian Studies*, 28(3): 221–43.

Moghadam, Valentine M. (2000). "The State and the Social Position of Women." In Ed. Parvin Alizadeh, *The Economy of Iran: The Dilemmas of an Islamic State*, 233–60. London: I.B. Tauris.

Narayan, Paresh Kumar and Russell Smyth (2006). "Female labour force participation, fertility and infant mortality in Australia: some empirical evidence from Granger causality tests." *Applied Economics*, 38(5): 563-572.

Rosenzweig, Mark R. and Kenneth I. Wolpin (1980a) "Life-cycle labor supply and fertility: causal inferences from household models." *Journal of Political Economy*, 88(2): 328-348.

Rosenzweig, RM. and Kenneth I. Wolpin (1980b). "Testing the quantity-quality fertility model: The use of twins as a natural experiment", *Econometrica*, 48: 227–240.

Ross, Michael L. 2008. "Oil, Islam, and Women." *American Political Science Review*, 102(1):107–23.

Salehi-Isfahani, D., M. J. Abbasi-Shavaz, and M. Hosseini-Chavoshi (2010) "Family planning and fertility decline in rural Iran: the impact of rural health clinics." *Health Economics* 19 (S1): 159-180.

Vere, James P. (2011). "Fertility and parents' labour supply: New evidence from US census data", Oxford Economic Papers, 63: 211–231.

World Bank (2004) *Gender and Development in the Middle East and North Africa*. MENA Development Report, Washington DC: World Bank.

Xie, Xiaodi (1997). "Children and female labor supply behavior." *Applied Economics*, 29(10): 1303-1310.

Notes

[1] Participation rates for urban women aged 20 to 65 have remained steady at about 15%, and rural participation has been fluctuating at rates around 22%. For a detailed discussion of these rates and more, see Majbouri (2010, 2015, and 2016).

[2] See World Bank (2004) for a thorough discussion of low FLFP in the Middle East and North Africa.

[3] Xie (1997) uses the generalized residual moment and shows that children are endogenous to the participation decision.

[4] Angrist and Evans (1998) used a different instrumental variable for the number of children: sex-composition of children to estimate the causal impact of number of children on the mother's participation in the labor market. In the US, parents like to have mixed gender children. That is, if the first two children are of the same gender, they are more likely to have a third child in hopes that the third will be of a different gender. In the context of Iran, however, Azimi (2015) shows that parents have a preference for sons rather than mixed gender children. Households whose first child or children are girls are more likely to have more children in hope of having a son. Hence, in this context, the instrument is son preference. But as will be discussed later, this instrument may not satisfy the exclusion restriction in Iran.

[5] Esfahani and Shajari (2012) also offered reduced form estimations of FLFP. Majbouri (2015) estimates a structural model of female labor supply. It finds a very elastic supply curve and attributes it to the fact that potential wages for women on the margin of working are similar to those who work. For a complete review of the literature, see Majbouri (2010, 2016).

[6] Majbouri (2010) and Salehi-Isfahani (2005) discuss these changes in educational attainment and their causes in detail. Majbouri (2018) argues that strong demand for education has been possibly the main driver for such increases in education.

[7] For a detailed description of women's labor market in Iran, see Majbouri (2010, 2016).

[8] Following other studies, such as Jecobsen et al. (1999), a third-order polynomial is employed. Controlling for higher polynomial order of age at first birth does not change the result.

[9] Iran is one of the few Muslim countries in which these techniques are legal and widely used today.

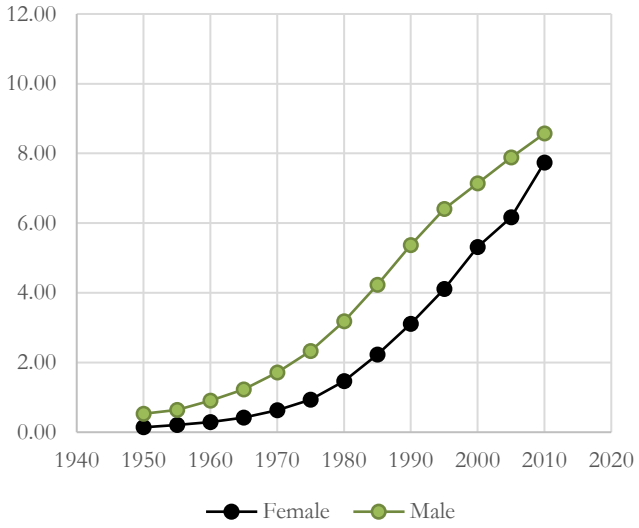
[10] This rate was over 3.4% in 2011 in the United States (Center for Disease Control website at https://www.cdc.gov/nchs/fastats/multiple.htm, accessed on April 2018).

[11] In addition, in an important study, Braakmann and Wildman (2014) show that the bias that is caused by not controlling for infertility treatments is small.

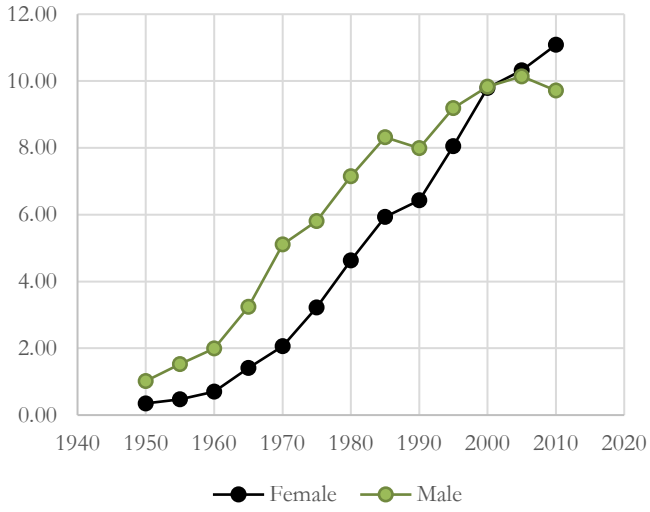
[12] There are 29 provinces. That translates into 58 clusters.

Figures

Figure 1 – Average Years of Education Since 1950 in Iran



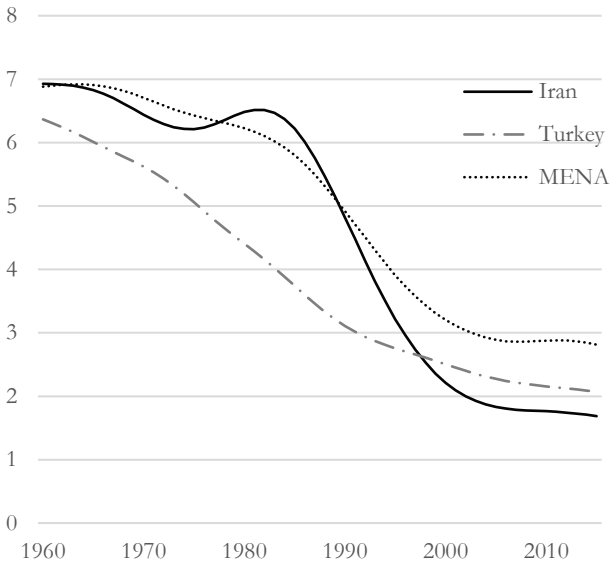
(a) Aged 25+



(b) Aged 20-24

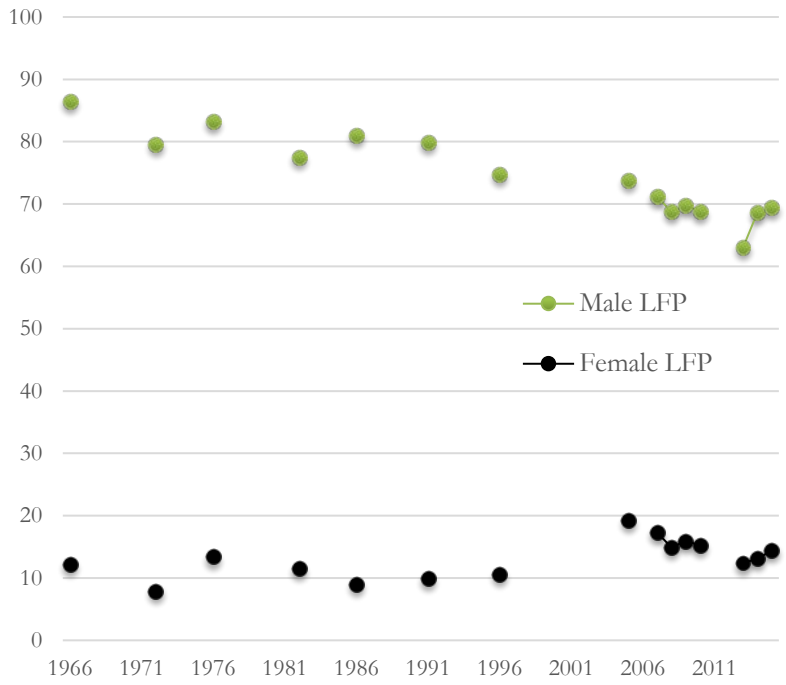
Date Source: Barro and Lee (2013).

Figure 2 – Total Fertility Rates, 1960-2015



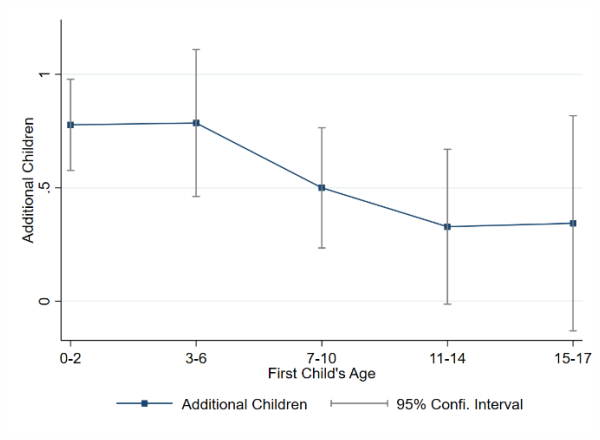
Data Source: World Bank Development Indicators.

Figure 3 – Male and Female LFP rates (15+ Population), 1966-2015

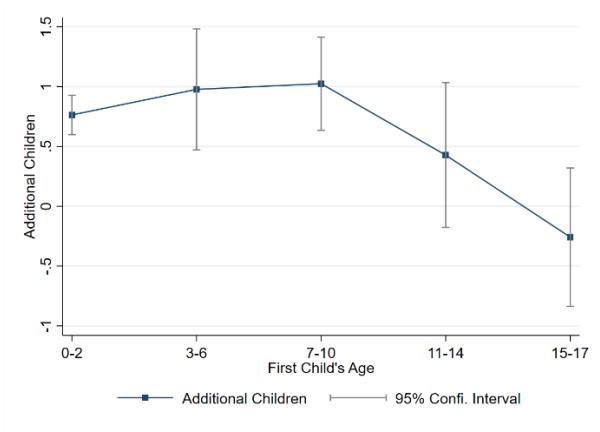


Data Source: World Bank Development Indicators.

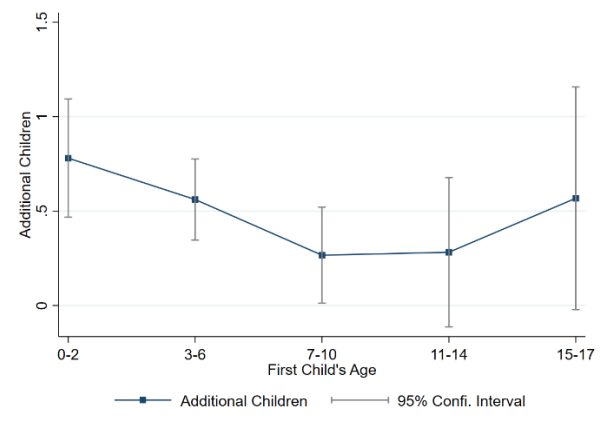
Figure 4 – Effect of Twins in the First Birth on the Number of Children



(a) All



(b) Rural



(c) Urban

Note: The dependent variable is the number of children. The figure shows coefficient of twins in the first birth when a polynomial of mother's age at first birth and education level dummies are controlled for.

Tables

Table 1 – Summary Statistics of the sample of Mothers ($n = 32{,}237$)

Variable	Women with at least one child			
	Mean	St. dev.	Min	Max
Labor force participation	0.21	0.41	0	1
Number of children	2.44	1.36	1	10
Twins	0.0065	0.0806	0	1
Age	29.22	5.75	14	49
Age at first birth (in months)	250.10	48.39	110	534
First child's age	8.34	5.10	0	17
Urban	0.55	0.50	0	1
Education				
Illiterate	0.19	0.39	0	1
Primary	0.38	0.49	0	1
Middle school	0.19	0.39	0	1
High school	0.19	0.39	0	1
College & above	0.05	0.22	0	1

Note: The individuals in the sample are mothers in households that 1) have only one mother, her husband, and the mother's own children (no mother's step-child, another spouse, or any extended family member), 2) the number of children present in the household is equal to the number of children ever born by the mother, and 3) the age of the first child is less than 18. These last two conditions are to make sure that we capture first-birth twins accurately. Twins is a dummy equal to one if mother gave multiple births at her first birth and zero otherwise. Illiterate is a dummy equal to one if the mother is literate and zero otherwise. Primary, Middle school, High school, and College & above are dummies equal to one if the mother completed or partially completed the corresponding education level. Urban is a dummy equal to one if the mother lives in urban area and zero otherwise. Labor force participation is a dummy equal to one if the mother had a job or was unemployed but was looking for a job in the last seven days.

Table 2 – GLS Estimates of the effect of Number of Children on Mother's LFP

	14 to 49 Years Old		
	All	Rural	Urban
Number of children	-0.003	-0.009*	-0.011***
	(0.003)	(0.005)	(0.004)
Age	0.003***	0.005***	0.006***
	(0.001)	(0.001)	(0.001)
Age at first birth	-0.009***	-0.006***	-0.012***
	(0.001)	(0.002)	(0.002)
Age at first birth$^2 \times 10^{-3}$	0.032***	0.023***	0.041***
	(0.005)	(0.008)	(0.006)
Age at first birth$^3 \times 10^{-6}$	-0.036***	-0.029***	-0.045***
	(0.006)	(0.009)	(0.007)
Primary	-0.010	-0.008	0.021**
	(0.008)	(0.010)	(0.010)
Middle school	-0.060***	-0.059***	0.021*
	(0.009)	(0.014)	(0.011)
High school	-0.002	-0.002	0.090***
	(0.010)	(0.019)	(0.012)
College and above	0.556***	0.510***	0.642***
	(0.014)	(0.048)	(0.016)
Province FE	Yes	Yes	Yes
Observations	41,194	19,157	22,037
Adjusted R-squared	0.143	0.108	0.237

Note: The dependent variable is a dummy that is equal to one if the individual (mother) has a job or is looking for a job in the last seven days and zero otherwise. Mother's age at first birth and its squared and cubed as well as dummies for mother's level of education (primary, middle school, high school, and college & above) are controlled for in these regressions. All regressions include province-fixed effects. Robust-heteroskedastic standard errors corrected for correlation within clusters are in the parentheses. Clusters are rural and urban areas in each province. There were 29 provinces and therefore 58 clusters in the whole sample.
*** p<0.01, ** p<0.05, * p<0.10

Table 3 – Two-Stage Least Squares Estimates of the Effect of Number of Children on Mother's LFP
(First-birth twin is the instrument)

	14 to 49 Years Old					
	All		Rural		Urban	
Variable	First Stage	Second Stage	First Stage	Second Stage	First Stage	Second Stage
First-birth twin	0.532***		0.695***		0.479***	
	(0.081)		(0.130)		(0.093)	
Number of children		0.026		0.002		0.049
		(0.060)		(0.067)		(0.085)
Kleibergen-Paap Wald†	42.61***		27. 58***		25.29***	
Average LFP Rate (in %)		21.4		24.0		19.4
Average Number of Children		2.4		2.6		2.3
Observations	32,237	32,237	14,382	14,382	17,855	17,855

Note: The dependent variable in the first stage is the number of children. The dependent variable in the second stage is a dummy that is equal to one if the individual (mother) has a job or is looking for a job in the last 30 days and zero otherwise. Mother's age at first birth and its squared and cubed as well as dummies for mother's level of education (primary, middle school, high school, and college & above) are controlled for in these regressions. Robust-heteroskedastic standard errors corrected for correlation within clusters are in the parentheses. Clusters are rural and urban areas in each province. There are 29 provinces and therefore 58 clusters.

† First stage Kleibergen-Paap rk Wald F-statistics for weak instruments. The critical values for 10% maximal IV size according to Stock and Yogo (2005) is 16.38.

*** p<0.01, ** p<0.05, * p<0.10

Table 4 – Two-Stage Least Squares Estimates of the Effect of Number of Children on Mother's LFP across the first child's age categories
(First-birth twin is the instrument)

	All				
	0-2	3-6	7-10	11-14	15-17
Number of children	0.029	-0.023	-0.073	0.069	0.282
	(0.090)	(0.089)	(0.125)	(0.166)	(0.429)
Kleibergen-Paap Wald	57.56	22.72	12.07	3.57	2.03
Observations	5,232	7,622	7,709	6,623	5,051
	Rural				
Number of children	-0.177***	0.108	-0.010	0.141	0.301
	(0.061)	(0.096)	(0.117)	(0.207)	(0.585)
Kleibergen-Paap Wald	83.05	14.35	21.45	1.91	0.77
Observations	2,509	3,648	3,525	2,812	1,888
	Urban				
Number of children	0.228	-0.315***	-0.102	-0.024	0.256
	(0.161)	(0.064)	(0.233)	(0.198)	(0.295)
Kleibergen-Paap Wald	23.95	26.69	4.16	1.96	3.59
Observations	2,723	3,974	4,184	3,811	3,163

Note: This table reports the estimates for β in Equation (2). The dependent variable is mother's employment status, and number of children a mother has is instrumented using multiple first birth. The sample and summary statistics are described in Table 1. All regressions include mother's age and education, a polynomial of age at first birth, and province fixed effects. Regions are areas within a country. Robust-heteroskedastic standard errors corrected for correlation within clusters are in the parentheses. Clusters are rural and urban areas in each province. There are 29 provinces and therefore 58 clusters.

Table 5 – Two-Stage Least Squares Estimates of the Effect of Number of Children on Mother's LFP by mother's education level
(First-birth twin is the instrument)

	All				
	Illiterate	Primary	Middle school	High school	College & above
Number of children	0.046	-0.174**	0.374	0.037	0.766
	(0.086)	(0.080)	(0.239)	(0.134)	(0.489)
Kleibergen-Paap Wald	11.02	18.76	6.626	14.01	2.507
Observations	8,176	14,458	6,864	6,949	1,898
	Rural				
Number of children	0.069	-0.143	0.235*	4.988	12.937
	(0.143)	(0.110)	(0.138)	(39.862)	(629.119)
Kleibergen-Paap Wald	4.698	17.11	13.77	0.0181	0.000327
Observations	5,285	7,548	2,134	1,089	139
	Urban				
Number of children	-0.029	-0.188**	0.515	-0.018	0.859
	(0.080)	(0.082)	(0.531)	(0.098)	(0.582)
Kleibergen-Paap Wald	7.85	6.91	3.13	14.87	2.10
Observations	2,891	6,910	4,730	5,860	1,759

Note: This table reports the estimates for β in Equation (2). The dependent variable is mother's employment status, and number of children a mother has is instrumented using multiple first birth. The sample and summary statistics are described in Table 1. All regressions include mother's age and education, a polynomial of age at first birth, and province fixed effects. Regions are areas within a country. Robust-heteroskedastic standard errors corrected for correlation within clusters are in the parentheses. Clusters are rural and urban areas in each province. There are 29 provinces and therefore 58 clusters.